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Information Technology and Economic Development

Strategies and Implementation Approaches to KM

Outsourcing and Manufacturing Strategies for BPO

Role of Top Management in KM

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Information Technology and Economic Development of India

Sanjay Kumar Singh

Information technology is an important emerging sector of the Indian economy. The size of this sector has increased at a tremendous rate of 35 per cent per year over the last decade. Its contribution to the national gross domestic product is expected to be around 8.5 per cent by 2010-11, which is similar to the GDP in the United States today. This paper examines whether information technology can contribute to India's economic development in a holistic and broad way, and if so, what policy measures would be required to facilitate the same.

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There is an impression that India is world class in information technology (IT). This is mainly due to the success of India's software industry and the contribution of people of Indian origin to the IT revolution in the United States. The fact that the IT sector in the country has increased at an incredible rate of 35 per cent per year for the last 10 years reinforces the view that India is world class in IT.

At the same time, India remains a poor country in terms of both per capita income (PCI) and the human development index (HDI). As per the 2004 Human Development Report, India is among the countries with the worst disparities between their gender-related development index (GDI) and HDI values. Although the per capita income in the country over the last 10 years has increased at the rate of 4.1 per cent per year, more than 250 million people still live below the official poverty line. While some have benefited from tremendous economic growth over the last decade, for India's poorest, there has been very little to celebrate. There is no doubt that inequality in income and inequality in various infrastructure facilities such as access to clean drinking water, decent housing, proper healthcare, good education, etc., is rising in the country.

This paper tries to examine whether IT can contribute to India's economic development in a broader way. It also examines the role of public policy, arguing that the government should promote IT use and make it accessible to every section of society, besides removing the infrastructure constraints, strengthening the training and education system and also introducing flexible labour laws.

The IT Sector in India

In IT, India has built up valuable brand equity over the years. In IT enabled services (ITES), India is emerging as one of the most preferred destinations for busi-

ness process outsourcing (BPO). The importance of IT industry in the Indian economy can be gauged from the fact that its contribution to the national gross domestic product (GDP) has increased by seven fold in a span of just one decade B from 0.6 per cent in 1994-95 to 4.3 per cent in 2004-05 (Table 1). Although industry figures are not directly comparable with GDP, as they are based on revenues rather than value added, they provide an indicator of growing importance of the IT sector in the country. Assuming that the Indian economy and IT sector will replicate the past six years performance during the next six years and value added in IT sector is two-thirds of its sales revenue, the contribution of the IT sector to national GDP will be around 8.5 per cent during the year 2010-11, quite similar to that in the United States today. The IT sector revenue is expected to increase from Rs 1,276 billion in 2004-05 to Rs 6,435 billion in 2010-11.

The Indian IT industry is broadly categorized into IT services and software, ITES-BPO, and hardware segments. Although IT services and software continues to remain the key contributor to the IT sector's revenues, ITES-BPO is emerging as the fastest growing segment of the sector (Figure 1). Between 2000-01 and 2004-05, the contribution of ITES-BPO to the IT sector's total revenue increased from 7.4 per cent to 20.2 per cent, whereas the corresponding figure for IT services and software fell from 64.5 per cent to 58.5 per cent. Presently, the ITES-BPO segment of the industry is almost as big as the hardware segment.

Table 1: India's GDP and IT Sector

Year	GDP at current prices (in Rs. billion)	IT sector revenue (in Rs. billion)	IT sector rev. to GDP ratio (in percentage)	IT sector revenue (in US $ billion)
1994-95	10128	63	0.62	2.0
1995-96	11880	99	0.83	2.9
1996-97	13682	137	1.00	3.8
1997-98	15224	186	1.22	5.0
1998-99	17409	253	1.45	6.0
1999-00	19296	362	1.88	8.2
2000-01	21043	566	2.69	12.1
2001-02	22929	658	2.87	13.4
2002-03	24661	780	3.16	16.1
2003-04	26954	978	3.63	21.5
2004-05	29380	1276	4.34	28.2

Source: http://mospi.nic.in and http://www.nasscom.org
Note: GDP figures are at market prices.

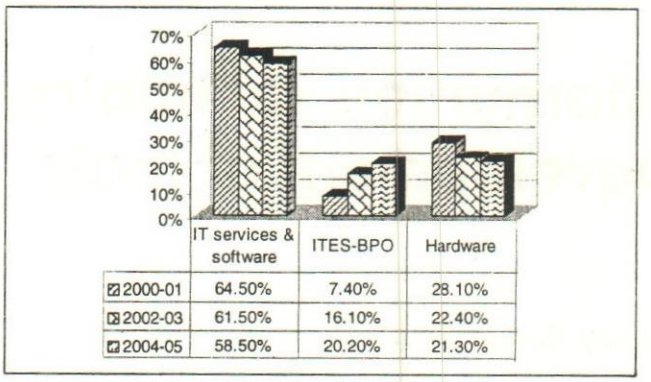


Fig. 1. Composition of Indian IT industry

Services and software versus hardware

The services and software segment of IT industry in India is more robust than its hardware counterpart. India has become one of the most favoured destinations for sourcing software and IT enabled services. The revenue of IT services and software and ITES-BPO taken together reached US $ 22.2 billion during 2004-05 out of which US $ 17.3 billion was earned through export. India ranks high in comparison to its competitors such as China, Philippines, Ireland, Australia, Canada, etc., in various parameters such as quality of the labour pool, cost advantage, linguistic capabilities, project management skills and overall quality control. In addition, India is able to offer a 24x7 service and reduction in turnaround times by leveraging time zone differences. India's unique geographic positioning makes this possible.

Emerging as one of the key investment markets in the country, the ITES-BPO segment of the industry is on a rapid growth path. This segment generated revenue of US $ 5.7 billion in 2004-05, representing a growth of 46 per cent over the previous year. Although 90 per cent of the revenue is generated through export, there has been tremendous growth in the domestic market as well. The size of the domestic market in the ITES-BPO segment increased from US $ 300 million in 2003-04 to US $ 600 million in 2004-05.

The hardware segment of the IT industry in India has not shown the same level of progress as experienced by IT-enabled services and software. But, it is also true that the hardware segment of the IT industry has not received the kind of government support received by its other counterparts. Complications in the local indirect tax structure and high rates of excise and sales taxes have only added to the hardware segment's woes. It is also evident from the fact that while pharmaceutical and automobile companies are

encouraged to do R&D through a 150 per cent write-off on expenditure, no such facility has ever been extended to the hardware. Again, while labour laws have been amended for IT services & software and ITES-BPO segment, no such initiative has been taken for the hardware segment.

Profitably manufacturing semiconductors and other sophisticated hardware components typically require infrastructure, large scale investments in capacity, and accumulated experience that India does not possess, and is not in a position to acquire easily (Singh, 2002). However, India does perform numerous hardware assembly tasks internally, almost entirely for the domestic market. Hardware components are typically imported from the Southeast or East Asian countries. As was the case with several East Asian countries, it is also possible for India to transform its capability from assemblers of sophisticated components produced elsewhere to producer of hardware through *learning by doing*. The design of hardware typically involves the development and use of appropriate software codes, therefore, hardware design could be a promising area for the Indian IT sector.

It is imperative that India should focus on the areas where software expertise matters more than the manufacturing infrastructure. Obviously, it will still require significant improvement in infrastructure, broader labour law reform and careful assessment of market demand. As Desai (2000) pointed out, there is a need for flexible labour laws not only to boost the hardware segment of the industry but also to realize the full benefits of growth in India's IT sector. In fact, a flexible and transparent regime of labour laws would contribute to increased employment and productivity and, therefore, appropriate legislation would be in the interest of both workers and manufacturers.

Export versus domestic market

Currently, export accounts for around 64 per cent of the total IT sector revenue. The IT sector export revenue touched the mark of US $ 18 billion during 2004-05, a jump of around 35 per cent from the previous year (Table 2). IT services and software accounts for 68 per cent of the total export revenue whereas ITES-BPO contributes 28 per cent of the same. The share of hardware in IT sector export revenue is just 4 per cent.

India's IT services and software export went from a few million dollars in the 1980s to over US $ 12 billion in 2004-05. The financial service sector (banking, financial service, and insurance) accounts for the largest share of Indian software and services export at around 40 per cent followed by the manufacturing with around 12 per cent. Telecom equipment (9 per cent), healthcare (5 per cent), retail (5 per cent) and telecom services (4 per cent) are emerging areas of export. The key service lines for Indian services and software exporters continued to be custom application development and maintenance, applications outsourcing, IT enabled services, and R&D services. Few Indian companies have made modest progress in segments like packaged software support and installation, product development and design services, and embedded software solutions. In terms of software service delivery, off-shore project revenue is increasing at a far higher rate than on-site revenues during recent years. In terms of geographies, although Indian IT companies began tapping regions outside the US market, the US remained the largest user of software solutions from India.

The revenue contribution from the US continued to increase on account of the large number of ITES-BPO projects getting outsourced to India. Although only the top five firms (TCS, Infosys, Wipro, Satyam, and HCL), which contribute more than one-third of software export revenue have some sort of global brand status, more than 3,000 firms are involved in software export in India. At the end of the year 2003, India has at least 65 companies with SEI CMM level 5 certificates indicating the strength of India's software export capabilities.

The ITES-BPO segment of the IT industry is rapidly emerging as an important contributor to export revenue. According to the National Association of Software and Service Companies (NASSCOM), the Indian ITES-BPO segment has witnessed a significant increase over the last few years. The number of seats has increased from 140,000 in March 2003 to 210,000 in March, 2004. Players in the ITES-BPO segment can broadly be categorized into captive units (of both MNCs and Indian companies) and independent third-party service providers. Currently, there are more than 400 companies operating in this segment of IT industry. Captive units continue to dominate the ITES-BPO segment, accounting for over 65 per cent of the value of work offshored to the country.

In terms of export, the US continued to be the main consumer of India's ITES-BPO services with around 66 per cent of the market, followed by Europe particularly UK which accounted for 20 per cent of export revenue. The global financial services are the largest user of ITES-BPO services, followed by telecom, healthcare, and airlines. Customer care and support services are the main revenue generating activities within ITES-BPO export market accounting for 38 per cent of the segment's employee base and 33 per cent of its revenue. Other leading service lines are finance with

revenue contribution of 23 per cent, administration and content development with revenue contribution of 15 per cent each. Customer analytics and customer relationship management (CRM), legal transcription support, knowledge process outsourcing, and financial process outsourcing are emerging as new high-potential service lines for ITES-BPO companies. In comparison to competing countries such as Ireland, Philippines, and China, India is able to attract the bulk of the global ITES-BPO business due to its comparative advantage in terms of price, performance, and quality.

Table 2: Export and Domestic IT market in India

(in US $ billion)	2002-03	2003-04	2004-05
IT services & software	9.9	12.8	16.5
-Export	7.1	9.2	12.2
-Domestic	2.8	3.6	4.3
ITES-BPO	2.6	3.9	5.7
-Export	2.4	3.6	5.1
-Domestic	0.2	0.3	0.6
Hardware	3.6	4.8	6.0
-Export	0.3	0.5	0.7
-Domestic	3.3	4.3	5.3
Total IT industry	16.1	21.5	28.2
-Export	9.8	13.3	18.0
-Domestic	6.3	8.2	10.2

Source: http://www.nasscom.org

Despite higher growth of export, the domestic market still represents around 36 per cent of industry receipts. The domestic IT market touched the revenue of US $ 10.2 billion during 2004-05, of which hardware contributed US $ 5.3 billion whereas services and software accounted for US $ 4.3 billion. The domestic market size of ITES-BPO segment is negligible in comparison to the export. Nevertheless, domestic sector of ITES-BPO segment recorded a healthy growth with revenue increasing from US $ 300 million in 2003-04 to US $ 600 million in 2004-05 mainly due to demand from banking, financial services and insurance (BFSI) sector and telecom companies. With competition increasing in BFSI and telecom sector, companies are emphasizing customer fulfillment and CRM activities more. Presently, all the major telecom service providers offer 24 hour customer self-support and also involve in a high degree of telemarketing. The scenario in the BFSI sector is similar to that of telecom.

The domestic IT services and software segment continued to lag behind the export segment on account of issues such as higher piracy levels, pressure on software prices, and lower level of IT spending by domestic companies. However, it experienced around a 20 per cent growth rate during the last year mainly due to demand from verticals such as banking, telecom and BPO vendors. Domestic IT spending is expected to increase further in coming years due to increase in telecom and internet penetration, higher IT budget allocations by the governments, IT spending by verticals like BFSI, manufacturing and engineering firms, automobile and retail sector and greater focus on maintenance and security infrastructure by vendor firms.

Hardware is the only segment of the IT sector in India in which the size of the domestic market exceeds that of export. MNCs dominate the hardware segment occupying the top positions in key categories such as desktop PCs and notebooks, servers and peripherals. The BFSI, government, and telecom service providers continued to be the key contributors. BFSI alone accounts for one-fourth of the total hardware spending in the domestic market. Although the size of the hardware domestic market still remains small, there is a huge potential for its growth. Currently, India is one of the fastest growing hardware markets in the world.

Human Capital and Infrastructure

Availability and adequate supply of skilled and knowledgeable workforce and the quality of infrastructure is critical for the growth of IT industry in India. An important reason for the success of Indian IT industry has been the large supply of IT skilled workforce. India's stock of IT professionals is estimated to be more than 1 million during 2004-05, so that the IT industry revenue per IT professional is about US $ 27,000 (Figure 2). A reasonable projection implies that IT industry revenue will increase by a factor of 5 from 2004-05 to 2010-11. Assuming 5 to 7 per cent growth in revenue per employee per year, the number of professionals required will increase at the rate of around 25 per cent per year from 2004-05 to 2010-11 to meet the demand.

Additional IT professionals required for the sector is likely to increase from 260,000 in 2005-06 to nearly 800,000 in 2010-11. Given the poor state of India's higher education, meeting the demand for IT professionals would be an uphill task. India produced 284,000 engineering graduates during 2004-05, out of which 165,000 can be categorized as IT professionals (computer science, electronics and telecommunication). Although there is large number of non-engineering graduates produced every year in the country, the quality of large fraction of these graduates is very much questionable. Even the quality of engineering graduates produced by large number of engineering colleges is

not up to the mark. For example, currently, according to the NASSCOM, only around 25 per cent of technical graduates and 10-15 per cent of general graduates are suitable for employment in the ITES industry. Although the current demand for workforce is primarily for lower end of the market (IT enabled services, BPO, coding and testing, etc.), which can be supplied by non-engineering graduates along with engineering graduates, sustained success in the global market will require the use of highly skilled and knowledgeable workforce. Sustained supply of high quality graduates would be difficult with the current state of higher education in the country. It is essential to improve the quality of higher education in general and in line with the IT industry's requirements in particular to avoid human capital becoming a bottleneck for growth of the sector.

Prevalent price distortions, lack of infrastructure of both physical and human capital, obsolete curriculum, government interventions, ineffective regulatory body and lack of encouragement for public-private partnership are some of the reasons for poor state of higher education in the country. Even at the elite educational institutions, faculty members are poorly paid in comparison to their counterparts in industries and physical infrastructure has deteriorated due to lack of investment. Many universities, particularly the state-funded ones, still follow the course curriculum designed during 1960s and 1970s. The Indian universities are controlled by the government and their state is somewhat similar to that of the Indian industry before economic reforms of 1991. Government interventions right from fee fixations to the appointment of faculties and head of institutions have led to the gradual decline of even the formerly reputed universities. Not that the public funding for higher education does not work at all but that the experience of many countries shows us that it does work only in the presence of autonomous and effective regulatory body.

The University Grants Commission (UGC) and All India Council for Technical Education (AICTE), the two most powerful regulators and disbursers of the government grants for higher education in the country, are left with little credibility in the market to enforce a structure where the good can be separated from the bad. It is high time to restructure the functioning of regulatory bodies in higher education sector of the country. Given the fiscal status of the central as well the state governments and resource requirement to enhance both quantity as well as quality of higher education, there is a need to encourage private initiatives in the sector. In the present situation where benefits of certain kinds of education are clear and immediate, it would be easy to attract private investment in the sector provided the government does not intervene in day to day functioning. Thus, there is a need to have substantial private involvement and adequate legislative cooperation to strengthen higher education in the country.

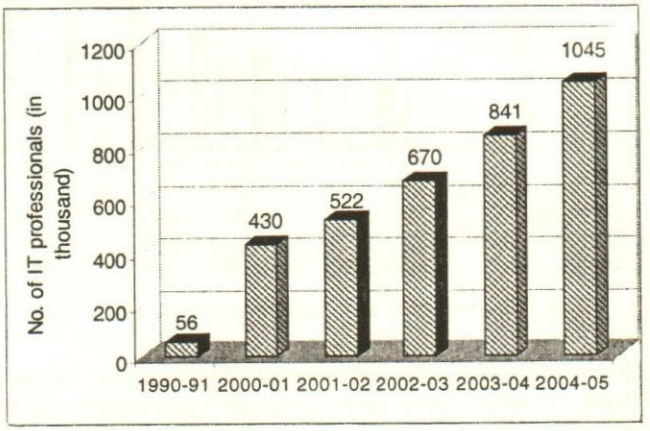
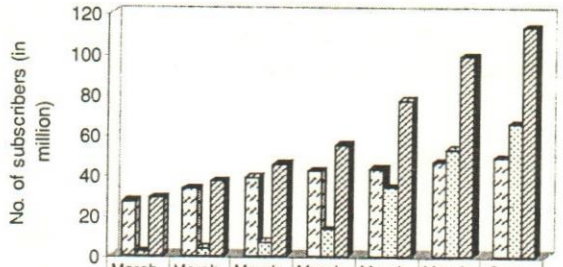


Fig. 2. Growth of IT professionals in India

Infrastructure (including good governance) is the basic building block for development. Among various infrastructural facilities, electric power, transport, and law and order are the most fundamental, and probably the most difficult ones to tackle. Although, it is beyond the scope of this paper to address infrastructural issues, the government needs to focus on improving law and order, transport infrastructure, and power supply in the country for the continuous development of IT industry. From the last five years or so, the telecom infrastructure in the country has improved significantly. Between the year 2000 and 2005, the number of subscribers of telecom services (fixed and mobile services taken together) has increased at an average rate of 28 per cent per year. The subscriber's base of telecom services in India has increased from 28.55 million in March 2000 to 113.07 million in September 2005 (Figure 3). Due to rapid increase in telecom services, tele-density in India has increased significantly from 6.63 per cent in December 2003 to 10.36 per cent in September 2005 (Telecom Regulatory Authority of India, 2005). Although tele-density in rural India is still less than 2 per cent, it is nearly 30 per cent in urban areas and approaching 50 per cent in mega cities. The tele-density in Delhi, Chennai, and Mumbai was 52.09 per cent, 48.03 per cent, and 45.81 per cent respectively in June, 2005. Today, India's telephone network is one of the largest in the world and the second largest among the emerging economies.

Although Personal Computer (PC) ownership and internet connectivity is still low in India, it is experiencing similar growth like telecom services during recent years. For example, internet connectivity in the country increased from 5.32 million in September, 2004 to 6.13 million in September, 2005. According to the *Broadband Policy 2004* document published by the Ministry of



	March, 2000	March, 2001	March, 2002	March, 2003	March, 2004	March, 2005	Sept., 2005
Fixed line	26.65	32.71	38.33	41.48	42.84	46.19	48
Mobile (GSM+CDMA)	1.9	3.58	6.54	13	33.69	52.22	65.07
Total	28.55	36.29	44.87	54.48	76.53	98.41	113.07

Fig. 3. Growth of fixed and mobile telecom services in India

Communication and Information Technology, Government of India, New Delhi, internet connectivity in the country is expected to be around 40 million by the year 2010. With PC prices dropping to as low as Rs. 10,000 per unit, PC penetration in the country is expected to increase rapidly. PC penetration in India is expected to increase from 11 million in 2004 to around 100 million in 2010. A denser telephone and internet network along with increased PC ownership will provide the opportunities for increasing the rate of training people for the IT industry.

IT and Economic Development

IT, in some sense, is a general-purpose technology. It can influence the national economy in a number of ways. It can create employment opportunities, reduce illiteracy, provide universal health service, and deliver good governance (through e-governance). IT can not only help the emerging sector such as ITES, biotechnology, pharmaceutical research, nanotechnology, etc., but also it is crucial for the development of strategically important sectors such as defense and intelligence, space research and development, weather forecasting and transportation.

The availability and use of IT is a prerequisite for economic development in the modern world. It allows countries to leapfrog stages of economic growth by being able to modernize their production systems and increase their competitiveness faster than in the past (Castells, 1999). Empirical studies show that there is a close relationship between diffusion of information technology and productivity and competitiveness of countries, regions, industries and firms (Dosi et al., 1988). The IT has potential to raise the long-term growth prospects through increased productivity in almost every sector of the economy. The resurgence of the American economy since 1995 is a classic example of the same. According to Greenspan (2000), the IT has produced a fundamental change in the US economy, leading to a permanent improvement in growth prospects. Similarly, Jorgenson (2001) argues that the development and deployment of the IT is the foundation of the American growth resurgence. The relentless decline in the prices of semiconductors and thus IT equipments has steadily enhanced the role of IT investment as a source of American economic growth. Furthermore, IT can play an important role in economic development in a broader sense, beyond just economic growth. Obviously, this depends on comparative advantage in providing IT products and services, global demand for these products and services, development of a robust domestic market, positive spillovers to rest of the domestic economy including rural economy, and impact on governance.

India has a comparative advantage in the global IT sector at least in terms of cost. With large pool of workers having software and language skills, it is in a position not only to strengthen its market share in lower end of the market such as IT enabled services, BPO, and coding and testing but also to move toward producing higher value-added goods and services. In fact, it has just started to move towards higher value added goods and services. IT service companies have included new service lines such as package software implementation, system integration, R&D engineering, and remote network management whereas ITES-BPO companies have started offering more complex services such as financial research and analytics, actuarial modeling, and corporate and business research. The availability of large number of workers with a combination of engineering and managerial skills will definitely be helpful to strengthen India's position in the world IT market.

Despite having a comparative advantage at least in a certain segment of the IT sector, India's share in the global market is just 2 per cent. This should be viewed as a great opportunity for the Indian IT industry. The global IT spending, which was more than US $ 1400 billion in 2004-05, is expected to increase at the rate of 7.9 per cent per year over 2004-08 (NASSCOM). The fact that ITES-BPO segment is expected to grow at the rate of more than 11 per cent per year over the same period and the US accounts for 47 per cent of the global IT spending which is not expected to change significantly will help India to increase its market share in forthcoming years. Although the domestic IT market is just marginally more than half of the export, it has started growing at a rate of 20 per cent per year or so during the recent years.

Improvement in telecom infrastructure, increase in PC and internet connectivity, and decrease in prices of

hardware and internet connection have provided great opportunities for firms to strengthen domestic IT market. The use of PC, an important access device for IT, and internet needs to be encouraged further for larger economic benefits. This can easily be used to provide distance education, telemedicine and a variety of other information. This can also enhance access and delivery of government services to various stakeholders and citizens. Internal record keeping, flow of information, and tracking decision and performance can be improved with the use of IT. The use of IT in governance can directly benefit the people, particularly the poor ones (since economically well off people in any case can get the information). Above all, IT has the potential to improve transparency and accountability and thus the efficiency of government delivery system. In India, many government organizations have started to adopt IT-based systems and solutions to manage payrolls, stock market, rail reservation, tax collection, etc. Various initiatives have been taken by the government to provide e-governance interface to citizens. The central government has recommended that each ministry should allocate 2-3 per cent of its budget for promotion of IT and move towards electronic governance. It is clear that IT can be used not only for improvement in competitiveness in the global market but also for overall economic development.

There are strong complementarities between IT and rest of the economy. IT can enhance the productivity and efficiency in other industries. It can improve efficiency in areas such as accounting, procurement, inventory management, and production and operations management. Although labour unions usually raise concern with IT adoption due to fear of job loss, evidence suggests that increases in other kinds of job as a result of IT use more than make up for job loss (Singh, 2002). Moreover, IT implementation may increase the productivity and/or quality more than that is feasible otherwise. The use of IT in rural banking and micro-finance may enhance efficiency in informal sector and can impact broader cross-section of population. Information access to farmers could benefit agriculture sector as well. Farmers can receive weather forecasts, market price quotes, advice on farming practice, offers to buy and sell livestock, and specific trainings. Even basic education could be enhanced in rural areas by the use of IT.

The IT sector is one of the largest employers of women, and therefore, can play a crucial role in women empowerment and the reduction of gender inequality. The sector provides flexibility to its employee of operating from home and in working time, which enables women to carry on with jobs with family life. It is estimated that during the year 2004-05, male to female ratio in IT services and software segment of the industry was 76:24. The ITES-BPO segment provides more opportunity for women. The ratio of male to female is reverse i.e., 31:69 in this segment. It is clear that the promotion of IT will help to address the gender issues in the country.

Encouragement and promotion of computer education and IT use among socially and economically weaker section of the society has potential to reduce inequality. The use of IT can enhance poor people=s opportunities by improving their access to markets, health and education. It can empower the poor by expanding the use of government services and reduce risks by widening access to microfinance (Cecchini and Christopher, 2003). To uplift the status of socially and economically weaker section of the society, the government needs to make IT accessible to them. Special efforts should be made to promote IT use in rural areas. There is a need to make significant capital investments in rural areas if not for some altruistic reasoning, at least because of a desire to enter a domestic emerging market that has been virtually untapped so far. The industry along with the central and the state governments should now look at taking IT services to villages. The Government can use a number of incentives/requirements to catalyze private investment and to assure that the private sector extend access to IT services in rural (Pigato, 2001). One should remember that without access to the IT, the rural people can be caught in a poverty trap caused by the digital divide between the haves and the have nots.

Efforts should be made to promote the development and availability of low cost PCs and other communication access devices with internet connectivity at the most reasonable prices. There is a need to resolve regulatory issues in communication, and reduction and rationalization of tariff structure on hardware and software to provide seamless communication connectivity to rural areas and promote value-added services and micro enterprises to enhance economic well-being of rural community.

It is important to note that even if IT reaches to rural areas, there is no guarantee that poor people will have access to the same. Many projects that provide internet access in rural India end up favouring middle-class and educated men (Pigato, 2001). Rural women in particular tend to be excluded because of their restricted mobility and lack of education. Illiteracy and lack of English language knowledge are among the main obstacles to people's use of IT in rural areas. To be relevant for poor people, applications must be available in local languages and, to the extent possible, be visually oriented and use voice interfaces. In addition, content provided through IT

should not be limited to knowledge from outside sources, but extended to draw on knowledge held by poor people (World Bank, 2002). Because learning is more effective through practice, innovative and interactive training should be provided to the rural people. At the same time, public awareness programmes should be initiated to communicate the benefits of IT use to the people.

Concluding remarks

The main aim of this paper has been to assess the possible role of IT in broad-based economic development of India. From the analysis, it is clear that the IT has potential of not only accelerating the growth in the Indian economy but also promoting the broad-based economic development. To realize the same, besides standard policy initiatives such as improving infrastructure, strengthening training and education system, and introducing flexible labour laws that affect every sector of the economy including the IT sector, the government needs to take specific measures to promote IT use and to make it accessible to every section of the society. The IT should be promoted to be used as a tool for raising the living standards of the common people and enriching their lives. IT literacy needs to be enhanced manifold among the population at large through conventional and non-conventional means, so that ordinary people can begin to use it to derive benefits, both economically and socially. India will not reap the full benefits of its success in IT unless its broader institutional and incentive regime creates opportunities for local communities and villages to realize the benefits from the same.

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Japan is not America; Korea is not America. Global giants like Wal-Mart fail in these countries because they don't try hard enough to localize their businesses.

– Edwin Merner

Strategy and Implementation Approaches to Knowledge Management

K. Momaya

Market forces have led to developments such as outsourcing, virtual teams and globalization, which have refocused on the need to capture, store and manage tangible information. The ability of an organization to remain competitive is measured by its knowledge base, its ability to recognize, find and use knowledge; the ability of its workers to share knowledge; and the ability of the company to facilitate knowledge work practices. How would an organization wanting to implement KM start? How would one know what is right for one's company? This paper examines the various strategy/implementation approaches proposed by pundits –both academic and practitioners.

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Organizations are still fazed when it comes to implementing knowledge management. There are so many theories, models and definitions. Information glut in the Internet has not helped to make things easier. Too many conferences, too many white papers only make the task daunting. Let us say a manager wants to know what steps are involved in implementing knowledge management (KM); one can find many books and consulting organizations proposing different ways of going about it. There is no way one could judge the quality of methodology.

Knowledge management has not lent itself to any existing clear-cut strategy or technique as stated by Amrit (2000, p-87). It is not very clear if the initiatives taken in one firm will succeed in another. Almost all researchers agree that there is no 'one-size-that-fits-all' solution when it comes to knowledge management.

KPMG's report on knowledge management concludes that organizations understand the need for KM and that the benefits are realized, but that the full benefits are being missed. Companies see the immediate, internal cost gains but fail to equate these to any external, longer term benefits, such as intellectual capital. Another significant conclusion of this report is that companies still see knowledge management as a purely technology solution.

A similar research by Ronald Maier, Ulrich Remus of University of Regensburg shows that it seems that the KM efforts of the responding organizations on average still have some way to go until the more advanced benefits can be harvested. This surveyed investigated the state-of-the-art of the use of KMS in the 500 largest German companies and the top 50 banking and insurance companies as well as the development of concepts, scenarios and reference models for the management of KMS in organizations.

For a successful implementation and a good return

on investment, it is necessary to understand the organizational needs and choose a right strategy to implement knowledge management. A company's choice of knowledge management strategy is not arbitrary – it must be driven by the company's competitive strategy. The choice of strategy would depend on what the company's overall business objectives are, and how it can create value through knowledge. Emphasizing the wrong approach or trying to pursue both can quickly undermine a business.

Some of the implementation strategies are discussed below. One should notice that unlike other fields where researchers/academicians take a lead and come out with a standard framework or model, which would be followed by practitioners, this is not the case with knowledge management. Since knowledge management started from practitioners there so many models and frameworks developed by organizations that have been implemented. Consulting organizations like Ernst & Young (E & Y), Andersen Consulting and KPMG have also implemented knowledge management successfully in their organizations. Hence their models cannot be dismissed easily. Universally there seem to be a few set of strategies followed by organizations which are discussed below.

Academic Approach

The first to discuss knowledge management strategies were Hansen et al Harvard Business Review (HBR), 1999. The advent of the computer and the increasing importance of intellectual assets have compelled executives to examine the knowledge underlying their businesses and how it is used. Because knowledge management as a practice is quite new, executives have lacked models to use as guides. To help fill that gap, authors recently studied knowledge management practices at management consulting firms, with healthcare providers and with computer manufacturers.

They found two very different knowledge management strategies in place. In companies that sell relatively standardized products that fill common needs, knowledge is carefully codified and stored in databases, where it can be accessed and used – over and over again – by anyone in the organization. The authors call this the codification strategy.

In companies that provide highly customized solutions to unique problems, knowledge is shared mainly through person-to-person contacts: The chief purpose of computers is to help people communicate. They call this the personalization strategy.

The authors warn that knowledge management should not be isolated in a functional department like HR or IT. They emphasize that the benefits are greatest – to both the company and its customers – when a CEO and other general managers actively choose one of the approaches as a primary strategy.

Approaches by Consulting Organizations

Teltech

Storehouse model: This model focuses on finding and capturing the intellectual capital of an organization's knowledge workers and making this available throughout the organization. This is based on the assumption that tacit knowledge could be captured.

Pointer Model: This is designed to connect people with a specific understanding and know-how of those who need it. Pointers could point to stored content or experts who carry the knowledge in their heads.

Gartner Group KM Strategies

Gartner Group have worked out the ratio of intangible assets (the incremental value of market capitalization over book value) to tangible assets for various companies, and based on that suggested strategies for KM.

Knowledge-Centric Strategy – The enterprise with a high ration of its market value knowledge and intellectual capital will benefit from knowledge centric strategy. Knowledge is mission critical asset that should be leveraged internally and also packaged into products and services to compete.

Knowledge-Enabled Strategy – Enterprises with a relative low ratio of their market value in their knowledge capital rely on operational competencies or tangible assets as primary sources competitive advantage. In these enterprises knowledge-enabled strategy may be more appropriate.

If the enterprise's I/T ratio is more than 2-to-1, a knowledge-focused strategy is appropriate. In such an enterprise, knowledge would be the key asset and critical to the enterprise's mission.

If the I/T ratio is less than 2-to-1, this indicates that the enterprise's operational competencies or tangible assets are the source of competitive advantage, and that a knowledge-enabled strategy may be more appropriate. Consulting companies are knowledge-focused enterprises. Nearly 100% of their market value is knowledge capital.

Table 1: Product Process View by Know-Net

The "product" view	**The "process" view**
Proposition: knowledge is a thing that can be located and manipulated as an independent object or stock it is possible to capture, distribute, measure and manage knowledge	Proposition: it is only feasible to promote, motivate, encourage, nurture or guide the process of knowing
it is possible to capture, distribute, measure and manage knowledge	*the idea of trying to capture and distribute knowledge seems senseless*
Focus: on products and artifacts containing and representing knowledge	Focus: on KM as a social communication process
usually, this means managing documents, their creation, storage, and reuse in computer-based corporate memories.	*which can be improved by various aspects and tools of collaboration and cooperation support.*
Strategic Implications of "Product" and "Process" Views	
The "product" view	The "process" view
Competitive Strategy:	**Competitive Strategy:**
Exploit organised, standardised and re-useable knowledge	Empower and channel individual and team expertise
Focus of KM Strategy:	**Focus of KM Strategy:**
Connect people with re-useable codified knowledge	Facilitate conversations to exchange knowledge
Focus of IT Strategy:	**Focus of IT Strategy:**
Heavy emphasis	Moderate emphasis
Develop document management systems	Develop network management systems
Focus of HR Strategy:	**Focus of HR Strategy:**
Train in groups	Train by apprenticeship
Reward for using and contributing to databases	Reward for sharing knowledge with others

However, caution is imperative. The enterprise must also consider its business direction (which may be moving from capital-intensive to service-intensive or vice-versa), the valuation (or devaluation) trend in its assets, and its market's direction in these same areas. Enterprises must choose the most appropriate strategic approach.

Know-Net Strategies

Know-net summarizes approaches in a neat format. They have adapted the concept of knowledge as a process or knowledge as product originally from Michael Zack.

- The process-centred approach, which focuses on knowledge management as a social communication process and is enabled by groupware support; and
- The product-centred approach, which focuses on the creation, storage and reuse of explicit knowledge objects.

Accenture Theory

Suggested by Accenture Institute of Strategic Change

This model has been taken from a presentation by Thomas Davenport and also from a white paper published in outlook 1999. Knowledge Management is complex and multi-faceted. As it is mentioned throughout the report companies are struggling to identify what will work for them. To help executives the institute has developed a framework that associates specific knowledge management strategies with specific challenges that companies face.

The model is based on the premise that the focus should be placed on the way knowledge is used to build the critical capabilities a company needs in order to success – on the core processes and activities that enable it to compete. For example enhancing a bank's know-how in evaluating credit risk should result in reduced losses.

The framework begins by assessing and categorizing the way work is done in the core process. Work is evaluated on two dimensions. First is level of interdependence involved and second is complexity of work.

The challenges in the transaction model are centred on the need to codify knowledge. In integration model where the challenge is orchestrate activity across various parts of the organization, executives might consider standard processes and cross-functional teams and feedback systems. In expert model knowledgeable individuals are the key. Here executives may choose to

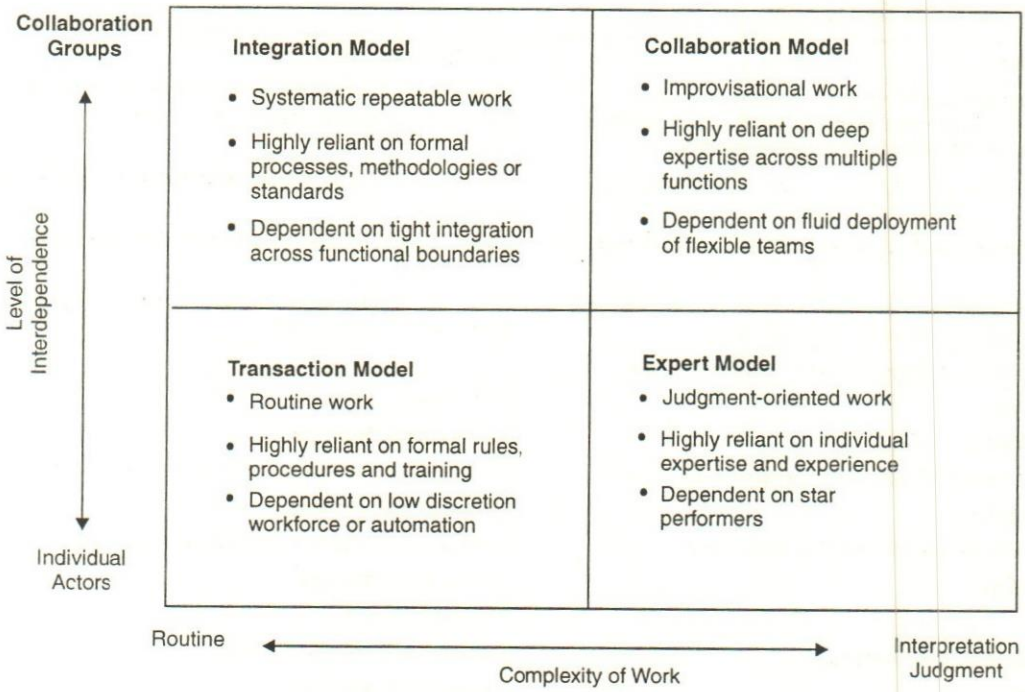

Fig. 1. Accenture Work Model

focus on programmes that develop stars internally through mentoring and training.

In collaboration model where the challenges revolve around creating breakthrough innovations, the choices may include action learning strategies or knowledge linking strategies that focus on learning through consortia or alliances.

The key characteristic of the framework is that it is focuses on all elements of KM such as technology, HR practices, organization and culture as it focuses on capabilities organizations need rather than on component solutions.

Analysis

There are two primary strategies namely codification and personalization which are universally accepted and followed. Hansen et al state that organization selling standard products chose codification and organizations selling unique solutions chose personalization. The answer to the question "what approach to follow" becomes simple. If you are a product organization, follow codification; if you sell unique products follow personalization. Is it as simple as it sounds?

Let us review the approaches proposed by the pundits:

- Knowledge Enabled
- Knowledge Focussed
- Store House
- Pointer
- Codification
- Personalization

Store House and Codification sound the same. Similarly pointer and personalization to some extent are similar. That leaves knowledge enabled and knowledge focussed strategy. Knowledge focused strategy is limited in its outlook that it applies to only those organizations that are in the business of selling knowledge – consulting companies. As per Gartner the rest of all the organizations should follow the knowledge-enabled strategy because they are in the business of products or services.

Codification is very much applicable to those companies that are involved in routine jobs like manufacturing where processes are very important. Personalization again would work well with consulting and service organizations.

However, organizations cannot simply follow one of these strategies. We all know that organizations consist of multiple departments which are different in nature. For example, the sales and marketing department of a manufacturing organization could be as dynamic as a

consulting organization. Knowledge of the market and competitors is critical and they change often. So codification may not work for this department even though it is part of a manufacturing organization. Again a R&D department of a pharmaceutical company is different compared to the Finance Department of the same company. Almost all organizations need both store house model, where whatever could be codified is available in digital format, and a list of pointers to contact experts where knowledge is more tacit.

Interestingly, companies most effective at organizing and transferring knowledge use both methods. "Seventy-one per cent of applications that applied a combination of both storehouse and pointer were high impact," says Machuda. Purely storehouse projects had a much lower level of success: 32 per cent were high impact. Purely pointer models had a similar success rate, according to Teltech.

Considering Gartner's knowledge-focussed strategy which states develop special knowledge and package it as a product sounds wonderful for a consulting company. However they also need knowledge enabling. Most of the assignments are similar in nature and it is more important for them to store all their assignments to arrive at new solutions. Plus knowledge-focussed strategy seems to address a strategic angle, while knowledge enabling addresses issues at the operational level. Hence they are incompatible.

Accenture Institute's model is nothing but a old wine in a new bottle. Joan Woodward's model for organization structure categorizes organizations based on the technical complexity.

Similarly Perrow's model divides the organization based on task analysability and task variability as high individualistic organizations, routine organizations, non-routine organizations and engineering organizations.

However, the Accenture model would definitely help executives to place their core work process in one of the four quadrants and therefore follow a certain strategy. However, the dilemma is if KM is to be implemented across the organization, work processes would follow in multiple quadrants. This means that the company should adopt different models for the R&D Department and the Supply Chain Department. Feasibility of this model then becomes a question. Implementations that have been very successful have targeted a business process mostly, e.g. Dow Chemical – Patent management.

If 70 pedr cent of the organization requires routine knowledge which should be codified and only 30% requires highly dynamic knowledge, the organization could choose appropriate technology, content and process strategy.

Knowledge management strategy as per me is not just about codification or personalization. Rather it should be devised after identifying the needs of each employee to perform optimally. Accordingly choose technology, content taxonomy, and processes to support collaboration/sharing and people strategy. KM strategy should look at all the dimensions of knowledge management implementation. Each component of the KM System should be chosen keeping in mind the end result the organization would like to achieve.

What problem does the company hope to solve through knowledge management? Business strategy and therefore the priority will also change. If the business strategy is responsiveness, then it could go for personalization. If the business strategy is better services or if the focus is R&D then the knowledge management strategy is be chosen accordingly.

Most of the companies focussed their effort on solving a problem or in other words had one goal in mind.

