NATIONAL PRODUCTIVITY COUNCIL

Productivity

Vol. 54 January - March 2014 No. 4

Focus: IT & ITeS

Guidelines for Contributors

Scope and Coverage

PRODUCTIVITY is the principal journal of the National Productivity Council of India. The Journal aims at disseminating information on concepts of and data on productivity and its growth in India and elsewhere. It also aims at disseminating knowledge on techniques and methods of productivity improvement through effective management of all types of resources. Thus, contributions from a large spectrum of disciplines are accepted for publication. Only those manuscripts that present the results of original research and analysis are acceptable to the Journal. The managerial/policy implications of the study should be highlighted separately towards the end of the paper.

Format of Manuscript

Contributions should be of about 5,000 words length. Tables, illustrations, charts, figures, exhibits, etc., should be serially numbered and typed in separate pages and should not be mixed with the main text. The text should be addressed to the **Editor, PRODUCTIVITY, National Productivity Council, Utpadakata Bhawan, Lodi Road, New Delhi - 110003. Email : npcres@rediffmail.com**

About the References

Only those references which are actually utilized in the text should be included in the reference list. In the text, references should be cited with the surname of the author(s) alongwith the year of publication and the page number, all in brackets. If there are more than one reference by the same author during any year, the year may be subscripted with 'a' or 'b'. For instance, reference may be given at the end of the sentence as: (Szendrovits, 1998a, p. 337). Sources of data need to be given below each table unless otherwise mentioned in the text. Reference list should be alphabetically arranged. Each reference should carry the surname of the author, followed by other names, the title of the paper in quotes, the name of the journal underlined, volume and issue numbers, and the year of publication. In the event of a book, the title should be followed by the publisher's name and year of publication. In the event of a report from an organization, the name of the organization may be cited in the place of the author.

Accompanying Material

The manuscripts should be accompanied by:

1. An abstract of the paper not exceeding 100 words.
2. A declaration that the paper is original and has not been submitted elsewhere for publication.
3. A note about the author(s) not exceeding 50 words.

Subscription :

Subscription and orders for the journal should be sent to the publisher: **MD Publications Pvt Ltd,** New Delhi.

Annual Subscription rates for subscribers are :

Institutional	**National**	**Rs. 2000.00**
	International	**US$ 200.00**

Postage and Handling Charges extra (Air Mail)	
Rs. 300.00	**US$ 90.00**

All remittance must be paid in favour of :
MD Publications Pvt Ltd,
payable at New Delhi, India

All business correspondence to be addressed to:

MD Publications Pvt Ltd
"MD House", 11, Darya Ganj,
New Delhi-110 002
Phone : +91-11-45355555
E-mail : contact@mdppl.com
Website : www.mdppl.com

ISSN : 0032-9924
e-ISSN : 0976-3902

Productivity

A QUARTERLY JOURNAL OF THE NATIONAL PRODUCTIVITY COUNCIL

Vol. 54 • January – March 2014 • No. 4

MD

MD Publications Pvt Ltd
New Delhi
www.mdppl.com

Publishers & Distributors:

MD Publications Pvt Ltd
"MD House", 11, Darya Ganj,
New Delhi-110 002
Phone : +91-11-45355555
E-mail : contact@mdppl.com
Website : www.mdppl.com

ISSN : 0032-9924
e-ISSN : 0976-3902

Published and printed on behalf of National Productivity Council,
by Mr Pranav Gupta, **MD Publications Pvt Ltd,**
at Printext, New Delhi, India.

Contents

Focus

India's Software Industry in Transition: Lessons for Other Developing Countries and Implications for South-South Cooperation

K. J. JOSEPH

India's success in software industry has attracted world wide attention on account of its remarkable performance in the export of software services. The emergence of ICT as the General Purpose Technology (GPT) of the new millennium is instrumental in enhancing efficiency, competitiveness and growth in all sectors of the economy. Almost all developing countries have undertaken policy measures and institutional interventions to develop ICT capabilities and harness the new technology as a short cut to prosperity. Though India's record is remarkable in exports of software, its record in harnessing IT and software for building efficiency, productivity and competitiveness of other sectors of the economy has been less remarkable. This has been reflected not only in the sluggish growth of India's manufacturing sector but also in the international competitiveness. However, of late there has been a significant change in the internal and external environment in which the industry operates. In this article an attempt has been made to explore whether there has been a greater domestic market orientation and the role of state policies therein. The study suggests that the industry is increasingly getting oriented towards domestic market. It is also argued that there is a shift in the nature of domestic market from services to high value added and skill intensive software products and engineering research and design.

K. J. Joseph is Ministry of Commerce Chair, Centre for Development Studies.

India's success in software industry which attracted the world attention mainly on account of the remarkable performance in the export of software services may be inspirational not only for other sectors within India but also for the other developing countries in general. The recorded growth in the software exports from India as well as the credibility that India earned there from has no parallels in India's economic history. It has also been shown that the organizational, managerial and other innovations introduced by the IT firms have been emulated by firms in other industries contributing to their enhanced performance (Arora and Athreya, 2002). However, India's performance in term of the use of IT and software in different sector of the economy has been less remarkable. In this context it has been argued that excessive export orientation could be inimical to innovation and the social marginal product of a dollar worth of software domestically consumed could be significantly higher than that of dollar worth of software exported (Parthsarathi and Joseph, 2002; Kumar and Joseph, 2005). However, the environment, both external and internal, in which India's software industry operate has undergone major changes. The global financial crisis seems to have adversely affected the export demand. At the same time, the industrial sector in India is increasingly being convinced that there is hardly any option to survive under globalization other than becoming efficient and competitive where in IT and software could play an important role. This is especially because the share of India manufacturing sector remained almost flat since 1991 indicative inter alia of the weak international competitiveness. The moot question here is; given the changes in the environment, both external and internal, governing software sector, has there been any change in

andscape of India's software sector and the role of
policies therein. This is the central issue being
essed by this article.

The remainder of this article is organized as follows;
on 2 analyses the performance of India's software
try. It begins with an analysis of the trend in
ction and exports and its contribution towards GDP
h and employment generation. Against this
round, further analysis undertaken in this section
nts evidence to suggest that there is an increasing
ation towards the domestic market. Section 3
ts an overview of India's policies towards software
amines the influence of state policy on the observed
wards the domestic market and reiterates the role
te could play in reorienting an industry in tune with
tional concerns. Concluding observations are
ted in the last section.

nance of Software Industry: Export vs Domestic

ction and Exports

ping countries are known to have comparative
ge in the production of services. This is on account
bundant supply of labour - the major input in the
ion of services - in developing countries leading to
ges. Since the technology of producing services
t differ significantly across counties, lower wages
n low cost of production of services in developing
es (Bhagwati, 1984). However, most of these
s have been unable to tap this advantage mainly
e most services are embodied in their providers
r export calls for the trans-border mobility of labour
subjected to series of restrictions. Though the
of globalization, which *inter alia* implied the free
ent of products and factors, accelerated momentum
he last two decades, there have been hardly any
on in the restrictions on labour mobility. Hence,
duction structure and employment in developing
es continues to be dominated by primary and
ary sectors. Nonetheless, India has been
sfully participating in the global division of labour
ent services and emerged as a leading player in
ort of software services *inter alia* by taking
age the opportunities opened up by new
ogies that increasingly splintered off services from
viders. While earlier studies argued that the
nance of India's software sector has been
dented in India's economic history (Schware, 1992;
Arora et. al, 2001, Joseph, 2002; Joseph, 2009; Jos
and Harilal, 2001; Kumar and Joseph, 2005 to list a fe
they have also been concerned about the focus of softw
industry on the low end of the value chain, limited domes
market orientation and its associated opportunity cos
Against this background this section analyses t
performance of software industry and explore if there a
any evidence of transformation. More specifically,
examines the trend in domestic market orientation an
movement along the software value chain in terms of mov
away from software services to other software activitie
involving higher skill and value addition like softwar
products and software engineering research and desig
including embedded software development.

Before proceeding further, a brief discussion on th
database of India's software industry is in order. Most o
the existing studies on India's software sector have bee
based on the data provided by the National Association o
Software and Service Companies (NASSCOM)
NASSCOM, the leading association of software companie
in India, has a total membership of over 1200 in 2011 an
it has been claimed that these companies account fo
nearly 95 per cent of the total software exports from the
country. NASSCOM also used to provide, until 2004-05
company level information on sales, export, employmen
and other information. Another source of firm level data is
the Centre for Monitoring Indian Economy. Since this
source covers only the companies listed in stock market
its coverage is much less as compared to NASSCOM
However, by comparing firm level information from these
two sources, it has been shown that NASSCOM estimates
on export involved some over estimation (Parthsarathi and
Joseph, 2002). Another source of data on software exports
and production is the Electronics and Software Expor
Promotion Council (ESEC), an autonomous body under
the Government of India and the Ministry of Information
Technology. Yet, another source is the Reserve Bank o
India (RBI) which is based on foreign exchange inflow into
the country. RBI, however, reports only the total expor
earnings and is available only from 2004-05. While there
existed differences in exports as reported by different
sources, it appears that such differences have significantly
reduced over the years. From table 1 it is evident that
software export data as reported by NASSCOM which
refers to the calendar year (Jan-Dec) is more or less
comparable to the exports data for the financial year (March-
April) as reported by RBI and Electronics and Software
Export Promotion Council.

Table 1: Data on total software export as reported by different data sources (US $ billion)

Year	Software exports (including BPO) as reported by			Exports excluding BPO (NASSCOM)	Share of software services, products and ER&D
	NASSCOM	ESEC	RBI		
2004-05	17.7	17.21	17.7	14.3	80.79
2005-06	23.61	23.72	23.6	18.41	77.98
2006-07	29.56	33.76	31.3	22.35	75.61
2007-08	40.42	43.47	40.3	30.51	75.48
2008-09	47.09	49.54	46.3	35.39	75.15
2009-10	49.69	51	49.71	37.29	75.05
2010-11	59.01	57.62	55.46	44.89	76.07

Note: NASSCOM data refers to the calendar year. That is, data for the year 2004-05 may be read as from January 2005 to December 2005

Here it is also to be noted that the different sources cited above uses different conceptual frame in defining the software sector. For NASSCOM the total exports/ production included computer hardware, software services, Business Process Outsourcing (BPO) and software products including engineering research and design. NASSCOM, however, provides disaggregated data on each of these items. Data provided by Electronics and Software Export Promotion Council includes whole electronics production, software and BPO. Here, unlike in NASSCOM, both software services and products are clubbed together as software and no disaggregated data on software services and software products are given. While RBI provides only data on exports the above two sources provide aggregate data on both production and exports.

In what follows, we shall make use of the date provided by the Electronics and Software Export Promotion Council for the trend analysis. Here, total software exports and production include software services, Business Process Outsourcing (BPO) and software products along with engineering research and design (mostly embedded software) –hereafter referred to as software products. Since the focus of the present article is on software industry, in the disaggregated analysis we shall not deal with BPO and therefore confine to software services and software products which is based on the data obtained from NASSCOM.

Data presented in table 2 clearly reinforces the findings of earlier studies which indicated that the performance of software sector during the last two decades has been remarkable by any standard. During the decade of 1990s the total production of software sector increased by 26 fold; from a little over $200 million in 1990-91 to US $5.5 billion in 1999-00, recording an annual average growth rate of over 44 per cent. With a total production of about $75 billion in 2010-11, the observed high rate of growth during 1990s was sustained since 2000 recording an annual average rate of growth of over 35 per cent.

More remarkable has been the performance with respect to exports. Total exports increased from $ 110 million in 1990-91 to nearly $ 4 Billion in 1999-00 recording an annual average growth rate of about 50 percent. Going by the available evidence, with a total export of $ 57.6

Table 2: Trend in software production and export (including BPO) from India

Year	Software production ($ Mill)	Annual growth rate (%)	Exports ($ Million)	Annual growth rate (%)
1990-91	209		110	
1991-92	289	38.3	166	50.9
1992-93	382	32.2	221	33.1
1993-94	545	42.7	325	47.1
1994-95	803	47.3	473	45.5
1995-96	1182	47.2	711	50.3
1996-97	1798	52.1	1159	63
1997-98	2929	62.9	1813	56.4
1998-99	4009	36.9	2599	43.4
1999-00	5538	38.1	3962	52.4
Average growth 1991-99		44.2		49.1
2000-01	8021	44.8	5978	50.9
2001-02	9931	23.8	7653	28
2002-03	12376	24.6	9607	25.5
2003-04	16141	30.4	12608	31.2
2004-05	21587	33.7	17216	36.5
2005-06	30404	40.8	23718	37.8
2006-07	42312	39.2	33757	42.3
2007-08	55144	30.3	43467	28.8
2008-09	61984	12.4	49540	14
2009-10	64956	4.8	51001	2.9
2010-11	74890	15.3	57616	13
Average growth 2000-10		35.3		38.2

Source: Electronics and Software Export Promotion Council, Statistical Year book, different years. Note: Software includes the software services, software products and BPOs

billion in 2010-11 the observed rate of growth was as high as 38 per cent since 2000 (see table 2). Thus viewed, in a context wherein India has been severely constrained by the availability of foreign exchange, software sector contributed significantly towards improving the external health of the economy.

Table 2 also indicates that with global financial crisis that affected initially the US - the leading market for India - and later spread to Europe, has had its adverse effect. This is evident from the drastic decline in the rate of growth in export from over 36 per cent in 2007-08 to 6.6 per cent in 2008-09. However as these economies are reviving from crisis, the adverse effect appears to have been short lived because the rate of growth in export also picked up as is evident from the higher export growth of nearly 24 per cent recorded in 2010-11.

Software in India's GDP and employment

Being one of the fastest growing sectors in the Indian economy software industry has also contributed towards the turnaround in India's GDP growth observed since 1991. Share of software production, which includes software services, software products and BPO, in GDP increased from 1.85% in 2000-01 to the highest level of 5.37% in 2008-09. Thereafter it has shown a marginal decline to reach 4.7% in 2010-11(Table 3). It is also evident that in the service sector driven growth of the Indian economy recorded during the recent years, software sector played a significant role as its share in service sector GDP increased by threefold since 2000. Equally remarkable has been its contribution in total exports which nearly doubled from 7.7 per cent in 2000-01 to 14.8 per cent in 2009-10 (see table 3).

Table 3: Contribution of software sector to India's GDP and exports

Year	% of GDP	% of Service GDP	% of total exports	% of Service exports
2000-01	1.85	6.48	7.73	18.61
2006-07	4.63	16.76	13.27	28.23
2007-08	4.85	17.55	13.82	29.26
2008-09	5.37	18.40	13.99	29.57
2009-10	5.06	16.68	14.77	31.24
2010-11	4.77	15.57	12.86	29.09

Source: Data on GDP: Government of India, Economic Survey 2012-13
Data on software production and export: Electronics and Software Export Promotion Council, Statistical yearbook different issues; Software includes the software services, software products and BPOs

According to NASSCOM Strategic Review (2012), the direct employment generated by the software industry (software services, products, BPO and hardware) is estimated at 2.54 Million in 2011 as compared to 160,000 in 1996. It is also estimated that the indirect employment is about four times the direct employment. The industry is creating job opportunities for highly qualified (majority with an engineering degree) young graduates with a relatively short experience.

The observed performance of software sector in employment generation appears highly impressive when considered against the fact that employment generation by the organized manufacturing sector has been on the decline during 1990s (Nagaraj, 2004) and according to NSS statistics during 1999-00 to 2004-05 growth in employment in the rural and urban areas has been only of the order of 1.97 per cent and 3.22 per cent respectively (Chandrsekhar et al., 2006). While contributing significantly to GDP, export earning and employment the industry has been undergoing major transformation within.

Trend in domestic sales and domestic market orientation

Given that the domestic use of software could be instrumental in enhancing competitiveness of all the sectors of the economy and the welfare of all sections of the society, the social marginal benefit of a dollar worth of ICT consumed domestically could be much higher than that of a dollar worth of software exported (Kumar and Joseph, 2005). In the current context where international competitiveness is the key to survival for all the sectors of the economy and that the major export markets are in the grip of crisis and growing opposition to offshoring of jobs, it is of relevance to examine if there has been an increased focus on domestic market by the Indian software industry.

However, there are again serious data limitations to address this issue. The reported data on domestic sales is likely to involve gross underestimation of domestic consumption because it will not include those software services rendered by the software personnel employed by the users. In India the common practice with larger organization with legacy systems have been to employ in-house software professionals for software development. The software development and maintenance undertaken by such professionals will not get reported as domestic sales where as such services, if rendered by a software company will be recorded in domestic sales. Just like the man who married his housemaid would reduce GDP, the commonly prevalent practice of appointing in-house

software personnel is likely to reduce the value of domestic consumption of software. As per NASSCOM (2011) even today the common practice is to undertake most of the software development work in-house supported by a software firm. Even in 2010, the extent of software development outsourcing ranged between only 20 to 70 per cent across different sectors with telecom at the highest with 70 percent.

Nonetheless, table 4 indicates that the domestic sales of software have also been highly vibrant and it is more so in the recent years. The observed rate of growth in the sale of software in the domestic market recorded an annual average rate of growth of over 36 per cent during 1990s, albeit from a lower base and over 30 per cent since 2000. Here it is worth noting that while the rate of growth in exports declined by 11 per cent (see table 2) as we move from the first period (1990s) to the second period (since 2000), the recorded rate of decline in domestic sale was only at much lower pace of about six per cent. More importantly, until 2005-06 the recorded annual rate of growth in the export of software in all the years was consistently higher than that of domestic sales. However, since 2005-06 there has been a reversal wherein the rate of growth in domestic sales exceeded that of exports in all the six years, the exception being only two years wherein export growth was marginally higher.

Table 4: Trend in Domestic sale of Software and share of domestic market in total production

Year	Domestic Sale ($ Mill)	Annual growth rate (%)	Domestic market share in production (%)
1990-91	99		47.37
1991-92	123	24.2	42.56
1992-93	161	30.9	42.15
1993-94	222	37.9	40.73
1994-95	330	48.6	41.1
1995-96	471	42.7	39.85
1996-97	724	53.7	40.27
1997-98	1150	58.8	39.26
1998-99	1379	19.9	34.4
1999-00	1537	11.5	27.75
Decadal growth		36.5	
2000-01	2043	32.9	25.47
2001-02	2278	11.5	22.94
2002-03	2769	21.6	22.37
2003-04	3533	27.6	21.89
2004-05	4371	23.7	20.25
2005-06	6686	53	21.99
2006-07	8555	28	20.22
2007-08	11677	36.5	21.17
2008-09	12444	6.6	20.08
2009-10	13955	12.1	21.48
2010-11	17274	23.8	23.07
Average growth 2000-10		30.6	

Source: Same as table 2; domestic sales include software services, BPO and Software products including embedded software.

Table 4 also indicates that the share of domestic sales in total production has been showing a steady decline until 2004-05 to reach the lowest level of 20 per cent. However, after 2004-05, despite a vibrant export market, the decline in the share of domestic market observed up to 2004-05 got arrested. If the empirical evidence for the last three years is any indication, a turnaround towards domestic market has already set in because; it is for the first time since 1991 that the share of domestic market has shown an upward trend consecutively for three years from 20.08 per cent in 2008-09 to 23.07 per cent in 2010-11.

Empirical evidence presented so far is further substantiated by the observation by NASSCOM that the domestic market for software has been experiencing a gradual upswing since 2003 (NASSCOM Newsline January 2011). Initially it was the Small and Medium sized software companies that focused on domestic sector. But over the years, especially during the global slowdown, the large players have also began addressing the untapped domestic market. NASSCOM strategic Review (2011) states that, there has been an increasing demand from Indian clientele during the last four to five years. During 2010 there were 93 domestic deals (see table 5 for the major domestic deals in 2010). Though the total number of deals declined to 65 in 2011 the average contract value ($23,000 to $24,000) was about 50 per cent higher than in 2010. The observed trend towards the domestic market and increase in the share of ICT expenditure in GDP has to be seen in the context of various e-governance initiatives along with the spread of various ICT projects oriented towards addressing varied developmental issues (see section 4).

The anecdotal evidence towards moving up the value chain could be empirically analyzed by examining the changing structure of software production and export. Since the focus of our analysis is software we have not taken

Table 5: Major domestic software deals in 2010

Name of the software Firm	Name of the Client	Project details
TechProcess	Indian Overseas Bank	Online payment services to the customers and expand the market each of its associated web merchants
Wipro	Janalakshmi	Implementation of public cloud CRM solution to support the new retail liability business
HCL technologies	National Power corporation	$100 million project for implementing smart grid solutions in the power sector
Spanco Ltd	Maharashtra State Electricity Distribution Co.	Rs 950 Million project on power distribution
IBM	Bharti Airtel	Infrastructure to support 500 million customers
TCS	Karnataka State Govt	Establishing and maintaining State data Centre
Consortium led by Wipro	Andhra Pradesh State Government	Health care system for public hospitals
SAP	Indian Navy	Online financial information system
ORG Informatics	BSNL Ltd	Rs 140 Million project for commissioning sitcom network for Indian Air Force

Source: Based on NASSCOM News line January 2011

into account the BPO services. Total production and export of software is divided into software services and software products which also include the engineering research and design mostly embedded software development. Since the level of skill intensity and value addition is higher in software products and embedded software, an increase in their share may be considered as indicative of moving up the value chain. In case of software services, the traditional practice has been on-site development and studies have already indicated a shift from on site to offshore development (Malik and Ilavarasan, 2011, among others)

Evidence presented in table 6 clearly indicates that there has been a shift from software services to high value adding and skill intensive software products and engineering research and design, mostly embedded software. The shift has been highly pronounced in case of domestic sales where in the share of software products increased by about eight per cent age points and that of software services declined correspondingly. In case of

Table 6: Change on the structure of domestic sales and export of software

Year	Domestic sales of software $ billion	Share of		Export of software $ billion	Share of	
		Software services	Software products and ER&D		Software services	Software products and ER&D
2005	4.2	83.33	16.67	13.1	76.34	23.66
2006	5.81	77.11	22.89	17.31	76.89	23.11
2007	7.13	77.56	22.44	21.99	77.54	22.46
2008	10.11	77.94	22.06	30.5	72.79	27.21
2009	10.92	75.37	24.63	35.4	72.88	27.12
2010	12.03	75.39	24.61	37.29	73.18	26.82
2011	14.49	75.91	24.09	44.84	74.60	25.40

Source: NASSCOM, IT BPO Strategic Review Different years.

exports, though the decline in case of low value adding services has been at a lower level, a shift towards a more value adding activities like software products could be discerned from the table. Entry of large number of new companies into software product development notwithstanding, this segment is still dominated by a few leading firms. In 2008, top five companies (Oracle/i-Flex Technologies, TCS, Infosys, 3i infotech, Subex) accounted for nearly 66 per cent of the total sales in India. While the share of top 10 companies is estimated at 84 per cent, that of top 200 climbs to 93 per cent.

Recent Policies for software development

Studies (Kumar and Joseph 2006, Joseph 2009) have shown that the observed growth performance of software industry has not been an outcome of benign state neglect but could be attributed to a vibrant national system of innovation in general and sectoral system specific to the software industry in particular which was manifested in varied policy measures and institutional interventions. Since the role of National and sectoral systems of innovation in the development of India's software industry has already been subjected to exploration here we shall focus only on recent policy initiatives in explaining the observed in the previous section.

In terms of the policy stance of the government towards software development, two phases could be discerned. During the first phase (up to early 2000) the focus has been on evolving a software industry as a foreign exchange earner in a context wherein the country was starved for foreign exchange. The major policy initiative undertaken during this period included, those relating to the building up of IT manpower, computer policy of 1984, software policy of 1986, establishment of software technology parks, initiatives in venture financing, and the setting up of National Taskforce on IT and Software development which aimed at $50 billion software export by 2008 and made various recommendations both for software and hardware. Along with the various policy initiatives by the Central government, almost all the state governments, beginning with the state of Karnataka, have enacted IT policy of their own and some of the states like Tamil Nadu and Karnataka have policies specific to ITES sector as well. A perusal of these policy documents tends to suggest that the focus of most of the states in the early years have been to attract export oriented investment in software sector of respective states through fiscal concessions.

During the second phase, since the early 2000, in a context of comfortable foreign exchange reserve and the realization of the need to harness ICT for enhancing efficiency, competitiveness and social welfare, there has been a shift in policy towards harnessing software for development which is manifested in various e-governance initiatives by the central and state governments. The recent IT policies by different state governments also aimed at enhancing the IT spending by the state governments to the tune of 3.5 per cent of State Domestic Product (SDP) and facilitation of wider use of IT in different sectors of the economy. At the same time, there were various projects initiated by the private sector and NGOs to harness ICT for addressing developmental issues. In what follows we shall briefly highlight the recent policy initiatives having bearing on the development of software industry in general and greater domestic use of software in particular.

Legal framework

In 2000 the national Government passed the Information Technology Act[1]. This act envisaged providing legal sanctity to all the electronic records and other activities carried out by electronic means. The Act also attempted to change the outdated laws and provided for ways to deal with cyber crimes. It also provided legal sanctity to digital (later amended as electronic signature) and this provided the legal infrastructure for the development of e-commerce. This act also made possible the electronic filing of documents with the Government agencies. In addition with passing of the Right to Information (RTI) Act in 2005 by the central government and some of the state governments ever before 2005, different agencies under the state and central governments are expected to maintain the data base on various aspects on a systematic manner which in turn also led to greater investment in IT and software within the country.

Working group on IT for masses

In 2002 Planning Commission constituted a Working Group for formulation of plan proposals for Tenth Plan (2002-2007). The Working Group had inter-alia recommended that a Plan Scheme on 'IT for Masses' may be formulated for taking IT to the masses. The following focal areas were considered to be covered under 'IT for Masses':

- IT infrastructure
- Electronics Governance

[1]For details please visit http://eprocure.gov.in/cppp/sites/default/files/eproc/itact2000.pdf

- Education
- Mass Campaign for IT Awareness

Accordingly, during the Tenth Five Year Plan activities proposed under IT for Masses were focused on Technology and Application Developments and IT Awareness Campaigns. As the spectrum of activities proposed by the Working Group was expansive on account of fund constraints, during the first four years of the tenth plan, under the IT for Masses, scheme projects were initiated in Telemedicine & Digital Library only. During the Eleventh Plan (2007-12) the IT for Masses scheme has been restructured to focus on Women Empowerment and uplifting of backward communities like scheduled castes (SCs) and scheduled tribes (STs) through ICT.

The National e-Governance Plan (2006)

The National e-Governance Plan was approved by the Government in May 2006 with a vision to provide public services to the common man in his locality at affordable cost. The NeGP is a multi-stakeholder programme which primarily focuses on making critical public services available and promoting rural entrepreneurship[2].

NeGP consists of 27 Mission Mode Projects (MMPs) encompassing 9 Central MMPs, 11 State MMPs and 7 integrated MMPs that span multiple backend Ministries/ Departments. It also includes 8 program support components aimed at creating the right governance and institutional mechanisms, core infrastructure, policies & standards and the necessary legal framework for adoption of e-Governance in the country. It is implemented at the Central, State and Local Government levels. MMPs are owned and spearheaded by various Line Ministries concerned for Central, State, and Integrated MMPs. The concerned Ministry/ Department is entirely responsible for all decisions related to their MMPs. There is also provision for each State to identify up to 5 additional State-specific MMPs relevant for economic development within the State.

The objective of NeGP is to transform traditional processes and service delivery mechanisms and create an environment that is citizen-centric, with rights based approach to governance while making interaction with Government easier, effective and transparent. NeGP is unique in itself. It is not restricted to Government or Industry, or Public alone, but has expanded its reach to all strata of society especially at the grassroots. NeGP's endeavour has been to improve the quality of life, by facilitating socio-economic development across the nation by giving access to crucial services and information in particular to the underserved population.

Out of the 27 Mission Mode Projects, 24 have been approved by the Government. 15 MMPs have gone live and are delivering services electronically by harnessing software, though may not be in the entire country or the entire set of services[3]. To facilitate the e-governance plan a State Wide Area Network (SWAN) with substantial software component has been envisaged as the converged backbone network for data, voice and video communications catering to the information communication requirements of all the Departments in all the states. By the end of 2010, SWAN was operational in all 23 States/UTs.

In addition, the Government approved the Common Services Centres (CSCs) scheme for providing support for establishing 100,000 Common Services Centres in 600,000 villages of India. The objective is to develop a software–hardware platform that can enable Government, private and social sector organizations, to align their social and commercial goals for the benefit of the rural population in the remotest corners of the country. As per the Annual Report of the Ministry of Information Technology (2011), as of December 2010, 87,594 CSCs have been established across the country. Today there are a number of e-governance initiatives undertaken at the instance of central and different state Governments and the IT policies announced by most of the state governments envisage 3.5 per cent of the State Domestic Product as IT spending that which generates demand for software.

A more recent e-governance initiative involving substantial investment by the state and harnessing the capabilities of software firms in the private sector involves setting up of the Unique Identification Authority of India entrusted with the task of issuing unique identification number (*Aadhaar* meaning foundation) for all the citizens of India. Apart from providing identity, the UID will enable better delivery of services and effective governance. As the unique identity database comes into existence, the various identity databases (voter ID, passports, ration cards, licenses, fishing permits, border area ID cards) that already exist in India are planned to be linked to it (see box 1).

[2]For details please visit http://india.gov.in/outerwin.php?id=http://mit.gov.in/content/national-e-governance-plan

[3]For more details please visit http://www.mit.gov.in/content/mission-mode-projects

Box 1

Unique Identification Number (UID): A major Domestic IT Project

A major recent initiative in India that involves harnessing of ICT and thereby substantial demand for software and hardware in the domestic market is the UID project being implemented by the Unique Identification Authority of India (UIDAI). This is headed by one of the most successful IT entrepreneurs of India and one of the founding members of Infosys, who has assumed the charge as Chairman with the rank of a Cabinet Minister. While there is hardly any software project in India that brings together different software firms with significant credentials, this project is being implemented with the active participation of a number of leading Indian IT companies.

The project involves the issue UID (Aadhaar) - a 12-digit unique number of all the Indian citizens and is implemented by the Unique Identification Authority of India (UIDAI). The number will be stored in a centralized database and linked to the basic demographics and biometric information – photograph, ten fingerprints and iris – of each individual. It is easily verifiable in an online, cost-effective way. By providing a clear proof of identity, Aadhaar will empower poor and underprivileged residents in accessing services such as the formal banking system and give them the opportunity to easily avail various other services provided by the Government and the private sector. The centralised technology infrastructure of the UIDAI will enable 'anytime, anywhere, anyhow' authentication.

Since the existing identity databases in India are fraught with problems of fraud and duplicate/ghost beneficiaries the UIDAI plans to enroll residents into its database with proper verification of their demographic and biometric information.

The UID project will generate domestic demand for the services of firms involved on software, hardware and communication services. Mindtree Ltd has been entrusted with task of application software development. For the collection of biometric and demographic data 209 agencies have been selected and the service of additional 91 more will be needed. Telecom companies like Aircel, Airtel, BSNL, Reliance, Tata telecom and Railtel have been entrusted with the task of providing connectivity between enrolment agencies and the Central ID data depository. Software companies involved in the implementation of biometric solutions include Mahindra Satyam and Accenture Services Pvt Ltd. Firms like Sagem Morpho Security Pvt. Ltd. Linkwell Telesystems Pvt. Ltd, Totem International Ltd, Sai Infosystem (India) Ltd. HCL Infosystems Ltd., Geodesic Ltd., I D Solutions will be engaged in the purchase of biometric Authentication systems. Wipro has been entrusted with task of supply, installation, commissioning for hardware and software for data centre at Bengaluru and National Capital Region.

In addition, Accenture Services, HCL Infosystems, HP India, HCL technologies, IBM India Pvt Ltd, Mahindra Satyam, TCS , Tech Mahindra and Wipro have been short listed to overlook the day to day functioning of the UID project once implementation is complete. Since the authentication of identity at the time of service delivery by different agencies will call for standardization of the data gathered across different users, there will be additional demand for software and integration services.

The official estimates for the project is $ 3.59 Billion (Rs 18.0000 Million) and for the opening year 2009, the central budget made an allocation of $19.95 Million (Rs 1000 million). This was followed by a budgetary allocation of $379.5 million for the year 2010-11 and $350.7 million for the year 2012-13.

By February 2012 out of the total revenue expenditure of Rs 8132 Million, Rs1224 million has been for information technology and out of the total capital expenditure of Rs 2545 Million, Rs 1789 has been for IT hardware.

Source: http://uidai.gov.in/ and NASSCOM Strategic Review 2011

Thanks to these initiatives, in the Networked Readiness Index (NRI), featured in the World Economic Forum's *Global Information Technology Report* series, India ranked 48th for the ICT usage of its government, clustering with Brazil (45th) and outperforming comparators Vietnam (68th), Indonesia (86th), and Pakistan (91st), as well as the lower-middle income group and Developing Asia averages (Mia, 2010).

Further focus on Domestic Market: National Policy on IT 2011

The National Policy on Information Technology brought out by the Ministry of Information Technology in October 2011, brought out against the backdrop of global slowdown, provides for an unprecedented focus on domestic market[4]. To quote

> Current negative trends in many economies around the globe provide both challenges and new opportunities. This necessitates the absolute imperative for Indian IT and ITES Industry harness emerging technologies such as Mobile Technology, Localization, Virtualization, and Cloud Computing provide Indian IT/ITES industry a major opportunity to become partners in value creation and drive transformation domestically.

The draft policy further states;

> India today stands at the cusp of development. The Indian workforce is young - with 50% of the population below 25 years. The younger generation is also quick to adopt new technologies. This factor is one of our core competitive strengths. Relying on this advantage, enhanced use of ICT (information & Communication Technologies) can help usher in sustained growth of the Indian economy. For India to retain its competitive edge in sectors in which it is traditionally strong like textiles as also in emerging sectors, it is imperative that ICTs are appropriately adopted. Similarly, the importance of ICTs in strategic sectors like Defence, Atomic Energy, Space etc is paramount.

The National Policy on IT focuses on application of IT enabled approaches to overcome monumental developmental challenges in education, health, skill development, financial inclusion, employment generation, governance etc. to greatly enhance efficiency across the board in the economy. The policy seeks to achieve the twin goals of bringing the full power of ICT within the reach of the whole of India and harnessing the capability and human resources of the whole of India to enable India to emerge as the Global Hub and Destination for IT and ITeS Services by 2020. The focus of the IT policy is therefore on deployment of ICT in all sectors of the economy and on providing IT solutions to the world. With a view to promoting the use of software by the Small and Medium enterprises, the policy has the provision for fiscal benefits to for adoption of IT by these units. This is expected to create major boost for the domestic market for software. The policy, among others, also aims at integrating Aadhaar, financial and location-based services to foster an ecosystem for innovation in services, create a pool of 10 million additional skilled manpower in ICT and make at least one individual in every household e-literate.

In addition to the various e-governance initiatives by the government there have been various initiatives by the private sector and NGOs towards harnessing ICT for addressing the development needs which in turn acted as a catalyst for domestic demand for both software and hardware (Singh and Kaushik (2004).

Role of Private sector and Industry Associations

It may be myopic to attribute the observed dynamism of the industry entirely to the policy initiatives by the state. While the state initiatives laid the foundation for faster growth, the industry associations[5], particularly the National Association of Software and Service Companies (NASSCOM) played an important role. During the early years of the development of India's software industry, NASSCOM played an important role in projecting India's image in the world IT market which helped exports For example, in 1993 NASSCOM appointed a full time lobbying firm in Washington. It facilitated the participation of Indian firms in a large of international IT exhibitions and projecting India's capabilities in the sphere of IT. Role that NASSCOM played in getting the visa rules relaxed by the developed countries, especially USA, is also well known. When it comes to the creation of domestic market for the software industry, its anti piracy initiatives were especially useful. It even took up the campaign against software piracy and conducted a number of well-publicised raids[6]. NASSCOM influenced the Central and State

[4]For details please visit http://mit.gov.in/sites/upload_files/dit/files/National_Policy_on_Information_Technology_07102011%281%29.pdf

[5]To begin with, there was the Computer Society of India, which is essentially an association of academics and professionals and did not address many of the issues faced by the industry. Hence a new association called Manufacturers Association of Information Technology (MAIT) was formed in 1982. This consisted of both the hardware and software firms. Later an association, currently known as NASSCOM, was formed to address specific issues being faced by the software and service companies. The Electronics and Software Export Promotion Council, an autonomous body under the MIT, though its various, initiatives also made significant contribution towards India's IT export growth.

[6]For a detailed account of the NASSCOM activities in promoting IT and role played by late Mr Dewang Metha, see " Power Lobbying", *Business India*, February 19 to March 4, 2001.

governments for enhanced use of IT which in turn has been instrumental in the creation of a larger domestic market.

Given the manpower constraint confronted by the industry especially since 2000, NASSCOM has undertaken varied initiatives to enhance the supply of manpower and improve their employability at all the levels. In a context wherein high income earning opportunities were provided by the IT industry for the graduates, there has been a decline in the number of students entering for post graduate courses and Ph D. In this context, NASSCOM has been working with Ministry of Human Resource Development to create highly specialized professionals with skill sets in emerging, "on-the-horizon" technologies that are not yet mainstream. In 2007 NASSCOM, in partnership with the Ministry of Human Resource Development, began the "Finishing Schools for Engineering Students" program, with a view to enable young technical graduates to become industry-ready. NASSCOM also has initiated the IT Workforce Development (ITWD) program, keeping the issues and concerns of the industry at one end and challenges of the academia at the other. As part of this initiative, NASSCOM has been nurturing the IT industry-academia interface through workshops and conferences, faculty sabbaticals, training programs and mentorship initiatives to ensure better synchronization between IT education and the industry requirements.

Concluding Observations

It is generally perceived that the greatest contribution by the previous century in the sphere of technology to the current century and beyond is the revolutionary changes in the Information Communication Technology (ICT). While the genesis of such revolutionary changes could be traced to the technological changes in microelectronics, it has been sustained by the developments in software. The cumulative effect has been emergence ICT as the General Purpose Technology (GPT) of the new millennium that is instrumental in enhancing efficiency, competitiveness and growth in all sectors of the economy regardless of their stage of development. If the available evidence is any indication, there is hardly any developing country that has not undertaken policy measures and institutional interventions to develop ICT capabilities and harness the new technology as a short cut to prosperity. In this context India's performance has been remarkable in terms of her success in recording high growth in the exports of software and services.

Remarkable export performance notwithstanding India' record in terms of harnessing IT and software for building efficiency, productivity and competitiveness of other sectors of the economy has been less remarkable. This has been reflected not only in the sluggish growth of India's manufacturing sector but also in the international competitiveness. However, of late there has been a significant change in the internal and external environment in which the industry operates. In the context the present article has been an attempt at exploring whether there has been a greater domestic market orientation and the role of state policies therein. The study tends to suggest that the industry is increasingly getting oriented towards the domestic market. While the share of domestic sales in total production has been showing a steady decline until 2004-05 to reach the lowest level of 20 per cent, after 2004-05, despite a vibrant export market, the decline in the share of domestic market got arrested. The empirical evidence from the recent years clearly point towards a turnaround with domestic market orientation. In fact it is for the first time since 1991 that the share of domestic market has shown an upward trend consecutively for three years from 20.08 per cent in 2008-09 to 23.07 per cent in 2010-11. It has also been argued that there has been a shift in the nature of domestic market from services to high value adding and skill intensive software products and engineering research and design. An examination of the various policies by the state along with the initiatives by the Industry associations like NASSCOM tends underline the role of state and other stakeholders in reorienting the industry to deal with national concerns.

References

Annamalai, Kuttayan, and Sachin Rao. (2003). What Works: ITC's E-Choupal and Profitable Rural Transformation, Washington, DC: World Resources Institute.

Arora, A. and S. Athreya (2002). 'The Software Industry and India's Economic Development', *Information Economics and Policy*, 14(2): 252-273.

Arora, A., V. S Arunachalam, J. Asundi and F. Ronald (2001). 'The Indian Software Services Industry', *Research Policy*, 30 (8): 1267-87.

Arora, A.and Gambardella, A. (2004), "The Globalization of the Software Industry: Perspectives and Opportunities for Developed and Developing Countries", Working Paper 10538, National Bureau of Economic Research, Cambridge. MA.

Athreye, S. (2005), The Indian Software industry and its evolving service capability, Industrial and Corporate Change, Vol. 14(3), 2005: 393-418.

Balakrishnan, P. (2006), Benign neglect or strategic intent? Contested lineage of Indian software industry, *Economic and Political Weekly*, 41(36), 3865–3873.

Bhagwati, J. N. (1984) Why are services Cheaper in Poor Countries?, *Economic Journal*, 94, 279-285.

D'Costa A. P., (2003), Uneven and combined development: Understanding India's software exports, *World Development*, 31(1), 211–226.

Ernst, D. (1993) *The Global Race in Micro Electronics*, Campus, Frankfurt and New York.

Hutchinson, F. and P. V. Ilavarasan (2008) IT/ITES sector and economic policy at the subnational level in India. *Economic and Political Weekly*, 43(46), 64-70.

Government of India (2012), *Economic Survey*, Ministry of Finance, New Delhi.

Gregory, N. S. Nollen, S. Tenev (2009) *New Industries from New Places: The emergence of the software and hardware industries in China and India*, The World Bank and Stanford University Press, Washington DC.

Heeks R., (1996) *India's software industry, state policy, liberalization and industrial development.* New Delhi: Sage Publications.

Joseph, K. J. (1997) *Industry Under Economic Liberalization The Case of Indian Electronics*, Sage Publications, New Delhi, Thousand Oaks, London

Joseph, K. J. (2002) 'Growth of ICT and ICT for Development: Realities of the Myths of Indian Experience', Discussion paper No. 2002/78, Helsinki: UNU/ WIDER.

Joseph, K.J. (2004) Development of Enabling Policies for Trade and Investment in the IT Sector of the Greater Mekong Sub region, UNESCAP, http://www.unescap.org/tid/projects/gms.asp

Joseph K. J. (2005) Transforming Digital Divide into Digital Dividend: The Role of South-South Cooperation in ICTs, *Cooperation south 102-125.*

Joseph, K. J. (2006) *Information Technology, Innovation System and Trade Regime in Developing Countries: India and the ASEAN,* Palgrave Macmillan London.

Joseph K. J. (2009) Sectoral innovation Systems in Developing Countries: the case of India's ICT in India, in Lundvall B A, K J Joseph, C. Cristina and Jan Vang (eds) Handbook of Innovation Systems and Developing Countries, Edward Elgar, Cheltenham

Joseph K. J. and G. Parayil (2008) Can Trade Liberalization Bridge Digital Divide: Assessing the Information Technology Agreement of WTO, *Economic and Political weekly, Vol 48, No. 1 January 5-11.*

Joseph, K.J. and K. N. Harilal (2001) 'Structure and Growth of India's IT Exports: Implications of an Export-Oriented Growth Strategy', *Economic and Political Weekly*, Vol. 36 (34): 3263-70.

Kaushik P D and Nirvikar Singh (2004) Information Technology and Broad-Based Development: Preliminary Lessons from North India, World Development, 32(4) 591-607.

Koanantakool, T. (2002) 'National ICT policy in Thailand', Paper presented at the Africa Asia Workshop on Promoting Co-operation in Information and Communications Technologies Development, Kuala Lumpur and Penang, Malaysia, 25–29 March

Kumar N. (2001) Indian software industry development: International and national Perspective, *Economic and Political Weekly*, 36 (45): 4278-4290.

Kumar, N. and K. J. Joseph (2005) 'Export of Software and Business Process Outsourcing from Developing Countries: Lessons from India', *Asia Pacific Trade and Investment Review* 1(1): 91-108.

Kumar, N and K. J. Joseph (2006) National Innovation Systems and India's IT capability: Are there any lessons for ASEAN New Comers? in Lundvall, B A, P. Intarakumnerd and J. Vang (eds) *Asia's Innovation System in Transition*, Edward Elgar, Cheltenham.

Malik, P and P V Ilavarasan (2011) Trends in Public and Private Investments in ICT R&D in India, JRC Technical Notes, European Commission.

Mia, I. (2010) Using Information and Communication Technologies to Boost India's Competitiveness, World Economic Forum Geneva.

Ministry of Information Technology (2011), *Annual Report*, Department of Information Technology New Delhi.

Mytelka, L. K. and John F.E. Ohiorhenuan, (2000) Knowledge-based Industrial Development and South-South Cooperation, *Cooperation South*, No.1 2000, pp 74-82.

Nagaraj, R (2004) Fall in organized Manufacturing Employment: A Note, *Economic ad Political weekly*, July 24 pp 3387-90.

NASSCOM (2011), *The IT-BPO sector in India; Strategic Review,* National Association of Software and Service Companies. New Delhi.

NASSCOM (2012), *The IT-BPO sector in India; Strategic Review,* National Association of Software and Service Companies. New Delhi.

NASSCOM (different years) *NASSCOM Newsline*, National Association of Software and Service Companies, New Delhi..

National Bureau of Statistics (different years) *China Statistical Yearbook*, China Statistical Press Beijing

Ojo, A. Tomasz Janowski, Rilwan Basanya, and Mike Reed (2008) Developing and Harnessing SoftwareTechnology in the South: The Roles of China, India, Brazil, and South Africa, Research Paper No. 2008/89, WIDER, Helsinki.

Patibandla M. and B. Petersen, (2002), Role of transnational corporations in the evolution of a high-tech industry: The case of India's software industry. *World Development,* 32 (3), 561-566

Parthasarathi A. and K. J. Joseph (2002) Limits to innovation set by strong export orientation: The experience of India's information and communication technology sector. *Science, Technology and Society,* 7(10), 13–49.

RIS, (1987) South-South Economic Cooperation: Problem and Prospects, New Delhi, Radiant Publishers

RIS (2004) UNCTAD X1 and the Development Dialogue for the 21st Century, RIS Policy Briefs No. 13, May, New Delhi, Research and Information System for Non Aligned and other Developing countries.

Schware, R., (1987) "Software Industry in the Third World: Policy Guide lines, Institutional Options and Constraints", *World Development*, Vol. 15, No 10/11, pp 1249-67.

Schware R (1992) "Software Entry Strategies for Developing Countries", *World Development*, Vol. 20, No. 2 pp 143-64.

Sukumar, S. and Narayana Murthy N R (2003) Influence of ICT on the Development of India's Competitiveness, in Dutta, S. et.al. (eds.), The Global Information Technology Report: Readiness for the Networked World, Oxford University Press, New York.

South Commission (1990) The Challenge to the South: The Report of the South Commission, Oxford University Press, New York.

UN ICT Taskforce (2005) *Innovation and Investment: Information Communication Technologies and the Millennium Development Goals*, UN ICT task force, New York.

UNCTAD (1986) South-South Economic Cooperation: Some Issues in the Field of Trade and Finance, RIS Occasional Paper No. 7, New Delhi, Radiant Publishers.

UNCTAD (2003) *E-Commerce and Development Report 2003*, (Geneva: United Nations).

The important thing about outsourcing or global sourcing is that it becomes a very powerful tool to leverage talent, improve productivity and reduce work cycles.

—Azim Premji

Focus

The Future Prospects of Cloud Computing in India

GURMEET SINGH AND SULTANA B. A. MAZUMDER

Cloud computing has recently emerged as a new paradigm for hosting and delivering services over the Internet. This article provides brief information on cloud computing and the future prospects of cloud computing in India. Cloud computing is one contemporary technology in which the research community has recently embarked. The main purpose of this article is to know about the future of cloud computing in India which is defined there with the help of SWOT analysis. The aim is to provide a better understanding of the design challenges of cloud computing and identify important research directions in this increasingly important area.

Gurmeet Singh is Assistant Professor, Naraini Group of Institutions, Karnal, Haryana, India and Sultana B. A. Mazumder is Assistant Professor, Department of Management, North Eastern Hill University, Tura Campus, Chandmari, Meghalaya, India.

Literature Review

According to Vogel (2008), current advancements in web technologies are enabling to develop new features of interactive systems that rely on cloud infrastructure and services. In this article, we present our efforts related to the development of three prototypes of a web-based visualization tool that use Google Cloud Services to process and visualize geo-temporal data. The domain in which these efforts are taking place is in the field of environmental science. The need of web-based visualization tools in this area indicates the importance of allowing users in an interactive manner to explore analyze and reflect on different representations of environmental data. We discuss the development of these prototypes and their features, as well as the different iterations that were carried out during these processes.

Armbrust, et al, (2009) define the long-held dream of computing as a utility, which has the potential to transform a large part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased. Developers with innovative ideas for new Internet services no longer require the large capital outlays in hardware to deploy their service or the human expense to operate it. They need not be concerned about over provisioning for a service whose popularity does not meet their predictions, thus wasting costly resources, or under provisioning for one that becomes wildly popular, thus missing potential customers and revenue.

Hilton (2009), also defines two additional characteristics of cloud computing: Service-Level Assured and Virtualized. The Service-Level Assured (SLA) component requires the service provider to offer guaranteed levels of performance for metrics such as server uptime, network responsiveness, security controls, etc. Associated with these guarantees are monetary penalties for the provider if they are not met. The virtualized

characteristic is a key enabling technology that underpins all of cloud computing.

In another work, Bragonier (2011), cloud service providers have been compared to utility companies whereby users "turning on the lights" (Bragonier, 2011, p. 29) via the Internet to access computing services. Users may plug into various services within the computing grid and determine how best to accommodate and pay for fluctuating demand related to computer services. This "perfect storm" of emerging technologies includes the same elements as the development of electricity: efficient mass production, reliability and infrastructure.

Introduction

Computing is being transformed to a model consisting of services that are commoditized and delivered in a manner similar to traditional utilities such as water, electricity, gas, and telephony. In such a model, users access services based on their requirements without regard to where the services are hosted or how they are delivered. Several computing paradigms have promised to deliver this *utility computing* vision and these include cluster computing, Grid computing, and more recently *Cloud computing*. The latter term denotes the infrastructure as a "*Cloud*" from which businesses and users are able to access applications from anywhere in the world on demand. Thus, the computing world is rapidly transforming towards developing software for millions to consume as a service, rather than to run on their individual computers.

Cloud computing is a new name for an old concept: the delivery of computing services from a remote location, analogous to the way electricity, water, and other utilities are provided to most customers.[1] Cloud computing services are delivered through a network, usually the Internet. Utilities are also delivered through networks, whether the electric grid, water delivery systems, or other distribution infrastructure. In some ways, cloud computing is reminiscent of computing before the advent of the personal computer, where users shared the power of a central mainframe computer through video terminals or other devices. Cloud computing, however, is much more powerful and flexible, and information technology advances may permit the approach to become ubiquitous.

Objectives

- To know about the future of cloud computing in India
- To know about service and deployment models of cloud computing
- Discuss about advantages and capabilities of cloud computing in India

What is Cloud Computing

The term "cloud", as used in this white paper, appears to have its origins in network diagrams that represented the internet, or various parts of it, as schematic clouds. "Cloud computing" was coined for what happens when applications and services are moved into the internet "cloud." Cloud computing is not something that suddenly appeared overnight; in some form it may trace back to a time when computer systems remotely time-shared computing resources and applications. More currently though, cloud computing refers to the many different types of services and applications being delivered in the internet cloud, and the fact that, in many cases, the devices used to access these services and applications do not require any special applications.

"A Cloud is a type of parallel and distributed system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resource(s) based on service-level agreements established through negotiation between the service provider and consumers."

Service Models

As shown in the following descriptions, cloud computing has three service models (figure 1).

Software as a Service (SaaS)

A cloud-computing approach to providing users with computer applications, Instead of each user having to install the software on his computer, the user is able to access the program via the internet (figure 2). Businesses commonly use software as a service (SaaS) in customer retention management, human resources and procurement. Technology companies, financial services companies and utilities have lead the business world in adopting SaaS technology.

The advantages of SaaS are that it is easy to implement, easy to update and debug and can be less expensive (or at least have lower up-front costs), since users pay for SaaS as they go instead of purchasing multiple software licenses for multiple computers. SaaS

[1] For a discussion of utility and other models of providing computing services, see M. A Rappa, "The Utility Business Model and the Future of Computing Services," *IBM Systems Journal* 43, no. 1 (2004): 32 –42, http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5386779.