BP Amoco – Enhance Drilling capabilities

Chevron – Share Best Practices

Schlumberger – Improve its rate of innovation

Siemens – Create value from Diversity

Skandia – Clone success formula in new markets

Motorola – Chronic Low profitability

Unilever – Reduce costs in mature markets

Buckman Labs – Better Customer Solutions by spreading knowledge globally

Microsoft – Locating expertise quickly

General Motors – Avoidance of costly mistakes through debriefing sessions to share lessons across the company

Their strategies were very much tuned to these goals. However it is true that the strategies were either codification or personalization in principle.

One key point is no organization can choose one strategy and completely ignore the other. They might have to implement both. However, the primary approach should be one. Otherwise it is bound to fail. Hence the weightage could be something like 80 per cent codification and 20 per cent personalization or vice versa.

Table 2: Strategic implications for content, technology, process and people

	Codification Strategy	Personalization Strategy
Content	Plan for Heavy Repositories	Plan for Forums, Expert chat
	Create Content Taxonomy	Organize the structure of forums
	Create Content formats	Plan for Content Refining
	Plan for Content Distribution	Plan for forum extract packaging
	Plan for Content Packaging & Delivery (Pull vs. Push)	Plan for pointers and yellow pages
	Plan for Meta-tagging	
Technology	Large repositories	Decide on Colla- boration platform
	Plan for RAID Levels	Plan for storage of collaboration transcripts
	Plan for Security, Roles, Workflows	Plan for access to forums/chat/video conferencing
	Customized desktops to view relevant knowledge links for a role	Plan for security/ hacking
	Powerful search and retrieval technologies	
	Plan for refining (auto categorization) & archiving	
Process	Content refining process	Refining collaboration transcripts
	Content workflow for publishing	Forum code of principles
	Content Archival	Seeding forums
	Content owners	Managing users
		Managing forums
		Forum owners
KM Team	Backend team	Team collaborates with employees
	Information specialists	Subject Matter Experts
	Library science people	Forum/chat specialists
People Strategy	Store all procedural formats so that people access the repository	Make all business conversation through forums or chat
	Reward mechanisms around contribution to repository	Push content to people
	Pull people to use repository	Encourage arguments
Metrics	Strategic Level	Strategic Level
	Revenue, Cost Savings	Revenue, Cost savings
	Balanced Score Card	Balanced Score Card
	Operational Level	Operational Level
	Number of hits for content	Number of people participating in a forum
		Forum value in terms solutions, revenue, savings
		SLA

Once an organization decides on the primary approach, technology, processes and other infrastructure should be aligned behind the approach for successful implementation. The table below gives an indication of how they should be aligned.

Concluding Remarks

Knowledge management will become increasingly important if India is to build on its services-driven economy and move up the value curve in industries such as BPO to KPO. Strategic choices on implementation approaches will play a critical role in leveraging KM for competitiveness. An attempt was made in this research to understand the alternatives and issues. While many firms in India ventured on so-called KM initiatives, not many have been able to leverage it effectively. It is important that the firms keen to leverage KM understand the implications of the strategic choices made. Indian firms need to move much beyond IT-enabled KM to deeper knowledge that can be created and used by even workers on shop-floor in manufacturing industries or people at the grassroots to innovate, differentiate and be internationally competitive.

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Teltech – Research Report – Making KM Work

Microsoft – Practising Knowledge Management

Cap Gemini – Managing Your knowledge for Sustainable competitive Advantage □

The objects that really make a difference to our lives are often the least noticeable ones, that don't try to grab our attention. They're the things that add something to the atmosphere of our homes and that we'd miss the most if they disappeared.

– Jasper Morrison

Knowledge Management: An Evolving Concept

Nikhil R. Nayak

Yesterday's data are today's information, which will become tomorrow's knowledge, and knowledge , in turn, recycles down the value chain back into information and into data i.e. it depends on different levels of use. In this paper a framework of KM is outlined that articulates the basic terms of this perpetual process. The proposed model defines operations and transformations of data-to-information, information-to-knowledge, and their reverse order. Such transformations correspond to a time dimension of past-present-future and resemble the process of abstraction levels. Based on our analysis, we conclude that knowledge management is truly a new idea, not a regenerated concept.

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Yesterday's data are today's information, and tomorrow's knowledge, which in turn recycles back through the value chain into information and then into data. This statement perhaps sums up the process that helps organizations identify, select, organize, disseminate and transfer important information and expertise that interchanges and resides within the organisation in an unstructured manner.

Indeed, information systems and information technology, as well as other scientific terms, suffer from over use when disseminated into public use. Concepts like byte, network, e-mail, even end- user, once the privilege of the few, are now common property. These buzzwords make a positive contribution as they draw attention to the subject at hand. At the same time they tend to create a shallow image of ideas and a notion that their introduction is more for marketing and sales orientation than to denote innovation. For example, for many people business process reengineering (BPR) is just another name for quality system analysis, and executive information systems (EIS) are a form of decision support software for executives. Even data warehousing did not escape scrutiny as to its newness. It can be regarded as a regenerated concept like database view of a given domain, despite its merits in terms of performance and efficiency. In other cases terms like data, information, and recently knowledge are often not distinguishable from each other [Alavi and Leidner, 1999].

In the beginning there were data and information. Then, data management and information management appeared. And now we have knowledge management (KM) and the coming of knowledge-based business (Davis and Botkin, 1994].

Serious attempts to clearly distinguish these concepts are being published [Alavi and Leidner, 1999; Davenport and Prusak, 1998; and Nonaka et al.,

1996] but still definitions of KM are conspicuously similar to those given in the past for MIS, DSS, EIS and related systems. For example, the definition "the derivation of knowledge management emanated from its earlier definition of capturing, storing, and analytically processing the data that resides in the various company databases for decision-making", is indistinguishable from MIS defined two decades ago. MIS may be an integrated, user-machine system for providing information to support operations, management, analysis and decision-making functions in an organization [Davis and Olson, 1985]. But, as Kanter points out, broadening the definition of knowledge to include the tacit or implicit knowledge carried in an individual's mind and not presented in company databases, suggests something of a new direction [Kanter, 1999].

Peculiarly, many KM and data mining studies have generously used the term "knowledge" and "information" interchangeably. However both the concepts should be integrated with intellectual capital and it must be exchangeable among persons, and be able to grow, which will enable effective and efficient problem solving, dynamic learning, strategic planning and decision-making.

In knowledge management, the focus and accent are on management, KM alludes to a function like management (*x*), where *x* can be anything, i.e., data, information, resource, project. Once the accent of KM is on management, the discussion is well structured, dealing with the capture, storage, sharing and so on, of that *x*. This approach is indeed a black box approach. For example in decision support systems, the focus is more on system than on the decision-making process. Hence instead of management, we will try to focus on the knowledge element without which this new endeavor is a mere recycling of management topics. We intend to employ some basic terms from those of KM and related fields to clarify and distinguish knowledge from allied concepts and thus help to establish the emerging field of knowledge management on solid foundations. Without manipulating the K word, the whole KM area may turn out to be yet another fad that will fade away in time.

Hence the aim of this paper is to zoom into the black box of knowledge within the realm of information systems and knowledge management, to review the basic operations and processes of inquiry, and propose a model of the transformations of data-to-information-to-knowledge, and the reverse, which are the foundations of information retrieval, decision-making, data mining, and knowledge management.

Foundations

Evolution of the concept of knowledge is as old as the history of human thought. From Plato to Descartes and to Kant, initial attempts were made to define knowledge as a symbolic representation built on basic primitives that can be manipulated by rules. This idea was later used as the basic concept of artificial intelligence (AI), which aimed to provide machines with knowledge. Symbolic and rule-oriented representations of knowledge are not accepted by all thinkers, and other models have been proposed in a wide area of epistemology.

Philosophers demarcate two types of knowledge: knowing-that and knowing-how. These types basically correspond to the factual knowledge. We call data or information as "knowing what" and the skill as "knowing how". The knowing how part normally resides in the person's mind. Before we move on the elaborate on the subject, we describe the foundations of Knowledge Management.

Knowledge Management

Knowledge Management (KM) can be viewed as turning data (raw facts/material) into information (finished goods) and from there into knowledge. The concept is described in Fig. 1. This basic input-to-output idea is scarcely a departure from the classical definitions of MIS, DSS, EIS and related systems.

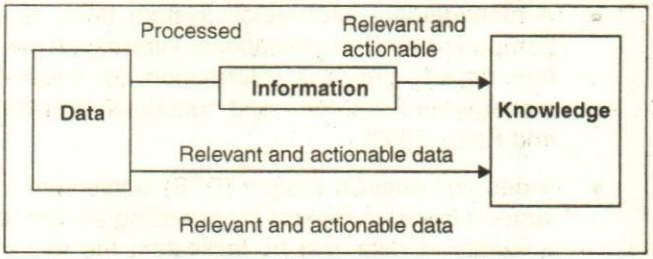

Fig. 1. Data, Information and knowledge

Davenport and Prusak (1998) define knowledge as a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experience and information. Knowledge originates and is applied in the mind of the knower. In organisations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices and norms. A more elaborate definition of KM is, it is a systemic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge of employees so that others may make use of it to be more effective and productive. They go on to define a knowledge management system

(KMS) as an information system designed to facilitate codifying, collecting, integrating, and disseminating organizational knowledge. Their concept is described more lucidly in Fig. 2.

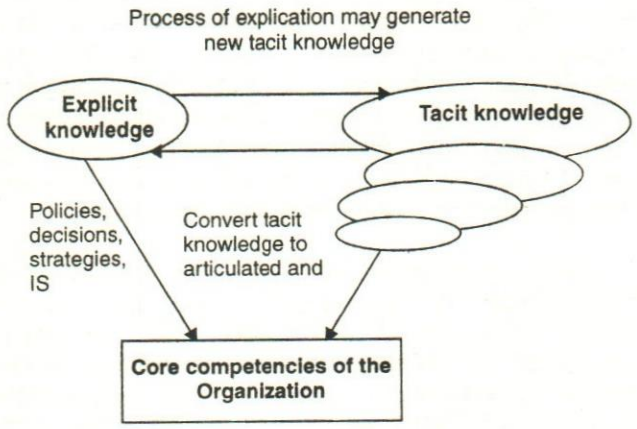

Fig. 2. How core competency is linked to Explicit and Tacit Knowledge

So What is New?

We have already noted the resemblance of these definitions to the classical definitions of MIS, DSS, EIS, and Expert Systems. The reader has the privilege to replace the word information or data with the word knowledge in the following definitions to realize the problematic effect. For example:

- A management information system (MIS) is a computer-based organisational information system, which provides information to support management activities and functions [Ralston and Reilly, 1993].
- A decision support system (DSS) is intended to support decision makers by providing access to a variety of data and by facilitating the use of analytical procedures, operations and models in a fast and flexible way [Peppard and Henry, 1988].
- Expert system (ES) generally consists of a knowledge base and an inference engine. It may also include a natural language interface and explanation facility, and a knowledge acquisition sub-system that is used to enhance the knowledge base [Hunt, 1986].
- Es is a computer programme that contains both declarative knowledge (facts about objects, events, and situations) and procedural knowledge (information about courses of action) to emulate the reasoning processes of human experts in a particular domain.

Are we then applying a new word to the same concepts simply because the old ones were overused? Is KM no better than the good old MIS, DSS, or ES? The business world is now discovering and recognizing that knowledge is an asset. So, we are still in pursuit of what is new with KM, claiming it to be the concept of knowledge.

Data and Information

Any definition of knowledge must start from data and information. Information is data endowed with relevance and purpose. Clearly, the receiver not by the sender determines the value of information. If data becomes information when they add value in some way, then information becomes knowledge when it adds insight, abstractive value, better understanding.

Information is normally associated with meaning. Such assigning of meaning to information is another example of up-gradation of a term that in due course becomes the norm. Ascribing meaning to information is hardly the original notion of information set forth by Claude E. Shannon (1962), founder of Information Theory. He claimed that information has little to do with meaning in the ordinary sense.

What is Knowledge

Knowledge is something that researchers have had a hard time defining. It has the curious characteristic of changing into different forms when talked about. As Dewire [1991] put it, "knowledge—we know it when we use it". When we attempt to capture record or store knowledge—it turns back into information or data. A wide range of characteristics is attributed to knowledge. Consider the following sample of definitions of knowledge (not of knowledge management):

- Knowledge is the power to act and to make value-producing decisions [Kanter, 1999, Polanyi, 1962].
- Knowledge is information made actionable in a way that adds value to the enterprise [Vail, 1999];
- It is a mission-specific professional expertise [King, in Bourdreau and Couillard, 1999]; and,
- Knowledge is things that are held to be true in a given context and that drive people to action [Bourdreau and Couillard, 1999].

The dimensions of knowledge range from a mere recalling of facts (hence can be stored) to action and expertise, to a potential ability. We can carry it a step

further and propose that knowledge is the production of new facts, or even more engaging, the production of new knowledge, a recursive or reflexive process that is indeed infinite.

As a basic starting point – we try to represent knowing-how in terms of knowing-that. Such representation is not always achieved by or related to the volume of facts. One would even make an inverse observation: the more facts the lower the information and knowledge value, a topic that merits a separate inquiry.

Polanyi [1962], in his pioneering work on personal knowledge, provides a comprehensive model of knowledge, defining three levels of knowing:

- *Skill* – acting according to rules,
- *Know-how* – skill plus acting in a social context, and
- *Expertise* – know-how combined with the ability to influence the rules and domain of knowledge. The expertise level is recursive or reflexive – it acts on itself.

Indeed, Polanyi defines knowledge as an activity, which would be better, described as a process of knowing. Based on Polanyi, two types of knowledge are generally identified.

- Tacit or implicit Knowledge – mental models and experiences of individuals
- Explicit Knowledge – formal models, rules, and procedures.

Although knowledge at the organizational level is hard to define, many believe it consists of the following components: Context, Experience, Basic truths, Best practices, Common sense, Judgment, Rules of thumb, Values and beliefs, Needs, Emotions, Desires and Socializing into culture.

In summary, knowledge is the process of knowing; a reflexive process that takes data and information, in a social context, together with the factors listed above, and generates new data, information, and/or knowledge. Thus, knowledge constantly evolves, or else reverts to its origin. This process is depicted in Figure 3. This phenomenon brings forth such novel aspects as human capital, the importance of organizational learning, and knowledge mapping.

Intellectual capital, Learning, and Knowledge Maps

One new aspect is the treatment of knowledge as intellectual capital. Ulrich (1998) defines intellectual capital as the competence of an individual and the commitment of the individual to contribute to the organizations goals. In other words it can be represented as,

Intellectual capital = competence × commitment

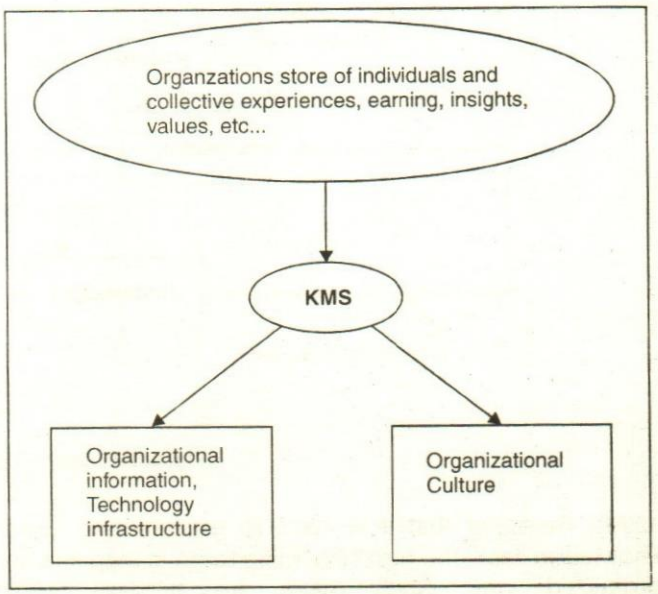

Fig. 3. Integration of organizational elements through a Knowledge-management system

On the other hand knowledge is a justified personal belief that increases an individual's capacity to take action. This concept focuses on the idea that knowledge is not deliverable end product, as information or data may be, but rather a means, an ongoing process that keeps evolving. That is why it is said that knowledge is information in action. As a recursive and reflexive process, it is most appropriately a part of KM, and as such, it certainly is a new idea.

Organizational learning is a fresh idea for management, with long-range strategic benefits that can draw on many aspects of related fields of the social sciences. It occurs when members of an organization share associations, cognitive systems and memories. Three steps can identify organization learning as:

1. Knowledge acquisition
2. Knowledge sharing and
3. Knowledge utilization

A third idea is the knowledge map. These maps are the links, yellow pages, and pointers between and among tacit and explicit knowledge available in an organisation that are meant for common benefit [Vail,

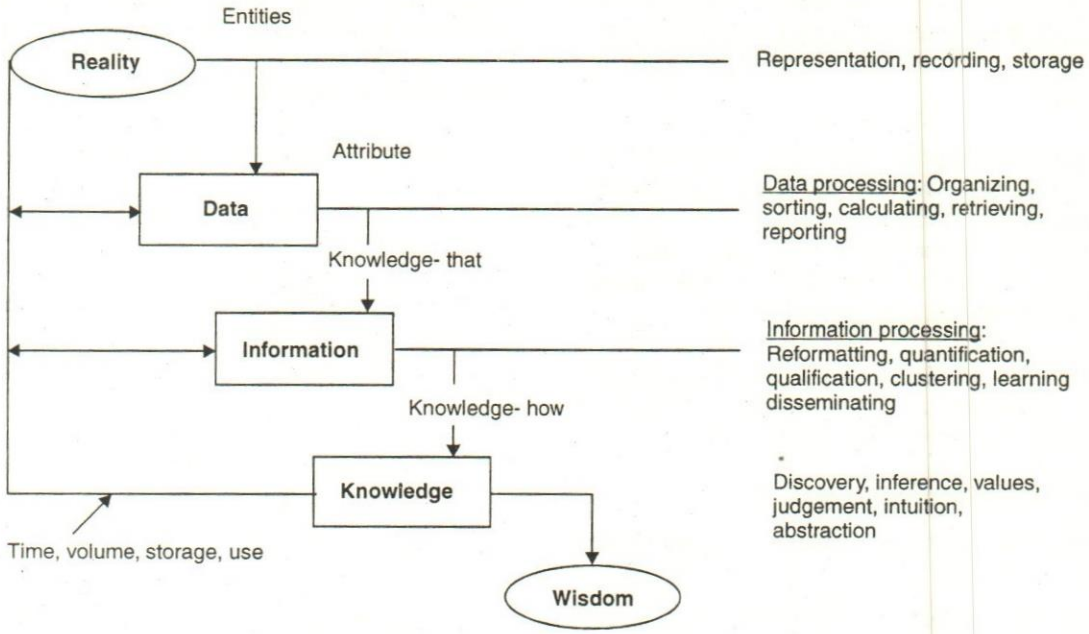

Fig. 4. Knowledge Terms and Transformations

1999]. Realizing that it is hard to capture and store knowledge itself, the next best thing to do is map it in an organized way. Such maps are perhaps what knowledge management is all about.

Technology

Technology cannot be replaced for knowledge. While knowledge is an ongoing process, technology can be a medium, a means, more of a vehicle for delivering data and information. The assumption that technology can replace human knowledge or create its equivalent has been proven false time and again [Davenport and Prusak, 1998]. Attributing knowledge to humans rather than to machines is a frequent discussion in AI, while dealing with the difference between humans and machines. Humans deal with and possess knowledge whereas machines handle the representations of knowledge, at least few steps lower in the abstraction of reality. This level is really data or information. Computers are called data processors, information processors, and even knowledge generators. But, as already pointed out, they can help store and access lots of facts—knowing-what, they cannot replace expert knowing how simply by adding more facts [Dreyfus, 1997]. We must take note of the correspondence between knowing- what and knowing-how and compare it with the correspondence between data and data mining. Data, stored in databases, are facts that can be recalled, processed and subjected to related activities. Once given relevance and purpose, data are turned into information and then into knowledge, which is knowing-how to do something. So the stated goals of data mining are—finding and discovering new insights and knowledge from large databases [Chen et al., 2000].

The limiting aspect of technology as a strategic asset of an organization is due to what Webber calls a self-cancelling advantage since the same technology is quickly available to everyone [Webber, 1993]. Thus, knowledge is the strategic advantage of an enterprise in the long run, not necessarily its information technology.

Model

Considering the wide range of dimensions of KM it can safely be classified as a distinct field. So to give a clear picture we now outline a model that relates and distinguishes the various terms and concepts of knowledge. We also include wisdom, insight and related concepts in it. As shown in Figure 4 reality is related to entities whereas data are the attributes of those entities. The concept of data, information, knowledge and wisdom represented in the model are explained as follows:

- Data (bases) represent, record, store, and maintain attributes about the entities.
- Information is knowing-that and is the result of data processing operations such as organizing, sorting, etc.

- Knowledge is defined as knowing-how and is a consequence of information processing operations.
- Wisdom is knowing when and/or if. Knowledge contributes to wisdom through activities such as discovery, inference, value, experience and more.

All these quantities are transformations in the process of knowing, thus giving a new idea regarding knowledge.

Transformations

Information systems are processes of transformation, where data is transformed into information and then to knowledge. In transformations, certain operations are required like data processing, information processing, and knowledge processing. These operations follow a path from that (D) to information (I) and to knowledge (K).

Here we use the notation of D → *I* → *K* and vice versa. The process and steps involved in these transformation processes are listed in table 1. Excluded from this discussion are database operations such as capture, verify, classify, index, store, and others.

Table 1: Transformations

Data Processing Operations: D → I	Information Processing Operations: I → K	Knowledge Processing Operations: K → W
Organize	Reformat	Discovery
Sort	Quantify (Statistics)	Inference
Calculate	Qualify (Specification)	Values
Retrieve	Associate, Cluster, Compare	Judgement
Report/Present	Aggregate, Summaries	Intuition and insight
	Apply, Connect	Creativity
	Learning (Heuristics)	Abstraction
	Communicate	
	Disseminate	

Knowledge turns into information (K → *I*) with lapse of time, volume, repetitive use, training, storage, computerization, and more. Knowledge and Information turn into data (*I* → *D* or *K* → *D*) with time, updates, re-use, application, and more. Indeed, as mentioned in previous sections, knowing too much may be counter-productive and turns such knowledge back into information or data. Fig. 4 (and the transformations it depicts) is also a model of abstraction, or stepping away from reality, but abstraction is beyond the scope of this paper.

Another observation from the transformation analysis is the time horizon of data, information, and knowledge. Data deals with the past, information works in the present, while knowledge usually has to do with aspects of the future. Thus, the transformations (*D* → *I* → *K*) and (*K* → *I* → *D*) differentiate these terms, and suggest time direction as to their management.

The process of generating knowledge is the association between the above-mentioned operations. The ability to associate, link, and apply require intelligence and knowledge. Association suggests another observation that distinguishes data and information from knowledge. As in neural networks. data is stored in the nodes and the rules can be thought of as the arcs. Hence, the ability to perform associations is not only related to the data of a net, but also to its logic, learning, experience, and indeed knowledge.

Knowledge Management in Context

We are now ready to place KM in context with the other related systems. Figure 5 depicts key components related to our discussion so far: environment, data, information, database, and action.

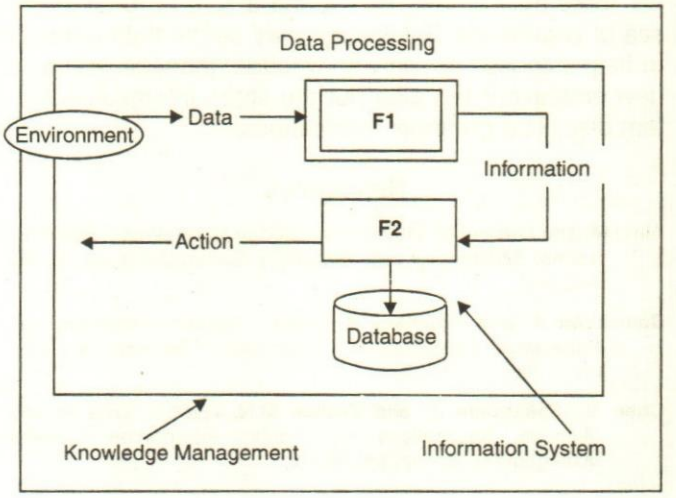

Fig. 5. Knowledge Management in Perspective

Two black boxes are shown in Figure 5, they are F1 and F2. F1 is the basic transformation of data into information. F2 portrays the turning of information into action upon the environment, and can easily represent the decision-making functions performed by managers. We also identify the three types of systems that are visible (chronologically) in such a setup. Data processing is really associated with turning of data into information. Information systems encompass a wider range of data

processing, decision support and databases. The emerging knowledge management systems are even wider in scope, taking into account the input/output transformation and because it includes implicit and explicit aspects of the enterprise environment and evolves over a period of time and situation.

Conclusion

Although knowledge management is, indeed, a separate branch of inquiry within information systems, it is not yet mature. It suffers from a lack of agreement on the definition of knowledge, confusing knowledge with data or information, leaving it as a black box, or having knowledge management and management information system indistinguishable. As such it leaves a sense of chaos.

The characteristics of knowledge discussed in this paper, together with ideas in organizational learning, intellectual capital, and knowledge maps, will establish knowledge management as a new and promising field within the wider domain of information systems. Overall, knowledge management is a new concept not a recycled one. It is now our job to think and develop knowledge management it further in terms of its own vocabulary and its own meaning. Our information system field and its deficiency of theoretical and philosophical roots may at last have found a safe harbour in the sea of knowledge. Knowledge may be the right concept to help establish not only knowledge management as a new endeavour but also put the entire information system discipline on firmer foundations.

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Clarity is the preoccupation of the effective leader. If you do nothing else as a leader, be clear.

– Marcus Buckingham

Deploying Scenario Analysis Technique to Observe the Tri-Pillars of Architectural Innovation: A BPO Case Study

Manasi Shukla & A.S. Narag

The Business Process Outsourcing (BPO) industry is in the upswing and needless to say it is here to stay. Our BPO case study deploys a research framework that rests on the tri-pillars of the innovation capability in the BPO dyad termed as the relational governance, transformative capability and the learning capability. To empirically validate our framework, we sought the support of scenario analysis techniques in the real-world setting. It was found that to ensure continuing business process innovation from their outsourcing deals, BPO client-vendor dyads need to prioritize and refine their business agendas.

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The size of the Business Process Outsourcing (BPO) market is expected to reach USD 1 trillion by the end of 2006. It is expected to grow at an annual rate of 9 per cent (Economic Times, 2004). In a BPO deal, an organization turns over the management and optimization of a business function to a third party that conducts the activity based on a set of predetermined performance metrics (Gartner Dataquest, 2003). The success of the outsourcing deal is viewed as the level of fitness between client's requirements and outsourcing outcome (Lee & Kim, 1999).

Organizations engage themselves in the BPO partnership as it enables them to achieve strategic, economic and technical objectives (Lee & Kim, 1999). The strategic outcomes, in a BPO deal, refer to the ability of a firm to focus on its core business by outsourcing peripheral activities (Grover, Cheon & Teng, 1996). Additionally, the economic outcomes are benefits accrued to the firm when it uses expertise and economies of scale in human and technological resources of the service provider and manages its cost structure through unambiguous contractual arrangements. Finally, the technological outcomes enable a firm to gain access to the leading-edge information technology (IT) related knowledge in order to avoid the risk of technological obsolescence.

Nevertheless, the variable that results in these strategic, economic and technological benefits is the innovation in the outsourced business processes. The process management leading to process innovation represents the core element of a BPO service. This process innovation is an ambitious management change programme designed to fuse information technology and human resource management for the purpose of improving business performance (Davenport, 1993). Such a process innovation combines the adoption of a process

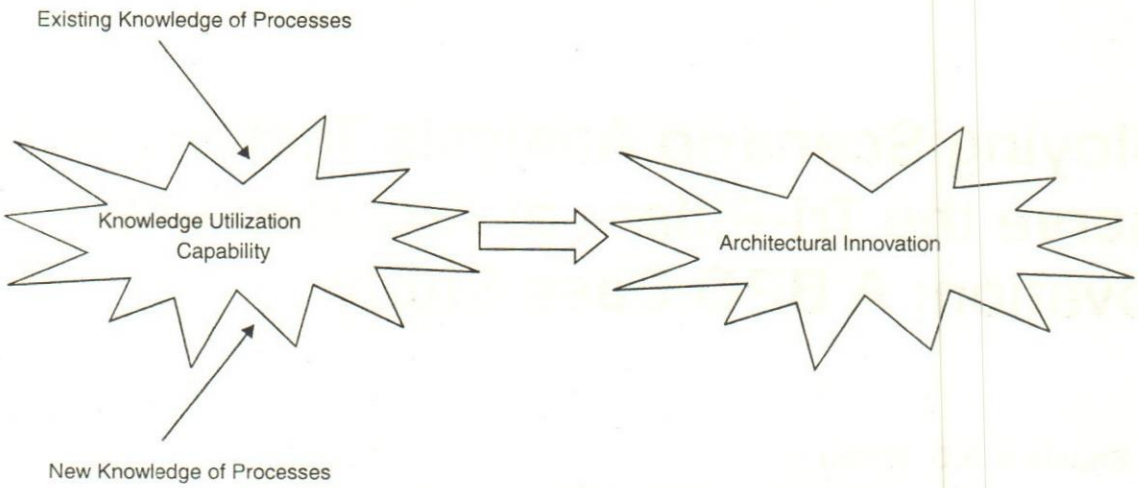

Fig. 1. A Conceptualization of Knowledge Utilization Capability (KUC)

view of the business with the application of innovation to key processes. The novelty and distinctiveness of this combination is its enormous potential for helping any organization achieve major reductions in process cost or time, or major improvements in quality, flexibility, service levels, or other business outcomes. Aforementioned business outcomes are achieved in processes owing to the innovations adopted by the vendors in BPO dyads.

Case Study Purpose

In the BPO dyad, both the client and vendor's technical, managerial and functional knowledge resources are reconfigured to produce process innovation. Specifically, this reconfiguration of knowledge resources – i.e., architectural type of business process innovation has been a subject of many studies (Galunic & Eisenhardt, 2001; Eisenhardt & Brown, 1999; Galunic & Rodan, 1998; Henderson & Clark, 1990; Sanchez & Mahoney, 1996). In this case study, it is proposed that certain dynamic capabilities that reconfigure the knowledge resources - that is, architectural innovation - may operate within the dynamic organizational forms viz. a BPO dyad (Galunic & Eisenhardt, 2001). One such dynamic capability is that of knowledge utilization that relates to the interaction among the various subsystems involved in the development and application of meaningful knowledge (Duncan, 1972). This knowledge utilization capability (KUC) is embedded in the operational processes of the BPO dyad. Thus, this case study details the knowledge utilization capability by which knowledge resources' recombinations occur in the BPO dyad (Fig. 1). These are the architectural innovations in the business processes that in turn cause the strategic, economic and technological outcomes (Davenport, 1993) in a dynamic organizational form i.e. the BPO dyad. Thus, we formulate the given case study in order to establish the effect of knowledge utilization capability and its nomological network of constructs on architectural innovations in the business processes.

In the outsourcing literature, there is repetitive reference to the three streams of relational governance, transformative capability and learning capability that predict the architectural innovations viz. "the knowledge recombinations" taking place in the BPO dyads. Firstly, it can be hypothesized that the chief predictor is the relational governance of BPO dyad, which ensures accessibility to the multitude of client-vendor knowledge resources. Secondly, the dynamic capabilities that predict the knowledge resource recombinations is the transformative capability. Thirdly, the learning capability of the BPO dyad implies the learning mechanisms of the dyad that enable active knowledge assimilation. In Fig. 2, the tri-pillars and their constitiuents are represented as antecedents to architectural innovation. By definition, these tri-pillars are formed of the relational governance that ensures knowledge resource inputs, transformative capability that assures the knowledge utilization and the learning capability that enables the effective knowledge management in a BPO dyad. In particular, the knowledge utilization capability along with choice and maintenance of knowledge comprises the construct of transformative capability; while learning intent, transparency, receptivity, dissemination and shared interpretation of knowledge engender learning capability of the BPO dyad. Thus, the predictors of architectural innovations form the tri-pillars of excellence in a BPO dyad. Based on the above discussion we propose:

The architectural innovation in a BPO dyad is predicted by the three antecedents relational governance, transformational capability and learning capability and their constituents.

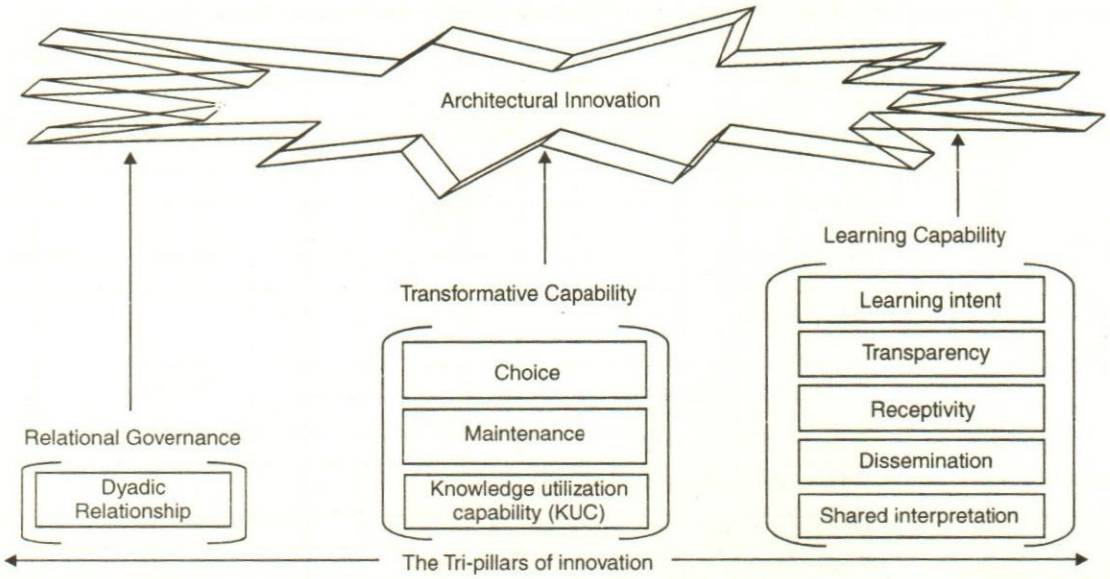

Fig. 2. The Knowledge Utilization Capability Driven Architectural Innovation in the BPO Dyad

This case study research methodology explores empirical existence of the framework discussed above. The data gathered from a leading Indian BPO vendor in Singapore is analyzed in the light of a novel empirical, simulation approach. This technique employs scenario elicitation to characteristically synthesize quantitative and qualitative information, thereby constructing multiple scenarios or alternate portraits of the future. We employ this simulation modeling to analyze the identified research variables in a BPO dyad and to identify related processes and suitable alternatives.

The BPO Industry Case Study

In this study, we approach a local sample site in Singapore BPO industry to carry out a scenario analysis research technique. Industry executives who take on the challenge of transformational outsourcing are experimenting with new innovative approaches like the scenario planning to set the direction, bond the people and share aspirations. Leading companies join in scenario-planning workshops that explore a range of possible futures to craft the sturdiest tactical and strategic plans. To take advantage of their outsourcing partner's unique skills and perspectives, executives should invite its specialists, thought leaders and experts to participate in the scenario workshops (Linder, Cole & Jacobson, 2002). Towards gathering data for this scenario analysis technique, we met the Country Manager of a leading BPO vendor at Singapore. We transcribed this detailed interview (see Appendix B). This interview is instrumental in zeroing in on the domain of BPO definition in our study, which is our prime construct. We further conducted three focus group interviews with different BPO project groups (Appendix A) to elicit the top ten most probable scenarios of architectural innovation in a BPO dyad.

Methodology

In keeping with the earlier studies of scenario analysis techniques (Boland, 1984; Weick, 1979), we urged the participants to help create a sense-making experience by placing themselves out into the future (via a scenario of this future) and then look backwards in time in an effort to make sense of the future. Instead of defining goals (or critical success factors) to identify necessary decisions and required information, participants raise and then question the assumptions and decisions that apparently led to this future. Hence, we argued persuasively for the adoption of scenario approaches to the design of organizational systems that lead to innovation in a BPO dyad. We had three focal groups that included the vendor representatives representing their specific BPO dyadic teams. The input data matrix consists of the following:

1. A list of all factor outcomes e_i (i = 1, 2,….., 20), where we denote the outcomes as high and low respectively for each factor in our research model.
2. The determined compatibility values k_{ij} for every two outcomes e_i and e_j (where k_{ij} = 1,…,5), where the compatibility values are used to determine the interdependence between the individual outcomes with a value of "1" denoting low compatibility and a value of "5" denoting high compatibility between the two outcomes e_i and e_j

Table 1: The BPO Dyad's compatibility Rankings and Marginal Probability Values for the Proposed Factor Outcomes

Marginal Probability			Architectural Innovation		Relational Governance		Choice		Maintenance		KUC		Learning Intent		Transparency		Receptivity		Dissemination		Shared Interpretation	
	Factors	Outcomes	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
0.79		High	0.00																			
0.21	Architectural Innovation	Low	1.00	0.00																		
0.76		High	4.33	1.67	0.00																	
0.24	Relational Governanace	Low	1.33	4.00	1.00	0.00																
0.69		High	3.33	1.67	3.33	2.00	0.00															
0.31	Choice	Low	1.67	3.00	2.00	3.00	1.00	0.00														
0.60		High	2.00	1.67	3.67	1.67	3.33	1.33	0.00													
0.40	Maintenance	Low	2.00	1.67	2.00	3.67	2.00	3.00	1.00	0.00												
0.74		High	4.33	1.67	3.33	1.33	3.67	1.33	3.33	1.67	0.00											
0.26	KUC	Low	1.67	3.67	2.00	2.67	2.00	2.67	2.00	3.00	1.00	0.00										
0.66		High	4.00	1.67	3.67	1.33	4.00	2.00	3.33	1.67	4.00	2.00	0.00									
0.34	Learning Intent	Low	2.00	2.33	1.67	3.00	2.00	3.67	2.00	2.67	2.33	3.67	1.00	0.00								
0.70		High	4.33	1.67	3.33	2.00	2.67	2.00	3.67	1.33	2.33	1.33	1.67	2.00	0.00							
0.30	Transparency	Low	2.00	3.67	2.00	4.00	1.33	2.67	2.00	3.33	2.00	1.67	2.00	1.67	1.00	0.00						
0.76		High	4.00	1.67	3.67	1.67	4.00	1.67	2.67	1.00	2.00	1.67	3.33	1.00	3.00	1.67	0.00					
0.24	Receptivity	Low	1.67	3.33	2.00	2.67	2.00	3.00	1.33	2.33	2.00	1.33	1.33	2.67	2.00	3.00.	1.00	0.00				
0.69		High	3.67	1.33	3.33	1.33	3.33	1.67	4.00	1.67	4.00	1.33	4.00	1.00	3.67	1.67	3.67	1.67	0.00			
0.31	Dissemination	Low	2.00	3.00	1.67	3.00	2.00	3.00	2.33	3.33	2.67	3.67	1.33	3.67	1.67	3.33	2.00	3.33	1.00	0.00		
0.70		High	4.33	1.67	3.33	1.33	4.00	1.67	4.00	1.67	3.67	1.33	4.00	1.33	3.67	2.00	4.00	1.33	4.00	1.67	0.00	
0.30	Shared Interpretation	Low	2.00	3.67	1.33	3.33	1.67	3.00	1.67	3.33	2.00	2.67	1.33	3.67	3.00	3.33	1.67	3.33	1.33	4.00	1.00	0.00

3. The estimated marginal probabilities $p(i)$ for the occurrence of each individual outcomes e_i.

The outcomes of the focal group discussions represent the participant teams' consensual judgments on each of the proposed factor and its outcomes. These results are summarily presented in a triangular, symmetric input matrix required for the scenario analysis techniques in the following Table 1.

Case Approach: Scenario Analysis Technique

In our study, the main objective of process innovation is to radically reshape or even transform key business processes to enhance business performance. This approach emphasizes innovation and not just improvement. The focus is on one-time change. Here, simulation models as explained by scenario analysis technique may be developed to investigate key processes to determine innovation strategies, to develop a vision of new processes and to evaluate alternative models of new processes. Models that support business process reengineering and process innovation normally deal with the flow of information and how resources may be redeployed. These models are usually people oriented as business processes normally involve human resources.

Simulation modeling could offer a great potential in modeling and analyzing business processes. For example, these models can represent different samples of parameter values, such as, arrival rates or service intervals, which can help identify process bottlenecks and suitable alternatives. Simulation models can provide a graphical display of process models that can be interactively edited and animated to show process dynamics. Finally, the simulation models provide quantitative information that can be used for decision-making and can be regarded as problem understanding rather than problem solving tools. There are several characteristics of simulation that make it suitable for business process modeling.

We employ scenario analysis as the qualitative forecasting simulation based technique to plan for the strategic capability of innovation in a BPO dyad. A scenario is a description of a possible future state of an organization's environment considering the possible developments of relevant interdependent factors in the environment. We can find the analogous definitions in the literature (Becker, 1983; Godet, 1983; Ko, 1999; Mercer, 1995; Sarin, 1979; Schoemaker, 1992). The scenario analysis techniques characteristically synthesize quantitative and qualitative information, constructing multiple scenarios or alternate portraits of the future. The experience and intuition of the manager is reflected in the qualitative information used.