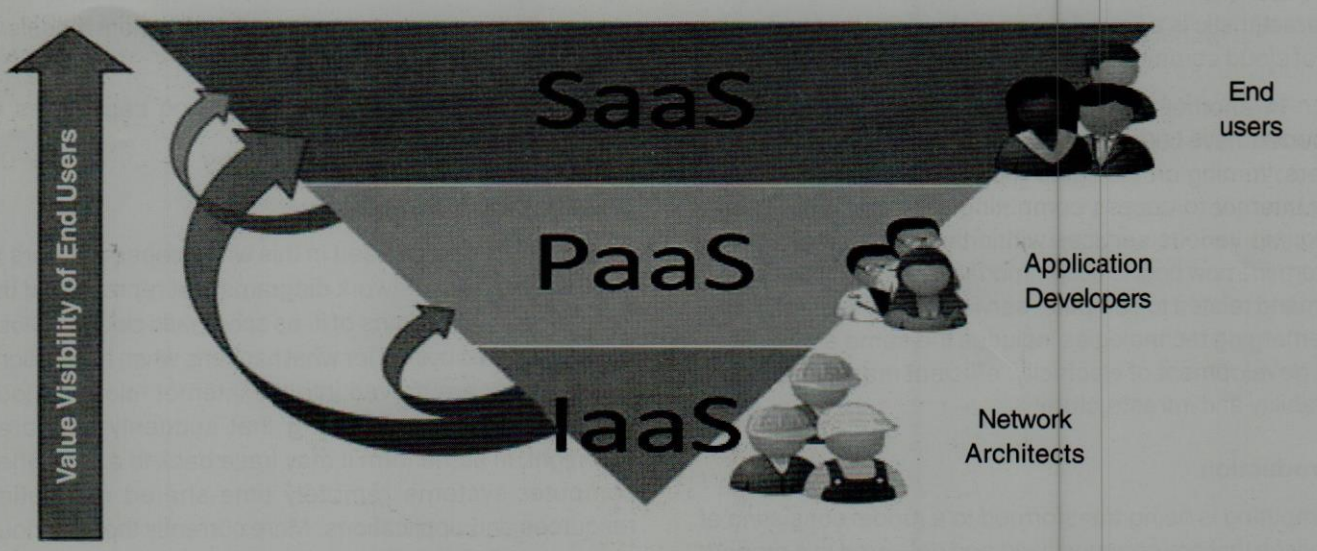


Figure 1: The three service models.

has numerous uses, including tracking leads, scheduling events, managing transactions, automating sign up, auditing and more.

Platform as a Service (PaaS)

"Cloud computing" has dramatically changed how business applications are built and run. Delivering a new application is now as fast as opening your internet browser. Platform as a service— or PaaS— is a proven model for running applications without the hassle of maintaining the hardware and software infrastructure at your company (figure 3). Enterprises of all sizes have adopted PaaS solutions like Salesforce.com for the simplicity, scalability and reliability. PaaS applications that always have the latest features without constant upgrade pain.

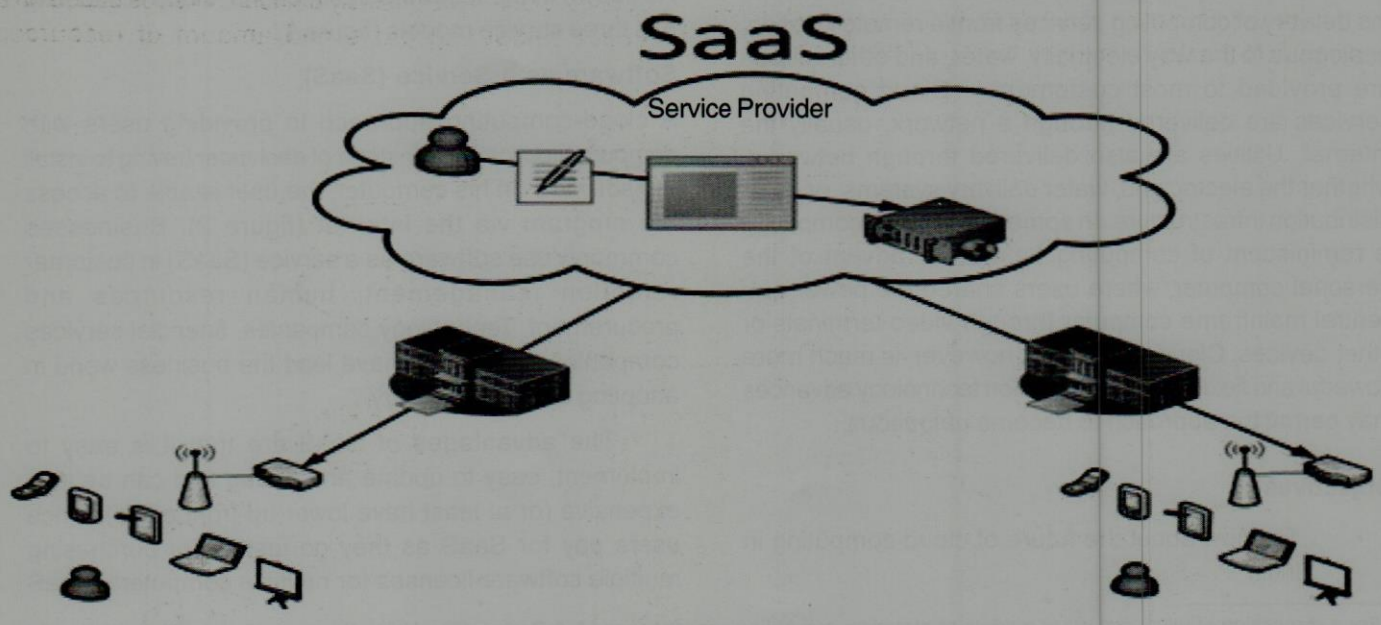


Figure 2: The SaaS model

The primary function of PaaS is to allow businesses to build and run web-based, custom applications in an on-demand fashion. Furthermore, developers have access to specific tools and libraries, while also controlling software deployment and configuration settings. The company offering the Paas service provides the networks, servers, and storage. Therefore, using this type of service allows the vendor access to an ideal infrastructure model that can be housed offsite. Because the hardware is located in another location, customers have access to unlimited computing power, while decreasing upfront costs dramatically since users only pay for the service that they use.

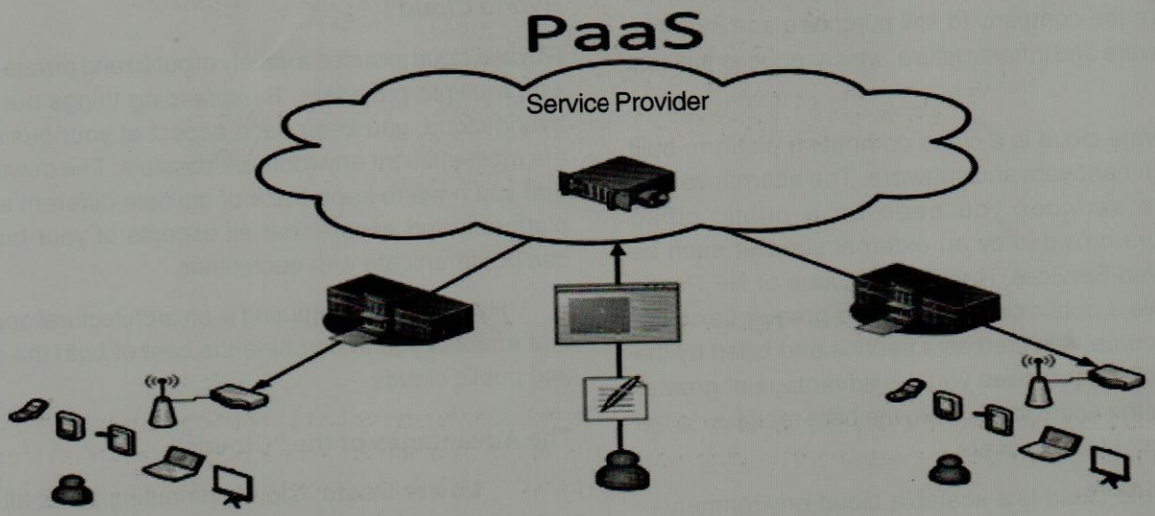


Figure 3: The PaaS model

Infrastructure as a Service (IaaS)

With "Infrastructure as a Service" (IaaS), customers get on-demand computing and storage to host, scale, and manage applications and services (figure 4). IaaS delivers computer infrastructure – typically a platform virtualization environment – as a service. Rather than purchasing servers, software, data-centre space and network equipment, customers buy those resources as fully outsourced services. Suppliers typically bill such services based on a utility computing basis and amount of resources

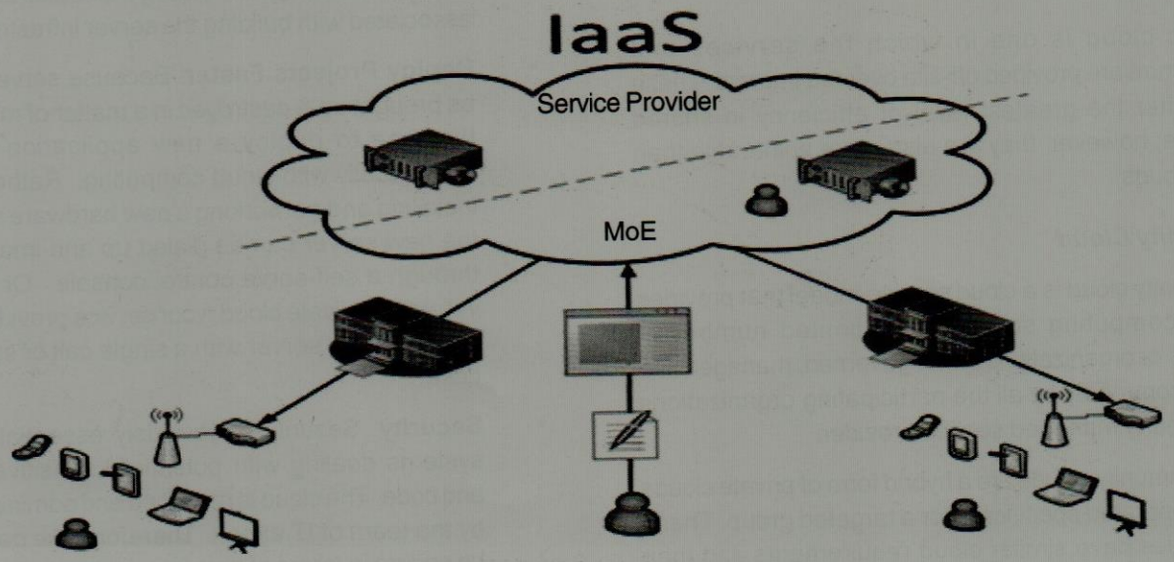


Figure 4: The IaaS model

consumed - therefore the cost will typically reflect the level of activity.

Deployment Models

Private Cloud

A private cloud is one in which the services and infrastructure are maintained on a private network. These clouds offer the greatest level of security and control, but they require the company to still purchase and maintain all the software and infrastructure, which reduces the cost savings.

A private cloud is a cloud computing platform built on your own hardware and software. The alternative is to deploy the services you need on a public cloud infrastructure provided by an external supplier such as Amazon Web Services, Rackspace Cloud or HP Public Cloud. While a public cloud can afford greater flexibility, with all resource delivered as a service and billed by the hour, a private cloud gives you the advantage of greater control over the entire stack, from the bare metal up to the services accessible to users.

A private cloud is a scalable cloud environment—providing the agility and efficiency of a public cloud—built on infrastructure dedicated exclusively for your organization. It can be hosted in your own data center, in a partner data center, or at Rackspace.

Private clouds are ideal when you need to accelerate innovation, have large compute and storage requirements, or have very strict control, security, and compliance needs.

Public Cloud

A public cloud is one in which the services and infrastructure are provided off-site over the Internet. These clouds offer the greatest level of efficiency in shared resources; however, they are also more vulnerable than private clouds.

Community Cloud

A community cloud is a cloud service model that provides a cloud computing solution to a limited number of individuals or organizations that is governed, managed and secured commonly by all the participating organizations or a third party managed service provider.

Community clouds are a hybrid form of private clouds built and operated specifically for a targeted group. These communities have similar cloud requirements and their ultimate goal is to work together to achieve their business objectives.

Community clouds are often designed for businesses and organizations working on joint projects, applications, or research, which requires a central cloud computing facility for building, managing and executing such projects, regardless of the solution rented.

Hybrid Cloud

A hybrid cloud includes a variety of public and private options with multiple providers. By spreading things out over a hybrid cloud, you keep each aspect at your business in the most efficient environment possible. The downside is that you have to keep track of multiple different security platforms and ensure that all aspects of your business can communicate with each other.

Hybrid cloud computing is an architectural approach that enables you to combine the best of both the private and public clouds.

The Advantages of the "Clouds"

- **Lower Costs**: Cloud computing pools all of the computing resources that can be distributed to applications as needed – optimizing the use of the sum of the computing resources and delivering better efficiency and utilization of the entire shared infrastructure.
- **Cap-Ex Free Computing**: Whether you go with a public cloud or outsourced private cloud computing option, cloud computing delivers a better cash flow by eliminating the capital expense associated with building the server infrastructure.
- **Deploy Projects Faster**: Because servers can be brought up & destroyed in a matter of minutes, the time to deploy a new application drops dramatically with cloud computing. Rather than installing and networking a new hardware server, the new server can be dialed up and imaged in through a self-serve control console. Or better yet, with a private cloud, your service provider can dial up a new server with a single call or support ticket.
- **Security**: Security is obviously essential in all systems dealing with potentially sensitive data and code. The cloud is managed and administered by the team of IT expert. Therefore, the data will be secure in terms of data loss and system crash.

- **Scale as Needed**: As your applications grow, you can add storage, RAM and CPU capacity as needed. This means you can buy "just enough" and scale as the application demands grow.
- **Self Service Model**: The one of the reason behind popularity of cloud based environment is self service model. In some cases users have the ability to upload files, build programs, deploy, schedule, manage, and generate reports. This service is available to the users based on demand.
- **Lower Maintenance Costs** are driven by 2 factors: Less hardware and outsourced, shared IT staff. Because cloud computing uses less physical resources, there is less hardware to power and maintain. With an outsourced cloud, you don't need to keep server, storage, network, and virtualization experts on staff full time. You get economy of scale of those expert resources through your cloud provider.
- **Resiliency and Redundancy**: One of the benefits of a private cloud deployment is that you can get automatic failover between hardware platforms and disaster recovery services to bring up your server set in a separate data center should your primary data center experience an outage.
- **Data Management:** Data management is an essential aspect in sense of storage, where data is flexibly distributed across multiple resources. Implicitly, data consistency needs to be maintained over a wide distribution of replicated data sources. At the same time, the system always needs to be aware of the data location at the time of replicating data across the data centers. Therefore, data management is a tremendous feature of cloud environment.
- Cloud computing provides some strong benefits. Selecting a public or private cloud implementation will depend on your application, performance, security and compliance requirements, but with the proper deployment cloud computing can provide significant savings, better IT services, and a higher level of reliability.

Clouds in the Future Internet

Cloud and IT service providers should act as responsible stewards for the data of their customers and users. However, the current absence of accountability frameworks for distributed IT services makes it difficult for users to understand, influence and determine how their service providers honour their obligations. The Cloud project will create solutions to support users in deciding and tracking how their data is used by cloud service providers. By combining methods of risk analysis, policy enforcement, monitoring and compliance auditing with tailored IT mechanisms for security, assurance and redress, Cloud aims to extend accountability across entire cloud service value chains, covering personal and business sensitive information in the cloud.

Specific Characteristics/Capabilities of Clouds

- ***On-demand self-service*** — A consumer can independently and unilaterally provision computing capabilities, such as compute time, network connectivity and storage, as needed automatically without requiring human interaction with each service's provider.
- ***Broad network access*** — Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms.
- ***Resource pooling*** — The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources, but may be able to specify location at a higher level of abstraction (e.g., country, state, region or datacenter). Examples of computing resources include storage, processing (compute), memory, network bandwidth, and virtual machines.
- ***Rapid elasticity*** — Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out, and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.
- ***Measured Service*** — Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, compute, bandwidth, active user

accounts, etc.). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Towards A Indian Vision

The market for cloud computing is expanding rapidly in India. Industry experts say that while the global cloud computing market is growing in excess of 30 percent, the growth is faster in India. Cloud computing refers to the delivery of computing services or virtualized information services to the client with shared infrastructure over the network. The hosting company owns and manages the physical infrastructure; the software and data reside on their servers. Typically, cloud suppliers host business applications with access via the Internet through a web browser. In India, there are many micro, small, and medium enterprises (MSMEs), which have budget constraints in terms of hiring IT professionals, building IT infrastructure, and such others. Hence most of the MSMEs are opting for cloud computing, which offers a protected IT set up with lower risk and helps to bring down the cost of ownership. In India, MSME contributes to over 30 percent of the cloud computing market. Cloud computing technologies will help these companies in India to achieve global competitiveness while bringing down the cost of ownership.

Cloud computing technology helps companies to improve their efficiency and performance levels. It also helps in streamlining the management of information while reducing the company's costs on IT infrastructure and other related costs. Cloud computing is a pre-requisite for CIOs for effective information management. In India, the need for consolidating data centers, reducing hardware costs, and other factors are driving the adoption of cloud computing technologies.

Swot Analysis

SWOT analysis is a strategic planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in any venture. It involves specifying the objective of the project and identifying the internal and external factors that are favorable and unfavorable to achieve the objective.

Strengths

India has a particularly strong IT industry that can be an important commercial factor for the western countries to consider in their future cloud related development. Accordingly, an Indian library does not have the economic strength to impact on the western countries. The main strength and hence advantage of India, however, consists in its consolidated and synergetic efforts to address new technological innovations, trends and governmental issues. As India has strong IT industry now, up-coming Indian companies are offering cloud services for Indian libraries at affordable prices. Moreover in India many institutes are not in condition to purchase high end server and costly software for their library, in this situation the cloud computing will provide grate platform to host their data on cloud to serve their users.

Weakness

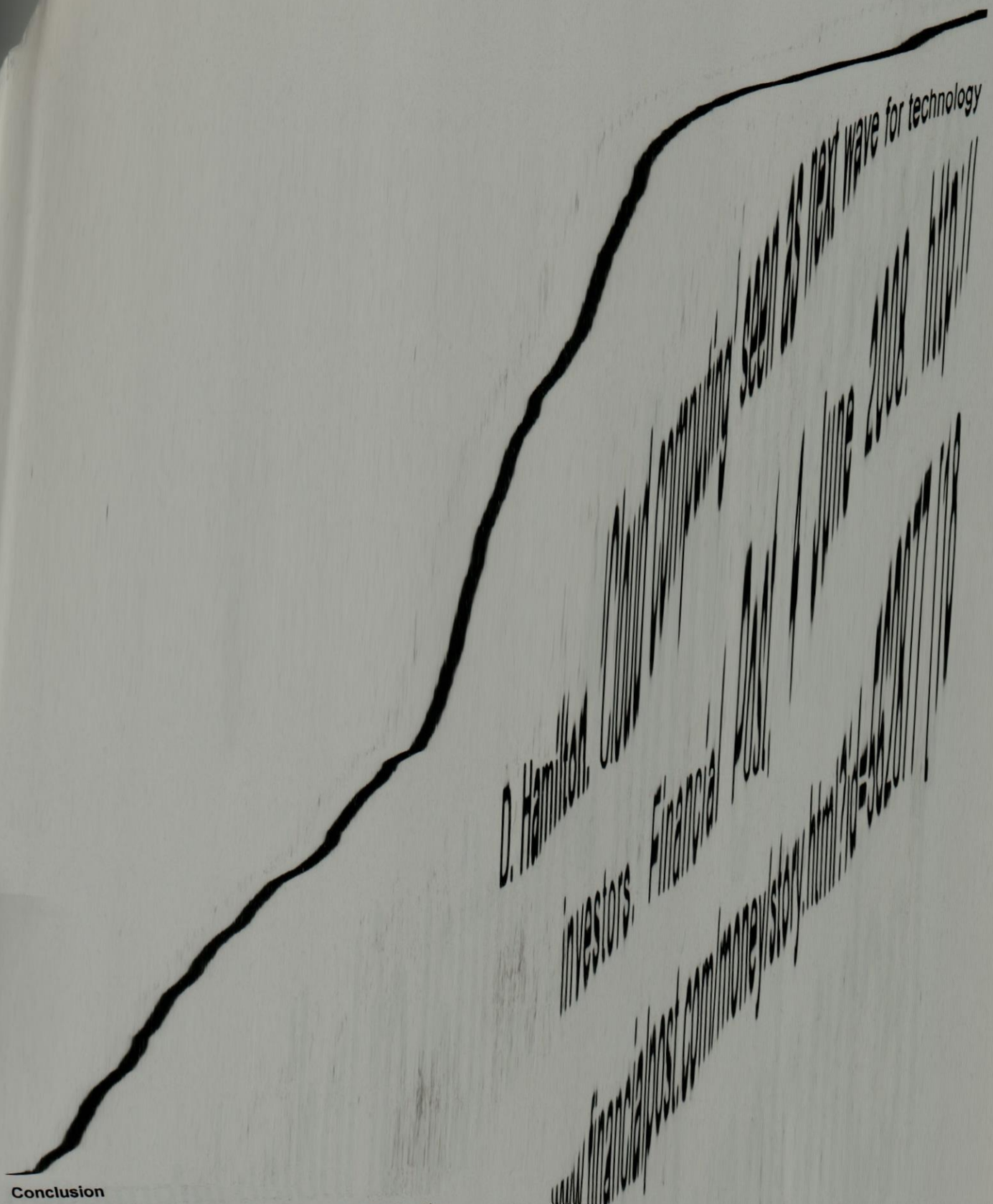
However, India is not as fast as US and Europe in the development and considering the timelines of research to reach market-readiness as opposed to the fast movements in the market itself. The time is a critical resource with respect to positioning India in the global cloud development market. Implementation of cloud in the libraries is not easy task as there are many administrative and financial matters involved. Adopting cloud services means we have to be depending on the service provider. Many Indian libraries does not have even internet connection to connect with the cloud, in this case, it is very difficult to implement cloud based services.

Opportunities

India is an emerging market for IT industry and, Indian government is also providing help to Indian university libraries to get high speed internet connection for research purpose, in view of these libraries/institutions/ universities can consider cloud based library services to serve their users. Using cloud computing libraries can offer modern information services in user friendly format. With the use of these advanced technology library staff can also get an opportunity to learn new technological changes occurred in the field. As the cloud is a third party service if, any problem occurs, then the experts will provide the quick solution without interrupting library services.

Threats

These opportunities are obviously counterweighted by some threats that particularly relate to the effort involved in the implementation. The threats namely connectivity problem, hidden cost for add-on services by service provider, compatibility, lock in period etc. The most important is migration of data from one service provider to other is a very difficult task.



Conclusion

To summarize, the cloud provides many options for the everyday computer user as well as large and small businesses. It opens up the world of computing to a broader range of uses and increases the ease of use by giving access through any internet connection. However, with this increased ease also come drawbacks. You have less control over who has access to your information and little to no knowledge of where it is stored. You also must be aware of the security risks of having data stored on the cloud. The cloud is a big target for malicious individuals and may have disadvantages because it can be accessed through an unsecured internet connection. The cloud computing has its own merits and demerits. Moreover, newly coming up libraries which do not have sufficient budget to acquire high end technology with proper hardware and software can choose cloud. But, in future it

July 2008]

Hilton, S. (2009). Ask Steve: The 7 components of cloud computing. Retrieved from http://www.informationweek.com/news/220300150

J. Elson and J. Howell. Handling Flash Crowds from your Garage. In *Proceedings of the 2008 USENIX*

Malis, A. (1993), 'Routing over Large Clouds (ROLC) Charter", part of the 32nd IETF meeting minutes' - available at *http://www.ietf.org/proceedings/32/charters/rolc-charter.html*

Massó, J (2009), 'Stormy Weather (Cloud & SaaS)'. INES General Assembly Keynotes – available at *http://www.ines.org.es/docs/4%20Asamblea/06%20-%20StormyWeather_jmasso_INES_8Jul.pdf*

S. Venugopal, R. Buyya, and L. Winton. A Grid Service Broker for Scheduling e-Science Applications on Global Data Grids

Conclusion

To summarize, the cloud provides many options for the everyday computer user as well as large and small businesses. It opens up the world of computing to a broader range of uses and increases the ease of use by giving access through any internet connection. However, with this increased ease also come drawbacks. You have less control over who has access to your information and little to no knowledge of where it is stored. You also must be aware of the security risks of having data stored on the cloud. The cloud is a big target for malicious individuals and may have disadvantages because it can be accessed through an unsecured internet connection. The cloud computing has its own merits and demerits. Moreover, newly coming up libraries which do not have sufficient budget to acquire high end technology with proper hardware and software can choose cloud. But, in future it may increase looking into the advantages of this technology, which relieves libraries and library professionals from maintaining the servers and software.

References

Amrhein, D. and Willenborg, R. (2009), 'Cloud computing for the enterprise, Part 3: Using WebSphere CloudBurst to create private clouds' - available at *http://www.ibm.com/developerworks/websphere/techjournal/0906_amrhein/0906_amrhein.html*

***Annual Technical Conference** (USENIX 2008)*, Boston, USA, June 2008.

Armbrust, Michael et al. (2009). *Above the Clouds: A Berkeley View of Cloud Computing*. CA: Electrical Engineering and Computer Sciences, University of California at Berkeley. (Technical Report No. UCB/EECS-2009-2)

Bragonier, D. (2011). Still foggy on cloud computing?. *CA Magazine, 144*(7), 26-35.

C. S. Yeo and R. Buyya. Integrated Risk Analysis for a Commercial Computing Service. In *Proceedings of the 21st IEEE International Parallel and Distributed Processing Symposium (IPDPS 2007)*, Long Beach, USA, Mar. 2007.

D. Hamilton. 'Cloud computing' seen as next wave for technology investors. *Financial Post*, 4 June 2008. http://www.financialpost.com/money/story.html?id=562877 [18 July 2008]

Hilton, S. (2009). Ask Steve: The 7 components of cloud computing. Retrieved from http://www.informationweek.com/news/220300150

J. Elson and J. Howell. Handling Flash Crowds from your Garage. In *Proceedings of the 2008 USENIX*

Malis, A. (1993), 'Routing over Large Clouds (ROLC) Charter", part of the 32nd IETF meeting minutes' - available at *http://www.ietf.org/proceedings/32/charters/rolc-charter.html*

Massó, J (2009), 'Stormy Weather (Cloud & SaaS)'. INES General Assembly Keynotes – available at *http://www.ines.org.es/docs/4%20Asamblea/06%20-%20StormyWeather_jmasso_INES_8Jul.pdf*

S. Venugopal, R. Buyya, and L. Winton. A Grid Service Broker for Scheduling e-Science Applications on Global Data Grids. *Concurrency and Computation: Practice and Experience*, 18(6):685-699, May 2006.

Vogels, W. (2008). A Head in the Clouds – The Power of Infrastructure as a Service Infrastructure as a Service. In First workshop on Cloud Computing and In Applications (CCA'08).

Webhosting Unleashed (2008), 'Cloud-Computing Services Comparison Guide'. Available at *http://www.webhostingunleashed.com/whitepaper/cloud-computing-comparison/*

WEBSITES

http://www.investopedia.com/terms/s/software-as-a-service-saas.asp Accessed on 05/05/2013

http://www.salesforce.com/paas/overview/ Accessed on 07/06/2013

http://edutechassociates.net/2011/02/23/cloud-watching-1-cloud-101/ Accessed on 15/05/2013

http://www.ubuntu.com/cloud/private-cloud Accessed on 26/05/2013

http://www.techopedia.com/definition/26559/community-cloud Accessed on 04/06/2013

http://resource.onlinetech.com/the-s

Outsourcing and globalization of manufacturing allows companies to reduce costs, benefits consumers with lower cost goods and services, causes economic expansion that reduces unemployment, and increases productivity and job creation.

—Larry Elder

Assessing Profit Potential of Indian Information Technology Industry: An Application of Michael Porter model

T.G. SAJI AND S. HARIKUMAR

This article takes an attempt to assess the profit potential of Indian IT industry under Porter's five forces analysis framework by observing its performance during the post 2000 period. Despite the terrific growth in the revenue position of Indian IT sector, the profit margins of its member firms have shrunk significantly during the period. Increasing rate of attrition cost and huge amount of research and development expenditure almost cancel out the effect of its revenue growth on profit margins. High degree of exposure to the external markets, the economic crisis in the developed world, especially in the US and Europe and the fluctuations in currency market are the factors among others, crucial to decide the future of Information Technology in India and abroad.

T.G. Saji is Assistant Professor, Post Graduate Department of Commerce and Management Studies, Government College, Thrissur, Kerala and S.Harikumar is Professor, Department of Applied Economics, Cochin University of Science and Technology, Kerala.

With the advancement in Information Technology (IT) information is being regarded as the fourth factor of production, together with the land, labor and capital. Information has therefore, become an important and distinct input in production. Along with three sector model of primary, secondary and tertiary industries, a fourth sector information related industries has emerged. Information is used as raw material of knowledge and the information industry has thus pervaded a wide range of industries, viz., manufacturing, education, entertainment, defense, trade, communications, etc. When the supply side of the industry includes computer hardware and software, telecommunications equipment and micro-electronics based industries, applications of IT and all economic sectors of the country constitute its demand side (Hanna and Dugonjic, 1995).

At present the entire world is looking as a knowledge economy where raw material that matters is intellectual rather than physical. The knowledge economy implies shift in the geographical centre from raw material and capital equipment to information and knowledge, especially in education and research centers and man – made brain industries (Low, 2000). The pervasive influence of IT is so strong that there is no sphere of human life in which it is not able to make a niche for itself.

Like any other industry, the outstanding growth of IT industry has been inviting a large number of players to the sector and often they are forced to operate under stiff competitive conditions. There are many factors which impel competition in the industry and decide its strength and weakness as well as profit potential. Since India is one of the leading supplier of IT and ITeS, understanding the industry context in which the Indian IT firms operates help to make a rational assessment of its profit potential. This

paper takes an attempt to assess the profit potential of Indian IT industry under Porter's five forces analysis framework by observing its performance during the post 2000 period.

Porter's five forces – A model for industry analysis

Porter (1985) provided a framework for analyzing the competitive conditions prevailing in an industry and its relation with the industry's profitability. In his model Porter has identified five competitive forces those altogether can drive competition or determine the profit potential or strength of an industry. The forces identified by Porter in his study include:

1. Threat of new entrants
2. Rivalry among the existing firms
3. Pressure from the substitute products
4. Bargaining power of buyers
5. Bargaining power of sellers

Threat of new entrants

New entrants to an industry put pressure on price and profits. Even if a firm has not entered an industry, the potential for it to do so places pressure on prices, because high prices and profit margins will encourage entry by new competitors. Therefore barriers to entry can be a key determinant of industry profitability.

Barriers to entry arise from several sources. Sometimes government creates barriers by restricting competition through the granting of monopolies and through regulation. Ideas and knowledge that provide competitive advantages are treated as private property when patented, preventing the others from using the knowledge and thus creating a barrier to entry. When an industry requires highly specialized technology or plants and equipment, potential entrants are reluctant to commit to acquiring specialized assets that cannot be sold or converted in to other uses if the venture fails. Most cost efficient level of production i.e. Minimum Efficient Scale (MES) which indicates the point at which unit costs for production are at minimum is another important barrier to entry for firms. To operate at less than MES there must be a consideration that permits the firm to sell at a premium price – such as product differentiation or local monopoly.

Rivalry among the existing players

When there are several competitors in an industry, there will generally be more price competition and lower profit margins as competitors seek to expand their share of the market. Slow industry growth contributes to this competition because expansion must come at the expense of rival's market share. Industries producing relatively homogeneous goods are also subject to considerable price pressure, because firms cannot compete on the basis of product differentiation. When the customers of the industry can freely switch from one product to another there is a greater struggle to capture customers which increases rivalry.

Pressure from substitute products

Pressure from substitute products means the industry faces competition from firms in related industries. To the economist, a threat of substitutes exists when a product's demand is affected by the price change of a substitute product. The availability of substitutes limits the prices that can be charged to customers.

Bargaining power of buyers

The bargaining power of buyers is the influence that the customers have on a producing industry. If a buyer purchases a large fraction of an industry's output, it will have a considerable bargaining power and can demand price concessions. Sometimes the buyers possess a credible backward integration net thereby can threaten to buy the producing firm or its rival. But when the products are not standardized the switching cost to buyer will be very high which constraints the buyer to switch from one product to another frequently.

Bargaining power of sellers

A producing industry requires materials, labor and other supplies. This requirement leads to buyer supplier relationships between the industry and the firms that provide it the supplies used to create products. If the suppliers of a key input has monopolistic control over the product or they supply critical portions of buyers input, then the supplier can demand higher prices for the goods supplied and squeeze profits out of the industry. Here the key factor determining the bargaining power of suppliers is the availability of substitute products. If the substitutes are available, the supplier has little clout and cannot extract higher prices.

Porter identified three generic strategies – cost leadership, product differentiation and focus that can be implemented at the business unit level to create competitive

advantage. The proper generic strategy will position the firm to leverage its strengths and defend against the adverse effects of the five forces.

Information Technology (IT) Industry in India

Information Technology is of recent origin, but is spreading fast in India. It was in the 70s that the computer as a productivity tool started proliferating in the Indian industries scene. But it was only by mid 80s that the forecasters, analysts and Indian government policy planners began to understand the potential of the Indian talent in computer software. The realization led to the formulation of the computer software policy in 1986. Then the economists began to analyze the potential of the Indian IT industry. It would be they said, one of the fastest growing sectors of the economy and would provide high quality employment for young people. It would earn significant revenue from exports and would be a highly desirable industry, as it required skilled manpower, few raw materials and was not any way damaging to the environment.

With the huge success of the IT companies in India, the Indian IT industry in turn has become successful in making a mark in the global arena. This industry has been instrumental in driving the economy of the nation on to a rapid growth curve. As per the study of NASSCOM-Deloitte (2008), the contribution of IT/ITES industry to the GDP of the country has soared up to a share of 5 per cent in 2007 (7 per cent in 2008 according to BMI) from a mere 1.2 per cent in 1998. Besides, this industry has also recorded revenue of US$ 64 billion with a growth rate of 33 per cent in the fiscal year ended in 2008.

World IT spending forecasts

Since India contributes a significant share of world IT production, an analysis of the worldwide IT spending forecasts made by professional agencies like International Data Corporation indirectly help us to assess the future of Indian IT industry. Divergent growth in IT spending in its various segments was expected during the period of forecasting (Table 1). The total spending on IT was expected to grow at Compound Annual Growth Rate (CAGR) of 5.2 per cent globally. IT enabled Services (ITeS) were likely to grow at a faster pace of 11.9 per cent CAGR as compared with other segments within the industry. The lowest rate of growth was expected on the Hardware segment with only 3.2 per cent CAGR.

Table 1: Worldwide IT spending forecasts

($ billion)	2007	2008	2009	2010	2011	2012	2008-12 CAGR(%)
IT services	528	557	578	605	636	672	4.8
ITeS – BPO	103	115	131	146	164	181	11.9
Services Total	631	672	709	751	801	853	6.1
Software	277	295	308	326	349	376	6.3
Hardware	570	594	597	620	652	683	3.6
Total	1478	1561	1614	1697	1801	1912	5.2

Source: International Data Corporation

Indian IT industry: its component segments

The Indian IT industry can be segregated into four main components: software products and engineering services, IT services, IT – enabled services and hardware. The services of the industry are spanned over various segments covering software development, software services, software products, consulting services, BPO services, e-commerce and web services, engineering services off shoring and animation and gaming. Banking, Financial Services and Insurance (also known as BFSI) is an industry name commonly used by IT/ITES/BPO companies to refer to the services they offer to companies in these domains.

Indian IT industry has been grown at a remarkable pace from the very beginning (Table 2). The overall revenue of the industry is estimated to have grown from USD 10.2 billion in 2001-02 translating to a CAGR of about 26.9 per cent. Despite the severe global recession, the industry grew at modest rate of 12.9 per cent in 2008-09. Table 2 reviews the performance of Indian IT-ITeS Industry in terms of its revenue growth (domestic and exports) during the period 2001-02 to 2008-09.

Exports continue to dominate the revenues earned by the Indian IT industry. The export intensity (ratio of export revenues to total revenues) of the industry has grown from 74.50 per cent in 2001-02 to 78.90 per cent in 2008-09. Total IT exports is estimated to have increased from USD 7.60 billion to USD 46.30 billion in 2008-09, a CAGR of 28.60 per cent. Analysis of segment wise export revenue trends shows that the software product is the fastest growing segment with CAGR 48.5 per cent. The share of exports from ITes -BPO segment has nearly doubled during the study period. But the rate of growth in revenues from Hardware segment is abnormally low in global market.

Though the IT-BPO sector is export driven, the domestic market is also significant. The revenue from the domestic Software and Services market is estimated to

Table 2: Indian IT - ITeS industry Revenue Trends

$ billion	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	CAGR(%)
Exports revenue (excluding hardware)	7.6	9.5	12.9	17.7	23.6	31.1	40.4	46.3	28.6
IT services	5.8	5.5	7.3	10.0	13.3	17.9	23.1	26.5	23.2
ITes-BPO	1.5	2.5	3.1	4.6	6.3	8.4	10.9	12.7	39.2
Software products &Engineering services	0.3	1.5	2.5	3.1	4.0	4.9	6.4	7.1	48.5
Hardware	N.A	N.A	0.5	0.5	0.6	0.5	0.5	0.3	9.7
Domestiv revenue (excluding hardware)	2.6	3.0	3.8	4.8	6.7	8.2	11.7	12.4	22.2
IT services	2.1	2.4	3.1	3.5	4.5	5.5	7.9	8.3	19.5
Ite SBPO	0.1	0.2	0.3	0.6	0.9	1.1	1.5	1.8	44.5
Software products & Engineering services	0.4	0.4	0.4	0.7	1.3	1.6	2.2	2.2	23.7
Hardware	N.A	N.A	4.4	5.2	6.5	8.0	11.5	11.8	21.8
Total (excluding hardware)	10.2	12.6	16.7	22.5	30.3	39.3	52.8	68.1	26.9
Export density	74.5	76.0	77.25	78.67	77.89	79.13	77.69	78.90	

Source: Department of Information Technology and CRISIL research reports*Estimated

have grown USD 2.6 billion in 2001-02 to USD 12.4 billion in 2008-09 a CAGR of about 22.2 per cent. ITeS-BPO segment in the domestic market has witnessed noticeable growth over the past few years. Modest growth in hardware demand could be seen in domestic market which is mainly driven by consumer Note book purchases. NASSCOM said that the domestic IT-BPO revenues excluding hardware are expected to grow at 16 per cent to reach USD 17.35 billion in the FY 2011.

Profitability of Indian IT Industry

From the previous discussions it is quite obvious that the revenue position of Indian IT industry spanned significantly during the period of our observation. However when we look into the profit margins of some of the leading Indian IT companies reported in Table 3 and Table 4, we cannot find the impact of growth in revenues on their net earnings position.

In fact most of the companies' profit margins have reduced over the years, albeit some improvements in some cases. When CMC was able to improve its net profit margin significantly, especially during the last four years, three companies in the group- Wipro, HCL Technologies and Tata Elxsi - were somewhat able to maintain their previous margins. But in terms of return on investments, the profitability of all companies has been in downward spiral.

Profit potential of Indian IT industry: assessment under Porter's five forces frame work

The maturation of an industry involves regular changes in the firm's competitive environment. As the title of this paper implies, this part relates the profitability of Indian IT industry with its structure and the pursuing competitive strategies under Porter's five forces framework.

Entry and exit barriers

In India both Central and State Governments are more supportive rather than restrictive by creating conducive environment for the development of Information Technology sector in the country. Government of India has been taking a lot of pro active measures for encouraging the new investment to the industry (making the entry of new firms to the industry more easy) through creating Special Economic Zones and by providing fiscal and non fiscal incentives. Income tax holiday for profits from IT exports (Sec 10A of Income Tax Act 1961), procurement of capital goods and other inputs at zero rate of excise duty, manufacture of IT software products at zero rate of excise duty etc... are some of such measures. Since major portion of this sector constituted by services, the production of which requires least amount of capital investments facilitates free entry and easy exist by the

Table 3: Net profit margin (%) of selected IT firms – (2001-2010)

Company	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Infosys	33.08	31.03	26.44	26.12	27.80	26.80	28.77	28.57	28.72	27.45
Wipro	21.80	25.29	20.37	17.82	20.67	19.76	20.77	17.51	13.83	21.37
HCL Info Systems	5.37	3.88	3.94	8.53	6.87	4.93	2.73	2.46	2.13	2.19
CMC	4.58	5.99	6.04	6.37	2.96	5.3	6.45	8.99	12.74	18.78
HCL Technologies	21.05	24.26	19.77	17.88	20.30	19.50	20.34	17.19	14.14	20.80
Polaris	22.28	21.71	13.87	11.81	7.8	1.93	8.75	5.5	9.79	11.42
Maestek	17.51	26.43	29.65	10.35	18.55	12.74	20.58	17.01	16.26	8.49
Tata Elxsi	10.14	12.90	10.67	11.43	14.15	14.57	16.92	13.12	13.88	12.73
GTL	53.14	20.62	13.14	16.49	19.43	11.05	6.22	7.44	7.57	10.21
Rolta	34.98	29.65	27.25	29.18	30.17	29.99	29.49	37.23	30.80	

Compiled from annual reports

Table 4: Return on Investments (%) for selected IT firms – (2001-2010)

Company	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Infosys	50.53	45.38	40.54	45.22	42.56	39.51	37.05	37.81	37.71	34.13
Wipro	37.72	36.78	27.11	30.01	35.57	36.18	33.30	23.24	21.36	24.96
HCL Info Systems	20.44	16.33	18.99	30.54	30.44	24.16	42.10	35.19	30.54	16.86
CMC	32.87	35.62	29.80	29.64	12.93	20.79	24.18	29.06	27.60	27.19
HCL Technologies	25.00	19.11	13.49	14.22	11.51	24.77	32.17	24.28	28.59	21.41
Polaris	31.24	25.26	12.37	13.71	10.09	2.50	13.97	8.75	16.02	16.75
Maestek	19.89	38.37	31.35	11.88	31.45	29.66	43.05	37.68	27.74	6.37
GTL	33.29	8.17	5.46	5.95	7.29	8.00	4.16	11.54	11.13	13.86
Tata Elxsi	38.60	56.19	41.60	50.47	66.01	69.48	73.13	42.61	47.40	30.56
Rolta	25.56	22.14	13.83	18.35	16.65	11.59	15.31	16.31	14.14	

Compiled from annual reports

firms from the industry. India is the hub of cheap and skilled software professionals, which are available in abundance which helps the Information Technology companies to develop cost-effective business solutions for their clients. This attracts new entrants to the sector which makes it more competitive in structure. Moreover the products offered by different firms in this sector are virtually identical; the rooms for product differentiation are very limited. Such a competitive environment of the industry makes the profitability of the sector often nominal or low.

Competitions

The Indian IT services market is highly competitive. Competitors include global consulting firms, sub divisions of large multinational Technology firms, IT outsourcing firms, Indian IT service firms, software firms and in house IT departments of large corporations. Size of the membership in NASSCOM almost doubled during the last decade (Table 5). Such a dazzling growth in the number of IT companies in India reflects the optimism of the entrepreneurs in the growth potential of IT –BPO sector in

Table 5: Number of IT companies having membership in NASSCOM

Year	No. of IT companies
2000-01	686
2003-04	840
Dec-2006	1138
Dec-2008	1246
Dec-2010	1250

Source: NASSCOM Annual report 2011.

the country. But the increased number of firms in the sector could intensify the competition among them which might become a barrier for the individual growth of most of the firms.

The increased acceptance of the global delivery model has driven MNC service providers to expand their base within India and encourage in predatory pricing. In order to counter this menace Indian firm has to invest more in Research and Development (R&D) and selling and marketing which again reduces their profitability. Increasing competition from China and other Asian countries for global Business Process Outsourcing market share is also a big threat to this counterpart of Indian IT industry (Business Monitor, 2010). Stiff competition, rapid technological changes and high rate of piracy demand frequent product introductions and enhancements which in turn pressure the firms in the industry to invest heavily in the Research and Development and marketing of new products, services and technologies, while keeping a constant check on piracy. As most of the products and services are standardized in form the customers of the industry can freely switch from one product to another and there is a greater struggle to capture customers among the market players which intensifies the severity of rivalry. All these actions most of the cases reach price wars among firms which negate their operating margins.

Buyers and markets

Corporate buyers, who account for a substantial portion of the market, are highly price sensitive and enjoy bargaining power. It is fairly easy to switch from one brand of computers to another as most of the computers use Intel microprocessors and Microsoft window operating systems. Until 2008, IT services players mostly faced margin pressure on the grounds of wage inflation and retention/attrition costs. However later environment has brought forth a whole set of challenges, putting margins under pressure because of dwindling of dollar revenue growth led by decline in billing rate and stronger rupee.

Exports account for nearly 78 per cent of the Indian IT industry (Table 2). Nearly 90 per cent of this revenue derived from US and Europe (Table 6). US alone constitute more than 60 per cent of India's IT exports.

Table 6: Major export destinations of Indian IT industry

Market	2004-05 (per cent)	2005-06 (per cent)	2006-07 (per cent)	2007-08 (per cent)
Americas	68.30	67.18	61.40	60.00
Europe	23.10	25.13	30.10	31.00
Rest of the world (incl. APAC)	8.60	7.69	8.50	9.00

Source: Department of Information Technology, Govt. of India

Europe and U.S have been in recession for the last four to five years (Table 7). Owing to the overwhelming dependence on these two regions for their overseas

Table 7: Quarterly GDP Growth rate of U.S and selected Economies from Europe (March 2007 - March 2012)

	USA	Europe		
Quarter		Germany	France	U.K
2007-Q1	1.2	0.3	0.7	0.8
2007-Q2	3.2	0.3	0.4	0.6
2007-Q3	3.6	0.8	0.7	0.5
2007-Q4	2.1	0.1	0.3	0.5
2008-Q1	-0.7	1.6	0.5	0.7
2008-Q2	1.5	-0.6	-0.4	-0.1
2008-Q3	-2.7	-0.3	-0.2	-0.9
2008-Q4	-5.4	-2.4	-1.5	-1.8
2009-Q1	-6.7	-3.5	-1.4	-2.5
2009-Q2	-0.7	0.4	0.3	-0.7
2009-Q3	1.7	0.2	0.2	-0.2
2009-Q4	3.8	0.7	0.6	0.1
2010-Q1	3.9	0.2	0.3	0.4
2010-Q2	3.8	1.1	0.6	1.1
2010-Q3	2.5	0.7	0.3	0.7
2010-Q4	2.3	-0.5	0.3	-0.5
2011-Q1	0.4	0.2	0.9	0.2
2011-Q2	1.3	-0.1	-0.1	-0.1
2011-Q3	1.8	0.6	0.3	0.6
2011-Q4	3	-0.3	0.1	-0.3
2012-Q1	2.2	0.5	0.2	0.3

Source: USA: Bureau of Economic Analysis, Germany: German Federal Statistical

Office, France: INSEE National Statistics Office, U.K: U.K Office for National Statistics.

business operations the downturn in these two economies especially, in times of the global meltdown has terribly affected the earnings of Indian IT industry.

BFSI sector (Banking, Financial Services and Insurance) is the key vertical for the Indian IT services industry which accounts for two – fifth of the Indian IT exports (NASSCOM, 2011). The brunt of slowdown in BFSI sector makes its profit margins under more pressure. The prevalent political climate in these countries and changes in government policies there with regard to the IT sector (For eg: debate over outsourcing in US) may impact player margins. More over the heavy dependence on exports makes the industry vulnerable to the fluctuations of Indian rupee against the major currencies of the world such as US Dollar, British Pound, Euro etc.. The appreciation of Indian rupee against these prime currencies during the past few years had been put the margins of IT players at risk until 2010 but after that the reversal trends in foreign exchange market posit Indian IT firms in better realization of their foreign exchange earnings.

Suppliers

Since major inputs of the product supplied by Information Technology firms constitute Processors, Operating Systems and Personnel (IT programmer or Professional) the bargaining power of suppliers in the IT industry is very high. A major cost component in the IT industry is employee related costs. These costs are also subject to a great deal of inflationary uncertainty. Also, as competition within the industry intensifies, the need for skilled man power gains dominance, firms also increasingly poach on each other's employees by offering better Pay packages. This results in a rise in employee costs, which in turn affects their margins. The suppliers of the other inputs to IT industry also exert big influence on the profit margins of its players. This is because the US computer giants 'Intel' dominate the microprocessor production and 'Microsoft' controls the operating systems market in the Industry. So whatever be the product manufactured by the firms in this industry they have to heavily depend on these multinationals to get their supplies. If they want to switch their suppliers over (like AMD for processors, LINUX for OS etc.) due to the inherent nature of their products it is more expensive for them.

Conclusion

This paper assesses the profit potential of Indian IT industry by observing data indicating its performance during the post 2000 period. Indian IT industry has been able to make a mark in the global arena and instrumental in driving the economy of the nation on to a rapid growth curve. The overall revenue position of the industry has improved significantly and exports constitute its major source of revenue. However the presence of competitive forces in the sector most often denies its member firms to bring in to the effect of revenue growth on profit margins. In fact even in the midst of revenue growth corporate profitability in the sector has been affected negatively. This might be due to the increase in attrition cost and enhanced amount of research and development costs to member firms. Even though there has been no substitutes for the products or services offered by the industry, the prevalence of other forces at aggravate level constrains its ability to increase their prices at par with its cost increase. More over high degree of exposure to the external markets, the economic crisis in the developed world and also the currency fluctuations are expected to make negative impact on the revenue growth of IT sector in the years to come.

References

Hanna, N. and Dugonjic, V. (1995), "Why a National Strategy of Exploiting Information Technologies," in UNCTAD, Advanced Technology Assessment System.

Indian Information Technology Report Q1 2010, Business Monitor International, London.

Low, L. (2000), *Economics of Information Technology and the Media*, Singapore University Press, Singapore.

NASSCOM (2011), *Annual Report.*

NASSCOM- Deloitte (2008), *Indian IT Industry: Impacting the Economy and Society,* February 13.

NASSCOM, *The IT Industry in India – Strategic 2003 Review*

NASSCOM, *The IT Industry in India – Strategic 2008 Review*

Porter, M. (1985), *Competitive Advantage: Creating and Sustaining Superior Performance*, New York: Free Press.

The new information technology... Internet and e-mail... have practically eliminated the physical costs of communications.

—Peter Drucker

Focus

Economic Analysis of Indian IT Sector

ROBIN SINGH, ANIRUDDH VIJAIVARGIYA AND V. UPADHYAY

IT industry has grown at nearly 50% and has emerged a major export earner. Performance of the sector is analysed using balance sheets and P&L statements of past 10 years of 5 major companies covering 80% of market share, using method of ratio analysis. Using the Significant-level testing in time domains 2003-08 and 2009-12, effect of the financial crisis 2008 on IT sector has been analysed. The pace of growth of the sector is faster compared to other sectors. Though few firms have performed well but overall profitability of the sector is affected due to financial crisis and increased competition.

Robin Singh is 4th year student, Indian Institute of Technology Delhi, New Delhi; Aniruddh Vijayvargiya is 4th year student, Indian Institute of Technology Delhi, New Delhi; and V. Upadhyay is Professor, Department of Humanities and Social Sciences, IIT Delhi, New Delhi.

IT industry has changed the face of India globally. Today's highly developed IT industry has been the result of many factors which have worked for a long time leading to the present phase. India's IT industry can be divided into five main components

i. Software products,

ii. IT services,

iii. Engineering and R&D services,

iv. IT-enabled services/BPO

v. Hardware

The Indian software industry is driven by some highly reputed firms like WIPRO, HCL, TCS and Infosys etc. Though Indian IT sector has been doing well but still the sector suffers from absence of practical knowledge and dearth of suitably talented candidates to lead the industry. Also there is a need to focus more on research and development. Most of the Indian IT sector is concentrated in a few cities only and hence there is a need to diversify the sector to other parts of the country also.

A major phase in the economies of various countries was the global financial crisis of 2008. The global economic meltdown affected almost all countries, even the companies in strongest countries like America are facing severe liquidity crisis. However, India's cautious approach towards reforms saved it from possible disastrous implications. But in reality Indian economy also faced a kind of slowdown. It is interesting to see the impact of the global recession on the Indian IT sector.

Objectives

In the study the analysis of the financial health of the Indian IT-Sector, the fastest growing sector, by calculating the Financial Ratio susing available balance sheets and

Profit and Loss accounts for the last 10 years. It will give some insight into predicting the future prospects of the sector and its contribution to the growth expectations of India. Five major IT-Companies (TCS, INFOSYS, Wipro, HCL, Tech Mahindra) constituting more than 80% of the market share have been taken here for the purpose of analysis. Their individual analysis as well as of the whole sector has been done to show the divergent trends this sector faces due to its diversity.

Although IT sector is growing at a much faster rate (above 30%) than any other sector in India, there has been a significant effect of the 2008 Financial crisis on some of its major companies because of their dependence on software exports.Significance-level testing has been done for the time-domains 2003-2008 and 2009-2012 to show whether the crisis has affected the sector or not i.e. pre-recession and post-recession analysis.Effects of the recession on their profitability, solvency, efficiency and liquidity have also been analysed.

Financial Analysis of major IT players

In this section we have performed the ratio analysis of 5 major Indian IT companies. Data from the past 10 years balance sheets has been taken and critical ratios which indicate the liquidity, profitability, efficiency and solvency of the companies. A sample calculation of the ratios has been done in the analysis of TCS. Subsequently the same relations have been used to calculate the ratios in all other companies as well.

Tata Consultancy Services (TCS)

Ratio Analysis calculations done using Financial Ratios (Jain, Khan 2007, Pg. 6.1-6.72)

The sample set of calculation is for financial year ending March'12 and units of monetary variables is Rs in Crore.The data has been taken from the consolidated balance sheets and Profit and Loss statements. (www.capitaline.com, accessed on Jan 28, 2012)

Liquidity Analysis:

$$\text{Current ratio} = \frac{\textit{Total current assets}}{\textit{Total current liabilities}} = \frac{22502.41}{10453.83} = 2.15$$

Total current assets = inventories + sundry debtors + cash and bank + loans and advances

Total current liabilities = creditors + current liabilities + provisions

- Analysts consider CR -2:1 as ideal, though not always.
- This ratio determines company's ability to meet its current liabilities and adequacy of working capital.

$$\text{Acid test ratio} = \frac{\textit{Sundry debtors+cash and banks}}{\textit{total current liabilitie}} = \frac{11520.35+6003.47}{10453.83} = 1.68$$

- Ideal ratio is 1:1 and determines short-term financial ability of company to meet its commitments.

Efficiency/activity ratios:

$$\text{Debtors turnover ratio} = \frac{\textit{net operating income}}{\textit{sundry debtors}} = \frac{48893.83}{11520.35} = 4.24$$

- It indicates the number of times debtors are converted into cash.

$$\text{Debtors collection period} = \frac{12}{\textit{Debtors turnover ratio}} \times 30 = 85\ \textit{days}$$

- Indicates the number of days the firm has to wait to see its debtors converted into cash.

$$\text{Creditors turnover ratio} = \frac{\textit{COGS}}{\textit{Creditors}} = \frac{30329.41}{3415.28} = 8.88$$

- Indicates the number of times the company pay its creditors in a year.

$$\text{Creditors payment period} = \frac{12/}{\text{Creditors turnover ration}} \times 30 = 41 \text{ days}$$

$$\text{Inventory turnover ratio} = \textit{COGS/inventories} = \frac{30329.41}{17.77} = 1707 \text{ days}$$

- It establishes relation in COGS and average inventory and indicates the frequency of stock replacement.

Solvency ratios:

$$\text{Long term debt-equity ratio} = \frac{\textit{Long term debt}}{\textit{Total shareholders funds}} = \frac{30767.21-29579.23}{29579.23} = 0.04$$

Long term debt = minority interests + secured loans+ unsecured loans + policy holders funds + other liabilities

- Ratio indicates proportion of debt fund in relation to owner's fund.

  Total shareholder's funds = share capital+reserves total+ equity warrants +equity money

- Debt equity ratio=

$$\frac{\textit{Total assets-Total shareholders funds+current liabilities}}{\textit{Total shareholders funds}} = \frac{30767.21-29.579.23+10453.83}{29579.23} = 0.39$$

$$\text{Interest coverage ratio} = \frac{\textit{Operating profit}}{\textit{Interest}} = \frac{14863.48}{22.23} = 669$$

- It is used to determine how easily a company can pay interest expenses on outstanding debt.

Profitability ratios:`

$$\text{Gross profit \%} = \frac{\text{Gross profit}}{\text{net operating income}} \times 100 = \frac{18564.42}{48893.83} \times 100 = 38\ \%$$

$$\text{Operating profit \%} = \frac{\text{Operating profit}}{\text{net operating income}} \times 100 = \frac{14863.48}{48893.83} \times 100 = 30.4\%$$

$$\text{Net profit \%} = \frac{\text{Net profit}}{\text{net operating income}} \times 100 = \frac{10523.45}{48893.83} \times 100 = 21.5\ \%$$

$$\text{COGS ratio} = \frac{\text{COGS}}{\text{net operating income}} = \frac{30329.41}{48893.83} = 0.62$$

$$\text{ROCE} = \frac{\text{Net profit} + 0.65 \times \text{interest}}{\text{Total liabilities}} \times 100 = 34.3\ \%$$

- It indicates rate of return on total funds invested, profitability of company and efficient utilization of funds.

$$\text{ROR on assets} = \frac{\text{Net profit} + 0.65 \times \text{interest}}{\text{Total liabilities} + \text{Total current liabilities}} \times 100 = 25.6\ \%$$

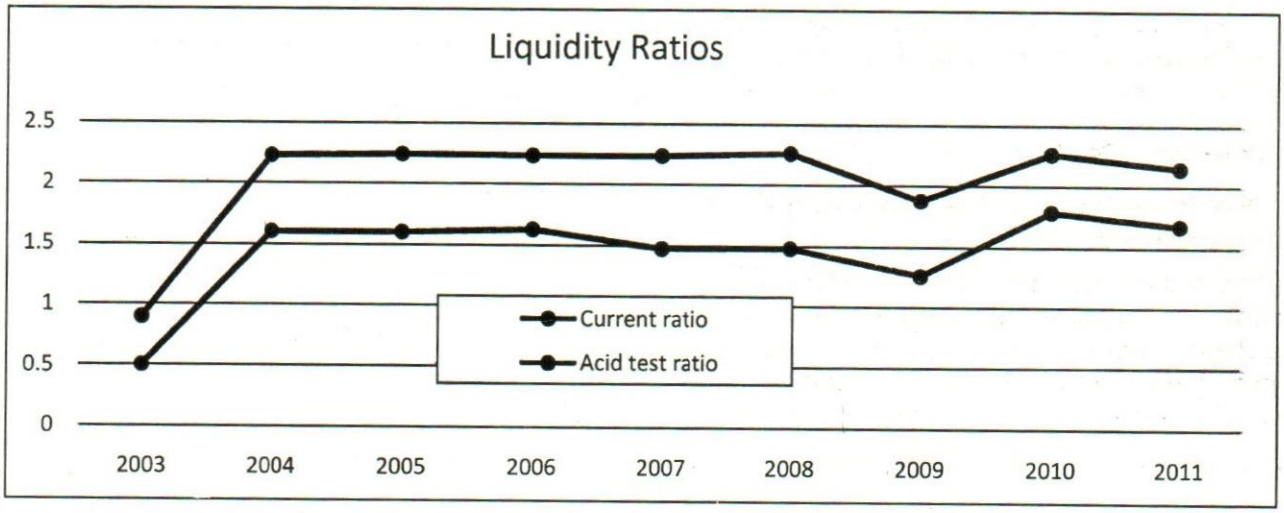
$$\text{ROR on equity} = \frac{\text{Net profit}}{\text{Total shareholder's funds}} \times 100 = 35.6$$

- It indicates the available returns on shareholder's funds and determines the profit generated by the owners.

The appraisal of the financial health of TCS limited is as follows:

Liquidity Analysis:

The liquidity position of TCS has been commendable during all the years of reference. For most of the time the current ratio was greater than 2, the values ranging from a minimum of 1.88 (in 2010) to a maximum of 2.27. Apart from 2010 the current ratio was greater than 2.2. Also the quick ratio has been in the range of 1.26 to 1.79, with a value greater than 1.5 for most of the years in consideration, which is a very good sign and enforces the capability of TCS to generate cash readily and hence inviting creditors' faith and the sufficiency of the working capital to deal with the obligations. Also the small difference between the current and the quick ratio puts light on the effective management of inventory. Figure 1 shows the plot of the current and quick ratios of TCS for the past 10 years.



Source: Author's Calculations

Figure1: Liquidity ratios of TCS

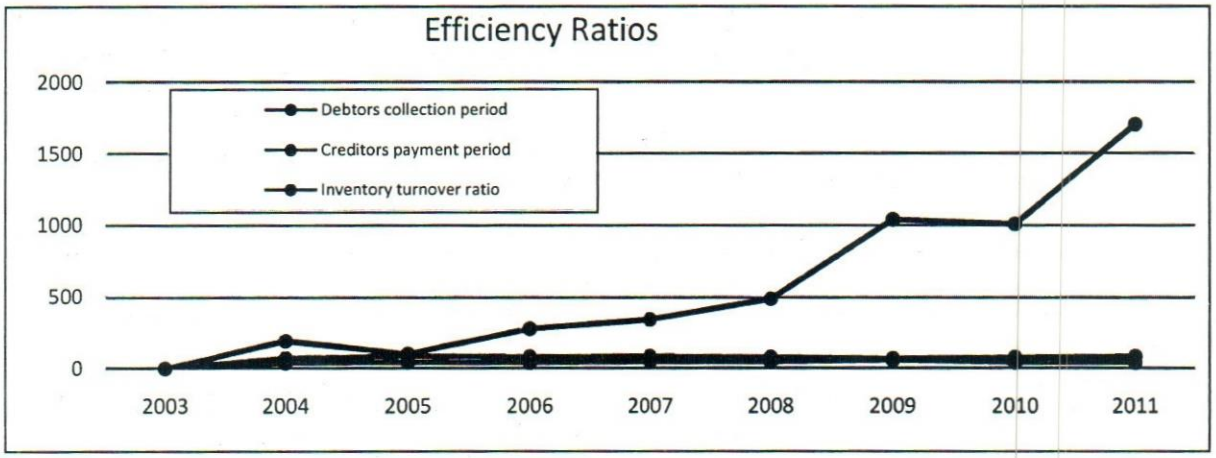
Solvency Analysis:

TCS stands on very high grounds in the matters of solvency because of extremely good interest coverage ratio and debt-equity ratio. There has been a continuous increase in the interest coverage ratio from 46 in 2004 to 669 in 2012, which shows the extremely safe situation of the company in terms of interest payment. Also the long term debt equity ratio for most of the time has been extremely low for the company (i.e. in the range of 0.03 to 0.08) and hence TCS is not likely to default in the fulfillment of its debt obligations. Comparing the long term debt equity ratio to total debt equity ratio (which lies in the range of 0.33 to 0.50) leads to conclusion that major part of the debt for

TCS are the short term borrowing and not long term debts, since the short term debts are less risky and owing to the small credit payment period, the company is extremely safe with respect to payment of debt. On the other hand such low interest coverage ratio shows over dependence on equity funds and ineffective utilization of debt and the leverage effects associated with the use of debt. Overall there has been an increasing trend in the interest coverage ratio which is an indication of increase in the capacity of the company to pay interest expenses on its outstanding debts.

Efficiency Analysis:

The debtors' collection period for TCS is relatively high lying in the range of 70 to 88 days which is roughly double the credit payment period which is in the range from 39 to 58 days. Though both periods seem to be satisfactory but relatively higher debt collection periods are slightly disadvantageous to the firm. But owing to the high acid test ratios of the firm, the difference is not much of a concern. The inventory turnover ratio for the company has greatly increased from 192 in 2005 to 1707 in 2012 indicating huge betterment in the stock management. Since the stocks are sold more quickly and hence less money is needed of their maintenance. Figure 2 plots the efficiency ratios of TCS with time.

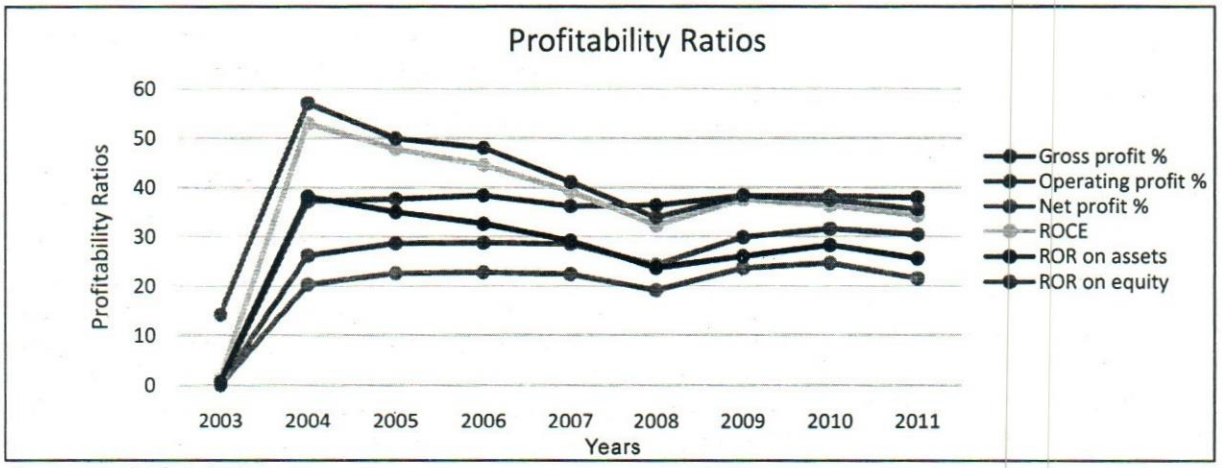


Source: Author's Calculations

Figure 2: Solvency ratios of TCS

Profitability Analysis:

The profit margins for TCS over the years have been good with gross profit in the range of 36.2 to 38.4 as shown in figure 3 which shows that not only the company is making good profit but also has a good control on the cost of goods sold. There has been an almost steady increase in the operating profit margins from 26.2 in 2004 to 30.4 in 2012 with a nearly constant gross profit margin, which



Source: Author's Calculations

Figure 3: Profitability ratios of TCS

indicates an improvement in the efficiency of operating process owing to utilization of advanced technology and resources. The cost of goods sold for the company has been more or less constant which indicates that not much increase has been done in the production levels of the company.

Over the given time period there has been a decline in the return on assets, equity and capital employed. The return on equity for example has declined from 57.1% in 2004 to 35.6% in 2012 which indicates a reduction in the profits earned by the shareholders.

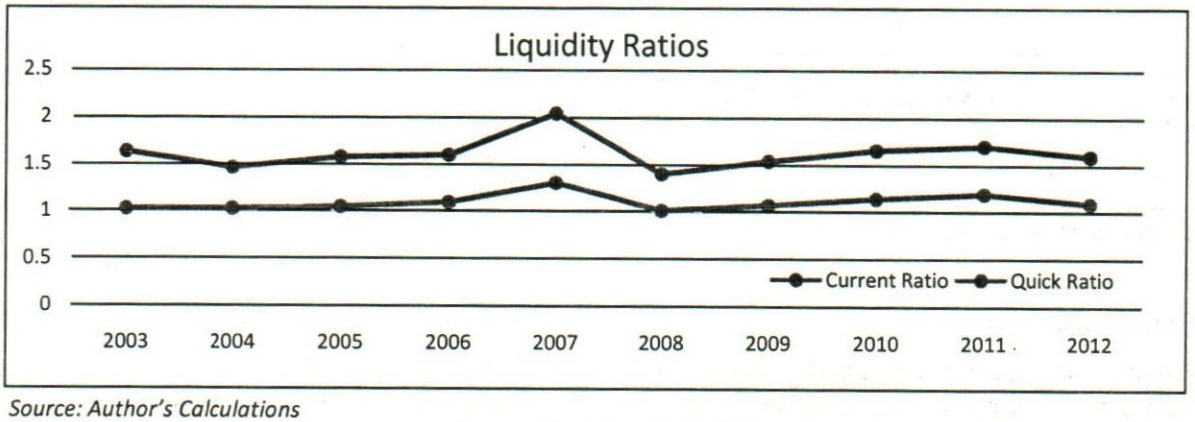
HCL Ltd.

In this section, the financial health of HCL, one of the leading Indian IT company has been analyzed through ratio analysis.

Liquidity Analysis:

HCL has been doing well in terms of liquidity with both the current ratio and the quick ratio at satisfactory levels. The current ratio has ranged from a minimum of 1.41 in 2008 to a maximum of 2.04 in 2007, though for most of the time it was below the targeted current ratio of 2 but above 1.5, which is an indicative of satisfactory liquidity position of the company. Also the acid test ratio for the company has been close to 1, ranging from 1.01 to 1.20 indicating a good amount of fast cash generation possible for the company and good to hold the faith of the creditors.

Interestingly there has been a sudden fall in the liquidity stand of the company from the year 2007 to 2008 with current ratio falling from an all-time high of 2.04 to 1.41 which was the minimum value for the period and similarly the quick ratio falling from 1.31 to 1.01. This fall was because of a sudden increase in the current liabilities for the firm from Rs 780.13 crore to 2029.76 crore and hence short term borrowing increased for the company during this time. Figure 4 shows the plot of the liquidity ratios of HCL.



Source: Author's Calculations

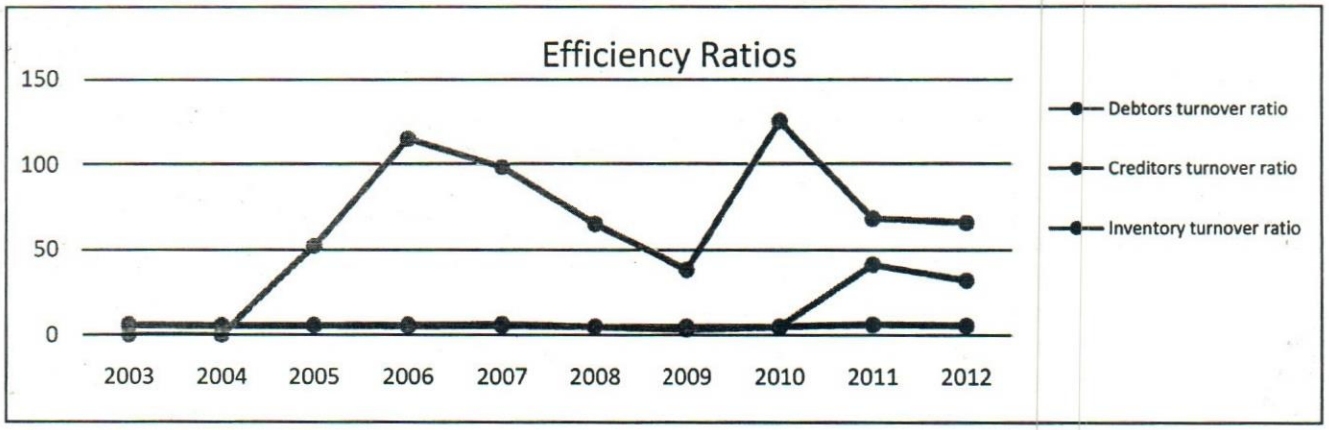
Figure 4: Liquidity ratios of HCL

Solvency Analysis:

The state of solvency for HCL has been with many ups and downs. The interest coverage ratio varied from a minimum of 10.3 in 2009 to a maximum of 210.4 in 2007. Owing to satisfactory value of the interest coverage ratio, HCL is not likely to default in payment of interest to its lenders as its operating profits (EBIT) have enough margins to meet its interest obligations. The total debt to equity ratio varied a lot but with a general increasing trend over the years. A sharp increase in the ratio from 0.63 to 1.38 was seen from 2008 to 2009, which was mainly due to an increase in the secured loans for the company with the shareholders' funds remaining almost constant. There is a considerable share of long term loans in the debt of the company which makes the company vulnerable to defaulting in situation of fall in profits.

Efficiency Analysis:

In the recent years there has been a sharp decrease in the credit payment period for the company from 66 days in 2005, a maximum of 113 in 2009 to 11 days in 2012, while no decrease was seen in the debtor's collection period which ranged from 60 to 77 days. This high debtor's payment to credit collection period ratio adds to problems of the liquidity problems for the company already suffering from a nominal current ratio.On the other hand the satisfactory levels of the inventory turnover ratio indicate efficient management of inventory by the firm. Figure 5 shows the plot of the efficiency ratios of HCL.

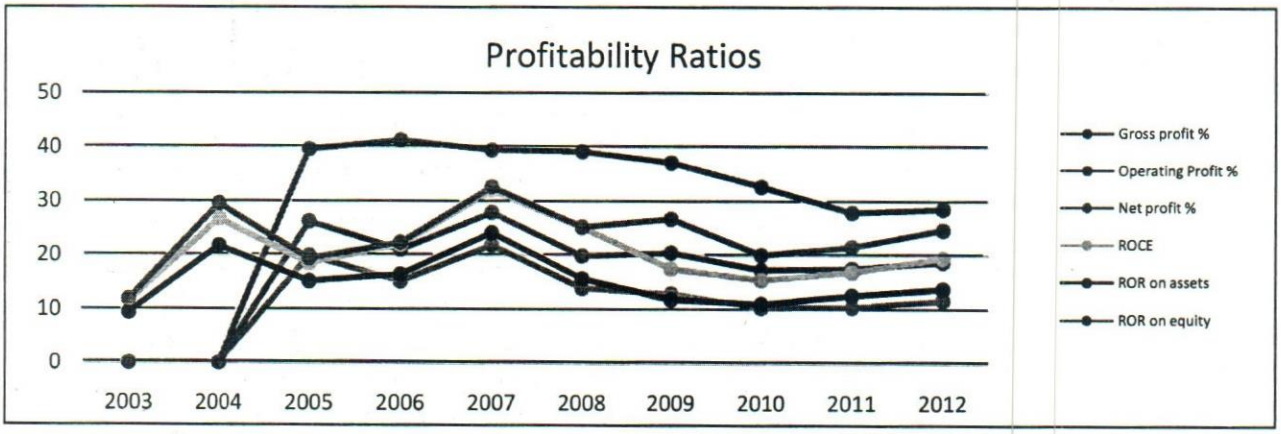


Source: Author's Calculations

Figure 5: Efficiency ratios of HCL

Profitability Analysis:

Over the years there has been a decreasing trend in the different profit margins for the company with the gross profit falling from 39.7% in 2005 to 28.5% in 2012.This indicates either a decrease in profitability of the firm or an increase in cost of goods sold. The operating profits for the firm have declined over the years but have shown a small increase in the past few years which has also had a positive effect on the ROR for capital employed in the past few years. It is important to note that there has been an increase in other rates of return also. For instance, the ROR on assets has improved from 11.8% in 2009 to 13.8% in 2012. Likewise, a notable increase has been observed in ROR on equity funds from 20% in 2010 to 24.7% in 2012. Figure 6 shows the plot of the profitability ratios of HCL.



Source: Author's Calculations

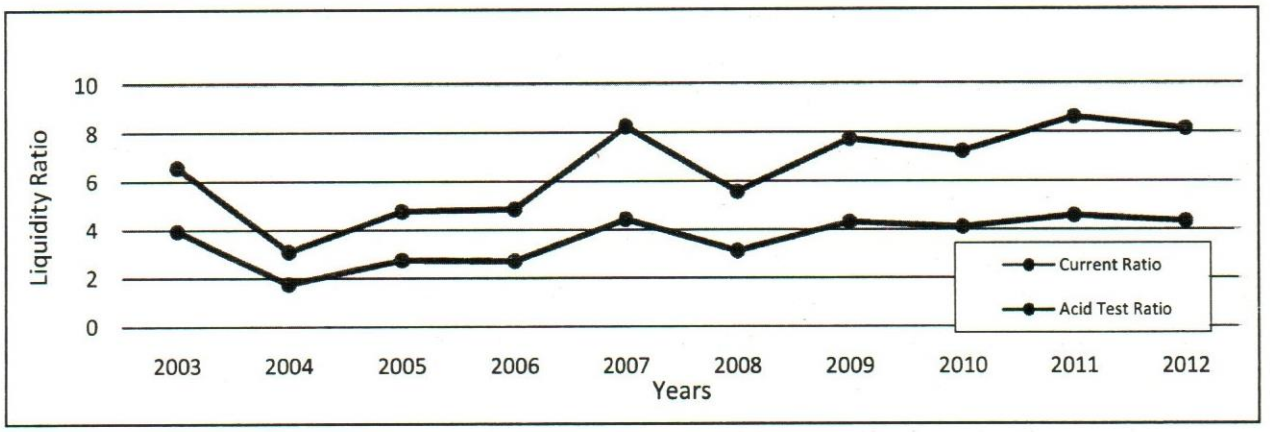
Figure 6: Profitability ratios of HCL

Infosys India Ltd.

In this section the financial status of Infosys India Ltd. has been analyzed.

Liquidity Analysis:

The liquidity position of INFOSYS looks good during all the years under reference except 2004 where it dipped below the normal required CR of 2. In fact, the significant difference between their CR and ATR is mainly because of the large amounts of loans and advances they had during these years. Net working capital of the company is constantly rising as compared to credit sales, showing a positive growth and less dependence on long term debt. Both CR and ATR show an increasing trend throughout the period which is definitely a good sign for the future prospects of the company. Figure 7 shows the plot of the liquidity ratios of INFOSYS.

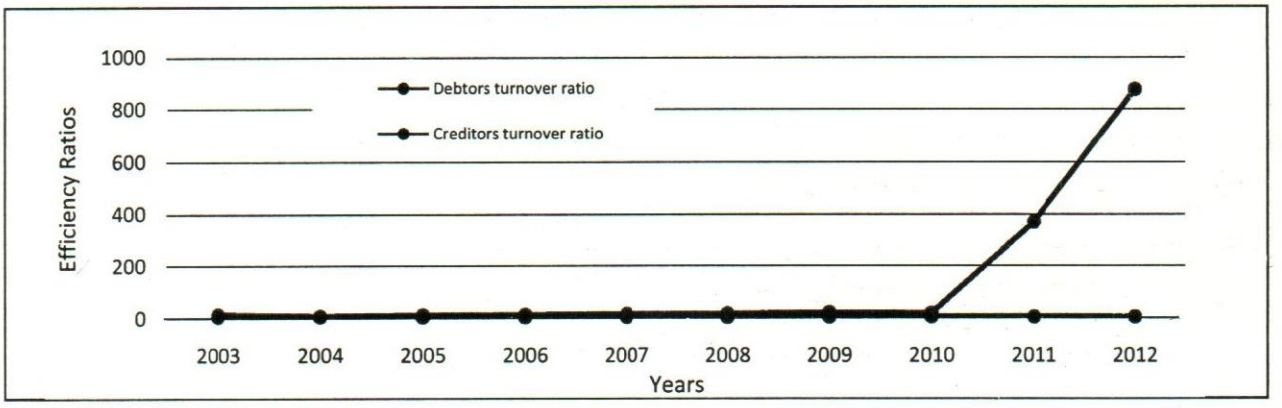


Source: Author's Calculations

Figure 7: Liquidity Ratios for INFOSYS Ltd.

Efficiency Analysis:

Creditor's payment period is constantly dipping as compared to debtor's collection period which is almost constant at around 60-70 days. It shows that creditors are not sure of the company's position in the market hence demand faster reimbursement. But since acid test ratio is significant, this gap is not the major problem in their operating cycle. Also their zero dependence on inventories is justified for an IT company. Creditor's turnover ratio is extremely high during the year 2012 and 2011 mainly because of the small amounts of sundry creditors they have. It implies that most of the company's functioning was financed through their current assets. Figure 8 shows the plot of the Efficiency ratios for INFOSYS.



Source: Author's Calculations

Figure 8: Efficiency Ratios for INFOSYS Ltd.

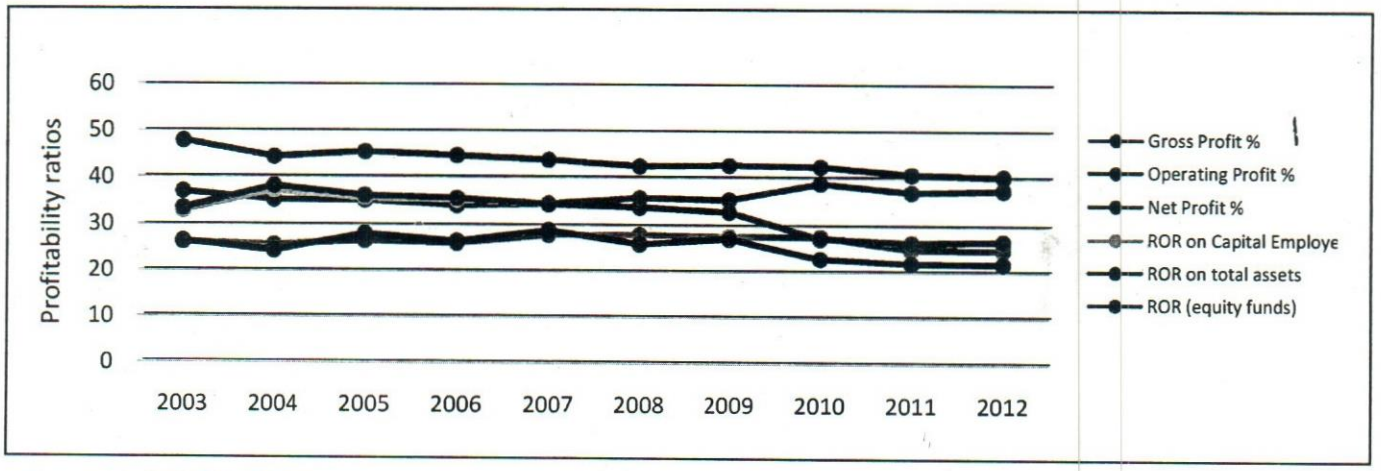
Solvency Analysis:

The solvency position of Infosys is sound for two reasons: First, it has an enormous level of interest coverage ratio during all the 10 years under consideration ranging between 1772 in 2003 to 5964 in 2008. It is not likely to commit default in payment of interest to its lenders as its operating profits (EBIT) have enough margins to meet its interest obligations. Secondly, both of its debt to equity and long term to equity ratios are very small mainly due to large reserves. This, in fact, is detrimental to their profit making but as far as solvency is considered it works just fine.

Profitability Analysis:

The profit margins of Infosys are very high which is expected from Indian IT firms (Gross-around 40%, operating- 38%, net- 27%). But ROR on capital employed has decreased during the years. Only COGS ratio has increased during all the years considered, all other ratios have dipped. But still profit margins are significantly high for a company.

Overall, the company is in good financial health as seen through all the ratios. Figure 9 shows the plot of the profitability ratios for INFOSYS.



Source: Author's Calculations

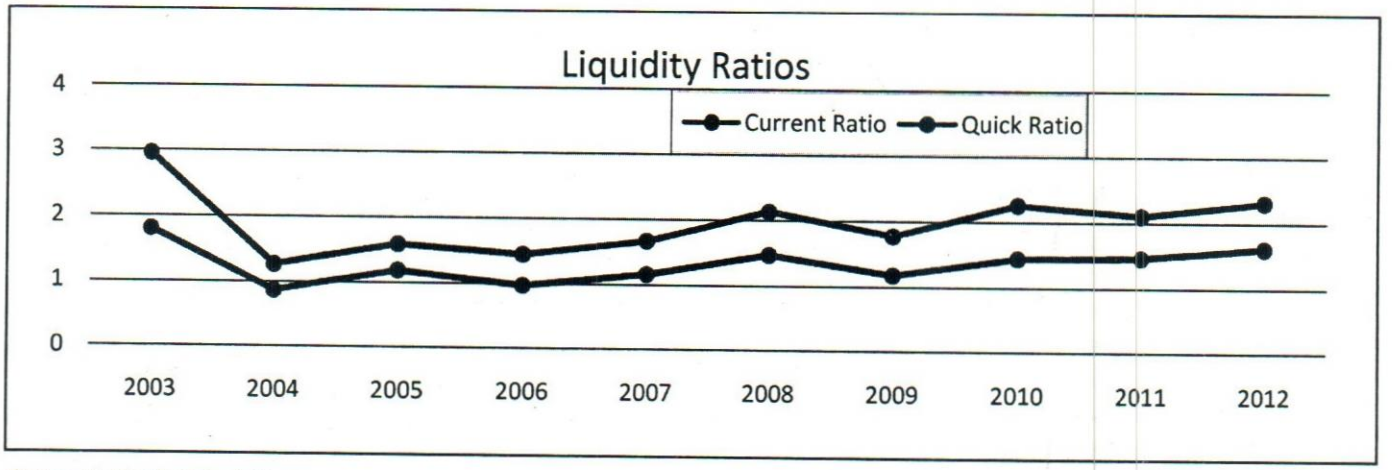
Figure 9: Profitability Ratios for INFOSYS Ltd.

Wipro Ltd.

Here the financial stature of Wipro Limited has been evaluated.

Liquidity Analysis:

Wipro is doing well in terms of liquidity with both the current ratio and the quick ratio at satisfactory levels. The current ratio has ranged from a minimum of 1.26 in 2004 to a maximum of 2.96 in 2003. Interestingly the liquidity stand of the company was relatively weak from the year 2004 to 2007 with current ratio ranging from 1.26 to 1.66. But for the last 3 years it has consistently maintained the current ratio above 2, ranging from 2.31 to 2.10. This shows that has strengthened its liquidity. It can be seen that their average current ratio has improved since 2008. Except 2009, their current ratio is above 2. The acid test ratio for the company has been above 1 for the last six straight years, indicating a good amount of fast cash generation possible for the company and good to hold the faith of the creditors. Its lowest quick ratio was 0.86 in 2004 while highest was 1.86 in 2003 as shown in figure 10. For the past 3 years, quick ratio is above 1.4. Wipro saw a sudden fall in liquidity from 2003 to 2004. After that there have ups and downs but the major trend is increase in liquidity. There was a sudden increase in current liabilities from Rs 3986 crores in 2008 to Rs 6646 crores in 2009 while current assets for the firm remained almost unchanged. So current ratio fell from 2.13 to 1.77, while quick ratio fell from 1.46 to 1.17. This happened because of the financial crisis.



Source: Author's Calculations

Figure 10: Liquidity ratios of WIPRO

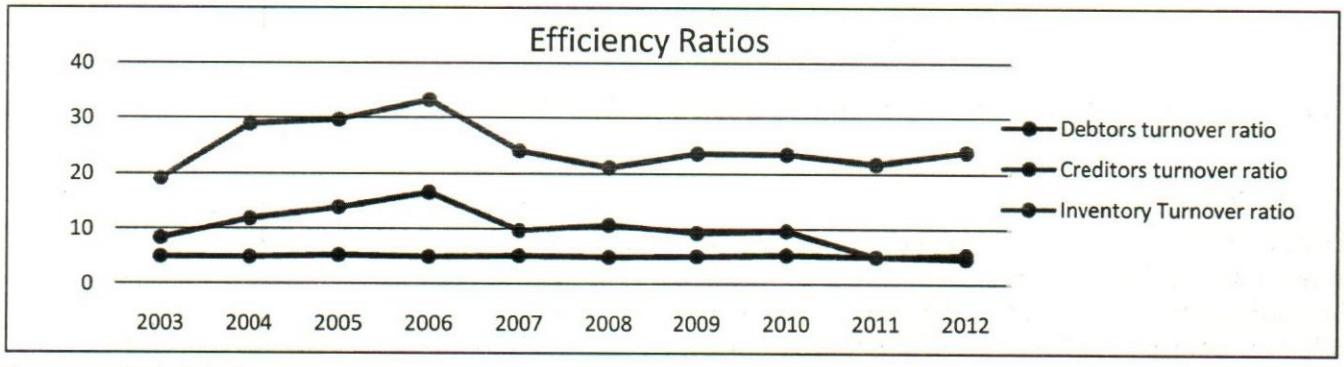
Solvency Analysis:

The state of solvency for WIPRO has seen many ups and downs. The interest coverage ratio varied from a minimum of 24.14 in 2012 to a maximum of 768 in 2006. Owing to the satisfactory value of the interest coverage ratio,WIPRO is not likely to commit default in payment of interest to its lenders as its operating profits (EBIT) have enough margins to meet its interest obligations. The total debt to equity ratio varied a lot but with a general increasing trend over the years.

A sharp increase in the ratio from 0.48 to 1.04 was seen from 2007 to 2009, which was mainly due to a sharp increase in the secured loans for the company with the shareholders' funds remaining almost constant. Also there isn't a considerable share of long term loans in the debt of the company which keeps the company safe from defaulting.

Efficiency Analysis:

In the recent years there has been a sharp decrease in the credit payment period for the company from 22 days in 2006, a maximum of 72 in 2011 to 67 days in 2012, while no decrease was seen in the debtor's collection period which ranged from 68 to 78 days. This high debtor's payment to credit collection period ratio adds to the liquidity problems for the company already suffering from a nominal current ratio. On the other hand levels of the inventory turnover ratio has decreased from its peak of 33 in 2006 to 24 in 2012 as shown in Figure 11 which indicates poor management of inventory by the firm.

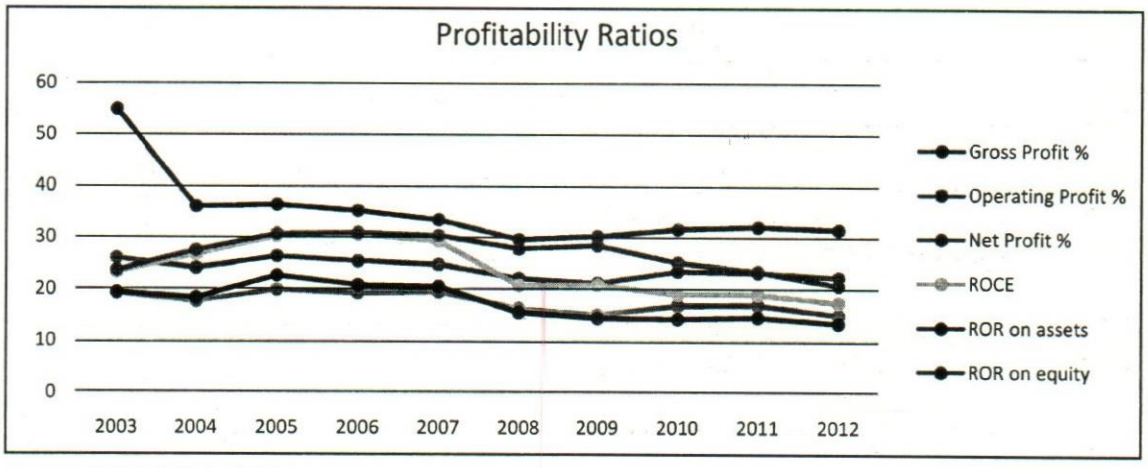


Source: Author's Calculations

Figure 11: Efficiency ratios of WIPRO

Profitability Analysis:

Over the years there has been a decreasing trend in the different profit margins for the company with the gross profit falling from 54% in 2003 to 31% in 2012.This indicates either a decrease in the income of the firm or an increase in the cost of goods sold. The ROR on equity and ROR on capital employed for the firm has declined over the years. The operating profit has been steady over years. The net profit margin peaked in 2007 to 20.5% while in 2012 it decreased to 15% as shown in figure 12.



Source: Author's Calculations

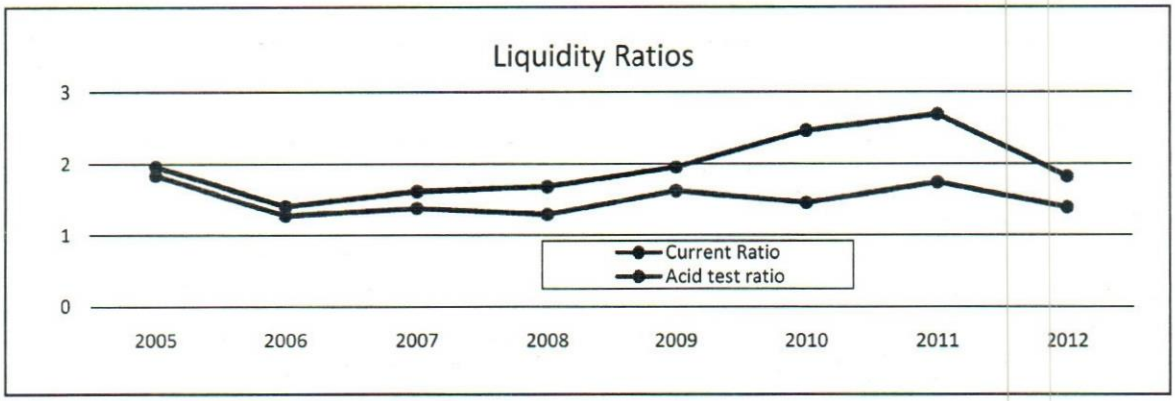
Figure 12: Profitability ratios of WIPRO

Tech Mahindra Ltd.

Tech Mahindra is another leading IT company of India and in the following section the analysis of the financial situation of the company has been done over the past few years.

Liquidity Analysis:

Tech Mahindra seems to be doing well in maintaining satisfactory levels of liquidity during the years under reference. The current ratios for most of the time have been close to 2, otherwise ranging from 1.41 to 2.69 as shown in figure 13. Also the quick ratio has been well above 1 for most of the time. Such a combination of ratios is an indicative of very optimum liquidity condition of the company and good management of inventory of the company.



Source: Author's Calculations

Figure 13: Liquidity ratios of TECH MAHINDRA

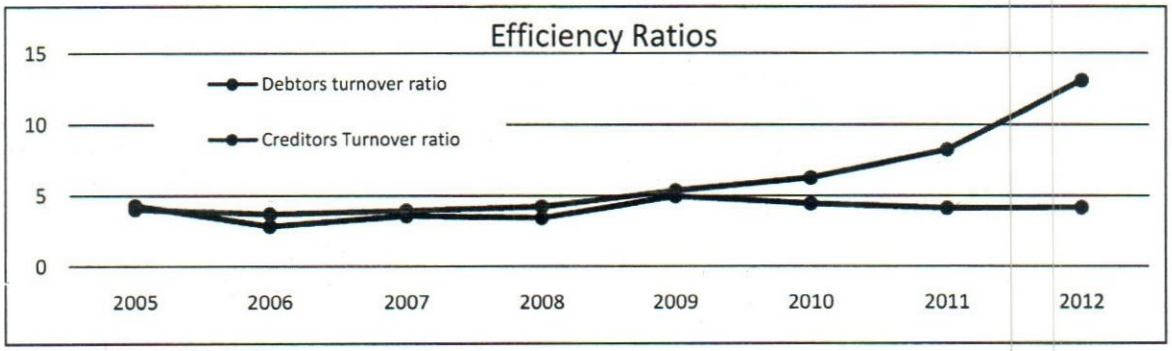
Solvency Analysis:

The state of solvency of the company had a sharp change during the year 2009-10 when there has been an incredibly sharp increase in long term debt to equity ratio of company from 0.01 to 0.74 which indicates a sudden need to deal with long term debt obligations and increase in defaulting risk for company. This happened because for first time the company leveraged its earnings in 2010 undertaking a secured loan of Rs 750 crores. The total debt to equity ratio for company has been less than 1 for most of time, showing the dominance of equity funds in investments for the company.

Efficiency Analysis:

Unfortunately for the company the credit payment period for the company has decreased from a high of 89 in 2005 to as low as 28 days in 2012, whereas on the other hand the debtors collection period has not witnessed such a change. Debtor's collection period remains almost constant ranging from 73 days to as high as 127 days. But owing to good current ratio levels for the company the delay in the debtor's collection and credit payment has been managed well.

The most important feature has been extremely high inventory turnover ratio as high as 18752 in 2012 and has risen steadily from 2004 as shown in figure 14. This shows that inventory is sold almost instantly and costs of holding the inventory have fallen.

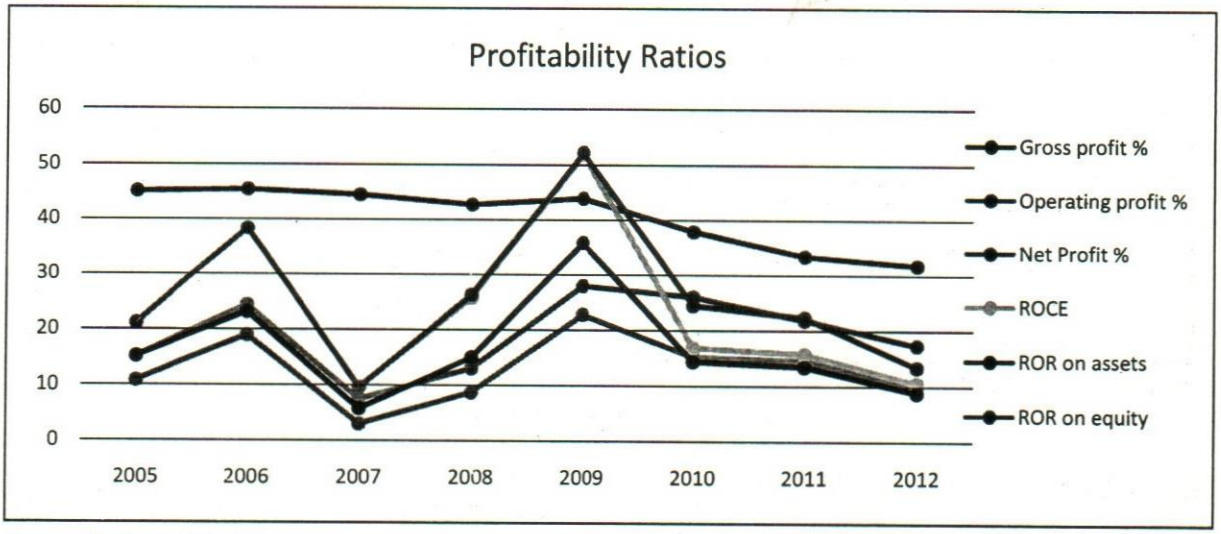


Source: Author's Calculations

Figure 14: Efficiency ratios of TECH MAHINDRA

Profitability Analysis:

The profit margins (gross, operating and net) of Tech Mahindra over the years have declined affecting the profitability of the firm. For instance the gross profit has fallen from 45.1% in 2009 to 31.7% in 2012, operating profits falling from 24.3 % in 2005 to 17.3% in 2012. This fall in profitability can be partially assigned to the constantly increasing COGS, which has increased from 0.55 in 2005 to 0.68 in 2012 and hence increasing expenditure in the production. Trend similar to the profit margins was followed by the ROR on assets, equity and capital employed. Overall the profitability of the firm is suffering from an increase in production costs which need to be controlled as the first priority. Figure 15 shows the profitability ratios of Tech Mahindra.



Source: Author's Calculations

Figure 15: Profitability ratios of TECH MAHINDRA

Effect of the financial crisis

The financial crisis that began in 2008, led to a global recession. A '2-tailed t test' has been conducted between 2 sets of data (i.e. 2004-08 and 2009-12) for 95% confidence interval to check whether there is a significant change in the performance of IT industry after the global recession (shown in Figure 16). If significance value is lesser than 0.05, it implies that the industry has suffered poor performance in the aftermath of financial crisis. Table 1 summarizes the significance analysis of liquidity ratios of the companies.

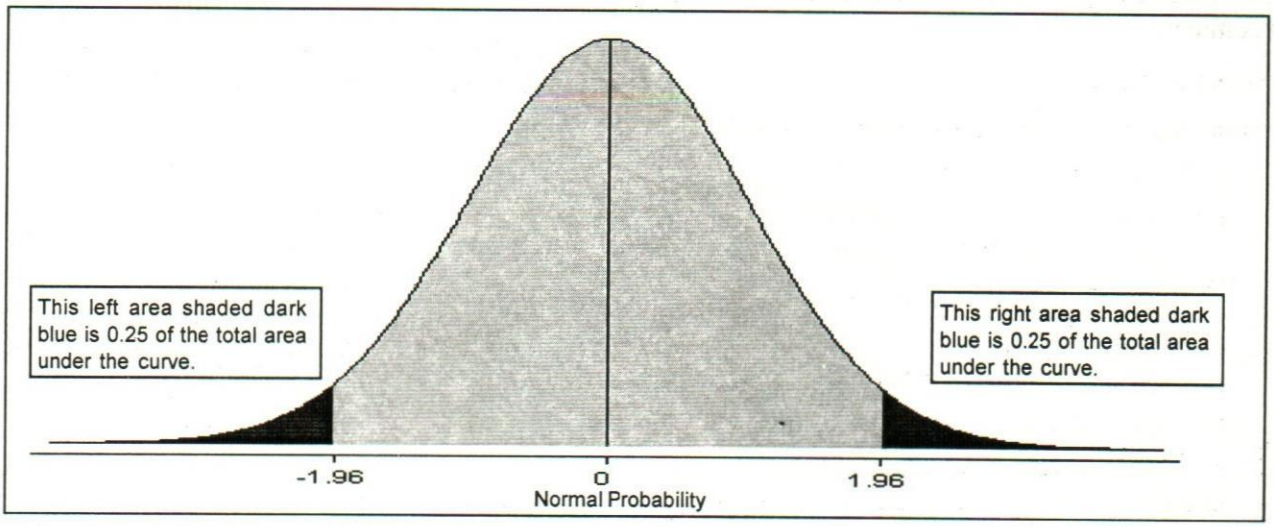


Figure 16: A general 2-tailed t-test probability distribution plot

Table 1: Analysis of liquidity ratios of the companies

Significance test	Industry	TCS	Tech Mahindra	HCL	Infosys	Wipro
Current ratio	0.051	0.575	0.065	0.957	0.032	0.368
Quick ratio	0.082	0.473	0.518	0.662	0.035	0.313

Source: Author's Calculations

The significant values show that the Indian IT industry managed to perform consistently after the crisis in liquidity front. However, Infosys performed worst after 2008 in terms of current ratio. Quick ratio of Infosys was also under pressure but rest of the industry was unaffected. Table 2 shows the summary of the significance analysis of the profitability ratios of the sector.

Table 2: Analysis of the profitability ratios of the sector

Significant test	Industry	TCS	Tech Mahindra	HCL	Infosys	Wipro
Sales growth YoY%	0.204	0.220	0.190	0.646	0.085	0.020
Gross profit %	0.006	0.584	0.026	0.030	0.014	0.091
Operating profit %	0.503	0.590	0.396	0.066	0.046	0.081
Net profit %	0.018	0.888	0.932	0.037	0.544	0.022
COGS ratio	0.006	0.584	0.026	0.030	0.014	0.091

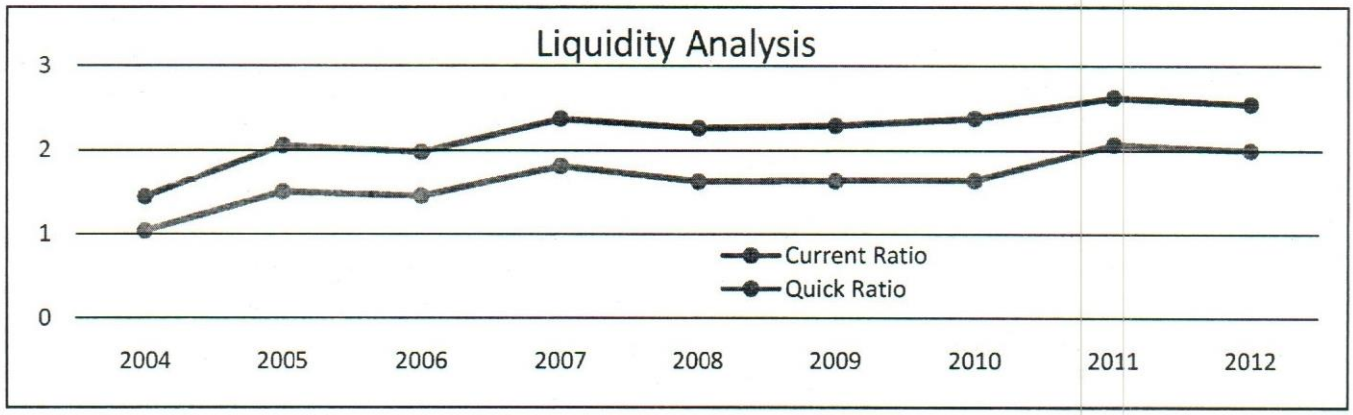
Source: Author's Calculations

Sales growth for industry remained consistently well, except for Wipro. There was significant pressure on the profit margins of the industry. TCS performed well in terms of profitability than its peers. There was a significant dip in the net profit margin of the industry after 2008 mainly because of HCL and Wipro. Gross profit of industry dipped but operating profit was maintained. This implies that they controlled their Admin and S&D cost to manage operating profit margin.

Analysis of the overall IT industry

Liquidity Analysis

The whole industry is growing at a pace faster than any other sector in India. As can be seen from the graph below both Current ratio and Quick ratio are increasing throughout the period considered. This shows that the industry survived the economic crisis of 2008 without any significant effect on its growth. Figure 17 shows the plot of the important liquidity ratios of the IT sector as whole.



Source: Author's Calculations

Figure 17: Liquidity analysis of the Indian IT sector

Profitability Analysis

In the initial years of industry, it was growing fast and faced relatively less competition. Also it earns most its revenues outside India. So after the financial crisis of 2008, their profit margins fell. Other factor that led to decline in profit margins is increase in competition. The difference between gross profit and operating profit has declined which implies that the industry has controlled its Admin expenses and S&D costs. Figure 18 shows the plot of the important profitability ratios for the Indian IT sector.