Illustratively, we contrast the scenario techniques with the more traditional quantitative forecasting methods. While the latter conceptually deal mostly with the existence of a single future state which they predict, scenario techniques attempt to ascertain the alternative future states and calculate their probabilities (i.e. the probability we can assign now to their future occurrence). Put into decision theory terms, scenario techniques are a strategic planning tool for decision making under risk (i.e. choosing among strategic alternatives) and for determining possible future environmental situations and their probabilities. Since, the future-oriented scenario techniques should operate without making direct extrapolations from past situations and frameworks; they require the consideration of qualitative, subjective information requiring the close collaboration of management in the building of scenarios.

Once we have determined a set of possible future states using scenario techniques, these scenarios can be included in different phases of the strategic planning process. They can now form a basis for the evaluation and selection of potential strategies, i.e., we can now produce an estimation considering the probabilities involved with each individual strategy. In the simplest case, in every scenario the same strategy will have a higher objective function value when compared to alternative strategies and therefore will be chosen as a common basis for further planning in the organization.

Scenario analysis follows three basic stages of analysis of the specific entities, the description of their future states and their synthesis into a strategic basis for action. An entity here is explained as the construct in question, which in this case is the BPO dyad's innovation capability. Following the three stages in scenario analysis mentioned above, in the first stage, we present the research and analysis of the key entity of innovation capability as discussed earlier in this paper. In the second stage, we ascribe the two future states of "high" or "low" to this key entity of the innovation capability in a BPO dyad. These states would be further governed by the future outcomes of "high" or "low" of BPO dyad's innovation capability and its determinants, which are the relational governance, transformative capability and the learning capability of a BPO dyad. In the third stage, we consider the existing interdependencies between the above mentioned factors' outcomes and establish the alternative scenarios through the synthesis of these different future states. For these we employ two scenario analysis techniques of Battelle method (Oberkampf, 1976; von Reibnitz, 1983) and the cross-impact analysis (Gordon & Hayward, 1968; Sarin, 1979).

In the first stage of our analysis, using the aforementioned Battelle method, we determine the most compatible scenarios. This is done by eliminating those scenarios that have any compatibility rating of "1", where their compatibility ratings are used to determine the interdependence between the individual outcomes. Those with a value of "1" denote low compatibility rating and those with a value of "5" denote high compatibility rating between the two outcome e_i and e_j combinations involving any two factors in the input matrix. For this stage we employ a filter programme for all scenario outcome matrices which have even a single k_{ij} (compatibility values) equal to 1. To simplify our investigation, we further filter-out the large number of scenario outcomes using either one of the following conditions. In the first alternative condition, we fix the average scenario matrix compatibility value rating to 3.5 or above. This is labeled as the "*weight*". For the second alternative condition, we fix the number of "2s" that hint at low interdependence to be less than or equal to 4. This number of "2s" in a generated scenario matrix is labeled as that scenario's "*mistakes*". A scenario to be finally qualified has to fulfill either of these two conditions or it will be filtered out. This procedure results in "K" selected scenarios in the first stage.

In the second stage of this procedure, using the cross-impact analysis, we approximate the probabilities of the scenarios chosen in the first stage. We deploy our MATLAB 6.5 based programme to construct matrices for a Linear Programming (LP) model such that the difference between preliminary and joint probabilities of the selected scenarios is minimized. The LP model for the K selected compatible scenarios has the form as follows. The LP model containing 921 constraints and 570 variables is constructed for the purpose of estimating the probability of the scenarios (y_s) in accordance with the theory of probability. The output of this stage is the selected scenarios' probabilities y_s, final joint probability $p^*(i \cdot j)$, (where, i, j $=1,\ldots,n$, j is the outcome

Table 2: Selected Compatible Scenario Outcomes

	Factors										
Scenario Number	Architectural Innovation	Relational Governance	Choice	Mainte-nanace	KUC	Learning Intent	Trans-parency	Receptivity	Dissemi-nation	Shared Interpretation	Weight
1	1*	1	1	1	1	1	1	1	1	1	3.53
2	1	1	1	1	1	1	1	1	1	2	3.11
3	1	1	1	1	1	1	1	1	2	1	3.17
4	1	1	1	1	1	1	1	2	1	1	3.20
5	1	1	1	1	1	1	2	1	1	1	3.27
6	1	1	1	1	2	1	1	1	1	1	3.19
7	1	1	2	1	1	1	1	1	1	1	3.17
8	1	2	1	1	1	1	1	1	1	1	3.13
9	2	1	1	1	1	1	1	1	1	1	3.10
10	2	2	2	2	2	2	2	2	2	2	3.07

*1 = High; 2 = Low

Table 3: Scenario No. 7

Factors	Factor Out-comes	Archi-tectural Inno-vation	Relational Governance	Choice	Maintenance	KUC	Learning Intent	Trans-parency	Recepti-vity	Dissemi-nation	Shared Inter-pretation
		High	High	Low	High	High	High	High	High	High	High
Architectural Innovation	High	0.00	4.33	1.67	2.00	4.33	4.00	4.33	4.00	3.67	4.33
Relational Governanace	High	4.33	0.00	2.00	3.67	3.33	3.67	3.33	3.67	3.33	3.33
Choice	Low	1.67	2.00	0.00	1.33	1.33	2.00	2.00	1.67	1.67	1.67
Maintenanced	High	2.00	3.67	1.33	0.00	3.33	3.33	3.67	2.67	4.00	4.00
KUC	High	4.33	3.33	1.33	3.33	0.00	4.00	2.33	2.00	4.00	3.67
Learning Intent	High	4.00	3.67	2.00	3.33	4.00	0.00	1.67	3.33	4.00	4.00
Transparency	High	4.33	3.33	2.00	3.67	2.33	1.67	0.00	3.00	3.67	3.67
Receptivity	High	4.00	3.67	1.67	2.67	2.00	3.33	3.00	0.00	3.67	4.00
Dissemination	High	3.67	3.33	1.67	4.00	4.00	4.00	3.67	3.67	0.00	4.00
Shared Interpretation	High	4.33	3.33	1.67	4.00	3.67	4.00	3.67	4.00	4.00	0.00

Value of Scenario Weight = 3.17

such that j is not in the same factor as i), the difference between the preliminary and the final joint probabilities d_{ij}^- (for $p^*(i \cdot j) > p(i \cdot j)$) and d_{ij}^+ (for $p^*(i \cdot j) < p(i \cdot j)$) and their maximum difference denoted as "d". The p(i) is the estimated probability for the individual outcomes of a factor and ai is the '0/1' column vector for K scenarios of the i^{th} factor's outcome. Hence, the final LP objective function and its given constraints are expressed in the following format:

min $\sum_{ij} (d_{ij}^- + d_{ij}^+) + M \cdot d$, where M is a large value, say 10,000

subject to

(1) $y_i^t \cdot a_i \leq p(i)$

(2) $y_i^t \cdot (a_i \cdot a_i) - p^*(i \cdot j) \leq 0$

(3) $\sum_{s=1}^{K} y_s \leq 1$

(4) $p^*(i \cdot j) + d_{ij}^- - d_{ij}^+ = p^*(i \cdot j)$

(5) $p^*(i \cdot j) + p^*(i \cdot j) \leq p(i)$

(6) $-d + d_{ij}^{-} \leq 0$
$-d + d_{ij}^{+} \leq 0$

(7) $0 \leq y_s, d_{ij}^{-}, d_{ij}^{+}, d, p^*(i \cdot j) \leq 1$

where, the superscript "t" denotes matrix transposition operator.

The next stage is to do the post-optimality analysis to find the sensitivity range of the scenario probability y_s. This is done by adding the objective function of the first LP Model as a constraint for further analysis:

(8) $\sum_{ij} (d_{ij}^{-} + d_{ij}^{+}) + 10{,}000 \cdot d = OFI_{min}$

where, OFI_{min} is the minimized value of he first LP Model.

Thus, the objective functions for this stage of LP analysis are represented as below:

min y_s , max y_s , subject to constraint (1)-(8)

This stage yields the final output of the scenario probability's upper and lower bounds depicting the sensitivity range of the scenario probabilities. The arithmetic means of these bounds is thereby obtained to group the final values of these y_s (mean) into similar clusters.

Results

Our input data comprises of 10 input factor variables with 2 outcomes each. By the rules of probability tree, this yields 2^{10} i.e. 1024 possible outcome combinations which are better termed as scenarios. We used MATLAB 6.5 to write the software programme to select the best scenarios out of these 1024 possible scenarios. The first stage of this procedure, results in short listing the top 10 scenarios as shown in Table 2 where "1" denotes a high factor outcome and "2" denotes a low factor outcome.

Every short listed compatible scenario can be represented as an overview table using our software package. For illustration, scenario 7 is shown in Table 3.

The second stage of this scenario analysis employs the LP model based optimization of the scenario probabilities. The output yields the values of selected scenarios' probabilities, their lower and upper range bounds and the arithmetic mean of the scenario probability range as shown in the Table 4.

Table 4: Scenario Probabilities and Arithmetic Means of their Upper and Lower Range Bounds

Scenario Numbers	Scenario Probability	Lower Bound*	Upper Bound*	Mean*
1	0.96	2.33	4.92	3.62
2	0.58	0.78	0.65	0.71
3	0.61	0.85	0.14	0.50
4	0.52	0.68	0.00	0.34
5	0.64	0.91	0.01	0.46
6	0.56	0.77	1.43	1.10
7	0.64	0.88	4.16	2.52
8	0.51	0.68	0.50	0.59
9	0.41	0.49	0.45	0.47
10	0.31	0.35	0.40	0.38

* For the Scenario Probability Range

Based on the probability values in Table 4, we infer that the highest probability range is for the scenario 1. This is an ideal scenario situation, so we regard it as the most probable outcome and the best scenario. However, the other scenarios can not be ruled out as they represent the next most favourable outcomes.

These outputs enable us to conclude that there could be few scenario situations under the given probabilities in real-world context of a BPO dyad (Table 5).

The scenarios have a meaning for each factor discussed in the proposed study. This leads us to conclude that the strategic capability of innovation for a BPO dyad can happen even if some of its determinant factors have a low rating. Illustratively, even though scenario "2" has high innovation outcome, still one of its determinants viz. knowledge's "shared interpretation" is low in the BPO dyad. Thus, even in the absence of a high level of knowledge sharing, but a higher degree of knowledge availability and utilization we can ensure high rate of innovation in a real-world BPO dyad. Similarly, we can draw minute inferences from each and every selected scenario's outcome. Finally, we may state that since scenario 1 (see Table 2) with all high factors outcomes is the top ranked scenario, our proposed research framework is empirically valid. This lends credence to our research model of tri-pillars of innovational excellence in a BPO dyadic organization.

Findings

The above case study has empirically validated the research framework and proposition in Figure 2 as the scenario with all high variable outcomes is the top ranked scenario. Hence, it would support the simultaneous high outcomes of all three independent vari-

Table 5: The Architectural Innovation Grid

Constructs / Scenario No.	Architectural Innovation	Relational Governance	Choice	Maintenance	KUC	Learning Intent	Trans-parency	Receptivity	Dissemi-nation	Shared Interpretation
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

High ▨ Low □

ables (& sub-constituents) to yield high dependent variable of architectural innovation in a BPO dyad. This lends credence to the research model's expostulation of the tri-pillars of innovational excellence in a BPO dyad.

The scope of this case research design has been to predict the validity of knowledge utilization capability (KUC) and its impact on the architectural innovations in an organizational setting. Once the sets of possible future states are determined using the scenario techniques, these scenarios can be included in different phases of the strategic planning process. They can now form a basis for the evaluation and selection of potential strategies on the basis of the estimations that take in to account the probabilities involved with each individual strategy.

Contribution

In this case design, a novel research methodology has been introduced that has ubiquitous acceptance in the industry circles and could as well be recognized as a highly utilitarian research approach. While the survey methodology is popular in management academic researches, the scenario analysis technique (SAT) is rarely used. The scenario techniques can be contrasted with the more traditional quantitative forecasting methods like surveys. While, the latter conceptually deal mostly with the existence of a single future state which they predict, scenario techniques attempt to ascertain the alternative future states and calculate their probabilities (i.e. the probability we can assign now to their future occurrence). Put into decision theory terms, scenario techniques are a strategic planning tool for decision-making under risk (i.e. choosing among strategic alternatives) and for determining possible future environmental situations and their probabilities. Since the future-oriented scenario techniques should operate without making direct extrapolations from past situations and frameworks; they require the consideration of qualitative, subjective information requiring the close collaboration of management in the building of scenarios.

Hence, in the interest of both economy and generalizability, previous theoretical developments have been utilized in distilling three dimensions of a BPO dyad's architectural innovation that form its three pillars. The first pillar is provided by relational form of governance in a BPO partnership. The second pillar is formed of the capacity to generate and acquire resources, which are defined by a BPO dyad's transformative capability. The third and last pillar has at its core the BPO dyad's learning capability. These tri-pillars (Figure 2) of architectural innovation capability in a BPO dyad are the precursors to the value addition being made to the outsourced processes and may well be the harbinger of a race to distinguish India's contribution to the global BPO industry.

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Appendix A

The Bpo Client Case Studies

1. SMRT (Singapore Mass Rapid Transit)

SMRT is the local transport corporation in Singapore. They signed a SGD 4 million BPO deal with HCL Technologies in July, 1999. It has been a continuing relationship, in which HCL has the responsibility to manage and streamline SMRT's "spare part maintenance" via a study of process and IT systems. This incorporates process changes via optimization engines' application. In due course, SMRT acquired TIBS and has contracted its related integration and process improvements to HCL again. For this contract, HCL and SMRT BPO dyad has a combined staff of approximately 25 participants.

2. CISCO (Commercial and Industrial Security Corporation)

CISCO is the leading private and commercial security corporation in Singapore. CISCO signed approximately SGD 3 million worth of BPO contract with HCL in July, 2000. This contract was initially of 3 years duration and is still continuing. The deal for HCL is to study and propose CISCO's business process changes. In the first phase, the BPO vendor realigned CISCO's processes with their IT systems by consolidating the double data entry operations into one server. This enabled both the HR and Finance departments to access similar data. This improved overall efficiency when implemented with the corresponding manpower planning as suggested by HCL. The entire business solution was based on an optimization engine. HCL also introduced the employment of hand held devices for CISCO's security personnel.

In the second phase, HCL studied and managed CISCO's Customer Relationship Management (CRM) systems. HCL streamlined CRM processes via centralized call centers with first level customer support, that could be then passed on to the relevant strategic business units at CISCO. In the Phase 3, that is presently continuing HCL is responsible for CISCO's business process maintenance and further enhancement of strategic systems. The CISCO-HCL BPO dyad has the cumulative staff strength of approximately 35 members.

3. JTC (Jurong Town Corporation)

JTC is the estate management corporation in Singapore. HCL bagged a BPO contract deal worth SGD 1 million from JTC in February, 2000. The contract is a continuing partnership to study and streamline inter-departmental systems at JTC. This incorporates changes in the layered architecture, replicating systems, common infrastructure services and the common workflow services. The credit of successful changes accomplished by HCL goes to the JTC's user departments' knowledge workers as well. The cumulative staff strength for this BPO dyad has been approximately 15 participants.

Appendix B

The following are the excerpts from an interview with the Country Manager of HCL Technologies, the leading BPO vendor in Singapore:

Interviewer: Sir, could you please explain your business model in Singapore and abroad?

Mr. D. Sen (Country Manager of HCL Technologies): We basically talk of a multi-shore business model as we operate from a multitude of locations. The first one of these is Utah in USA, which is an expensive place in terms of the labour cost. The second one is the Belfast in Ireland, which has become one of the most expensive cities in the world. HCL also has a location in Malaysia. These three are the supporting locations for the prime target which is the BPO industry in India.

Interviewer: What is making India the prime locale for the BPO industry?

Mr. D. Sen: Basically, the business process outsourcing is essentially an Indian phenomenon, since, most of these business deals proliferating in the west owe their existence to the fluent English speaking populace in the Indian sub-continent.

Interviewer: Now there is this question whether BPO is a bubble like a dot-com phenomenon or is it there to stay?

Mr. D. Sen: But then again BPO has been there for many years. Only now it is proliferating in its present offshore model due to advances in telecommunications.

Interviewer: What in your opinion makes BPO significant?

Mr. D. Sen: Everyone has personal opinion about BPO, even those who perform BPO. From a core competency point of view, sometimes BPO doesn't make sense for the client company unless it's a hardcore manufacturing operation. This is because outsourcing something like

HR function on which the company is closely reliant on, doesn't actually necessitate outsourcing.

Interviewer: Does any innovation take place in BPO?

Mr. D. Sen: If it is business transformation outsourcing the view is completely strategic. In practice two things are happening, firstly, when outsourcing a process you are giving it more structure as otherwise it will be difficult to manage so it could be called adapting certain best practices; secondly, when outsourcing a process you are looking at an outbound processing. In this situation, a client might hesitate twice because of huge costs and the concern of accountability in such a situation. Since, the present ITES organizations' business model pretty often is with regard to pay i.e. it's a pricing model. With respect to US and UK (not with respect to Singapore), Indian costs are a fraction because of cheap India labour. Now that is a catalyst for people to try out new processes. In this case risk decision is simpler, the companies are ready to take risks. Now is it innovation.....

Interviewer: Can you contrast BPO with ASPs or Application Service Providers?

Mr. D. Sen: Application Service Providers usually give whatever readymade products or services they have which are meant to fit the client's processes. In contrast to this, in BPO its more of what are the possibilities rather than what you have. Every client wants to achieve process excellence when long-term outsourcing is happening. Clients in BPO normally adhere to a strict SLA and clear demarcation of inner bounds as well as outer bounds of their projects. There are usually monthly targets and payments based on people working on projects e.g. the banks outsourcing their backend processes like management of balance sheets would require cost-cutting as a prime target and efficiency in management as a secondary target of their BPO deals.

Interviewer: Can you explain the positioning of BPO in the ITES industry?

Mr. D. Sen: There are three pillars in the ITES services industry as we at HCL define it. First one is the BPE i.e. the Business Process Excellence, the second one is BPM i.e. the Business Process Management and the third is the traditional BPO in itself. These may be in a sequence or not. An example of outsourcing is talent warehousing which incorporates the human resource requirement planning via inventory of people, talent matching etc. which are complex processes. These might be predefined in some industries so that they are called the best practices. Hence, the first step is to adopt these processes via in-house or an external collaborating partner as in BPO. Second phase is to segregate your own processes into sub-processes and allot resources to them, like time resource, funds etc. Thirdly, it would be required to decide which processes to do internally and which to outsource. BPE implies following best practices whereas BPM is putting a metrics onto your sub processes when you choose to outsource viz. a BPO! As a result, you get a streamlined process with which you can work with the external vendors.

Interviewer: What are the chief criterion for a business process outsourcing?

Mr. D. Sen: Business practices can be one criterion for outsourcing but not all the time. For instance, we at HCL have Microsoft technical helpdesk outsourced to us, why? It's because of two reasons. Firstly, there are the historical reasons i.e. in-house competences of Microsoft technologies; secondly, due to the knowledge related to Microsoft project and thirdly, it's because of the know-how of how Microsoft distributor network operates. But that's a criterion and not a motivation to outsource.

Interviewer: So what would be your comments to end this interview?

Mr. D. Sen: See nowadays outsourcing is herd mentality and drivers for it are the business drivers alone. BPE is essentially talking about institutionalized best practices which can be domain specific but more often cross domain by definition so it has to be generic. Take for example, best practices pf procurement in transportation industry which may or may not be applied to any other industry like pharmaceuticals. BPM is essentially dividing its process into its least common denominators of sub processes and putting a matrix there. It could also be said to be defining of the input and output controls and resources and putting numbers on them. That is how you manage a business process. In the end, BPO essentially is outsourcing a part of process to a collaborative partner in a real time, long-term mechanism. □

Outsourcing and Manufacturing Strategies for Business Process Outsourcing – A Conceptual Study

Vidhu Shekhar Jha & Deepak Chawla

The paper tries to understand the basic conceptual strategic issues and concerns for Manufacturing Strategy applied by some global companies. An effort is made by the authors to explore the concept of outsourcing with the key issues for Manufacturing Strategy. It also looks into the concept of Business Process Outsourcing (BPO) and how it is being applied by some select companies, making India a hub of outsourcing.

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Skinner (1978), one of the great management thinkers, who has been credited for linking Manufacturing Strategy with Corporate Strategy, considers that Manufacturing Strategy for any organisation answers some of the following points given below. Terry Hill (1985) also supports these ideas. Skinner's idea about Manufacturing Strategy is given below:

- The Manufacturing function can be a strong competitive resource if properly designed and operated
- Cost, efficiency and productivity, while commonly accepted as the most important performance objectives, are generally too narrow and limited and, paradoxically, self-defeating to create competitive advantage.
- The performance objective for a company which needs to be considered are
  - (i) Cost, efficiency, productivity
  - (ii) Delivery Lead-times
  - (iii) Quality
  - (iv) Service, Reliability
  - (v) Flexibility for product to change
  - (vi) Flexibility for volume change, and
  - (vii) The investment required in the production system
- A focused strategic objective or "manufacturing task" is based on one or two of the seven objectives and is desired by the firm's competitive strategy, economics and technological opportunities.
- To meet the task, the operations system is designed and tailored to focus on that task, with limited ranges of products, markets, technologies, degrees of process demands and order quantities.

- The key job of high-level managers is the design of the structure. A strategically designed structure is the key to the operations function becoming a powerful competitive weapon.
- The structure of an operating system is derived from decisions concerning Make vs. Buy, Capacity, Equipment and Processes, Number, Size and Location of Facilities, what products are made in which Plants, and the Management Systems for Production Planning, Scheduling and Control, Information Systems, Quality Control, Organisational Structure, and Work-Force Management.

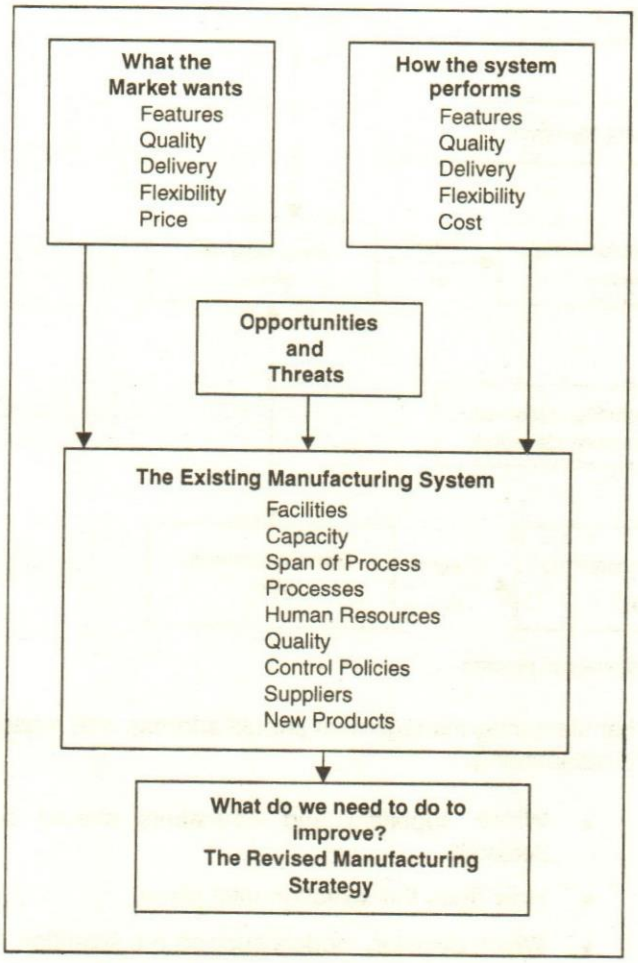

Fig. 1. A Framework for Manufacturing Audit

The audit procedure (Platts & Gregory, 1990) guides the user through a logical process of identifying manufacturing objectives, measuring current manufacturing performance, determining the effects of current manufacturing performance, determining the effects of current manufacturing practices and identifying where changes are required. The framework of the process as given by Platts & Gregory, synthesized from the works of Skinner (1978), Wheelright (1978), Hill (1985) is given in Fig. 1. It is very pertinent for organizations to understand this framework for manufacturing audit. This will help an organization to build upon their manufacturing strategy.

A typical Manufacturing Strategy Process could be represented by Fig. 2 as given by Marucheck, Pannesi and Anderson (1990) as given below:

There have been assessments of the impact of manufacturing practices, which have been typically based upon evidence drawn from single, or multiple case studies of particular practices e.g. Hammer and Champy (1993), Womack et al., (1990). Large-scale surveys of manufacturing practices have also been attempted. They have concentrated upon general objectives such as Quality or Lean production (Hansen et al, 1994); other scholars have looked at cellular based manufacturing. Waterson et al (1998) have shown use of manufacturing practices used in the survey to understand how much the practices are used in various industries in UK as given below:

- When were the practices introduced
- Primary reasons for introducing each practice.
- Which practices are viewed as most and least successful
- What trends in future
- What can be concluded from each practice

Waterson et al (1998) looks at 12 manufacturing practices as given, for achieving competitive advantage in UK-based companies.

1) Business Process Reengineering, 2) Supply chain partnering, 3) Outsourcing, 4) Learning culture, 5) Empowerment, 6) Team-based working, 7) Total productive maintenance, 8) Concurrent engineering, 9) Integrated computer-based technology, 10) Use of manufacturing & Flexible cells, 11) Use of Just-in-time production (JIT) and Total Quality Management (TQM).

In fact, we feel that TQM practices encompasses all of the above 11 issues as discussed by Waterson et. al in 1998. These practices are all part of the TQM Strategy, which could form part of Corporate Strategies for companies around the world to gain competitive advantage in the present era of global competitiveness.

Outsourcing as a practice for Manufacturing Strategy

Klepper and Jones (1997) define outsourcing as contracting out certain manufacturing processes and

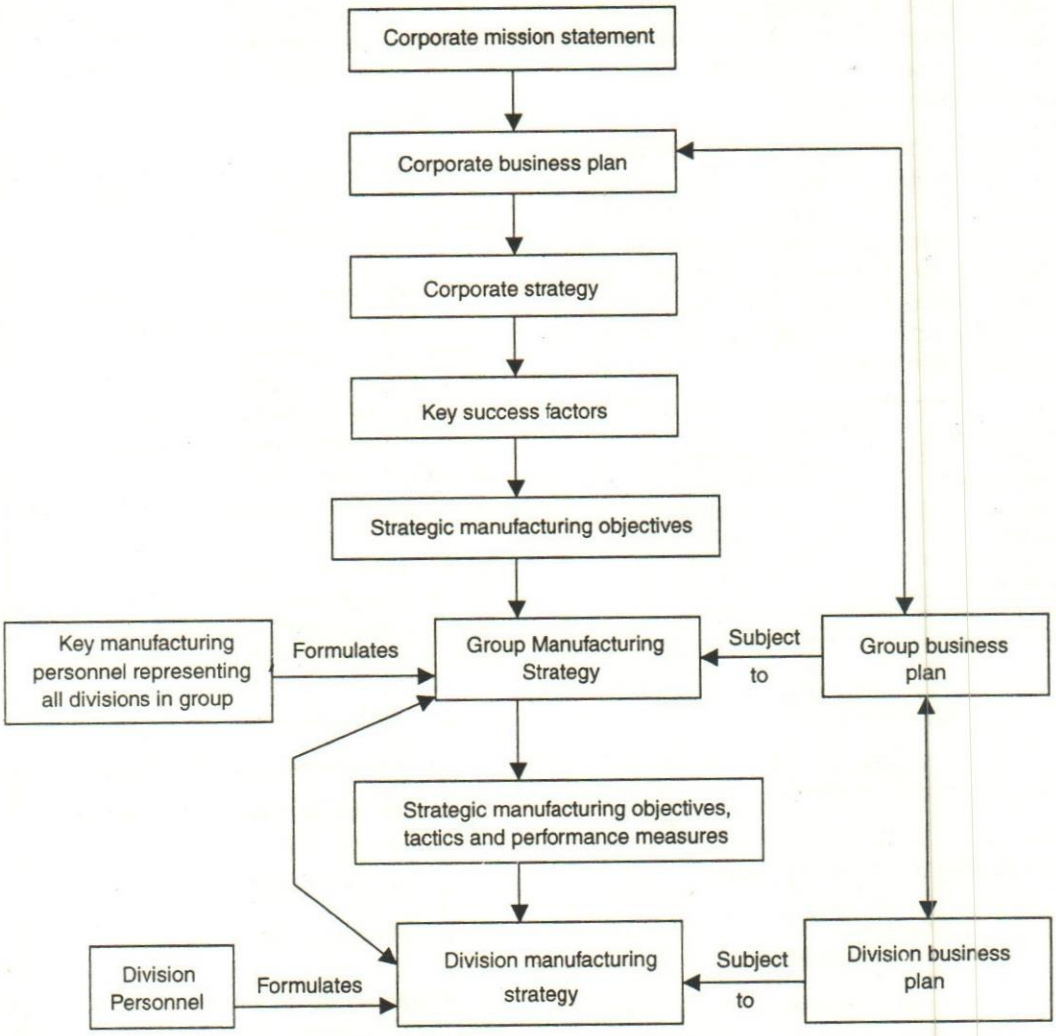

Fig. 2. The manufacturing strategy process

sub-processes to other companies (rather than making everything in-house).

Waterson et. al in his study has found that around 64% of UK companies are using outsourcing as a party to their manufacturing strategy.

Industrial companies are facing a challenging environment. Even though, the changing environment increases performance requirements and imposes constraints, it provides at the same time opportunities for exploiting resources meeting business demands.

Dekkers (2000) has looked in his paper how Boeing, a top American Aerospace Company in the world, has demonstrated the importance of this issue when manufacturing management and especially outsourcing did not keep up with sales and the introduction of new generation of aeroplanes. This leads to questions which manufacturing management should address with regard to outsourcing:

- Which suppliers and co-makers should be selected
- How does the selection take place
- Which decision models support the selection
- How do we manage the manufacturing operations over the total value chain

Reflection on Core and Non-core activities in Manufacturing for Outsourcing

Zhang et. al (1997) give us the terminology of global manufacturing and asks the questions: which activities to outsource and how to allocate their own resources. Globalisation puts a very strong emphasis on defining

manufacturing strategy, and paying attention to outsourcing and capacity management.

Friedrich (1996) raises the key issue for outsourcing as to which areas of manufacturing or production are needed to maintain the value-added chain and on which key areas the company should achieve optimal performance.

Prahlad and Hamel (1990) introduced the concept of core competencies. This expands the view of technology from a broadly described feature whose importance is determined by its support of the corporate mission, to a specific source of corporate uniqueness. Core competencies for an organization, in view of Prahalad and Hamel includes how to coordinate diverse production skills and integrate multiple streams of technology. These core competencies relate strongly to the strengths following from a Strength, Weakness, Opportunities and Threats (SWOT Analysis).

Hayes and Pisano, (1994) have concluded that when we link core competencies to decision making on resource acquisition and capacity management, it would lead to a clearly designed manufacturing strategy for global manufacturing.

A survey done by Van Der Velde (1999) shows that only few approaches to decision making for outsourcing take core competencies into account. The survey illustrates models for decisions on outsourcing as given below:

(i) The transaction cost theory by Willianson;

(ii) The political model by Pfeiffer,

(iii) The core competence paradigm

(iv) The model for information systems outsourcing decision-making.

Doft (1996) describes the sequential steps for designing a virtual enterprise, a form of global manufacturing. They are:

- Describe the Business Process
- Write specifications for each process;
- Assess capabilities and Core Competencies
- Design the business systems of processes
- Assign processes as co-located, networked or outsourced;
- Evaluate and iterate the steps required.

The decision to collocate or disperse certain processes or assign tasks might follow the impact pattern as proposed by Doft in Table 1. Defining a profile for a specific process with four items will enable companies to determine if the activities should be:

- Outsourced
- networked with employees
- co-located centrally

Table 1: Impact Pattern for Outsourcing

Impact Item	Characterize		
Competency required	Peripheral	Significant	Core
Nature of tasks	Common	Important	Creative
Stability of tasks	Stable	Evolutionary	Dynamic
Effect of task or activity	Autonomous	Loosely connected	Systemic

Many scholars study the measure for productivity growth for US economy. They examine whether the marked increase in the rate of technological change or it can be explained by non-technological factors such as factor utilisation, or returns based on scale of economics in production. All factors have positive impacts but technological change is found to be the dominating factor mainly in durable manufacturing.

Outsourcing & Productivity Growth

Efficient firms allocate their resources to activities for which they enjoy comparative advantage. Other activities not enjoying such advantages are increasingly being outsourced to external suppliers as discussed earlier in this paper. Outsourcing is expected to involve production cost savings relative to internal production because outside suppliers benefit from economics of scale, smoother production schedules and centralization of expertise as found by Andersen and Weitz (1986), Williamson (1989), and Roodhooft and Warlop (1999).

Although companies, worldwide are facing skill shortage and an exhaustion of standard options to drive productivity, they have increasing pressures to improve business performance. Automation is not expected to entirely compensate for the shortage of labour supply. Offshoring of business processes and functional activities is one of the options available to a global business to improve business performance (Gandhi, Banwet, Shankar, 2004).

According to transaction cost economics, outsourc-

ing is desirable only when the cost of asset specific investments is lower than the production cost advantage. However in practice, outsourcing as a strategy is not a Make Vs Buy decision. It rather considers previous investments as sunk cost and thus negatively affects the outsourcing decision.

There are a number of studies that focus on explaining the difference between productivity growth rates in manufacturing and services and effects of outsourcing on manufacturing performance. Ten Raa and Wolff (2001) have found a positive association between the rate of outsourcing and productivity growth in the goods sector.

Fixler and Siegel (1999) present fire testable hypotheses in their empirical results.

(i) Increasing wages to active outsourcing

(ii) The presence of a positive correlation between productivity and outsourcing

(iii) Output increased due to increased demand

(iv) A lower service productivity growth due to high labor intensive service production and

(v) An adjustment in production function, leads to an increase in service productivity.

Business Process Outsourcing

Outsourcing becomes a catch phrase in business areas in the 1990s. It was a well-appreciated concept. An organisation typically has processes like Procurement, Finance & accounting, Logistics, Engineering & Research and development, Facilities operations and Sales & marketing, Customer care and Management & training. Outsourcing is a corporate strategy that companies adopt to enhance competitiveness of the company. By outsourcing the non-core part of business operation and only concentrating on the core competence, as discussed earlier, companies can increase productivity, efficiency and even effectiveness.

Outsourcing as a strategy is not new. Some examples of outsourcing, such as General Motors, and EDS, Xerox and EDS, Kodak and IBM etc. are more than a decade old. Over the years, the scale and scope of outsourcing has evolved considerably. It has migrated from large companies to mid-size companies throughout the world. In the 1970s many Western companies began manufacturing products off shore locations such as Japan, Korea, Thailand and Taiwan. Despite the relative high cost of transporting the goods by sea and air, it was cheaper to make them in the Far East and also in Latin American countries like Mexico, than to keep manufacturing in the USA or Europe.

Most companies are now adjusting to manufacturing being done offshore. What earlier took place by Western companies in manufacturing is now occurring in backroom processing and services. It has become very much as a strategy for Western companies to outsource to countries like India and Philippines.

Manufacturing and service outsourcing have changed over time. It is a macroeconomic trend to which every company needs to re-set. If one's competitor can make a product and provide associated services for less than your company, then one needs to follow the competitor or risk being out of the business.

Although initially low skilled jobs in manufacturing and then in-services like call-centres, computer coding were shifted abroad from USA and Europe to countries like India, China or Philippines or Taiwan but now even functions like Human Resources and knowledge skills like Technology are being outsourced.

Outsourcing as a strategy has become a major one in the new economy in the business world. Despite the anti-outsourcing rhetoric (which has been noticed in USA over the last 2 or 3 years), businesses must remain profitable in today's highly completive global economic environment.

The Debate on Outsourcing

CNN's Lou Dobbs identified over 300 American corporations that outsource to remain profitable in today's global economy. Forester Research in USA predicts that 3.3 million jobs will be outsourced across from USA in the next 15 years. "The number of outsourced jobs increased from 6.5 million in 1983 to over 10 million total jobs today" (Gregory Taillon, 2004).

Opponents of outsourcing see it in USA as a new type of homeland insecurity that harms USA. Proponents of outsourcing call this practice "globalisation". Outsourcing benefits people and brings about the benefit of "insourcing".

Just as the U.S firms outsource positions, foreign firms outsource positions to USA. Foreign automobile manufacturers cannot overlook the fact that USA is their world's largest consumer. "The number of insourced jobs" has increased from 2.5 million jobs in 1983 to over 6.5 million jobs today" (Taillon, 2004).

The ability to conduct business globally and across

multiple time zones increases the customer base immensely. Outsourcing, despite higher taxation for US companies is clearly a benefit to these corporations.

Business Process Outsourcing Concept to be understand

Business Process Outsourcing (BPO) is a term that has been around quite a bit in the last couple of years but very few people define the same concept in one manner.

According to Lisa Stone, Research Director, Sourcing at Gartner, BPO is "the delegation of an IT-enabled business process to a third party who owns, manages, and operates the selected business process according to a defined set of metrics". In other words, the client is outsourcing a business process like accounts payable to a service provider that has both the IT and personnel resources to mange it.

BPO differs from traditional IT outsourcing because the latter focuses exclusively on outsourcing IT resources. Those resources usually reside at the service provider's site and are run by their personnel. "IT outsourcing has been mostly focused on the infrastructure, applications, data center, help desk and so on...(with BPO), one is talking about the entire business process that uses all this technology".

Beyond just the BPO technology and business models, Stone stresses that "metrics are absolutely key in BPO. The ability to measure first the insourced versus outsourced environment and then, once the process is outsourced, to measure the operational enhancements that are made to the process". Before and after BPO metrics for an HR application, for example; might be new employees recruitment time taken and cost per hire.

Issues & Concerns for Outsourcing in India

Many managers and decision makers face rising bewilderment. To navigate through this uncharted topography of outsourcing, we need to answer three basic questions

(i) What is the right business model for my outsourcing strategy?

(ii) How can my organisation create the right relationships?

(iii) What steps must my business take to ensure that we meet our business objectives?

The relationship and trust between the outsourcing organization and the outsourcing provider is a critical factor in realizing the expanding potential for outsourcing. With the advent of reliable, cheap global communication technologies, the internet and other IT-based technologies, abundance of skilled labour forces in many developing countries like India, many companies in the West have moved their various processes to India for a competitive advantage.

To become more flexible in changing the business landscape, enterprises are developing complex spectrums of outsourcing relationships, ranging from mundane payroll outsourcing to more complex, business-critical processes like Research & Development & Engineering.

Some Recent Examples

- Banking Industry: HSBC has outsourced 4,000 finance jobs to India, China and Malaysia to slash costs.
- Insurance Industry: In 2001, Guardian insurance began outsourcing IT processes to India. They have expanded their scope to include help desk, desktop support and disaster recovery. They have had $12.5 million savings with no loss in productivity.
- Automotive Industry: GM announced that it is setting up a $21 million technology centre in Bangalore, India to carry out Computer Aided Design (CAD) & Computer Assisted Engineering (CAE) research.
- General Electric, Oracle and Intel – big global companies have set up R&D and technology centres in India lately.
- Investment Banking: J.P Morgan Chase off shoring scope of its stock market & equity research to India. The firm is hiring Indian MBAs, who will do the heavy-duty number crunching at J.P. Morgan in India, which is being done presently in USA.

The dark side of Strategic Sourcing

Rossetti and Choi (2005) raise a concern on how outsourcing can have misapplication. They have taken an example from the Aerospace Industry in USA. They argue that misapplication of Strategic Sourcing can lead to unintended consequences for the buying firm's competitiveness. This is explained in Fig. 3.

Rossetti and Choi have also looked at Strategic Sourcing Initiatives: Definitions & Outcomes in their paper in 2005. This is given in the Table 2. This will help understand executives in Indian Aerospace Industry

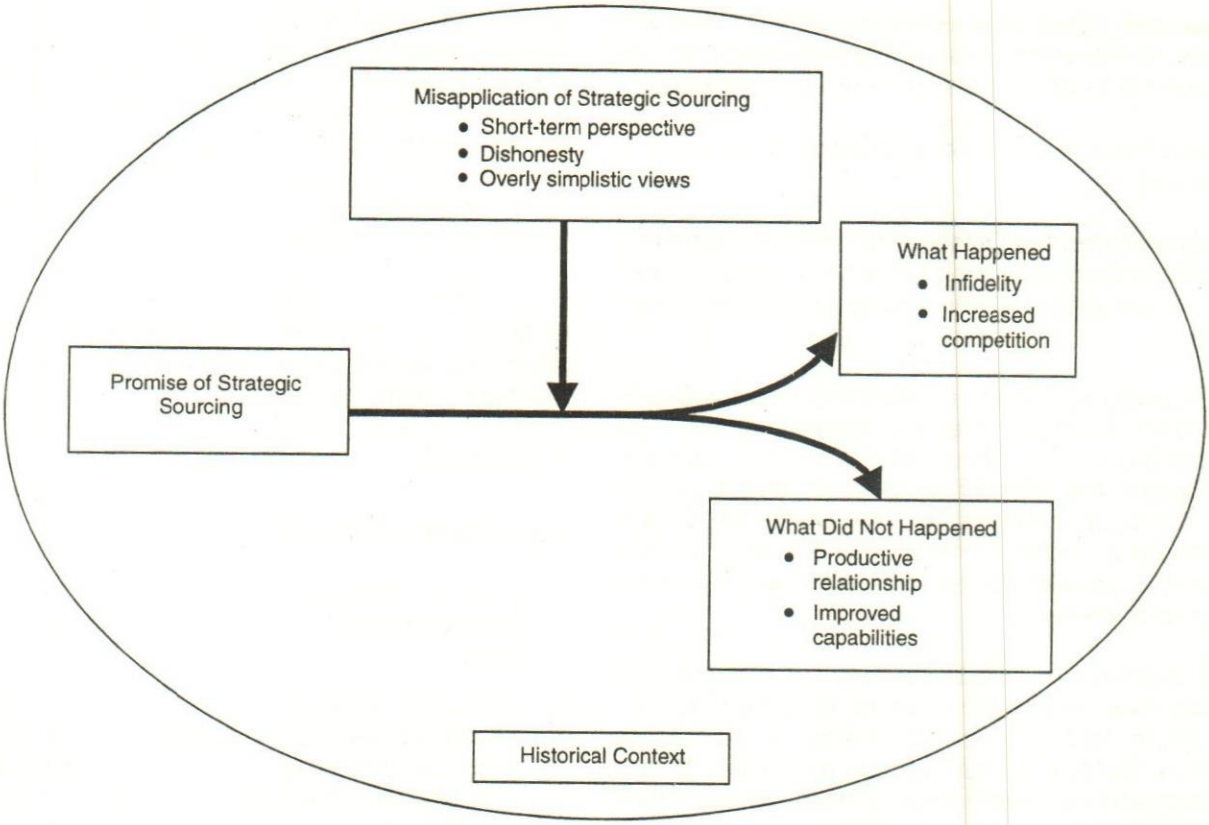

Fig. 3. The Overall Outsourcing Framework as given by Rossti & Choi

especially Hindustan Aeronautics Ltd (HAL) and other executives of India to understand the correct motives of strategic outsourcing and Fig. 3 would give some kind of concern for how things can go wrong, if the strategies are not applied well.