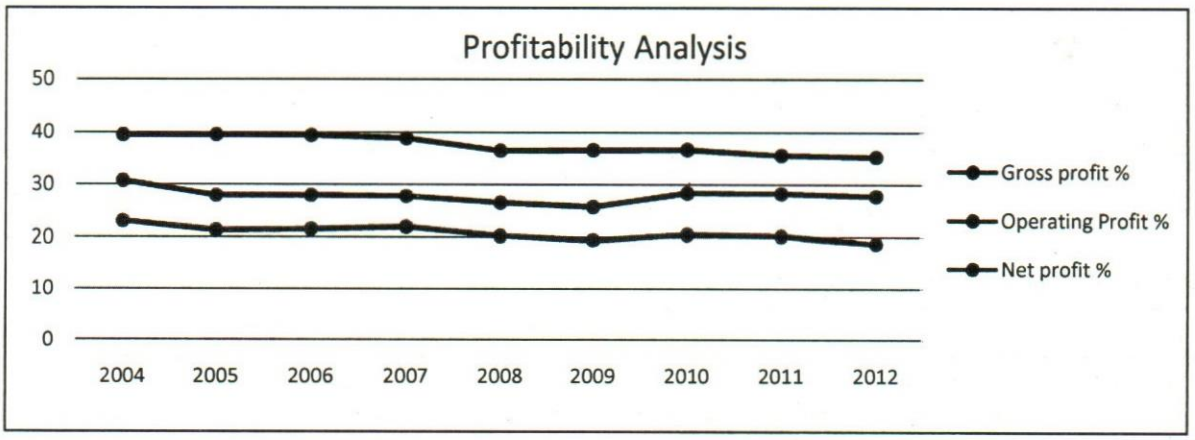


Figure 18: Profitability ratios of the Indian IT

Conclusions and managerial applications

The sector has been growing constantly at a high rate of around 30% per year in terms of capital gains. Unlike initial years of the industry, the industry now faces huge competition. Despite the huge competition faced by the industry currently, it has a high growth rate. Also it earns most of its revenues from outside India. So, after the financial crisis of 2008, their profit margins fell. A major factor that led to the decline in their profit margins is increase in competition. The difference between gross profit and operating profit has declined which implies that the industry has controlled its Administration expenses and S&D costs. The financial crisis of 2008 has had only a little effect on the overall health of the sector which is shown by the significance level testing.

Whatever may be the challenges, definitely, Indian IT industry has changed the whole scenario. Transforming it to be an 'equalizer' depends on government and social system changes, where access to ICT products and employment opportunities to be assured to all. The sector, as can be seen from the above analysis, is growing way much faster than any other sector. It plays an important role in the overall Indian GDP.

The major implication which stems from the study is the resistance of the sector to the recession abroad, unlike other sectors. This presents an opportunity for the investors and government, to increase investment at the time of recession. Being a major exporter, the sector earning helps control the current account deficit for the country. The companies are performing well in terms of liquidity and hence should work on improving profitability by reducing more of managerial costs.

REFERENCES

Indian Institute of Technology (2012) Delhi, "Balance Sheet consolidated, P & L Consolidated" https://www.capitaline. com/

Jain P K, Khan M Y, (2007)."Financial Management", Tata Mcgraw Hill, 5th edition.

The price of success is hard work, dedication to the job at hand, and the determination that whether we win or lose, we have applied the best of ourselves to the task at hand

—Vince Lombardi

Focus

Personalised Marketing: Concepts and Framework

SUMAN KUMAR DAWN

In a dynamic and competitive market, marketers are going towards the personalised marketing to serve better to its customers than their competitors. Personalisation is the use of technology and customer information to tailor a particular product to the specific needs of an individual customer. After the globalization of the Indian economy and also with the rapid development of information technology, the new Indian economy with characteristics of the Internet and e-commerce has become more vibrant, and brought huge impact on enterprise operation and management mode. At the same time, along with the rapid development of society and economy, personalized need for product is more and more obvious. Due to the enormous competition in the market, it is imperative for an organization to develop personalized marketing to enhance the competitive advantage. This article makes an analysis of how enterprises develop customized marketing strategies in the commercial environment. In this paper, we have also discussed about the concept of personalized marketing and make an attempt to develop a model to show how Information Technology (IT) helps to develop a personalised marketing to provide better service to the customers.

Suman Kumar Dawn is Asst. Professor, Centre for Management Studies, JIS College of Engineering, West Bengal.

Introduction and rationale of the study

Personalised marketing is an essential element of the marketing mix and our innovative system pinpoints prospective and existing customers by focusing on the individual customer, using a combination of marketing activities. Duncan and Caywood (1966) proposed an inversion of attention, from internal organisation to focusing on the external customer groups, later all stakeholders, mapping out their brand contact points, each of which represents 'a message, a form of marketing communications'.

Personalised marketing is an approach that is used primarily with customer relationship management strategies usually where a firm has access to customer database information, or where a firm has the ability to tailor its offering. It basically refers to approach the customer as an individual and having a tailored marketing mix designed for that one customer. However, many large businesses could undertake personalized marketing activities, without being a niche marketer. For example, a large bank, with millions of different customers, could easily engage in personalized marketing due to the amount of customer data/information they have. As part of a direct marketing promotional campaign, they could send each customer a unique offer (of account type, interest rate, fees, and other conditions) that is based upon the customer's particular needs, profile, and campaign response history. The bank may approach many customers at once as part of the same overall campaign, but technically each customer has received a unique offering. Here, the bank is not a niche marketer: they are simply tailoring their marketing mix to meet the unique needs and responsiveness of each of their customers.

Personalised marketing recently has become the dominant in advertising and marketing since using digital

technology can offer many benefits such as increasing revenues, reducing costs and increasing the size of the company market. The Internet provides companies with an extraordinary ability to communicate directly with customers. Also new technologies allow all businesses of all sizes to have the opportunity to build competitive advantages. Companies use digital technology for selling their products for several reasons, one of the main reasons is the cost effectiveness and the convenience for customers. Another reason for using database is that companies can reach customers than ever before. Beside that database marketing allows companies to locate customers where ever they are, identify their needs precisely, communicate with them, and deliver their products and services with relatively low costs (Paulo Rita, 2003).

Organisations have been talking about one-to-one marketing for years. With the looming threat of tightening budgets due to the economic downturn, the benefits that personalised marketing yields — increased response and higher conversion rates, greater profits, enhanced customer loyalty and the ability to measure individual campaigns more effectively — are even more essential. Combined with information gleaned from the web and customer relationship marketing programmes, brands can employ unparalleled levels of targeting and personalised communications. Marketers need to personalise the marketing messages, focus on telling stories, need to create a sense of belonging, generate a powerful emotional connect with people and create a platform for advocacy. Personalization is a major factor in marketing. To know the customers, supply them with materials which solves some specific problems, marketers must always strive for relevance.

Literature review and conceptual framework

The growth of personalized marketing has led a revolution in the marketplace. First, whereas traditional marketing has been concerned with demand management, customer-centric marketing will lead the marketing function toward delivering better value. Second, traditional firms and customers are generally separate with little interaction whereas in personalized marketing will lead to customers and firms both about making products, pricing, and distribution.

Personalised marketing can affect traditional marketing in two ways. First, it increases efficiency in creating marketing functions. Second, the technology used in marketing can increase company profitability (Strauss and Frost, 2001).

Companies try to build their positions in markets through adapting specific marketing strategies. Those strategies reflect the firm's short-term and long-term responses to challenges and opportunities posed by the business environment. Also companies' strategies refer to how companies deal with their suppliers, competitors, and customers. The ultimate goal on any personalized marketing strategy is to attract customers and acquire loyalty. This can't be done without building a strong and flexible long term strategy which can be adapted to reflect customers' need (Lages, 2002).

Service firms routinely practice personalization during face-to-face service encounters (Gwinner et al., 2005; Mittal and Lassar, 1996). They also increasingly use information technology applications to personalize products and services (Ansari and Mela, 2003; Winer, 2001) to develop longer term, more personal relationships with their valuable customers. Despite personalization's strong intuitive appeal for service firms, we know relatively little about its role in delivering customer satisfaction and enhancing service relationships. Knowing how customers actually respond to personalization is of particular relevance to researchers and practitioners of service personalization.

Personalised marketing advocates tailoring of one or more aspects of the firm's marketing mix to the individual customer (Peppers, Rogers and Dorf, 1999). It represents an extreme form of segmentation, with a target segment of size one. There are two forms of personalized marketing: personalization and customization. Personalization is when the firm decides, usually based on previously collected customer data, what marketing mix is suitable for the individual (Nunes and Kambil, 2001). Customization is when the customer proactively specifies one or more elements of his or her marketing mix.

It is becoming an essential tool for managing customer relationships (Sheth and Parvatiyar, 1995) in organizations and is supposed to have positive impacts on service relationships.

Othman Aman (2010) concentrates on the barriers doing online business by Akapiman Enterprise. The case study indicates that the 4Ps (Price, products, place and promotion) are significant elements in marketing. The result in his study shows that the weakness of promotion as part of 4Ps plays an important function in business flow. The failure of promotion especially for the new competitor will also affect the overall business cycle. It is important

for the entrepreneur to realize that the promotion is a fundamental element to expose the company to the customers.

The traditional marketing 4 P's is now being transformed into five "I"s in the digitization era of commercial process of business. They are: Identification, Interaction, Individualization, Integration, and Integrity.

(i) **Identification:** In this phase the activities are to know the customers in as much detail as possible. Not just name and addressable characteristics, but habits, preferences, and so forth. It is ability to know each customer and to link information about that customer across the company and throughout the duration of the customer's relationship with the firm.

(ii) **Individualization.** Once a firm's customers have been identified, the next step is to individualize the firm's approach to each customer, offering a benefit to the customer based on what *that* customer needs, and expending an effort to get, keep, and grow the customer's business based on *that* customer's long-term value to the enterprise. The more differences exist among an enterprise's customers, the more compelling and cost-efficient it will be for the firm to individualize.

(iii) **Interaction:** Interaction with a customer is necessary so an enterprise can gain a greater understanding of both the customer's articulated and non-articulated needs from the firm. The tremendous cost-efficiency and exploding acceptance of the Internet now makes this an extremely compelling vehicle for practicing personalised marketing.

(iv) **Integration:** The company that commits to personalized relationships with its customers will not be able to operate solely within discrete functional or product units. Rather, it must coordinate all its activities with respect to each customer, one customer at a time. This has immense implications for managing the enterprise. The initiatives taken in the future must be coordinated by *customer* rather than simply by product or division.

(v) **Integrity:** More than is the case with traditional marketing, the customers of a personalized marketer must collaborate with the enterprise, and this means the enterprise must secure the trust of its customers. So integrity is indispensable to the personalized marketer.

With the right kind of post-purchase marketing messages, marketers can turn these youngsters into loyal brand advocates in the digital world. The good news is that marketing technology has advanced to make it easier to make this vision of one-to-one marketing a reality. There are four key areas that have been impacted by these technology advances, and to which forward-looking marketers should turn their attention:

(i) Targeting: Technology is now able to compile a complete view of a customer by drawing on data in various formats and from various locations and channels throughout the organisation. Integration with popular data mining tools enables organisations to perform even deeper customer analysis, segmentation, and profiling.

(ii) Messaging: Messaging is the hook that captivates a customer's attention. If the marketing message is not relevant it won't garner the attention. Personalisation is taken to new heights when thousands of different offers can be based on customer attributes and business rules. These may be based on his or her preferences, product purchases, or recent life events, such as a new property purchase. Marketing technology not only enables this, but makes it possible to track responses to each content area as well as to the offer in its entirety.

(iii) Executing: A critical component of personalized marketing is to detect and know the customers when they will be most receptive to a contact regarding a new offer. It identifies valid reasons to contact customers and provides marketing staff with consultative opportunities and opportune loss interventions. By signaling when a customer is most likely to respond to a communication, it can improve customer satisfaction.

(iv) Delivering: Delivering personalised messages whenever a customer connects with a company is powerful. Today's technology allows marketers to quickly develop and run all forms of marketing communications from scheduled campaigns, event-driven programmes, and real-time conversations with customers across multiple channels – including electronic and print. A coordinated approach makes it easy for marketers to drive effective interaction strategies that reach individual customers at the right time with the best offer on their preferred channel.

With technology advances in targeting, messaging, execution and delivery, organisations are now empowered to make the dream of one-to-one marketing a reality. Concentrate on these four areas of personalisation, and the overall business result is satisfied, repeat customers and higher bottom-line profitability.

Designing strategies and model to develop personalized marketing

There are three types of personalization: (i) interaction personalization, (ii) transaction outcome personalization, and (iii) continuity personalization. These three types of personalization induce customer attributions to the firm on the dimensions of performance, benevolence, and value provision. Customer attributions affect relationship status variables such as satisfaction, value, trust, and commitment.

Personalization strategies influence relationship antecedents through attribution processes. Specifically, the three, interaction, transaction outcome, and continuity induce customers to make attributions (positive, negative, and summary) of a firm's performance, benevolence, and value provision. It is the attributions of performance, benevolence, and value provision on the part of the customer, rather than personalization strategies on the part of the business firm, that directly influence trust, relational value, satisfaction, and, ultimately, commitment. The question of personalization effects may thus be reframed as: which personalization strategies are capable of inducing favorable inferences on dimensions of performance, benevolence, and value provision? (See Figure 1):

1. Interaction personalization refers to individualized courtesy and recognition behavior in firm-customer service interactions. Firms may address a customer by name, cordially refer to something particular about the customer, or display other cues of personal intimacy in service interactions. Examples may include personalized mails, emails, or individualized interactions on websites or through telephone (Johnson and Nunes, 2003; Kasanoff, 2001; Tamminga, 2003).
2. Transaction outcome personalization refers to customization of products or service offerings based on customer specifications. A firm may offer to customize certain features of its product or service.

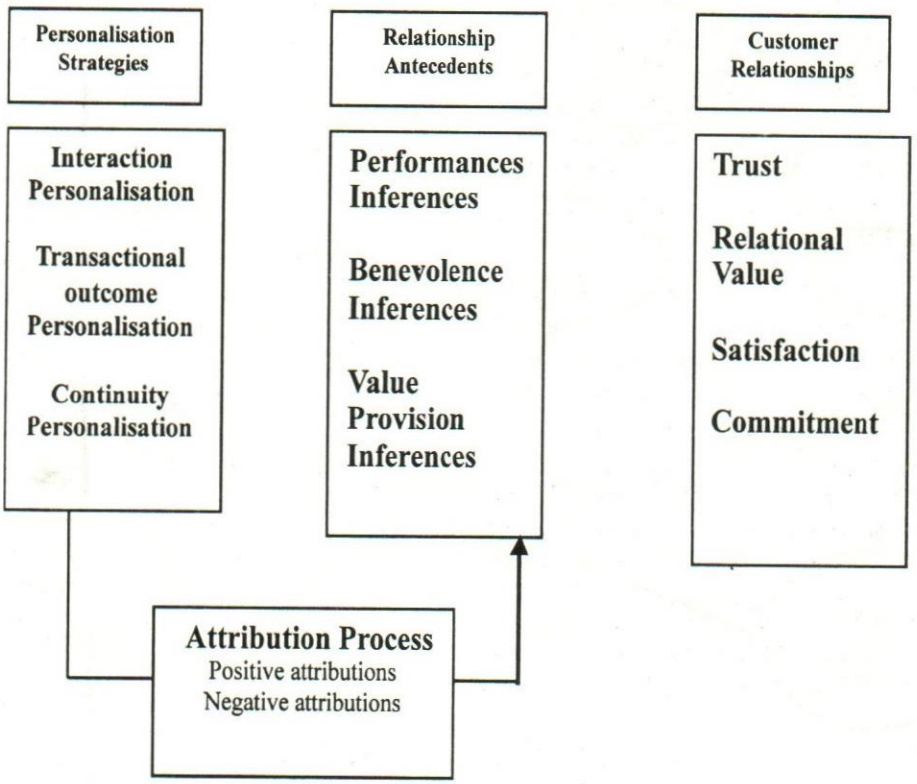


Figure 1: Personalisation effects on marketing

This may involve the customization of website messages (Ansari and Mela, 2003; Moon, 2002) or website-based product configuration (Dellaert and Stremersch, 2005; Fiore et al., 2004). Transaction outcome personalization is a close parallel of service-offering adaptive behavior, although it does not involve the behavior of a service representative either.

3. Continuity personalization refers to ongoing customization based on adaptive learning and knowledge of customer preferences. A firm may offer to personalize, continuously learns about the customer's preferences or goals and, based on knowledge of the customer's preferences or goals, leverages its expertise to customize service offers to this individual customer. The customer firm dyad is engaged in a technology-mediated learning relationship (Pine et al., 1995; Rust et al., 2000).

Trust is a critical mechanism to enhance relationship commitment (Chaudhuri and Holbrook, 2001; Doney and Cannon, 1997; Singh and Sirdeshmukh, 2000). It can be defined as a customer's confidence in the service firm's reliability and integrity (Morgan and Hunt, 1994). Commitment refers to a customer's enduring desire to maintain a valued service relationship (Moorman et al., 1992).

Customer's perceived value may also play a critical role in delivering relationship satisfaction and customer loyalty. (Sirdeshmukh et al., 2002). Relational benefits (Gwinner et al., 1998) refer to the intrinsic and extrinsic benefits provided by the ongoing relationship whereas relational costs include both monetary and non monetary sacrifices (Gwinner et al., 1998; Sirdeshmukh et al., 2002). Relational value may be enhanced by value provision that offers a more favorable, satisfying benefit cost structure (Gwinner et al., 1998; Zeithaml, 1988). Marketing stimuli such as personalization induce perceptions of performance, benevolence, and value provision through the process of customer attributions (Folkes, 1988).

Based on the above discussed strategies a proposed model is developed. The following discussion will describe the detail functioning of the model.

A. Basic Architecture

Figure 2 represents the basic structure the proposed personalised marketing model. It shows two entities, marketer and the customer. The marketing system interacts with the above mentioned entities. The system has four different processes like (i) update, (ii) Customer registration/login/update (iii) Webpage customization, and

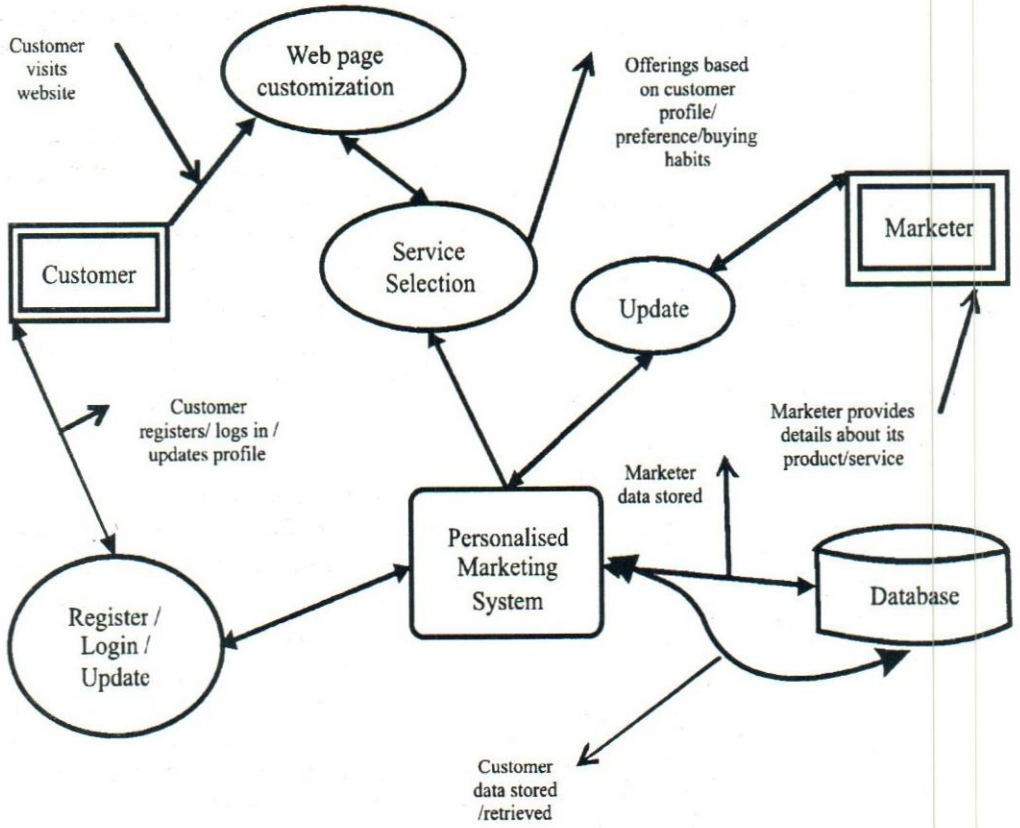


Figure 2: Personalised Marketing Model

(iv) Service Selection. Each of these processes is represented by ellipses. Rectangles are used for external entities. Arrow heads shows the flow of data in and out of the marketing System and also in between different processes

Working of the System

This section contains entire details of each process mentioned in figure 2.

Process-1 of figure 2 represents the Update process. This process is for the marketer or the business or organizations that are using the service to provide customized services to its targeted consumers. The marketers provide their personal details and detail of marketing information. Personal details contain information which would help consumers to conduct business with the marketer or contact the marketers when required. Thus the marketer will have the flexibility of updating their marketing information, to be delivered depending upon their own policies at any point of time.

Process-2 of figure 2 represents customer registration/login/update process. This process is needed for collecting customer details, which include customers' demographic profile, interests (liking and/or disliking), contact details and so on. This login process requires an email-id and password as the login criterion provided at the time of registration. This information is then stored in a customer database for any future reference or correspondence and analysis of customers buying behaviour or attitude to provide better tailored services to the customers.

Process-3 of figure 2 represents the Webpage Customization process. This is a very crucial process deciding the success of the entire customized marketing system. Every time a customer logs into the website of the marketer, this system dynamically generates a customized welcome webpage that is specifically tailored to the need, want, demand, choice, preference, habits of each customer. This is made possible through the use of customer data already stored in the customer database in the previous process.

Process-4 of figure 2 shows the process by which consumer/customers finally get access to the service they choose on the customized welcome or home page of the website. When a customer makes a choice the desired service is provided according to the norms/policies of the company, stored in the database for the marketer.

The system will not only function when a customer visits the website of the company, but will also generate and send customized email of SMS alerts to customers informing specials offers, promotional schemes or any other information relevant to a customer.

Examples on Personalised Marketing

In connection to the proposed model as well as the knowledge through literature survey by the authors, here are some examples shown as the successful personalised marketing all over the world. In India, the concept and application of personalized marketing is still in very nascent stage, but in developed countries the organization are adopting this concept and getting success. Indian companies will be benefited if they will adopt the concept and model.

Budget airline EasyJet (http://www.easyjet.com) has tapped into this demand for personalisation by creating a homepage for individual EasyJet visitors. Customers could get pricing and travel suggestions based on their past interactions. It shows flights from their nearest airport along with imagery and content based on their past travel history. The homepage shows live pricing for relevant flights from their local airport and the visitor can add those flights to their basket. When testing the new homepage in its 2012 January sale, EasyJet reported its best ever sales record – with five sales per second.

Flight aggregator Momondo (http://www.momondo.in/) has started to offer "personalised" online travel guides to potential customers. Customers can select the type of trip according to online guides graded by colour that provide travelers with personalised recommendations from fellow travelers on what to see and do in a certain city, depending on their specific type of trip. According to their opinion, personalisation is important for offering, and provides guidance which helps the company to understand its customers better.

Technology company Intel followed up on its "Museum of Me" (http://www.intel.com/museumofme) Facebook campaign last year, with "Me, The Musical" (http://www.intel.com/musical). This allows users to see their timelines in a song and dance format. This is another example of how the B2B brand is using public social data to create personalised web experiences and broaden its brand appeal. The musical starts with the user's birthday through to present day. The app pulls in general information such as the day the internet launched or when Facebook was created as well as personal information.

Abcam (http://www.abcam.com/) found that investing in a personalised and sophisticated e-mail marketing campaign generated impressive ROI figures. The company produces and distributes antibodies to academic and commercial clients in more than 70 countries and covers hundreds of disciplines including cancer, immunology and neuroscience.

Swedish furniture maker Ikea (http://www.ikea.com/) found that tapping into this common desire helped transform perceptions about its product offering. Research found that thirty-something shoppers associated Ikea with smaller items such as lamps, rugs and other accessories rather than large items and rooms. Ikea developed the "share space", an online destination where people showcase how the brand has helped them achieve a personalised style in their home. This campaign increased sales by 7.4 per cent. It was especially successful in the sales of rooms: sales of living rooms rose 9 per cent and kitchens 12 per cent. Ikea's "share space" (http://www.theshare-space.com/) site had over 36,000 unique users during its first month.

The Magical Story machine (http:// www.magicalstorymachine.com/) allows customers to record their own children's audio book, along with a personal message. Users pick from a selection of popular children's stories, and then record the words online using their computer's microphone and a web based autocue tool. Appropriate sound effects and music are automatically mixed in with the storyteller's voice, and the result is made available for download as an MP3 file.

Conclusion

Personalised marketing helps an organization in building a database about its customers that describes relationships in sufficient detail so that marketers can access that information to potentially match customer needs with products offered, remind customers of specific ticket offers, and help the organizations track what their customers have purchased. The Internet has become one of the major facilitation technologies that allow marketers to provide customized information and complete transactions at a fraction of the cost of other media. The Internet has certain characteristics that aid customer-centric marketing. First and foremost, it has the capability of addressing individual customers and also being responsive (Deighton, 1997). Second, it has the ability to store vast amounts of information, be interactive, and also complete transactions (Peterson, Balasubramanian, and Bronnenberg, 1997). Finally, the Internet allows customers to seek unique solutions to their specific needs.

References

Ansari, A. and Mela, C.F. (2003): "E-customization", *Journal of Marketing Research*, vol. 40, May, pp. 131-45

Chaudhuri, A. and Holbrook, M.B. (2001): "The chain of effects from brand trust and brand affect to brand performance: the role of brand loyalty", *Journal of Marketing*, Vol. 65, April, pp. 81-93.

Deighton, J. (1997): "Commentary on Exploring the Implications of the Internet for Consumer Marketing", *Journal of the Academy of Marketing Science*, vol. 25, no. 4, pp. 347-351.

Dellaert, B.G.C. and Stremersch, S. (2005): "Marketing mass-customized products: striking a balance between utility and complexity", *Journal of Marketing Research*, vol. 42, May, pp. 219-27

Doney, P.M. and Cannon, J.P. (1997): "An examination of the nature of trust in buyer-seller relationships", *Journal of Marketing*, vol. 61, April, pp. 35-51

Duncan, T. and Caywood, C. (1996): "The concept, process, and evolution of integrated marketing communication", in Thorson, E. and Moore, J. (eds) *Integrated Communication, Synergy of Persuasive Voices* , Laurence Erlbaum Associates, Mahwah, NJ , pp. 13 – 34

Fiore, A.M., Lee, S-E. and Kunz, G. (2004): "Individual differences, motivations, and willingness to use a mass customization option for fashion products", *European Journal of Marketing*, vol. 38, no. 7, pp. 835-49

Folkes, V.S. (1988): "Recent attribution research in consumer behavior: a review and new directions", *Journal of Consumer Research*, vol. 14, March, pp. 548-65

Gwinner, K.P., Gremler, D.D. and Bitner, M.J. (1998): "Relational benefits in services industries: the customer's perspective", *Journal of the Academy of Marketing Science*, vol. 26, no. 2, pp. 101-14

Johnson, B.A. and Nunes, P.F. (2003): "*Let's talk: applying the art of conversation to customer contact*", in Freeland, J.G. (Ed.), The Ultimate CRM Handbook: Strategies and Concepts for Building Enduring Customer Loyalty and Profitability, McGraw-Hill, New York, NY, pp. 118-25.

Kasanoff, B.C. (2001): "Making it Personal: How to Profit from Personalization without Invading Privacy", Perseus Publishing, Cambridge, MA

Lages, Luis Filipe (2000), "A Conceptual Framework of the Determinants of Export Performance: Reorganizing Key, Variables and Shifting Contingencies in Export Marketing," *Journal of Global Marketing*, vol. 13, no. 3, pp. 29-51

Mittal, B. and Lassar, W.M. (1996): "The role of personalization in

keep your customers forever?", *Harvard Business Review*, vol. 73, no. 2, pp. 103-13

Rust, R.T., Zeithaml, V.A. and Lemon, K.N. (2000): *Driving Customer Equity: How Customer Lifetime Value Is Reshaping Corporate Strategy*, Free Press, New York.

service encounters", *Journal of Retailing*, Vol. 72, no. 1, pp. 95-109

service encounters", *Journal of Retailing*, vol. 72, no. 1, pp. 95-109

Moon, Y. (2002): "Personalization and personality: some effects of customizing message style based on consumer personality", *Journal of Consumer Psychology*, vol. 12, no. 4, pp. 313-25

Moorman, C., Zaltman, G. and Deshpande´, R. (1992), "Relationships between providers and users of marketing research: the dynamics of trust within and between organizations", *Journal of Marketing Research*, vol. 29, August, pp. 314-29

Morgan, R.M. and Hunt, S.D. (1994): "The commitment trust theory of relationship marketing", *Journal of Marketing*, vol. 58, no. 3, pp. 20-38

Nunes, P. F., A. Kambil (2001), "Personalization? No Thanks," *Harvard Business Review*, vol. 79, no. 4, pp.32-34

Othman Aman, Mohd Fazli Mohd Sam & Izaazwati Hazih, (2010): "E-Business: Obstacles And Marketing Strategy In Selling Fishing Tools In Akapiman Enterprise".

Paulo Rita (2003): "The relationship between e-marketing strategy and e-performance : A conceptual framework", International Conference WWW/Internet 2003

Peppers, D., M. Rogers, B. Dorf (1999): "Is Your Company Ready for One To One Marketing?" *Harvard Business Review*, vol. 77, no. 1, pp. 151-160

Peterson, R. A., Balasubramanian, S., and Bronnenberg, B.J. (1997): "Exploring the Implications of the Internet for Consumer Marketing", *Journal of the Academy of Marketing Science*, vol. 25, no. 4, pp. 329-346

Pine, B.J., Peppers, D. and Rogers, M. (1995): "Do you want to keep your customers forever?", *Harvard Business Review*, vol. 73, no. 2, pp. 103-13

Rust, R.T., Zeithaml, V.A. and Lemon, K.N. (2000): "Driving Customer Equity: How Customer Lifetime Value Is Reshaping Corporate Strategy", Free Press, New York, NY

Sheth, J.N. and Parvatiyar, A. (1995): "Relationship marketing in consumer markets: antecedents and consequences", *Journal of the Academy of Marketing Science*, vol. 23 no. 4, pp. 255-71

Singh, J. and Sirdeshmukh, D. (2000): "Agency and trust mechanisms in consumer satisfaction and loyalty judgments", *Journal of the Academy of Marketing Science*, Vol. 28, no. 1, pp. 150-67

Sirdeshmukh, D., Singh, J. and Sabol, B. (2002): "Consumer trust, value, and loyalty in relational exchanges", *Journal of Marketing*, vol. 66, January, pp. 15-37

Strauss, J. and R. Frost (2001): "E-marketing", 2nd ed, Prentice-Hall, New Jersey

Tamminga, P.J. (2003), "*Making customer interaction more profitable*", in Freeland, J.G. (Ed.), The Ultimate CRM Handbook: Strategies and Concepts for Building Enduring Customer Loyalty and Profitability, McGraw-Hill, New York, NY, pp. 111-17

Winer, R.S. (2001), "A framework for customer relationship management", *California Management Review*, vol. 43, no. 4, pp. 89-105

Zeithaml, V.A. (1988): "Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence", *Journal of Marketing*, vol. 52, July, pp. 2-21

It's hard to pay attention these days because of multiple affects of the information technology nowadays. You tend to develop a faster, speedier mind, but I don't think it's necessarily broader or smarter.

—Robert Redford

Feature

Time Study and Inventory Management of a Bearing Manufacturing Line

V. DURGA PRASADA RAO, CH. GOPALA RAJU AND C.V.S.R.K. RAJU

There is a body of knowledge which has evolved over the years that is designed to increase the productivity of the organization and of the individuals who make up the organization. The objective of present study is to minimize the time consumption and to increase the productivity by maintaining the inventory levels at each machine of the manufacturing line of a radial ball bearing unit using standard time calculations of time study. After deciding the required inventory to be maintained at each machine, the company would meet the demand and foresee profits.

V. Durga Prasada Rao is Professor, Department of Mech. Engg, SRKR.Engg. College, Bhimavaram and Ch.Gopala Raju and C.V.S.R.K.Raju are Associate Professor, Dept. of Mech. Engg, SRKR.Engg. College, Bhimavaram.

The term ball bearing means a bearing assembly which uses spherical balls as the rolling elements to reduce friction between moving machine parts. The main parts of a radial ball bearing are: inner ring, outer ring, spherical balls, cage or retainer and z-shield. A radial ball bearing uses axially symmetric inner and outer races or rings that are so shaped that a set of balls are seated between them and the load passes radially through the bearing. Most radial designs also support modest axial loads. The retainer helps the balls to hold at proper distances so that they do not touch each other (Norton,2009). The z-shield acts like a cover to prevent overflow of the lubricant used in bearings. The sequence of operations involved in the manufacturing of radial ball bearings is shown in Figure 1.

In the present study, Time study is used to record the times and rates of working for the elements of the bearing manufacturing unit and thereby establishes the standard time of every machining operation or process. These standard times are used to calculate the standard productions of the corresponding machines which are then compared with the company's target or desired quantities. This automatically gives the raw inventories to be maintained at all the machining processes. The maintenance of inventories at each machine at required levels ensures continuity in the manufacturing process (Starr and Miller,1986). Also by implementing certain possible changes in the sequence of operations and by making the calculations in a more scientific way, the present study helps in increasing the productivity of the manufacturing unit.

Methodology

Every machine in the manufacturing line has its own standard time but it varies depending on the operative's ease of working, his interest and fatigue, and machine

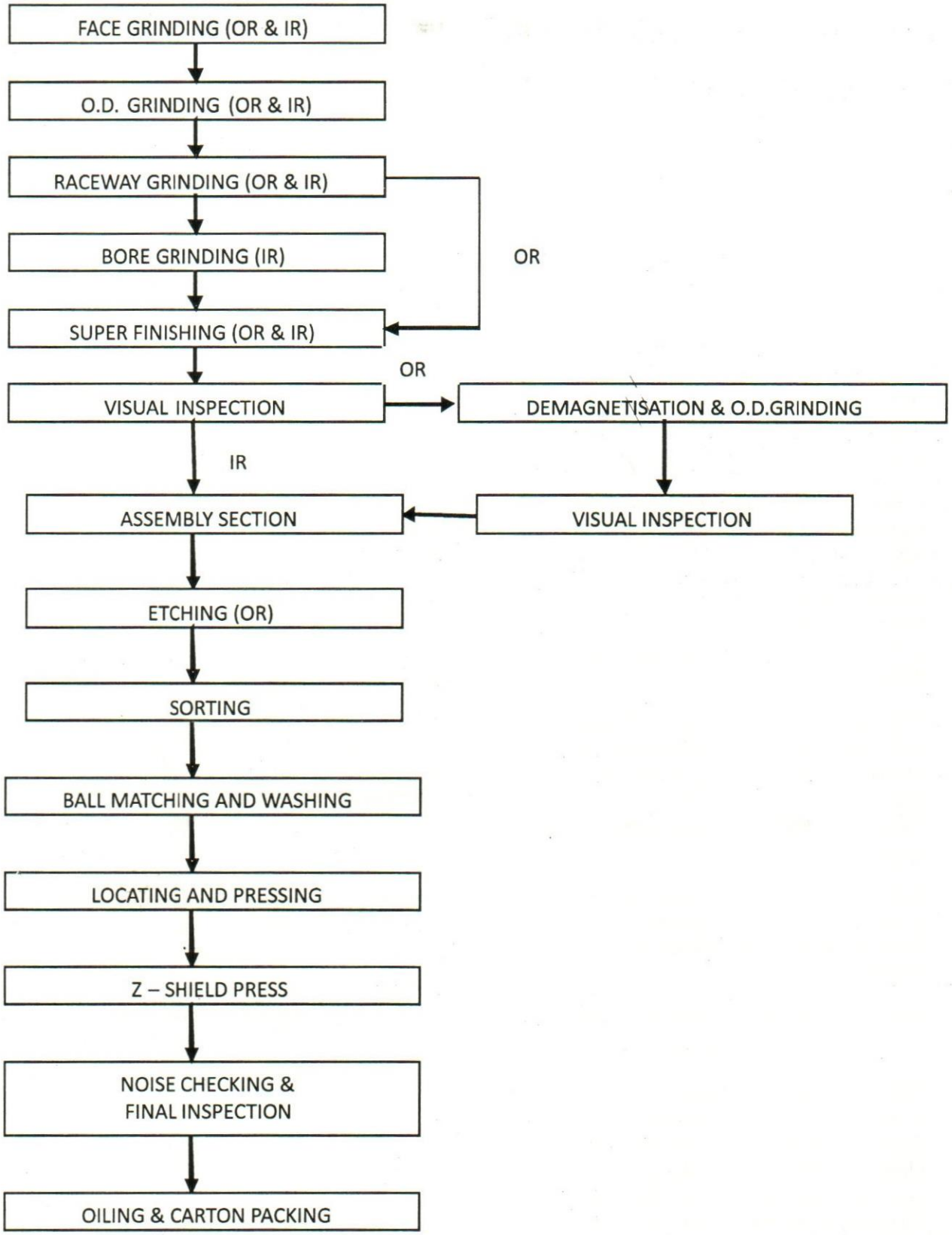


Figure 1: Sequence of operations in bearing manufacturing line

breakdown levels, etc. Hence the time study technique of work measurement is made used to calculate the standard times of each machining operation. The observations and calculations made under time study sheet gives the detailed information about the basic time, rating, allowances considered at each machine and standard time. These calculations are based under one hour production. The time study equipment consists of a stop watch, a study board and time study forms. The purpose of the study is first explained to each worker and they were asked to work at their usual pace. The steps in making time study (Barnes,1980) are:

1. Obtaining and recording all the information available about the job, which is likely to effect the carrying out of the work.
2. Recording a complete description of the method, breaking down each operation into "elements".
3. Examining the detailed break down to ensure that the most effective method and motions are being used.
4. Measuring with a timing device (stop watch) and recording the times taken by the operative to perform each "element" of the operation (on time study forms).
5. At the same time assessing the effective speed of working of the operative relative to the observer's concept of standard rating. In this study, 0-100 scale of rating is used. When this scale is used, it is expected that the average pace will fall in the range of 110 to 120.
6. Extending the observed times to basic times by applying the corresponding rating factors. The basic time of an element is given by the formula:

   Basic Time = Observed time x Observed rating / Standard rating
7. Calculating the time allowances to be provided to worker(s). The different allowances that are considered in the study are the contingency allowance, the fatigue allowance, and the perscnal needs allowance. The contingency allowance is assumed to be 2.5% of basic time and the fatigue allowance is taken to be 6% of basic time. The personal needs allowance is about 5% of total work elements which is the sum of total basic time and the contingency allowance. The total relaxation allowance is then calculated by adding the fatigue allowance to personal needs allowance.
8. Determining the "standard times" for the operation. The standard time of an operation is calculated by using the formula:

   Standard Time = Total work elements + Total Relaxation allowance

In the present study the observed time, calculation of basic time of each operation is done for 5 components and is shown in Tables 1 and 2. The calculation of standard time for each operation is done based on average basic time and is shown in Table 3. Then the numbers of components that can be machined by a particular machine in one hour are calculated using the standard time. The raw inventory required for each operation is finally calculated by using the standard time and company targets of each machine (Table 4). The stage wise inventory calculated using these results gives the detailed information of the inventory maintained at each machine.

Results and suggestions

Every machine has its own standard time, but it varies depending on the operative's ease of working, his interest and fatigue, the machine breakdown levels, etc. Hence the time study is made used to calculate the standard times of each machine (operation). It is observed from Table 4 that the standard time obtained by time study to produce 5 radial ball bearings is 844 seconds and the standard time according to company's target to produce 5 bearings is 751 seconds. Also the company has to produce a total of 3780 bearings. Therefore,

The number of bearings that are produced as per the target time = (751 / 844) x 3780
= 3363 bearings.

But, it is generally desired to reduce the total cycle time so that the total production can be increased, which in turn results in increase of total profit of the company. This can be achieved by the following two important suggestions:

1) The total standard time as per time study calculations (Table 4) for 5 components of inner ring, which includes times of bore grinding, super

Table 1: Observed times and calculation of basic times of operations of bearing manufacturing line

Operation	Sample	01		02		03		04		05		06		07		08		09		10	
Face grinding of IR (Quantity =5)	Element	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Rating (%)	95	95	90	95	95	95	100	95	95	95	90	95	90	95	100	95	95	95	90	95
	Obs.Time (s)	1.05	4.9	1.1	4.95	0.95	5.1	1.0	4.95	1.1	4.85	0.9	4.95	1.05	4.85	1.05	4.9	1.0	5.0	1.05	4.95
	Basic times (s)	0.99	4.65	0.49	4.70	0.90	4.8	1.0	4.70	1.04	4.60	0.81	4.70	0.94	4.60	1.05	4.05	0.95	4.75	0.94	4.70
Face grinding of OR (Quantity =5)	Element	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Rating(%)	90	95	95	95	90	95	95	95	90	95	100	95	95	95	100	95	95	95	90	95
	Obs.Time (s)	1.1	5.6	1.05	5.55	1.05	5.7	0.9	5.45	0.95	5.5	0.9	5.7	0.95	5.8	1.0	5.65	1.0	5.4	1.05	5.6
	Basic time (s)	0.99	5.45	0.99	5.27	0.94	5.4	0.8	5.10	0.9	5.22	0.95	5.41	0.95	5.36	0.95	4.96	0.94	5.13	0.85	5.45
O.D. grinding of IR (Quantity =5)	Element	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Rating (%)	95	95	90	95	90	95	95	95	100	95	100	95	95	95	90	95	100	95	90	95
	Obs.Time (s)	0.95	5.15	1.05	5.05	1.1	5.2	0.9	4.95	0.85	5.2	0.8	5.0	1.0	4.9	1.05	5.1	0.9	5.05	0.95	5.1
	Basic time (s)	0.90	4.89	0.94	4.79	0.99	4.9	0.8	4.70	0.85	4.95	0.8	4.75	0.95	4.65	0.94	4.84	0.9	4.79	0.85	4.84
O.D. grinding of OR (Quantity =5)	Element	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Rating (%)	90	95	100	95	90	95	90	95	95	95	95	95	90	95	100	95	95	95	90	95
	Obs.Time (s)	1.15	5.1	1.0	4.95	1.05	5.2	0.9	5.25	0.9	5.1	1.05	4.9	1.1	5.0	0.85	4.95	0.95	5.2	1.1	5.15
	Basic time (s)	1.03	4.84	1.0	4.70	0.94	4.9	0.9	4.98	0.9	4.84	0.85	4.33	0.99	4.45	0.85	4.70	0.90	4.95	0.99	4.89
Raceway grinding of IR (Quantity =5)	Element	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Rating (%)	95	95	90	95	90	95	90	95	100	95	100	95	95	95	95	95	95	95	90	95
	Obs.Time (s)	1.05	90.7	1.15	92.25	0.95	92.7	1.2	87.1	1.0	88.2	0.95	92.05	1.1	88.8	1.15	88.8	1.1	93.1	1.2	98.8
	Basic time (s)	0.99	86.2	1.03	87.6	0.85	88.1	1.08	82.79	1.0	83.7	0.95	87.44	1.04	84.3	1.09	84.4	1.04	88.4	1.08	93.9
Raceway grinding of OR (Quantity =5)	Element	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Rating (%)	90	95	95	95	100	95	95	95	90	95	100	95	90	95	95	95	95	95	95	95
	Obs.Time (s)	1.0	123.4	1.1	126.5	0.95	128.6	1.15	125.5	1.15	125.9	1.0	124.8	1.1	128.1	1.15	126.3	1.0	123.1	0.95	130.8
	Basic time (s)	0.90	117.2	1.04	120.2	0.95	122.	1.09	119.2	1.03	119.6	1.0	118.6	0.99	121.7	1.09	120	0.95	117	0.90	124.3
Bore grinding of IR (Quantity =5)	Element	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Rating (%)	90	90	95	90	95	90	100	90	95	90	90	90	95	90	100	90	90	90	95	90
	Obs.Time (s)	1.85	59.7	1.95	58.25	1.8	59.1	1.75	58.15	1.9	58.4	1.95	65.35	1.85	58.8	1.75	57.8	1.9	57.3	1.85	58.1
	Basic time (s)	1.66	53.7	1.85	82.42	1.71	53.2	1.75	52.33	1.8	52.6	1.75	58.81	1.75	52.9	1.75	52.1	1.71	51.6	1.75	52.2

Operation	Sample	01			02			03			04			05			06			07			08			09			10		
Super finishing of IR (Quantity =5)	Element	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
	Rating (%)	95	100	90	90	100	90	90	100	95	95	100	90	100	100	95	95	100	100	90	100	100	95	100	95	90	100	100	100	100	95
	Obs.Time (s)	25	71	12	30	68.1	13	30	72	11	27	7	14	26	66	12	28	68	13	30	67	11	30.6	68	14.1	31.8	66.9	12	26	68.7	12
	Basic time(s)	24	71	11	27.3	68.1	12	27	72	10	26	70	13	26	66	12	26	68	13	27	67	11	29.1	68.	13.4	28.6	66.9	12	26	68.7	11
Super finishing of OR (Quantity =5)	Element	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
	Rating (%)	90	100	95	90	100	100	100	100	95	95	100	90	90	100	95	95	100	90	100	100	90	95	100	90	100	100	95	90	100	100
	Obs.Time (s)	10	84	10	9.6	81.9	10	8.8	82	8.6	9	84	8.5	9.1	80	9	8.4	83	8.3	9.	84	8.8	8.15	82	9.0	10	80.8	9.8	9.2	81.2	9.7
	Basic time(s)	9.1	83	9	8.6	81.9	10	8.8	82	8.2	9	85	7.6	8.2	80.5	8.5	8.0	83	7.5	9	84	7.9	7.74	82	8.1	10	80.8	9.3	8.3	81.2	9.7

Table 2: Observed times and calculation of basic times of operations of bearing manufacturing line (continued)

Visual inspection of IR (Quantity =5)	Element	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
	Rating (%)	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
	Obs.Time (s)	1.8	9	1.2	1.5	9.5	1.2	1.4	9.5	1.3	1.4	8.5	1.2	1.4	9	1.2	1.5	9.5	1.3	1.5	9.5	1.2	1.4	8.5	1.3	1.1	8.5	1.3	1.5	9.5	1.2
	Basic time(s)	1.4	8.5	1.1	1.4	9.0	1.1	1.3	8.0	1.2	1.3	8.0	1.1	1.3	8.5	1.1	1.4	9.0	1.2	1.4	9.0	1.1	1.3	8.0	1.2	1.4	8.0	1.2	1.4	9.0	1.1
Visual inspection of OR (Quantity=5)	Element	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
	Rating (%)	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
	Obs.Time (s)	1.8	9.5	1.2	1.5	9	1.2	1.4	8.5	1.3	1.4	9.5	1.2	1.4	9	1.2	1.5	8.5	1.3	1.5	9	1.2	1.4	9.5	1.3	1.1	9.5	1.3	1.5	9	1.2
	Basic time(s)	1.4	9	1.1	1.4	8.5	1.1	1.3	8	1.2	1.3	9	1.4	1.3	8.5	1.1	1.4	8	1.2	1.4	8.5	1.1	1.3	9	1.2	1.4	9	1.2	1.4	8.5	1.1
Operation	Sample	01			02			03			04			05			06			07			08			09			10		
Demagnetisation of OR (Quantity =5)	Element	A			A			A			A			A			A			A			A			A			A		
	Rating (%)	95			95			95			95			95			95			95			95			95			95		
	Obs.Time (s)	12.4			12.1			11.9			12.1			11.8			11.9			12.2			12.0			11.8			11.8		
	Basic time(s)	11.7			11.5			11.3			11.5			11.2			11.3			11.6			11.4			11.2			11.2		
O.D. grinding of OR (Quantity =5)	Element	A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B	
	Rating (%)	90	95		100	95		90	95		90	95		95	95		95	95		90	95		100	95		95	95		90	95	
	Obs.Time (s)	1.1	5.1		1	4.9		1.05	5.2		0.95	5.25		0.9	5.1		1.05	4.9		1.1	5		0.85	4.9		0.95	5.2		1.1	5.1	
	Basic time(s)	1.03	4.84		1	4.70		0.94	4.9		0.94	4.98		0.90	4.8		0.85	4.33		0.99	4.45		0.85	4.70		0.90	4.95		0.99	4.89	
Operation	Sample	01			02			03			04			05			06			07			08			09			10		
Visual inspection of OR (Quantity =5)	Element	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
	Rating (%)	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
	Obs.Time (s)	1.8	9.5	1.2	1.5	9	1.2	1.4	8.5	1.3	1.4	9.5	1.2	1.4	9	1.2	1.5	8.5	1.3	1.5	9	1.2	1.4	9.5	1.3	1.1	9.5	1.3	1.5	9	1.2
	Basic time(s)	1.4	9.0	1.1	1.4	8.5	1.1	1.3	8.0	1.2	1.3	9.0	1.4	1.3	8.5	1.1	1.4	8.0	1.2	1.4	8.5	1.1	1.3	9.0	1.2	1.4	9.0	1.2	1.4	8.5	1.1
Operation	Sample	01			02			03			04			05			06			07			08			09			10		
Etching of OR (Quantity =5)	Element	A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B	
	Rating (%)	95	100		95	100		95	100		95	100		95	100		95	100		95	100		95	100		95	100		95	100	
	Obs.Time (s)	7.1	21.3		7.0	21.9		6.9	21.6		6.9	21.05		7.2	21.1		7.1	21.8		7	21.4		6.05	21.1		7.1	21.6		7.2	21.4	
	Basic time(s)	6.79	21.35		6.6	21.7		6.6	21.6		6.5	21.05		6.8	21.1		6.7	21.5		6.6	21.4		6.6	21.1		6.7	21.6		6.8	21.4	
Sorting of IR & OR (Quantity=5)	Element	A			A			A			A			A			A			A			A			A			A		
	Rating (%)	95			95			95			95			95			95			95			95			95			95		
	Obs.Time (s)	1.8			17.8			17.2			17.8			17.4			17.2			17.6			17.7			17.1			17.5		
	Basic time(sec)	17.09			16.9			16.3			16.4			16.5			16.3			16.7			16.8			16.2			16.6		
Ball matching (Quantity =5)	Element	A			A			A			A			A			A			A			A			A			A		
	Rating (%)	100			100			100			100			100			100			100			100			100			100		
	Obs.Time (s)	16.3			20.02			14.02			15.5			17.6			18.7			19.4			19.2			18.4			17.9		
	Basic time(s)	16.3			20.02			14.02			15.5			17.6			18.7			19.4			19.1			18.4			17.9		
Locating and Pressing (Quantity =5)	Element	A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B	
	Rating (%)	95	95		95	95		95	95		95	95		95	95		95	95		95	95		95	95		95	95		95	95	
	Obs.Time (s)	18.6	39.1		22.3	40.1		19.7	43.02		20.2	42.8		21.8	41.5		19.3	39.6		20.7	43.1		20.2	41.6		19.8	42.7		18.9	40.2	
	Basic time(s)	17.7	37.2		21.2	38.1		18.7	40.8		19.2	40.7		20.7	39.4		18.3	37.6		19.7	40.9		19.2	39.5		18.8	40.5		18	38.1	
Z-shield Pressing (Quantity =5)	Element	A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B		A	B	
	Rating (%)	95	95		95	95		95	95		95	95		95	95		95	95		95	95		95	95		95	95		95	95	
	Obs.Time (s)	19.1	14.8		17.8	13.8		19.5	15.1		18.5	13.6		19.2	14.2		17.9	14.06		18.6	13.7		19.6	14.1		18.7	15.04		19.5	14.9	
	Basic time(s)	18.2	13.5		16.9	13.1		18.5	14.3		17.6	12.9		18.2	13.5		17.05	13.3		17.7	13.09		18.6	13.4		17.8	14.2		18.5	14.2	

Table 3: Calculation of standard times of operations of bearing manufacturing line

Operation	Average Basic time of elements (S)			Total Basic time (S)	Fatigue allowance (S)	Contingency allowance (S)	Total work elements (S)	Personal needs allowance (S)	Relaxation allowance (S)	Standard time for 5 components (S)
	A	B	C							
Face grinding of IR	0.96	4.63	—	5.59	0.327	0.139	5.73	0.28	0.607	6.437
Face grinding of OR	0.93	5.28	—	6.21	0.371	0.155	6.37	0.318	0.689	7.061
O.D.grinding of IR	0.89	4.82	—	5.71	0.339	0.142	5.96	0.298	0.638	6.6
O.D.grinding of OR	1.01	4.72	—	5.73	0,343	0.143	5.87	0.293	0.636	6.509
Raceway grinding of IR	1.01	86.55	—	87.56	5.25	2.189	89.75	4.488	9.739	99.5
Raceway grinding of OR	0.99	120.0	—	120.99	7.34	3.02	124.01	6.2	13.54	137.55
Bore grinding of IR	1.75	53.2	—	54.95	3.298	1.37	56.32	2.896	6.194	62.514
Super finishing of IR	26.9	68.77	12.08	107.75	6.46	2.69	110.44	5.552	12.016	122.456
Super finishing of OR	8.71	82.4	8.67	99.8	5.987	2.495	102.295	5.11	11.097	113.392
Visual inspection of IR	1.41	8.55	1.20	11.15	0.669	0.278	11.435	0.57	1.239	12.774
Visual inspection of OR	1.41	8.64	1.20	11.252	0.674	0.28	11.532	0.576	1.25	12.782
Demagnetization of OR	11.285	—	—	11.285	0.682	0.284	11.669	0.583	1.266	12.935
O.D.grinding of OR	1.01	4.72	—	5.73	0.343	0.143	5.873	0.293	0.636	6.509
Visual inspection of OR	1.41	8.64	1.20	11.252	0.674	0.28	11.532	0.576	1.25	12.784
Etching of OR	6.72	21.39	—	28.118	1.68	0.7	28.818	1.44	3.12	31.93
Sorting of IR & OR	16.628	—	—	16.628	0.997	0.415	17.043	0.852	1.85	18.893
Ball matching	17.736	—	—	17.736	1.06	0.443	18.179	0.908	1.97	20.149
Locating and Pressing	19.19	39.33	—	58.526	3.511	2.36	60.886	3.044	6.555	67.441
Z-shield Pressing	17.94	13.60	—	31.551	1.892	0.788	32.34	1.617	3.509	35.849

Obs. time: Observed time; OR: Outer ring: IR: Inner ring;O.D: Outer diameter

Table 4: Inventory calculations

Operation		Standard time for 5 components : ST (S)	Components produced in 1 hour : CP = 3600 x 5 / ST	Company target (components) in 1 hour: CT	Standard time for 5 components as per company's target: STc (S)	Raw inventory (components) to be maintained or work-in-process inventory: (CT – CP) or (CP - CT)
Face grinding of IR		6.437	2796	4200	4.285	1404 (raw inventory)
Face grinding of OR		7.061	2549	3000	6.000	451 (raw inventory)
O.D.grinding of IR		6.6	2727	3800	4.736	1073 (raw inventory)
O.D.grinding of OR		6.509	2765	2800	4.736	1035 (raw inventory)
Raceway grinding of IR		99.5	181	270	66.67	89 (raw inventory)
Raceway grinding of OR		137.55	131	160	112.5	29 (raw inventory)
Bore grinding of IR		62.514	288	240	75.00	48 (work-in-process inventory)
Super finishing of IR		122.456	147	160	112.5	13 (raw inventory)
Super finishing of OR		113.392	159	160	112.5	01 (raw inventory)
Visual inspection of IR		12.774	1409	1500	12.00	91 (raw inventory)
Visual inspection of OR		12.782	1408	1500	12.00	92 (raw inventory)
Demagnetization of OR		12.935	1392	1500	12.00	108 (raw inventory)
O.D.grinding of OR		6.509	2765	3800	4.736	1035 (raw inventory)
Visual inspection of OR		12.784	1408	1500	12.00	92 (raw inventory)
Assembly	Etching of OR	(31.93 + 18.893 + 20.149 + 67.441 + 35.849) + 50 = (174.263) + 50 = 224.263	80	90	200	10 (bearings)
	Sorting of IR & OR					
	Ball matching					
	Locating and Pressing					
	Z-shield Pressing					
	Washing, Oiling, Noise checking, Carton packing					
Total		844	—	—	751	—

finishing and visual inspection, is 197.75 seconds. Also the total standard time for 5 components of outer ring, which includes times of super finishing, visual inspection, demagnetization, outer diameter grinding and visual inspection, is 158.39 seconds.

These operations are after raceway grinding of the inner and outer rings, and simultaneously performed. So their difference of 39.35 seconds, being idle, can be rectified by carrying out the process of etching of outer ring after the O.D. grinding of outer ring instead of performing it in the assembly section.

2) The company uses CNC machines for bore grinding of inner ring, raceway grinding of inner and outer rings, which made the process faster. In the same way, if the face grinding and outer diameters grinding of outer and inner rings are performed on CNC machines, the machining time can be reduced from 10 to 15 seconds.

Therefore, it is possible to reduce the total standard time for 5 bearings by 54 seconds so that the new standard time will be (844-54 =) 790 seconds. Then,

The number of bearings that can be produced as per the target time = (751 / 790) x 3780

= 3593 bearings.

Hence, the increase in production of bearings = 3593 – 3363 = 230 bearings.

Conclusions

The present case study on the radial ball bearing manufacturing line helps in increasing the total production

by making use of time study and inventory calculations, and by introducing small changes in manufacturing line as suggested in previous section. The production can further be increased by following the suggestions given below:

1) The use of material handling equipment like belt conveyors reduces the time in carrying the material from one machine to other, thus making the flow continuous. In case if the belt conveyors are considered to be costlier, large capacity trolleys instead of small trolleys, which are being used presently, may be used.

2) Twice or thrice in every month standard times at each machine are to be calculated in order to check whether the required target is reaching or not in accordance that the workers complete the job successfully within the required time.

References

Barnes. R. M., (1980). Motion and time study – Design and measurement of work, Seventh edition, John Wiley & sons.

Norton. R. L., (2009) Machine Design – An integrated approach, Second edition, Pearson education.

Starr. M. K. and Miller. D. W., (1986) Inventory control – Theory and Practice, Fourth printing, Prentice Hall of India private Ltd.

It is impossible to work in information technology without also engaging in social engineering.

—Jaron Lanier

Feature

Firm Level Performance of Indian Services Sector: A Malamquist Approach

SANDEEP KUMAR AND N.K. TANEJA

The services sector covers a wide range of activities from the most sophisticated information technology (IT) to simple services provided by the unorganized sector, such as the services of the barber and plumber. By using the non-parametric technique of DEA-type Malmquist index in this study, we measure the productivity changes for the Indian service sector from 1991-92 to 2010-11. This model helped us to isolate the contributions of technological change, efficiency change and scale change to productivity change in the industries. Thus, results for Malmquist Productivity Index (MPI) synthesis that Total factor Productivity Change (TFPCH) in aggregate for all the service sectors for nine sub-sectors have shown a productivity growth over the period and two sub period (1991-2000 and 2001-2011) of study. The foremost contributing factor as per decomposition is found out to be the technology innovations effect rather than technical efficiency change/catching up effect.

Sandeep Kumar is Research Associate, National Centre For Agricultural Economics and Policy Research, New Delhi and N. K. Taneja is Professor, Department of Economics, Ch. Charan Singh University, Campus Meerut.

The services sector covers a wide range of activities from the most sophisticated information technology (IT) to simple services provided by the unorganized sector, such as the services of the barber and plumber. National Accounts classification of the services sector incorporates trade, hotels, and restaurants; transport, storage, and communication; financing, insurance, real estate, and business services; and community, social, and personal services. In World Trade Organization (WTO) and Reserve Bank of India (RBI) classifications, construction is also included.

For the services sector Performance to successfully meet the objective of 56.6 per cent share for the services sector in GDP certain specific measures are required, some of which form part of India's overall development priorities and strategies. There are several policy measures, briefly discussed here, that would have to be pursued simultaneously. The share of services in India's GDP at factor cost (at current prices) increased from 33.5 per cent in 1950-5 to 55.1 per cent in 2010-11 and to 56.3 per cent in 2011-12 as per (AE) [Economy Survey, 2011-12].

The rate of services sector growth is determined by rate of expansion in productive resources employed in service and the rate of improvement in total factor productivity growth, i.e. the overall efficiency in the use of resources. Since there are constraints to resource expansion in developing countries, for a high rate of industrial growth to be achieved and sustained over a long period requires substantial improvement in total factor productivity growth. Empirical studies for developing countries have indicated that total factor productivity growth in an important source of industrial growth.

By using the non-parametric technique of DEA-type Malmquist index in this study, we measures the productivity changes for the Indian service sector from

1991-92 to 2010-11. This model helped us to isolate the contributions of technological change, efficiency change and scale change to productivity change in the industries. Thus, results for Malmquist Productivity Index (MPI) synthesis that Total factor Productivity Change (TFPCH) in aggregate for all the service sectors for nine sub-sectors have shown a productivity growth over the period and two sub period (1991-2000 and 2001-2011) of study. The foremost contributing factor as per decomposition is found out to be the technology innovations effect rather than technical efficiency change/catching up effect. All nine industries for each manufacturing and service sector confirm the productivity growth while adopting the technical change includes new production processes, called process innovation and the discovery of new products called product innovation. With process innovation, firms figure out more efficient ways of making existing products allowing output to grow at a faster rate than economic inputs are growing. The cost of production declines over time with process innovations, i.e. new ways of making things.

Review of Literature

Early studies on productivity are based on factor productivities such as labor productivity or capital productivity. Over the time, studies started to focus on TFP because it reflects the effectiveness of whole inputs as well as the technological change. The importance of the frontier approach arises from its availability to express TFP by the combination of several different components. Although there has been much theorizing on the impact of India's economic reforms of 1991 on Indian manufacturers, there is hardly any previous study that has taken up the task of actually asking the manufacturing firms as to what the true impact of economic reforms has been on them?.

India started undertaking major economic policy reforms from the year 1991. However, the question that arises is as to what has been the change in performance of firms that grew up in a highly protective economic environment prior to 1991? Several earlier studies have attempted to analyze the impact of the economic reforms of 1991 on the economy and industrial sector of India. In one of the earlier studies Nambiar et al. (1999) started from the expectation that trade liberalization "encourages economic activity and hence raises production and employment"; he then asked whether this was also true in the Indian case.

Kumar and Siddharthan (1994) analyzed the relationship between R&D expenditure and exports for a sample of 640 Indian firms and found R&D expenditure to be an important factor in low and medium technology industries, and concluded that India does not have a competitive advantage in high technology industries.

Sangeeta D Misra (2010) analyzed the relationship between industry advertising intensity and market structure using pooled data of 59 industries of the Indian consumer goods and services sector from 1999 to 2008. For this, a theoretical model had been developed which was an improvisation of Dorfman-Steiner's model (1954) and Lee's model (2002). The results of the theoretical model showed that sign of the relationship between industry advertising intensity and concentration depends upon whether the firms which enjoy high revenue market share are more advertising competent than the firms which are having low market share. The empirical results showed that there is a positive relationship between industry advertising intensity and market concentration in the Indian consumer goods and services sector. Further she found that for a given level of concentration, the industries which earn lower price-cost margins engage themselves more rigorously in advertising activity than the industries which earn higher price-cost margins.

U. S. Kambhampati and P. Kattuman (2003) analyzed the effects of increased trade exposure on the profitability of firms in Indian industry. An efficiency index is created to directly analysed the impact of changing efficiency levels on firm profit margins. Results indicated that liberalization significantly influenced profit margins. However, its main effect is through the impact that it has had on other firm variables–market shares, advertising, R&D and exports–all of which changed after 1991. While exports have had a pro-competitive effect on profit margins in the selected sample, AD and R&D both cause an increase in profit margins. It is also found that neither capital nor managerial capabilities (as proxied by remuneration) are particularly effective in increasing profit margins.

Uma Karmbhampati et.al (1997) investigated the labour market impact of the 1991 trade reforms in India using a detailed panel data set on firms in five different import competing industries. They found only a small and insignificant effect of the reforms on employment - overall and in each of the five import competing industries. Second, we investigate the relationship between labour demand and mark-ups and find that there is a significant negative relationship between mark-ups and the demand for labour-overall and in four of the five industries studied.

Using contemporary data for a firm-level sample of over 600 Indian firms, K. Chhibber and Sumit K. Majumdar

(1998) investigated the impact that an export-orientation has on the profitability of the firms studied. The results, based on a two-stage least squares method, establish a positive and significant relationship between firms' levels of exports and profitability. For firms from developing and transition economies like India it does pay to venture abroad, and the ability to sell goods overseas has a significant impact on firms' economic performance.

Using contemporary data for an extensive sample of 1020 Indian firms, Sumit K. Majumdar (1997) investigated the impacts that size and age of firms have on firm-level productivity and profitability. In India older firms are found to be more productive and less profitable, whereas the larger firms are, conversely, found to be more profitable and less productive. These performance differences are explained as arising from the market-restricting industrial policies that have been followed in India over the past three decades.

Data and Methodology

Firm level performance in services sector will be measured in the form of productivity growth in the present study. In the last two decades, the productivity growth measurement literature has been extended from the standard calculations of TFP employing production function framework towards more refined decomposition methods. To overcome the shortcomings of growth accounting approach and to identify the components of productivity change, techniques have been developed that are based on the decomposition of TFP index. A method of measuring productivity with growing popularity is the use of Malmquist index. After its use from a non-parametric perspective by Caves, Christensen and Diewert (1982), who developed it as a way of measuring output produced per unit of input, Fare, *et al.* (1994) went further and employed Shepherd output distance functions and a non-parametric linear programming approach to measure productivity change for OECD countries. We have use of secondary data from the Centre for Monitoring Indian Economy (CMIE), Reserve Bank India (RBI), Economic Survey, and Hand Book of Statistics on Indian Economy.

Malmquist Total Factor Productivity Index

Malmquist Total Factor Productivity (TFP) index is a nonparametric model, which is derived from Data Envelopment Analysis (DEA). Malmquist index model is based on Farrell (1957). It is developed further by Farrell and Field house (1962), Seitz (1970) and Afriat (1972). Fare et al. (1982), Banker et al. (1984) and Fare et al. (1985) showed how Farrell's technical efficiency measure will be decomposed into its components. They also showed the way of having information about scales of decision making units analyzed. Fare et al. (1994a and b) added time dimension to the model and as a result, it became possible to measure productivity change over time.

Let P(x) be the feasible production function that represents the set of all output vectors; y, that can be produced using a given input vector; x. Under the assumption of technology satisfies the axioms listed by Coelli et al. (1998, Chapter 3), the output distance function is defined as

$$Do(x,y) = \min\{\delta: (y/\delta) : \in P(x)\}$$

Do (x,y) cannot take a value greater than one if it is an element of feasible production function. If the output vector, y, is placed on the outer boundary of P(x) the distance function will be equal to 1. If the output vector, y, is placed outside the feasible P(x) the distance function will be greater than 1.

DEA Malmquist TFP index is used to calculate the ratio of the distances of each observation relative to the technology frontier and measure the TFP difference between two observations. The Data Envelopment Analysis (DEA) is a special mathematical linear programming model and test to assess efficiency and productivity. It allows the use of panel data to estimate changes in total factor productivity and breaking it down into two components, namely, technical change (TECHCH) and technical efficiency change (EFFCH).

The analysis in this article adopts the output-oriented approach of DEA-Malmquist to put greater weight on the expansion of output from a given amount of inputs. Therefore, TFP index is a ratio of the weighted aggregate output to weighted aggregate input. Input and output quantities of the industries are the set of data used to construct a piece-wise frontier over the data points. Efficiency measures are then calculated relative to this frontier that represents an efficient technology. The best practice industry determines the production frontier, that is, those that have the highest level of production given a level of economic inputs. Since many inputs are used, and shared outputs may be produced, the Malmquist approach was developed to combine inputs and outputs and then measure changes. The Malmquist index measures the total factor productivity change (TFPCH), between two data points over time, by calculating the ratio of distances of each data points relative to a common technology.

Fare *et al.* (1994) specify the Malmquist productivity change index as:

$$MI_0\,(y_s, x_s, y_t, x_t) = \left[\frac{D_t^s(y_t, x_t)}{D_s^s(y_s, x_s)} \times \frac{D_t^t(y_t, x_t)}{D_s^t(y_s, x_s)}\right]^{\frac{1}{2}} \quad (1)$$

y_s, x_s notion in the equation (1) represents the output produced by ith DMU during the period s and the input used by ith DMU during the period t, respectively.

The $D_t^s\,(y_t, x_t)$ term in equation (2) refers to the distance between the observation at the period t to the technology at the period s and $D_s^t\,(y_s, x_s)$ term represents the distance between the observations at the period s to the technology at the period t. If MTFP is greater than one it indicates an increase in the TFP change from period s to period t. A value of MTFP is less than one point to a decrease in the TFP change from period s to period t

$$MTFP_s^t(y_s, x_s, y_t, x_t) = \frac{D_t^t(y_t, x_t)}{D_s^s(y_s, x_s)}\left[\frac{D_t^s(y_t, x_t)}{D_s^s(y_s, x_s)} \times \frac{D_t^t(y_t, x_t)}{D_s^t(y_s, x_s)}\right]^{\frac{1}{2}} \quad (2)$$

The above equation represents the productivity of the production point (*xs,ys*) relative to the production point (*xt,yt*). This index uses period t technology and the other period s technology. TFP growth is the geometric mean of two output-based Malmquist-TFP indices from period t to period s. A value greater than one will indicate a positive TFP growth from period t to period s while a value lesser than one will indicate a decrease in TFP growth or performance relative to the previous year.

The Malmquist index of total factor productivity change (TFPCH) is the product of technical efficiency change (EFFCH) and technical change (TECHCH) as expressed (Cabanda, 2001):

$$\text{TFPCH} = \text{EFFCH} \times \text{TECHCH} \quad (3)$$

The Malmquist productivity change index, therefore, can be written as:

$$M_0\,(ys, xs, yt, xt) = \text{EFFCH} \times \text{TECHCH} \quad (4)$$

$$Technical\ Efficiency\ change(TEC): TEC_s^t = \frac{D_t^t(y_t, x_t)}{D_s^s(y_s, x_s)} \quad (5)$$

$$Technical\ change(TC): TC_s^t = \left[\frac{D_t^s(y_t, x_t)}{D_s^s(y_s, x_s)} \times \frac{D_t^t(y_t, x_t)}{D_s^t(y_s, x_s)}\right]^{\frac{1}{2}} \quad (6)$$

In equation (3), the first multiplier is technical efficiency change between period's s and t in the output oriented model described by Farrell (1957). It represents the ratio of the technical efficiency in periods to the technical efficiency in period t. The second multiplier in equation (4) corresponds to the technical change which is a geometric mean of the shift in the technology frontier between the periods s and periods t.

Furthermore, the efficiency change in (5) can be further decomposed into pure efficiency change (or efficiency change under VRS) and scale efficiency change.

$$Pure\ Efficiency\ Change\ (PEC): PEC_s^t = \frac{D_{t-VRS}^t(y_t, x_t)}{D_{s-VRS}^s(y_s, x_s)} \quad (7)$$

$$Scale\ Efficiency\ Change\ (SEC): SEC_s^t = \frac{D_t^t(y_t, x_t) \Big/ D_{t-VRS}^t(y_t, x_t)}{D_s^t(y_s, x_s) \Big/ D_{s-VRS}^t(y_s, x_s)} \quad (8)$$

Where, D_{VRS} denotes a distance function under variable return to scale (VRS) assumption.

Malmquist Productivity Index

Productivity improvement is regarded as a contributing factor to economic growth of a nation. The total factor productivity (TFP), as a measure of overall productivity, has been gaining recognition not only for its theoretical correctness but also for its peculiarity among policy makers and economic analysts. Growth of total factor productivity (TFP) provides society with an opportunity to increase the welfare of the society. Productivity growth is defined as the efficiency with which inputs are transformed into output in the production process (Van Den Berg, 2001). This study applies Malmquist Productivity Index (MPI) to measure Total Factor Productivity Growth (TFPG) and its sources using DEA Approach.

Table 1 present that the annual estimation demonstrates the TFPCH or productivity growth of all service sub-sector during the period of 21 years. It may be noted that the TFPG/TFPCH in the aggregate of all period the service sub-sector is 1.18 per cent over the period study, technology change has increased by 1.49 per cent but technical efficiency increased by 4.11 per cent. So it can be concluded that on an average the productivity growth of all services sub-sector is due to improvements in technical efficiency of catching up rather

Table 1: Year-wise Malmquist Index Summary of Service Sub-sector in Entire Phase of liberalization, during 1991-2011

Years	Technical Efficiency Change	Technical Change Efficiency	Pure Technical Change	Scale Efficiency Change	Total Factor Productivity (TFP) Change
1991	-	-	-	-	-
1992	1.00	0.85	0.98	1.02	0.84
1993	0.96	1.08	1.02	0.94	1.04
1994	0.93	1.14	0.87	1.06	1.05
1995	1.02	0.92	1.23	0.83	0.94
1996	1.12	0.81	1.00	1.12	0.91
1997	0.83	1.02	1.00	0.83	0.85
1998	1.21	1.06	1.00	1.21	1.28
1999	0.94	0.89	0.97	0.97	0.84
2000	1.30	0.71	1.01	1.29	0.92
2001	1.20	0.86	1.02	1.18	1.03
2002	1.33	0.77	1.00	1.33	1.03
2003	1.04	0.95	1.00	1.04	0.99
2004	0.95	1.03	1.00	0.95	0.97
2005	0.98	1.02	1.00	0.98	1.00
2006	0.74	1.23	0.99	0.75	0.91
2007	1.18	1.29	0.98	1.10	1.01
2008	1.08	1.20	1.03	1.05	1.20
2009	0.96	1.31	0.99	0.97	1.15
2010	1.03	0.89	1.02	1.01	0.91
2011	1.03	1.07	1.00	1.03	1.10
Mean	1.04	1.01	1.01	1.03	1.01

Source: Authors' calculation from the data compiled for Service firms in India

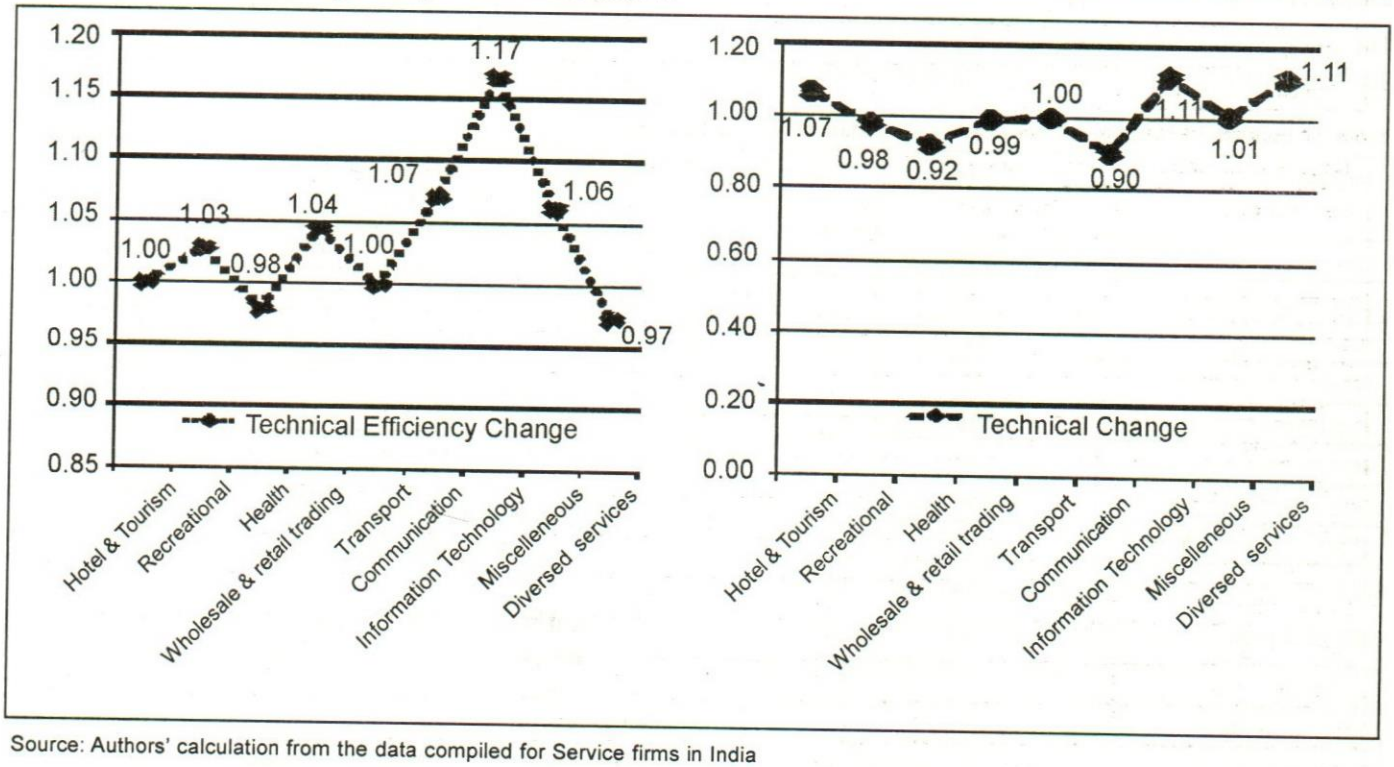
Table 1.1: Malmquist Index Summary of Service Sub-sector in Entire Phase of liberalization, during 1991-2011

Sub-sectors	Technical Efficiency change	Technical Change	Pure Technical Efficiency	Scale Efficiency Change	Total Factor Productivity (TEP) Change
Hotel & Tourism	1.00	1.07	1.03	0.99	1.00
Recreational	1.03	0.98	1.01	1.02	0.98
Health	0.98	0.92	1.00	0.98	0.87
Wholesale &	1.04	0.99	1.00	1.05	0.98
retail trading					
Transport	1.00	1.00	1.00	1.00	0.98
Communication	1.07	0.90	1.00	1.07	0.95
Information	1.17	1.11	1.00	1.17	1.24
technology					
Miscellaneous	1.06	1.01	1.00	1.06	1.05
Diversified	0.97	1.11	1.00	0.97	1.07
Mean	1.04	1.01	1.01	1.03	1.01

Source: Authors' calculation from the data compiled for Service firms in India

than technical change or innovations effect. Table 1.1 explains that productivity growth during 1991-2011 for all Service industries is observed in 1993, 1994, 1998, 2001, 2002, 2007, 2008, 2009 and 2011 during others years decline has been exhibited. The most significant factors behind the improvement in productivity in the years 1992, 1994 and 2009 are technology change or innovation effects. But during the year 2001 and 2002 it is the technical efficiency or catching up effect, whereas, during 1998, 2007, 2008 and 2011 it is both the catching up / technical efficiency change and technology innovations that contributed towards positive TFPCH. The regress in productivity in rest of the years can be giving less importance to efficiency and technologies. As per decomposition of technical efficiency, there is presence of PECH in years 1993, the presence of SECH 1994, 1998, 2002 and 2007, whereas the presence of both SECH and PECH in year 2000, 2001 and 2008 correspondingly.

Table 1 demonstrates the overall productivity growth of all service sub-sectors over the 1991-2011 periods of 21 years. Turning to the sub-sector wise analysis, table 1 demonstrates average estimates of value of malmquist productivity index alongwith those obtained from decomposition. The result reveals that all the nine sub-sector have recorded productivity growth over the year. The TFPCH has increased by 23.84 per cent in Information technology industry followed by Miscellaneous industry (5.07 per cent) and Diversified industry (7.06 per cent), however, in case of Hotel & Tourism (-0.17 per cent), Recreational industry (-1.60 per cent), Health industry (-13.08 per cent), Wholesale & retail trading industry (-1.95 per cent), Transport industry (-2.43 per cent) and Communication industry (-5.38 per cent) although there is presence of productivity growth but the negative rate of growth is very low. As per the decomposition of TFPCH, the growth of Information technology industry and Diversified industry is depicted due to technology change / innovation effects; but the growth of miscellaneous industry is depicted due to technical efficiency change / catching up effect. So it can be concluded that on an average the productivity growth of all service industries is due to improvements in technical change or innovations effect rather than technical efficiency of catching up. As Technical Efficiency Change (EFFCH) is further decomposed into Scale Efficiency Change (SECH) and Pure Technical Efficiency Change (PECH), scale efficiency indicates whether the firm can increase its productivity by becoming larger. The positive value of the scale efficiency suggests that the manufacturing industry has succeeded in taking advantage of the growth in size of the industry, while the improvement in pure technical efficiency change suggests that there will be a learning process adopted by the



Source: Authors' calculation from the data compiled for Service firms in India

Figure.1: Mean Technical Efficiency Change and Technical Change of Service Sub-sector in Entire Phase of liberalization, during 1991-2011

manufacturing industry as predicted by theories of intra-firm diffusion (Kalirajan and Shand, 2001). Thus, the results from the table conclude that there is presence of SECH in Information technology industry and miscellaneous industry units.

Figure 1 shows that the mean score of technical efficiency change (TE) and technical change (TC) for all service sub-sectors; the mean TE score for Hotel & Tourism service is 0.02 per cent; Recreational service is 2.79 per cent; Health service is -2.06 per cent; Wholesale & retail trading service is 4.41 per cent; Transport service industry is -0.09 per cent; Communication service is 7.08 per cent; Information technology service is 16.71 per cent; Miscellaneous service is 6.25 per cent and for Diversified service it comes out to be -2.68 per cent. The mean technical change (TC) score for Hotel & Tourism service is 6.64 per cent; Recreational service is -2.19 per cent; Health service is -7.81 per cent; Wholesale & retail trading service is -0.81 per cent; Transport service industry is -0.18 per cent; Communication service is -9.96 per cent; Information technology service is 11.42 per cent; Miscellaneous service is 0.64 per cent and for Diversified service it comes out to be 11.19 per cent. The level of TE implies that around 3.60 per cent and TC is 0.99 per cent.

Empirical Results

The descriptive statistics of the full sample from 1991 to 2011 is given in Table 2. The descriptive statistics of the selected variables are given in Table 2. As discussed earlier, the objective of this chapter is to analyze the relationship among openness, raw materials intensity, energy intensity, advertising intensity, profit margin, market share, investment intensity and total factor productivity change for the Indian services sector using pooled data of nine sub-sectors of the Indian services sector from 1991 to 2011.

An analysis of the statistics of the key variables shown in Table 2 show that on an average the industries of the all Indian services sector spend 11.26 per cent of their total sales on raw materials, 4.64 per cent on energy, 3.06 per cent on advertising and 18.34 per cent on investment. The results further show that there is large variation in openness, raw materials, investment, market share and profit margin in the Indian services sector. There are a few industries in the Indian services sector which spend around 47.40 per cent of their total sales on raw materials and 21.08 per cent on energy. The standard deviation of raw materials intensity of industries of the Indian services sector is 11.28 per cent and 19.11 per cent is investment intensity. The mean total factor productivity growth lies at 1.01 with a maximum value of 3.22.

Table 3 presents the correlation matrix of the selected variables which affects the extent of total factor productivity growth in Indian services sector firms. All variables are positively related with total factor productivity growth. Market share variable have a low relationship with

Table 2: Estimation Results of descriptive statistics of All Service Sector

Variables	Mean	Standard Error	Median	Standard Deviation	Minimum	Maximum
Openness	23.84	1.40	19.15	18.81	0.50	93.99
Raw materials Intensity	11.26	0.84	6.26	11.28	0.12	47.40
Energy Intensity	4.64	0.37	3.01	4.95	0.09	21.08
Advertising Intensity	3.06	0.16	2.80	2.10	0.07	10.74
Profit Margin	11.70	0.64	10.78	8.57	4.55	54.18
Market Share	10.83	0.98	7.24	13.21	0.63	61.36
Investments Intensity	18.34	1.42	10.64	19.11	0.95	89.64
TFPG	1.01	0.03	0.92	0.43	0.14	3.22

Source: Authors' calculation from the compiled foe all services firms in India.

total factor productivity growth. Values of 'r' are strongest in case of profit margin and investment intensity. Some of the selected variables are correlated. The correlation coefficients between total factor productivity growth and openness, raw materials intensity, energy intensity, advertising intensity, profit margin, market share and investment intensity of the firm are turned out to be positive. Hence, we can assume that a positive change in the total factor productivity growth will turn out to positively relate the above variables and there is a unidirectional relationship between the total factor productivity growth and the other variables.

Table 3: Estimation Results of Correlation Coefficients between Different Explanatory Variables of Services Sector (Pearson Correlation, Sig. (2-tailed))

Variables	Openness	RMI	EI	AI	PI	MS	II	TFPG
Openness	1.000							
RMI	-.405** .000	1.000						
EI	.298** .000	-.048 .520	1.000					
AI	.273** .000	-.103 .167	.191* .010	1.000				
PI	.154* .039	.098 .189	.219** .003	.275** .000	1.000			
MS	.028 .709	-.128 .086	.078 .296	.432** .000	.310** .000	1.000		
II	.045 .546	.052 .491	-.036 .635	.540** .000	.285** .000	.402** .000	1.000	
TFPG	.237** .001	.283** .000	.128 .086	.322** .000	.352** .000	.050 .502	.205** .006	1.000

**. Correlation is significant at the 0.01 level

*. Correlation is significant at the 0.05 level. List wise N=180.

Source: Authors' calculation from the compiled foe all manufacturing firms in India.

Table 4: Definition of variables used in the study

Sl. No.	Symbol	Variables	Definition
1.	O	Openness	Openness intensity is defined as the ratio of the total export+import to gross value added.
2.	RMI	Raw materials Intensity	Ratio of the total raw materials exp. to total sales.
3.	EI	Energy Intensity	Ratio of the total energy exp. to total sales.
4.	AI	Advertising Intensity	Ratio of the total advertising expenses to total sales.
5.	PI	Profit Intensity	Ratio of the total profit after tax to total sales.
6.	MS	Market Share	Ratio of the sales of sub-sector to total sales of sector.
7.	I	Investments Intensity	Ratio of the total investment to total sales.
8.	TFPG	Total Factor Productivity Growth	The dependent variable used for the total factor productivity change which is measured by the malamquist index.

Regression Results of Services Sectors

The results of regression model of entire period of liberalization (1992-2011), for all services firms are presented in Table 5. It is observed that the coefficients of openness, raw materials, advertising and profit are statistically significant at 1 per cent level of significant. Thus, thesis variables positively influence the total factor productivity growth of Indian services firms and it can be concluded that with the increase in the openness, raw material, advertising and profit are screening positive influence on the total factor productivity growth. While for all other factors the results are proved to be statistically insignificant in the model. So, energy intensity, market share and investment do not seem to affect the level of total factor productivity growth for all the Indian services sector firms considered together. Thus, Pant (1993), Export-Import Bank of India (1996), and Dholakia and Kapur (1999) find a positive influence but Siddharthan (1989) and Patibandla (1992) find a negative relationship between import intensity and firm level export performance in India.

Conclusions

India's services sector has been resilient even during the tumultuous years of the global economic crisis maintaining a steady growth of around 10 per cent. This happened

Table 5: Estimation Results of Regression Model of All Services sector (Entire period of Liberalization, 1992 to 2011)

Variables	Coefficients	Standard Error	t-value	p-value
Dependent	Total Factor Productivity Growth (TFPG)			
Constant	0.429*	0.072	5.923	0.000
Openness	0.007*	0.002	4.136	0.000
Raw materials Intensity	0.015*	0.003	5.639	0.000
Energy Intensity	-0.006	0.006	-0.926	0.356
Advertising Intensity	0.056*	0.017	3.340	0.001
Profit Margin	0.012*	0.003	3.435	0.001
Market Share	-0.003	0.002	-1.296	0.197
Investments Intensity	0.000	0.002	-0.132	0.895
R Square	0.34			
Adjusted R Square	0.31			
Observations	180			

Note: * Statistically significant at 1 per cent level of significant.
Source: Authors' calculation from the compiled foe all manufacturing firms in India.

even when overall GDP growth dipped sharply to 6.7 per cent in 2008-09. A dissection of the growth rates of different services shows that this resilience was, to some degree, due to the government's policies of higher social expenditure and commitments for pay arrears under the new revised scale for government employees resulting in very high growth rates of 12.5 per cent and 12.0 per cent in community, social, and personal services in 2008-09 and 2009-10. This dominant sector in terms of both shares and growth is a growth engine not only for the national economy but also for many states. It is second only to agriculture in terms of employment both in the national economy and in the majority of states. Unlike the unskilled or semi-skilled nature of jobs in the agriculture sector, this sector provides myriad job opportunities ranging from highly skilled to unskilled in a variety of activities. Hence, services along with a revival in manufacturing activity, can be major drivers of overall employment. Unlike the merchandise sector, the services sector is a net foreign exchange earner with exports of some services growing exponentially. It is also the major FDI-attracting sector with the five services topping the list of sectors attracting FDI to the country. Thus India's services sector is like an uncharted sea with plenty of opportunities and also new challenges.

The first challenge is to not only maintain the present growth tempo in the service sector but also to accelerate it. The second challenge is to make some of the fair-weather services like business and financial services more stable and less vulnerable to external shocks. While these sectors cannot be fully insulated from external shocks in this highly globalized world, efforts are needed to make them at least as stable as software and telecom services.

This brings us to the third challenge of domestic regulations in most of these sectors. While in the WTO, India has been at the forefront of negotiations for removal of such regulations in other countries, we also have to take a lead in making regulatory improvements domestically as such regulations could come in the way of further growth of the services sector. Addressing data problems in the services sector is another area where there is need for early consolidation of isolated efforts. Addressing the challenges of the diverse sub-sectors of the services sector by better and coordinated strategies can lead to exponential gains for the economy.

References

Ahluwalia, M. S. (2002). "Economic Reforms in India Since 1991: Has Gradualism Worked?" *Journal of Economic Perspectives*, Vol. 16, No. 3, pp. 67-88.

Caves, D. W., L.R. Christensen, and W.E. Diewert (1982). "The Economic Theory of Index Numbers and the Measurement of Input, Output and Productivity", *Econometrical*, Vol. 50, No. 6, pp. 1393-1414.

Dholakia, R.H. and Kapur, D. (1999). "Trade, Technology and Wage Effects of the Economic Policy Reforms on the Indian Private Corporate Sector", *The Indian Journal of Labour Economics*, Vol. 42, No. 4, pp. 981-992.

Economic survey 2004-2005, (http:/indiabudget.nic.in)

Export–Import Bank of India (1996). "Export and Import Performance: A Firm Level Survey of Companies assisted by Exim Bank – 1992-1995", Occasional Paper No. 45(OP45), March 1996

Fare, R., *et.al.*, (1994). "Productivity Growth, Technical Progress, and Efficiency Change in Industrialised Countries" *American Economic Review*, Vol. 84, No. 1, pp. 66-83.

Pant, Manoj (1993). "Export Performance, Transnational Corporations and the Manufacturing Sector: A Case Study of India", *Indian Economic Review*, Vol. XXVIII, No. 1, pp. 41-54.

Papola, T.S. (2005). http://www.rbidocs.rbi.org.in/

Patibandla (1992). "Scale Economies and Exports in an Import Substituting Regime – Some Observations for Indian Industry", *Economic and Political Weekly*, Vol. XXVII, No. 9, February 29, pp. M-24 to M-30

Rashmi Banga, (2004). "Impact of Japanese and US FDI on Productivity Growth: A Firm-Level Analysis", *Economic and Political Weekly,* January 31, 2004

Siddharthan, N.S. (1989). "*Impact of Import Liberalization on Export Intensities: A Study of the Indian Private Corporate Sector*", The Indian Economic Journal, Vol. 37, October-December, 1989,pp.103-111.

Kleijweg, A., Leeuwen, G., Van, H.R. and Zeelenberg, K. (1989). "*The demand for energy in Dutch manufacturing; a study using panel data of individual firms, 1978–1986*", Research Paper 8906, Research Institute for Small and Medium-sized Business in the Netherlands, Department of Fundamental Research, The Netherlands

Kumar, N. and N.S. Siddharthan, (1994). "Technology, Firm Size and Export Behavior in Developing-Countries - The Case of Indian Enterprises", *Journal of Development Studies,* 31, 289-309

Nambiar, R.G., B.L. Mungekar, G.A. Tadas, (1999). "Is Import Liberalisation Hurting Domestic Industry and Employment?", *Economic and Political Weekly*, February, p. 417-424.

Uma S. Kambhampati, (2003). "Trade Reforms and the Efficiency of Firms in India", *Oxford Development Studies*, Volume 31, Issue 2, pp 219-233

Kambhampati,U.S., Krishna,P., and Mitra,D., (1997). "The Impact of Trade Policy Reforms on Labour Markets: Evidence from India", *Journal of International Trade and Economic Development*, Vol.6, No.2, pp.287-297

Knowledge is not simply another commodity. On the contrary. Knowledge is never used up. It increases by diffusion and grows by dispersion.

—Daniel J. Boorstin

Feature

Perspective

Poor Management Research in the India: Time for Collective Responsibility

ARINDAM BANERJEE

The article acknowledges the fact that developing nations such as India may have challenges in allocating public funds for academic research, given that there are many primary requirements that need to be met for its citizens. However, it emphasizes that the problem may just not be centred on the lack of adequate funding.

The paper points to some historic reasons for poor productivity in research including, a) unproductive competition among institutions due to a false sense of self sufficiency, b) lack of adequate research infrastructure at the individual institution level together with the, c) long standing thinking in India that has considered teaching to be the core activity in our University system. It emphasizes the need for collaborative action across institutions that by themselves do not have the wherewithal to upgrade the quality of research. It also stresses the need to build specialized competence in individual faculty members to strive for excellence in a core academic activity, be it research, teaching or executive training and administration. The traditional view of a faculty being a superior performer in all aspects of academics may not yield the results needed to attain global standards of excellence. Like teaching, research requires a separate and detailed agenda in the Higher Education Policy.

Arindam Banerjee is a Professor at the Indian Institute of Management, Ahmedabad.

The enormity of size together with India's heterogeneity in many aspects of development throws contradictory challenges that need to be addressed many times by the same public institution. It is no different in the Higher Education realm of the country, particularly in the institutions set up by the government. Research productivity appears to be a topic of intense discussion in recent times and has gained prominence especially when the global positioning of India on the value addition cycle appears to be weak. However, it is an obvious fact that developing nations such as India have fewer resources to deploy for its plethora of development priorities and hence there can be issues related to satisfying its disparate priorities. For instance, priorities in the education sector can be related to increasing literacy level, to up skilling our vast lowly qualified work force to educating more scientists and professionals to allocating resources for research. It is unclear what may be the true balance that is needed to satisfy the myriads of segments of constituencies in different stages of the development cycle and hence differing in expectations from the same social institutions.

For instance, with the introduction of many new business schools set up by the government in the country, the scope of quality business education in the country has significantly enhanced with the consequent capacity expansion. However, what may have been compromised in the short term is the need for more quality faculty to deliver the education in these new institutions as well as the ability of the limited number of faculty members already present to have a balanced academic life with a healthy mix of teaching, research, consultancy and administrative responsibilities. Like many other instance, shortages have forced imbalances in the work portfolio with sub-optimal outcomes. Be that as it may, this paper focusses on the live issue of research in the context of business schools

in India and their current quality of output. The paper attempts to unravel some of the factors that have influenced the quality of research activities at business schools in India and what may be the opportunities to improvement, irrespective of the investment made (availability of resources) in this venture.

The rest of the paper is divided in the following sections. The next section traces the origins of modern management research followed by a section on the key facilitators of academic research globally. The latter part of the section focusses on the current situation in the Indian context and the factors that may be impeding the progress in this domain. Finally in Section 3, the paper provides some leads into what may be appropriate ways apart from funding to accelerate the establishment of a quality research climate in the context of the business schools in India.

The Modern Origin of Management Research

Formal and theoretical research in management has evolved fairly recently, in the past 60-70 years, although traces of its existence can be found in military epics in history (Johnson and Breckon, 2007). Modern management theory owes its genesis to the more fundamental stream of social science which has been researching on the world's most intriguing entity for centuries – the human being. However, the true fillip to this interdisciplinary science was provided in the post War phase, when ravaged western economies required multi-faceted help to rebuild their fortunes (Baalen and Karsten, 2012).

Given its nascent status in the evolutionary process, and its multi-disciplinary approach, the stream of management research has significant entrenchments in the practice environment of business and industry, borrowing handsomely from the definitely more evolved streams of Economics, Psychology and Statistics / Operations Research.

Not surprisingly, the realm of management research is today facing an increasing challenge of balancing the requirements of practice as well as building rigor into the enquiry process by increasing specialization and fragmentation (Klein, 1990). This has spawned some very significant strides in terms of research papers, models, theories and propositions, though the discipline remain still strongly associated through the umbilical connection with the mother science, the realm of the social behaviour.

Academic Research in Management: Some Crucial Facilitators

This evolutionary track in a practice cum theory dominated environment has not come without the generous support from various stakeholders. The domain of practice has significantly contributed in many ways to ensure an environment that produces cutting edge research. Interestingly, many of the theory building exercises today do not have direct relevance to the practicing world. That has thankfully not diluted the interest that practitioners have for academic output. They hope that some day or, at an appropriate time, the knowledge will trickle down to practice with big impact.

It is therefore not surprising to find that a majority of the globally recognized publications in management theory emanate from the North American and some European universities (Tsui, 2004). Financial support for academic research in terms of business school grants provided by industry and government help foster a healthy climate of rigorous enquiry process that ensure the best of standards in scientific research being conducted. This is complemented by an effective rewards and recognition and compensation system that encourages organized and high level of enquiry in an evolved research environment. A lot has already been discussed about this process in many forums.

The formation of research alliances through the setting up of research bodies such as the INFORMS / Marketing Science Institute, the Operations Research Society of America, the Academy of Management and the likes are adequate evidence of the symbiotic relationship that exists between industry and academia to promote academic research of top quality.

As an illustration, a top quality research journal in the United States would either be administered by an academic institution of repute or, one of these research bodies and in a sense with the tacit support of the industry.

The Case of Management Research in India

Let me turn the spotlight on India, which is the subject matter of this article. A lot has been commented on India's growth story in the past 10-15 years. Surprisingly though, among the BRICS nations, India stands out as one that is lagging behind significantly on research and innovation and academic productivity. Not one of its universities or academic institutions of repute show up in the QS[1] and THE[2] rankings of Top 200 universities globally. Naturally, this is a matter of extreme concern for the long term

[1]Quacquarelli Symonds

[2]Times Higher Education

sustenance of the growth story of our country. It is perhaps necessary to delve into the complexity of low productivity in academics in India. But like many other niggling issues in India, a "broad brush" approach at finding a resolution to this problem may not prove to be very effective.

The health of the Indian academic environment is perceived in varied ways. What is agreed upon though by many experts and policy makers is that the investment of time and resources in pure research should increase by leaps and bounds. However it is unclear to many, including myself, as to what may kick start a sustainable climate for research.I must qualify my earlier assertion by stating that management research as a serious academic activity is not alien to the academic environment in India. Historically, research has remained an individual pursuit in our university system that was recognized largely for promotional considerations though with non-existent standards set on the dimensions of quality of output. In fact, the occasional spark of brilliance that appears in our academic research work is largely due to such individual dedication and not driven by any account, due to a systematic policy towards facilitating such quality endeavours.

In recent times, these perceptions may be changing just a bit. The establishment of a formal Performance Management System (PMS) in many institutions which highlight the importance of research output as an element of measured faculty productivity seem to support such a shift in priorities. However, the debate on "what" and "how" to research in management remains largely unresolved. I will turn the attention of the reader to these two important dimensions.

At a recent colloquia on the "State of Management Research in India"(Khatri et al., 2012), contributors provided mixed views on the priorities to be set for academic research in India. While a section of academia strongly believes that the priorities need to be specific to the requirements of the Indian environment and should not merely "ape" the western model of publications, there was also enough arguments to the contrary - that the Indian model of academic research should not and, need not be exclusive and insulated from similar pursuits elsewhere in the world. What was agreed upon by many is the requirement to set up institutions such as the Indian Academy of Management that may provide a pan India academic-industry coordination council to stimulate research infrastructure in the country.

While it is a good idea to have an overseeing body that both facilitates and lends direction, what may be really critical to initiate change are more unit level enhancements in the focus on research at the academic institutions. An overarching body such as the Academy of Management can help in providing a scaled development of shared infrastructure across institutions with identified strengths. At the same time individual institutes should recognize the necessity to complement their resources with that available at other institutions.

Interestingly, a review of the spending on research activities at a representative academic institute will typically reveal[3] that a very large proportion of money was being spent over multiple years on two major Heads that have, at best, a secondary association with research – 1) expense to hire a research assistant and, 2) expense on travel. While both these may be somewhat relevant for conducting good quality research, typically high spending on two seemingly peripheral areas of a conventional research process raises questions about the nature and, at times, the quality of research that gets done in this environment. Part of this "polarized" spending habit on supposedly specific research inputs can be attributed to the lack of measurability of the quality. However, to be fair to the researchers, skewed research investments of this nature may also reflect the type (and content) of research that they embark upon. For instance, high incidences of case writing and macro-technical reports using published data that may require extensive literature search to done by assistants and as a result the research grants are largely used to address the hiring cost of requisite staff. My hunch is that lack of other portent research tools and facilitators that may also be a reason for limited scope of work that can be realized in this milieu.

To cite an example of such a limitation, let me describe a facet of the typical empirical research work that is conducted in India. This research area lacks either, a) infrastructure to collect data on large scale or, b) the network across institutions to make available syndicated microscopic (unit level) data or other such inputs for academic research. The true problem is actually a mix of both these dimensions. Given the enormous potential that unit level data provides to empirically study management phenomenon at a great degree of detail, it is unfortunate that it remains inaccessible to many researchers.

It is not entirely appropriate to say that there is zero availability of this type of data in India. Certain governmental agencies and others in the private sector have steadily built their own collection infrastructure over the years to

[3]Based on primary data analysis

compile large scale cross sectional and time series information that capture the enormous details regarding the Indian markets and society of significant use to the realm of academic enquiry. The complication is that such expertise in data collection has not been fully complemented by powerful analytics that can expose important insights about the Indian environment.

Part of the reason for this incompleteness in the intellectual prowess has been in the gap between objective of such massive data gathering initiatives and our understanding about their true potential to provide insights. Hence, many organizations in the business of large data collection have mainly focussed on reporting aggregated level facts and figures pertaining to the economic, social and cultural landscape of the country[4]. While motivation seems to be a key driver in this pursuit, I also suspect that many institutions with large scaled data bases may lack sufficient analytical capabilities to truly mine the data to reveal deeper level insights that may be worthy of a superior academic venture. At the same time, other research organizations that may possess the capability to conduct deeper analyses may find such data resources unavailable to them.

Needless to say, the evolution of better academic enquiry may be somewhat stifled by such skewed capabilities across our research institutions. This asymmetry in ownership of potentially useful databases and, analytical capabilities/motivation for mining such databases has given rise to a challenging situation. While the research climate in India was never evolved in terms of fostering collaborative ventures, it has been difficult to forge academic tie-ups across institutions that have varying degrees of capabilities to do research. Even in the case of the IIMs, collaborative research programs have largely remained in the cold storage in spite of it being discussed actively in various pan-IIM forums. For that matter, a suggestion to offer doctoral level coursework to research students across all IIMs has, to the best of our knowledge, yet to take off in spite of its widespread support.

What is instead available in the public domain in the form of data for consumption are macro level or aggregated indices that are computed from such data repository by commercial enterprises which are available on purchase. The less commercially savvy enterprises such as the governmental agencies publish their own reports for mass consumption or, if they do share the data, it is done informally. Formal institution-wide collaborations for sharing research inventory of any kind are still in the planning stage.

[4]I will include the NSSO, CMIE and NCAER in this category of institutions.

Other Factors Impeding Superior Research in India

Traditional Focus on Business Education and Research

Building research infrastructure is a topical challenge facing the management academia in India. A probable reason for the lack of rapid development of research infrastructure at premier institutes may be attributable to the original tenet which led to the initiation of business education in India. Then, it was largely driven by the requirement of the vocation with the predominant view being that apprentices should be provided with skills to equip them for the practice world. Inevitably, the enquiry process was centred more about achieving practice excellence rather than developing theoretical rationale of the management phenomenon. That may well have served the purpose of these institutions then and perhaps even now, except that with the globalization and opening up of the education market, the benchmark set for attaining global standards are somewhat different than what were back when these institutions were conceived.

It is important to emphasize at this stage that the research agenda need not force academicians to choose one of the many paths. The mission of resolving problems of practice in the local environment will remain important for India-based business schools. However, that should not preclude these institutions from finding resolutions to more fundamental problems of management science that require newer theoretical constructs with universal appeal.

The competitive dimension of the Indian Business school

There is an additional element that stymies collaboration among Indian Business schools – competitiveness. When it comes to rankings of their PGP/MBA programs, there is a certain aggressive competition which should certainly not be derided. However, the competitiveness tends to get drawn in many unnecessary areas and, may have also stalled the process of building cross-institutionally networked research. Instead, what may have been created are unhealthy tussles in areas where these institutions are hardly self-sufficient. Whereas, resource sharing and joint initiatives could have mitigated this problem to an extent, we find an amazing redundancy of limited resources across institutions who are unwilling to cooperate or, not knowing how to cooperate. How else can one explain the fact that each of these premier institutes has its own research journal and conference to boast, which attracts many researchers from various schools, but surprisingly there is still little recorded interaction or cross pollination

among researchers associated with these institutions. A possible consequence of such behaviour is that many of these publications and conferences become seemingly the mascots of their respective institutions, fostering similar (to the MBA program) but unproductive competition.