Outsourcing & Sustainability Issues

Multinational corporations were the first to utilize cost differences across the globe by moving production plants to low-wage countries, R&D to countries with high subsidies for such activities, sales and manufacturing to the rich countries and their headquarter to tax havens. Lacify, Willcocks and Fenny (2004) have discussed how innovative companies like BAE Systems, Bank of America, Barclays Bank, and Lloyds of London have actually transformed their back-offices into commercial enterprises.

Gupta & Suryanarayana (2004) have looked at the issues of sustainability of the outsourcing model. They have looked at three case-studies like GE, BPO operations, JP Morgan chase offshore operations, and Oracle outsourcing in India. They argue that a three-pronged communication approach is found to be useful in managing the relationships. By communicating often and openly with the provider, identifying issues early, and resolving them quickly and fairly, then the personnel on both sides will adopt to the partnership. This issue is summarized by Gupta & Suryanayana (2004) in Fig. 4.

Some select examples of Outsourcing in Indian Manufacturing Company

In the first case of its kind, Tata Steel Ltd., the first integrated steel plant in Asia which started in India in 1907 and is among the lowest cost producer of steel in the world, used the strategy of outsourcing the marketing of its secondary products division to MetalJunction.com in 2004, (a 50:50 joint venture of Tata Steel and Steel Authority of India Ltd. SAIL is a Govt. owned public sector company).

According to the plan, Metal Junction will absorb the employees of Tata Steel's secondary products Marketing Division. Industry Analysts say "Tata Steel's decision to outsource the marketing process of secondary products to the MetalJunction.com is in line with the company's strategy to reduce costs and bring more efficiency in its own operating system". Metal Junction currently sells around 40,000 tonnes of Tata Steel

Table 2: Strategic Sourcing Initiatives: Definitions and Outcomes

Strategic Sourcing Initiative	Definition	Intended Outcomes
Supply Base Rationalization	Reduction of the total number of suppliers	• Decreased resources needed to mange suppliers • More focused relationship building
Commodity Management	Matching corporate needs for parts of similar processes and materials with changing capabilities of the supply base.	• Increased understanding of supply markets for given commodity • Decreased supplier's internal cost due to improving economics of scale • Closer technical relationship between buyer and supplier.
Spend Consolidation	Increased dollar spent on purchases from one supplier	• Increased purchasing leverage • Increased interdependence between buyer and supplier
Global Sourcing	Exploiting global markets for improved capabilities, such as low-cost labour for the manufacturing of labor-intensive parts	• Decreased cost per part • Increased competition in supply market
Sole Sourcing Agreements	Purchasing a product or family of products form one supplier	• Lower prices from suppliers • Increased interdependence between buyer and supplier
Long-Term Agreements	An understanding that buyer-supplier relationship will extend over several years or indefinitely	• Improved quality, delivery and price due to supplier's buyer-specific investments • Expectation of trust and co-prosperity between buyer and supplier.
JIT Purchasing	Minimization of supply lead time	• Reduced level of inventory • Increased supplier responsiveness

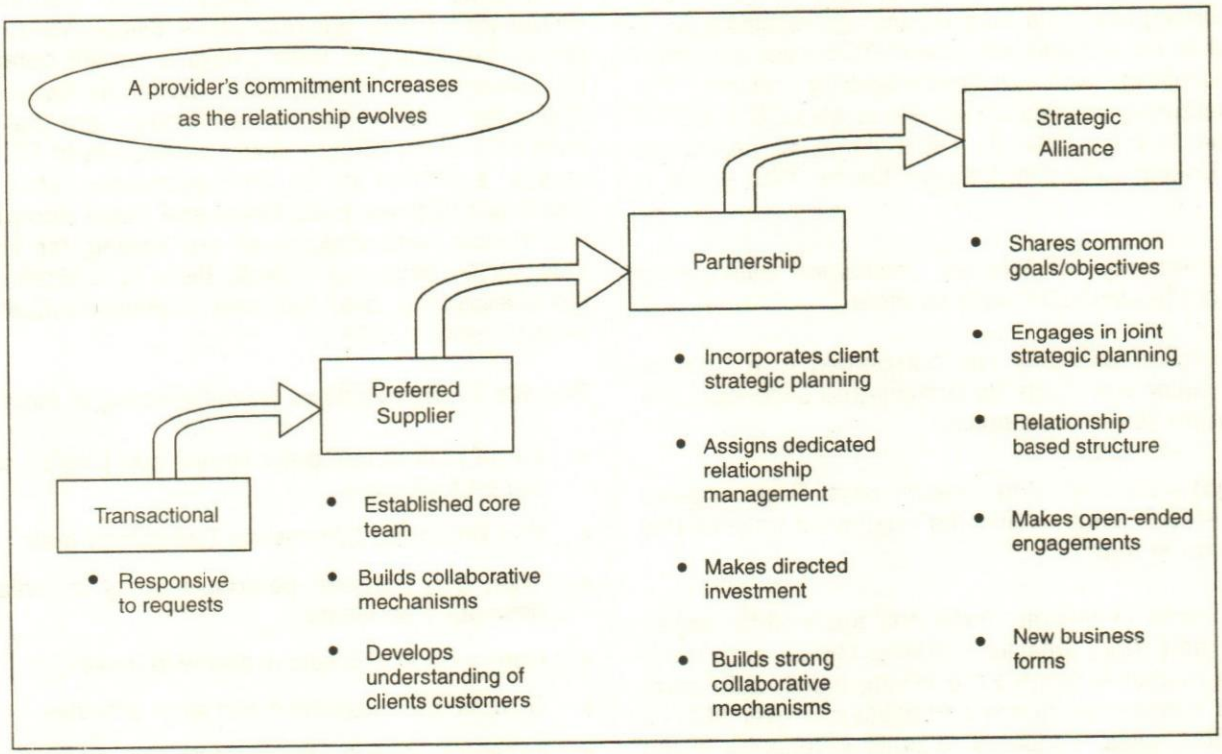

Fig. 4. Relationship arrangements in Outsourcing

products per month, out of which secondary grade of products make up 20,000-25,000 tonnes per month.

Tata Steel had outsourced its Information Technology function to IBM way back in year 2001. It has given Tata Steel the cost competitiveness and has helped IBM also in its operations.

In 2004, Tata Steel has outsourced its payroll processing (which earlier done by Tata Steel's employees) to Prolease India, a HR solution provider. This has reduced Tata Steel's cost by 20% in the payroll processing process. This is in line with the company's strategy to focus more on steel making and to restructure and outsource non-core areas.

Jameshedpur Utility & Services Ltd. (Jusco), a wholly-owned subsidiary of Tata Steel, is looking at taking over the company's non-core activities in a phased manner. There is the possibility of looking at Town Management activities like basic maintenance, electronic supply to Jamshedpur and also other townships in the near future, which is presently run by Tata Steel on its own. It is also thinking in terms of outsourcing programme in processes like fleet management, guest houses, education services, healthcare etc in the future.

Tata Chemicals has outsourced its IT function to Tata Consultancy Services (TCS) a Tata group company. Outsourcing of IT and core technology functions is expected to be a significant area of TCS from the global manufacturing and process industry sector. The manufacturing practice constitutes to about 20% of TCS revenue in 2001-2002. Its client name is majors like Ford, Boeing, Chevron, Lafarge, Lucas, TVS, Voltas in India.

Some examples of Foreign companies outsourcing some of their manufacturing for India

Bosch of Germany has outsourced to a Chennai based super auto forge for primary and secondary pistons worth $6 million annually.

Ford India Managing Director says, "I am amazed at the kind of engines and the number of engines that are made in India".

In terms of volume, India has the world's largest tractor and three wheeler markets. Global auto component market is worth $750 billion. Indian auto component manufacturers are competitive in over 50% of the components compared to other companies in the world, if only costs are compared.

Multinationals are setting up international purchase official (IPO) in India providing the biggest inputs to the outsourcing movement. Volvo at Bangalore, India, Daimler Chrysler (Bangalore) Caterpillar (Chennai), Cummins (Pune & Jamshedpur), Ford (Chennai) are among some odd IPOs that have set up their bases in Indian cities. Most of them source products worth $ 10 million. In cases like Hyundai and Ford, 100% subsidiaries act as the representative purchase office in India while the $13.1 billion Tyco Electronics has strategic outsourcing team at Whitefield, Bangalore in India. Managing Director of Tyco Electronics believes that India will be a one-stop shop for low cost design engineering, tooling and manufacturing in delivering results to Tyco's strategy for competitiveness. The Executive Director, Hyundai Motor India says, "Even within our different factories (world-wide) we believe that Hyundai Motors India will be the most competitive for the small car. So HMI will be our small car hub".

The Managing Director of Toyota Kirloskar Motor, in Chennai, India says "my proposal to set up the new project to source transmission from India had competition from the Philippines and China. But we believed, it would be more economical to make it in India."

Quoting from a newspaper report in October 2005 in India's Economic Times "India is the hottest thing going in the Silicon Valley in USA. Roughly half of the jobs being outsourced by Silicon Valley companies are going to India", says a survey conducted by University Professor, Mario Beloti at Santa Clara University in USA. The survey findings are that more than 53% of the Silicon Valley companies in USA outsource a portion or all their operations. India gets about half of these jobs. China and major competitors like Russia, and Philippines are trailing far behind. This survey says that overall, there is a slight dip in the outsourcing over the past 3 years in California, Silicon Valley in USA.

Benefits for organizations for outsourcing to India

- Large pool of computer literate and English speaking professionals
- Well organised Information Technology skills
- Wide gap between personnel costs in India and developed countries.
- Combination skill sets available in India
- Govt. is also supportive and such activities
- Excellent training infrastructure and good telecom infrastructure in major cities in India.

Conclusion

Strategies in the new millennium will have to look at manufacturing strategy as part of their corporate strategy for competitive advantage. Outsourcing as a part of Manufacturing Strategy, will play a major role for companies in the future. The manufacturing strategy in Japan is ultimately one which recognizes that eventually Japan will become the assembly base of highly functional products. Most Japanese companies agree that the necessary conditions for prosperity are: the need to have growing products in line with the market needs and in accordance with trends as; a very active R&D; needs-oriented product development; very proactive thinking among people at the top in organisations; progressive development of new business; utilization of ideas and knowledge from outside sources; extensive utilization of information technology; clear and easy management policy and strategy which could be able to be implemented from the shop floor to the senior management. These are the lessons learned post-1988 in Japan as explained by Hajime Yamashina (1996).

Some of these concerns and issues would be true for many developing countries like India as well. The challenge for economic survival is in the manufacturing and agricultural sectors in India. The key to success in the area of manufacturing strategy is the key to success in the area of high level technology and continuous technical innovation. It is firmly believed that revitalizing the power of industrial competitiveness lies in the engineering and manufacturing capability within each firm in each industry. Outsourcing as a strategy, as discussed in the paper, its implementation and concerns, will form an important part of the manufacturing strategy of companies to be competitive in the new millennium worldwide. Indian market will play a very crucial role for many companies in the world especially in automobiles, electronics and computers (Hardware as well as Software). Research & Development, Engineering and Project Management, Information Communication Technology (ICT), would be keys in the manufacturing and outsourcing strategies.

If India has to achieve an overall growth of 8% per annum (GDP Growth), it is essential that both manufacturing and services frown at more than 11% even when agriculture growth picks up to close to 4%.

A comparison with major Asian countries shows that the size of the value added in the Indian manufacturing sector was less than one fifth of the Chinese manufacturing sector and even less than half of the Korean manufacturing sector. Share of manufacturing sector in India's GDP has remained more or less stable around 17%, while in China the manufacturing sector accounted for around 35% of GDP and for Korea, it was around 31%. India does have advantage of labour costs as compared to Malaysia and Indonesia as per a FICCI study in 2005. It is quite obvious that if India has to become a global hub for manufacturing, many policy issues for the manufacturing sector growth by the government and policy maker and various concerns for manufacturing strategies as highlighted in this paper will have to be addressed.

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Asian consumers are showing a new form of modernity and sophistication that would challenge even the most experienced brands. The retailers with the local knowledge and distribution network will ultimately emerge as the winners.

– Martin Roll

Role of Top Management in Knowledge Management: Indian Scenario

Rajesh K. Pillania

The paper focuses on the role of top management in knowledge management in three sectors of Indian industry namely software, pharmaceutical and petroleum marketing, thus covering both the private (software and pharmaceutical) and the public (petro-leum marketing) sector. The findings of this research work are not very encouraging. Top management, in general, has failed in being the torchbearer in KM efforts. The overall scenario is worse in the public sector as compared to the private sector.

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Knowledge management is a comprehensive concept covering various aspects as well as requiring various ingredients for successful implementation. Top management is one of the most important prerequisites for any KM initiatives. If the boss takes knowledge seriously, the rest of the company will follow (Kluge, Stein and Licht, 2001). If the top management is not serious about KM initiatives, the employees will see it just a management fad. If we look at KM as a journey than, top management role is like a light house giving continuous directions.

This research work is an attempt to find out what is the role of top management in knowledge management in Indian industry. To have a macro view of the situation, experts from industry, academia and policy makers were asked about the role of top management in knowledge management in the Indian industry. To have the micro view, five firms each from two industries namely software, pharmaceutical and four firms from petroleum marketing sector were studied, thus covering both private (software and pharmaceutical) and public (petroleum marketing) sector.

Though there is general agreement and acceptance over the importance and relevance of knowledge and knowledge management, there exist a number of perceptions and definitions. Almost every individual and organisation has got his own definition. The definitions used in this research work are as follows:

Definition of Knowledge: *Knowledge is a whole set of intuition, reasoning, insights, experiences related to customers, products, processes, markets, competition and so on that enable effective action.*

Definition of Knowledge Management: *Knowledge Management is a systematic, organised, explicit and deliberate ongoing process of creating, disseminating,*

applying, renewing and updating the knowledge for achieving organisational objectives.

Definition of Top Management: *Top management consisted of functional heads and the chief executive officer for the present research study.*

Literature Review

DeTienne, Dyer, Hoppes and Harris (2004) strongly feel that without effective leaders who set appropriate examples, employees will not be motivated to freely participate in the KM initiatives. Leaders should determine what knowledge is valuable for the firm in the first place and then determine how best to distribute knowledge. The new position of Chief Knowledge Officer can greatly enhance and coordinate a company's efforts to implement and maintain the KM programme. They conclude that leadership has a critical role in a company's KM efforts.

Viitala (2004) tries to find out the answer to the question "What should leaders actually do in their units if they want to support learning which contributes to the capability of the organization?" She finds that the most central dimensions of knowledge management are orienteering learning, creating climate that supports learning, supporting learning process at group and individual level, and being a role model.

Alvesson and Sveningsson (2003) investigate how managers position themselves and their work in terms of leadership in a large knowledge-intensive company. The study undermines some of the dominant notions of leadership, for example, the leader as a consistent essence, a centred subject with a particular orientation to work. Value commitment appears as disintegrated and contradictory. The study indicates a need to radically rethink dominant ideas about leadership.

Baird and Henderson (200) write this book on the basis of a study undertaken for four years of nine organisations in U.S.A. They use 'knowledge engine' as a metaphor which consist of two interactive cycles, namely, the production cycle, consisting of to acquire, to structure and to target, in which knowledge is driven into performance and the strategic cycle, consisting of to focus and to reflect, in which performance is the source of knowledge. Leaders will have to know how to create and leverage knowledge assets and the knowledge engine will drive organisations forward in the future.

Lloyd and Stewart (2002) discuss the role of leadership in knowledge management. Leadership has an ionizing role as it generates and sets the direction for energy in an organisation. It sets the tone and culture. Asking the right questions and ability to listen to answers and apply that knowledge, are a vital part of critical role of leadership. Leadership needs to bring the knowledge issues to the surface and then make sure they are included into Board discussions about strategy. They should increase trust levels. They need to have a knowledge perspective of the organisation and help create conditions where managers will encourage its development.

Nonaka, Toyama and Konno (2002) outline a firm-level model of knowledge creation consisting of three elements, namely, the SECI process of knowledge creation via conversion from tacit to explicit knowledge, ba-the shared context for knowledge creation and knowledge assets – The inputs, outputs and moderators of knowledge-creating process. These three elements have to interact with each other organically and dynamically. They further discuss the role of leadership creating and communicating the knowledge vision of the company, facilitating and utilising ba-effectively, understanding the knowledge assets of the firm – in facilitating the knowledge-creating process.

Bontis (2001) drawing from his own experiences and the literature available discusses the complex role of CKOs and lists five perspectives for CKOs. These are: Knowledge sharing icon; trust steward; total trainer; techno nerd; and number crunching accountant. The CKO needs to maintain an evangelical approach to knowledge management.

Kluge, Stein and Licht (2001) emphasize while leaders across all levels of the organisation have unique and important roles to play in managing knowledge, it is particularly important for the CEO to be involved in the knowledge sharing process. This involvement is critical because the CEO sets the tone and establishes the rules for an organisation; therefore he or she has an enormous impact on whether or not knowledge management becomes a company-wide effort. They explain that if the boss takes knowledge seriously, the rest of the company will follow.

Politis (2001) undertakes a survey of 227 persons who are or have been engaged in knowledge acquisition activities to investigate the relationship between different leadership style dimensions and knowledge acquisition attributes. Results show that the leadership styles that involve human interaction and encourage participative decision-making processes are positively related to the skills and traits that are essential to knowledge management.

Singh (2001) interviews Rajat Gupta, McKinsey's Managing Director on leading knowledge-based global consulting organization. Gupta stresses that when he started as managing director one of the most important things he emphasized was making sure they are in the forefront of knowledge not as much from an academic point of view as from a truly applications point of view. He made a strong personal involvement and investment to make sure they took on knowledge development efforts.

Takeuchi (2001) suggests three ways in which CEOs and other top managers should provide direction for where the company should head in terms of KM. First of all, top managers must articulate a 'grand theory' of what the company as a whole ought to be. Second, top management must incorporate its vision for knowledge management into the company's corporate objectives or policy statement. Third, top managers must strategically decide which KM efforts to support and develop and then must follow that strategy. He argues that by performing these actions, the organisation's leadership will not only link together the many disparate activities of the organisation into a coherent whole, but will also establish clear and visible standards and objectives for the rest of the company to follow.

APQC (2000) study the KM efforts at 49 companies. It stresses on aligning KM strategy with business strategy and leadership role and support needed to sustain a KM strategy. The study finds that at every successful large scale KM-initiative it has examined, an important senior champion or group saw the strategic value of KM and endorsed what became a significant investment in it.

Brelade and Harman (2000) stress on the need for leaders to help employees avoid conflicts of interest with KM practices and to help resolve such conflicts when they occur. While going through this "process" of change, the authors state that managers' roles will change to "facilitators rather than controllers" due to the increased power of the knowledge workers in relation to the managers themselves.

Eppler and Sukowski (2000) place leadership at the top of the pyramid of the platforms, norms, processes, and tools necessary for effective team knowledge management; and emphasize the need for knowledge managers to achieve and maintain equilibrium between motivating team members with urgency and providing them with time and space to reflect.

Hackett (2000) based on a Conference Board survey of 200 senior executives at 158 global companies in Nort America, Europe and Asia-Pacific says that practices associated with knowledge management and organisational learning have begun to make real business contributions. Eighty per cent of companies have some KM effort underway, including the creation of a chief knowledge officer/chief learning officer in 25 per cent of companies. The most successful methods for turning knowledge into action are the results of informal employee networks, customer focus and other workplace practices. Top management leadership is very important and KM should be viewed as a long-term investment that involves all segments of the business.

Herschel (2000) describes one of the CKO's main functions as follows: "The CKO's goal is to foster a corporate culture that is constantly learning and growing by getting the firm's individuals committed to learning, and to embed that in the process structure of the business".

Teleos (2000) realising the significant role of leaders in successful knowledge management and with a purpose to acknowledge their tremendous contribution asked senior managers at Fortune Global 500 companies and a panel of chief knowledge officers and leading knowledge management practitioners around the world to nominate and rank senior executive against two set of criteria to identify 10 most admired knowledge leaders. A panel of 32 internationally recognised New Economy thought leaders was assembled to select the winners. The winners were John Seely Brown, Robert H. Buckman, Jan R. Carendi, John Chambers, Stephen Denning, C. Jackson Grayson, Yotaro Kobayashi, Laurence Prusak, Hubert Saint-Onge and John F. Welch, Jr.

American Productivity and Quality Centre's International Benchmarking Clearinghouse (1999) conducted this study to discover how best practice organisations facilitate and nurture an environment for knowledge sharing. It demonstrates that there is no one right set of motivators to encourage people to share insights and build on ideas of others. Instead, what draws people to share is different in different organisations and matches the organisations' core values and other organisational processes. Alignment with the current culture and a practical purpose to share is, specifically, what draws people most strongly to share knowledge.

Anonymous (1999) identifies the primary task of an CKO to develop a knowledge management programme, and to show managers that knowledge management will benefit everyone from the chief executive officer (CEO) to the office junior. CKOs tend to be entrepreneurial by nature-self-starters, excited by

business development and the creation of a new corporate role for themselves, and the desire to build a project and see it through to completion.

Beckman (1999) expands management's responsibilities in the KM process to include motivating employees, providing equal opportunities and development, and measuring and rewarding the performance, behaviour and attitudes that are required for effective KM.

Cashew (1999) discusses a study undertaken by Delphi Group which shows that CKO phenomenon pales in comparison to other approaches being used to instill knowledge leadership. Many organisations mistakenly apply a very traditional, hierarchical organisational model to knowledge leadership. The role of knowledge leader is to build the bridges. Knowledge leadership is an essential part of competition in the next millennium.

Huseman and Goodman (1999) examine the evolution of the corporation, illustrate the forces of change on corporate structure and the techniques used to restructure the corporation, analyse the impact of change on corporate education and the emergence of knowledge organisations and present a model for conceptualising and leveraging knowledge. The strategic model has vision at its heart and consists of four phases, namely, identifying and capturing knowledge; valuing and prioritizing knowledge; sharing and leveraging knowledge; and, creation and connection of new knowledge. A clear vision is the major prerequisite to understanding and implementing the four phases of the model. A survey of 202 of the 1,500 largest companies in America done by the authors establishes the importance and need for knowledge organisations.

Liebowitz (1999) identifies key ingredients for successful knowledge management initiatives. One of the key elements is to develop a KM strategy with senior management active involvement and support in moral and financial terms.

Copeland (1998) suggests that CKOs facilitate knowledge sharing, document areas of expertise, and also set up incentive programmes. He adds: "A big part of the CKO's job is getting employees to abandon their territorial ways and share what they know".

Ichijo, von Krogh and Nonaka (1998) show that developing leadership that values and is committed to knowledge management require investments of both time and resources from companies, but the benefits that come from doing so more than make up for the costs associated with such efforts.

Ruggles (1998) examines the results of a study of 431 U.S. and European organisations, conducted in 1997 by the Ernst and Young Centre for Business Innovations, and describes what firms are doing to manage knowledge, what else they think they could be or should be doing, and what they feel are the greatest barrier in their efforts. More than 67 per cent admitted that their number one obstacle to knowledge management-culture could be overcome by more deliberate management. The sentiments of almost every executive who participated in the study echo those of Drucker: that leveraging organisational knowledge is not only important, but it may be the most important job management has.

Stewart's (1998) research shows that most CKOs shoulder at least three core responsibilities. The first is evangelizing the necessity of knowledge sharing in every department of the organisation. The second is to find and endorse projects that effectively distribute knowledge throughout the firm. The third responsibility of CKOs is to maintain the performance levels of their own staff. This threefold mission of CKOs is a firm starting point in defining this new position.

Davenport (1997) tries to find out what organisations are actually doing in KM projects and what factors lead to success based on the research work done with two Ernst and Young researchers in which they interviewed managers of 31 different KM projects in 22 firms. They found out that the crucial success factors are senior management support, supporting culture, employee motivation and enabling IT infrastructure.

Stewart (1997) asserts that even companies with promising cultures and highly effective incentive programmes will not succeed without dedicated and responsible managers. Interestingly, however, many researchers and professionals are now realising that if firms wish to have such managers, managers who are dedicated to achieving KM goals and who are prepared to do what is necessary to achieve those goals, they must be willing to deliberately develop these managers and provide them with adequate and ongoing training, direction and incentives.

APQC (1996) study identifies strategy and leadership as one of the KM enablers. It identifies the strategies for KM in practice by companies. The most widely used strategy among the participants was 'the transfer of knowledge and best practices' in order to improve operations or to embed them in products/

services. Further it observes several approaches and solutions being used for implementing KM initiative. KM tends to be decentralised management responsibility and funding usually comes from the MIS department.

Drucker (1993) discusses a number of issues like emergence of knowledge as the most critical resource, economics of knowledge, productivity of knowledge etc. He stresses that society is in a management revolution stage in which knowledge is applied to knowledge itself. The most important responsibility of management is productivity of knowledge because it is going to be the determining factor in the competitive position of a nation, an industry, a firm.

Nonaka (1991) in this path-breaking paper explains the knowledge-creating process at Japanese firms and the lessons western companies/world can learn from them. Japanese approach puts knowledge creation exactly where it belongs: at the very centre of a company's human resource strategy, He distinguishes between tacit and explicit knowledge and explains the process of new knowledge creation which consists of four basic patterns, namely, from tacit to tacit, from explicit to tacit, from tacit to explicit and from explicit and from explicit to tacit, from tacit to explicit and from explicit to tacit resulting in a kind of spiral of knowledge. He tells how figurative language and symbolism helps in converting tacit knowledge into explicit knowledge. Further, he emphasises the importance of redundancy and creative chaos in the knowledge-creating Japanese companies.

This literature review brings out five important points:

1. Top management plays a critical role in successful KM initiatives Top management which is more participative and democratic gets more success in KM efforts.
2. Top management's active involvement and support can help in overcoming most of the barriers like culture, lack of trust, lack of participation etc in knowledge management.
3. Though it takes a lot of time, energy and investment by top management in successful KM initiatives, the returns are tremendous.
4. Chief Knowledge Officer is emerging as an important position for KM in organisations, though the roles and responsibilities of CKO are still vague and not clearly defined/articulated.
5. There is a lack of studies on the role of top management in knowledge management in Indian organisations which justifies the current study.

Research methodology

Knowledge Management is in the introduction stage in India (Pillania, 2005). This study was first of its kind in the Indian context, so instead of going into details and covering all the aspects, the research work focused on looking at few major issues and was exploratory in nature. The methodology used for carrying out the research is discussed briefly here.

Data Sources: This research work was based mainly on primary data collected from companies under study and experts from industry, academics, Govt. bodies etc.

Research Approach: A survey method was adopted to gather primary data Research Instrument: Two sets of questionnaires were prepared. One questionnaire was administered to experts in the field of knowledge management to study role of top management in knowledge management in Indian Industry. The experts consisted of academicians, industry consultants and government officers/policy makers. The second questionnaire was a structured questionnaire, which was prepared keeping in mind the objectives of the study. The questionnaire was first pre-tested on a sample of 20 respondents and necessary improvements were made.

Contact Method: To collect the primary data, the questionnaires were sent by mail/post/by hand depending on the distance to the concerned person and after that few personal interviews were taken.

Sampling Plan: The universe for the industry study consisted of three sectors of Indian economy, namely: software, pharmaceutical and petroleum marketing sector. From pharmaceutical sector the firms taken, namely, Ranbaxy, Cipla, Glaxo and Dr. Reddy's Lab are leading firms in BT 500 (2000) survey of India's most valuable companies for the year 2000. Though Novartis is ranked fourth in the survey, it did not respond to the study and so Dabur, which was ranked sixth in the pharmaceutical sector, was taken as the fifth firm for the study.

From the software sector, the firms taken namely, Wipro, HCL Technologies and infosys were leading firms in BT 500 survey. Tata Consultancy Services (TCS), the biggest software firm in India, was not a public listed company and so falls out of BT 500 survey, and was taken for study. Lastly, though Satyam Computer Services was ranked fourth in BT 500, it did not respond to the study and so CMC, though lower in rank in BT 500 survey, was taken as the fifth company of the study.

From petroleum marketing sector all the four major

players, namely, Indian Oil Corporation (IOC), Bharat Petroleum (BP), Hindustan Petroleum (HP) and IBP Ltd. (IBP) were included in the study.

From each firm, ten people were taken on a random basis for the study.

For expert opinion, 30 responses were gathered from industry, academics and Govt. servants/policy makers. This was more of a judgmental/convenience sampling and discussion groups at yahoo website were also used for it.

Data Analysis: The data so collected was tabulated. Appropriate statistical measure like percentages was used for analysis of data and drawing deductions. In the final presentation appropriate graphs and tables were used.

Limitations of the Study: The study had two limitations. First, it was limited to only three sectors and only five firms from software and pharmaceutical sector and four from petroleum marketing sector. Second, the sample size was not very big i.e. 50 people from the software sector and pharmaceutical sector and 40 people from the petroleum marketing sector.

Research Findings

Expert Opinion

- Top management has a crucial role to play in knowledge management. Ninety two per cent of the respondents say that top management has a crucial role to play; six per cent say that top management has a role whereas only two per cent say that top management has no role to play in knowledge management.
- There is need for more interest into and more support to KM by the senior management in the organizations; 53.33 per cent of the respondents say that senior management sees KM as very important and provides full support; 23.33 per cent say that senior management sees it very important but hardly supports it; 13.33 per cent say senior management sees it as a waste and hardly bothers; and 10 per cent say senior management was very supportive in the beginning but has lost interest.

Software Sector

- Senior management is pushing hardest to have a knowledge management programme followed by middle management as displayed in the Fig. 1.

Majority of the respondents at each firm namely CMC (80 per cent), HCL Tech (70 per cent), TCS (60 per cent), Wipro (60 per cent) and Infosys (50 per cent) are of the view that senior management is making most efforts for the KM programme.

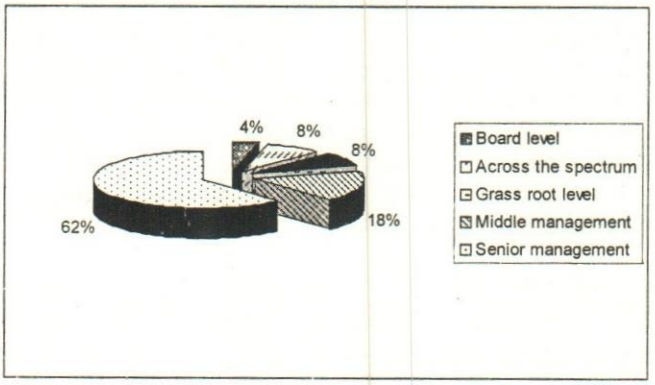

Fig. 1. Management level in the organisation pushing hardest to have a KM programme

- The Fig. 2 exhibits the attitude of senior management w.r.t. knowledge management. They should show more interest and provide continuous support for knowledge management. eighty per cent people at Infosys, 90 per cent at Wipro, 70 per cent at TCS, 60 per cent at HCL Tech and 40 per cent at CMC are of the view that top management sees KM very important and provides full support.

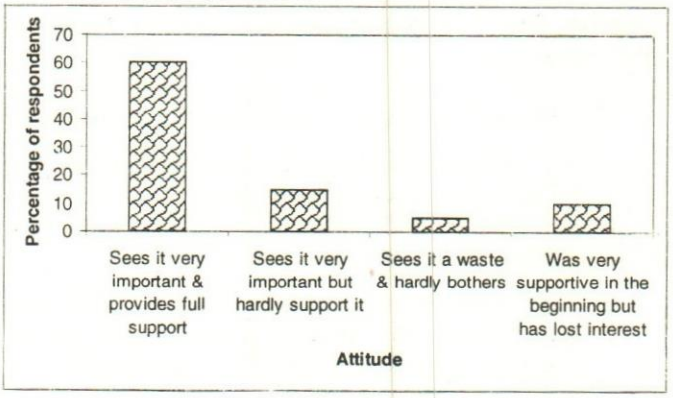

Fig. 2. Attitude of Senior Management w.r.t. KM in the organization

- Chief Information Officer is a very important person as far as responsibility for knowledge management is concerned. Twenty per cent of the respondents say that each department head is responsible for their organisation KM efforts, 40 per cent say the responsibility lies with the chief information officer, 20 per cent say this role is played by the chief quality officer supported by the chief knowledge officer and 20 per cent go for the chief knowledge officer.
- Forty two per cent of the respondents say that their

top management regularly review promotion practices to make sure they are not losing people with strategically important knowledge, 36 per cent do not think so and a significant number i.e. 22 per cent have no idea about it. Sixty per cent of the respondents at Infosys, 50 per cent at Wipro and 50 per cent at TCS say that their top management regularly review promotion practices to make sure that they are not losing people with strategically important knowledge whereas 90 per cent of the respondents at CMC and 50 per cent at HCL Tech do not think so or are not aware of it.

- The impact of a key employee leaving the organization is quite significant as revealed in the Fig. 3. A significant number of people at Infosys (50 per cent), TCS (50 per cent), Wipro (40 per cent), HCL (50 per cent) and CMC (30 per cent) find no such impact; at Wipro (30 per cent) find loss of some business.

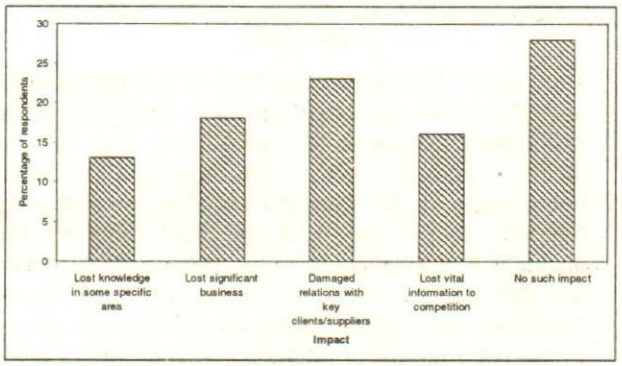

Fig. 3. Impact of a key employee leaving the organisation

Pharmaceutical Sector

- Senior management is pushing hardest to have a knowledge management programme followed by middle management as displayed in the Fig. 4. Majority of the respondents at each firm namely Reddy's Lab (70 per cent), Ranbaxy (60 per cent), Glaxo (70 per cent), Cipla (80 per cent) and Dabur (60 per cent) are of the view that senior management is making most efforts for the KM programme.

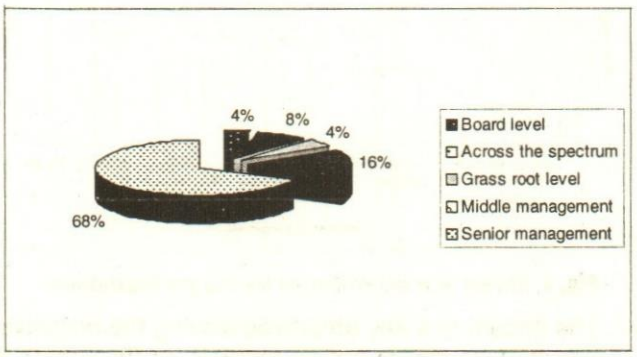

Fig. 4. Management level in the organisation pushing hardest to have a KM programme

- The Fig. 5 makes a strong case for change in the attitude of senior management w.r.t. knowledge management. They must show more interest and provide continuous support for knowledge management. Only 30 per cent people at Cipla, 40 per cent at Glaxo, 50 per cent at Dabur, 60 per cent at Ranbaxy and 60 per cent at Reddy's Lab are of the view that top management sees KM very important and provides full support.

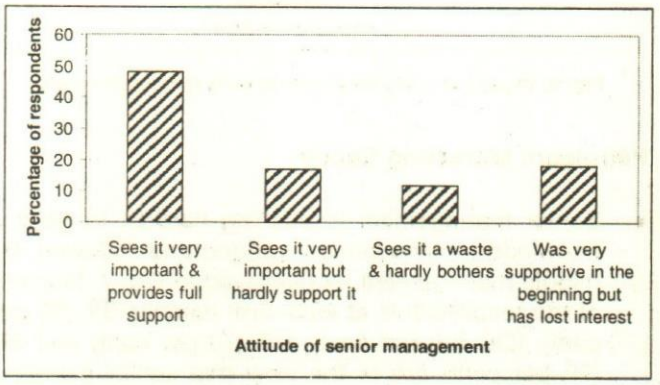

Fig. 5. Attitude of senior management w.r.t. KM in the organisations

- Each department head is a very important person as far as responsibility for knowledge management is concerned. Fifty two per cent of the respondents say that each department head is responsible for their organisation KM efforts, 24 per cent say the responsibility lies with the chief information officer, 6 per cent say this role is played by the director business improvement and a significant number of the respondents i.e., 18 per cent have no idea about it.
- Forty per cent of the respondents say that their top management regularly review promotion practices to make sure they are not losing people with strategically important knowledge, 34 per cent do not think so and a significant number i.e., 26 per cent have no idea about it. Fifty per cent of the respondents at Reddy's Lab and 50 per cent at Dabur say that their top management regularly review promotion practices to make sure that they are not losing people with strategically important knowledge whereas 70 per cent of the respondents at Ranbaxy, 60 per cent at Glaxo and 70 per cent at Cipla do not think so or are not aware of it.
- The impact of a key employee leaving the organisation is quite significant as revealed in the Fig. 6. A significant number of people at Reddy's Lab (40 per cent), Glaxo (30 per cent) and Ranbaxy (30 per

cent) find no such impact; at Cipla (40 per cent) find relationship trouble with clients; and at Dabur (30 per cent) find loss of some crucial information.

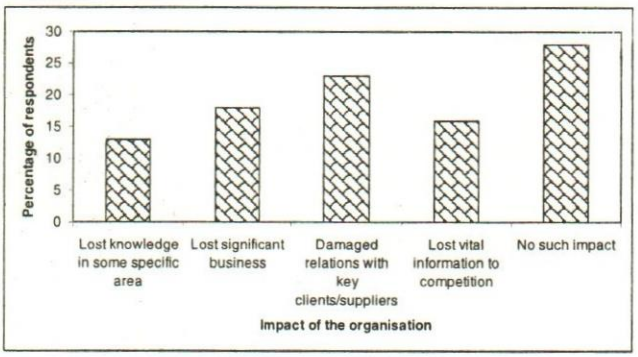

Fig. 6. Impact of a key employee leaving the organizations

Petroleum Marketing Sector

- Senior management is pushing hardest to have a knowledge management programme followed by middle management as displayed in Fig. 7. Majority of the respondents at each firm namely IBP (70 per cent), IOC (60 per cent), HP (70 per cent) and BP (50 per cent) are of the view that senior management is making most efforts for the KM programme.

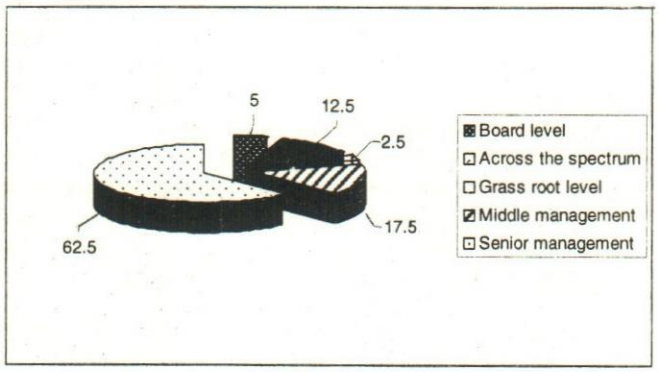

Fig. 7. Management level in the organisation pushing hardest to have a KM programme

- Fig. 8 makes a strong case for change in attitude of senior management with regard to knowledge management. They must show more interest and provide continuous support for knowledge management. Sixty per cent people at BP, 50 per cent at IOC, 50 per cent at HP, and 30 per cent at IBP are of the view that top management sees KM is very important and provides full support.
- Each department head is a very important person as far as responsibility for knowledge management is concerned. Sixty two per cent of the respondents say that each department head is responsible for their organisation KM efforts, 22.5 per cent say the responsibility lies with the chief information officer, 2.5 per cent say this role is played by the director business improvement and a significant number of the respondents i.e., 15 per cent have no idea about it.