Therefore, whereas the need for collaboration in building research infrastructure is critical, in reality the marginal investment in research infrastructure is seemingly consigned to unsustainable competition among various business schools.

What may be addressed to improve collaborative research climate

For starters, collaborative attempts are needed desperately in this nascent setting. It may not be about the lack of motivation alone that prevents us from a productive collaboration. Historically, there are very few pointers to provide guidance on collaborative initiatives amongst the top business schools other than perhaps conducting the admission examination (CAT). There is also the predominant view that research has to be individual driven and that collective initiatives have very little role to play in this pursuit.This is a reason why internal academic planning processes have been largely focused on the teaching dimension and the research has been left to individual pursuits. Here are some strong perceptions that support this hypothesis:

Many institutions have started their own conferences and journals for publishing articles. But for a majority of these institutions the driver for such activity has been the regulatory body (AICTE or UGC) asking for allocation of budgets to conferences and publications. There is hardly any mechanism to determine the quality of the output. For instance, India's 4000 plus B-schools published altogether 36 papers in journals tracked by UT Dallas between 2009 and 2012[5]. In the bargain, they remain symbols of achievements only on paper for many B-schools and have no significant impact on academics or industry. As mentioned earlier, there is the need to look at an academia–industry supported body that facilitates the appropriate forum for creation and dissemination of knowledge.

Exchange of training and research activities under the FPM and doctoral programs across business schools is limited if not non-existent. Hopefully, the recent initiatives of the MHRD to create a pan IIM venture would help in cementing these relationships in the long run.

There are no major standards organization other than the AICTE and the UGC to monitor the quality and standards of the research programs in the Higher Education sector in Management. There has been a debate about the efficacy of the standards that are being implemented in spite of the elaborate and detailed reviews conducted by these agencies. Perhaps, a review of the standards set for higher education in the management stream is overdue.

Faculty compensation structures are not aligned to incentivize research given that there are less costly options available to faculty to enhance their compensation. Since comparable salaries in the industry are much higher than academia, there is an obvious motivation to look for other permissible and lucrative opportunities to enhance pay. The fact of the matter is that research being a long duration venture cannot be incentivized by the standard short term performance driven incentives which are applicable in the corporate sector. Rather it may require better pay structures to attract talent who are subjected to appropriate tenure based evaluation processes to maintain high level of motivation towards conducting research. Unfortunately, this issue has largely being left in the cold storage for long in spite of it being debated now and again in various management forums.

Lately, there has been some talk about getting high quality researchers at higher pay bands from overseas institutions. However, what may be sustainable in the long run would be to institutionalize higher pay for certain higher level of accountabilities in academic work (such as global quality research) and to introduce a process of regular evaluation of performance against expectations, in the same lines as the tenure system in US universities. The Planning Commission's twelfth Five Year Plan on Higher Education recognizes the role played by the some schools such as the ISB, Hyderabad in achieving higher quality research publication among the Indian B-schools. Part of this achievement could be attributed to a combination of strategic focus and faculty remuneration and, what may be termed as a system of "disincentivizing" poor quality (or zero) research by pruning faculty at regular intervals, especially the ones who do not perform up to the stated expectations. Pitroda, 2008, makes a mention about enhancing remuneration to attract the "brightest minds" to research and academia. However, as he rightly points out, remuneration has to go hand in glove with a rigorous evaluation process for output.

In this respect, a further modification in the PMS at various premier B-schools may be worthy of consideration. The research component should be reviewed on a longer

[5]"Why Indian B-schools lag in publishing research papers: Indian B-schools are far behind their global counterparts in publishing research papers."Madhavan, N. *Business Today*, Oct. 28, 2012.

cycle and not so much as annually. Shorter review cycles generally encourage "quick hits" and need not necessarily facilitate quality research of the kind that has global appeal. Hence, the PMS should truly drive better performance on long term initiatives rather than get relegated to a HRM[6] device to record annual employee "productivity".

Finally, a joint action across the top level institutions to better develop infrastructure locally through partnership programs to foster both empirical and theoretical research is worthy of consideration. Simply left to individual researchers to resolve such daunting problems will not foster a rapid rate of research productivity. In this regard, it may help to take assistance from willing investigators in more developed research environments to form healthy networks of collaboration. This will certainly provide the necessary ingredients to initiate the process. However, in the long run, the Indian academia needs to be somewhat self-sustainable in terms of its research productivity, irrespective of its linkages with academia from other parts of the globe.

Concluding Remarks

While the situation at the moment does not look very optimistic, what should perhaps be actively considered is to go well beyond macro level policies regarding fund allocation to research initiatives to the more unit level changes that are crucial for increasing productivity. Academic leadership in the country must come together to put in place the necessary pillars for a collaborative and healthy research environment. For all the well intentioned policy on the part of the government, lackadaisical implementation and imperfect detailing can wash out all the promise of a healthier research culture in no time.

Second, changes in the working model at B-schools may also be considered. Good research programs cannot be sustained on limited institutional facilitation such as money and some "shop talk". The premier B-schools may require a change in their expectation of faculty output, specifically, do away with the system where every faculty member is expected to contribute significantly to all areas of activity - teaching, administration and research. The overall quality of academic output will continue to remain mediocre if such diktats are sustained– the law of large numbers is not surmountable since it is not humanely possible to strive for excellence with such diluted focus. This is yet another reason for the flagging research climate in our institutions.

May be it is time to look at some specialization in our academic institutions with various kinds of faculty focussing on varying mix of activities across teaching, research and innovation academic administration and applied research, depending on their competence and with the assurance that they are compensated appropriately for the expected output that they are supposed to produce. The success of the future B-school in India requires a system that fairly monitors intellectual output quality ongoingly to ensure compliance of its employees (faculty) to their specific contractual agreement with the organization, which should ideally be coupled to their specialization and capabilities (Ladha, 2012). Perhaps, the time has arrived to unbundle the faculty pool into several independent clusters with separate, but specific mandate for achieving top quality academic output, irrespective of which dimension they focus on. No doubt, there can be overlaps in the mandates across faculty clusters, but the end objective would be to channelize effort in those areas that individual academics have aligned capabilities, instead of managing a portfolio of diverse tasks that require varied capabilities.

References

Baalen, Peter van and LuchienKarstan (2012), " The evolution of management as an interdisciplinary field", *Journal of Management History,* Vol. 18, No. 2, pp. 219-237.

Johnson, James and Donald Breckon (2007), Managing Health Education and Promotion Programs: Leadership Skills for the 21-st Century, Chapter 2, Jones and Bartlett Publishers, Sudbury, MA.

Khatri, Naresh, Abhoy Ojha, Pawan Budhwar, Vasanthi Srinivasan and Arup Varma (2012), " Management Research in India: Current State and Future Directions", *Mangement Review*, Vol. 24, No. 2, June 2012.

Ladha, Krishna K. (2012), " Strategic Opportunities for Quality in Higher Education in India", IIM Kozhikode Society *Management Review,* Vol. 1 No. 2, July 2012, pg. 65-74.

Pitroda, Sam (2008), Letter to the prime Minister of India on recommendations on increasing Ph.D. Quality in India, Nov. 8, 2008.

Tsui, Anne S. (2004), " Contributing to Global Management Knowledge: A case for High Quality Indigenous Research", *Asia Pacific Journal of Management,* 21, pp. 491-513.

The difference between a successful person and others is not a lack of strength, not a lack of knowledge, but rather a lack of will.

—Vince Lombardi

[6]Human Resource Management

Feature

Technology Upgradation: Boon or Bane for MSMEs in India

ANITA KUMARI

To nurture MSMEs, several policy measures have been taken by the government. The study attempted to answer a pertinent question: whether policy measures towards upgradation of technology through acquisition of advanced technology has been boon or bane for MSMEs in India since globalization. A detailed empirical analysis has been carried out for all the industry groups of MSMEs in an attempt to do so. An econometric model has been formulated based on the various hypothesis discussed in the literature and to account for the changing environment as per the changes in the policies for MSMES. The analysis revealed that the technology upgradation through acquisition of advanced technologies has been boon for MSMEs in India. Nevertheless, various other factors have also been playing a strategic role along with in augmenting productivity and competitiveness of enterprises in MSMEs across all industry groups.

Anita Kumari is Assistant Professor at Institute of Economic Growth, University of Delhi, North Campus, Delhi.

1. Introduction

Technology has become inevitable for growth of all enterprises irrespective of being micro, small, medium or large especially with the advent of globalisation. With the opening of Indian economy since 1991, Government of India has taken several initiatives for making enterprises more and more competitive by developing technology dynamism. Micro, Small and Medium Enterprises (MSMEs) also known as small and medium enterprises (SMEs) or small scale industries (SSIs) make up the vast majority of enterprises around the world irrespective of their varying name or the definition as per the country's structure. With increasing globalization, immense opportunities have been opened for outsourcing, subcontracting or ancillarisation of the products. For MSMEs to derive maximum benefit out of these opportunities, their technological backwardness has to be mitigated by having access to advanced technologies. International organizations, The World Bank and UNIDO, as well as national organizations (Government of India, MSME) have also concluded that small scale sector suffers from scarcity of technological input needed for increasing the productivity and competitiveness of these enterprises. Therefore, for infusing growth of MSMEs, need was felt to give them a conducive environment through formulation of appropriate national policies for providing them access to advanced technologies considered important for increasing the productivity and competitiveness. As a result, in August 1991 new policy for small scale enterprises in India was also announced to face foreign competition and open market. These measures have been in the form of facilitating capacity building and empowerment of enterprises through technology upgradation, modernization and integrated infrastructure facilities. All these facilitation measures should have motivated the MSMEs to acquire advanced technology to improve their performance. Over the years, MSMEs in India have registered continuous growth in the

number of enterprise, production, employment and exports. The role of MSMEs in providing employment has also been widely acknowledged. Further, there have been many studies/reports which have highlighted that technology used in MSMEs was poor and therefore MSMEs have to achieve technology dynamism to increase the competitiveness in the era of globalization. But there remains an important question as to whether all the policy measures towards facilitating access to upgradation of technology for increasing productivity and competitiveness of MSMEs in India have been boon or bane?.

Therefore, the objective of this study has been to provide some authentic answer to this important question. This has been achieved through formulation of an econometric model to analyse the impact of the advanced technologies on the productivity of MSMEs in India since the period of globalization.

The rest of the article is organized as follows: Section 2 delves into the policies for MSMEs in India followed by literature review in Section 3. Section 4 discusses the model and the data base for the study turning to analysis of results in section 5. Finally main findings are summed up in the Section 6 on conclusion.

2. Evolution of Policies for MSMEs in India

The evolution of policies of Government for Micro, Small and Medium Enterprises(MSMEs) earlier known as Small Scale Industries (SSI) and Agro & Rural Industries(ARI) can be classified into two periods: Before 1991 and After 1991(Ministry of MSMEs, various reports). The period before 1991 provided the support required to nurture MSMEs through reservation of items for exclusive manufacture in MSMEs. Bank credit was also made available to these enterprises on priority through priority sector lending programme of commercial banks. Other benefits included excise exemption, reservation under Government purchase programme and 15% price preference in purchases, infrastructure development and establishment of institutes for entrepreneurship and skill development.

With the liberalisation and globalisation of Indian economy in 1991, new policy for small, tiny and village enterprises was also announced in August 1991 to replace protection with competitiveness (Government of India, 1991). During this period, supportive measures were provided for improving infrastructure, technology and quality with the objective of bringing more vitality and growth of MSMEs. For quality certification, testing centers and new tool rooms were also established. SIDBI- The Small Industries Development Bank of India and a Technology Development and Modernisation Fund had also been created to accelerate finance and technical services. Also, a delayed payment act had been enacted for facilitating quick payment of dues to MSMEs. IID-Industrial Infrastructure Development scheme had also been launched for setting up mini industrial estates for small industries.

In 1999, Ministry of MSME (Micro, Small and Medium Enterprises) came into being in place of Ministry of SSI & ARI (Small Scale Industries and Agro & Rural Industries and in August 2000, new policy packages were announced for providing further the focused attention towards credit, infrastructure, technology and marketing. To encourage technology upgradation-a Credit Linked Capital subsidy scheme and for providing collateral free loans–a Credit Guarantee Scheme were launched. The other important measures included, the exemption limit from payment of Central Excise Duty being raised to Rs. 1 crore and the formation of Market Development Assistance Scheme for providing relief to MSMEs.

In 2006, The Micro, Small and Medium Enterprises Act 2006 was passed with the objective of increasing further the competitiveness of these enterprises. Under this act the concept of industries has been widened to that of enterprises to include both manufacturing and services sector besides defining medium enterprises for the first time. MSMEs have been defined on the basis of investment in plant and machinery and equipment respectively for manufacturing and services enterprises. The ceiling on investment has also been raised substantially (Appendix 1) Other provisions under this act had been the establishment of specific funds, progressive credit policies and practices, preference in government procurement to products and services of MSMEs, more effective mechanisms for mitigating the problems of delayed payments for enhancing the competitiveness of these enterprises. List of products reserved for production in the MSME sector were also reduced gradually each year because of adverse implications of reservations. These measures helped in facilitating further investments for technological upgradation and higher productivity and enlarging the scale of operations keeping with global standards.

Working group constituted by the planning commission also suggested a specific plan for facilitating the overall growth of MSME sector within the 12th plan period (2012-17). The group has recommended key initiatives for strengthening MSMEs in the areas of finance, technology, infrastructure, marketing, training and institutional support.

3. Literature Review

The micro, small and medium enterprises (MSME) or small scale industries (SSI) or small and medium enterprises (SMEs) play a vital role in economic growth of nations (Kyophilavong, 2008, Hallberg, 2000 and Mazzarol, et al., 1999). In most of the economies, MSMEs have been generating the highest rates of employment growth, industrial production and exports (Swierczek and Ha, 2003). In India also, the MSMEs (earlier known as small scale industries and Agro & Rural Industries) play an important role in the development of the country accounting for about 45% of the manufacturing output and around 40% of the total exports of the country (MSME, 4th Census Report).

Figure 1 depicts the contribution of MSMEs across diverse economies, though MSMEs have been defined in different ways, mainly in terms of employment or assets by different countries. In India, MSMEs have been defined in terms of assets whereas in USA, Japan, Korea and Indonesia in terms of employment, in Singapore both in terms of employment as well as assets and in Taiwan along with assets and employment, paid up capital has also been considered (Pandey and Shivesh, 2007). For India, figures are based on the definition before 2006.

MSME sector in India has grown consistently at a rate higher than that for overall industrial sector (Figure 2) (MSME, various reports). Labour intensity of this sector is estimated to be almost 4 times and capital intensity to be almost 3 times higher than that for large enterprises (SIDBI 1999, Asher 1987).

The role of technological changes in the growth of an economy has been discussed by Mathur 1969 and Solow 1957. Studies by Kumari 2010, Odagiri 1985, Scherer 1984 and Griliches and Mairess 1984, Cuneo and Mairesse 1984 have shown that technological advancements results in the increase of the productivity. These studies have mainly been done for the manufacturing industry as a whole.

Many studies have analysed the impact of information and communication technologies (ICT) on

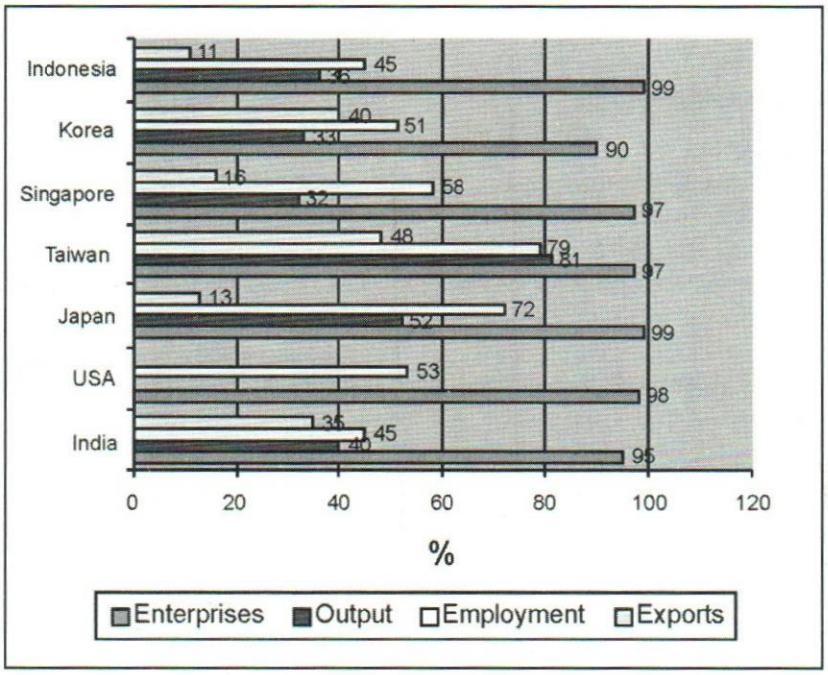


Figure 1: Contribution of MSMEs in India vis a vis other countries of the world

productivity. The findings have been found to be mixed (Nkama, 2007). For developed countries, a substantial role of ICT on productivity for US (Jorgenson et al., 2002) and Germany (Hempell, 2002) has been found. In Japan, United Kingdom and France, ICTs did not increase productivity (IMF, 2001). A positive and significant contribution of information and communication technologies on productivity of large firms has been found for India by Lal 1996.

With respect to MSMEs, many survey based studies have been done on the factors, like SMEs characteristics, way of doing business, customer and market or external environment, etc., affecting the business success of

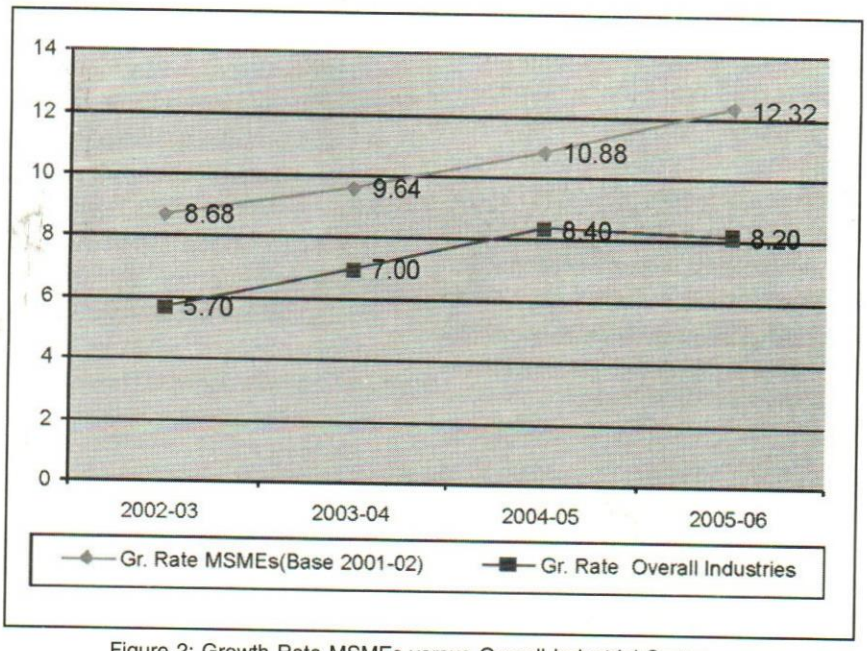


Figure 2: Growth Rate MSMEs versus Overall Industrial Sector

MSMEs in Thailand, and many other countries like Bangladesh, Indonesia, Australia, Japan, Finland, Singapore and Vietnam (Chittithaworn et al , 2011)

Some studies have also analysed impact of information and communication technologies (ICTs) usage on productivity of MSMES. The positive impact of ICTs (mobile phones/internet usage) usage was found on productivity of MSMES in 13 African countries (Esselaar et al. 2007) and MSMEs in Kenya (Mutua and Wasike, 2009).

In India, studies conducted for small scale industries are mainly related to aspects such as importance and contribution of MSMEs (Venkatesh and Muthiah, 2012, Das 2011, Rathod, 2007), growth/performance of small scale industries with respect to no. of units, production, employment and exports (Bargal et al 2009, Sania and Kansal, 2009, Subrahmanya, 2004, Dhar and Lydal 1961, Bhateja et al. web), problems faced by small scale industries (Basant and Sebastain, 2006). Some studies (Gunasekaran et.al., 1996) have discussed the importance of productivity improvement for SMEs.

Studies on technology development in MSMEs in India found that technology used in MSMEs was poor and therefore MSMEs have to achieve technology dynamism to increase the productivity and competitiveness in the era of globalisation (Lal 2007, Bhavani, 2002, Subrahmanian, 1995, Awasthi and Sebastian, 2003, NCAER, 1993). A significant impact of information and communication technology (phones/mobile phones/ internet) on productivity of MSMEs in India has also been found in some studies (Muller-Falke, 2001).

This study formulates an econometric model to analyse the impact of advanced technology on productivity and competitiveness of MSMEs in India. At the enterprise level or sector level, competitiveness refers to advantages obtained through productivity. In the literature, labour productivity has been considered as the key driver of competitiveness (Broersma and van Dijk, 2010, van Den, 2008).Therefore for analyzing productivity and competitiveness, labour productivity has been considered. We have confined to the definition of MSMEs as per the definition of 2006 to manufacturing enterprises having investments in plant and machinery up to Rs. 10 crores and registered under companies act. The advanced technology has been considered to be upgraded technology reflected in current investments and imported technology acquired through arms length purchase or embodied in imported materials or capital goods or transferred through foreign equity participation. For productivity of MSMEs, the labour productivity has been considered. Thus, the study analyses the impact of advanced technology on labour productivity of MSMEs in India. In the section below, we shall briefly discuss the hypothesis and the econometric model for analysing the productivity of MSMEs in India.

4. The Model and the Database

It has been hypothesized that productivity of enterprises depends on various factors. The more the dynamism in the enterprise, the greater will be the enthusiasm to avail the various opportunities provided by government for the development of MSMEs in lieu of globalisation and hence the larger will be the level of productivity. Growth of value added has been considered to measure scale of production that is an important factor to account for dynamism in the enterprises. Growth of an enterprise provides an opportunity to exploit the benefits of economies of scale. Relatively large firms will have larger productivity levels as size of enterprises enables them to take risk and compete in the market. Therefore size of firms shall also be included in the model. The dominance in the market helps the enterprises to take advantage of increase in the demand and hence enterprises with larger market share will have high productivity levels. In the era of boom in the information technology, adoption of information technology in the literature has been shown to play a crucial role in affecting the productivity of enterprises by increasing the efficiency of enterprises through facilitating awareness about occupational requirements and hence access to computers has also been included. Use of large capital per unit of labour facilitates better machinery and thus will increase labour productivity through increasing the competitiveness in the enterprises and hence necessitates the inclusion of this variable in the model. Technology upgradation through acquisition of advanced technology facilitates in overcoming the scarcity of technological input needed to face competition in the market and to avail opportunities opened for outsourcing/subcontracting/ancilliarisation in lieu of globalization. Therefore, advanced technology helps in increasing the efficiency of enterprises and hence is expected to increases the productivity.

Based on the hypotheses discussed of various factors affecting productivity, the following econometric model has been developed to examine the impact of advanced technology on labour productivity of MSMEs in India.

$$LP=f(GO, LS, MS, KL, IT, ADTECH)$$

where, LP is labour productivity of an enterprises in an industry measured as ratio of value added to labour and labour has been measured by employee cost, i.e., wages. GO is growth of gross value added of enterprises, LS is size of firm measured as logarithm of sales, MS is market share measured as ratio of enterprises sales to industry sales, KL is capital intensity measured as ratio of capital per unit of labour, IT is information technology measured as ratio of computers to gross fixed capital. ADTECH consists of various forms of technology: INV- measured as ratio of current investments to gross fixed capital, MT- technology imports intensity, payments for royalty and technical fees made abroad as a ratio of sales, IM = Intermediate Inputs Import Intensity measured as imports of materials, spares, components, etc. to total sales, IK=capital goods import intensity measured as payments made for import of capital goods as a ratio of sales , FE measured as ratio of dividend declared in foreign currency to total dividend paid. In addition various year dummies and industry dummies have also been included in the model to account for year specific effects and industry specific effects.

The above model has been estimated by using the data on enterprises from Capital line data set brought out by Capital Market Publishers India Pvt. Ltd. The sample consists of about 5208 observations belonging to different industry groups over the period 1992 to 2004. MSMEs have been the enterprises engaged in the manufacture of goods registered in the companies Act and having investment in plant and machinery up to 10 crores of rupees as per the definition of MSME Act 2006. Enterprises in this sector have been producing a wide range of products. The analysis has thus been done at the aggregate level of industries as well as for nine disaggregated level of industries, namely, Food products, Textile and Leather, Wood and Paper, Chemical and Chemical Products, Pharmaceuticals, Non-Metallic Mineral Products, Metal and Metal Products, Machinery and Equipment and Transport Equipment.

5. Analysis of Results

For analyzing the trends in MSMEs, data has been taken from the reports of Ministry of MSMEs and refers to MSMEs as per the definition prior to 2006 for the sake of comparison (see Appendix 1 for definition). Trends for various characteristics of MSMEs in India from 1991-92 to 2005-06 have been shown in the Appendix 2, figures A2-1 to A2-4). It is interesting to note an exponential trend in all the characteristics, number of units, employment, production (current prices) and exports of MSMEs.

Figure 3 illustrates the compound growth rates of these characteristics. It shows that no. of units of MSMEs have grown at the average compound growth rate of 4.07 per cent per annum whereas number of employees have grown at the average compound growth rate of 4.19 per cent per annum over the entire period from 1991-92 to 2005-06. Production at current prices has grown at the average rate

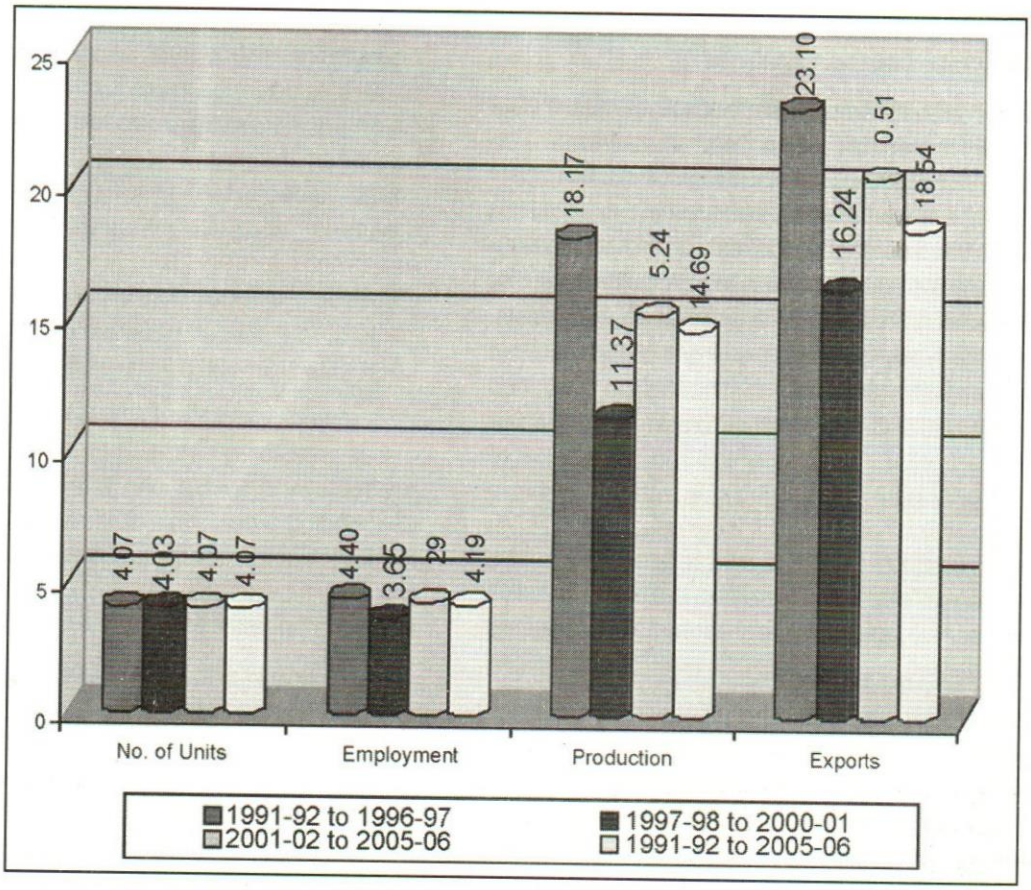


Figure 3: Average annual compound Growth Rates of MSMEs in India

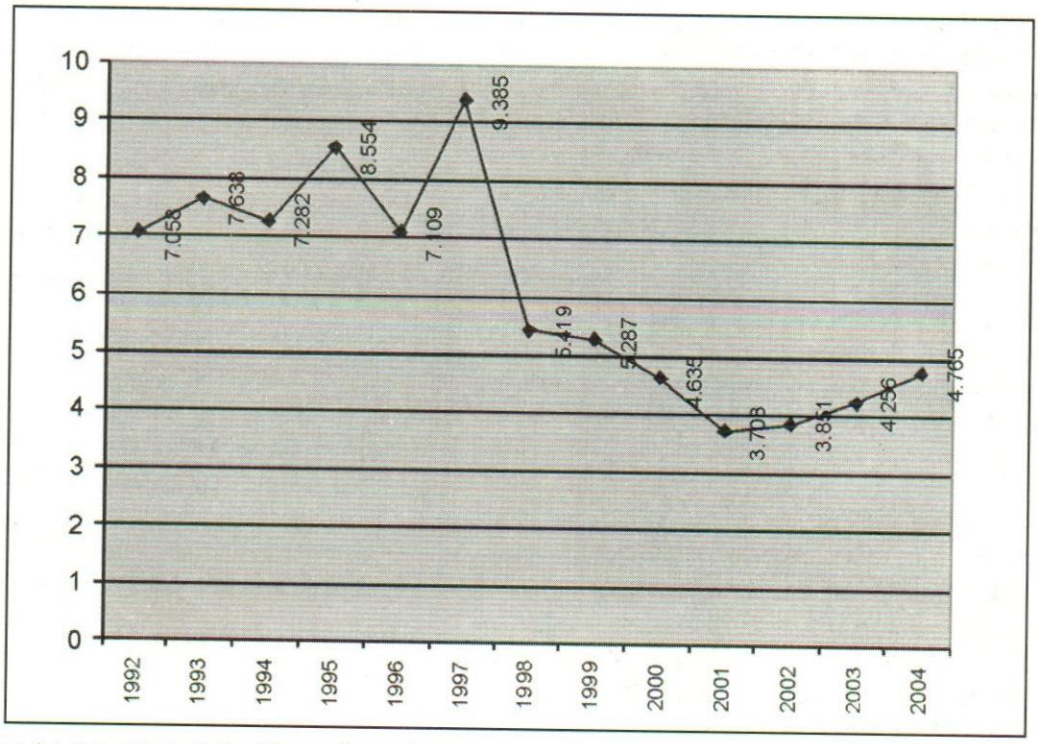


Figure 4: Labour Productivity of Enterprises in Manufacturing Sector of MSMEs in India All Industries

of 14.7 per cent per annum and exports at the average rate of 18.5 per cent per annum.

For analyzing the impact of South East Asian crisis of 1997, growth rates have also been analysed for sub periods, 1991-92 to 1996-97, 1997-98 to 2000-01 and 2001-02 to 2005-06. It is worth noting that growth rate of all the characteristics have declined in the period 1997-98 to 2000-01. However, growth rates for both the production as well as exports declined drastically in the period after the crisis. Growth rates for production declined from 18.2 per cent in the period 1991-92 to 1996-97 to 11.4 per cent in the period 1997-98 to 2001-02. Growth rate of exports on the other hand declined from 23.10 per cent in the first period to 16.2 per cent only in the next period. Growth rates started picking up again and had been 15.2 per cent and 20.5 per cent in the period 2001-02 to 2005-06 respectively for the production and exports. These trends in the characteristics of MSMEs describe how the global situation has affected Indian MSMEs.

Labour productivity for aggregate level of industries has been shown via figure 4. Labour productivity has been seen to be varying over the years. It increased from 7.06 per cent in 1992, the immediate year after the initiation of liberalization in India, to 9.38 per cent in 1997. Thereafter it started declining and declined to 3.71 percent in 2001. Again it started increasing and increased to 5.57 percent in 2004. Decline in labour productivity since 1997 may have been the result of overall economic slow down of India, as of other economies in the world, as a result of South East Asian crisis from the year 1997. South East Asian crisis has been the result of low demand from South Asian countries because of gradual slow down in the markets in the industrialized countries from mid 1990s. Therefore, excessive expenditure on capital expenditure and infrastructure done in lieu of liberalization of policies in India could not be utilized because of lack of demand (Kumari, 2008, Government of India web).

Across various industries, labour productivity has been above that for all industries in chemical and chemical products and textile and leather whereas lower in the descending order of industries in metal and metal products, food products, pharmaceuticals, wood and paper, non metallic mineral products, machinery and equipment and transport equipment (Figure 5).

To analyze the impact of various factors on labour productivity, the estimates of econometric model specified earlier are presented in table 1. At the aggregate level of industries, it has been observed that advanced technology in current investment has a positive and highly significant impact on labour productivity of enterprises in MSMEs. However, technology acquired through other means is not found to have a positive and significant impact. Interestingly,

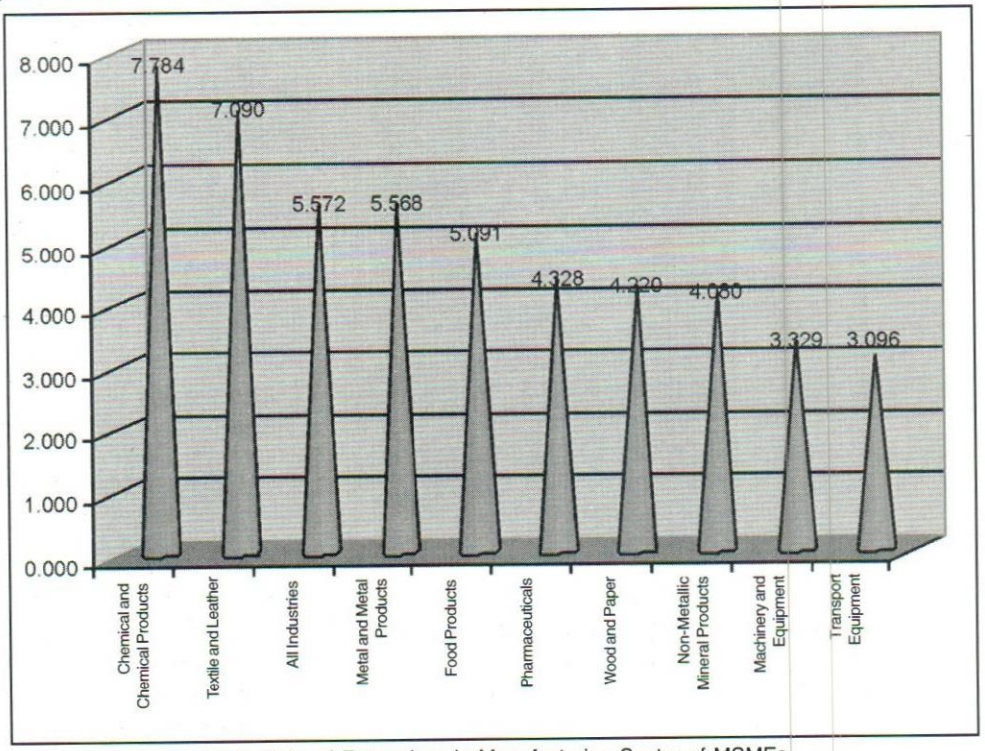


Figure 5: Labour Productivity of Enterprises in Manufacturing Sector of MSMEs in India Across Groups 1992-2004

Table 1: Econometric Results for Labour Productivity of Enterprises in Manufacturing Sector of MSMEs in India

	All Industries		Food Products	
Variables	Coefficient	t-Statistic	Coefficient	t-Statistic
C	-5.311***	-3.966	-2.899**	-2.363
GO	0.058	1.410	0.033	0.690
LS	2.260***	12.666	2.167***	10.126
MS	40.304***	7.560	1.757	0.634
KL	0.265***	26.876	0.099***	5.634
IT	23.532***	5.816	110.758***	4.507
ADTECH				
INV	0.285***	5.634	1.144***	3.014
MT	3.281	0.137	-6701.546	-0.549
IM	-3.194**	-2.312	44.815***	8.336
IK	-0.634	-0.308	13.454	0.567
FE	-2.004	-1.461	-27.823	-1.078
Adjusted R Sq	0.21		0.51	
F Statistics	33.860***		14.87***	
Observations	5185		289	
	Textile and Leather		Wood and Paper	
Variables	Coefficient	t-Statistic	Coefficient	t-Statistic
C	-2.008	-0.773	-2.056	-0.801
GO	0.021	0.484	0.301	1.311
LS	2.565***	5.409	1.199***	3.081
MS	27.627	1.090	157.017	1.228
KL	0.205***	9.023	0.110***	12.037
IT	302.194***	24.411	-4.880	-0.728
ADTECH				
INV	0.063	1.186	0.631	0.641
MT	66.371	0.471	-1.600	-0.041
IM	-5.151	-0.955	-0.333	-0.150
IK	11.287**	2.017	15.090	1.312
FE	-0.658	-0.239	-0.645	-0.533
Adjusted R Sq	0.51		0.49	
F Statistics	33.46***		10.150***	
Observations	676		209	

Note: * significant at 10 %, ** significant at 5%, *** significant at 1 %. Dummy variables have not been shown for want of space.

information technology has also been found to have a positive and highly significant impact on labour productivity. Among other variables, it has been observed that capital intensity measured as the ratio of capital to labour has been found to have a positive and highly significant impact

Table 2: Econometric Results for Labour Productivity of Enterprises in Manufacturing Sector of MSMEs in India (Cont.)

	Chemical and Chemical Products		Pharmaceuticals	
Variables	Coefficient	t-Statistic	Coefficient	t-Statistic
C	-12.154***	-3.853	-0.482	-0.348
GO	0.246	1.174	0.443***	3.082
LS	4.395***	8.151	1.240***	4.832
MS	104.573***	6.715	-5.148	-0.301
KL	0.384***	14.335	0.147***	7.613
IT	16.855	1.053	26.967***	2.667
ADTECH				
INV	0.646***	4.077	0.315***	2.563
MT	20.059	0.384	-53.352	-0.873
IM	0.683	0.225	2.989**	2.151
IK	1.922	0.482	-32.831	-0.352
FE	-14.664	-1.419	-7.441**	-2.051
Adjusted R Sq	0.21		0.22	
F Statistics	18.47***		6.96***	
Observations	1461		461	
	Non-Metallic Mineral Products		Metal and Metal Products	
Variables C	Coefficient -0.603	t-Statistic -0.459	Coefficient -4.576***	t-Statistic -3.590
GO	0.179***	3.201	0.171**	2.081
LS	0.411	1.103	2.136***	8.752
MS	66.094***	2.992	18.795	0.663
KL	0.211***	9.162	0.282***	30.339
IT	61.694***	4.963	28.130	0.884
ADTECH				
INV	0.547	0.875	3.238***	8.215
MT	179.977	1.399	41.377	0.719
IM	-2.689	-1.065	-2.862	-1.444
IK	-7.345	-0.391	-11.317	-1.106
FE	5.296	1.185	-0.516	-0.049
Adjusted R Sq	0.53		0.66	
F Statistics	8.64***		53.89***	
Observations	150		597	

Note: * significant at 10 %, ** significant at 5%, *** significant at 1 %. Dummy variables have not been shown for want of space.

on productivity. As expected, size of enterprises has also been found to play a significant role in productivity of the

Table 3: Econometric Results for Labour Productivity of Enterprises in Manufacturing Sector of MSMEs in India

	Machinery and Equipment		Transport Equipment	
Variables	**Coefficient**	**t-Statistic**	**Coefficient**	**t-Statistic**
C	-0.033	-0.062	-0.877	-0.950
GO	0.055	1.552	0.213***	3.497
LS	0.935***	10.721	-0.098	-0.430
MS	-0.116	-0.047	109.565***	4.617
KL	0.227***	27.377	0.429***	12.708
IT	1.141	0.938	5.233	1.151
ADTECH				
INV	0.576***	3.552	-0.194	-0.343
MT	8.279	0.768	-28.664	-0.691
IM	1.312*	1.645	-1.719	-0.836
IK	-1.752	-1.365	-6.895	-0.147
FE	-0.015	-0.028	4.288*	1.676
Adjusted R Sq	0.45		0.58	
F Statistics	44.66***		10.48***	
Observations	1182		155	

MSMEs. Also enterprises having dominance in the market, reflected by large market share (MS) have been found to have higher labour productivity.

Across various industrial sectors, it has been observed that in food products also, advanced technology in current investments has been found to have a positive and significant impact on productivity of MSMEs. Among other means, technology embodied in imported materials is also found to have a positive and significant impact. Information technology in this sector has also been found to be positively and significantly affecting labour productivity. Increased use of capital per unit labour along with size of the enterprises has also been found to have a positive and significant impact on labour productivity of enterprises.

Interestingly, in the case of enterprises in textile and leather industry, advanced technology embodied in imported capital goods has been found to have a positive and significant impact on productivity. Information technology as in the other groups is highly significant for this group as well. Among other factors, capital intensity has been found to have a positive and significant impact on the productivity. Again, in this industry as well, size of enterprises has been found to have a positive and significant impact on productivity. Surprisingly for enterprises in wood and paper, except capital intensity and size of enterprises no other variable has been found to be significant. In case of chemical and chemical products also, advanced technology in current investments as well as increased use of capital per unit of labour has been found to augment labour productivity of enterprises. Among other factors, size and market share of enterprises have also been found to be important in increasing labour productivity. In pharmaceutical industry, advanced technology in current investments and in imported inputs have been found to be significant in augmenting productivity. Among other variables, capital intensity and size of enterprises have been found to be significant.

In case of non-metallic mineral products, information technology, growth of scale of production, capital intensity and market share have been found to play an important role in increasing labour productivity of enterprises. For enterprises in metal and metal products, advanced technology in current investments, capital intensity and also growth of scale of production and size of enterprises have been found to be significant in increasing labour productivity. In the case of machinery sector also; advanced technology in current investments and imported materials along with capital intensity and size of firms has been found to be significant. For transport equipment, capital intensity, growth of scale of production and market share has been found to be important in increasing productivity. Interestingly, foreign equity participation has been found to have a significant impact on productivity of enterprises in this group.

6. Conclusion

As part of economic reforms, Government of India introduced new policy for MSMEs (SSIs) also in 1991 to infuse technological dynamism in enterprises of this sector for improving productivity and competitiveness to face open market in lieu of globalisation. The study observed that liberalized policies since 1991 has resulted in the increase of labour productivity of MSMEs in India. However, the momentum of increasing productivity was lost from 1997 due to South East Asian crisis led by decline in demand as a result of slow down in the developed world.

The study further developed an econometric model, based on the various hypothesis discussed in the literature, to provide an answer to the pertinent question: Whether policies for technology upgradation through acquisition of advanced technology have been boon or bane for increasing the productivity and competitiveness of MSMEs in India?

Various forms of advanced technologies acquired have been considered to analyse the impact of these policies along with other important characteristics of MSMEs. An econometric analysis revealed a significant impact of advanced technologies at both the aggregate level of industries and also at disaggregated level of most of the industries. Though, across industry groups, variations have been noticed with respect to the type of technology being important for a particular small scale industry as characteristics of industries differ. The analysis therefore finds that technology upgradation has been boon for MSMEs productivity and competitiveness along with various other characteristics of firms like, scale, size, market share, and capital intensity and information technology.

Hence, the continuing efforts put in by the Government of India since globalization towards the process of encouraging and facilitating MSMEs to tide over the scarcity of technology through access to advanced technologies have provided conducive environment to enterprises in the sector. An otherwise vibrant MSME sector derived the maximum benefit out of this conducive environment and acquired advanced technologies to strengthen their technological base. The access to advanced technologies among others has helped in increasing the productivity and competitiveness of enterprises in this sector in the current economic environment.

The world economy is undergoing radical transformation. Therefore, in the current economic environment, enterprises are not insulated from these developments. Therefore, in lieu of new developments efforts should be accelerated further with due significance to technology developments for enhancing the competitiveness of MSMEs and hence the overall growth of Indian economy.

References

Asher, K.R. (1987), "Small Scale and Cottage Industries in India" in J.S. Pappal (ed.) India's Economic Problem.

Awasthi, K., & Sebastian. (1993), "Research Report on Impact of New Economic Policies on Small and Tiny Industries Sector", Entrepreneurship Development Institute of India, Ahmedabad.

Bargal, H., M.Dashmishra and A. Sharma (2009), "Performance analysis of Small scale Industries-A Study of Pre-Liberalisation and Post-Liberalization Period", International *Journal of Business and Management,* Vol.1, No.2.

Basant, R. and Morris Sebastain (2006), "Small Scale industries in the age of liberalization", INRM Policy Brief No. 11, Asian Development Bank

Bhateja, Ranchay, Amit Tyagi and Mani Tyagi, (Web) "Liberalisation and Small Scale Industries in India", www.wbiconpro.com/225-Ranchy.pdf

Bhavani, T.A., (2002), "Impact of Technology on the Competitiveness of the Indian Small Manufacturing Sector: A Case Study of the Automotive Component Industry", United Nations University WIDER, Discussion Paper No. 2002/76, Helsinki.

Broersma, L. and Jouke van Dijk, (2010), "Labour Productivity and Competitiveness, University of Groningen, Department of Economic Geography, The Netherlands, http://www.joukevandijk.nl/files/WP_19-10_Labour_productivity_and_competitiveness_DEF.pdf

Chittithaworn, C., Md. A. Islam, T. Keawchana, D. H.M.Yusuf (2011), "Factors Affecting Business Success of Small & Medium Enterprises (SMEs) in Thailand"Asian Social Science, Vol 7, No 5. http://www.ccsenet.org/journal/index.php/ass/article/view/7506/7371.

Cuneo, P. and J. Mairesse, (1984), "Productivity and Rand D at firm level in French manufacturing", in Z.Griliches (ed.) R and D, patents and productivity, University of Chicago Press: 375-392.

Das, Keshab (ed.) (2011), "Micro and Small Enterprises in India: The Era of Reforms", (Routledge: New Delhi), 2011.

Dhar, P. N. and H. F. Lydal (1961), "Role Of Small Enterprises In Economic Development", *New Econometrics,* Vol. 39, 199-211

Development Commissioner of MSME. (2009), "Micro, Small and Medium Enterprises in India: An Overview", Ministry of MSME, Government of India, http://dcmsme.gov.in/ssiindia/MSME_OVERVIEW09.pdf.

Esselaar, S., C.Stork, A.Ndiwalana, M.D.Swarray (2007), "ICT Usage and Its Impact on Profitability of SMEs in 13 African Countries", *Information Technologies and International Development,* Vol.4, No.1, Fall 2007, 87-100.

Government of India (1991), "Policy measures for promoting and strengthening small, tiny and village enterprises", Ministry of Commerce & Industry, N.Delhi.

Government of India(web), "External Economic Situation in India" http://planningcommission.gov.in/reports/wrkpapers/wp_eco.pdf

Griliches Z, and J. Mairess (1984), "Productivity and R and D at the Firm Level" in Z. Griliches. (Ed.) R and D, Patents and Productivity, University of Chicago Press: Chicago, 339-373.

Gunasekaran, A., P.Okko, T. Martikainen, and P.Yli-Olli(1996), "Improving Productivity And Quality in Small And Medium Enterprises: Cases and Analysis", *International Small Business Journal,* **15 (1),** 59-72

Hallberg, K. (2000), "A Market-Oriented Strategy for Small and Medium Enterprises" IFC Discussion Paper No. 40, 2000, The World Bank, Washington, DC.

Hempell T. (2002), "Does Experience Matter? Productivity Effects of ICT in the German Service Sector"; Paper Presented at WIDER

Conference on the New Economy in Development, Helsinki.

International Monetary Fund–IMF (2001), World Economic Outlook; October.

Jorgensen et. al. (2002), "Projecting Productivity Growth: Lessons from the US Growth Resurgence", Paper Presented at WIDER Conference on the New Economy in Development, Helsinki.

Kumari, A. (2010) 'India's Productivity Performance-An Analysis by Technology Levels of Manufacturing Industry, *The Asian Economic Review,* August 2010.

Kumari, A. (2008), "India's Industrial Growth: Sources and Determinants", Bookwell, New Delhi.

Kumari, A. 2010,'Impact of Technology Policy on Productivity Growth-An Econometric Study of Pharmaceutical Industry in India', *Productivity Journal,* Vol.50, No.4, January-March 2010.

Kyophilavong, P. (2008), "SME Development in Lao PDR", in H.Lim (ed.), SME in Asia and Globalization, ERIA Research Project Report 2007-5, pp.191-215. Available at:http://www.eria.org/SMEs%20Development%20in%20Lao%20PDR.pdf

Lal, K. (2007), "New Technologies and Indian SMEs", The IUP Journal of Applied Economics, IUP Publications, Vol. O (1), pp 20-41, January.

Lal, K.(1996), "Information Technology, International Orientation and Performance: A Case Study of Electrical and Electronic Goods Manufacturing Firms in India"; *Information Economics and Policy,* Elsevier, Vol. 8(3): 269-280, September.

Mathur, P.N. (1969). "Input Output Framework for Explorations in Theoretical and Empirical Economic Research, Arth Vijnana, 11 (2), 133-147.

Mazzarol, T., Volery, T., Doss, N. and Thein, V. 1999, Factors influencing small business start ups, *International Journal of Entrepreneurial Behaviour and Research,* **5(2),** p48-63.

Ministry of Micro, Small and Medium Enterprise (2012), "Report of the Working group on MSMEs Growth for 12th Five Year Plan (2012-2017), New Delhi. http://msme.gov.in/Report_working_group_5yearplan-2012-17.pdf

Ministry of Micro, Small and Medium Enterprise, Various reports, www.msme.gov.in.

Ministry of Micro, Small and Medium Enterprise (2006-2007), Development Commissioner, Government of India, Fourth Census Report, www.dcmsme.gov.in.

Muller-Falke, D. (2001), "The Use of Telecommunication and Information Technologies in Small Business – Evidence from Indian Small scale Industry", unpublished draft.

Mutua,J.M. and W.S.K. Wasike 2009, "ICT Adoption and performance of Small-Medium Sized Enterprises in Kenya", Draft Final Report submitted to African Economic Research Consortium, Nairobi, Kenya, https://researcher.gdnet.org/CMS/getRepoDoc.php?community

NCAER. (1993), "Structure and promotion of small-scale industries in India: Lessons for future development". Summary Report: National Council for Applied Economic Research, New Delhi.

Nkama, Arsene Honore Gideon(2007), "Analyzing the Impact of ICT Investments on Productivity Growth in Developing Countries: Evidence from Cameroon", African Economic Conference, Addis Ababa, Ethiopia 15 –17 November, http://www.afdb.org/fileadmin/uploads/afdb/documents/knowledge/25068321-en-nkama-ict-investment-addis.pdf.

Odagiri, H. (1985), "Research Activity, Output Growth and Productivity Increase in Japanese Manufacturing Industries", *Res. Policy,* **14 (1),** 117-130.

Pandey, A.P. and Shivesh (2007), "Indian SMEs and their Uniqueness in the Country", MPRA (Munich Personal RePEc Archive Paper No. 6086, posted 4 December, http://mpra.ub.uni-muenchen.de/6086/

Rathod, C. B. (2007), "Contribution of Indian Small Scale Entrepreneurs to Economic Growth in India: Opportunities and Challenges in Global Economy", Prabandh- Journal of Management & Research, Vol. 23, June 2007, pp: 1- 12.

Sania and Rajeev Kansal (2009), "Globalizations and its Impact on Small Scale Industries in India", *PCMA Journal of Business,* (Online), Vol. 1, No. 2 June, pp. 135-146. www.publishingindia.com.

Scherer, F.M. (1984), "Innovation and Growth: Schumpeterian Perspectives", Cambridge, MA: MIT Press.

Small Industries Development Bank of India (1999), SIDBI Report on Small Scale Industries Sector, Lucknow.

Solow, R. (1957), "Technical Change and the Aggregate Production Function", *Review of Economics and Statistics,* **39 (1)** 313-320.

Subrahmanian, K.K. (1995), "Technology Dimensions of Small-Scale Industry", *Productivity,* **36(1),** 26–30.

Subrahmanya, M.H. (2004), "Small Industry and Globalization: Implications, Performance and Prospects", *Economic and Political Weekly,* Vol. XXXIX, No. 18, May 1, pp: 1826-1834.

Swierczek, F. W., & T. T. Ha, (2003), "Entrepreneurial Orientation, Uncertainty Avoidance and Firm Performance: An Analysis of Thai and Vietnamese SMEs" *"International Journal of Entrepreneurship and Innovation",* **4(1),** p.46-58.