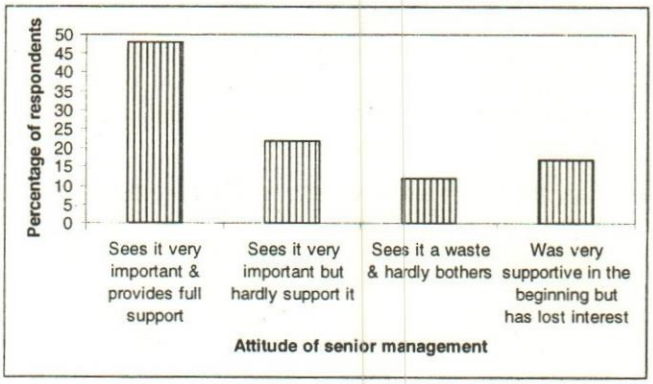

Fig. 8. Attitude of senior management w.r.t. KM in the organizations

- Only seven and a half per cent of the respondents say that their top management regularly review promotion practices to make sure they are not losing people with strategically important knowledge, 75 per cent do not think so and a significant number i.e., 17.5 per cent have no idea about it. A high majority of the respondents at each firm IBP (100 per cent), BP (90 per cent), HP (90 per cent) and IOC (90 per cent) do not think or are not aware of that top management regularly reviews promotion practices to make sure that they are not losing people with strategically important knowledge.

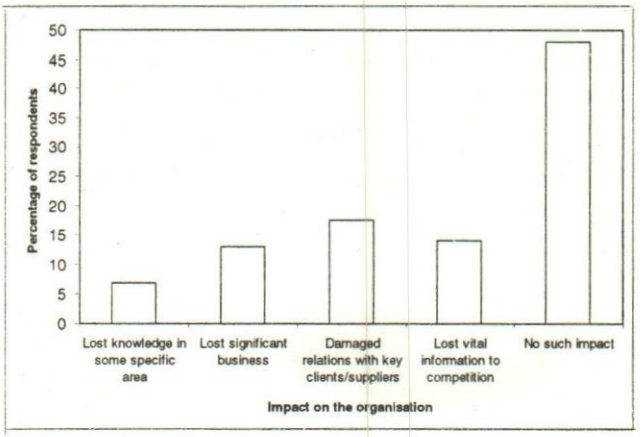

Fig. 9. Impact of a key employee leaving the organisation

- The impact of a key employee leaving the organisation is quite significant as revealed in the Fig. 9. A significant number of the people at BP (90 per cent)

and IOC (60 per cent) find no such impact; at HP (30 per cent) find relationship trouble with clients; and at IBP (30 per cent) find loss of some crucial information and (30 per cent) find business loss.

Sectoral Comparison

- Majority of the respondents in each sector namely, software sector (64 per cent), pharmaceutical sector (68 per cent) and petroleum marketing sector (62.5 per cent) say senior management is pushing hardest to have a KM programme.
- Majority of the respondents in the software sector (62 per cent) say their top management sees KM as very important and provides full support whereas only 48 per cent of the respondents in the pharmaceutical sector and 47.5 per cent in the petroleum marketing sector think so.
- Majority of the respondents in the petroleum marketing sector (60 per cent) and nearly half of the respondents in the pharmaceutical sector (52 per cent) say that each departmental head takes care of KM whereas the response from software sector is quite fragmented. The single largest response i.e., 40 per cent comes for chief knowledge officer being responsible for KM efforts in the software sector.
- Forty two per cent of the respondents in the software sector, 40 per cent in the pharmaceutical sector and only seven and a half per cent in the petroleum marketing sector say that their top management regularly reviews promotion practices to make sure they are not losing people with strategically important knowledge.
- The impact of a key employee leaving the organisation is more in software and pharmaceutical sector as compared to petroleum marketing sector. The single largest impact across the three sectors is the same-damaged relations with key clients/supplier.
- The overall scenario is worse in the petroleum marketing sector i.e. public sector as compared to software or pharmaceutical sectors i.e. private sector. Software sector is the best performer among the three sectors under study.

Implications

Top management is a guiding torch, a role model for the organisation. For successful KM initiatives, the active involvement and support of top management is one of the most crucial prerequisites. In Indian industry it is the top management, in general, which has taken the initiative which is good news. But most of the time, there is a lack of continuous support and involvement of top management in the KM programme. CKO is still a rare position in Indian industry which shows the lack of assigning clear responsibilities and accountability for KM efforts. Loss of people with strategic knowledge is making its impact on the organisations. All this reflects that Indian organisations, in general, are not taking KM quite seriously and the top management is not performing the right role. This will have serious implications for the competitiveness of organisations and the industry because knowledge management is perceived as the most important source of sustainable competitive advantage, globally. Drucker (1993) has rightly said that the most important responsibility of management is productivity of knowledge because it is going to be the determining factor in the competitive position of a nation, an industry, a firm.

Conclusion and Directions for Future Research

Top management sets the vision and the perspectives for KM in the organization. The findings of this research work are not very encouraging, Knowledge management is very crucial from a developing country's perspective. Top management, in general, has failed in being the torchbearer in KM efforts. The few organizations which are doing well in KM are benefited by the active involvement and support from top management. The overall scenario is worse in the petroleum marketing sector i.e. public sector as compared to software or pharmaceutical sectors i.e. private sector.

Directions for Future Research: Role of Top Management is crucial for successful KM initiatives. Further research must be carried out for investigating the role and impact of Top Management in KM in Indian context and in different sectors of India industry.

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You know you've read a good book when you turn the last page and feel a little as if you have lost a friend.

– Paul Sweeney

Feature

JIT Implementation in the Service Sector

Sanjay Sharma & D.K. Singh

Various factors which are useful in the implementation of JIT in the service sector have been discussed in this paper. The Indian telecommunication industry has been chosen for studying the impact of the JIT service implementation. A detailed JIT analysis has been carried out while comparing the performance of two groups of industry, both Government-owned and private. It has been observed that private companies offer a more conducive environment for implementing JIT service compared to public sector companies. The telecom revolution in India can largely be attributed to major contributions from its private companies.

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JIT (Just-in-time) manufacturing has gained wide acceptance by the world market in recent years. The JIT philosophy has produced immense benefits for the manufacturing sector by eliminating the wastage of inventory and thus reducing the overall costs of production. Many industries have implemented JIT and the remaining are in the process of knowing more and more about it.

Japan's success stories are inspiring industries to mend their ways and come out of the darkness by improving their products and service. Dr Deming, the father of quality, has become the buzzword and quality has become a driving force in changing the focus of industries and helping them to aspire for a broader presence in the world market. The JIT principle basically emphasizes on the quality of produced goods, which increases their marketability. A quality product has huge potential to attract a large number of customers towards itself and can result in a significant rise in productivity and profitability for a company.

The concept of 'JIT service' is relatively new and needs to be explored in depth. Gone are the days when customers used to suffer because of poor quality of services offered to them. Today customers are more quality conscious than in the past. In today's highly competitive world, no one dare be left out of the race because of one's inability to satisfy a customer. Quality has become the demand of the customer and needs to be always taken care of, continuously improved upon and sustained for keeping a customer satisfied.

Quality attainment is not a one-time affair which is forgotten later on. The future of a business is today largely dependent on its capability to maximize the level of customer satisfaction by continuously supplying quality products and services. JIT service can prove to be highly instrumental in fulfilling this objective. Quality forms the basic tool for the JIT service. The main focus should be on the requirements of the customer and quality should be aimed at fulfilling those requirements. JIT can play an important role in improving the state of the service units. The main service providing units in-

clude hospitals, post offices, civil aviation, railways, banks and financial institutions and telecommunication, besides others.

Service Sector Versus Manufacturing Sector

The service sector is radically different from the manufacturing sector in many respects and hence the approach to implement JIT in this sector is also different. Manufacturing units are based on producing tangible goods, whereas service units do not produce tangible goods, but rather offer services. JIT is an effective means of managing inventory for manufacturing sectors which helps in reducing the overall production costs.

It offers the advantage of reducing the inventory to its minimum level by effective management and thus keeping the inventory related cost to a minimum. Since inventory cost constitutes a significant part of the total cost, this cost needs to be optimally decided. JIT has been successfully implemented in manufacturing sectors and the firms using this philosophy have registered a significant growth in their business. It has helped the companies to increase their productivity and market share manifold.

Many firms have acquired a world class status since the adoption of the JIT philosophy. Although JIT philosophy is most effective in manufacturing systems, it can be applied to service sectors too. JIT principles are being used widely in the retail industry by companies such as Wal-Mart, Home Depot and Kmart (Martinich, Joseph S; 1997). Earlier these companies were using the conventional methods of managing the inventory and hence always faced the problem of keeping excessive inventory to meet the unexpected market demand to avoid being out of stock. Today with the help of optical scanning and electronic data interchange (EDI), inventory management has become more realistic. Suppliers are able to know the approximate requirement and they ship the products to the retailers as soon as inventory level decreases to a certain minimum level, without waiting for the retailer to process a purchase order. Both parties have been benefited in this process. The supplier can plan his own production effectively so that he can meet the exact requirement of the retailers on time, removing all kinds of uncertainty.

Customer Satisfaction: A Central Focus in Service Sector for implementing JIT

The focus of the JIT systems is on improving the process. If the processes are improved, it becomes easier to implement JIT. Improved processes have the capability to produce defect-free services which ultimately become a key component of customer satisfaction. A successful business unit is one which is able to satisfy its customers to the maximum level.

Productivity of the service sector is greatly dependent on the number of satisfied customers. Hence customer satisfaction is vital for service sectors. Service sectors such as the telephone industry, banks and financial institutions, railways and civil aviation are continuously thinking of how to improve their operations in order to achieve a high level of customer satisfaction. Their activities and operations need to respond instantaneously i.e. just-in-time.

The idea of being 'close to the customer' is very important for a service providing company. Customer satisfaction is not a one-time affair and requires a continuous effort by the company. A high level of customer satisfaction is indicative of a well managed service unit. It leads to increased productivity of the organization. In today's highly competitive business environment, a company feels pressurized to find new ways to satisfy its customers due to continuous change in their demands with changing time. The success of a company is strongly dependent on its ability to continuously keep on satisfying its customers (Benett, Roger; 2003). Services provided on JIT basis have the maximum potential to satisfy a customer.

JIT Components Critical for Service Sector

Consistently High Quality

Quality matters everywhere. Be it a quality product or quality service. Qualitatively, it refers to the degree to which a product or service meets a customer's expectations. It reflects the 'goodness' of the product or service to the customer. Quantitatively, quality means conforming to the design specifications for a product or service. Customer satisfaction through quality has become a mandatory requirement for a company's survival.

Industries are becoming increasingly aware of the importance of quality and are using it as a competitive tool to gain market advantage. Quality attainment is associated with reduction or elimination of waste, thus reducing operation costs. Production of high quality, defect-free and efficient service is the foremost requirement for service sectors. Consistently high quality has been the top most requirement in a list of competitive priorities of eight factors (De Meyer, Arnauld et al; 1987). A high quality product or service has increased possibility of acceptance in the market. On the other hand, poor quality has a damaging effect and can result in loss of market share due to bad reputation. Redressal of

complaints in a shorter time forms the integral part of quality service.

Better Response Time

Time is a critical dimension of competition in both the manufacturing and service industries. Rapid response is critical for service units. A firm with the fastest response to customer demands has the potential to achieve an overwhelming market advantage. Offering services at the fastest rate is not less important than making them available at lower costs. Cutting response time can make services efficient. Firms able to respond quickly have reported growth rates of over three times the industry average and double the profitability, which results in market dominance (Blackburn, Joseph; 1990).

Reliability

Continuity in service can be ensured by the reliability of its operation systems. A reliable and dependable service system has increased potential to satisfy customers. A maintenance function is required to keep the equipment operating effectively in order to maintain the designated quality standards. Routine preventive maintenance reduces the frequency of equipment failure, thus making services more reliable and continuous. With the increased level of preventive maintenance, the breakdown and repair, downtime and quality-related costs trend to decrease.

Early Market Entry

Decision about how and when to enter the market for a product or service to be launched for the very first time is very important because it decides its future. Correct entry time has a long-term effect. It is beneficial for a product or service to enter the market earlier and there is strong evidence that pioneers get 'first-mover advantage' (Trott, Paul; 2000). Pioneer products or services influence customer expectations and shape how customers make evolutions of products or services in new fields. They can set the standards, establish a distinctive quality position and take the lead in the continuing evolution of the technology.

Continuity in Services

Interruption causes great annoyance to the customer. The productivity of a service unit can be measured in terms of continuity ensured in the services offered to the customer. It helps to retain the existing customers and encourages new customers to join. Continuity can be ensured in stable operating environment which can produce on-time delivery. Good results can not be expected in a highly erratic and unpredictable atmosphere.

Competitive Cost

A quality product or service is expected to be available at an affordable competitive price. Cost is a critical parameter affecting directly the profit component of a company. A high quality service provided at a relatively lower cost has a lasting effect on the mind of a customer. A business unit can attract more customers in such situation resulting in increased productivity and profitability for the company. Cost is also proving to be a strategic tool to dominate the market. Continuation of the firm greatly depends on its ability to offer its products and services at a highly competitive cost.

Continuous Improvement

Service needs to be continuously improved upon in order to ensure that the customer always adheres to the parent company and to avoid any switchover. Several tools are in existence which can be used to ensure continuous improvement. Kaizen is such a tool which provides a solid platform for imparting little changes made continuously to improve upon things in the system. Quality circle has a significant impact on improving the product or service quality. Poka yoke is useful in ensuring defect-free operation and quality certification helps in gaining a good image of the product or service. A quality certified product or service has hidden potential to attract large number of customers. ISO 9000 is a universally accepted quality certification parameter.

Customized Services

The success of a business unit is closely related to its perception about a customer's expectations and its ability to bridge the gap between those expectations and its operating capabilities [10]. Service precisely meeting the expectations or requirements of a customer is called customized service. Customization requires flexibility and quick responsiveness and offer more acceptability by the customer due to increased level of customer satisfaction.

Computerization and Automation

Computerization and automation ensure defect-free operations making services more effective and efficient. Minimum human involvement in a computerized environment reduces the chances of failures, leading to smooth functioning of the unit. It

also reduces the handle time along with providing a neat and clean atmosphere resulting in a higher level of customer satisfaction.

Freedom of Choice

Freedom of choice gives a customer unlimited number of options. The customer can choose the best from a group of many options according to his requirements and financial obligations. Large options offer increased number of satisfied customers. It encourages competitive environment, forces a company to cut down the cost and subsequently benefits the customers.

Indian Telecom Industry

Growth of Indian Telecom Industry

Telecommunication is perhaps the only sector where the impact of liberalisation is the most visible. India is one of the fastest growing telecom markets of the world. The telecom industry grew very slowly in the past. A poor tele-density (the number of phones per hundred population) of just 0.02 in 1948 increased to 1.94 in 1998. Thus the industry registered an average growth rate of 1.92 per cent per year during the last 50 years between 1948 and 1998, thus showing a very marginal growth. It has achieved a tremendous growth after the Telecom Regulatory Authority of India (TRAI) was set up in 1997. A New Telecom Policy (NTP) was announced in 1999 and after that industry has been moving with an accelerated pace. A tele-density of 2.33 in 1999 increased to 9.11 in March 2005, mainly due to a rapid increase in mobile subscribers. By the end of November 2005, the tele-density further increased to 11. A seven-year growth of tele-density is shown in Table 1.

Table 1. Growth of Tele-density

Financial Year	Tele-density	% increase over previous year
1998	1.94	–
1999	2.33	20.10
2000	2.86	22.75
2001	3.58	25.17
2002	4.28	19.55
2003	5.11	19.39
2004	7.02	37.38
2005	9.11	29.77

Source: Study paper No. 2/2005 "Indicators for Telecom Growth", TRAI Website.

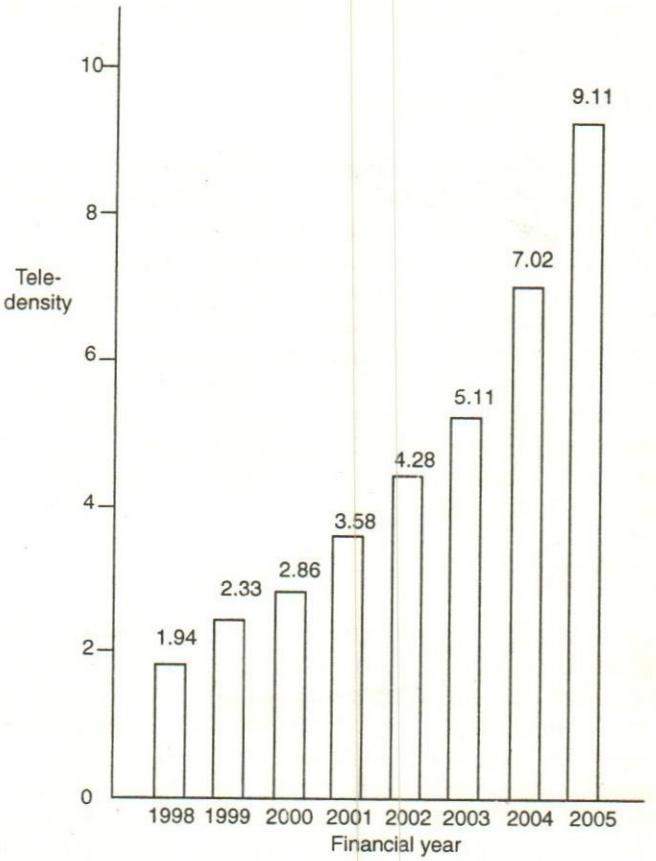

Fig. 1. Growth pattern of Tele-density in recent years

Figure 1 shows that the tele-density is increasing gradually over the year during this period. The increase in tele-density is due to increase in subscribers of both fixed and mobile phones, mainly due to rapid rise in the later one. The number of telephone connections (basic and mobile) increased from 18.68 million in 1997-98 to 98.41 million in 2004-05, registering an average growth of 53.35 per cent per year during this period. This includes the contribution of public sector companies and private companies both. The increase of 79.73 million in subscriber base during 1997-98 and 2004-05 included 28.37 million fixed telephones and 51.36 million mobile telephones. By the end of November 2005, India had touched a telecom base of 120 million, with 71.46 million mobile subscribers. In the month of November 2005 itself, a record number of 3.79 million subscribers were added to the total base. Growth of fixed and mobile phones since 2001-02 is separately shown in Table 2 and Table 3.

Figure 3 shows the contribution of public sector and private sector companies for mobile telephones. Public sector companies are far behind private companies. A comparative growth pattern for public sector companies and private sector companies is shown in Figure 4. A

total of 34.28 million new subscribers were added by public sector companies during 1997-98 and 2004-05, registering an average growth rate of 24 per cent during this period. Out of 34.28 million new subscribers, basic (fixed) phones constituted 23.28 million and mobile phones 11.00 million. On the other hand, private sector companies added 45.45 million new subscribers during this period, registering an average growth rate of 645.6 per cent.

Table 2. Growth of Fixed Telephones

Financial Year	Fixed Telephones (million) PSUs*	Pvt. Sectors	Total	% of PSUs	% of Pvt. Sectors
2001-02	37.90	0.52	38.42	98.65	1.35
2002-03	40.53	1.10	41.63	97.36	2.64
2003-04	40.49	2.36	42.85	94.49	5.51
2004-05**	40.33	3.80	44.13	91.39	8.61

Source: Economic Survey 2004-05

* PSUs stand for Govt. owned Public Sector Undertakings such as BSNL and MTNL

** Till Oct. 2004

Table 3. Growth of Mobile Telephones

Financial Year	Mobile telephones (million) includes WLL*** PSUs*	Pvt. Sectors	Total	% increase over previous year	% of PSUs	% of Pvt. Sectors
2001-02	0.26	6.28	6.54	–	3.98	96.02
2002-03	2.64	10.35	12.99	98.62	20.32	79.68
2003-04	5.99	27.70	33.69	159.35	17.78	82.22
2004-05**	8.99	35.50	44.49	32	20.21	79.79

Source: Economic Survey 2004-05

* PSUs stand for Govt. owned Public Sector Undertakings such as BSNL and MTNL

** Till Oct. 2004

*** WLL stands for Wireless in Local Loop

Table 2 clearly shows the monopoly of two public sector companies Bharat Sanchar Nigam Ltd (BSNL) and Mahanagar Telephone Nigam Ltd (MTNL) in respect of fixed (basic) telephones. The contribution of public sector and private sector is shown in Figure 2. Both BSNL and MTNL taken together accounted for more than 90 per cent of subscribers for the years 2001-02, 2002-03, 2003-04 and 2004-05. But their market share is gradually shrinking from 98.65 per cent in 2001-02 to 91.39 per cent in 2004-05. This loss in market share of public sector units is reflected in terms of gain in market share for private companies from 1.35 per cent in 2001-02 to 8.61 per cent in 2004-05. It clearly indicates that private players have started their presence felt in basic telephones.

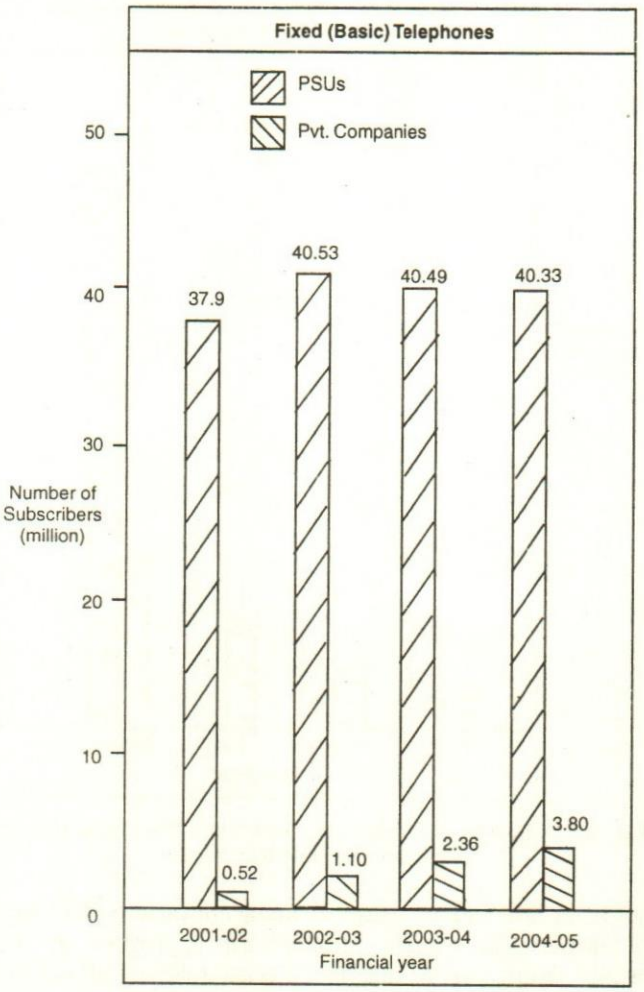

Fig. 2. Contribution of Public Sector & Private Sector Companies in respect of fixed telephones

Out of 45.45 million subscribers, fixed phones constituted just 5.09 million while mobile phones whopping 40.36 million. Out of 18.68 million total subscriber (basic and mobile) during the financial year 1997-98, fixed phones contributed 17.8 million in comparison to just 0.88 million mobile phones. In 2004-05, total subscriber (basic and mobile) increased to 98.41 million, where basic phones contributed 46.19 million in comparison to 52.2 million mobile phones. Fixed (basic) line growth between 1997-98 and 2004-05 remained marginal but the growth of mobile phones during the corresponding period was initially slow, but became fast especially after 2001-02. The majority of the subscribers of private companies are mobile users.

The factors for this stupendous mobile growth of private companies included lower costs, better quality of their service, increased and varied options, improved signal receiving, reduced related problems and better connectivity compared to basic phones

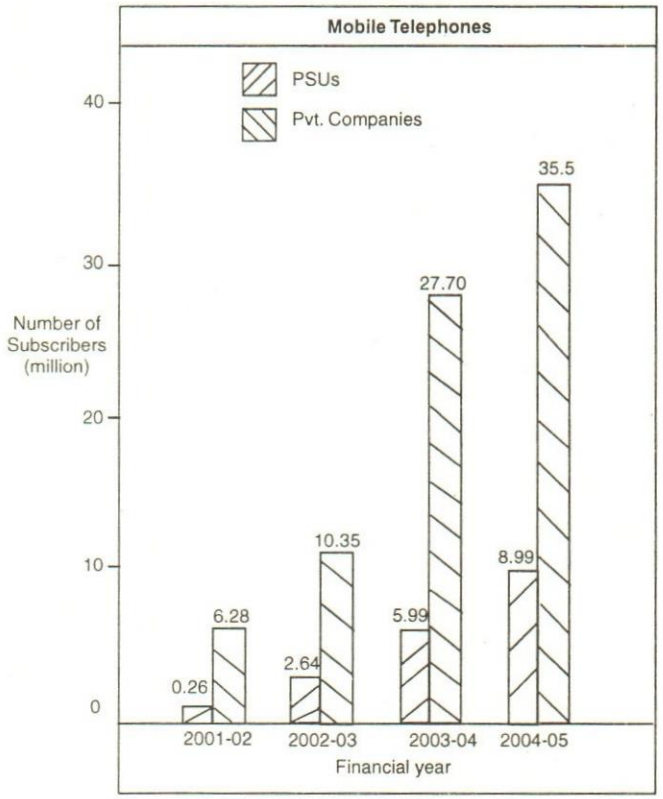

Fig. 3. Contribution of Public Sector and Private Sector Companies in respect of mobile telephones

such as line faults, delay in installations etc. The rate of growth of mobile subscribers is higher in the recent years mainly due to its availability at affordable costs and round the clock connectivity. The improved/continuous connectivity makes the subscriber well informed of his business and keeps him always updated as compared to basic phones, where connectivity is confined to a particular location. The earlier concept of having a basic phone per family is fast eroding and is replaced by one mobile phone per member of every family. In 1999, mobile phones constituted only 5 per cent of total phones, which increased to 50 per cent in October 2004. Similarly, the private sector accounted for only 5 per cent of total phones in 1999, which then increased to 44 per cent in October 2004.

Indian Telecom Industry and the Global Scenario

Although, the Indian tele-density figure has registered a sharp growth since 1999, it still continues to lag far behind other countries. Table IV gives a global view of tele-density. United Kingdom, Australia and USA have a tele-density much higher than India. Even China, which has the largest population in the world, has a tele-density figure approximately seven times higher

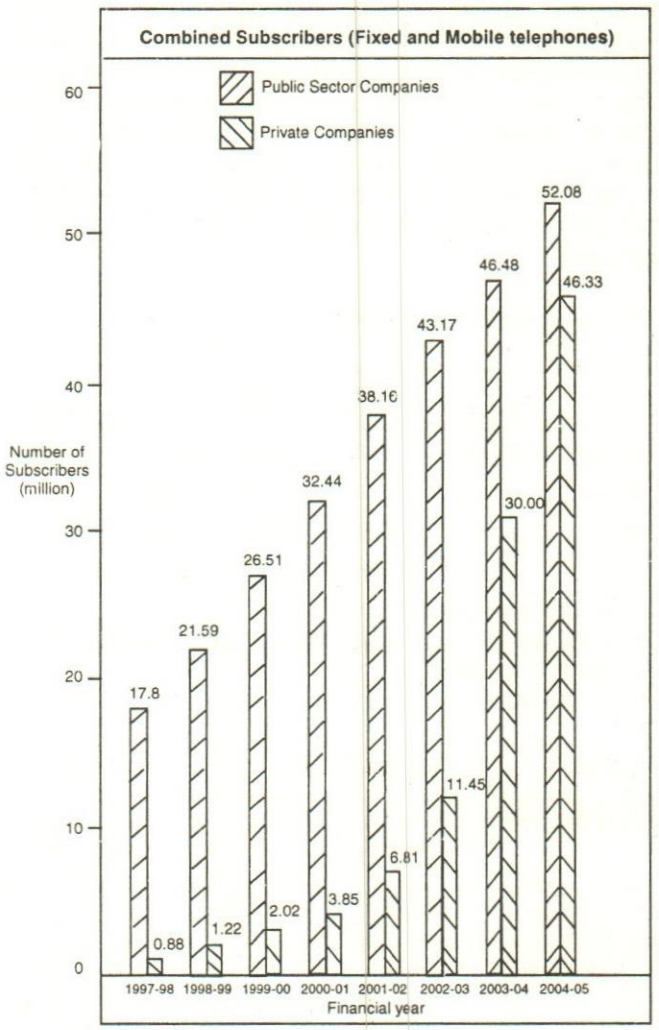

Fig. 4. Growth pattern of Public Sector and Private Sector Companies.

than India. By the end of December 2004, the total number of subscribers, basic and mobile both, in China was 674.5 million. Out of 674.5 million subscribers, fixed line subscribers accounted for 325.4 million and mobile subscribers 349.1 million.

On the other hand, India had total number of subscribers 98.08 million by the end of March 2005; fixed line subscribers accounted for 45.9 million as compared to 52.17 million subscribers of mobile telephones. Subscriber growth in basic and mobile telephones for Chinese telecom industry was 15.50 per cent and 23 per cent respectively on YOY basis by the end of December 2004. The corresponding figure of Indian telecom industry for basic and mobile telephones was 8 per cent and 55 per cent by the end of March 2005. In 2001, the growth rate of mobile service in India surpassed growth rate of China, however in the fixed line segment, India continues to lag behind China.

Table 4. Tele-density: A Global View

Country	Tele-density (Dec. 2003)
U.K.	143.13
Australia	126.18
USA	116.43
Brazil	42.38
China	42.32
Sri Lanka	9.57
Indonesia	9.17
India	6.60
Pakistan	4.42
Nepal	1.70
Bangladesh	1.56

Source: ITU/Economic Survey 2004-05

JIT Implementation

Necessity of JIT

There used to be a long waiting period of getting a telephone connection in the past. Only the Government-owned companies BSNL and MTNL were assigned the job of providing telecom services. Due to poor infrastructure and limited capital resources, it proved to be a daunting task for them to meet the requirements of the market, what to talk of offering quality services to the customer.

Customers were not provided the quality services they deserved and were left with no option but to depend on these two companies. Frequent interruption in telephones lines used to be a common problem. Once a fault occurred, it took a long time to get it rectified. It was probably due to use of electromechanical telex machines used by most of the telephone exchanges. The customer was not the central focus and customer satisfaction was never given a serious thought. Customer complaints used to be taken very casually. Private companies were not allowed to enter the market. It was quite obvious that getting a defect-free quality service in such a situation was difficult. But with the announcement of the New Telecom Policy in 1999, the market was opened for private companies and the situation changed dramatically afterwards. JIT has huge potential and can bring many changes that can revolutionize the Indian telecom industry in a very short time.

Analysis of JIT Parameters

JIT implementation is greatly effected by the design of the service product and the design of the service system. The two parameters vary with the type of services offered.

Customer involvement in designing service products is very critical because it decides what does a customer exactly wants and how he can get improved services. The process of involving the customer accelerates the service by reducing the service time and results in enhanced customer satisfaction. It also reduces the service costs directly or indirectly by eliminating several non-value adding processes. A feedback mechanism is important to be evolved in order to increase customer involvement, which can help to improve the service system.

Based on the result of the analysis of feedback, the service system can be made more reliable, dependable and efficient. Private companies take greater care of customer's requirements. This is clearly reflected in their increased market share in the mobile segment, where they have dominated the market. Table III clearly shows that an increase in subscribers' base of private companies is much higher than the public sector's subscribers' base. It indicates that private service providers have superior customer satisfying capabilities which can fulfill the just-in-time requirements of the customers. In short, it can be concluded that private companies offer a more conducive atmosphere for JIT implementation.

Lack of finance, infrastructure and a competitive environment along with a limited choice and higher tariffs are some of the major problems in the way of implementing JIT in service sectors. The situation started changing with the launch of the new Telecom Policy in 1999. The market was opened to private companies and the licence-permit system was gradually abolished. Things moved more rapidly with the introduction of mobile phones. Many private players such as Airtel, Reliance, Hutch, Tata Indicom and Idea jumped into the market to tap the huge potential and give customers their long overdue quality service requirements. Airtel, being the pioneer service provider, benefited the most with the largest number of mobile subscribers.

With the arrival of private companies in the market, the telecom industry got a tremendous boost. The Indian tele-density figure improved significantly, mainly due to an increased influx of mobile phone subscribers. When cellular phones were launched in the mid-90s, they were considered a rich man's toys. In 2002-03 alone, the cellular segment recorded a growth rate of 98 per cent over the previous year. In the next year i.e. 2003-04, the growth was 159 per cent [Table III]. Table III also shows that in 2001-02, the public sector companies contributed only 3.98 per cent as compared to

96.02 per cent by private companies. In the meantime, public sector companies also changed their way of doing their work and improved their quality, thus making it customer-oriented. As a result, their market share gradually started increasing and they achieved a 20.25 per cent market in 2004-05 as compared to 79.79 per cent market captured by the private companies, which is primarily due to their consistent high quality approach.

Private companies redress the customer's complaints better than public sector units. They have better response facilities and thus quickly respond to customer's complaints and take minimum time to get the problem rectified. Their better response time is collectively reflected in their increased market share. With the arrival of private companies, the waiting period is reduced to zero and telephones were made available on demand, meeting the customers just-in-time requirements. These companies kept on increasing and sustaining their increased market share by constantly providing quality service to the customers. On the contrary, public sector units are not so responsive and customer-friendly and are little interested in improving their services. As a result, their subscribers' base started declining and the customers are switching over to private companies.

The situation has deteriorated to such an extent that today very few customers are interested in getting a telephone connection through BSNL and MTNL. Table II shows that these two Government-owned companies have lost their market share in fixed telephony from 98.65 per cent in 2001-02 to 91.39 per cent in 2004-05 and are on the fast track of losing even more in the coming days. This decrease in share of fixed telephony is basically a gain for private companies. But gradually public sector companies are realizing the gravity of the problem and are mending their ways. The result is that they improved their market share from 3.98 per cent in 2001-02 to 20.21 per cent in 2004-05, mainly due to the compulsion of working in a competitive environment, but overall, their share declined from 90 per cent to 55.6 per cent.

Over the last four years since 2001-02, the public sector companies constituted only 16 per cent on an average as compared to the average market share of 84 per cent of the private companies [Table III]. This clearly indicates that private companies are in a better position to implement JIT compared to public sector companies. Private companies know the requirements of the customers more precisely and hence believe in offering customized services. Today the market is flooded with various types of fixed and mobile handsets with a number of salient features, which can meet the requirements of every customer based on his paying capacity. At the same time, several schemes have been launched based on the length of talk time and recharge value including pre-paid and post-paid systems. Public sector companies are facing stiff competition from the private companies, but the latter, because of their flexibility and a more customized service, have a dominance over the former.

The stupendous growth in subscriber base and teledensity would not have been possible without a decline in telecom tariffs in the recent years. There is a strong correlation between declining tariffs and rising subscriber base. The long distance rates for both international and domestic calls are declining regularly. Table V shows the tariffs for long distance calls. While there has been no change in tariffs for a distance of up to 50 kms since 1999-2000, tariffs have been declining very rapidly for long distance calls. The highest decline of 92 per cent is observed for a distance beyond 1,000 kms.

Table 5: Tariff for long distance calls

Distance	Period						Decline in tariff since 1999-2000
	1999-2000	2001	2002	March 2003 onward	April 10 – Sept. 09, 2004	Sept. 10, 2004 onward	
Up to 50 kms	1.20	1.20	1.20	1.20	1.20	1.20	Nil
50 kms - 200 kms	6.00	4.80	4.80	2.40	2.40	2.40	60 %
201 kms - 500 kms	15.60	12.00	4.80	4.80	3.60	2.40	85 %
501 kms - 1000 kms	21.60	18.00	9.60	4.80	3.60	2.40	89 %
Above 1000 Kms.	30.00	24.00	9.60	4.80	3.60	2.40	92 %

Source: Economic Survey 2004-05

Note: Tariff is expressed in Indian currency (Rs. per min.)

The mobile tariffs have declined drastically since 1999. It has come down from above Rs 15 per minute in 1999 to below Rs 2.00 per minute in 2005. The regular and sharp decline in tariffs for both mobile and basic (fixed) services has triggered a surge in subscription base more dominantly in mobile telephones than basic ones. The mobile growth stepped up significantly once mobile and fixed line tariffs became equal. Now, the mobile has become the telephone of the working class. The subscriber base for mobile telephony during 1999-2005 increased from 1.2 million to 52.2 million. The quantum jump in the subscriber base of mobile telephony is also due to low ARPU (average revenue per user). India has the lowest ARPU in the world.

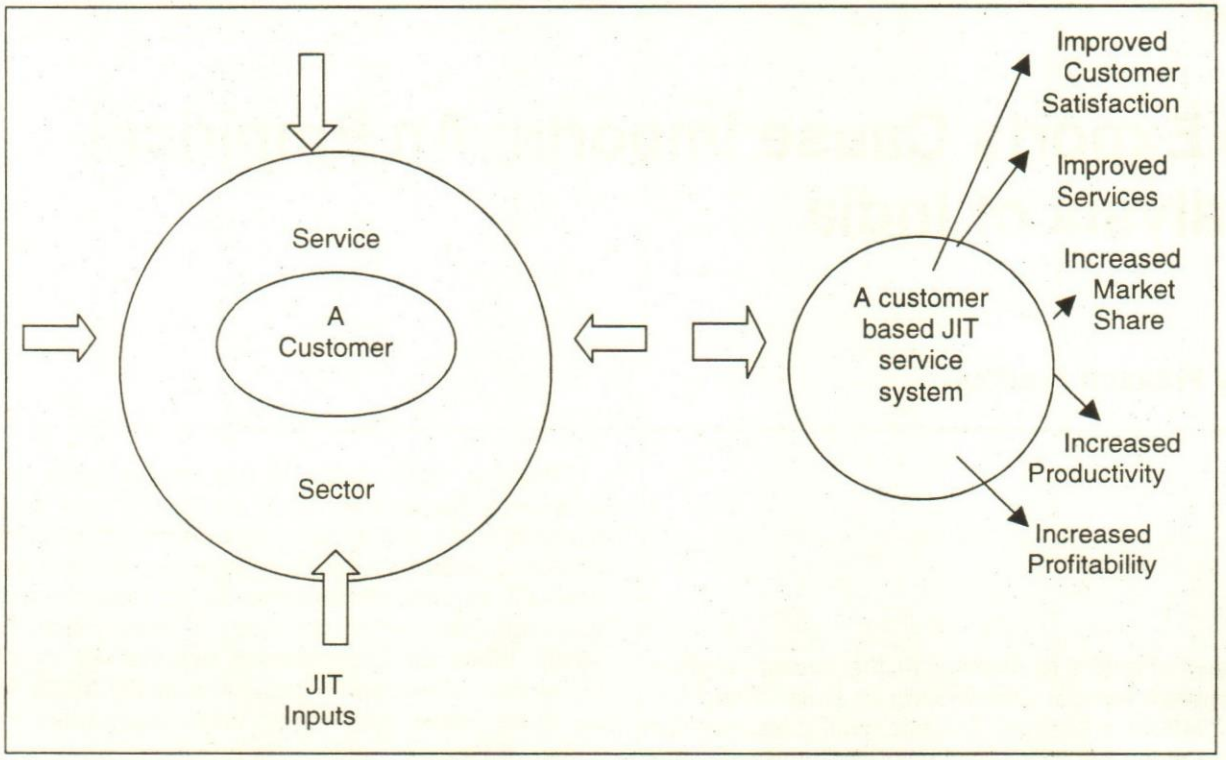

Fig. 5. A JIT Service System with possible benefits

India's ARPU was just about $ 8 as compared to the world average of $ 21.30.

Conclusion

A customer-oriented JIT system is recommended for service sectors keeping in mind its central role in the development of such sectors. This system can take care of not just the design requirements of a service product but also fulfilling a customer's performance requirements and thus has maximum customer satisfaction level. Such a proposed model is shown in Figure-5.

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□

Feature

Do Exports Cause Imports: An Empirical Analysis of India

Rudra Prakash Pradhan

The paper attempts to investigate the causal relationship between exports and imports in India during the period 1949-50 to 2004-05. The statistical tools used for the same is the causality test, which is followed by the cointegration test and unit root test. The empirical results confirmed that both exports and imports are stationary at the first difference level and are statistically cointegrated, indicating an existence of stable long run relationship between the two. The causality test empirically clarified that exports cause imports in India but that the reverse is not statistically significant.

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Foreign trade plays a paramount role in the economic development of a country. It is a treasure house of static and dynamic gains such as competition, efficiency, market, resources base, etc. Its contribution (through exports and imports) to economic growth is very significant in an economy (Frankel and Romer, 1999). While an expansion of exports will induce a higher rate of economic growth (Michaely, 1977; Balassa, 1978; Heller and Porter, 1978; Tyler, 1981; Feder, 1983; Kavoussi, 1984; Ram, 1985; Ahmad and Harnhirum, 1996; Chandra, 2002; Mallick, 2005), an increase of imports will raise the expenditure base of the country (Nandi and Kumar, 2005). But the increase of import expenditure entirely depends upon the level of Gross Domestic Product (GDP) in the economy, which is partly financed through increasing exports. This way imports and exports are interrelated to each other, though this relation may be influenced by changes in terms of trade (Basu and Mcleod, 1991) and more flexible trade policies (Clark, 1997).

But in the developing countries like India, there is instability of exports and that affects the GDP adversely (Krishnamoorthy and Reddy, 2002). The volatility of exports may come up due to a number of reasons such as price change, exchange rate change, change in terms of trade, etc. (Lim, 1976). The uncertainty in exports and the resulting volatility in GDP cause fluctuations in the levels of imports. The latter can disrupt the private development expenditure also. This way we get an export-import nexus in the Indian economy. This paper empirically investigates the causality between exports and imports in India.