Van den, Bergen (2008), "Welvaartsgroei en productiviteit", in: CBS (ed), De Nederlandse economie 2008, Voorburg: CBS. [In Dutch].

Venkatesh, S. and K.Muthiah (2012), "SMEs in India: Importance and Contribution", *Asian Journal of Management Research,* Vol. 2, Issue 2, 2012.

Our technological powers increase, but the side effects and potential hazards also escalate.

—Alvin Toffler

Appendix 1

Definition of MSME

As per MSME Act 2006, Enterprises have been classified into 2 categories-(1) engaged in the manufacture of goods pertaining to any industry and (2) providing services. Enterprises have been defined as Micro, Small and Medium on the basis of investment in plant & machinery (for manufacturing enterprises) and equipment (for enterprises providing Services) excluding land and building as shown below:

Classification	Investment Ceiling	
	Manufacturing Enterprises (in Plant and Machinery)	Service Enterprises (in Equipment)
Micro	Up to Rs. 25 lakhs	Up to Rs. 10 lakhs
Small	Between Rs. 25 lakhs and Rs. 5 Crores	Between Rs.10 lakhs and Rs.2 Crores
Medium	Between Rs. 5 Crores and Rs. 10 Crores	Between Rs.2 Crores and Rs.5 Crores

Classification of MSMEs Prior to MSME Act 2006

Classification	Investment Ceiling	
	Manufacturing Enterprises(in Plant and Machinery)	Service Enterprises(in Equipment)
Micro	Up to Rs. 25 lakhs	Up to Rs. 10 lakhs
Small	Between Rs. 25 lakhs and Rs. 1 crore	–
Medium	Not Defined	Not Defined

Source: Development Commissioner, Micro, Small and medium Enterprises (www.dcmsme.gov.in/ssiindia/definition_msme.htm)

Appendix :2

Fig. A2-1

No. of Units in the MSMEs (lakhs)

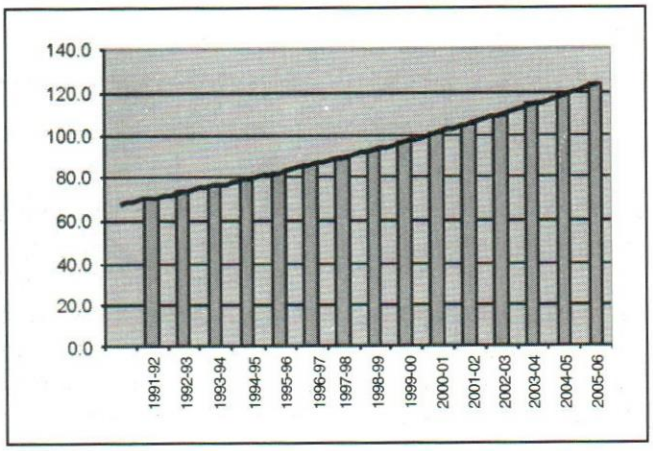


Fig. A2-2

Employment in the MSMEs (lakh persons)

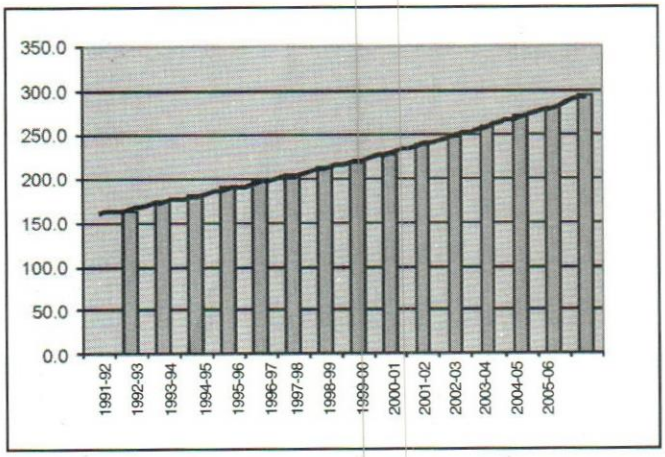


Fig. A2-3

Production (Current Prices) in the MSMEs (Rs. Crores)

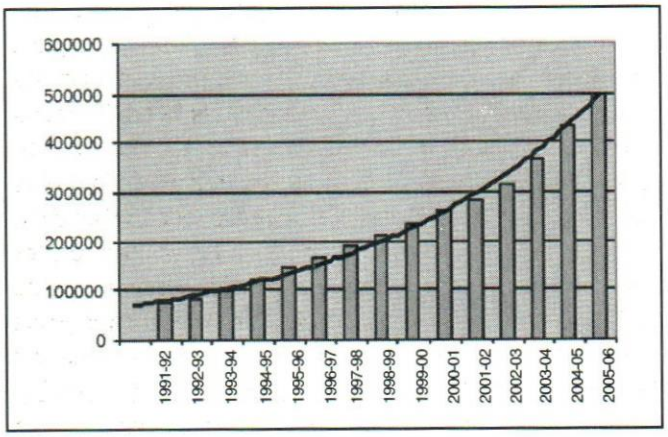
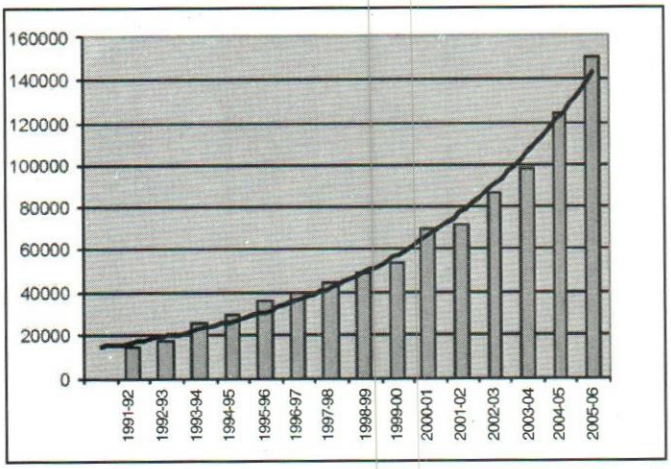


Fig. A2-4

Export from the MSMEs (Rs. Crores)



Feature

Emerging Retail Sector in Agricultural Marketing*

SANGEETA SHROFF, S. S. KALAMKAR AND JAYANTI KAJALE

In view of the changes in the marketing system in Indian agriculture, corporate have entered agricultural markets with a "farm to fork retail plan" and to promote an efficient supply chain through backward and forward integration. This paper is a case study on marketing of onions by Deepak Fertilizers Petro Chemical Limited and its comparison with traditional marketing. The paper observed that, farmers selling to Deepak fertilizers received a net price which was 9 percent higher than those who sold to regulated markets because they did not incur marketing costs. However, marketing operations of Deepak Fertilizers are very limited and restricted only to purchase of superior produce. These constraints must be overcome by spread of its extension services.

Sangeeta Shroff is Faculty Member, Gokhale Institute of Politics and Economics, Pune, Maharashtra; S. S. Kalamkar is Director and Professor, Agro-Economic Research Centre (Ministry of Agriculture, GOI), Sardar Patel University, Vallabh Vidyanagar, Anand, Gujarat and Jayanti Kajale is Faculty Member, Gokhale Institute of Politics and Economics, Pune, Maharashtra.

Commercialization of agriculture in India which was made possible by the new seed-water-fertilizer technology, popularly known as "Green Revolution", ensured self sufficiency in foodgrains to the country. Policy makers then focused on the need to diversify agriculture to achieve not only higher growth but also adjust to changing consumption pattern of the population which was experiencing urbanization and rising per capita incomes. India is now one of the leading producers in the world in milk, fruits and vegetables and eggs (GOI, 2011). This increased production has brought in its wake new challenges to handle in terms of huge marketable surplus. Thus while increasing productivity and production in the agriculture and allied sector have always been the focus of Indian agriculture, attention is now being drawn on building up an efficient marketing system which includes adequate physical facilities for safe and economic handling of produce as well as institutional and legal support for orderly transactions. In the traditional agricultural value chain, bulk of trade in agricultural commodities takes place in the wholesale regulated markets which are managed by Agricultural Produce Market Committees (APMC). Commission agents in these wholesale markets organize auctions on behalf of the farmers so as to sell the produce to the highest bidder. The intended aim of the commission agent is to enable farmers to get highest possible price and the farmer can directly witness the auction of his produce. Further, the commission agents also ensure that accurate and timely payment is made to farmers, so that transactions are in order.

Despite several advantages that regulated markets had, there still existed several limitations. A number of

*This is a part of the project report carried out for the Ministry of Agriculture, Govt. of India. Authors acknowledge with thanks the support of the Ministry and GIPE, Pune. Usual disclaimer applies.

regulated markets could not function efficiently owing to collusion among traders in bidding low prices. There was similar collusion in the lack of prompt action by the Market Committee against breach of rules by any trader. The Market Committees for all practical purposes were dominated by traders' interest and there was restriction on entry of new functionaries. Also, at times the proportion of village sales was so large that it made the operation of the APMC Act ineffective in providing fair price to the producer.

In view of the above, market reforms were felt necessary and accordingly a Model APMC Act was finalized in 2003 by Government of India and all states were required to make changes in their APMC act so as to accommodate changes recommended in the Model Act. With amendments made in APMC Act, direct marketing, contract farming, corporate entry into agricultural markets etc. have begun to make inroads into agricultural marketing. The APMC Act which brought about market regulation soon after independence, often caused the supply chain to become inefficient due to the presence of a large number of intermediaries in agricultural marketing. These intermediaries perform the distribution function as produce is normally consolidated in the regulated markets and reconsolidated again by intermediaries atleast two or three times before it reaches the final consumer. The supply chain is dominated by traders who operate on high margins for not much value added. In such a process there is wastage leading to huge losses, and both the farmers and producers lose in terms of price. Hence a more integrated market structure where the farmer is provided both backward and forward linkage helps to minimize inefficiencies in the marketing system.

Since the marketing system in Indian agriculture has undergone amendments, corporate units like Reliance, Godrej, Deepak Fertilisers and Petro Chemicals Ltd, Bharati group, ITC, etc. have entered agricultural markets to capitalize on opportunities such as market integration. These companies have linkages with small and large farmers and have a "farm to fork" retail plan. Some of these corporates even provide extension services to farmers and supply them with quality inputs and finally buy back the produce from farmers. As a result India's agri retail sector has been witnessing some form of transformation with organized retail making inroads to consolidate the markets.

Objective and Methodology

Organized retail, is still in a nascent stage in India. Retail firms are adopting different formats for entry, expansion, export, etc. of agricultural produce. These players have an opportunity to bring about an efficient supply chain by sourcing vegetables and fruits directly from farmers, thus giving them a better price and also reducing wastage. Accordingly in this paper an attempt is made to study the impact of corporate entry of Deepak Fertilizers Petro Chemicals Ltd. (DFPCL) in agricultural marketing. The main purpose of the paper is to observe and compare the price spread and marketing costs of onion in case of sales by farmers in the regulated markets with that to DFPCL. This comparison will enable us to observe if the vertically coordinated supply chain by a corporate has eliminated or reduced inefficiencies in agricultural marketing which normally arise due to multi-layer intermediaries operating with high margins and thus reducing the share of the farmer in the price paid by the ultimate consumer.

In order to study the price spread for onion, the district selected was Nasik in Maharashtra and the taluka selected was Satana. Maharashtra is a leading producer of onion and contributes to about one-third of onions produced in the country. In Maharashtra, Nasik is a leading producer of onions. A comparison was made in the price spread, in case farmers sold in Satana APMC with the price spread when farmers sold to DFPCL. The purpose was to observe if farmers benefited from a more integrated supply chain due to organized retail. Accordingly primary data was collected in 2009, from a sample of 35 farmers who sold to Satana APMC, while in case of sales to DFPCL, only 12 farmers in Satana were found to be cultivating onions by using the services of the company and also finally selling their produce to the company. Further data was collected from five retailers to obtain qualitative and quantitative information such as purchase price, transaction costs, etc. Finally, a focus group discussion with committee members of APMC was also held, in order to get a clear picture of market charges, market practices, etc. Consumers were also interviewed regarding their preference of purchase of fruits and vegetables.

Deepak Fertilizers and Petro Chemicals Limited

Deepak Fertilisers and Petro Chemicals Ltd. (DFPCL) has entered into agricultural markets with the purpose of providing cost effective technology to farmers so as to produce quality fruit. It also procures produce for domestic and international buyers as well as for processors.

DFPCL was initially established for the purpose of manufacturing fertilizers in India. However, it diversified through its Agribusiness & Farming Solutions (ABFS) Division in providing cost effective solutions to farmers,

complete agronomic advisory service and plant nutrition solutions, pre and post harvest technology dissemination and all round efforts to make the Indian farmer globally competitive. The Agri Service division of DFPCL is known as Saarrthie and DFPCL has seven Saarrthie centres in key agri areas of Maharashtra state.

Saarrthie centers are located in major districts of Maharashtra namely Nashik, Aurangabad, Pune, Solapur, Sangli and Ahmednagar. Saarrthie aims at providing total agri solutions through soil, water, plant testing facilities along with complete crop nutritional management, using its range of plant nutrient products which include micronutrients. These centres also provide marketing linkage to the farmers for his farm produce with product buyback and retailing. The main aim is to provide a complete basket of solutions and techno-commercial services to ensure higher yields and thus profitability of farmers. Each Saarrthie extension centre operates from a centrally located office in a potential area/market place. Each centre is managed by an Agronomist who is assisted by a team of supervisors and technical assistants. The ABFS division of DFPCL also helps farmers to obtain Global Gap Certification so that they can capitalize on the opportunity to export to the high valued European and US markets. ABFS also conducts training programmes for farmers to enable them to develop standards which can be easily audited and thus promotes Good Agricultural Practises (GAP). The training programme creates awareness among farmers on Integrated Crop management, Integrated Pest Control, Quality Management System, Hazard Analysis and Critical Control Points and Worker Health and Safety. Further, ABFS also helps farmers in post harvest handling, grading and packaging of produce.

Comparison of Price Spread for Onion in case of sales to APMC (Satana) and DFPCL

The supply chain in case of sales in regulated markets is different from that in case farmers sell to DFPCL. In case of regulated market sales, the farmer sells his produce through a commission agent to a wholesaler, who in turn sells to a retailer. The consumers then purchase from a retailer. In some cases before the produce reaches the retailer, there are two wholesalers involved in the supply chain. However, the purchase operations of DFPCL are shorter as the company sources purchase the produce directly from farmers and supplies it to malls or exports it depending upon the orders it receives from organized retail or overseas buyers.

It can be observed from Table 1 that in case of sales through regulated markets although the farmers in the sample received Rs 711/- per quintal, they had to incur marketing costs of Rs 74.94/- per quintal and hence their net price after deducting marketing costs was Rs 636.06/- per quintal. (It may be noted that Rs 711/- per quintal is the weighted average price of the sample farmers which is calculated by using quantity sold as weights). The farmers sold to wholesalers who incurred marketing costs and margins of Rs 445.05/- per quintal. There was also wastage of onions during the time taken to transport the produce from the APMC to the retail outlets. The sale price of the onion retailer was Rs 1437.65 /- per quintal. Finally, it can be observed from Table 1 that the share of the farmer in the retailer's price incase of sales to regulated markets is 44.24 percent, while marketing costs as a percentage of retailer's price is 44.25 and marketing margins as percentage of retailer's price is 11.05 percent.

With respect to sales through DFPCL (see, Box 1), it can be observed that although the sample farmers received a lower price than the auction price in APMCs, they did not have to incur marketing costs as their produce was picked up by the agent of the company from the farmer's field. Hence Rs 694/- was the net price received by the farmers incase of sales to DFPCL, which was about 9 percent higher than the price received by farmers who sold through regulated markets. From the farmers' field, the produce goes to retail outlets such as malls or in some cases it is exported. The margin of the retailer in case of sales to DFPCL is obviously much higher than that observed in the traditional APMCs and is 44.9 percent. It may be noted here that the retailer's margin includes the margin of DFPCL which purchases the produce from farmers and supplies it to the retail outlet. About 42 percent of retailer's margin is the share of DFPCL for its service charges. The share of the farmer in retailer's price in case of sales to DFPCL is 43.4 percent which is negligibly lower than those who sold in wholesale markets. The marketing channel through corporates is much shorter than the traditional channel as the wholesalers are eliminated though the retailer's margin is higher. The retail price under sales to DFPCL is also higher than the traditional channel because the agent of the company who buys the produce, normally does sorting of the produce and buys only selected produce which finally fetches a higher retail price.

Broad conclusions and Policy Implications

The organized agri-retail sector is making attempts to expand although it is still at an infant stage. Discussion

Table 1: Price Spread and Marketing Costs for Onion

Sr.No.	Price Spread	Sales through APMC	Sales through DFPCL
I	**Price received by farmer**	711	694
I	**Total Marketing costs of farmer**	**74.94**	-
	(a) transport to APMC	23	-
	(b) loading and unloading	2	-
	(c) weighing & other related expenses	7.30	-
	(d) commission	28.44	-
	(e) standard deduction considered as wastage	14.2	-
	Net Price received by farmer	636.06	694
	Net profit (Net Price received-Paid Cost)	**434.06**	405.0
II	Marketing Costs and margins of wholesaler	**445.05**	-
	(a) market fee	3.32	-
	(b) gunny bags	32	-
	(c) stitching gunny bag	3	-
	(d) hamali	6	-
	(e) wastage during transport	284.4	-
	(f) transport to terminal market	95	-
	(g) wholesaler's margin	21.33	-
	Purchase price of wholesaler plus marketing costs & margins	**1156.05**	-
IV	Marketing cost and margins of Retailer	281.6	906
	(a) Hamali from point of purchase to tempo	10	2
	(b) Transport to retail outlet	10	12
	(c) Miscellaneous expenses such as cess to corporation, watchman for unsold stock, supermarket overheads, etc	2	103
	(d) Wastage	115.60	70.5
	(e) Retailer's margin	144	718.5
	(b) sale price of retailer	**1437.65**	**1600**
V	Share of farmer (%) in retailer's price	**44.24**	**43.4**
VI	Marketing Costs as % of retailer's price	**44.25**	**11.7**
VII	Marketing margins as % of retailer's price	**11.05**	**44.9**
VIII	Modified Measure of Marketing Efficiency*	**0.87**	**0.77**

Note: * as per formula suggested by Acharya and Agrawal, 2004.
Source: computed from field survey data (Shroff, et al., 2011)

with customers revealed that a number of factors such as urbanization and rising per capita incomes are encouraging corporate entry into organized retail. Customers mainly from upper middle and high income categories prefer supermarkets because there are several potential benefits associated with purchasing from these markets. Malls and supermarkets are a self service store offering a wide variety of fresh produce which adds to the convenience of customers. The basic appeal of a super market is also the availability of products at competitive prices and stores being open till late hours so that customers have easy access to these markets. These markets also advertise their products in newspapers so that customers are aware of discount offers. Further, fruits

Box1: Agricultural Marketing through Emerging Marketing Channels

Till date, the most common method of sales of agricultural commodities is through regulated markets. However, with amendments in APMC, a number of corporate are entering into the retail segment especially with respect to fruits and vegetables. Deepak Fertilisers and Petrochemicals Corporation (DFPCL) is one such corporate which not only directly purchases fruits and vegetables from farmers for domestic and export markets but also provides them with extension services through its 'Mahadhan Saarrthie Centres". These centres provide crop specific and soil specific advisory services to farmers, to build brand loyalty, enhance quality of produce and thus increase farm production. Since inception, the Saarrthie centres have cumulatively serviced about 5440 hectares of land and by 2009-10 the Saarrthie centres had 7189 farmer members. In 2008-09, DFPCL sold 1110 MT of fruits and vegetables while in 2009-10, the quantity increased to 1727 MT. DFPCL does not have its own retail outlet but caters to the requirements of other corporates dealing in retail. Its main customers are Aditya Birla Retail Ltd, Metro Cash & Carry, TESCO India, Future Value Retail Ltd, etc. It also caters to export markets. In case of onions, in 2009-10, DFPCL purchased 4769 quintals of onion for export to Dubai which were purchased at Rs 8 per kg and sold in overseas market for Rs 10 per kg. DFPCL through its Agri-Business and farming Services has also helped farmers to obtain GAP certification from "Food Cert B.V" which is mandatory in order to export.

Discussions with officials of DFPCL revealed that they are quality conscious in their purchases. Hence besides buying from farmers, they also purchase from traders as traders are willing to give them selected produce while farmers complain to them that if good quality produce is taken away, then the residual has to be sold at very low price in the regulated market. The traders also accommodate the company in case of loss in weight due to shrinkage, moisture loss, etc. In case of purchases from farmers, the company makes immediate payment within a maximum period of 7 days by cheque. The main reason that farmers prefer to sell to DFPCL is that they save on commission charges as well as packing and transport expenses. However, in view of limited demand by DFPCL only few farmers can benefit from better prices and saving on marketing costs. Farmers in general have to therefore depend upon the traditional channel which accepts all the produce.

DFPCL directly sources from farmers and traders on behalf of its customers who normally sell the produce in super markets and malls. A discussion with some of its customers revealed that the super markets have a purchase team which decides the price at which the produce will be sold and normally maintain a margin of 10 to 20 percent in its sales. However, it was revealed by some officials in the supermarkets that there are cases when the produce is sold at a loss but the company is able to sustain the loss because it deals in several fruits and vegetables and losses in one item are made up by profits in another agricultural commodity. Further, it was revealed that the price at which the supermarket's competitor was selling the produce was a very important factor determining the price at which the supermarket would fix its selling price. In some cases, the supermarket would immediately reduce its price to the competitor's level, even if it meant a loss to the supermarket. Hence prices are benchmarked depending upon the price of the competitor. Also, if the staff in the supermarket finds that the quality of the produce is deteriorating, they immediately contact the purchase team which immediately gives its decision to sell the produce under "Reduce To Clear" code (RTC code). The officials also noted that thousands of consumers visit the supermarket every day, and therefore the agricultural produce which is displayed for sale is handled by several consumers. This constant handling of the produce leads to deterioration in quality and has to finally be sold at a discount.

and vegetables are graded, sorted, labeled and well packed which adds to the convenience of customers. Some consumers feel that super markets comply with all standards which suit their requirements and they can also make payment through credit card and facility is available to park their vehicles.

However, the marketing operations of corporates such as DFPCL are very limited and restricted to purchase

of superior quality produce. These operations mainly reach farmers who have availed of the farm advisory services of DFPCL through expert advice, field visits and crop guidance. Farmers also revealed that since only quality produce is picked up by DFPCL, the balance produce is treated as low quality and sold at a lower price. These constraints can be overcome only if the company increases the scale of its operations and spreads its extension services so that farmers make minimum losses in production and can gain maximum through better prices and lower marketing costs.

References

Acharya, S. S. and N. L. Agarwal (2004), *Agricultural Marketing in India*, Fourth Edition, Oxford and IBH Publishing Co. Pvt Ltd, new Delhi.

GOI (2011), *Agricultural Statistics at a Glance*, 2011, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

Shroff Sangeeta, S.S. Kalamkar and Jayanti Kajale (2011), *"Impact of Emerging Marketing Channels in Agricultural Marketing in Maharashtra, Benefit to Producers-Sellers and Marketing Costs and Margins of major Agricultural Commodities,* Gokhale Institute of Politics and Economics, Pune, unpublished AERC Project Report, April.

"Few people are capable of expressing with equanimity opinions which differ from the prejudices of their social environment. Most people are incapable of forming such opinions."

— Albert Einstein

Feature

Eco-industrial Clusters: Pathways for Evolving New Business Models for Eco-innovation and Green Growth

A. N. SARKAR

Industrial Clusters development has so far been very successful experience in transforming the economy of many countries and spread of multi-national companies (MNCs) in several parts of the world. Unlike Industrial-clusters per se Eco-Industrial Clusters (EICs), are defined as: "A community of business; geographic concentration of interconnected companies in a specialized field that cooperate with each other and with the local community to efficiently share resources (information, materials, energy, water, infrastructure, finance, etc), leading to improved environmental quality, economic gains, and equitable enhancement of human resources for both the business and local community." Essentially, an Eco-Industrial Cluster (EIC) aims at efficient use local renewable/ recyclable resources while achieving economic development targets and meeting the social demands of the local community. The potential benefits expected from eco-industrial cluster development are multiple, viz. zero emission, employment generation, new product development, branding, eco-labelling and green growth.

The paper attempts to put together and highlight some of the recent innovative planning, use of eco-designing approaches and achievement in developing the concept as well as project-based applications of eco-industrial clusters, with focus on eco-innovation, sustainable development and green growth by developing innovative and replicable business models for local and regional development. The paper also highlights the evolution of various types of Eco-clusters, criteria for selection of clusters; and some of the successful eco-industrial cluster-based business models in many parts of the world, including in India, and the learning thereof for future improvement. Impact analysis and business potential of Eco-industrial clusters are also discussed briefly in the paper.

A.N.Sarkar is Senior Professor (International Business) & Dean (Research), Asia-Pacific Institute of Management, New Delhi.

Current researches in industrial ecology indicate that geographic proximity of economic activities enables higher levels of productivity and innovation. Clusters, i.e. geographically co-located producers, suppliers, service providers, research laboratories, educational institutions, and other institutions in a given economic field, are important drivers of dynamic regional economies. Way back in the late 19th century, the renowned economist Alfred Marshall (Marshal, 1820, 1890) investigated industrial districts. He identified externalities that were caused by the local availability of qualified labour, a growing demand in the location and a high specialization of companies at different levels of the value-chain. He came to the conclusion that the industrial atmosphere contributes to the improvement of social and economic performance of the companies located in the districts.

The geographic agglomeration of firms within industries is a visible fact in many countries and has been recognized many years ago. The auto industries clustered around Detroit in the USA and Turin in Italy are well-known examples. Later, the high-tech industries settled in Silicon Valley at San Francisco and around Boston in the USA whereas Dublin is known as a home for high-tech firms in Europe. Economists have developed a lot of different theories explaining why firms may locate next to each other and which kind of competitive advantages they gain from their location. However, when it comes to the size of these location benefits there are only a limited number of empirical studies mainly due to lack of relevant data, and the studies are mainly case-based and examine the performance of a few selected clusters (Glasser *et al.*, 1992).

Cases of industrial agglomeration or clusters arise in the presence of industry-specific and local externalities,

also called Marshallian externalities. The standard argument is that such externalities may justify a policy of infant-industry protection to allow and encourage clusters to emerge (Rodríguez-Clare, 2007). There is abundant evidence that such externalities exist and lead to industry-level agglomeration (Rosenthal and Strange, 2004).

The targeting of industrial development programmes at specific industry clusters generally will provide greater economic development benefits than those associated with more unfocused industrialization efforts because of instant availability of local resources and skilled manpower. The concentration of an industry at a particular location may result in significant cost savings to firms in the cluster, as a result of a greater availability of specialized input suppliers and business services; a larger pool of trained, specialized workers; public infrastructure investments geared to the needs of a particular industry; financial markets familiar with the industry; and an enhanced likelihood of inter-firm technology and information transfers. In addition, clustering encourages networking or cooperation among firms in an eco-system and industry clusters facilitate new firm start-ups and futuristic growth.

According to the President's Council on Sustainable Development, Eco-efficiency Task Force Report, Washington (DC), 1997, Eco-Industrial Clusters (EICs), are defined as: "*a community of business; geographic concentration of interconnected companies in a specialized field that cooperate with each other and with the local community to efficiently share resources (information, materials, energy, water, infrastructure, finance, etc), leading to improved environmental quality, economic gains, and equitable enhancement of human resources for both the business and local community.*" Essentially, an Eco-Industrial Cluster (EIC) aims at efficient use local renewable/ recyclable resources while achieving economic development targets and meeting the social demands of the local community. As one of the applications of industrial ecology principles and business competition theories, EICs can become an emergent venture of integrated environmental and economic planning. The driving force of an EIC is inter-firm networks for the optimized use of both direct and derived resources. Recycling, reusing and finding alternate use for discarded waste materials are essential characteristics of such networks for building a competitive advantage. Thus, the emphasis of an eco-industrial cluster is rather a closed-loop material cycle/ recycling than a linear chain of material flow in the identified project sites. Promoting the concept of eco-industrial clusters in potential eco-systems represents a focusing mechanism for eco-restructuring of industrialization at regional or even local level for fostering green growth. This also shows the future pathways of a sustainable development opportunity with job prospects for ecologically degraded, economically distressed and socially isolated local communities.

The objective of the paper is try to build a comprehensive understanding about the principles of eco-clustering of industrial units and their scope of future development to economic advantage on a competitive basis with focus on eco-innovation, sustainable green growth by developing innovative and replicable business models for local and regional development. Impact analysis of eco-clustering initiatives – both globally and locally; and looking into the future business potential of Eco-industrial clusters are also the other objective of the paper.

Foundation of Eco-Industrial Clusters

Industrial Clusters development has so far been very successful development in transforming the economy of many countries as well as in the spread of multi-national companies (MNCs) in several parts of the world. However, the concept has not gained adequate attention in the development of micro, small and medium enterprises (SMEs) where there is enormous potential for enhancing 'inclusive growth'. The introduction of clusters; especially the eco-clusters in these enterprises, can offer various advantages compared to a situation where such small businesses are located in geographically scattered areas with limited resources for future expansion. The potential benefits expected from eco-industrial cluster development are multiple, viz. zero emission, employment generation, new product development, branding, eco-labelling, improved efficiency in production and marketing as well as conducive environment for eco-innovation etc. (Anbumozhi, 2008, Chiu and Geng, 2004, IGES, 2007, Fujita, 2008, Michael, 2008, Matsuomoto, 2008, Visvanthan, 2008). Various studies undertaken by several research workers in recent times in selected economic sectors points towards a variety of drivers that propel the process of eco-industrial cluster development which varies from response to climate change impact, environmental regulation and governance, the strategic intent of developmental assistance policy (e.g. green-funding) to economic dislocation (e.g. climate refugee) and spontaneous response to international market opportunities. Regardless of the origin or sector, the following characteristics are identified as key foundations of EICs clusters:

Inter-firm Networks

Successful Eco-Industrial Clusters (EICs) are made up of enterprises that constantly seek inter-firm networks, not only in terms of minimizing recyclable wastes and reduce pollution, but also to look in for all types of eco-innovations (e.g. eco-technology, renewable energy) to improve zero emission processes with eco- standards to develop new eco-products. Agreements among the eco-enterprise players based on mutual trust within a network of community aim to share by-products, wastes and physical and natural resources including labour, technology and financial resources. Such networks can generate new and emerging eco-markets, logistics, supply chains and cluster-related management operations. The environmental, economic and social benefits gained through such inter-firm networks are expected to be quite substantial over a period of time.

In many Asian economies, the industrialization does not happen overnight. It evolved from the backyard family operations, to small and medium enterprises (SMEs) located in un-zoned areas. Furthermore, they developed into linked businesses due to supply chain force, and eventually many of them succeeded to become medium and big multinational companies (MNCs) located in clustered industrial estates. Similarly, the total quality environmental management (TQEM) approach of the eco-industrial clusters also has their four developmental stages. They can be explicitly described as given in Table 1 (Chiu, 2000):

Table 1: Total Quality Environmental Management (TQEM) approach of Eco-industrial Clusters

Stage of Achievement	Features and Approaches
Stage I. Internally Neutral	Plant / Business Complex Level minimal impact For example, applying strategic Cleaner Production (CP) / Green Productivity (GP) / Eco-efficiency approaches
Stage II. Externally Neutral	Estate with some Locators Level minimal impact For example, using Environmental Management of Industrial Estates (Cote, UNEP Tech Report 39)
Stage III. Internally Supportive	Estate **and** all Locators Level cumulative minimal impact For example, implementing Programmatic Systems and Approaches in Industrial Estates in one or various aspects such as CP, EIA, EMS, Biodiversity, APELL, etc. (Cote, 2000)
Stage IV. Externally Supportive	Total System Level synchronized minimal impact Optimal harmony of Industrial Ecology into the System (Synergy of resources at holistic approach at the right industry mix achieving economic, environmental, and social impact.)

Source: Chiu, 2000

Stage IV is achieved when it envelops all the three key features of industrial ecology.

Social Capital

Well-established social networks among project communities and a trusting relationship between cluster firms, academic institutions and community-based organizations greatly facilitate inter-firm collaboration as well as diffusion of new technologies. The creation of social capital through the formation of an eco-industrial cluster generally gives a fillip to the eco-industry to reach its full potential in a given time. There is a good example of a Wood Industrial Cluster in Japan (Box 1) where, high social capital that includes the relationships, attitudes and values

Box 1: Example of Eco-initiatives within a Wood Industrial Cluster in Japan

Production of wooden boxes for packing is the mainstay of the wood industries in Maniwa City, Okayama Prefecture. This region has a population of 52,000 and is home to 75 wood based SMEs. The production process generates waste such as wood trimmings and shavings. Inter-firm network of various businesses in the supply chain realised the commercial value in such waste products and explored options of wood as a biomass fuel, extraction of ethanol and wood-based concrete. Technologies such as boilers enabled the process to be carried out, and knowledge/information was brought in by the Universities of Tokyo and Okayama University. Taking leadership and participation by business in community based social networks increased the availability of market information and lowered its cost. It also led them to reach collective decisions and implement actions together. Maniwa City promoted a "biomass town" initiative encouraging businesses with several kinds of funds and subsidiaries. (Source: Nakashima, 2006)

governing the interactions among people, businesses and institutions, facilitated the sharing and development of ideas and pertinent market information thus reducing the transaction cost for businesses operating within the EIC. While the concept of mutual trust among competitors is not the norm among businesses, evidences indicate that it has the potential to build through progressive action by community-based cluster players such as the local Non-Government Organizations (NGO) or Self-Help Groups (SHGs).

A critical mass of clusters creates demand for availability of natural resources, access to eco-technology, intellectual and financial resources and infrastructure for producing a reinforcing cycle that stimulates a region's future prospects for competitive advantage and sustainable green growth of the eco-industry. Sustainable regional strategies in such cases, among other things, focus on growing clusters of eco-firms, and not just individual firms. All industry clusters are composed of related industry sectors. The interconnections between and among these sectors illustrates the '*clustering effect*'.

Types of Eco-Industrial Clusters

Eco-industrial clusters can be broadly divided into three categories; namely established clusters, evolving clusters and emerging clusters depending on the stage of evolution and maturity for full-scale development.

Established clusters are those traded industry clusters in which a region has a potential competitive advantage relative to the nation. They are made up of *traded-related industry sectors.* The sectors that comprise the cluster are sufficiently concentrated to represent a regional specialization compared to the same sector grouping nationally—making them "traded." Established clusters are those typically identified by widely accepted quantitative cluster analysis methods.

Evolving clusters are those already established or traded industry clusters that are evolving because of the presence of *newly related industry sectors,* which hold the promise of transforming the established portion of the cluster over the long term. The newly related industry sectors serve as potential agents of change and diversification. Evolving clusters are composed of both traded-related and newly related industry sectors. The newly related industry sectors are insufficiently concentrated to contribute a traded competitive advantage to the cluster compared to the same industry sectors nationally. However, activity within these new sectors is quantitatively identified as *highly related* to the established cluster and considered *dynamic.* Over a period of time, these related sectors could alter the cluster's competitive direction, having an impact on regional economic growth prospects. Impacts of the Evolving clusters are easy to assess, because they have an established base for growth and benefit from all the advantages of eco-clustering.

Emerging clusters are those industry clusters that exhibit the potential for developing a regional competitive advantage but have not yet done so. They are composed solely of *newly related industry sectors.* These sectors are not considered traded. Sometimes, emerging clusters are clusters in decline. However, they can also represent the presence of technology commercialization from a center of excellence that is gaining economic momentum. The growth of evolving and emerging clusters can signify a positive trend and, in other cases, a negative one depending upon job quality and productivity. The terms *evolving* and *emerging* are value neutral. They relate to changes in the data that need to be contextualized regionally for purposes of interpretation. Not all regions have evolving and/or emerging cluster activity. In some instances, industry-clustering activity is limited to established clusters and sometimes is associated with economies experiencing economic stagnation.

In India, Bangalore- the Silicon Valley of Asia, houses the most prominent cluster in India. From a mere 13 software firms in 1991-92, the city now has a pool of over 1,200 software firms working in areas such as computer chip design, systems software and communication software, employing over 100,000 IT professionals. Compared to other locations in India, Bangalore has high-end technology/industry concentration such as VLSI and telecom services and higher degree of MNC presence with over 200 foreign firms in operation. It is now ranked fourth as a global hub of technological innovation, behind San Francisco and Austin of US, and the Taiwanese capital Taipei (Ramachandran & Ray, 2003).

Cluster is considered to be a good example of corporate collaborative action as well as social networking in that it could help develop its members in improving their business competitiveness across eco-industrial enterprises and in gaining thereof their financial benefits well within growing competition of the modern eco-industrial economies. The concept of business cluster is lately being transferred in the field of corporate environmental management and industrial ecology to provide new ways of collaborative ventures for the upcoming firms on facing environmental challenges resulting from the climate change phenomena, which in turn, could allow them to achieve

simultaneously the objectives of economic viability (Karaev *et al.*, 2007) of the region.

Corporate environmental management literature presents many terms and concepts to clarify how collaborative actions of firms on environmental issues could contribute to natural resources preservations and scientific utilization to provide livelihood support to mankind. Some recently introduced terms coined for the purpose include: eco-clusters, industrial ecology, industrial symbiosis, corporate environmental network and eco-parks. Although those types of firms' formation focus on solving environmental problems, nevertheless they provide essential conditions for creating innovation and improving competitive advantages. According to Esty and Porter (1998) industrial ecology thinking would assist firms to make productivity improvements by using raw materials drawn from nature and therefore to improve their competitiveness in the process because of limitations imposed by the availability of natural resources. Mirata and Emtairah (2005) were of the view that industrial symbiosis could provide eco-innovations through implementing common activities to eliminate environmental impacts and help develop inter-organizational collaboration and learning strategies. However, the terms that are used so far to describe collaborative efforts of firms in the field of corporate environmental management take different meanings and orientation when attempts are made to go in for eco-design in the potential eco-industrial projects. For example, industrial symbiosis, industrial ecology, eco-parks focus mainly on topics such as environmental performance, resource productivity and geographical proximity, while the terms of eco-clusters and eco-industrial networking seems to face loosely the geographical proximity.

Criteria for Selecting Industry Clusters: The Regional Economic Development Research Laboratory (REDRI), University Clemson, South Carolina, USA uses approach to cluster identification and targeting by following three principal steps:

Step 1: Identify industry concentrations for which the region has experienced recent employment growth.

Step 2: Construct value chains for the industry clusters selected in Step 1.

Identify industries in the value chains with the greatest linkages to the local industry concentrations.

Step 3: Rank the selected industries from Steps 1 and 2 by expected economic and fiscal impacts on the local economy.

The REDRL approach to industry targeting focuses on identifying industry clusters for which the study area exhibits promise for attracting and growing. Such a focus on growing industry clusters takes advantage of the roles of historical path dependencies and external economies of scale in determining the attractiveness of a region to manufacturers. The REDRL approach has been applied to local and state industrial development efforts. The interested reader may refer to the following publications for examples of the industry clusters targeting methodology (Barkley *et al,* 1998, 2002).

Eco-industrial Park: an Innovative way of Clustering Business Enterprise

Eco-industrial Park is one of the emerging forms of Eco-industrial Cluster of new and emerging business enterprise. There are several definitions of the term Eco-industrial Park. In 1995, Coˆte´ and Hall proposed this definition: *An eco-industrial park is an industrial system which conserves natural and economic resources; reduces production, material, energy, insurance and treatments costs and liabilities; improves operating efficiency, quality, worker health and public image; and provides opportunities for income generation from use and sale of wasted materials.* An industrial park is also defined as *"a large tract of land, sub-divided and developed for the use of several firms simultaneously, distinguished by its shareable infrastructure and close proximity of firms".* Types and synonyms of industrial parks include: industrial estates, industrial districts, export processing zones, industrial clusters, business parks, office parks, science and research parks, and bio-technology parks. Eco-industrial parks have now been added to this list.

The concept of an eco-industrial park evolves from the emerging discipline of industrial ecology. By collectively managing environmental and energy issues, eco-industrial park members seek to enhance their environmental and economic performance and, as a result, achieve a combined benefit that is greater than the benefits each company would have realized from optimizing only its individual performance. An eco-industrial park is a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resources issues including energy, water and materials. By working together in harmony, the community of businesses seeks

a collective benefit that is apparently far greater than the sum of the individual benefits each company would have realized if it optimized its individual commercial interests for sustainable economic gains with long-term perspective.

Lowe Warren (1996) observed from their research findings that an Eco-industrial park may include many of these features but the essential feature is the interactions among businesses and between the businesses and the natural environment for green growth in an eco-friendly manner without detriment to the environment and ecology. As is the case with the field of industrial ecology, the definition of an eco-industrial park is still evolving with the passage of time and through developing new eco-industrial models based on eco-innovations.

Current Global Experiences in establishing Eco-industrial Parks

The following examples of eco-parks are based on summaries provided in the PCSD 1997 Report, The Road to Sustainable Development: A Snapshot of Activities in the United States (http://www.calrecycle.ca.gov/LGCentral/Library/innovations/recoverypark/CaseStudies2.htm).

Northampton County, Virginia: An example of the first type of eco-park is the Port of Cape Charles Sustainable Technologies Industrial Park, located in Eastville, Northampton County, Virginia. Cape Charles is in the Chesapeake Bay coastal region. The area serves as a critical flyway for migrating birds, with some of the highest bird counts on the whole eastern shore. In addition to its natural features, the area has a rich cultural and historic heritage, characterized by Native American archeological sites and historic homes. The community, as part of a comprehensive Sustainable Development Action Strategy, is designing the Port of Cape Charles eco-park. If successful, the facility will create local jobs and provide protection for the area's natural and cultural resources. The eco-park will provide for water recycling among the resident companies by means of a used-water collection system, a water recovery facility, and a recycled-water distribution system. In addition, a technical panel will analyze and determine whether other companies within the park can use the by-products of existing and proposed companies. Construction on the eco-park began in October 1996, with funding from local, regional, State, and federal sources. The first tenant will be Solar Building Systems Inc. The Northampton County Department of Sustainable Economic Development/Joint Industrial Development Authority is managing the project. Initial efforts have focused on recruiting compatible companies and on developing effective management for the park as an industrial ecosystem. The local community is enthusiastic and committed to the project, and it will be a key to the park's future success.

Brownsville, Texas: An example of the second type of eco-park (a "virtual" eco-park) is a project in Brownsville, Texas. Brownsville is located on the southern tip of Texas in the Rio Grande Valley and is often referred to as a city "on the border, by the sea." It has a rich natural environment and is considered to be one of the three top bird-watching sites in the United States. At the same time, the city has some of the most serious environmental problems in the northern hemisphere and is struggling to address its high poverty and unemployment rates. Local and state government officials have been the primary drivers behind the development of an eco-park in this border region. Clearly if the region's industrial growth is to continue, the nature of that development must change to protect both human health and the environment

As a virtual eco-park, the Brownsville project takes a regional approach to exchanging waste materials and by-products. This approach is sometimes referred to as regional "industrial symbiosis." The project could eventually include a group of businesses that are geographically located together, but co-location is not the driving force behind the project at this time. As currently envisioned, the project will include not only industrial facilities but also small businesses and the agricultural sector. Planning for the Brownsville project has focused on identifying firms that could benefit from participating in regional industrial symbiosis. Project planners have developed a database of companies in Brownsville and in the neighboring city of Matamoros, Mexico. They are analyzing it to identify potential materials exchanges among these industries and/or new companies. The Texas Department of Commerce and the Brownsville community have provided initial funding, and project leaders are working to secure long-term support. State officials will be working closely with project leaders to ensure that permitting procedures do not become a barrier to development. After adding cost-based data to the database, project planners will develop a marketing plan to evaluate and recruit participants. They plan to educate and involve the local residents in implementing the project. The project holds great promise for improving the lives of the people of Brownsville.

Burlington, Vermont: An example of the third type of eco-park (eco-development) is the Riverside Eco-Park in Burlington, Vermont. This project will create an agricultural-industrial park in an urban setting that will:

1. Generate electricity using biomass technologies that use readily available resources (e.g., wood chips).
2. Use the waste heat generated by the power plant to support the greenhouse production of fish and horticultural products.
3. Use biologically-based "living systems" to digest liquid organic wastes (which are common in the food processing industry) to purify water and create high strength fertilizers.
4. Recycle and compost the area's waste foodstuffs and yard debris to replenish local soils, increase agricultural production, and support value-added organic food industries. All of these emerging technologies are being developed with the ultimate goal of transferring them to other industries and communities.

This project is expected to have several positive results, including reducing the waste heat that is released into the air and water, improving soil conditions and water quality, and creating sustainable jobs for the local people. A feasibility study that examined the inputs, outflows, and costs of the biomass energy systems and the living systems led to the conclusion that combining the two systems could be economically and environmentally beneficial. The next steps will be to prepare engineering and cost analyses of the linked systems. A Community Development Block Grant, the Burlington Electric Department, the Department of Public Works, and Cornell University are providing support. Project leaders have applied to the U.S. EPA and the U.S. Department of Energy for funding. The leaders have also recruited a number of organizations and companies to participate in the first demonstration project. They plan to bring in additional partners as the strengths and weaknesses of the project become evident. Project leaders have developed an aggressive five-year plan. They expect to transfer this eco-development model to other sites and to the development of commercially viable spin-off industries.

In the United States, a number of initiatives have been taken pursuant to support from the United States Environmental Protection Agency and the President's Council on Sustainable Development. Similarly, Canada has a few industrial projects underway embodying ecological characteristics embedded with the potential for many more across the country. The "*Industrial Park as an Ecosystem*" project in 'Burnside industrial Park' for instance, began in 1992 as a multi-disciplinary research initiative, investigating the possible application and interpretation of ecological characteristics and functions to develop into an eco-industrial park. The expected outcome of the research guidance was first, on the transformation of Burnside itself and second, for the establishment of future eco-industrial parks. A similar study has been underway in the Portlands Industrial District in Toronto, Ontario since 1995. This industrial area also involves enterprises in a variety of sectors in manufacturing and services with the potential for waste and energy exchanges. A recent study of the potential for integrated eco-industrial parks with co-generation, energy cascading and recycling across Canada identified 40 sites of which nine were deemed to have excellent possibilities for eco-industrial development. There are a number of sites in Canada where limited industrial ecosystems are in operation. In Sarnia, Ontario, some symbioses exist between oil refineries, a synthetic rubber plant, petrochemical facilities and a steam electrical generating station and more linkages are possible. At the Bruce Energy Centre, also in Ontario, the "eco-park" is organized around Ontario Hydro's nuclear power station to take advantage of its waste heat and steam generation capacity. The following Table 2 shows the current potential of some Eco-industrial Parks in Canada.

Table 2: Eco-industrial Parks' current Potential in Canada

Province	Key industries
Vancouver, British Columbia	Steam generator, paper mills, packaging, industrial park
Fort Saskatchewan, Sask.	Chemicals, power generation, styrene, PVC, biofuels
Sault Ste.Marie, Ontario	Power generation, steel, paper mill, flakeboard mill, industrial park
Nanticoke, Ontario	Thermal generating station, oil refinery, steel mill, cement, industrial park
Cornwall, Ontario	Power and steam generation, paper mill, chemical, food, electrical equipment, plastics and concrete products
Becancour, Quebec	Co-generation plant, chemical plants (H^2O^2, HCL, Cl, NaOH, Alkylbenzene) magnesium, aluminum
Montreal East, Quebec	Co-generation plant, petrochemicals, refineries, compressed air, gypsum board, metal refinery, asphalt
Saint John, New Brunswick	Power plant, paper mill, oil refinery, brewery, sugar refinery industrial parks
Point Tupper, Nova Scotia	Generating station, pulp and paper, building board, oil refinery

Source: Report prepared for Environment Canada, Industry Canada and Natural Resources Canada, Ottawa, 1997.

A brief description of some of the Eco-industrial Park Models set up in other parts of the world is given below as illustrations for better understading on the subject.

The Finnish Ecological Parks: Located at *Rantasalmi,* the Finnish Ecological Parks usually consist of forest industry businesses which use their wood-derived wastes for energy, selling electricity to the community, utilizing residual heat from electricity generation for industrial process steam and district heat for residential areas. The *Rantasalmi* eco-industrial park project can, however, be considered the first attempt to plan and organize an eco-industrial park in Finland. Real Estate (Fig.1). Rantasalmen Silva Oy also acts as a development company in the region and one of the aims is to generate a strong knowledge and business concentration in the area. It is owned by Rantasalmi municipality (49%), Rantasalmi Oy (49%) and Spikera Oy (2%).

The evolution of eco-industrial parks into ecosystems is still at a nascent stage of development. Although some research and design projects have attempted to identify the essential characteristics as well as uniqueness of eco-

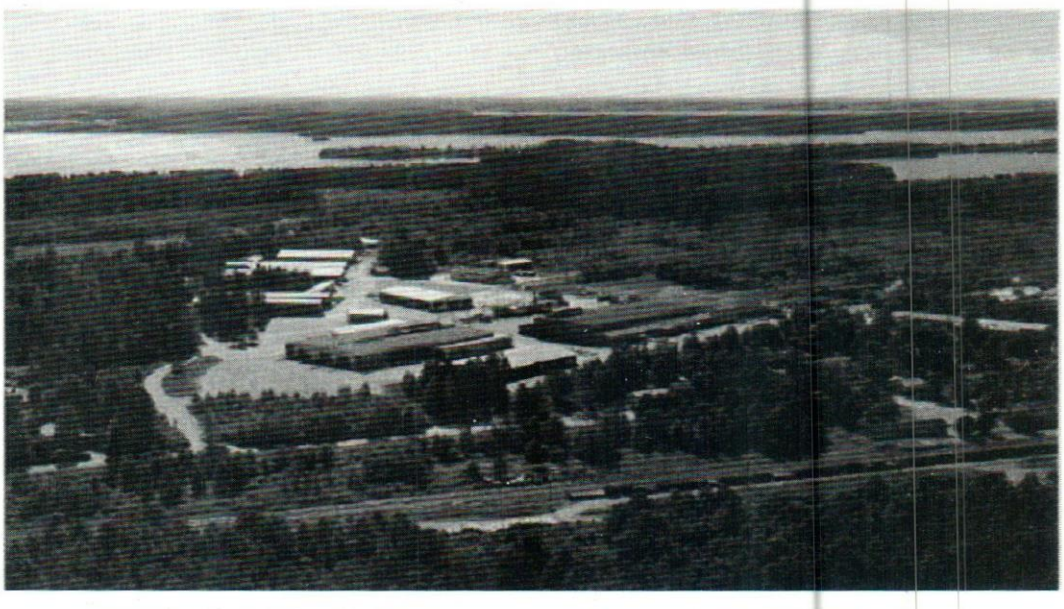


Figure 1: Aerial View of an Eco-industrial Park at Rantasalmi, ETELÄ-SAVO, Finland

industrial parks, there is, apparently, no agreement as yet. All the same, there does appear to be some general consensus emerging from the learnings of the French, Japanese, American and Canadian eco-project initiatives; as also from the UNEP technical report on Eco-industrial parks development as a new economic development proposition.

Landskrona, Sweden: The Landskrona Industrial Symbiosis Project was introduced in 2002 by the International Institute for Industrial Environmental Economics, IIIEE, at the University of Lund, Sweden. A team of IIIEE researchers coordinated the application of a systematic approach for assisting the development of symbiotic connections. The project is supported by the Swedish Business Development Agency (NUTEK). The companies contribute to the project financially, even though the sums contributed are relatively small.

National Industrial Symbiosis Program, NISP, Great Britain: The National Industrial Symbiosis Programme, NISP, is the first industrial symbiosis initiative in the world on a national scale. NISP is a business-led initiative and it is supported by the UK Government and industrial organizations. The program serves as a link between industries and various sectors.

The Luxembourg Eco-Innovation Cluster: Luxembourg hosts a thriving eco-innovation sector. There are numerous eco-companies in the country, working mainly in the field of eco-construction, renewable energy, waste management, water and electro- mobility, supported by numerous public agencies and research organizations. The goal of eco-innovation is to reduce the environmental impact of processes, products and services. Whether it is by finding a more energy-efficient process, a way to address environmental problems or a replacement for an

excessively polluting production method, the scope is very wide. Luxembourg's research activities in environmental technologies focus on environmental management, life-cycle assessment, clean technologies and process engineering, environmental modelling as well as the sustainable management of aquatic and terrestrial ecosystems.

The take-up of green technologies is empowered by an ambitious Government action plan, which has recently been adopted in order to stimulate the production of eco-technology products, the management of natural resources and changes in the design and development of production and consumption systems, in order to make them cleaner and more resource efficient (eco-construction, eco-design, environmental regulations of processes, recycling materials, etc.). Another priority is to support research and development in the environmental technologies field, thereby leading to greater sustainability and economic diversification.