Econometric Modeling and Database

The concept of causality due to Granger (1969) is appropriate and used by most of studies for testing the relationship between economic growth and exports. But Granger causality tests using time series data based on

this earlier methodology rendered conflicting results on trade growth dynamics (Karunaratne, 1996). Some studies suggested that exports unidirectionally caused economic growth (Chow, 1987) and others exposed the existence of reverse causality or that economic growth caused exports (Jung and Marshall, 1985) or the bidirectional causality between economic growth and exports (Darrat, 1986). However, these correlations and regressions are econometrically defective and produce spurious results owing to the neglect of the stochastic properties of time series data (Engel and Granger, 1987). The methodology failed to capture the short-run dynamics and produced biased results (Granger, 1988). Subsequently, the application of updated Granger causality tests capturing fully the stochastic and short run dynamics through the error correction mechanism are unequivocally applicable to all time series data.

According to Engle and Granger (1987), if two series say X and Y are individually integrated of order one [i.e., I (1)] and cointegrated, then there would be a causal relationship in at least one direction. The presence of cointegration among variables rules out the possibility of 'spurious' regression. Though cointegration indicates the presence or absence of Granger causality, it does not indicate in which direction the causality runs between the variables. The direction of Granger's causality can be detected through the vector error correction model of long run co-integrating vectors. Furthermore, Granger's representation theorem demonstrates how to model a cointegrated I (1) series in a Vector Auto Regression (VAR) format. VAR can be constructed either in terms of level data or in terms of their first differences, i.e., I (0) with addition of an error correction term to capture short-run dynamics.

If the series is I (1) but not cointegrated, the causality test may give misleading results unless data are transformed to induce stationary. In estimating the cointegration and causality models, cointegration equation requires non-stationary variables. Hence, the first step is to examine the stationary of exports and imports. And for this, the Dickey Fuller and Augmented Dickey Fuller Test (ADF) are performed. The same test also applied to identify the order of integration (Dickey and Fuller, 1979; Dickey et al. 1986) on exports and imports.

In short, the empirical investigation of our present study follows three step procedures: unit root test, cointegration test and causality test.

Unit Root Test

The objective of this test is to check the presence or absence of unit root (non-stationary) in a time series variable. A time series variable 'X_t' is said to be stationary, if its mean, variance and autocorrelation are independent of time. Mathematically, a time series X_t (for t = 1, 2....n) is said to be stationary, if it satisfies the following:

- Mean: $E(X_t) = \mu$ is constant for all t;
- Variance: $Var(X_t) = \sigma^2$ is constant for all t;
- Covariance: $Cov(X_t, X_{t-1}) = E[(X_t - \mu)(X_{t+k} - \mu)]$ is constant for all t and $k \neq 0$.

A series X_t under consideration may be either:

(a) Trend stationary, if $X_t = a + bt + e$ and $e = X_t - \hat{X_t}$ is stationary;

(b) Difference stationary: ΔX_t stationary; and/or

(c) The series may have to be detrended and differenced in order to obtain stationary series (Enders, 1995).

If a macro variable is characterised by unit root, it implies that any random shock (arising due to any other factors) will produce significant and long-lived effects on the level of series. The shock persistence feature imparts a tendency for the variable not to return to its long-run trend and instead drift apart over the time. Any time series data can be thought of as being generated by a stochastic or random process. The Dickey-Fuller Test (1979; 1981) is employed to examine the stationary of the series. To test the stationary of the series, we have taken the following regression model:

$$Y_t = \rho Y_{t-1} + u_t \qquad ...(1)$$

Where, $-1 \leq \rho \leq 1$, t is a time trend and U is a white noise error term. If $\rho = 1$, then there exists unit root and hence, it is a non-stationary situation. If the time series is differenced once and the differenced series is stationary, then it is integrated of order one [i.e., I (1)]. If the time series is differenced twice and the differenced series is stationary, then it is integrated of order two [i.e., I (2)] and so on. Thus, any time series of order one or greater is considered to be a non-stationary time series. To check the unit root, we first estimate the equation (1) and find out Dickey-Fuller 'τ' (tau) statistics and compare with its critical value. If the calculated 'τ' is higher to its critical value then we reject the null hypothesis ($\rho = 1$) and concludes that the series is stationary. Otherwise, we go for testing higher order of integration and for this, we have to regress the following model:

$$\Delta Y_t = \delta \Delta Y_{t-1} + u_t \qquad ..... (2)$$

Where, $\delta = \rho - 1$ and Δ is the first difference operator. If $\delta = 0$, then $\rho = 1$ and we have a unit root or non-stationary. But if it is negative, we conclude that Y_t is stationary. Now to test whether the coefficient of Y_{t-1} is zero or not, we use τ-statistics. The test follows the comparison of calculated τ with tabulated τ. If the calculated value is greater than that of its critical value, we reject the H_0: $\delta = 0$ and conclude that the variable is stationary. But it is important to note that in conducting the Dickey Fuller (DF) test, it is assumed that the error term u_t is uncorrelated. However, if u_t is correlated, then the test of stationary follows Augmented Dickey Fuller (ADF) test and the test procedure follows the estimation of the following regression model:

$$\Delta y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad ...(3)$$

Where, t is time trend, ε_t is white noise error with zero men and unit variance, Δ is first difference operator and β_1, β_2, α_1, ...α_m are the parameters to be estimated. The null hypothesis and alternative hypothesis in the unit root test are: H_0: $\delta = 0$ (Y_t is non-stationary) against H_1: $\delta \neq 0$ (Y_t is stationary). The optimal lag lengths have been chosen here by Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC), as they give very consistent results in the selection of lags (Judge et al., 1985; Maddala, 1988).

Cointegration Test

The test is meant to know the existence of a long run equilibrium relationship between the two variables and that has been captured through the cointegration technique. The idea of cointegration between the two non-stationary series means that each of the variables reveal a tendency to converge systematically in the long run, even if they may drift apart in the short run. The cointegration between two time series variables can be obtained, if the linear combination of two non-stationary variables is stationary. Two variables are cointegrated, if the following three conditions are satisfied (Masih and Masih, 1994):

1. The variables must be integrated of the same order and number of times each variable has to be differenced in order to turn the series stationary.
2. There should be a linear relationship between them. That is,

$Y_t = \alpha + \beta X_t + \varepsilon_t$, and β coefficient should be significant ...(4)

3. The residuals in the above equation, i.e., the extent by which the two variables deviate from the long run equilibrium relationship [given by the equilibrium error (μ_t)] should be stationary.

To test the third condition, we may employ Dicky Fuller (DF) test or Augmented Dicky Fuller (ADF) test and Cointegrating Regression Durbin-Watson Test (CRDW). For DF test, let U_t denote residuals from equation (4) and

$\Delta u_t = \phi u_{t-1} + \varepsilon_t$, where t-statistic for ϕ is to be computed. ...(5)

For ADF test, the equation is to be modified by

$$\Delta u_t = \phi u_{t-1} + \sum_{i=1}^{p} b_i \Delta u_{t-1} + \varepsilon_t, \text{ where p is lag length} \quad ...(6)$$

The following procedure is adopted when estimating equations (5) and (6). We first estimated equation (5) and employed the Ljung-Box test to test the error term (ε_t) for autocorrelation. If the error term is tend to be white noise than the employ of DF test is considered to be best. If the error term is not white noise than we proceed to equation (6) and repeat the Ljung-Box test to test whether the error term shows serial correlation. The process is to be repeated till the error terms become white noise. Therefore, in a long-run relationship between two variables both must be integrated to the same order and the error term is to be I (0).

The Ljung-Box Test

The test is a variant of Box-Pierce Q statistic test and the joint hypothesis that all the autocorrelation coefficients (ρ_k) are simultaneously equal to zero. The Ljung-Box (LB) is defined as:

$LB = [n(n+2)] [\sum \rho^2_k / (n-k)]$, where n is sample size and m is lag length ...(7)

The LB statistics follows a χ^2 (m) distribution and hence, if the computed LB statistics exceeds the critical value for a given level of significance, one can reject the null hypothesis that all the (ρ_k) are zero. In the large samples, both the Box-Pierce Q statistic and the LB statistic follow the χ^2 distribution with 'm' degrees of freedom. However, the LB statistic has found to be more powerful in small samples (Gujarati, 2005).

In the below, we point out the following cases, where cointegration is possible and where it is not.

Case 1: If $Y_t \sim I(1)$ and $X_t \sim I(0)$, then $U_t \sim I(1)$ and X_t and Y_t are not cointegrated.

Case 2: If $Y_t \sim I(1)$ and $X_t \sim I(1)$, then $U_t \sim I(0)$ and X_t and Y_t are cointegrated.

Case 3: If $Y_t \sim I(0)$ and $X_t \sim I(0)$, then $U_t \sim I(0)$ and cointegration is not possible.

Case 4: If $Y_t \sim I(0)$ and $X_t \sim I(1)$, then $U_t \sim I(1)$ and X_t and Y_t are not cointegrated.

It is to be noted that in the long run relationship between two variables, both must be integrated of the same order and the error term is to be I (0) [Kunst and Marin, 1989; Hakkio and Rush, 1989; Sephton and Larsen, 1991; Deadman and Charemza, 1992; Raju, 2000]. If the series under consideration are integrated, then they follow similar stochastic pattern and tends to be in equilibrium in the long run. Therefore, the first and foremost condition is to test their position of stationary and that has been checked through the unit root test only.

We have also used Cointegrating Regression Durbin-Watson (CRDW) test to examine the cointegration of two variables. The test statistic follows the value of Durbin-Watson (DW) 'd' statistics, which is obtained from the cointegration regression (Sargan and Bhagava, 1983). The null hypothesis corresponds to the DW statistics being zero (i.e., H_0: d =0). But the power of the CRDW depends upon the goodness of fit of the OLS estimate of equation (4). The DW is tested to know, whether the residuals appear stationary. If they are non-stationary, the DW will appear zero. The test rejects the no-cointegration (finds co-integration), if the DW is too big (Engle and Granger, 1987). The test procedure is that if the computed 'd' value is greater/smaller than the critical CRDW, we accept/reject the hypothesis of co-integration at a given level of significance.

Causality Test

This test detects the direction of causality. That means, for two variables say X and Y, the causality explains, whether X causes Y or Y causes X or there exists bi-directional relationship between the two or independent relationship between the two. To examine the same, we employed the Granger causality test. The test states that if X is influenced by lagged X and lagged Y, then Y causes X. Similarly, if Y is influenced by lagged Y and lagged X, then X causes Y. If X causes Y and also Y causes X, then it is a bi-directional causality between X and Y. If only one is true, then it is a case of uni-directional causality. If both fail, then they are independent of each other. A simple F-test can convey, whether the lagged values of Y contribute significantly to the explanatory variable X or vice versa (Granger, 1986; 1988). According to Granger, there is causality from Y to X, if the inclusion of the past values of Y as a group improves the estimation of X significantly (i.e. by F-test). Since the present can not affect the past, the direction of causation is from past to present only. Technically, the following steps have to be considered to test the causality:

Step 1: Regress the restricted equation, i.e.

$$X_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i X_{t-i} + \varepsilon_t \qquad ...(8)$$

And obtain the residual sum of square (RSS_R). But an important issue in applying the Granger Causality test is the choice of the finite lag-lengths (for dependent as well as independent variables) to approximate the theoretically infinite lag distribution. The test clarifies, whether the past values of the independent variable have significant marginal predictive value. If the lag length of the dependent variable is not long enough to capture all non-zero coefficients, then it yields spurious causality. If the lag length is too short, serial correlation in the residuals may exist invalidating the F-test (Kementa, 1986).

Step 2: Regress the unrestricted equation, i.e.,

$$X_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i X_{t-i} + \sum_{i=1}^{n} \beta_i Y_{t-i} + \varepsilon_t \qquad ...(9)$$

And find out unrestricted residual sum of square (RSS_{UR}).

Step 3: Test the null hypothesis H_0: $\sum \alpha_i = o$ against the alternative hypothesis H_1: $\sum \alpha_i \neq 0$.

Step 4: Apply F-test to test the above hypothesis and it is given by

$$F = \frac{(RSS_R - RSS_{UR})/m}{(RSS_{UR})/(n-k)} \text{ and } F \sim (m, n\text{-}k). \qquad ...(10)$$

Where, K = no of parameters; m = no of lags; and n = the sample size.

Step 5: If the computed F value exceeds the critical F-value at the chosen level of significance, we reject the null hypothesis and accept Y causes X.

In the similar way, we test the reverse causality and for this, the general regression is as follows:

Table 1: Results of Unit Root Test

Variables	Level Form					First Differenced Form				
	Without Tend		With Trend			Without Tend		With Trend		
	DF 'τ' Co	DF 'τ' Cr	DF 'τ' Co	DF 'τ' Cr	Conclusion	DF 'τ' Co	DF 'τ' Cr	DF 'τ' Co	DF 'τ' Cr	Conclusion
Exports	2.43	-2.57	-1.227	-3.13	I (1)	-4.744	-2.57	-5.425*	-3.13	I (0)
Imports	1.317	-2.57	-1.485	-3.13	I (1)	-6.029	-2.57	-6.239*	-3.13	I(0)

Note: Co: Computed value of 'τ'; Cr: Critical levels of 'τ'; and for the critical values of DF test, see McKinnon (1991).

Table 2: Results of Cointegration Test

Dependent Variable	Independent Variable	Results of Cointegration Regression	Adj. R^2	ADF	Conclusion	CRDW
Export (X)	Import (M)	X_t = -0.177 +1.013 M_t (-2.152) (56.74)	0.983	-2.82*	$U_t \sim$ I (0)	0.513*
Import (M)	Export (X)	M_t = 0.237 +0.971 X_t (-2.152) (56.74)	0.983	-2.84*	$U_t \sim$ I (0)	0.520*

Note: For the critical values of ADF, see McKinnon (1991) and Engel and Yoo, 1987; For the critical values of CRDW, see Sargan and Bhargava (1983) and Engle and Granger (1987).

$$Y_t = \alpha_0 + \sum_{i=1}^{n} \gamma_i X_{t-i} + \sum_{i=1}^{n} \eta_i Y_{t-i} + \varepsilon_t \qquad \ldots(11)$$

And the rest of the procedure is almost all same, as per our earlier discussion. The empirical analysis has been carried out on annual flows of exports and imports during the period of 1949-50 to 2004-05. The necessary information is secondary in nature and has been collected from Hand Book of Statistics on Indian Economy, Reserve Bank of India (RBI, 2005) and Economic Survey, Government of India (GOI, 2004-05).

Results and Discussion

The results of the unit root test at the log level as well as first difference level (for without and with trend) are reported in Table 1. It reveals that both exports and imports are non-stationary [i.e., I (1)] at the level data, as the null hypothesis has not been rejected because the calculated ô-statistics is considerably low to its critical value (See McKinnon, 1991). But they found stationary [i. e. I (0)] at the first difference level. This indicates that both exports and imports are integrated of order 1 [i.e. I (1)]. Since the variables are stationary at first difference and their order of integration is same, the cointegration test can be applied to examine whether exports and impost drift from each other arbitrarily in the long run. The results of cointegration test are reported in Table 2. It reveals that there exists a cointegration between exports and imports in India during the period 1949-50 to 2004-05. This has been confirmed by both Augmented Dickey Fuller (ADF) test and Cointegrating Regression Durbin-Watson (CRDW) test. The above results reflect that both exports and imports are non-stationary but their linear combination is stationary at the level data. The implication of this result is that exports and imports in India are not drifting form each other rather they converge towards an equilibrium path in the long run. The elasticity of two cointegration regression is around unity, which is to be expected in the long run. This implies that a one percent of India's imports are harmonised by one per cent of India's exports and vice versa, resulting long run trade balances in the economy.

Since the two variables are cointegrated [i.e. they have a long-run equilibrium relationship], it would be interesting to study, whether they share a causal relationship as well and the direction of causality. Applying Granger's causality test, it has been clarified that exports causes imports in India but the reverse is not statistically supported (See Table 3). This indicates that there is unidirectional causality from exports to imports but no reverse causality from imports to exports. Hence, we exposed that the level of exports affects the levels of imports in the Indian economy but not vice versa.

Conclusion

The study investigated the causality between ex-

Table 3: Results of Granger-Causality Test

	Direction of Causality and Decision			
	X ⇒ M	Decision	M ⇒ X	Decision
Lags	F-value		F-Value	√
2, 2	0.475	X	11.195*	√
3, 3	0.373	X	6.333*	√
4, 4	0.787	X	5.917*	√
5, 5	0.967	X	4.427*	√

Note: X: Denotes no causality; and √: Denotes causality.

ports and imports in India during the period 1949-50 to 2004-05. The statistical tool used for the same is causality test, which is followed with unit root test and cointegration test. Unit root test confirmed that both exports and imports are non-stationary at the level data but found stationary at the first difference. This signals that both exports and imports are integrated of order one [i.e., I (1)]. Cointegration test enlightened that there exists a cointegration between exports and imports, indicating an existence of long-run equilibrium relationship between the two. The causality test finally clarified that exports causes imports in India but the reverse is not statistically supported. This implies that there is unidirectional causality from exports to imports but no reverse causality from imports to exports. The findings support the conclusion that increase of exports promotes imports in India but the inverse is not true. Eventually increasing exports is a vital factor in India to expand its foreign trade in particular and overall economic growth in general.

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Proper etiquette is generally acquired through a combination of upbringing and common sense, augmented by the occasional attention-focusing embarrassing moment in one's youth.

– Joe Sharkey

Feature

Determinants of Development in Developed and in Developing Economies

R.S. Tiwari

This paper focuses on labour productivity and workforce as a principal determinant of development. General finding tends to suggest that higher labour productivity determines the level of development in developed countries. Such a result is relatively found to be less significant in the context of developing countries. It is suggested that labour productivity in association with technological knowledge and techniques of production are likely to enhance the trade in developed and developing countries during the period 1980 to 2002.

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The problem of development has assumed critical importance in economic development literature. Though it is a debatable subject as to which factor tends to determine development, yet certain determinants are held responsible for higher or lower level of development.

Such determinants are generally known as:

(i) population pressure on land;

(ii) agriculture with high disguised employment;

(iii) low level of capital availability;

(iv) low level of per capita income;

(v) practically zero saving by the mass population;

(vi) dominance of agriculture, forestry and mining;

(vii) agricultural output mainly containing low level of protein;

(viii) major expenditure on food and necessities;

(ix) export consists of food stuff and raw materials;

(x) low volume of trade per capita;

(xi) poor credit and marketing facilities;

(xii) high fertility rate;

(xiii) high mortality rate;

(xiv) inadequate nutritional diet;

(xv) rudimentary hygiene, public health and sanitation;

(xvi) rural over-crowding;

(xvii) rudimentary education: usually literacy ends up to high school standard;

(xviii) extreme prevalence of child labour;

(xix) inferiority of women's status;

(xx) traditional values among bulk of population;

(xxi) low yield per acre;

(xxii) inadequate and crude communication and transportation facilities, especially in rural areas;

(xxiii) crude technology. (Higgins, B; 1966)

Development indicators described above relate to both economic and non-economic spheres, which jointly determine the level of development, but practically it is an extremely difficult task to take account all determinants.

Instead, per capita GDP, which has generally been accepted as the most appropriate proxy for development, has been considered. So as to determine per capita GDP, we consider labour productivity as well as workforce as independent explanatory variables. Labour productivity has generally been defined as output divided by worker or gross value added divided by total number of workers. Such a method has usually been employed in case of a single country. However, if the number of countries is large, the data does not permit us to use such a method. Thus, owing to the paucity of data for a large number of countries labour productivity, in the present study, this has been defined as GDP divided by workforce. It may be mentioned that labour productivity used in this empirical analysis may only be treated as rough proxy indicator for the labour productivity. It has been done due mainly to the absence of data for the cross country analytical exercise.

Description of Growth Models

The most popularly known economic system is mix-capitalism, under which, baring a few strategic economic sectors, most of the economic activities are under the control of the state or central government. Under this system, profit maximisation is the principal motivational factor and it is used as an engine of growth. So as to maximise profit, individual entrepreneurs are given the freedom to function independently with regard to the choice of products produced, location of the enterprise, quality and quantity of the products, destination of the sale of the products, prices charged for the sale of the products. These forces tend to determine the profit, which ultimately originates from micro and macro-economic efficiency, which in turn, is an outcome of innovational comparative efficiency and labour productivity. Consumers at large are the sole controlling authority of this economic system. Those products that can compete in the perfectly competitive market structure through cost minimisation would survive, whereas others that are deemed to be non-efficient, non-profit oriented and non-productive will be thrown out of the market.

Such an economic system did not survive indefinitely. Those unsatisfied, frustrated and inefficient expressed their desire to have an invisible hand to protect their interest. As a breakthrough of the mix-capitalisation, mid-socialistic model of development came into being in which the names of Marx, Lenin and others were associated. Under such an economic system, government intervention was taken up as a prime force for the social welfare of the society. Generally, except certain strategic economic activities, a large part of economic activities is controlled, guided and operated under the overall control of the government. In real sense of the term the distinction between mix-capitalisation and mix-socialism is a relative concept. The governmental control was maximum under the mix-socialism while such control was minimum under the mix-capitalism. The pure capitalism and the pure socialism are simply a theoretical concept, which do not exist practically in society. Nevertheless a clear-cut distinction between these two did not seem apparent in reality. Whatever may be the distinction between the mix capitalistic and the mix socialistic model of development, it is in degree rather than in kind.

Most of West European countries pursued the mix-capitalistic model of development, whereas mix-socialistic model of development has been pursued by the East European economies. In between these two lies the mixed economy, which assimilates the characteristics of both the mix-capitalistic as well as the mix-socialistic pattern of society. For instance, India's private sector is a symbol of mix-capitalism, whereas public sector has been transformed from mix-socialism. Thus, in the world, three economic systems are generally in operation. These economic systems tend to determine the level of development (Misra, SK & Puri VK; 2000).

Methodology and Database

We may describe the methodology adopted for indicators of determinants of development. Generally, various indicators have been used but none of them is flowless. For example, per capita GDP reflecting the level of development does not take into account equal income distribution. It would imply that, though a country may be rated with high level of per capita GDP, still a large section of population may also be deemed to be so poor that may even be subjected to hunger, besides inadequate housing, clothes and other basic necessities of life. The similar type of argument may even be advanced for almost all, economic, social and sociological indicators of development (Lavadon, H & Oxoby R, 2005). It is, therefore, considered appropriate to consider per capita GDP as the proxy for development, which in turn, is proposed to be determined by

labour productivity and work force. The functional form of equation thus is explained here below:

$$Y = a + b_1 x_1 + b_2 x_2 + U$$

Where,

Y is rate of growth in GDP per capita,

X_1 is the rate of growth in labour productivity, and

x_2 is the rate of growth in labour force.

The selection of these explanatory variables is primarily on account of availability of information from the published sources. Also, there seems to be a positive relationship between high level of development and labour productivity. This is particularly so in the context of developed countries, where labour productivity owing advanced technological knowledge is extremely high than in the developing countries. Similarly, workforce has now been considered in developed countries as embodied capital, which is treated as an asset. Thus, the two explanatory variables as a determinant of development in countries, both in developed and developing, appear to be justifiable. For such an exercise, the two sets of regression models have been used one for developed and other for the developing world.

Developed countries constitute: (1) Australia, (2) Canada, (3) Hong Kong, (4) France, (5) Ireland, (6) Italy, (7) New Zealand, (8) Norway, (9) Spain, (10) Switzerland, (11) U.K., and (12) USA. Countries within the developing world include: (1) Algeria, (2) Bangladesh, (3) Bolivia, (4) Botswana, (5) Brazil, (6) Tanzania, (7) Chad, (8) Chile, (9) China, (10) Cambodia, (11) Casto Rico, (12) Domican Republic, (13) Ecuador, (14) Egypt, (15) Greece, (16) Guatemala, (17) Guinea, (18) Haiti, (19) Honduras, (20) India, (21) Indonesia, (22) Jamaica, (23) Lesotho, (24) Malaysia, (25) Mali, (26) Morocco, (27) Mozambique, (28) Nepal, (29) Oman, (30) Pakistan, (31) Panama, (32) Peru, (33) Philippines, (34) Poland, (35) Porto Rico, (36) Sri Lanka, (37) Sudan, (38) Trinidad and Tobago, (39) Tunisia, (40) Turkey, and (41) Uganda. The rest of the countries both developed and developing, have not been included owing to the fact that these portrayed inconsistent and insignificant relationships between dependent and the independent variables. Therefore, these are omitted in the analysis.

Based on the availability of data, both dependent as well as independent variables have been expressed in terms of annual average rate of growth between 1980 and 2002 at current prices. It appears apparent that higher level of development is primarily on account of much higher labour productivity as well as the work force. It has thus been hypothesized that there exists a positive relationship between the labour productivity and development. It would imply that the higher level of development that we observe today in west European countries is mainly due to higher labour productivity and labour force.

Results

Table 1 presents results. The results are interesting and are as expected. In case of developed countries as a group, the rate of growth in labour productivity pushed up the GDP per capita by 9.65 per cent. The relationship between rate of growth in per capita GDP and the labour productivity has not only been found positive but also significant statistically. As far as the relationship between rate of growth in labour force and per capita GDP is concerned, it is found to be positive but non-significant statistically.

Table 1: Growth Rate in GDP Per capita as a Function of Growth rate in per capita Labour Productivity and the size of Population in Developed and in Developing countries: 1980-2002

Regression Equation $Y = a + b_1 x_1 + b_2 x_2 + U$

Dependent Variable	Constant Term (a)	Independent Variable		R^2 = Values	F = Statistics
		(X_1)	(X_2)		
A - Developed Countries[1]					
Y	15.23	9.65*	1.98	0.76	33.12*
B – Developing Countries[2]					
Y	20.41	6.72** (2.72)	-5.97 (-0.88)	0.44	39.13*

* Indicates significant at 1 per cent level

** Indicates significant at 5 per cent level

[1] Includes: (1) Australia, (2) Canada, (3) Hong Kong, (4) France, (5) Ireland, (6) Italy, (7) New Zealand, (8) Norway, (9) Spain, (10) Switzerland, (11) U.K., and (12) U.S.A

[2] Includes: (1) Algeria, (2) Bangladesh, (3) Bolivia, (4) Botswana, (5) Brazil, (6) Tan Zania, (7) Chad, (8) Chile, (9) China, (10) Cambodia, (11) Cast Rico, (12) Domical Republic, (13) Ecuador, (14) Egypt, (15) Greece, (16) Guatemala, (17) Guinea, (18) Haiti, (19) Honduras, (20) India, (21) Indonesia, (22) Jamaica, (23) Lesotho, (24) Malaysia, (25) Mali, (26) Morocco, (27) Mozambique, (28) Nepal, (29) Oman, (30) Pakistan, (31) Panama, (32) Peru, (33) Philippines, (34) Poland, (35) Porto Rico, (36) Sri Lanka, (37) Sudan, (38) Trinidad Tobago, (39) Tunisia, (40) Turkey, (41) Uganda.

Note: Other countries both from developed and developing have been dropped, which have not been included in the above model on account of internal inconsistencies.

Sources: World Development Report, Work Bank, UNCTAD, Commodity Year Book, Various Issues, UNCTAD, Hand Book of Trade and Development Statistics, Various issues.

Results in the case of developing countries consisting of a group of 41 countries as a group, have followed by and large the similar nature as that of the developed countries, which consisted of 12 countries as a group. The relationship between rate of growth in labour

Table 2: GDP Per Capita and Labour Productivity in Developed Countries

A. Developed Countries		
A-1:	Countries whose per capita GDP and Labour Productivity have increased during 1980 to 2002	(1) Australia, (2) Austria, (3) Belgium, (4) Canada, (5) Denmark, (6) Finland, (7) France, (8) Ireland, (9) Israel, (10) Italy, (11) Netherlands, (12) New Zealand, (13) Norway, (14) Spain, (15) Sweden, (16) Switzerland, (17) United Kingdom, (18) United States.
A-2:	Countries whose per capita GDP increased but labour productivity has declined during 1980 to 2002	(1) Hong Kong, (2) Kuwait, (3) Saudi Arabia, (4) United Arab Emeritus
A-3:	Countries whose per capita GDP and labour productivity have fluctuated during 1980 to 2002	(1) Japan, (2) Singapore
B. Developing Countries		
B-1:	Countries whose GDP per capita and labour productivity have increased during 1980 to 2002	(1) Bangladesh, (2) Bolivia, (3) Botswana, (4) Brazil, (5) Burkina Faso, (6) Chad, (7) Chile, (8) China, (9) Colombia, (10) Cost Rica, (11) Czechoslovakia Rep., (12) Dominican Rep., (13) Ecuador, (14) Egypt Arab Rep., (15) E.L. Salvador, (16) Greece, (17) Guatemala, (18) Guinea, (19) Haiti, (20) Honduras, (21) Hungary, (22) India, (23) Indonesia, (24) Jamaica, (25) Lesotho, (26) Malaysia, (27) Mali, (28) Mauritius, (29) Morocco, (30) Mozambique, (31) Nepal, (32) Oman, (33) Pakistan, (34) Panama, (35) Peru, (36) Philippines, (37) Poland, (38) Portugal, (39) Porto Rico, (40) Sri Lanka, (41) Thailand, (42) Trinidad and Tobago, (43) Tunisia, (44) Turkey, (45) Uganda.
B-2:	Countries whose GDP per capita has increased but labour productivity has declined during 1980 to 2002	(1) Algeria, (2) Argentina, (3) Bulgaria, (4) Burundi, (5) Cameroon, (6) Central African Rep., (7) Cote & Ivory, (8) Ethiopia, (9) Ghana, (10) Iran, (11) Latvia, (12) Mauritania, (13) Namibia, (14) Niger, (15) Nigeria, (16) Libya, (17) Madagascar, (18) Malawi, (19) Papua New Guinea, (20) Paraguay, (21) Rwanda, (22) Saudi Arabia, (23) Sierra Leone, (24) South Africa, (25) Syrian Arab Repub., (26) Tanzania, (27) Zimbabwe, (28) Zambia
B-3:	Countries whose per capita GDP and labour productivity fluctuated during 1980 to 2002	(1) Benin, (2) Gabon, (3) Gambia, (4) Nicaragua, (5) Senegal, (6) Slovak Rep., (7) Togo, (8) Uruguay

productivity and that of GDP per capita is found to be positive with beta coefficient of 6.72. It would imply that one per cent increase in labour productivity would lead GDP per capita by 6.72 per cent. In sharp contrast to the above, the rate of growth in work force leading to growth in GDP per capita has not only been found statistically non-significant but sign of β coefficient turns out to be even negative, which is unexpected. The crux of the result suggests that higher level of development that is observable in the context of developed countries is primarily the outcome of higher labour productivity. Thus, it is imperative that a much higher level of development is pushed up by the labour productivity. This is underlined by the present empirical exercise, which needs to be reinforced by the data at the level of disaggregation.

Disaggregated Analysis

For the purpose of analytical convenience, the entire countries both from the developed and developing, have been re-grouped into three categories:

(i) countries whose per capita GDP as well as productivity of labour have increased from 1980 to 2002;

(ii) countries whose GDP per capita and labour productivity have declined;

(iii) countries whose per capita GDP and labour productivity fluctuated over the years. Information has been recorded in Table 2.

Within the developed countries, there are 18 countries, whose labour productivity and GDP per capita increased from 1980 to 2002. In sharp contrast to the above, in four countries per capita GDP increased but labour productivity declined over the years. However, in two developed countries the per capita GDP and labour productivity did not show a consistent trend, which, in fact fluctuated over the years. Within the group of developing countries, there are 45 countries whose GDP per capita and labour productivity both increased from 1980 to 2002. Cn the other hand, there exists 28 developing countries whose GDP per capita increased but labour productivity declined during the years. However, in case of seven developing countries both per capita GDP and labour productivity did not portray any consistent trend, which, in fact showed a fluctuation. Appendix-I provides the GDP per capita and labour productivity in developed countries, while Appendix-II provides the similar information in the context of developing countries.

What emerges from the above empirical exercise is the fact that the higher the labour productivity, the higher the level of development and vice-versa. Thus, the hypothesis advanced earlier appears to be confirmed by this particular empirical analysis. As a follow up from the above, it seems that developing countries' higher level of development is primarily on account of higher productivity of labour. This is found to be true in 18 out of 24 developed countries and 45 out of 81 developing countries. It would imply that in case of 75 per cent developed and about 56 per cent developing countries, higher labour productivity has led to a higher level of development. However, higher labour productivity with higher level of development is self-defeating in itself. Higher labour productivity in developed countries must, therefore, be accompanied with higher levels of capital, advanced technology, use of qualitative inputs and overall the smooth functioning of firms conducive to development needs of the country. What is stressed here is the assimilation of technological knowledge with higher labour productivity and the fact that both need to be treated jointly rather than in isolation of only one factor alone.

Policy Implication

Historically, it has been realised that there exist gaps in development across different sets of countries. Although, it is a difficult task to define the development, yet certain characteristics are advanced to demarcate developing from the developed world, but it has never been without debate and confusion. In the present empirical analysis, based on the availability of data, per capita GDP has been treated as a proxy for development, which, in turn, is explained by labour productivity and work force. The statistically reliable results show that level of development is explained positively by the labour productivity both in developed as well as in developing countries. The relationship between GDP per capita and workforce both in developed as well as in developing countries has been found to be statistically non-significant. Results, thus, would imply that labour productivity has been the main driving force for development in case of 18 out of 24 developed and for 45 out of 81 developing countries.

From the policy prescription viewpoint, there is need to integrate labour productivity with technological knowledge qualitative input use pattern as well as the overall functioning of the firms. This is likely to help both developed and developing countries to achieve their self-sustained development. It may, however, be pointed out that other determinants of development are also required to be incorporated to explain the level of development in a more quantitatively described fashion than what has been attempted in the present empirical analysis.

References

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Appendix-I

GDP Per Capita and Labour Productivity in Developed Countries

Countries	1980		2002	
	GDP per capita in US $	Labour productivity in US $	GDP per capita in US $	Labour productivity in US $
Australia	10673	23896	20471	40942
Austria	9610	22612	25508	53702
Belgium	11802	30262	24540	57068
Canada	10528	21573	23043	42520
Hong Kong	28734	57467	23076	44870
Denmark	13264	24564	34588	59634
Finland	10261	21378	26302	50503
France	12307	27924	24259	53010
Ireland	6693	15446	17349	71435
Israel	5645	15053	14813	35755
Italy	8083	20028	20419	46081
Japan	90534	18518	31444	58727
Kuwait	28639	57278	17685	35369
Netherlands	12275	30689	26119	55721
New Zealand	7490	17284	14648	29296
Norway	15821	33307	38095	79365
Saudi Arabia	17387	55888	8567	26178
Singapore	5859	10653	2131	43485
Spain	5717	15110	15929	36081
Sweden	15695	29895	26701	50065
Switzerland	16941	32789	38206	68576
United Arab Emeritus	29625	49375	23653	44350
United Kingdom	9596	19977	26547	54009
United States	11930	24597	36052	70014

Source: UNCTAD, Commodity Year Book; UNCTAD, Data Base on Trade Control Measures; UNCTAD, Statistical Pocket Book; UNCTAD, Trends in Developing Economies, Various Issues.

Appendix-II

GDP Per Capita and Labour Productivity in Developing Countries

Countries	1980		2002	
	GDP per capita in US $	Labour productivity in US $	GDP per capita in US $	Labour productivity in US $
Algeria	2229	8821	1804	5083
Argentina	2748	7193	2834	6499
Bangladesh	148	321	350	657
Benin	467	824	385	898
Bolivia	615	1537	867	2167
Botswana	971	2427	2637	6591
Brazil	1942	4927	2600	5537
Bulgaria	2227	4357	1936	3777
Burkina Faso	244	450	261	539
Burundi	230	400	103	184
Cameroon	749	1822	566	1394
Central African Rep.	398	664	263	581
Chad	182	330	250	501
Chile	2507	7256	4010	9870
China	206	374	989	1646
Colombia	1336	3553	1839	4171
Cost Rica	2416	6039	4209	10523
Cote & Ivory	1272	3083	687	1744
Czech. Rep.	2913	9496	6951	12195
Dominican Rep.	1105	3158	2406	5552
Ecuador	1467	4693	1870	4767
Egypt Arab Rep.	559	1602	1361	3469
EL Salvador	715	2234	3571	5101
Ethiopia	136	306	90	210
Gabon	4285	10713	4971	8285
Gambia	233	777	357	510
Ghana	404	855	308	635
Greece	4015	10565	12075	28875
Guatemala	1126	3426	1940	5173
Guinea	26	46	402	868
Haiti	292	585	429	1145
Honduras	642	2138	938	2525
Hungary	2015	4346	6584	13437
India	251	575	486	1085
Indonesia	527	1331	816	1659
Iran	2376	7920	1640	5130
Jamaica	1340	2679	2624	5622
Latvia	28639	57278	17685	35369
Lesotho	368	736	1020	1020
Libya	11848	39494	3826	11957
Madagascar	449	940	275	564
Malawi	206	399	173	366
Malaysia	1749	4620	3954	9214
Mali	233	479	306	601
Mauritania	355	886	323	745
Mauritius	1132	3773	4533	9066
Mexico	2909	8861	6309	15064
Morocco	991	2689	1203	2983
Mozambique	169	303	200	375
Namibia	2190	5475	1452	3630
Nepal	139	274	231	491
Nicaragua	715	2144	720	1636
Niger	423	906	197	402
Nigeria	1311	3155	313	823
Oman	5982	19940	6770	29013
Pakistan	285	809	407	1068
Panama	1796	5131	4099	9458
Papua New Guinea	849	1699	563	1042
Paraguay	1526	4163	918	2623
Peru	1215	3826	2093	5434
Philippines	677	1738	975	2280
Poland	1585	3085	4847	9498
Portugal	2853	6201	12160	23384
Parito Rico	4810	14436	16974	45265
Rwanda	233	447	217	394
Saudi Arabia	17387	55888	8567	26178
Senegal	503	1206	504	1145
Sierra Leone	5859	972	98	392
Slovak Rep.	5859	10653	2131	43485
South Africa	2916	7645	2316	5759
Sri Lanka	268	745	872	1972
Sudan	356	952	409	1024
Syrian Arab Rep.	1451	5225	1222	3711
Tanzania	300	600	268	518
Thailand	688	1326	2047	3384
Togo	379	1033	2768	692
Trinidad and Tobago	6236	15590	9638	16047
Tunisia	1457	3974	2102	5256
Turkey	1564	3679	2624	5450
Uganda	97	192	232	480
Uruguay	3377	8443	4043	7581
Zombie	647	1618	370	840
Zimbabwe	765	1673	639	1361

Source: UNCTAD, Commodity Year Book; UNCTAD, Data Base on Trade Control Measures; UNCTAD, Statistical Pocket Book; UNCTAD, Trends in Developing Economies, Various Issues.

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Feature

Small Holders & Flow of Institutional Credit

Kamal Vatta & Parminder Singh

This paper analyses the existing flow of credit to the small holders in two villages of Punjab. Also, an attempt has also been made to identify some important determinants of the amount of institutional credit flow and the default of institutional credit by the rural households.

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Indian agriculture is overwhelmingly a small farmers' enterprise. The small and marginal farmers (below 2 ha) operate 80.3 per cent of the total number of operational holdings and around 36 per cent of the operational area in the country (Anonymous, 2004). These farmers are the most disadvantaged group, as they lack the required resources and hence are unable to derive sufficient income from agriculture.

Lack of credit has remained a major constraint in the economic betterment of these people and the formal credit institutions have still not been able to save them from poverty. The institutional credit covers only 2.6 per cent of the marginal and 6.8 per cent of the small holdings in India. The new economic policy has further reduced the flow of credit to rural areas by relaxing the compulsion of branch expansion in the rural areas (Banerjee *et al,* 1994).

Database and methodology

Two districts in Punjab, namely Ludhiana and Moga, were selected for the study. One village was selected randomly from each of the districts. Data was collected from 50 village households, out of which 30 were small holders with an operational holding below 2 ha. In order to compare the credit flow of small holders with other households that take credit, ten households were selected each from the landless labourer category (with no operational land) and the large holders (with an operational holding above 2 ha). The information collected focused mainly on the borrower's socio-economic identity, credit and non-credit activities, his credit needs, transaction costs, terms of the credit and the broad economic context in which the credit flow was taking place.

The Censored Least Absolute Deviation (CLAD) model was used for estimating the determinants of institutional credit to rural households. A regression of institutional credit on a number of explanatory variables yields biased estimates by the OLS technique (Lanzouw and Shariff, 2004). This is because the OLS technique

does not properly take into account the censoring of dependent variable at zero (corresponding to all households which do not get any institutional credit). The CLAD approach consists of estimating a quantile regression on full sample, predicting institutional credit on the basis of parameter estimates, dropping those observations for which the predicted values are negative, re-estimating the regression and repeating the exercise until all the predicted values of the dependent variable are positive (Jollife, 1998). The CLAD model was applied to the data on all 50 households. The estimated function was as follows:

CREDIT = f(LAND, WORKER, INCOME, PCNI, WEXP, FAM, MEDU, PCNAI)

Where, CREDIT is the total amount of institutional credit obtained by a household (in Rs.), LAND is the area operated (in ha), WORKER is the number of workers in the family, INCOME is the total household income (in Rs.), PCNI is the proportion of credit from non-institutional sources, WEXP is the working experience with the institutional source (in years), FAM is the familiarity with some important village personnel (whether yes or not), MEDU is the male education (number of years of schooling) and PCNAI is the per cent share of household income from non-agricultural sources. It was hypothesized that the amount of institutional credit is positively related to LAND, WEXP, FAM and MEDU and is negatively related to WORKER, INCOME, PCNI and PCNAI.