The Luxembourg Eco-Innovation Cluster is a network that supports the various actors of the eco-innovation sector in Luxembourg with the goal of creating and developing new and sustainable business opportunities through collaborative R&D and innovation projects. The Luxembourg Eco-Innovation Cluster comprises companies, research institutes and public organizations involved in the field of eco-technologies. Due to this unique mix of competences, the Luxembourg Eco-Innovation Cluster provides support for the development of collaborative project ideas, the identification of potential business partners and the search for suitable funding in order to empower the development of the eco-technologies sector in Luxembourg and to increase the uptake of "green technologies". Its activities also include the organization of regular networking events, visits, themed conferences and workshops. The Luxembourg Eco-Innovation Cluster comprises companies, research institutes and public organizations involved in the field of eco-technologies. Due to this unique mix of competences, the Luxembourg Eco-Innovation Cluster provides support for the development of collaborative project ideas, the identification of potential business partners and the search for suitable funding in order to empower the development of the eco-technologies sector in Luxembourg and to increase the uptake of "green technologies". Its activities also include the organization of regular networking events, visits, themed conferences and workshops.

Eco-Industrial parks in China: In China the environmental management of industrial parks has been enhanced with the help of EMS's, usually ISO14001. Comprehensive environmental management systems (CEMS) have also been implemented in the industrial areas. EMS's are established for individual firms as well as for the industrial estate management. The aim is to enhance cooperation based on different EMS's. CEMS tries to find similarities between different EMS's and integrates them into common policies, activities and management strategies. Chinese industrial parks have governing administrative bodies that take care of various activities, services, products and the park as a whole. The estate administration is responsible for implementing legislation and regulations, planning and designing the park's supply services (e.g. energy), infrastructure and economic development. These activities can be managed and improved meet the ISO 14001 standard and so the estate administration or government receives the standard. The idea is that the standard can improve the environmental management of governmental institutions. The next step from the CEMS-system is to implement an eco-industrial park on the estate.

There are few studies of eco-industrial parks in the world. There are probably numerous self-evolved parks that have not been identified and studied yet. However, some research on self-evolved systems has been conducted and in many cases synergies have been developed further. New eco-industrial parks have been designed and engineered by researchers, companies and developers in different parts of the world, e.g. in the Netherlands, Austria, Spain, Costa Rica, Namibia, South Africa, Australia and several Asian countries, on the inspiration provided by the research.

Asian Initiatives: Philippines and India have both started doing the EIN earlier than the neighboring economies. Thailand, on the other hand, has shown strong enthusiasm and the infrastructure is very strong. While some countries have already been practicing some EIN components unofficially, there are also other nations like Vietnam and Nepal conducting initial feasibility studies (Sathasivan and Hoang Hai, 2001).In Malaysia, earlier publication on website by USAEP revealed environmental activities in the industrial estates, but similar to Japan, they were rarely referred to as EIN or Eco-industrial Park (EIP). More and more EIN or Environmental Management Projects are in different stages of developments; the Table 3 browses through some of the EIP related activities in the Asian economies:

Table 3: Eco-industrial Parks in Asia

China	Dalian, Tianjin, Suzhou, Yantai, Guidang, Nanhai
Philippines	Laguna International Industrial Park, Light Industry & Science Park, Carmelray Industrial Park, LIMA, Laguna Technopark, Philippine National Oil Company Petrochem Industrial Park; Clean City Center project (USAID)
Indonesia	Lingkungan (LIK), Tangerang; Semarang; Industri Sona Maris
India	Naroda; Tirupur Textile sector; Tamil Nadu tanneries; Calcutta foundries; Tamil Nadu Paper / Sugar; Bagelore Water project; Ankleshwari, Nandeseri, Thane-Belapur
Malaysia	LHT Resources Linkage
Japan	12 ecotowns (e.g. Kitakyushu, Itabashi), Fujisawa, Toyota City
Taiwan	Tainan Technology & Industrial Park, Changhua Coastal Industrial Park; Corporate Synergy System (CSS II) projects
Vietnam	Amata (envi mgt), Hanoi Sai Dong II (feasibility study)
Thailand	Industrial Estate Authority of Thailand plans (Map Ta Phut, Northern Region, Amata Nakorn, Eastern Sea Board, Bang Poo); Samut Prakarn Province CPIE project (ADB funded); Bangkok (Panapanaan)
Sri Lanka	Ministry of Economic and Industrial Development plans

Source: Lowe (2001)

Eco-Town Projects in Japan: The Ministry of Economy, Trade and Industry and the Ministry of Environment, Japan are presently promoting an Eco-Town project, aiming for the construction of a resources-recycling economic society through the development of industrial industries by utilizing local industrial accumulations, the prevention, and the promotion of recycling of wastes based on the uniqueness of local districts. The Eco-Town projects are operated by local authorities to support advanced environment-conscious town building through cooperation with local residents and industries (Eco-Town Projects/Environmental Industries in Progress, Ministry of International Trade and Industry (MITI) in 1997: Environment-Conscious Type of Town-Building Models of Eco-Town Municipalities/Business Firms: Case Introduction: http://www.meti.go.jp/policy/recycle/main/3r_policy/policy/pdf/ecotown/ecotown_casebook/english.pdf). The details of the Eco-Town Project are given below in Figure 2:

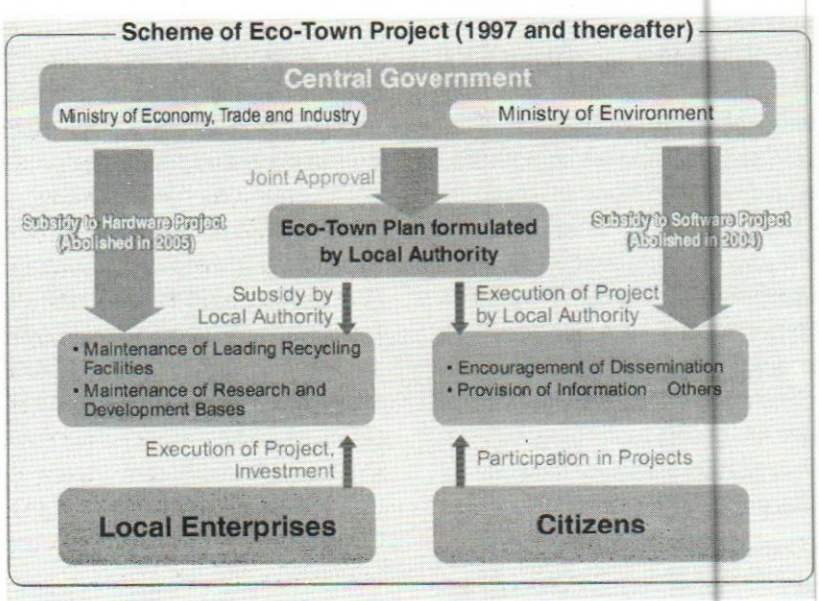


Figure 2: Schematic Project Plan of Eco-Town Project in Japan

In Japan, Eco-town projects can be promoted and funded by a government program started by the Ministry of International Trade and Industry (MITI) in 1997. The main objective of the programme is to encourage community development throughout the environmental industry and development of environmentally sound community systems involving industrial and public sectors. The programme was initiated as the result of a waste management crisis. As discussed above, Japan has been facing a serious problem with its waste management. Waste treatment facilities and landfills are almost exhausted. Yet, the environmental and recycling industries are considered "venous industry" (receptive, secondary) and have yet to develop a viable eco-market with high business potential. By promoting the environmental industry, the program attempts to involve both community and industry in waste management, which, in turn, promotes local economy and community. The central government provides both technical and financial support to local governments that wish to establish eco-towns as areas where regional zero emissions are promoted through various recycling and industrial symbiosis efforts. Once a development plan is submitted by a local government and approved by MITI, they are eligible for federal financing to promote and encourage ecologically sound industrial activity (Eco-Town Programme:http://www.meti.go.jp/policy/recycle/main/english/3r_policy/ecotown.html; METI, 2000).

Local governments of Japan can use MITI funds to develop and implement comprehensive plans for the area, attract companies that will actively facilitate recycling and waste and energy use reduction programs. The area may also serve to attract businesses developing environmental technology, and may contain research and development facilities. The most unique feature of this program is that funds are made available to private businesses and projects located in the region that develop new environmental technologies to promote regional zero emissions (Fujimura, 1999). This public-private partnership is noted as an important factor in the success of this program as it can facilitate local economic development. Up to 50% of the project cost, both for managerial activities, such as planning or promotion, and for technical costs, such as recycling facilities or new environmental technologies, can be financed by the funds.

Under this arrangement, local governments and communities benefit by having an opportunity to reduce and repair environmental degradation and improve human health and safety. In addition, local governments are given a way to promote economic development by attracting new business. Many businesses also perceive improved public relations benefits from being members of an eco-town. The central government benefits by promoting environmentally friendly business and development, and easing the burdens associated with waste disposal, scarcity of virgin resources, and environmental damage in Japan. Moreover, these projects promote the development of high-tech environmental products that can benefit Japan's economy and trade. There are 10 projects currently approved as Eco-Town Projects in Japan. Each of these projects takes a different form in carrying out eco-town plans. Some involve eco-industrial parks or regional by-product exchange, while others focus on recycling technologies. The bottom line is that each area develops its plan in the context of region specific characteristics and advantages. For instance, Omuta, Akita, and Uguisuzawa will develop the area abandoned after the closing of mines and utilize the technologies in pollution prevention and resource extraction for the development of eco-industrial projects and the encouragement of local economy. The flexibility of the eco-town projects allows local government to develop their plan in accordance with their specific geo-climatic distribution characteristics and business situations.

Eco-industrial Ventures in Andhra Pradesh: An Indian Experience

For demonstrating systematic and comprehensive planning of new Eco- industrial parks, a Multi-product Andhra Pradesh Special Economic Zone Project at Visakhapatnam, covering an area of 5,683 acres (2,300 hectares) was taken up. The Project is co-funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Ministry of Environment and Forests (Eco-Industrial Parks in Andhra Pradesh: GTZ- http://www.giz.de/Themen/en/30432.htm). The environmental impact assessment (EIA) taken up on the Eco-industrial Project included study of baseline environmental conditions, meteorology, ambient air quality, inland water quality, ground water quality, surface water quality, soil quality, flora and fauna, marine environment, socio-economic conditions, risk analysis and disaster management planning, traffic studies and transportation management. Based on the EIA studies, Site Master Planning was taken up comprehensively. The plan includes special elements such as transport network, storm water drainage system, cogeneration plant, common waste water treatment and disposal, treatment of sewage and reuse, waste management, green belt and provisions for disaster risk management. Based on impact assessment findings,

there is now a spurt of fresh demands coming up on larger application of the concepts for establishing new eco-parks with added elements of energy efficiency, renewable energy, and addressing environment and climate change issues. With the increased environmental/energy personnel at APIIC Project Centre of Andhra Pradesh and propagation of eco-industry park concepts, a number of activities have been initiated for reduction of negative environmental impacts from industrial parks including stopping of illegal discharge of industrial effluents and wastes, initiation of actions against defaulting industries, plantation activities, identification of infrastructure requirements their augmentation, construction of a Common Effluent Treatment Plant (CETP) in one of the industrial parks (Vijayawada) Also, significantly visible is the plantation taken up by APIIC for 40 eco-industrial parks and planning to set up CETPs in various industrial parks.

Round Tables on "Eco Industrial Parks" were recently organized in Hyderabad (Andhra Pradesh) and Ahmedabad (Gujarat). Environmental awareness programmes were organized in industrial parks in Kakinada, Visakhapatnam, Tirupati, Nellore and Shamshabad, coupled with tree plantation. Particularly on the occasion of the *World Environment Day* 2009, the theme of "*Unite to Combat Climate Change*" was propagated through a massive rally in Hyderabad and parallel events in several industrial parks. For promoting eco industry park concepts and sustainability concepts, a number of activities related to Counseling, Training, Workshops and Exhibitions were organised. To start with, activities to be implemented during 2009 to 2010 were identified through a Planning Workshop organized in December 2008 with APIIC officials (Project implementation partner). Support was provided to the workshop on *"Eco Industrial Areas"* organized by the Andhra Pradesh Pollution Control Board which had over 150 participants from industry, experts from the field of environment. The workshop helped promoting the eco industrial park initiatives. An Awareness Workshop on "ECO-PROFIT Programme" was held at Hyderabad on April 16, 2010 in cooperation with the Federation of Andhra Pradesh Chamber of Commerce & Industry (FAPCCI) for the member industries of FAPCCI. A 'Tool Box on Eco-Industrial Development' was developed by GTZ – the German International Funding Agency, drawing on experiences of eco-cluster projects from India, Thailand, China, the Philippines and Tunisia.

Multiple impacts **: Replication of Eco-Industrial Park concepts started in Andhra Pradesh and other parts of India:** The Project succeeded in replication of the Eco-Industrial Park concepts within Andhra Pradesh and beyond in several parts of the country with multiplier effects. APIIC had scaled up the application of the concepts from the two eco-industrial parks that were taken up initially to 32 eco-industrial parks. The results are forthcoming in 15 industrial parks with more convincing results. In the state of Gujarat, the activities were initiated for transformation process of two existing industrial parks at Naroda and Vatva near Gandhinagar. Activities for promoting eco-industry park concepts in pharmaceuticals sector have also been initiated in cooperation with the Department of Pharmaceuticals (DoP) of the Indian Ministry of Chemicals and Fertilizers. The focus is in five states having significant presence of pharma industries and these include: Andhra Pradesh, Gujarat, Maharashtra, West Bengal and Tamil Nadu. Further, for the Government of Orissa, a proposal was developed for planning and development of 450 acre 'Solar Technology Park' through the Industrial Promotion and Infrastructure Corporation Ltd. (IPICOL). A cooperation agreement was made with the Engineering Staff College of India (ESCI) in Hyderabad, with the Centre for Climate Change taking lead in implementing Eco-profit and other training measures for pharmaceuticals industries.

Eco Industrial Park concepts were expanded with climate-relevance. The relevant tools viz. Eco-profit, Environmental Audit and Energy Audit, were demonstrated in industries with content-inclusion of climate-relevant measures, which specifically aim at energy and resource efficiency. Also, the originally conceived concepts of Eco Industrial Parks were expanded while targeting expansion of the concepts to other parts of India. For example, for expansion to the pharmaceuticals sector in India and for eco industrial development in the state of Gujarat, the focus had been provide for infrastructure strengthening including on renewable energy and on resource/energy efficiency in individual industries.

Eco-industrial Cluster Analysis and its Economic Significance

Industrial cluster analysis is a tool to better understand our regional economy. The purpose of cluster analysis is to identify those areas of the economy in which a region has comparative advantages and to develop short and long-term strategies for growing the regional economy. Increased regional prosperity is achieved by creating a positive environment to nurture these clusters. An industry cluster is considered to have a comparative advantage if the output, productivity and growth of a cluster are high relative to other regions. In addition, local infrastructure

and collaborative efforts afford cluster industries other advantages that are a result of their shared geographic location and common goals. While the total number of jobs in comparative-advantage industries in a region may not represent the majority of the region's employment, these industries are the economic engines of the rest of the economy. Workers, inventors, community, institutions such as government and education, and others need to support the cluster industries and affect a broad range of industry cluster groupings.

The Standard Industrial Classification (SIC) system has been used on a selective basis in some of the eco-project sites in different parts of the globe to classify employment sectors by the type of activity in which they are engaged throughout the late 1900's. This traditional method can, at times, have difficulty defining the driving industries in a region in terms of their spatial location, employment size, wage rates, infrastructure needs, suppliers and competitors. The SIC system is based on a four-digit industry coding system and groups industries by sectors such as Wholesale Trade, Services, and Manufacturing. Today, new driving industries like biotechnology, software, environmental technology, and communications do not fit into classic SIC sector definitions of the Manufacturing or Service sectors. Industries broadly labeled. Within the next few years a new industrial classification system will be implemented in the NAFTA countries. The North American Industry Classification System (NAICS) in the NAFTA region will be a more detailed one and will allow for multi-national comparisons across the borders. While some definitional problems may be solved, the grouping of "biotech" straddle sector definitions, somehow does not fall neatly into the categories outlined by the SIC system. The use of clusters, particularly the eco-industrial clusters as a descriptive tool for regional economic relationships provides a richer and more meaningful representation of local industry drivers and regional dynamics than the one provided by the traditional Standard Industrial Classification (SIC) system.

Firms within an eco-cluster by and large exhibit strong inter-relationships and connectivity for maintaining resilience in the project eco-system. The flow of goods, information and services between geographically concentrated industries in a cluster is stronger than the flow linking them to the rest of the economy. An eco-industry cluster is different from the classic definition of industry sectors (e.g., construction, manufacturing services, etc.) because it represents the entire value-chain of a broadly defined industry from suppliers to end producers and consumers, including supporting services and specialized infrastructure. By locating the eco-clusters close to one another, businesses are able to acquire information, communicate and share inputs in such a way as to add to a "collective" advantage that could not otherwise be achieved alone. Clustering facilitates collaboration to overcome shared problems and obstacles. This can be done directly by the formation of industry associations, or indirectly through regional legislation. Even though some firms may be competing, certain collaborations, such as providing industry-relevant training, transfer of eco-technology, access to renewable resources etc are extremely beneficial for setting up eco-clusters more effectively. Common goals and geographic concentration of eco-clusters leads to the development of specialized skills, institutions, and alliances within the cluster agglomeration because of the spin-off and multiplier effects more synergistically.

Focusing on clusters does not mean that economic prosperity will be limited only to those employed in cluster industries nor does it suggest that other industry sectors are unimportant. It must be emphasized that high technology employment sectors include many non-high technology jobs. Thus, cluster focus is not an attempt to pick winners nor does it focus solely on very high skilled, elite jobs. Clusters are a way to track employment trends underlying structural shifts in our economy. Cluster analysis is an attempt to maximize the efficiency of public policy and investment by focusing efforts primarily on the economic drivers of the region. More importantly, positive benefits are gained by non-cluster sectors as a result of the inter-industry relationships that exist in a manufacturing and service-based industries will likely remain an important issue that will require cluster analysis for clarification. In India, there is currently a strong emphasis to develop industrial clusters in identified Special Economic Zones (SEZ) with distinct competitive advantage.

Because industries in an economy are linked and inter-related, positive investment in one sector is also felt by numerous other sectors of the economy. Focusing on the economic drivers of an economy is not a new approach. The manufacturing sector used to be the primary driver of a regional economy and was the recipient of past economic investments. Since today's driving industries are no longer solely located in manufacturing, economic policy has adapted to incorporate broader industries—made possible with industrial cluster analysis. Cluster analysis is therefore perceived to be an evolving analytical tool, and over time cluster definitions and the statistics used to track them

will need to be revised with newer experiences in the field of industrial ecology in general eco-industry in particular.

Integrating Economic Development through Environmental Linkages

Developing countries, particularly in Asia, are struggling to cope with the negative impacts of concentrated industrial activities. Inspired by the theory of industrial ecology, eco-towns or eco-industrial parks are frequently promoted in many localities as a strategy for reducing the environmental burden of industry in a way that is consistent with economic development. Yet the reach of those eco-approaches are limited to traditional manufacturing industries concentrated in urban areas. However, for countries looking beyond simple manufacturing and which are turning to the adoption of new kinds of industries, it is the inner regions, the zones of transitions which begins with the edge of residual green space and the fringe areas making up the hinterlands between urban and rural areas that offer an opportunity for equitable growth. These areas are already used as sites for clusters of new industries that want equal access to raw materials as well as to urban markets. However, rather than just co-existing, these companies could become interconnected, sharing resources and achieving economic, social and environmental success. The solution is to create an Eco-Industrial Cluster (EIC). The key foundations of EICs, as can be learned from these four prototype cases in India, Japan, Thailand and Viet Nam are: inter-firm networks, enabling technologies, social capital and public policy support. It is important that these infrastructures should be created simultaneously with new industries, and not after environmental problems have already developed, as has been done in the past (http://enviroscope.iges.or.jp/modules/envirolib/upload/1593/attach/policy%20brief%20no.8-e.pdf). Changes in policy orientation are essential to promote the EIC as a new model for sustainable regional development. Joint efforts that cut across three main policy streams of industrial policy, environmental policy and regional development policy that favour co-operative, multi-stakeholder and often location specific approaches are needed to unleash the sustainability potentials of the future eco-industrial clusters in any part of the world.

Sensing the Eco-Industry's Business Potential

The green industry focuses on making a profit while having a negligible (or even a beneficial) impact on the environment. Leaders make sustainability a key consideration in decision-making throughout the organization as they work to minimize both use and production of harmful chemicals, excess materials, and waste byproducts in the delivery of their goods and services. Recognizing the importance of our planet's dwindling natural resources, the green industry seeks to meet the demands of today without compromising the needs of tomorrow.

More businesses than ever are taking strides to build an eco-conscious business model. In fact, consumers are behind the push, looking for and even demanding that companies turn to an environmentally friendly focus. Manufacturers are doing so even when the immediate financial rewards are non-existent. What are businesses doing to meet these demands? Manufacturing companies can make changes in plenty of ways and in the long-term, the financial rewards will pay off. The use of biodegradable packing or minimalist packaging is another example of how manufacturers can make significant changes. It is difficult exactly to define the "eco-industry", and therefore also its growth and export potential.The environmental industry comprises firms which provide goods and services for both environmental protection and resources management (e.g. waste recycling, renewable energy supply and water supply). Eco-industries have been defined according to the definition contained in "The Environmental Goods and Services Industry – Manual for Data Collection and Analysis" (OECD/Eurostat, 1999, 2005). This defines eco-industries as: *"Activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, products and services that reduce environmental risk and minimize pollution and resource use".*

A recent EU study has made estimation on the situation in the EU-15 and the Candidate Countries (ECOTEC, 2010 a & b). The eco-industry is broadly defined as "activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and ecosystems. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use". This means that pollution management, resources management, clean technologies and renewable energies are included, while areas such as nature protection and organic farming are not included. The report says that EU eco-industries is a strong and diverse export sector, and

is major global player alongside the USA and Japan. The global eco-industry market is estimated at around 550 Bn euros in 1999. This means the EU has approximately one third of the overall market (183 Bn euros), equal to the USA. The Japanese market is estimated to be worth about 84 Bn euros. The Canadian market is the next most significant at 36 Bn Euros. The overall turn-over (Million Euros) of the Eco-Industries in EU Region during 1999 is given in Table 4.

North America remains the EU's biggest export market and has shown significant growth, while the Candidate Countries are becoming increasingly important export markets, in particular for EU Member States with close historical trading relationships to that region. The favoured method of EU company penetration into this market is through setting up a joint venture with domestic companies. EU companies are amongst the world leaders in developing new renewable energy technologies, both for domestic markets and worldwide. The strong and expanding domestic markets provide the basis for many

Table 4: Turn-Over (Million Euros) of Eco-Industries in EU Region, 1999 Scenario

Country	Pollution Management	%	Resources Management	%	Total Turnover	%
Austria	8,270	7	620	1	8,900	5
Belgium	2,400	2	2,380	4	4,770	3
Denmark	5,400	4	1,220	2	6,630	4
Finland	1,790	1	310	1	2,100	1
France	22,330	18	15,660	28	37,990	21
Germany	41,190	32	15,510	28	56,710	31
Greece	1,040	1	850	2	1,900	1
Ireland	530	0.4	250	0.5	790	0.4
Italy	10,700	8	5,280	9	15,980	9
Luxembourg	160	0.1	110	0.2	280	0.2
Netherlands	7,170	6	2,440	4	9,610	5
Portugal	920	1	830	1	1,750	1
Spain	5,530	4	2,510	4	8,030	4
Sweden	2,620	2	690	1	3,310	2
UK	17,090	13	7,390	13	24,470	13
EU-15	**127,140**	**100**	**56,070**	**100**	**183,220**	**100**

Source: ECOTEC (2002a)

EU companies to be active in worldwide markets. For example, the EU is the largest market for wind energy developments, with 75% of the total world installed capacity of 18.5 GW. The EU operates a trade surplus in environmental products with the rest of the world of around 5 Bn euros in 1999 which is less high than the surplus in 1997 and 1998 as a result of increased imports and a levelling out in exports. The balance of trade with respect to environmental services is unknown. The economic perspective for setting up of eco-industry can be gauged from the following statistical summary (ECOTEC, 2002a &b):

- The total EU eco-industries supply some 183 Bn euros of goods and service a year, of which 54 Bn euros are investment goods and 129 Bn euros are services, including 'in-house' non-market services.
- Total Pollution Management and Cleaner Technologies eco-industry supplies are around 127 Bn euros of goods and services a year.
- Total Resources Management eco-industries (excluding renewable energy plant) supply around 56 Bn euro of goods and services a year.
- The current size of the renewable energy plant market in the EU is around 5 Bn euros a year.

- In real terms, total pollution management expenditure has risen by 5% per annum since 1994. The proportion of expenditure spent on operating costs has increased in real terms by 8% per annum to a level of 69% in 1999.
- There has been an increase in waste management activities during the period (of 11% per annum) and waste water (by 3% per annum) while air pollution control expenditure has fallen by 5% per annum. This is likely to be a result of substantial investments having already been made during the past 10 years. Contaminated land remediation and noise and vibration control expenditure have both risen.
- The private sector is increasingly important in driving pollution management expenditure rising from 45% of total expenditure in 1994 to 59% by 1999. Household expenditure remains around 5% of total expenditure.
- From 1994, the number of direct investment related jobs in the EU in 1999 has increased by around 75% to 550,000 jobs.
- The estimated value added provided by eco-industries, based on direct labour costs, in 1999 is 98 Bn euros, which has gone up from 35 Bn in 1994.

According to the ECOTEC study, direct employment in the EU in eco-industries amounts to over 2 million (FTE) jobs in 1999. Employment levels for the wider environmental industry sector are significantly larger than the core eco-industry (i.e. pollution management) definitions used in the past. A high-end estimate of environmental employment is around 4 million jobs, using various procedures to give more realistic coverage and including the use of 'multipliers', which try to build in the indirect effects of environmental expenditure (ECOTEC, 2002a). Environmental sector employment accounts for on average 1.3% of total paid employment in the EU-15, although it is higher in some countries (e.g. Austria, Denmark, and France). For every 1 Bn euro of investment in environmental goods and services there is another 1.6 Bn euro generated in operating expenditure and the generation of 30,000 direct jobs (ECOTEC, 2002b).

A detailed estimate of environmental jobs is offered in a study for London, making a distinction between core environmental jobs and non-core ones. The non-core environmental jobs are the environmental goods and services activities in the non-environment sectors. They consist of environmental accounting, book-keeping, green finance provision, environment sector organizations (NGOs), environmental lawyers, researchers and the like. Employment in the core is estimated at 35,000 in 2001 (1% of London employment) whereas total employment in environmental activities is estimated at 140,000 in 2001 (3.4% of total employment in London), considerably higher than software development and consultancy (68,000). This suggests that environmental employment in the broadest sense (comprising all work activities that are concerned with dealing with environmental issues) is important.

According to a study by the Swiss Federal Statistical Office, Switzerland employed approximately 50'000 people in the eco-industrial sector in 1998, equivalent to approximately 1, 3% of all employees that year (SFO, 2003). This figure comprises 15'000 employees in fully eco-industrial activities and 35'000 employees in partially eco-industrial activities. In biological agriculture, which uses few environmentally harmful processes and therefore on the edge of the eco-industrial sector, had 12'500 employees in 1998? In the fully eco-industrial sector, 77% of the employees were active in sewage purification, waste disposal and other disposal and 20% and 3% respectively in the areas of recovery and preparation for recycling and wholesale of scrap and waste material. Of the employees in the fully eco-industrial sectors, 6% were women and 94% men, of which only 53% of the women and 92% of the men were employed on a full-time basis.

Rennings and Ziegler (2006) offered estimates about employment effects of environmental innovations in the adopting company, which are found to be small. Overall 88 % of the eco-innovating firms said that the adoption of the most important eco-innovation had no notable effect on employment. In 9 % of the cases the number of long-term employees increased due to the innovation, in 3 % of the cases it decreased. This shows that there is a weak but positive relation between the introduction of eco-innovations and employment *at the company level*, with product innovations and service innovations having an above-average positive employment effect (18 % and 20 %). A number of studies have shown the positive link between environmental performance and job creation. The research shows how 'greening the economy' can boost job creation in areas directly connected to the environment such as conservation, waste, water and air quality. These are often referred to as eco-industries and are covered in studies such as:

- Analysis of the EU eco-industries, their employment, and export potential (Ecotec, 2002);
- Eco-industry, its size, employment, perspectives and barriers to growth in an enlarged EU and;

- Study on the competitiveness of the EU eco-industry (Ecorys and IDEA, 2009)

These studies use a statistically delineated definition which relies heavily on Environmental Protection Expenditures (EPE). However, this definition focuses on money spent to protect the environment, and is much weaker on jobs that depend on a good environment, or depend on natural resources. A study by GHK, IEEP and Cambridge Econometrics (IEFP, 2007) on 'Links between the environment, economy and jobs', looked not just at the direct jobs captured in the eco-industry concept, but also used multiplier effects to calculate the 'indirect' jobs created and jobs dependent on a good environment within for example eco-tourism and organic farming.

According to the above mentioned studies, "the eco-industry "produces" goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes technologies, products and services that reduce environmental risk and minimize pollution and resources". The sectors fall into two general categories, pollution management and resource management.Estimating the number of jobs starts with estimating the turnover of the sector, and then requires the number of jobs associated with that employment to be estimated. Both of these steps are subject to uncertainty, although the data and methodologies are improving. Therefore, for preparing the update of the number of jobs dependent on the environment and resource efficiency improvements the Ecorys and IDEA (2009) study has been conducted in two ways. Firstly, only the EPEs were updated, secondly, the methodology was updated and applied. Based on updated Environmental Protection Expenditures (EPEs), new methodology and updated labour compensation levels, the following key figures were derived:

- Around 2, 2 million people worked in the EU-27 eco-industry in 2000.
- About 2, 7 million people worked in the EU-27 eco-industry in 2008 which represented 0, 81% of the total workforce (people age 15 - 64).
- For 2012, with extrapolation from reported figures, the total number of people working in eco-industries is around 3, 4 million.
- The average annual growth (2000 - 2008) in eco-industry jobs is approximately 2, 72 % corrected for inflation.
- The EPE levels in 2000 amounted to EUR 223 - 243 million, depending on methods for calculation and representing 2, 95% of EU-27 average GDP.
- In 2012, the estimated EPE of EU-27 is EUR 557 million.
- The average growth rate for EPE (2000 – 2008) was 2, 8%.
- The annual growth rate over 2004 – 2008 for employment in eco-industries was 0, 7%.

The update of the GHK study shows how a broader definition of jobs related to the environment increases the numbers. If one uses the broader definition, some 19 million jobs in Europe are related to the environment which represents some 5% of the total working population (2010 figures). This study explored how 'greening the economy' can boost job creation in areas directly connected to the environment such as conservation, waste, water and air quality. In 2012, it is estimated that the total number of people working in eco-industries is around 3, 4 million which represents around 1% of the total workforce, and that the eco-industries have a turnover of around EUR 550 million. The general trend is of a growing number of 'green jobs' and case studies show, not surprisingly, that improving resource efficiency leads to job creation. The global market for eco-industries is estimated at roughly EUR 1.15 trillion a year in 2010. There is broad consensus that the global market could almost double, with the average estimate for 2020 being around EUR 2 trillion a year. The EU-27 has a strong export position vis-à-vis nearly all of the world's largest economies. Estimates on the growth potential vary among European companies working in environmental and resource efficiency related sectors. Generally speaking, the European companies are performing well on the global market. In three out of seven sectors – photo-voltaic, air pollution control, and waste disposal - the EU has a revealed comparative advantage. Hydropower and other environmental equipment are more middle performing sector with growing competition coming from Brazil and Russia in the former sector and the US in the latter.

From a global perspective, resource efficiency has gained strategic importance. Globalization and rapid economic growth in emerging economies has led to increased global competition for natural resources and recyclable materials. It has led to resource shortages on the global market, which results in higher prices, which is significant when, as is the case for the EU, there is a

dependence on imports. This has further implications for the EU economy as non-EU companies with easy and cheap access to resources may gain a competitive advantage relative to their European counterparts. As such, there is a positive correlation between the resource efficiency of countries and their competitiveness. There is also some evidence that higher levels of resource productivity go hand in hand with the competitiveness of a sector or even individual companies (Ecorys and IDEA, 2009). Resource scarcity and dependency on resource imports into the EU-27 present a clear threat to the international competitiveness of the EU, making resource efficiency a strategic factor in the European economy and as such implicitly in the European employment market.

Green eco-industries currently account for a 15% share (approx. USD 430 billion) of the world's economic stimulus packages. According to calculations made by the International Monetary Fund, every "dollar used for green purposes" attracts another dollar. Europe alone is plowing EUR 7 billion into energy efficiency – to make cars more economical and buildings and factories more energy-efficient. EUR 6 billion is being channeled into development of renewable energies, while EUR 3.5 billion has been earmarked for energy infrastructure. A further half a billion euros will be spent on offshore wind farms. In the midst of the crisis, Germany has injected some EUR 80 billion into the economy, about 13% of which is set aside for climate and environmental protection activities. Compared to the international community, that is a fairly modest sum. South Korea, for example, plans to pump around USD 36 billion – fully 80% of its overall stimulus package – into energy efficiency, renewable energy and water pollution control over the next four years. In absolute terms, China is spending most (in the context of economic stimulus) to protect the environment and the climate: more than USD 220 billion – twice as much as the USA. As early as 2013, the market for environmental technologies including renewable energy should be worth USD 1 trillion in the People's Republic.

According to study made by Lifestyles of Health & Sustainability (LOHAS-Green Business), three trends appear to be shaping the face of the green industry (Green Business - eco-industry worldwide: http://www.lohas.de/content/view/1279/195/). The first is fierce predatory competition as the first movers are accompanied by smart followers – companies that intelligently plug into other companies' technological developments. A willingness to invest heavily in research and development will be critical to the success of today's market leaders. Green technology is an extremely innovative industry characterized by short innovation cycles, so most growth happens when good ideas are quickly turned into marketable products. Patents are a good indicator of growth. Recent surveys of the environmental technology industry show that their number rose by about 19% per annum to 1,044 in the period from 2004 through 2007. German companies lead the field around the world. Of all new environment-related patents granted by the European Patent Office in 2007, 23% came from Germany. The USA (22%) and Japan (19%) followed close behind. It is important to use patents to protect good ideas.

In the past, German companies have not always been good enough at transforming R&D into market success. This because the road from basic research to marketable application is often too long one of the biggest challenges is for science and industry to work closely together – including strategic alliances with the public sector. An outstanding example of such cooperation is the Fraunhofer Centre for Sustainable Energy Systems in Masdar (Abu Dhabi), the world's first carbon-neutral city. Such approaches ensure that theoretical research finds its way directly into practical applications (Green Business - eco-industry worldwide: http://www.lohas.de/content/view/1279/195/).

Second, many environmental technology markets are only now reaching the critical mass they need to accommodate production on an industrial scale. Fragmentation remains a conspicuous feature of the environmental technology industry. Roland Berger Strategy Consultants believes that waves of consolidation will sweep over the industry in the years ahead. This will be the case especially in areas where off-the-peg products enable ever greater economies of scale. A series of well-resourced companies is already exploiting growth opportunities by means of acquisition strategies.

Third, even price-conscious target groups nowadays consider ecological aspects of consumption when making product purchase decisions. In the USA, 30% of consumers already see themselves as belonging to the "lifestyle of health and sustainability" group, or LOHAS. LOHAS like to enjoy life, but only with a good conscience, for which they are more than happy to pay a dollar or two more. Marketing experts distinguish between a hard core of environmentally aware consumers and a wider circle of consumers who vacillate between buying ecological and non-ecological products depending on the situation. The hard core really does want to make the world a better

place by shopping green and creating a "demand pull" for more environmentally friendly products. Though not very big in absolute terms, they form a well-networked community that has a seminal influence on the image of green products.

The current estimates of the current global market for environmental goods and services range between 330 and 410 billion EURO. OECD countries currently account for approximately 90% of the total global market. Approximately 50% of the global market value relates to the provision of environmental services. Equipment and resource management activities (including water utilities) each account for approximately a quarter of world environmental markets. Split by environmental media, the two largest sub-sectors of the global environmental industry are waste management and wastewater treatment, which together account for approximately 80% of the market value. Until the late 1970s the environmental industry was mainly located in and focused towards markets in developed countries, particularly Western Europe and North America.

The challenge of reconciling economic and ecological interests demands a new concept of progress. In this context, the environmental technology industry is emerging as an extremely dynamic factor. Companies in Germany can tap vast potential not only in their domestic market but also in the USA, Japan, Brazil, Russia, India and China. The true extent of this potential is revealed by a study commissioned by the US chambers of foreign trade. In collaboration with Roland Berger Strategy Consultants, they asked 300 companies in the US green-tech industry – including the US subsidiaries of a number of German firms – about their expectations for the future. Some 34% of the US companies said that they expect their revenues to grow by more than 10% within the next year and by a further 51% in the next five years. The mood among the subsidiaries of German firms in the USA was even more upbeat: 38% expect at least 10% higher revenues in the next year and a further 60% increase over the next five years. The labor market will also benefit: fully 87% of companies in the study plan to quickly create new jobs.

Conclusion

The present study on Eco-industrial clusters indicates that these clusters are unique in terms of creation of eco-innovation opportunities and in developing new business models that are eco-friendly, replicable, economically viable, environmentally sustainable and have huge potential to provide local jobs with multiplier effects. It was also observed that eco-clusters provides for local resources mobilization, waste minimization, energy conservation, low-cost technology testing and scaling, experience & information sharing, eco-market development, community actions, effective business communication and networking involving the community at large. Future eco-cluster models should focus on evolving new frontier of eco-innovations with system-based eco-designs that should not only be eco-friendly and commercially competitive; they should be so located and designed that they can offset the adverse impact of global climate change and bring in reduction of green-house gas emissions and thereby progressive reduction of carbon footprints in carbon space to help promote ecological and economic revival.

REFERENCES

Amundsen A., (2000). Networking among companies represents a potential for CO_2 reduction, *Journal of Cleaner Production*, 8, 495-501.

Barkley, D. L., M. S. Henry, and S. Wright (1998), Industry Targeting for Economic Development, Anderson County, 1998, EER 170, Clemson University, Department of Applied Economics and Statistics, Clemson University.

Barkley, D. L., M. S. Henry, and M. Warner (2002),Targeting Growth Opportunities in Lancaster County, 2002, REDRL Research Report 10-2002-04, Regional Economic Development Research Laboratory, Clemson University, Clemson, S.C. www.cherokee.agecon.clemson.edu/redrl_rpt8.pdf

Chiu, Anthony SF. 2000. Discovering Asian EIP Case Book from its Cover. Presentation at Taiwan Eco-Industrial Park Training Workshop, December 11-13, 2000. Taipei, Taiwan.

Chiu, A.S.F and Geng Y (2004), On the Industrial Ecology Potential in Asian Developing Countries, Journal if Cleaner Production: Special Issue on Industrial Applications. 12 (8-10), 1037-1045.

Côté RP, Hall J. (1995). Industrial parks as ecosystems, *Journal of Cleaner Production* 1995; 3(1, 2):41–6.

Cote, Raymond and Reid, Holly (1097), The Environmental Management of Industrial Estates. 1997. Compiled by. UNEP, France.

Eco-Industrial Parks in Andhra Pradesh: GTZ- http://www.giz.de/Themen/en/30432.htm

Eco-Town Projects/Environmental Industries in Progress, Ministry of International Trade and Industry (MITI) in 1997: Environment-Conscious Type of Town-Building Models of Eco-Town Municipalities/Business Firms: Case Introduction: http://www.meti.go.jp/policy/recycle/main/3r_policy/policy/pdf/ecotown/ecotown_casebook/english.pdf

Eco-Town Prohramme:

http://www.meti.go.jp/policy/recycle/main/english/3r_policy/ecotown.html; MITI, 2000

Ecorys and IDEA (2009), Study of the competitiveness of the EU eco-industry, Study prepared for the European Commission – DG ENTR

ECOTEC (2002a), Analysis of the EU Eco industries, their employment and export potential, The Final Report for DG, Environment, ECOTEC Research & Consulting Limited; Priestley House 28-34 Albert Street, Birmingham B4 7UD, United Kingdom.

ECOTEC (2002b), EU Eco-industries: Trade and international markets, ECOTEC Research & Ed. Thousand edited by David Annandale, John Phillimore and Dora Marinova, Edward Elgar, Cheltenham, London.

Esty D.C. and Porter M.E., (1998), Industrial ecology and competitiveness, *Journal of Industrial Ecology,* **2 (1),** 35-43

Fujimura, H. (1999) "Zero-Emission Technologies and Eco-Cities" Mayors' Asia Pacific Environmental Summit, Summit Proceedings

Fujita T (2008). Urban simulation Systems to Integrate Circular Economy and Low Carbon City, in the Summary Proceedings of the Asia-Pacific International Workshop on Industrial Ecology

Glaeser, L. Edward, Hedi D. Kallal, Jose A. (1992), Scheinkman and Andrei Shleifer: Growth in Cities, *Journal of Political Economy,* vol. 100, no. 6, 1992.

IEEP (2007), Links between the environment, economy and jobs, DG Environment Report submitted by GHK Consulting in association with Cambridge Econometrics, Institute of European Environmental Policy.

IGES (2007), Eco-Industrial Clusters in Urban-Rural Fringe Areas: A Strategic Approach for Integrated Environmental and economic planning, Kansai Research Centre, IGES, Japan.

LOHAS-Green Business - eco-industry worldwide: http://www.lohas.de/content/view/1279/195/

Lowe E, Moran S, Holmes D.(1985), A field-book for the development of eco-industrial parks. Report for the U.S. Environmental Protection Agency. Oakland (CA): Indigo Development International, 1995.

Lowe, Warren J. (1996), The source of value: an executive briefing and sourcebook on industrial ecology. PNNL-10943, Richland (Washington): Pacific Northwest National Laboratory, 1996.

Lowe, Ernest A. (2001), Eco-industrial Park Handbook for Asian Developing Countries, Report to Asian Development Bank, October 3, 2001, Prepared by Ernest A. Lowe , Based upon Eco-Industrial Parks, a handbook for local development teams (1995-98), Indigo Development Working Papers in Industrial Ecology (1997-2001), and field experience in the Philippines, Thailand, and China

Matsumoto T. (2008), Progress and Evaluation of Kitakyushu EIP as a Resource Recovery Model, Proceedings of the Asia Pacific International Workshop on industrial Ecology

Karaev A., Koh L.S.C. and Samosi L.T., (2007), The cluster approach and SME competitiveness: a review, *Journal of Manufacturing Technology Management,* **18, (7),** 818-835.

Marshall, Alfred (1920). Principles of Economics (Revised Edition Ed.). London: Macmillan; reprinted by Prometheus Books, ISBN 1-57392-140-8.

Marshall, Alfred (1890), Principles of Economics. (First Edition ed.), London: Macmillan: http://archive.org/stream/principleseconо00marsgoog#page/n8/mode/2up, Retrieved 2012-12-07.

Michael John (2008), Eco-Industrial Park Research: Experiences and Lessens from Kwinana Industrial Area/Western Australia.

Mirata M., (2004). Experiences from early stages of a national industrial symbiosis programme in the UK: determinants and coordination challenges, *Journal of Cleaner Production,* **12,** 967-983.

Nakashima (2006), Sustainable Regional Development through Optimized Biomass Use: Development of Eco-industrial Clusters in Maniwa city, Japan, Proceedings of the International Workshop on Eco-Industrial Clusters Leading to Sustainable Local Development, 28 October, Kobe, Japan.

OECD/ Eurostat (1999), The Environmental Goods & Services Industry: manual for data collection and Exploratory Study Using the Theory of Constraints in Nordic Organizations", Business Strategy and the Environment, Vol.18, pp. 277–290.

OECD and Eurostat (2005), Oslo Manual Guidelines for Collecting and Interpreting innovation data, third edition, Paris, Luxemburg

PCSD 1997 Report, The Road to Sustainable Development: A Snapshot of Activities in the United States

(http://www.calrecycle.ca.gov/LGCentral/Library/innovations/recoverypark/CaseStudies2.htm

President's Council on Sustainable Development, Eco-efficiency task force report. Washington (DC), 1997.

Ramachandran, K. & Sougata Ray (2003), Formation of information Technology Clusters: How Late Movers Follow Models Different from Early Movers, Paper presented at a NSF workshop in ISB, Bangalore in March 2003

Rennings, K. & A. Ziegler (2006), Environmental innovations and economic success of companies, paper for conference Green roads to growth in Copenhagen

Report prepared for Environment Canada, Industry Canada and Natural Resources Canada, Ottawa, 1997

Rodríguez-Clare, Andrés (2007), Clusters and comparative advantage: Implications for industrial policy, *Journal of Development Economics* **82** (2007) 43 – 57

Rosenthal, S.S., Strange, W.C., (2004), Evidence on the nature and sources of agglomeration economies, In: Henderson, J.V., Thisse, J.-F. (Eds.), *Handbook of Regional and Urban Economics,* vol. 4.

Sathasivan, A. and Hoang Hai, (2001), Feasibility of Converting Sai Dong Industrial Zone in Hanoi, Vietnam to Eco-Industrial Park. Article to be read in International Symposium on Development and Environment, Ho Chi Minh City, April 20-22, 2001.

SFO (Swiss Federal Statistical Office, 2003), Statistisches Jahrbuch der Schweiz, Zürich, Switzerland.

Thermoshare. Integrated eco-industrial parks with cogeneration, energy cascading and recycling. A report prepared for Environment Canada, Industry Canada and Natural Resources Canada, Ottawa, 1997.

Visvanathan C. (2008), 3R in Asia: A Gap Analysis in Selected Asian Countries, Asian Institute of Technology, Bangkok.

The other part of outsourcing is this: it simply says where the work can be done outside better than it can be done inside, we should do it.

—Alphonso Jackson

Database

Contributions of Capital Deeping (IT and Non IT) and Total Factor Productivity in Labor Productivity Growth: Major Asian Countries

RAJESH SUND

Deputy Director (Economic Services Group), National Productivity Council, New Delhi

Information Technology (IT) capital has emerged as a significant contributor to Labor Productivity in the recent decades.Tracking the size and growth of IT capital, that is, computers and copying machines, communication equipment, computer software, etc., has become a standard practice in productivity research, following attempts to establish the driving force behind productivity resurgence in developed economies, starting with the US in the 1990s. Unlike technological advancements in the past, which were largely confined to manufacturing, Information Technology can permeate the economy and bring about significant production gains, for example, wholesale and retail, banking and finance, and transportation and telecommunications (that is, service sectors that traditionally have struggled with slow productivity growth). This database report presents Labor Productivity Growth, Capital Deepening Growth both in terms of IT and Non IT Capital and Total Factor Productivity Growth across 10 major Asian economies during the last two decades compiled from APO productivity Datebook 2012 & 2013

The yearly accumulation of IT capital enabled for countries to capitalize on the productivity gain from the IT revolution. Reflecting on these results, capital accumulation appears to be a necessary step to economic growth, and countries may go through cycles of capital accumulation and assimilation. The evident rise in the contribution of IT capital is noteworthy. By 2000, the IT capital share rose to above 5 per cent in most countries, with the exception of India, Iran, and Indonesia. There has been a big push in IT investments in India during the last decade. China has been a late comer as far as investing in IT capital is concerned. The contribution of IT capital took off around 2000 and peaked at 16 per cent by 2005 (APO, 2012).

Labor productivity in the two fast-growing emerging Asian economies (i.e. China and India) has accelerated. China clearly has leapt from a labor productivity growth rate of around 7 per cent in the late 1990s to a rate of 10 per cent in the late 2000s, and the transition period was in the early 1990s. India's passage to accelerating labor productivity growth is more gradual than China's, from around 2.5 per cent in the late 1990s to 7.4 per cent in the second half of the 2000s. Both TFP growth and capital Deeping took a leap in 2005–10 to reinforce the positive trend.

Share of TFP and Capital Deepening (IT and Non-IT) and Labor Productivity Growth (Average Annual Growth) across ten major Asian countries for four different time period such as 1990–95, 1995–2000, 2000–05 and 2005–10 are reported in the following tables:

CHINA

Sr. No.	Year	Labor Productivity	Capital Deepening		TFP
			IT Capital	Non- IT Capital	
1	1990–1995	10.6	0.1	3.4	7.1
2	1995–2000	7.1	0.2	3.8	3.1
3	2000–2005	8.6	0.7	3.9	4.1
4	2005–2010	10.2	0.5	5.1	4.6

HONG KONG

Sr. No.	Year	Labor Productivity	Capital Deepening		TFP
			IT Capital	Non- IT Capital	
1	1990–1995	4.6	0.4	3.2	1.0
2	1995–2000	0.2	0.6	1.7	-2.1
3	2000–2005	3.1	0.5	0.9	1.8
4	2005–2010	3.5	0.3	1.0	2.2

INDIA

Sr. No.	Year	Labor Productivity	Capital Deepening		TFP
			IT Capital	Non- IT Capital	
1	1990–1995	3.4	0.1	1.6	1.8
2	1995–2000	2.5	0.1	1.0	1.3
3	2000–2005	3.9	0.1	1.1	2.6
4	2005–2010	7.4	0.2	3.4	3.8

JAPAN

Sr. No.	Year	Labor Productivity	Capital Deepening		TFP
			IT Capital	Non- IT Capital	
1	1990–1995	2.0	0.3	2.0	-0.3
2	1995–2000	2.0	0.4	1.3	0.2
3	2000–2005	1.8	0.4	0.6	0.9
4	2005–2010	1.1	0.2	0.4	0.5

KOREA

Sr. No.	Year	Labor Productivity	Capital Deepening		TFP
			IT Capital	Non- IT Capital	
1	1990–1995	5.2	0.3	3.4	1.5
2	1995–2000	4.4	0.5	2.7	1.3
3	2000–2005	4.2	0.5	1.8	1.9
4	2005–2010	4.4	0.2	1.8	2.4

MALAYSIA

Sr. No.	Year	Labor Productivity	Capital Deepening		TFP
			IT Capital	Non- IT Capital	
1	1990–1995	6.4	0.3	4.5	1.6
2	1995–2000	0.8	0.4	2.9	-2.5
3	2000–2005	3.0	0.7	1.0	1.4
4	2005–2010	2.4	0.5	0.3	1.6

PHILIPPINES

Sr. No.	Year	Labor Productivity	Capital Deepening		TFP
			IT Capital	Non- IT Capital	
1	1990–1995	0.1	0.0	0.9	-0.8
2	1995–2000	1.9	0.4	1.7	-0.2
3	2000–2005	1.4	0.4	0.1	0.9
4	2005–2010	2.7	0.2	0.6	2.0

SINGAPORE

Sr. No.	Year	Labor Productivity	Capital Deepening		TFP
			IT Capital	Non- IT Capital	
1	1990–1995	3.8	0.7	1.2	1.9
2	1995–2000	3.7	0.6	3.0	0.1
3	2000–2005	2.7	0.5	1.1	1.2
4	2005–2010	1.1	0.3	-0.8	1.6

THAILAND

Sr. No.	Year	Labor Productivity	Capital Deepening		TFP
			IT Capital	Non- IT Capital	
1	1990–1995	7.4	0.5	5.0	1.9
2	1995–2000	0.4	0.3	2.6	-2.5
3	2000–2005	2.9	0.2	-0.5	3.2
4	2005–2010	1.8	0.3	0.4	1.1

VIETNAM

Sr. No.	Year	Labor Productivity	Capital Deepening		TFP
			IT Capital	Non- IT Capital	
1	1990–1995	4.3	0.1	0.6	3.6
2	1995–2000	3.1	0.2	1.8	1.1
3	2000–2005	6.3	0.3	2.9	3.1
4	2005–2010	3.2	0.5	3.1	-0.4

[1]*Source for all tables:* Compiled from APO Productivity Data Book- 2012 & 2013
Full Report can be down loaded at www.apo-tokyo.org/publications

Annual Index of Productivity Vol. 54
(April 2013 – March 2014)

Vol. 54, April-June, 2013, No. 1
(Focus: Biotechnology)

Vol. 54, July-September, 2013, No. 2
(Focus: Industry)

Vol. 54, October-December, 2013, No. 3
(Focus: Governance)

Vol. 54, January-March, 2014, No. 4
(Focus: IT & ITeS)

Registered with Registrar of Newspapers REGD. NO. 4757/59

Productivity

Announces

a

Special Issue

Vol. 55, No. 1,

April - June, 2014

on

AGRICULTURE

Place your orders with :

MD Publications Pvt Ltd
"MD House", 11, Darya Ganj
New Delhi-110 002
Telephone : 91-11-45355555
E-mail : contact@mdppl.com
website : www.mdppl.com