The estimation of determinants of default of institutional credit was done by using the probit model (Gujarati, 1995). The dependent variable was binary in nature i.e. 1 or 0 depending on whether a household was defaulter or not. The variables hypothesized to influence the default of institutional credit were FAM-familiarity with some village influential personnel; PY- per capita household income; PCAGR – share of agriculture in total household income; WEXP – working relationship with the institutional source (in years); DAYS – number of days between application and acquiring of credit; INSTC – total credit from institutional sources; TOTC – total credit (both institutional and non-institutional); PCNI – per cent of credit from non-institutional sources and FLEX – flexibility of loan re-scheduling by the institutional source. Larger values of the variables such as FAM, PCAGR, DAYS, TOTC and PCNI were expected to encourage the default of institutional credit, while larger values of the rest of variables were expected to discourage such default.

Results and discussion

Access to credit, costs and credit use

Only 30 per cent of the small holders used to get credit from the commercial banks against 50 per cent of the large holders and 60 per cent of the landless households (Table 1). The access of small holders to cooperative credit was much better to the extent of 96.67 per cent. The large holders have a clear advantage over the small holders in access to different sources of credit. Interestingly more than 90 per cent of both the small and large holders, in spite of having access to the institutional sources were still resorting to borrow from the non-institutional sources.

Table 1: Access of village households to various sources of credit

Source	Household type			
	Landless	Small	Large	Overall
Commercial Banks and RRBs	60.00	30.00	50.00	40.00
Cooperative Banks, PACS and LDBs	30.00	96.67	100.00	84.00
Total Institutional	80.00	96.67	100.00	94.00
Non-Institutional	80.00	93.33	90.00	90.00
Overall	80.00	96.67	100.00	94.00

Figures are the percentage of total households in each category

It is largely in a bid to get more credit, which is not possible by relying entirely on the institutional credit, owing to relatively poor access and smaller amount of credit as compared to the large holders. This argument is further strengthened by the data in table 2. The amount of credit per household increased with an increase in the land holding status i.e. from landless households to large holders. Total credit flow to the large farmers was more than six times higher (Rs. 367,900) than that of small holders (Rs. 54,800).

Table 2: Amount of credit obtained by various households across different sources

(Amount in Rs.)

Source	Household type			
	Landless	Small	Large	Overall
Commercial Banks and RRBs	8250.00 (50.93)	7033.33 (12.83)	87900.00 (23.89)	23450.00 (21.38)
Cooperative Banks, PACS and LDBs	2100.00 (12.96)	21166.67 (38.63)	146000.00 (39.68)	42320.00 (38.58)
Total Institutional credit	10350.00 (63.89)	28200.00 (51.46)	233900.00 (63.8)	65770.00 (59.96)
Non-institutional credit	5850.00 (36.11)	26600.00 (48.54)	134000.00 (36.42)	43930.00 (40.04)
Total credit	16200.00 (100.00)	54800.00 (100.00)	367900.00 (100.00)	109700.00 (100.00)

Figures in parentheses are % share of respective source in the total credit.

The landless households are further disadvantaged. Comparatively higher dependence of small holders on

the non-institutional credit is also reflected in the table. The proportion of credit from non-institutional sources was more than 48 per cent for the small holders, 36.42 per cent for large holders and 36.11 per cent for landless households. Although, there was no significant difference in the proportion of cooperative credit for various household categories, the proportion of commercial bank credit was much less i.e. 12.83 per cent for small holders than that for large holders i.e. 23.89 per cent of the total credit. In a nutshell, small holders have poor access to the institutional credit both in terms of coverage as well as amount of credit when compared to the large holders. It may largely be ascribed to their poor economic standing. Landless borrowers are the worst placed with even lesser amount of institutional and less access to non-institutional sources also being poorly reflected in their overall poor credit worthiness.

In addition to the poor access, the average size of the loan for small holders is also very small, being less than one-fourth of the size for large holders (Table 3).

Table 3: Source-wise average size of loan across borrower's landholding status

(Amount in Rs.)

Source	Household type			
	Landless	Small	Large	Overall
Commercial Banks and RRBs	41250.00 (0.20)	17583.33 (0.40)	32291.67 (2.72)	25258.33 (0.93)
Cooperative Banks, PACS and LDBs	3500.00 (1.67)	10690.23 (1.98)	46852.94 (3.12)	16484.73 (2.57)
Total Institutional credit	7537.43 (1.87)	11463.41 (2.38)	40051.37 (5.84)	16395.81 (4.00)
Non-institutional credit	1837.50 (3.18)	4598.10 (5.79)	20989.58 (6.38)	7324.28 (6.00)
Total credit	3948.17 (5.05)	6645.21 (8.17)	30099.31 (12.22)	10796.62 (10.00)

Figures in parentheses are average number of borrowings per household

It has not been the case only with a particular source of credit but for all the sources of institutional as well as non-institutional credit. It may appear that perhaps the difference in amount of institutional credit may be due to the difference in size of the operational holdings but the average size of credit per unit of operational land is also more for large farms (Table 4). The demand for investment loans is certainly higher for the large farmers and hence the difference, more particularly in case of CBs, which generally cater to these requirements.

The gap further widens in case of the credit from commercial banks, where the average size of credit to the large holders is more than double the size of credit

Table 4: Average amount of credit per unit of land for small and large holders

(Rs./ha)

Source	Small Holders	Large Holders
Commercial Banks and RRBs	6394	16099 (151.78)
Cooperative Banks,PACS and LDBs	19242	26740 (38.97)
Total Institutional credit	25636	42839 (67.10)
Non-Institutional credit	24182	24542 (1.49)
Total credit	49818	67381 (35.25)

to the small holders. No significant difference exists for the average amount of credit from non-institutional sources. Another distinguishing feature is the average number of loans, which showed an increase with the increase in land holding status. It means that the larger households are not only able to get larger amounts of credit from various sources but also get more benefits in contrast to their smaller counterparts. The average number of loans from all the credit sources was 8.17 and 12.22 for small and large holders respectively (Table 3). Although, the difference in number between the two categories was not much in case of non-institutional sources, it was almost in the ratio 1:2.5 for the institutional sources.

Table 5: Borrower's transaction costs per loan across various credit sources

(Rs. per loan)

Source	Household type		
	Landless	Small	Large
Commercial Banks and RRBs	230.0 (0.56)	683.21 (3.89)	45.00 (0.14)
Cooperative Banks, PACS and LDBs	20.00 (0.57)	18.53 (0.17)	22.90 (0.05)
Total Institutional	42.46 (0.56)	130.24 (1.14)	33.19 (0.08)
Non-institutional	17.50 (0.95)	8.43 (0.18)	12.22 (0.06)
Overall	26.74 (0.68)	43.91 (0.66)	22.24 (0.07)

Figures in parentheses are the costs per hundred rupees of credit obtained

Table 5 clearly indicates how small holders pay huge costs to get credit especially from institutional sources (that too from commercial banks). The overall cost per loan for institutional credit was three to four times higher than the landless and large borrowers. In case of the commercial banks, the cost per loan for the small holders was almost thrice the cost of landless bor-

rowers and more than fifteen times than that of large holders. There was not much difference in the cost of credit from the cooperative as well as non-institutional sources.

This cost converted to rupees per hundred of credit revealed another interesting fact. The cost for the small holders was Rs. 3.89 (per rupees hundred) in case of commercial banks, Rs. 1.14 in case of overall institutional credit and Rs. 0.66 in case of overall credit. It ranged between Rs. 0.56 to Rs. 0.95 for the landless borrowers. In all the other cases, it was less than Rs. 0.20 per hundred of credit obtained.

It means that the effective rate of interest paid for the institutional credit (which included nominal rate of interest and per unit cost of loan) is much higher for the small holders. Little access, smaller amounts of credit coupled with larger effective rate of interest harm the very purpose of institutional credit and priority sector lending.

Table 6 highlights the proportion of credit used for the productive purpose. In another sense it also reflects the diversion of institutional credit. More than 81 per cent of the institutional credit on large holdings is used for the productive purpose while only 73.14 per cent on the small holdings. Such proportion is 79.71 per cent for the landless households. It indicates that the diversion of institutional credit was relatively more in case of small holders as compared to that for the landless and large holder categories. Such diversion also indicates the inadequacy of institutional credit, especially for consumption requirements, which is being met in supplements from non-institutional sources. It may also influence the default of credit.

Table 6: Proportion of credit used for productive purpose across various household categories

Source	Household type			
	Landless	Small	Large	Overall
Commercial Banks and RRBs	100.00	70.62	78.50	78.59
Cooperative Banks, PACS and LDBs	-	73.98	90.60	79.57
Total Institutional credit	79.71	73.14	81.40	79.22
Non-institutional credit	-	35.84	76.04	59.41
Total credit	50.93	55.04	79.45	71.29

Source: Primary survey, 2001

Credit delivery and working experience

Small and large holders used to get the entire amount of commercial bank credit, more than 75 per cent of the cooperative credit and 75 to 92 per cent of the non-institutional credit in cash (Table 7). The proportion for landless borrowers is 33, 56 and 63 per cent from the respective sources. Larger proportions of credit disbursed in cash and the failure to effectively link the credit with inputs or other productive activities by the institutional sources may result in significantly higher defaults.

Table 7: Proportion of credit disbursed in cash from various sources

Source	Household type		
	Landless	Small	Large
Commercial Banks and RRBs	33.33	100.00	100.00
Cooperative Banks, PACS and LDBs	55.56	78.55	75.00
Total Institutional	37.85	83.90	84.40
Non-institutional	62.50	92.20	76.84
Overall	46.75	87.93	81.64

The relationship between the borrower and lender is an important factor, which not only facilitates better selection but also, timely recovery of credit. On the borrower's side, it also helps to use the credit in a more efficient way so that better returns could be ascertained, thereby ensuring a full pay back of the credit. Working experience of the small holders was the lowest i.e. 5.63 years as against 6.2 years for the large holders and 6.50 years for the landless borrowers (Table 8).

Table 8: Borrower's working experience with the lending institutions.

(Experience in years)

Source	Household type		
	Landless	Small	Large
Commercial Banks and RRBs	6.50	5.63	6.20
Cooperative Banks, PACS and LDBs	10.00	14.86	19.00
Overall Institutional	8.63	14.86	19.00
Non-institutional	18.12	31.95	40.00

The borrower's experience ranged between 10 to 19 years with the cooperative sources, 18 to 40 years with non-institutional sources and 8 to 19 years with the institutional sources (overall). The length of working experience was positively associated with the land size. It is indicative of the institutional sources first approaching the large holders and expanding their business operations later to the small holders and landless households.

Table 9: Behaviour of trust related variables in terms of security sought by different lending sources

Particulars	Institutional Sources			Non-institutional sources		
	Landless households	Small holders	Large holders	Landless households	Small holders	Large holders
No security is required	38	97	90	100	89	100
Security required in form of third party guarantee	50	94	80	0	11	0
Security asked in the form of group guarantee	13	22	60	0	0	0
Agreement asked in form of input purchase	38	0	0	0	4	11
Agreement asked in the form of labour sale	0	0	0	0	0	0
Agreement asked in the form of output sale	0	0	0	0	85	100
Various material asked for against the loan	0	21	0	0	00	0
Borrower's desire to stop lending from these sources due to collateral requirement	0	0	0	0	94	100
Ranking index for flexibility in loan rescheduling	1.20	1.10	1.00	1.00	1.00	1.00
Ranking index in terms of scope for conveniently spacing the loan instalments	1.20	1.26	1.00	1.00	1.00	1.00
Ranking index in terms of flexibility in documentation and other conditions	1.60	1.48	2.00	1.62	1.07	1.00
Ranking index in terms of provision of incentive/ concessions to encourage good borrower behaviour	2.60	1.57	2.60	2.00	3.19	4.33

Source: Primary survey, 2001

Figures from serial nos. 1 to 8 represent the percentage of respondents responding positively to the particular question. Index values from serial no. 9 to 12 range from 1 to 5. Value of one represent highest flexibility/scope for spacing the loan/provision for incentives and value of 5 represent the least flexibility/spacing/incentive etc.

Institutional credit and some important trust related indicators

Table 9 highlights the values of various trust related variables concerned with institutional as well as non-institutional credit for different borrower household categories. A major difference, which appeared between the institutional and non-institutional sources of credit, was the requirement of security for getting the loan. While security is required in majority of the loans from institutional sources, none of the borrowers expressed any such requirement by the non-institutional sources except 11 per cent of small holders. The security required by the institutional sources was either in the form of third party guarantee or group guarantee or both.

Another revelation is that there exists very poor linkage of credit with input purchase or output sales. The institutional credit was linked with the purchase only in case of 38 per cent of the landless households and not for any other borrower category. There was no linkage with the labour sale for any borrower category and both the sources of credit. The linkages with output sale did not exist for the institutional credit. It was widely prevalent in the case of non-institutional credit. This linkage was absent for landless borrowers due to absence of any agricultural output.

Non-institutional credit is perceived to be more flexible than the institutional credit. It is clearly visible from the value of indices for flexibility in loan rescheduling, conveniently spacing the loan and flexibility in documentation and other conditions. Still, the small holders appear to be slightly disadvantaged as compared to their large counterparts. The position of landless borrowers is even worse. Due to a lot of risk and uncertainty involved in agriculture, the outcome of various operations is unsure and the farmers may face unexpected losses despite putting in great efforts. In such circumstances, the repayment of loans may become impossible. The flexibility in terms and conditions of loans may result in a renewed interest of the borrowers in the lender. The index of flexibility highlights that the small holders enjoy the maximum flexibility for payment of institutional credit. The flexibility was less for the large holders followed by the landless households; the reasons being quite contrasting i.e. lesser credit worthiness of landless households and larger amounts of credit for the large holders leaving less room for flexibility. The flexibility was observed to decrease with the increase in land holding status due to the latter reason.

All the households feel the most uncomfortable with non-institutional sources of credit. It is obviously due to a very high interest being charged by them (Table 10).

The comfort level is much higher with the institutional sources and even better for the small holders. The large holders felt relatively less comfortable with both the institutional and non-institutional when compared to the small holders; probably due to more formalities and documentation required, as the amount borrowed is much larger.

Table 10: Index of borrower's comfort level with different sources of credit

Source	Household type		
	Landless	Small	Large
Commercial Banks and RRBs	1.83	2.00	1.83
Cooperative Banks, PACS and LDBs	1.00	1.00	1.00
Overall Institutional	1.75	1.29	1.50
Non-institutional	3.25	4.73	5.00

The index value ranges from 1 to 5. It is 1 when the borrower enjoys maximum comfort and 5 when the least.

The index of recommendation tended to gauge the preference of borrowers for various sources of credit to be recommended to other households for borrowing (Table 11). For both the small and large holders, value of index was the highest for cooperative sources followed by the non-institutional sources.

Table 11: Indices of recommendation with different sources of credit

Source	Household type		
	Landless	Small	Large
Commercial Banks and RRBs	1.50	2.36	1.90
Cooperative Banks, PACS and LDBs	1.67	1.00	1.05
Non-institutional	1.80	1.33	1.50

The index value ranges from 1 to 5. It is 1 for the highest recommendation and 5 for the least.

It is due to a relatively small number of formalities required by both the sources in comparison to commercial banks, which were the least preferred source. For the landless households, the most preferred source is the commercial banks. It is due to the reason that cooperative credit is likely to be directed towards the landholders. Most of the borrowers preferred to leave the non-institutional sources of credit provided adequate credit is made available from other sources. Eighty per cent of the small holders, 90 per cent of the large holders and 40 per cent of the landless borrowers preferred to leave the non-institutional sources of credit.

Determinants of institutional credit

The estimates of the hypothesized parameters affecting the amount of institutional credit obtained by the application of CLAD model are given in Table 13. The size of operational holding and the household income were found to be significant determinants of institutional credit to the rural households. The institutional credit was found to increase significantly with an increase in the operational area. It reveals the biasness of institutional credit towards larger holdings. The flow of credit decreased with an increase in the household income. The reason may be quoted from the demand side. The households with higher income may have lesser demand for the institutional credit. Other hypothesized variables such as percentage of working population in the family, per cent income from non-agricultural sources, working relationship with the source of credit, familiarity with some influential person of the village and the male education were found to be non-significant. These results indicate the need for reorientation of the institutional credit on the basis of requirements of the rural households and not on the basis of the size of operational holding. Table 13: CLAD estimates of the determinants of institutional credit to rural households

Table 13: CLAD estimates of the determinants of institutional credit to rural households

Parameter	Coefficient
CONSTANT	-85698.80^{NS} (125269.6)
LAND	52462.47* (9458.77)
WPOP	159.76^{NS} (1234.53)
INCOME	-0.65* (0.24)
PCNFOR	-1188.10^{NS} (1012.18)
WFOR	4677.91^{NS} (2709.23)
FAM	-7667.39^{NS} (28459.61)
MEDU	-10054.20^{NS} (23236.81)
Pseudo R^2	0.89

* means significant at 5% level, NS is non-significant, figures in parentheses are the standard errors

Credit default and its determinants

Table 14 reveals that the default of institutional credit was a major problem with the small holders and landless households.

Table 14: Sourcewise incidence of default across various household categories

Source	Household type		
	Landless	Small	Large
Commercial Banks and RRBs	60	40	
Cooperative Banks, PACS and LDBs	100	38	-
Total Institutional credit	100	52	-
Non-institutional credit	75	15	10
Total credit	100	52	10

The figures represent percentage of households in the respective category.

Most of the landless households defaulted on repayment. Such incidence amounted to 52 per cent with the small holders and with none of the large holders. Less incidence of default of the non-institutional credit was due to their larger flexibility in rescheduling the repayments. The default rate for the institutional credit was inversely related to the size of operational holding. It was 47.59 and 18.65 per cent for the landless and small holders and none for the large holders (Table 15). The default rate was higher with the commercial banks than with the cooperative banks.

Table 15: Sourcewise default rate across various household categories.

Source	Household type			
	Landless	Small	Large	Overall
Commercial Banks and RRBs	52.44	31.49	-	8.62
Cooperative Banks, PACS and LDBs	28.57	14.39	-	4.60
Total Institutional	47.59	18.65	-	6.11
Non-institutional	22.31	6.31	10.53	9.50
Overall	38.47	13.24	3.71	7.39

The figures are % of the total credit not paid till the due date.

The probit estimates of the determinants of incidence of default of institutional credit are given in Table 16. None of the hypothesized variables such as per capita income, share of agricultural income, duration of processing the loan application, total household borrowings, proportion of the non-institutional credit etc. were found to be significant. It reflects the tendency of wilful default, which is a serious concern and needs to be addressed immediately.

Conclusions and Policy Implications

The small holders have relatively poor access to the institutional credit compared to their large counterparts. As a result the dependence of small holders on the non-institutional sources of credit was higher. The situation of landless households was no different than the small holders. Hence, the credit policy must aim at larger coverage of the small holders which are still very much dependent on the non-institutional sources for their credit needs. The incidence of diversion of institutional credit for non-productive purposes was much higher on the small farms. The incidence of default of institutional credit by the small holders was to the tune of 52 per cent. The transaction cost of institutional credit per loan activity was almost four times for the small holders as compared to the large holders. Land size and family income were found to significantly affect the amount of institutional credit. Hence, there is need to re-orient the flow of institutional credit so that it may meet the requirements of small holders which are normally neglected owing to their poor credit worthiness. None of the hypothesized variables such as per capita income, share of agricultural income, duration of processing the loan application, total household borrowings, proportion of the non-institutional credit etc. were found to be significant. It reflects the tendency of wilful default, which is a serious concern and needs to be addressed immediately.

Table 16: Probit estimates of determinants of incidence of default of institutional credit

Parameter	Coefficient	Probability
CONSTANT	2.52*	0.04
FAM	-0.15^{NS}	0.50
PY	-0.28^{NS}	0.43
PCAGR	-0.59^{NS}	0.44
WORK	-0.98^{NS}	0.12
DAYS	0.76^{NS}	0.87
FORMAL	0.93^{NS}	0.63
TOTAL	-0.83^{NS}	0.51
PCNFOR	-0.28^{NS}	0.85
FLEX	0.16^{NS}	0.76
Restricted log-likelihood	-32.48	
Chi-Square	19.72*	

* significant at 5% level, NS-non significant

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Feature

Manufacturing Practices in Indian Batch Manufacturing Firms

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Manufacturing activity plays a major role in the economic and industrial development of a country. This paper focuses on the mapping of various practices of manufacturing planning and control (MPC) in batch manufacturing industries in India. This study shows that in planning joint ventures or selecting supplies from India – either to supply fully foreign owned foreign direct investment operations in India or to operations elsewhere – these MPC practices must be taken into account in the management and organisation of batch manufacturing.

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Manufacturing activity plays a major role in the industrialisation of a country and contributes a lot to the development of a good manufacturing base. Effective manufacturing planning and control (MPC) is the key to high performance of manufacturing firms that treat manufacturing function as a competitive weapon. MPC coordinates and synthesizes the major activities of departments such as finance, engineering, marketing and production with the firm's manufacturing game plan, which must be consistent with the strategic plans, the firm's capabilities and departmental budgets.

Batch manufacturing is a typical mode of manufacturing in many countries and aims at producing a large variety of products and models using a common resource base. In India, batch manufacturing contributes about 35 per cent of GNP and about 50 per cent of the actively traded scripts in the Indian National Stock Exchange are batch manufacturing firms. As the Indian industry starts integrating with the global economy, the manufacturing lot sizes will be reduced, the product variety will be increased, and the efforts to increase the manufacturing flexibility will be given a lot of importance. All these are symptoms of moving towards the production of a greater number of product varieties in the coming years. Thus any further studies on MPC practices will deserve greater attention by manufacturing practitioners and academicians.

The introduction of methods and tools such as materials requirement planning (MRP) and manufacturing resources planning (MRPII), just-in-time (JIT), and optimized production time table (OPT) for MPC, has increased interest in the further study of MPC (Rho and Whybark, 1990; Handfield, 1994; Huang, Wang and Ip, 1998; Nagendra and Das, 1999; Lane and Szwejczewski, 2000; Guide and Srivastva, 2000; and Howard, Kochhar and Dilworth, 2000; Swamidass and Winch, 2002; Sale and Inman, 2003; and Mckay, 2003). Further, in spite of a plethora of studies conducted in developed countries, it appears that studies on MPC

practices are quite limited. The objective of the study is to map the MPC practices of batch manufacturing firms in India through a descriptive analysis.

The literature in the field of MPC is not rich in the conceptual development as it is still in the evolution phase. Descriptive surveys are still being carried out in order to compare the MPC practices across manufacturing industries (Ward, Miller and Vollmann, 1988; Kim, Kee and Miller, 1990; and Kotha and Swamidass, 2000). Adam and Swamidass (1989), Kotha and Swamidass (2000), and Swamidass and Winch (2002) assessed operations management from a strategic perspective to identify the missing themes and notice that manufacturing structural and infrastructure decisions such as MPC, plant location, and total quality control (TQC) have strategic implications and further mentioned these topics failed to receive direct attention in the literature.

The literature available, pertaining to MPC, appears to be inadequately understood with regard to MPC practices that deal with procedures, formats and control parameters at the shop floor level (Ansari and Modarress, 1990; Samson and Terziovski, 1999).

Dierdonck and Miller (1981) developed a contingency model to explain aggregate differences in the specifications for MPC systems across firms using technical (investment in information processing systems) and the organizational (integrativeness) factors. The empirical research work conducted by Wheelright (1978), Swamidass and Newell (1987), Miller and Roth (1988), Kotha and Swamidass (2000) case histories (Hill and Duke-Wooley, 1983; Skinner, 1985), and conjectural writings (Edmonson and Wheelright, 1989; Grunwald, Strickwold and Weoda, 1989) has played the central role in the development of the MPC discipline. Several researchers (Rho and Whybark, 1990; Handfield, 1994; Huang, Wang and Ip, 1998; Nagendra and Das, 1999; Lane and Szwejczewski, 2000; Guide and Srivastva, 2000; Swamidass and Winch, 2002; Mckay, 2003) identified the characteristics of MPC system under various environments. From the past literature it is clear that exploratory - descriptive methods have to be adopted to understand the MPC practices and the problems faced in the Indian batch manufacturing firms.

Data Collection

In developed countries, the range of research conducted so far in manufacturing is from optimisation of the variables to the field experiments. Research in the MPC area has to be conducted more in developing countries due to the paucity of studies. Hence a survey-based research through a descriptive analysis was employed to understand the nature, pattern and behaviour of MPC in batch manufacturing industries in India. The present investigation is cross sectional in nature, because the study attempts to examine the status of MPC practices in batch manufacturing firms in India, at a single point of time.

A questionnaire was developed for examining MPC with a view to map the present practices, techniques and methods of manufacturing planning. The questionnaire was divided into sections covering broad details of activities of MPC, review meetings and reports, computer usage, sales forecasting, production and material planning, actions to meet demand fluctuations, shop floor control, application of MRP/JIT/OPT methods, problems and areas of concern with respect to MPC in the batch firms in India.

A list of major batch manufacturers that are comparable in terms of product range, size and spread of business was compiled from the information available in Mumbai Stock Exchange Directory (2005), which is apt for exploratory studies. In this method, the sample was chosen based on the selective criteria, just on consideration of availability. The respondents of the study were the senior managers of batch manufacturing firms and had over 20 years of experience in various industries and at least five years of experience with their present employer. Out of 159 firms, 92 firms responded with full details and in usable form for further analysis.

Method of Analysis

Using the responses to the questionnaire, a descriptive analysis was performed to prepare a profile of the MPC systems in batch firms, and to highlight some practices and areas of concern, across firms. In order to describe the MPC practices, the responded firms were classified. From the analysis of the firms four categories of batch manufacturing firms emerged: i) mechanical ii) electrical iii) electronic and iv) chemical. Additionally, the firms were categorised on the basis of the total number of employees so as to examine the effects of size on MPC practices. Table 1 provides details of ownership of the sample firms (mostly private firms responded) and the classification of sample firms.

Results of Analysis

The details of responses were analysed and the results have been presented under various sub-headings such as MPC function, sales forecasting, production planning, materials management, shop floor activities and exposure to MRP, JIT and OPT in the following sections.

Table 1: Ownershipwise distribution of respondents

Sl. No.	Private Sector		Public Sector		Total no. of firms
	Firm	Division	Firm	Division	
1	39	29	12	10	90
2	13	07	03	05	28
3	10	02	04	13	29
4	04	05	02	01	12
Total	66	43	21	29	159

MPC Function

The details of responses on (i) the major activities of MPC, (ii) reports and (iii) the extent of usage of computers for various activities of MPC were included under the MPC function.

(i) Major activities of MPC

The firms not only identified the MPC activities but also ranked the top five out of the 18 activities. Table 2 provides details concerning the distribution of major activities of MPC department across manufacturing industry categories. All companies identified 'production plan preparation' as the most important activity of their MPC department. This was followed by the checking of production plan for capacity availability and materials requirement planning (2nd and 3rd ranks) by mechanical and electrical industries. However, the electronics and chemical industries identified them as third and second respectively. The preparation and issue of shop loading schedules has been ranked as the fourth most important activity by the mechanical and electrical industries, whereas maintaining load capacity records and checking the production plan for capacity availability have been given the fourth rank by the electronic and chemical industries, respectively. Surprisingly, the shortage list preparation, production progress reporting and evaluation of production do not figure as critical activities of MPC function. Perhaps the reason is that these are highly routine.

(ii) MPC reports

The MPC reports are expected to identify the critical tasks and areas that need the attention of the management as a part of control systems of manufacturing. These reports along with meetings constitute the backbone of the control systems of material flow and throughput. According to the survey, the preparation of material shortages list (36 out of 159), the loss-of-production report (35 out of 159), the report on bottlenecks and shortages in production (27 out of 159) and the report on adjustment to production plan (10 out of 159) are prepared. However, most of the firms (99 out of 159) informed that the performance reports on production are prepared by them. A report on scarce resources utilization is seldom prepared by the batch manufacturing firms in India though it is very important from the view of manufacturing strategy.

(iii) Computer usage in MPC

Computers are being used increasingly to assist the work of MPC activities. Broadly the computer is used for the following MPC activities: 1) material planning 2) production management information system reports preparation 3) production plan/schedule preparation 4) shortage list preparation 5) preparation of work orders

Table 2: Distribution of Major Activities of MPC Department

Rank of activity	Industrial Category (weighted average)			
	Mechanical	Electrical	Electronic	Chemical
Rank 1	Production plan preparation (1.33)	Production plan preparation (1.48)	Production plan preparation (1.45)	Production plan preparation (1.90)
Rank 2	Checking production plan for capacity availability (2.17)	Checking production plan for capacity availability (1.90)	Materials requirement planning (1.93)	Materials requirement planning (2.00)
Rank 3	Materials requirement planning (2.28)	Materials requirement planning (2.50)	Checking production plan for capacity availability (2.50)	Checking production plan for capacity availability (2.40)
Rank 4	Preparation of detailed shop loading schedule and issue (3.17)	Preparation of detailed shop loading schedules and issue (2.92)	Maintaining load capacity records (2.75)	Checking production plan for capacity availability (2.50)
Rank 5	Maintaining load capacity records (3.20)	Preparation of work order job card and ticket and issue (3.10)	Progress chasing (3.10)	Production plan preparation (2.51)

and also shop-loading schedules and 6) movement of work-in-progress materials.

Sales Forecasting

In this section, the practices followed by the batch manufacturing firms with regard to the sales forecasting activity have been compiled. These include techniques used for sales forecasting, and frequency of revision of forecasts. The details are given in the following paragraphs.

(i) Techniques used

The ranking of techniques used for sales forecasting, in the order of decreasing popularity, has been: (a) sales personnel estimates, (b) current order backlog, (c) expected market share and, (d) past sales. In the case of chemical and electrical industries, the order of usage seemed to be different. The details are shown in Table 3. This shows that quantitative methods for sales forecasting such as moving average of sales, exponential smoothing and econometric models are not at all popular.

Table 3: Techniques used for sales forecasting

Rank of Technique	Industrial Category (weighted average)			
	Mechanical	Electrical	Electronic	Chemical
Rank 1	Sales personnel estimates (1.91)	Current order backlog (1.87)	Sales personnel estimates (1.60)	Sales personnel estimates (1.62)
Rank 2	Current order backlog (2.12)	Sales personnel estimates (2.00)	Current order backlog (1.93)	Past sales (2.25)
Rank 3	Expected market share (2.26)	Expected market share (2.15)	Expected market share (2.16)	Past Sales (2.33)
Rank 4	Past Sales (2.34)	Executive opinion (2.66)	Past Sales (2.55)	Moving average of sales (2.50)

(ii) Frequency of revision

Majority of the firms prepare a sales forecast for each product with details in terms of monetary and physical units (64 per cent of the firms prepare sales forecast for individual products, 48 per cent in physical units and 46 per cent in monetary units). Revisions made to the sales forecast every quarter (47 per cent) seem to be predominant. Revisions of forecast half yearly and monthly are also found to be popular among firms.

Production Planning

The criteria for formulation of the aggregate production plan (APP) and its uses, and frequency of revision across the firms are provided in this section. This section also includes methods to check the availability and to optimize the APP before its finalisation.

(i) Formulation criteria

The APP is prepared annually on the basis of business factors. This activity has been ranked as the top activity of MPC (refer Table 3). The four critical factors that constitute the criteria for the formulation of the APP in the order of decreasing ranking are: (a) actual pending orders/backlog, (b) sales forecast (in the case of chemical industries, the ranking is in reverse), (c) production capacity and (d) customers' plans (in the case of mechanical and electrical only and reverse ranking in the case of chemical). For electronic industries, the level of inventories and production capacity constitute the third and the fourth ranked inputs into formulation of the plan. The details are summarized in Table 4.

Table 4: Important factors used for preparation of APP

Rank of Important Factor	Industrial Category (weighted average)			
	Mechanical	Electrical	Electronic	Chemical
I	Actual orders/ backlog (1.50)	Actual orders/ backlog (1.56)	Actual orders/ backlog (1.54)	Sales forecast (1.25)
II	Sales forecast (2.37)	Sales forecast (2.15)	Sales forecast (2.23)	Actual orders/ backlog (1.66)
III	Production capacity (2.39)	Production capacity (2.40)	Level of inventories (2.41)	Customers' plans (2.00)
IV	Customers' plans (2.63)	Customers' plans (2.64)	Production capacity (2.50)	Production capacity (2.35)

(ii) Uses and revision frequency

The APP has many uses in the Indian batch manufacturing firms. The most important use of the plan is the budget preparation activity in all the firms. In the case of mechanical industries, facilities planning, manpower planning and operations scheduling are the other important uses. In the case of electrical and chemical industries, the other uses mentioned are material planning, operations scheduling and manpower planning. For the electronic ones, material planning, purchase and operations scheduling have been mentioned. The revision of the APP is resorted to every quarter in a majority of

manufacturing firms (37 per cent). In the case of electronic firms, the revision is done half yearly (41 per cent).

(iii) Capacity availability and APP finalization

Almost all firms check the available machine capacity before finalization of the aggregate production plan (95 per cent). The methods used for checking the available capacity of machines before finalization of the plan are (a) experience/rough estimates (58 per cent); (b) industrial engineering data (47 per cent); (c) work centre profiles (25 per cent). This shows that firms use more than one method to check the available capacity. In answer to the question on the optimization technique used for finalization of the annual production plan, 53 per cent firms said that they use their past experience to achieve optimisation. A total of 30 per cent firms claimed that they apply assembly line balancing approach towards optimization, followed by 29 per cent who apply economic manufacturing quantity.

Materials Management

Some of the materials management (MM) activities for which practices in Indian batch manufacturing industries have been mapped and are presented in the following sections.

(i) Function responsible for MM and basis of purchase order

The materials department looks after the purchase of materials in 100 firms and MPC in 49 firms, out of the total 159. The APP is the basis of the order for purchase of materials in 82 firms, followed by the actual customer order in 42 firms.

(ii) Lot sizing for material procurement and manufacturing

The top ranking method for lot sizing of materials for procurement is the requirement over a fixed period, in the case of mechanical, electrical and electronic firms. But in the case of chemical firms, it is the discounts for bulk purchases. The other methods used are planner decide lot size, fixed period quantity, and economic batch quantity. The methods predominantly used for lot sizing in manufacturing are planner decide lot size, fixed order quantity, fixed period requirement, economic batch manufacturing quantity and part-period balancing. The details are shown in Table 5.

(iii) Techniques for inventory planning and control

The most popular technique used for inventory planning and control is the material requirements planning (61 per cent), followed by ABC analysis (50 per cent). The reorder point system (maxima-minima or two bin system) is also one of the techniques (27 per cent) used, followed by periodical review system or time-phased ordering (15 per cent). The just-in-time system, (also called 'zero inventories') is followed by a few firms (9 per cent). This shows that firms use more than one technique for inventory planning and control. The details are shown in Table 6.

Table 5: Lot sizing methods for materials procurement and for manufacturing in shops

Rank of method	Industrial Category (weighted average)			
	Mechanical	Electrical	Electronic	Chemical
A. Material procurement				
I	For a fixed period (1.23)	For a fixed period (1.14)	For a fixed period (1.19)	Bulk discounts (1.20)
II	Planner decide lot size (1.42)	Planner decide lot size/Fixed order (1.22)	Planner decide lot size (1.11)	For a fixed period (1.25)
III	Fixed order quantity (1.47)	Lot for lot (1.57)	Fixed order quantity (1.30)	Economic batch quantity (1.50)
B. Manufacturing				
I	Planner decide lot size (1.46)	Fixed order quantity (1.16)	Fixed order quantity (1.33)	For a fixed period (1.00)
II	Lot for lot (1.46)	For a fixed period (1.30)	Planner decide lot size (1.50)	Economic batch quantity (1.50)
III	For a fixed period (1.50)	Planner decide lot size (2.00)	For a fixed period (1.58)	Part period balancing (1.55)

(iv) Methods to face sudden changes in capacity requirements

The most popular method used to increase the capacity availability is the subcontracting, followed by the use of overtime. The other methods resorted to are back-order production, capacity-on-lease and the hiring of additional workers. On the other hand, when demand downturn takes place, the inventory build-up seems to be the most popular option, followed by the use of under time as the next option. The other methods resorted to are capacity-on-lease and reduction in work time.

(v) Actions for timely supply of materials and subcontracting

Long-term contracts seem to be the most widely used

Table 6: Techniques for inventory planning and control

Technique	Industrial Category (No. of responses				
	Mechanical (90)	Electrical (28)	Electronic (29)	Chemical (12)	Total (159)
Supply-on-hand quantity	09	02	03	03	17 (11%)
ABC analysis	46	17	13	04	80 (50%)
Reorder point system	30	05	03	05	43 (27%)
Time phased ordering (periodical review system)	11	04	07	02	24 (15%)
Standing order system	07	–	01	–	08 (05%)
Materials requirement planning	52	20	19	06	97 (61%)
Multi-dimensional analysis	03	02	05	01	09 (06%)
JIT system	06	03	04	02	15 (09%)

method to get timely supply of materials, followed by multiple sourcing. The least preferred alternatives are single sourcing, sister/associate firms and large purchases. Production load is the major reason for subcontracting, irrespective of category of the industrial firm. The other important reasons mentioned for subcontracting are production difficulty, lower costs and firm's policy.

Shop Floor Activities

The practices covered in this section pertaining to the activities of shop floor were mapped and given in the following paragraphs:

(i) Basis of production ordering and time standards in production scheduling

The production ordering is done by MPC (68 per cent of firms), followed by production (27 per cent). The ordering of production is mostly done with the production plan/schedule (42 per cent), followed by job card (32 per cent) and actual customer orders (23 per cent). 70 per cent of the firms use standard times developed for scheduling of production and 19% of the firms use them occasionally.

(ii) Releasing jobs to production

MPC is responsible for establishing the sequence to release jobs to production (80 per cent of firms), followed by production department (20 per cent). Delivery dates committed to the customer seem to be the top ranking basis of releasing jobs to production, followed by marketing department preference and process time required for balance work, except in the case of chemical firms where the selling price seems to play an important role.

(iii) Methods for determining and promising delivery dates

Commonly the delivery time is negotiated with the customer (40 per cent of the firms), followed by the customer preference (31 per cent) and the firm's decision on the basis of its strategy (25 per cent). Production complexity plays an important role (38 per cent), followed by fixed time delivery policy (29 per cent) and customer importance (12 per cent) in promising the delivery dates to the customer.

(iv) Methods for data collection and controlling material flow

The physical check and progress chasers are the two most popular methods (58 per cent of the firms) for collecting data from shop floor, followed by the computer terminals/updates. This shows the use of multiple methods for data collection. The material flow is controlled through movement cards (65 per cent of firms), followed by WIP stores (30 per cent).

Exposure to MRP, JIT AND OPT

The manufacturing management literature is replete with new methods for manufacturing planning and control. The most important methods are MRP, JIT and OPT. MRP seems to be in use extensively and firms are seen to benefit from it (95 firms out of 159). JIT is under study in various firms and OPT is relatively unknown. Eight firms using MRP and eleven firms using JIT reported that they have not benefited from the respective methods used by them. The details are shown in Table 7.

Major Problems of MPC

A total of 12 problems which are faced by MPC function were identified and included in the questionnaire for getting the perceptions of the top five problems faced by the manufacturing firms. The responses were compiled under four categories of manufacturing firms and details are presented in Table 8. The most severe problem faced by MPC in Indian batch manufacturing firms appears to be the lack of timely availability of raw materials, followed by fluctuations in demand. The third one is that of meeting the due date of delivery; however,

Table 7: Exposure of firms to MRP, JIT and OPT

Technique	Industrial Category (No. of responses)														
	Mechanical (90)			Electrical (28)			Electronic (29)			Chemical (12)			Total (159)		
	M R P	J I P	O P T	M R P	J I P	O P T	M R P	J I P	O p T	M R P	J I P	O P T	M R P	J I P	O P T
Level of Exposure															
Never heard of it	04	05	30	01	–	08	–	–	07	03	04	06	08	09	51
Using it & benefiting from it	55	06	14	19	07	08	17	08	04	04	01	03	95	22	29
Using it but not benefiting from it	03	06	00	03	01	–	02	04	–	–	–	–	08	11	–
Knowing it, but feeling no necessity to introduce it	05	20	08	–	06	04	01	05	07	–	–	01	06	25	20
Just starting to introduce	10	17	10	05	08	05	05	03	04	03	01	–	23	29	19
Trying to introduce	10	27	09	01	06	03	02	08	04	01	05	01	14	46	17

Table 8: Major problems in manufacturing planning and control

Rank of Influencing Factor	Industrial Category (weighted average)			
	Mechanical	Electrical	Electronic	Chemical
I	Raw material non-availability (1.7)	Raw material non-availability (1.28)	Raw material non-availability (1.62)	Raw material non-availability (1.88)
II	Demand fluctuations (2.08)	Demand fluctuations (2.23)	Demand fluctuations (2.07)	Demand fluctuations (2.14)
III	Meeting due dates of delivery (2.61)	WIP non-availability (2.33)	Meeting due dates of delivery (2.50)	Meeting due dates of delivery (2.40)
IV	WIP non-availability (2.86)	Scheduling production orders (2.67)	WIP non-availability (2.52)	Introduction of productivity programmes (2.70)
V	Utilisation of critical equipment (3.0)	Meeting due dates of delivery (2.93)	Scheduling production orders (2.52)	Rejection rates (3.00)

the timely availability of WIP (work-in-progress) seems to be a problem in electrical firms. The fourth one is the timely availability of WIP in the case of mechanical and electronic firms, scheduling of production orders in the case of electrical firms and introduction of productivity programmes in the case of chemical firms. Finally, there are problems of utilisation of critical equipment (mechanical), of meeting due dates of delivery (electrical), of scheduling production orders (electronic) and of rejections (chemical).

Discussions

A study of 159 batch manufacturing organisations showed that MPC functions are carried out in some form or the other in order to meet the final objectives of the firm. As very few chemical firms responded to the survey, one has to be cautious in accepting the results of the survey analysis. Unless a full scale study of MPC practices in chemical batch manufacturing industries is carried out, no inferences can be drawn. The manner in which a strong majority of the organisations performs MPC is summarised below.

The five important activities performed by MPC are: production plan preparation, checking production plan for capacity availability, materials requirement planning, preparation and issue of detailed shop loading schedules, and maintenance of load capacity records. The three most important MPC reports prepared daily are: (i) shortages of materials, (ii) loss-of-production and (iii) bottlenecks or constraints in production. A weekly report provides the necessary information for the weekly review meeting. Use of computers is quite popular for (i) materials requirement planning, (ii) production information system, and (iii) production plan/schedule

preparation. Predominantly qualitative methods are used for sales forecasting such as: sales personal estimates, current order backlog, expected market share, and past sales. Sales forecast for each product in terms of monetary and physical units is prepared and revised quarterly.

While finalising the Aggregate Production Plan (APP), a number of factors are considered which include actual pending orders, sales forecast, availability of production capacity and customer plans. The responsibility for the finalization of APP is with the head of the division (similar to sales forecast). The four important uses of APP are budget preparation, material planning, facilities and manpower planning, and operations scheduling. The production plan is revised in every quarter in tune with the sales forecast. Most of the firms check the available machine/equipment capacity before finalization of the APP and methods used are: industrial engineering data, rough estimates, and work centre capacity profiles, and the responses showed that firms use more than one method. The optimization methods based on past experience, assembly line balancing and economic batch manufacturing quantity are used.

The MM department uses the APP to initiate the purchase activity. Lot sizing of material procurement for a 'fixed period' and the method 'planner decide lot size' for lot sizing in manufacturing are popular. The most common methods for the planning and control of inventory are materials requirement planning, ABC analysis, and reorder point system. Methods used to meet the sudden surges in demand are the subcontracting and the use of overtime. When downturn of demand takes place, the methods used are the inventory building and the use of undertime. Some of the actions adopted for the timely supply of materials are long term contracts, multiple sourcing. The important reasons for subcontracting are: production load, production difficulties, lower costs and the firm's policy.

The MPC department initiates the production activity. The bases of ordering production are purchase plan, job cards and actual customer orders. Standard times are used for scheduling the production. MPC is responsible for establishing the sequence of jobs release to production. The bases for releasing jobs are: customer order due dates, sales preference, and processing time required for completion of jobs. Factors that influence the change of priorities for production are pressure from customers, shortages of materials, pressure from marketing and orders from the top management. Most of the firms negotiate with their customers before finalizing the delivery dates. The factors considered are production complexity, fixed-time delivery policy and customer importance. Physical check and progress chasing are used for collection of data from shop floor. Movement cards and WIP stores are used for controlling the flow of materials.

Among the new methods of MPC, the materials requirement planning (MRP) appears to be most popular. A large number of firms are trying to understand or to start JIT programs. OPT is relatively unknown in India. The major problem appears to be the lack of timely availability of material inputs. The other problems mentioned are fluctuations in demand, meeting the committed dates of delivery, WIP availability, scheduling of production, introduction of productivity programmes, utilisation of critical equipment (mechanical) and rejection rates (chemical).

Conclusion

In this paper, we have attempted to map the present practices and methods of MPC in the Indian batch manufacturing firms through a descriptive analysis. There are some important differences in MPC practices across the industrial sectors as disclosed in the study. Surprisingly, differences are greater between electronic and electrical industries than between mechanical and electrical. The response for the survey from chemical industries has been low perhaps because practices are different.

Time is just ripe for the Indian firms to live with more frequent revisions of sales forecast as the Indian market is slowly showing a sign of variability in demand and it has become overdue to introduce models of market demand rather than rely on sales personnel estimates for sales forecasting. The normal jobs attributed to MPC function such as shortage list preparation, production progress chasing and evaluation, seem to have been become very routine.

There exists a lot of potential for the application of quantitative methods in sales forecasting, optimization of production plan, and lot sizing for material procurement and manufacturing. However, the potential available in the Indian firms for increasing their knowledge and use of computers, and of some of the newer techniques that are available for forecasting, planning and control is tremendous and it is possible to achieve remarkable improvement in these activities. Computers are used more for processing of historical data and for reports preparation. The top management appears to have very little influence on the shop floor activities and this shows their lack of connection or knowledge, as observed by Skinner (1969). Perhaps, this is one of the critical issues to be addressed by the top management in manufacturing firms in India to correct the imbalance.

The important aspect that has become a prerequisite for Indian firms to learn quickly is regarding accommodating customer preferences and demands when the production is in progress, i.e., midstream corrections to accommodate changes. The customer appears to be gaining importance in the finalization of delivery dates and seems to influence changes in production priorities. Extensive usage of movement cards and WIP stores shows the potential available for the introduction of JIT. A major problem to be addressed by firms immediately is how to handle the timely supply of raw materials, which calls for new methods of supplier integration. Somehow, the introduction of productivity improvement programmes has been given a low priority by the firms, thereby exhibiting a lack of concern for improvement.

The survey also showed that it is the right opportunity to streamline the production planning at aggregate levels and move towards economic batch manufacturing and economic purchase quantities for effective manufacturing and purchase management. It is also worth noting that building inventory is not an economic solution. Further, reducing cycle time is of top priority. It is an occasion for Indian batch manufacturing firms to look at the possibilities of overcoming material shortages by resorting to supplier's integration and supply chain management.

The implications of the study are very clear. In planning joint ventures or selecting supplies from India – either to supply fully foreign owned foreign direct investment operations in India or to operations elsewhere – these MPC practices must be taken into account in the management and organisation of batch manufacturing. These fundamental distinctions must be addressed in order to minimise the difficulty in integrating the practices in the Indian firms with the firms in other countries.

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□

'Doing your own thing' is a generous act. Being gifted creates obligations, which means you owe the world your best effort at the work you love. You too are a natural resource.

– Barbara Sher

Feature

Automobile Industry and Productivity

J.P. Sharma & Anjali Bhatnagar

The automobile industry in India is booming, especially after restrictions on foreign collaborations were lifted. The auto-component industry, has also become a key sector in the economy, with a turnover of around Rs.120 billion. The automobile industry is also the largest consumer of raw material like CR/HR steel, aluminum and zinc alloys, and also of high value rubber and plastics. This paper examines these multiplier effects on the manufacturing and service industries and analyses why the automobile industry is viewed as an engine of growth in India.

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The transport sector is the backbone of an economy's growth and development. Transportation has made possible an unprecedented level of mobility across geographical boundaries and has given people many more options than they had years ago. It has broadened the base of business by introducing new markets and increasing the available pool of resources. Thus, the relevance of this sector cannot be undermined. Trade facilitated by transportation has been a growing component of the national income all over the world. Needless to say the transport sector is equally important for both developed and developing economies.

The transport sector includes water transport, aviation (air) transport and surface (land) transport. Automobiles as a commodity, which includes passenger cars, multi-utility vehicles, commercial vehicles, and two and three wheelers, is a major constituent of road transportation.

The automobile industry is one of the largest industries with deep forward and backward linkages and hence has a strong multiplier effect. Among the forward linkages the key generators of employment are the oil industry, distribution, after-sales service network and supply of spares and replacement by the auto component industry. It is estimated that over 3 million persons are employed in the distribution and after sales industry. Other critical forward linkages include the auto finance and leasing industry, estimated at Rs 70 billion and insurance, estimated at Rs 35 billion (Society of Indian Automobile Manufacturers (SIAM).

The biggest impact is on the auto-component industry, which today has become a key sector in the Indian economy, its turnover being around Rs.120 billion with exports close to Rs 12 billion. As for the backward linkages, the automobile industry is the largest consumer of raw material like CR/HR steel, aluminum and zinc alloys, and also of high value rubber and plastics. Moreover, the automobile industry is the most important driver of machine tool industry, the bed-rock of industrial growth.

It is due to these multiplier effects on the manufacturing and service industries that the auto industry is viewed as the engine of growth by developed economies. This multiplier effect is most pronounced in developed economies, for example, 1 out of every 6 persons employed in Germany is in the automobile or related industry as compared to India's 1 in 40 persons. The automobile industry has headed for a turn around ever since after the friendly union budget of 2001, as most of the restrictions on importing cars were done away with after 45 years of ban on importing cars. The automobile industry has registered an aggregate increase of over 200 per cent in the production of vehicles during the period 1995-96 to 2004–05. These changes also require an in-depth analysis of financial aspects of this industry.

History of Automobiles

The history of automobiles dates back to the time when the 'wheel' was invented. It was a stepping-stone to the revolution in mechanical engineering. The automobile as we know it was not invented in a single day by a single inventor, but rather reflects an evolution that took place worldwide. It is estimated that over 100,000 patents created the modern automobile. However, we can point to the many firsts that occurred along the way. Both Leonardo da Vinci and Issac Newton had drawn up the first theoretical plans for a motor vehicle.

French army captain Nicholas Cugnot invented the first self-propelled land vehicle in the 1769. Cugnot used a steam engine to power his vehicle, built under his instructions at the Pans Arsenal by mechanic Brezin. It was used by the French army to haul artillery at a whooping speed of 2 ½ mph on only three wheels. The vehicle had to stop every ten to fifteen minutes to build up steam power. The steam engine and boiler were separate from the rest of the vehicle and placed in the front. The following year (1770), Cugnot built a steam-powered tricycle that carried four passengers. Historians who accept that early steam-powered road vehicles were automobiles, feel that Nicolas Cugnot was the inventor of the first automobile.

In 1789, the first U.S patent for a steam-powered land vehicle was granted to Oliver Evan who produced a mobile steam dredge in 1805. Richard Trevithick (1801) built a road carriage powered by steam, which came to be the first in Great Britain. Steam engines were not the only engines used in early automobiles, electrical engines were also invented. Between 1832 and 1839 Robert Anderson of Scotland invented the first electric carriage. Electric cars used rechargeable batteries that powered a small electric motor. The vehicles were heavy, slow, expensive, and needed to stop for recharging frequently. Both steam and electric road vehicles were abandoned in favour of gas-powered vehicles. However, around 1900, electric land vehicles in America outsold all other types of cars. Then in the several years following 1900, sales of electric vehicles took a nosedive as a new type of vehicle came to dominate the consumer market but the Stanley Brothers in the United States continued to manufacture steam automobiles until the early 1920s.

Later on Eugene Langen and Nicolaus August Otto in Europe developed the internal combustion engines. Americans superceded the Europeans in using the combustion engines first for lumbering, pumping, power generation, and marine use and later for carriage purposes. In 1885, German mechanical engineer, Karl Benz designed and built the world's first practical automobile to be powered by an internal-combustion engine. On January 29, 1886, Benz received the first patent for a gas-fueled three-wheeler car; he built his four-wheeled car in 1891. Benz & Cie, the company started by the inventor, became the world's largest manufacturer of automobiles by 1900. Benz was the first inventor to integrate an internal combustion engine with a chassis, designing both together. The first automobile to be mass produced in the United States was the Curved Dash Oldsmobile, built by the American car manufacturer Ransome Eli Olds (1864-1950). Olds invented the basic concept of the assembly line and started the Detroit area automobile industry. American car manufacturer, Henry Ford (1863-1947) invented an improved assembly line system for mass production in 1908, in the United States and installed the first conveyor belt-based assembly line in his car factory in 1913-14 followed by Rolls Royce Britain in 1911.

In Europe, Gottlieb Daimler manufactured the world's first motorcycle and motorboat in 1882. In 1885, Karl Benz brought out the first gasoline engine vehicle. Most early automobile companies were small shops, each produced a few handmade cars and nearly all of them soon abandoned business. Henry ford's introduction of the assembly line were the landmark achievements. By the 1920s the automobile industry was being ranked as a major industry.

The era of classic cars began in the 1920s which saw the emergence of many European producers Austin, Morris, Singer, and Fiat to name a few. The period from 1925-1935 was notable as many new small automobiles appeared along with many ultra large ones.

Developments in India

The first motorcar on the streets of India was seen

in 1898 as India started importing motorcars from the United States and Europe. Mumbai had its first taxicabs in early 1900, which were being operated by an American company. For the next fifty years, cars were imported to satisfy domestic demand. Between 1910 and 1920 the automobile industry made a humble beginning by setting up assembly plants in Mumbai, Calcutta and Chennai. The import/assembly of vehicles grew consistently after the 1920s. In 1928 the General Motors India Limited set up a plant in Bombay to assemble trucks and cars from components and spare parts imported from USA.

Later on, the Ford Motor Company of India Limited came up with similar assembly units. M Visveswaraya, a noted engineer, presented a proposal to the British government for the production of indigenous cars, which was refused. In 1946, Premier Automobile Ltd (PAL) earned the distinction of manufacturing the first car in the country by assembling 'Dodge DeSoto' and 'Plymouth' cars at its Kurla plant. Hindustan Motors (HM), which started as a manufacturer of auto components graduated to manufacture cars in 1949. India became one of the fifteen countries in the world to have pioneered this industry.

In 1952, the Government of India set up a tariff commission to devise regulations to develop an indigenous automobile industry in the country. After the commission submitted its recommendations, the Government of India asked assembly plants, which did not have plans to set up manufacturing facilities, to shut operations. As a result, General Motors, Ford and other assemblers closed operations in the country. This decision of the government in 1954 marked a turning point in the history of the Indian car industry. The Government of India in those days also decided the type of vehicle to be manufactured. Therefore, each product was safely cocooned in its own segment with no fears of any impending competition. Also, no new entrant was allowed even though they had plans of a full-fledged manufacturing programme. The restrictive sets of policies were chiefly aimed at building an indigenous automobile industry. However, the restrictions on foreign collaborations led to limitations on import of technology through technical agreements. In the 1950s, the Government of India granted approval to only seven car dealers to operate in India, HM, API, ALL, SMPIL, PAL, M&M and TELCO. The protectionist policies continued to remain in place while the 1960s witnessed the establishment of the two and three wheeler industry in India.

The Government of India's control on carmakers related to production capacity and distribution and even extended to fixation of prices for cars and dealer commissions. This even triggered the start of a protracted legal battle in 1969 between some carmakers and the Government of India. Simply put, the three decades following the establishment of the passenger car industry in India and leading up to the early 1980s, proved to be the 'dark ages' for the consumer, as his choice throughout this was limited to two models, viz Ambassador and Padmini.

It was only in 1985, after the entry of Maruti Udyog, that the carmakers were given a free hand to fix the prices of cars, thus, effectively abolishing all controls relating to the pricing of the end product. In the early 1980s, a series of liberal policy changes were announced marking another turning point in the automobile industry. The Government of India entered the car business, with a 74 per cent stake in Maruti Udyog Ltd. (MUL), the joint venture with Suzuki Motors Ltd. of Japan. In 1985, the Government of India announced its famous broadbanding policy which gave new licenses to broad groups of automotive products like two and four-wheeled vehicles. Though a liberal move, the licensing Raj system was still very much intact and still prevalent.

The de-licensing of the automobile industry in 1993 opened the gates to a virtual flood of international automobile makers into the country. Also, the lifting of quantitative restrictions on imports added to a flurry of foreign cars in the country.

Many companies entered the car manufacturing sector, to tap the middle and premium end of car industry. The new entrants are Daewoo (Matiz), Telco (Indica) and Hyundai (Santro) in upper end of economy car market. GM, Ford, Peugeot, Mitsubishi, Honda and Fiat have entered the mid-sized car segment and Mercedes-Benz is in the premium end of market. Car manufacturers like the Malaysia-based Proton, are also in line to hit the Indian roads.

Structure of the Automobile Industry

The Indian automotive industry comprises of the automobile and auto-components sectors. Of late, it has expanded overseas through acquisitions and joint ventures. The automobile industry is headed for interesting and challenging times and has reached significant milestones from about 69,000 vehicles in 1960 to 8.4 million vehicles in 2004, including two wheelers, three and four wheelers. The automobile industry has a relatively low share (5 to 6 per cent) of industrial output in India compared to the (8 to 10 per cent) share in developing countries like Mexico and Brazil and a much higher share of around (15 to 17 per cent) in developed countries like the US & Germany (Automotive Industry of India (ACMA).

The Indian automotive industry has a 6 per cent share in the countries' industrial output and gross value added, 5.5 per cent share in industrial employment and more than 17 per cent share in indirect tax collection. In absolute numbers the automobile industry employs more than 0.2 million personnel directly and 1.0 million personnel indirectly. India currently produces about 6 million two wheelers, 1 million passenger cars and multi-utility vehicles (MUVs) and 0.3 million commercial vehicles (CVs). India ranks second in the world in the production of the two-wheelers only after China, fifth in the production of commercial vehicles and thirteenth in the production of passengers cars.

Given below are the salient features of the automobile industry which constitutes the three categories viz commercial vehicles, passenger cars and multi-utility vehicles and 2 and 3 wheelers. It is significant to assess the relative market share of each segment for the purpose of understanding their relative importance. Two wheelers constituted the largest market share in the automobile industry.

As seen from Table 1 during the year 2004-05, the composition of the market share reflected the largest share 78.63 per cent for two wheelers as against passenger vehicles which constituted only 13.44 per cent. Three wheelers and commercial vehicles had about equal share in the market in 2003-04 while in 2004-05 the position changed marginally as the commercial vehicles share rose slightly. Figure 1 depicts Table 1 pictorially.

Table 1: Market Share of Components of Automobile Industry

Market Share	(2004-05)	(2003-04)
Commercial Vehicles	4.03 %	3.83 %
Passenger Vehicles	13.44 %	13.26 %
Two wheelers	78.63 %	78.96 %
Three wheelers	3.9 %	3.95 %

Source- http://www.siam.com

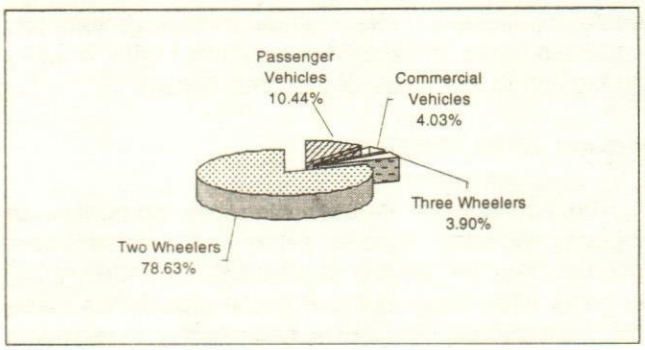

Fig. 1. Market share 2004-05

Given below is the profile of each of the product categories in the automobile industry.

Commercial Vehicles

Increased urbanization also has led to an increase in freight and passenger movement. Hence, the importance of commercial vehicles segment can hardly be overstated. It comprises three sub-divisions: the LCVs, MCVs and HCVs, indicating light, medium and heavy commercial vehicles. India's $5 billion truck and bus market, the world fifth largest has been enjoying a 30 per cent annual growth rate in the past three years. An expanding network of highways and purchases made to replace ageing trucks drives this growth.

Heavy commercial vehicles are used to transport bulk cargo over long hauls (over 500 km on an average) typical end-user industries are steel (secondary transport), cement both (primary and secondary transport), fast moving consumer goods (primary transport), pharmaceuticals (primary transport) containerized transport and general goods transport. Light commercial vehicles find application in transportation of goods and people over short distances and within city limits.

The transport industry has witnessed a shift towards flexible and consumer friendly transportation solutions. Nevertheless, we see its growth impending due to factors such as non-existence of the vehicle scrapping norm in India and the poor state of road infrastructure. This is reflected in the poor state of the National and State Highways which constitutes 8 per cent of the total road length in our country and which carries 80 to 90 per cent of the total road freight traffic. Further, the length of the National Highway is only 2 per cent of the total road length and carries 40 per cent of the freight traffic (Agarwal, P N, "A Comprehensive History of Business in India - From 3000 B.C to 2000 A.D," Tata McGraw Hill Publishing Company Ltd, New Delhi, 2001).

Half of the total road length is unsurfaced and only 1 per cent of the National Highway length has a four-lane carriageway. The loss by way of higher operating costs on account of bad road conditions has been estimated to Rs.1,50,000 million per annum.

Multi-Utility Vehicle Segment (MUV)

In the last fifty years the MUV's market has grown from around 2000 vehicles in the late 1940 to around 181,000 vehicles in 2004-05. This category of vehicles which till the mid-80s was primarily used by the government, army, police and para-military forces exclusively

is today a primary mode of mass transport in rural and urban India.

In most emerging auto markets, utility vehicles feature in the light truck category and not in the passenger cars segment. Hence, they enjoy the benefits of same duties and concessions as commercial vehicles, which are substantially lower than those of passenger cars. Segmentation of utility vehicles is very different in developed countries where vehicles are sports/leisure vehicles for the high and premium end of the market, but in countries like India, the need is still more utilitarian in nature.

Passenger Cars

India is one of the oldest automotive industries in south and south-east Asia, with the first passenger car made in the early 1940s. However, since then, the development of the industry shifted to two wheelers and LCVs.

The industry profile in India is very different from the global profile. Globally, passenger cars are the largest segment of the automobile industry, but in India it is much smaller. The budget for 2006-07 has reduced the excise duty on small cars from 24 per cent to 16 per cent with the intention to become more price competitive in order to make India a hub for exporting small cars. In 2004 the Indian automobile industry overtook China as the fastest growing automobile market, and closed the year with sales of a million passenger vehicles.

Table 2 exhibits the comparative sales figures of small cars in India vis-a-vis other countries of the world.

Table 2: Sales Figures For Global Small Car

India (2003)	503,000
Japan (2003)	1,820,000
China (2003)	480,000
Europe (2002)	890,000

Source: Business World, 19th January 2004.

Till 1984 when Maruti started operations in partnership with Suzuki motors, the passenger car industry was supply constrained. The most recent step forward of the automobile industry was taken in 1991 as part of the liberalization movement with the delicensing of the passenger car segment subsequently in 1993. Even as this segment was opened up in terms of entry, the excise concessions had been removed to make this segment the most heavily taxed among all segments (excise duty of 40 per cent). This clearly indicated the government's bias against this segment and cars being viewed as a luxury product.

Of late, with one of the largest potential markets in the world, India's open door policy has attracted a large number of global players to set up operations in India, which has led to over capacity and presence of large-scale diseconomies of operation. India's highest competitive edge lies in the fast growing domestic market and the lowest labour cost in the world. Table 3 shows a comparative cost per unit analysis of India and China.

Table 3: Relative Unit Costs of Manufacturing in India and China

(In Percentage)

Costs	India	China
Raw Materials	81	59
Depreciation	6	6
Salaries & Wages	5	1
Interest	3	1
Others	5	10
Total Costs	100	77
Import Duty	25–30%	5–7%
Others	24–25%	17%
Power & Fuel Costs / KWH	$ 0.13	$ 0.09
Labour costs ($)	330–440	180–360
Labour Productivity*		
(Gross value added/ employee)	$ 4,750	$ 5,200
Interest Rates	12%	6%

Source: Business World, 19th January 2004.

We observe from the Table that it is 23 per cent cheaper to make a car in China than in India. Still, the potential of this industry to contribute to the economic growth has not been fully exploited. The share of employment is at 5.5 per cent in India as compared to 3 to 7 per cent in developing countries and around 15 per cent in mature economies. Even the current low penetration levels in India in all the three segments has resulted in failure to exploit the potential of this industry and has led to low share of industrial output.

Two and Three Wheelers

The two-wheeler industry basically comprises of mopeds, scooters, scooter setters and motorcycles. Scooters form the largest segment in the industry (37 per cent), while the major part of the growth has come from motorcycles. The Indian two-wheeler market was mainly a scooter market till the mid-1980s, but now

mopeds/motorcycles currently account for around two-thirds of the two-wheeler market demand. The majority of increase in demand is from the rural areas where these are preferred vehicles. Three wheelers operate as a means of carrying both passengers and goods.

Profile of the Industry

The automobile industry made a humble beginning in the 1950s. Till the 1970s this was considered a low priority sector because no major policy decisions regarding this sector were made. The decision in the late 1980s to allow foreign collaboration in automotive segments was a milestone for the Indian automobile industry. The industry benefited immensely from the new economic order ushered in by the economic liberalization.

The total investment in productive assets in the automobile industry can be observed from Figure 2, which has risen from roughly Rs 40 million to Rs 400 million. This is a tenfold increase during the nine-year period from 1991 to 2000.

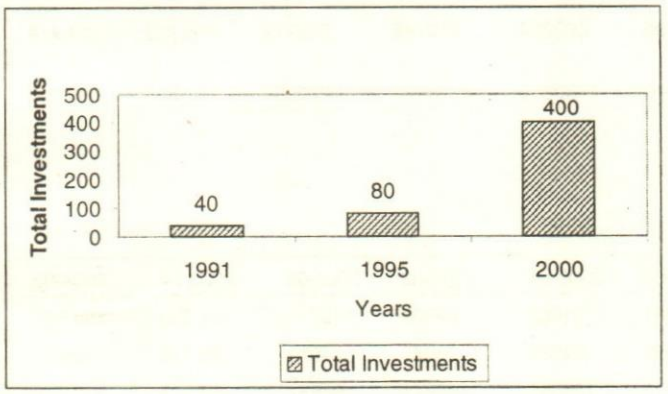

Fig. 2. Total investment in productive assets in Indian Automobile Industry

Source: SIAM Research

Installed Capacity

The installed capacity of the divisions of the automobile industry is given in Table 4. As is obvious the 2 and 3 wheelers segment holds the largest share (amounting to four-fifth) of the installed capacity in the industry.

The two-wheeler segment in the automobile industry has grown at a compounded average growth rate (CAGR) of 14 per cent over the past 10 years. Within the two-wheeler segment the sales of motorcycles exhibited an increasing trend and sales of scooters and mopeds were found receding. The Indian commercial vehicles industry has exhibited cyclical trends over the past two decades, with sales being directly related to general economic trends and development of infrastructure related projects. The passenger car industry has exhibited a CAGR of 17 per cent over the past decade. In fact, in passenger cars segment, India is one among the few countries in the top fifteen car producing nations of the world, which exhibited a growth of nearly 30 per cent in 2003, In comparison the US market size, which ranked number two in the year 2002 decreased by as much as 10 per cent while Japan which topped the rankings, decreased by 2 per cent in 2003.

Table 4: Installed Capacities In The IndiaN Automobile Industry, 2002-03

Vehicles	Rs.(million)	Percentage
Four Wheelers	1586400	16.22
Two & Three Wheelers	7954000	81.34
Engines	238000	2.43
Total	9778400	100

Source- http://www.siam.com

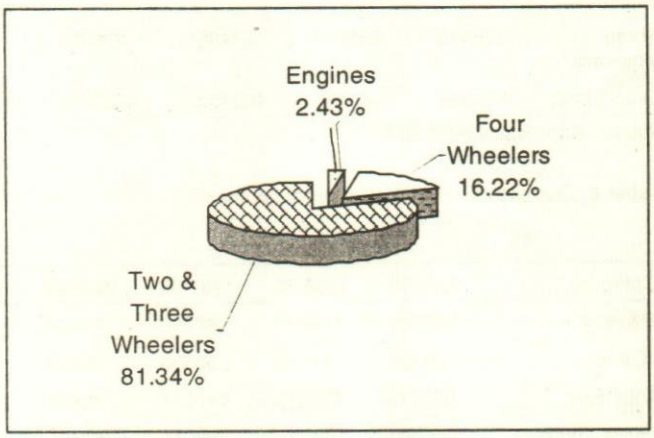

Fig. 3. Installed capacities in the Indian Automobile Industry 2002-03

Production Trend

During 1993-94, 2.8 million vehicles (Automotive Industry of India 1999-2000, (ACMA) were produced in the automobile industry. The production has increased almost 2.5 times from 1995-96 to 2004-05, from 3.5 million vehicles produced to 8.5 million vehicles as reflected in Table 5. In recent years India has had a growing market potential for automobiles due to a rise in demand and as a result there is an increased production to tap the growing demand both at home and in the foreign markets. This is reflected in the sale and production figures of the industry. Especially remarkable is the motorcycle division, where production has risen by more than six times. This is followed by the passenger car segment, which has almost trebled in the said period.

Table 5: Production Trend in the Automobile Industry

Figures (In Millions)

Category	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
M&HCV' s	129651	155696	95854	80528	112308	88210	96752	120502	166123	211,143
LCV's	87786	84855	65040	55363	61213	68922	65756	83195	108,917	138,890
Total CVs	217437	240551	160894	135891	173524	156706	162508	203697	275,040	350,033
Passenger cars	348240	411145	401002	390709	577347	513415	500301	557410	782,562	960,505
UV's	106251	134583	134653	113328	124308	127519	105667	114479	146,325	181,778
MPV's	–	–	–	–	–	–	63751	51441	60,673	67,371
Total passenger vehicles	454491	545728	535655	504037	701655	640934	669719	723330	989,560	1,209,654
Total 4 wheelers	671928	786279	696549	639928	875179	797640	832227	927027	1263764	1559687
Scooters	1224889	1312920	1279467	1315055	1259423	879759	937506	848434	935,279	986,208
Motorcycles	809087	988233	1125958	1387286	1794078	2183785	2906323	3876175	4,355,168	5,193,752
Mopeds	622041	678074	667242	672167	724510	694974	427498	351612	332,294	346,587
Total two wheelers	2656017	2979227	3072667	3374508	3778011	3758518	4271327	5076221	5,622,741	6,526,547
Three wheelers	176413	221619	234867	209033	190259	203234	212748	276719	356,223	374,414
Grand total	3504358	3987125	4004083	4223469	4843449	4759392	5316302	6279967	7,243,564	8,460,648

Source: http://www.siam.com

Table 6: Domestic Sale in the Automobile Industry

Figures (in Millions)

Category	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
M&HCV' s	119781	144511	88259	79124	106261	81960	89999	115711	161,395	198,561
LCV 's	80302	77165	55555	50698	55350	54625	56672	74971	98,719	119,877
Total CVs	200083	221676	143814	129822	161611	136585	146671	190682	260,114	318,438
Passenger cars	316489	374144	388015	384483	615318	567728	509088	541491	696,153	819,918
UV's	101273	132157	130014	109082	118323	122832	104253	113620	146,388	176,339
MPV' s	–	–	–	–	–	–	61775	52087	59,555	65,033
Total Passenger vehicles	417762	506301	518029	493565	733641	690560	615116	707198	902,096	1,061,290
Total 4 wheelers	617845	727977	661843	623387	895252	827145	821787	897880	1162210	1379728
Scooters	1199543	1274815	1232432	1297115	1233781	876224	908268	825648	886,295	923,566
Motorcycles	760931	928329	1085976	1360196	1761439	2114693	2887194	3647493	4,170,445	4,964,442
Mopeds	583843	635617	598943	646114	698321	643461	408263	338985	307,509	320,852
Total two wheelers	2544317	2838761	2917351	3303245	3693541	3634378	42033725	4812126	5,364,249	6,208,860
Three wheelers	144841	198463	215138	189082	172135	181899	200276	231529	284,078	307,887
Grand total	3307003	3765201	3794332	4115894	4760928	4643422	5225788	5941535	6,810,537	7,896,475

Source: http://www.siam.com

A large number of joint ventures and technical collaborations of world-renowned manufacturers have been approved for production of automobiles and their components within the country for domestic and internal needs. This is likely to further increase the investment and market employment.

Domestic Sale Trend

As seen in Table 6, domestic sales figures for the automobile industry have more than doubled over the last ten years i.e. from 1995-96 to 2004-05. The sales figure for motorcycles has shot up by more than five times. In the two wheeler segment only scooters and mopeds have exhibited declining tendencies. Passenger vehicles have shown an increase in domestic sales to the tune of 2.5 times while commercial vehicles have grown 1.5 times.

An analysis (Economic Times, 22nd April, 2005) of the ten-year data as seen in Table 10 for the Indian auto industry indicates that auto industry has now seen a three-year growth run. While two wheelers continued to show impressive growth volumes even into the fourth year of growth spurt that began from 2001-02, passenger car and commercial vehicles are showing signs of slow growth. They have shown more fluctuations in growth than two wheelers in the past ten years as well. Two wheelers suffered just one year of negative growth, a 2 per cent reduction in 2000-01 over the previous year.

In contrast passenger cars had two years of falling sales over the previous years, a 4 per cent reduction in 2001-02 over the previous year, which was a good recovery from the 10 per cent drop in 2000-01 over 1999-00. Commercial vehicles showed four years of dropping sales closely tracking industrial growth. The sharpest drop in commercial vehicles sales was a 33 per cent drop in volumes in 1998-99 over 1997-98, in addition to a steep 28 per cent drop in 1997-98. However, as in passenger cars, commercial vehicles also showed a smart recovery in 1999-00 only to drop 10 per cent again in the next year. The cyclical nature of the industry is quite visible in the ten-year data.

Table 7: Percentage Growth Rate In Domestic Sale

(Domestic Sales in Lakh, Growth in per cent)

Years	Passenger Vehicles (PV)		Commercial Vehicles (CV)		Two-Wheelers	
	Domestic Sales	Growth	Domestic Sales	Growth	Domestic Sales	Growth
2004-05	10.6	17.7	3.2	22.4	56.6	16
2003-04	9	27.9	2.6	35.3	48.8	9.7
2002-03	7.1	4.3	1.9	31.7	44.5	15.4
2001-02	6.8	-4	1.5	-2.9	38.6	12
2000-01	7	-10.1	1.5	-10.9	34.4	-1.8
1995-96	4.1	30.2	2.6	30.1	24.2	19.5

Source: SIAM and ETIG analysis

PV-Passenger Vehicles includes Cars and SUV/MUV

CV-Commercial Vehicles includes LCV, MCV & HCV

It was the two wheelers which rode the storm well. There was only a 2 per cent drop in volumes sold in 2000-01, but apart from this dip, two-wheelers have capitalized on better styling, better quality of ride and engineering as well as aggressive financing schemes that made their mark from 2002-03 onwards. This drove a 16 per cent growth in volumes to 56.6 lakh units in 2004-05, taking the share of two wheelers in the overall industry to 78.6 from 77.2 in 2003-04. As in two wheelers, the real impact of the arrival of new brands and companies in passenger vehicles began to show up in the past three years, with the passenger vehicles market expanding. A key driver of this expansion was the utility vehicles sub segment, where a series of brand launches from M&M, Hyundai, Maruti, Ford, Toyota and Honda repositioned these bulky vehicles as lifestyle statements and spurred sales. In commercial vehicles, the replacement cycles were impacted by the new laws in several states banning old trucks from plying the roads, as well as the emergence of new 13-40 tonne trucks from the three main companies in this business Tata Motors, Ashok Leyland and Volvo India.

Export Trend

Export performance of the Indian automobile sector has also exhibited a steady growth with the value of exports crossing $ 3 billion. The industry is now on its way to becoming a major foreign exchange earner for the country. The percentage growth rate in the exports category in the auto industry has surpassed all of the industry's growth rates. As seen from Table 8 India exported 160,677 passenger cars and 36,6724 two wheelers in the financial year 2004-05 against about 28,851 passenger cars and 11,3971 two-wheelers in financial year 1995-96. Exports of all kinds of vehicles have gone up by three times from Rs 7,445 million in 1993-94 to Rs 20,182 million in 1996-97 and to Rs 629,887 million in 2004-05 (Economic Times, 27 April, 2005). Passenger cars have registered a growth of over 300 per cent followed by motorcycles with a 285 per cent growth.

Exports of made in India vehicles soared by 31 per cent in financial year 2004-05 as passenger cars, two and three wheelers, commercial and utility vehicles continued to charm overseas buyers. A total of 6.29 lakh units were shipped during financial year 2005 over 4.79 lakh units during the same period last year in 2004. Of this, car exports recorded a robust growth of 28 per cent. Commercial vehicle exports stood higher by 72 per cent at 29,949, while exports of medium and heavy vehicles grew by 64 per cent to 13,491 units, those of light commercial vehicles grew 78 per cent to 16,458 units.

Table 8: Export Trend in the Automobile Industry

Figures (in Millions)

Category	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
M&HCV' s	8560	6606	5872	4544	5089	5510	4824	5638	8,188	13,491
LCV 's	6995	7230	8212	5564	4823	8260	7046	6617	9,244	16,458
Total CVs	15555	13836	14084	10108	9912	13770	11870	12255	17,432	29,949
Passenger cars	28851	37161	29705	25468	23272	22990	49273	70263	125,320	160,677
UV's	2987	2484	3288	2654	5148	4122	3077	1177	3,049	4,509
MPV' s	–	–	–	–	–	–	815	565	922	1,227
Total passenger vehicles	31838	39645	32993	28122	28420	27112	53165	72005	129,291	166,413
Total 4 wheelers	47393	53481	47077	38230	38332	40882	65035	84260	146723	196362
Scooters	23106	26236	30267	28753	20188	25625	28332	32566	53,687	60,766
Motorcycles	48596	50353	45338	35461	35295	41339	56880	123725	187,287	277,100
Mopeds	42269	48139	49899	35788	27754	44174	18971	23391	24,078	28,858
Total two wheelers	113971	124728	125504	100002	83237	111138	104183	179682	265,052	366,724
Three wheelers	32214	21973	18595	21138	17725	16263	15462	43366	68,144	66,801
Grand total	193578	200182	191176	159370	139294	168283	184680	307308	479,919	629,887

Source: http://www.siam.com

Among the category of two wheelers, motorcycle exports accounted for the maximum, at 2.77 lakh units for the last fiscal. Scooter sales, which have been showing a downtrend in the domestic market, saw exports rise 13 per cent at 60,766 units while moped exports increased 19 per cent to 28,858 units.

Europe continued to be the biggest importers of cars from the country while African nations bought the bulk of buses and trucks. The Asian region became the prime destination for Indian two-wheelers. Meanwhile, many passenger car companies have announced plans of making India an export hub and component units have chalked out investments of Rs. 1000 crores in the next one year. Much of the current auto boom has been taken care of by engaging idle capacities and productivity enhancements like six sigma, defect reduction and quality control systems.

The government has decided to implement the Rs 1,718 crore National Automobile Testing and R & D Infrastructure Project (NATRIP) to improve the global competitiveness of the Indian automotive sector. The project world help usher in better safety, emission and performance standards, which will improve its export potential. World class testing centres will be set up at Manesar and Chennai and the existing facilities at ARAI in Pune and VRDE in Ahmednagar will be upgraded. A state of the art proving ground or testing tracks will also be set up in due course. All this is likely to boost the current exports of 10,000 crores by an increase ten-fold within the next five to seven years.

Gross Turnover

The size of gross turnover has shown an impressive jump of overall 64 per cent over a period of seven years (1996-97) for the entire industry from Rs. 0.36 million to Rs. 0.59 million (Table 9).

Table 9: Gross Turnover in Automobile Industry

Year	Rs. (In Million)
1996-97	364450
1997-98	365411
1998-99	368262
1999-00	422933
2000-01	492024
2001-02	499136
2002-03	595184

Source: http://www.siam.com

Current Status

India's 30 per cent growth in calendar year 2004 is already double that of China's 15 per cent. In the 2003-08 estimated CAGR list, India scores 16 per cent to China's 12.4 per cent. That is a marked turnaround from

the 1998-03 CAGR where China's 21 per cent tally was way ahead of India's 12.3 per cent. Analysts estimate that growth will make the Chinese market the second largest in the world by 2008. India, for its part will be the seventh largest by then. According to analysis by German consultants Roland Berger, India is already the second most attractive auto engineering destination scoring 7.5 out of 10 on the index, just below China's 10 on 10. While Latin America also scores a 7.5, East Europe, the other growth engine in autodom, is at 5. Asia and Australia score 0, as does Africa.

Table 10 shows the comparative cost analysis of countries across the globe. According to the US Bureau of Census, India's per hour labour cost is the lowest after China. China's tally of $0.5 per hour tops the list followed by India at $0.8 per hour, Thailand at $1, Mexico at $2.3, Japan at $19.5, the US at $19.9 and Germany at $22.3 per hour.

Table 10: Hourly Labour Cost of countries across the World

(in dollar)

Country	Labour Cost Per Hour
China	0.5
India	0.8
Thailand	1
Mexico	2.3
Japan	19.5
US	19.9
Germany	22.3

Source: US Bureau of Census

Table 11: Penetration Level Of Vehicles In South-Asian Countries

Country	Vehicle Penetration Level (per thousand persons)
India	10
China	20
Indonesia	29
Philippines	30
Thailand	101
Malaysia	255
South Korea	300
Australia	500
Japan	575

Source: The Economic Times, 27 April, 2005.

Table 11 highlights the penetration level of vehicles in South-Asian countries. As observed India's 10 per thousand people vehicle penetration levels may be up from the 6 per thousand mark it hit two years ago, but it is still half of China's 20 per thousand and way behind countries like Japan with a high penetration level of 575 per thousand.

Conclusion

The Indian automobile industry offers significant growth potential, given its existing low penetration levels and a fast growing economy with a burgeoning middle and high-income group of consumers. In terms of manufacturing base, India offers some significant advantages, namely a large pool of well qualified manpower, which can also be utilized in fostering local research and development, availability of enough land and other natural resources like iron ore, coal, bauxite etc, decreasing costs of funds and a well defined legal environment. These factors of competitive advantage assume special significance in the light of changes in the business practices of automobiles majors with respect to increased Business Process Outsourcing of key activities within the ambit of automobile companies.

In spite of the above advantages the Indian automotive industry still continues to be plagued by issues such as multiplicity of local taxes, cascading impact of taxes and duties, high import duties on raw materials, taxes on services in addition to corporate taxes and inflexible labour loss. Incidentally, road transport industry is the highest tax-generating segment in the country, equivalent to 40 per cent on cost. In a nutshell, road transport industry has always been saddled with pressure in terms of paying taxes and duties in spite of the fact that road transport industry is considered to be the backbone of the country's economy.

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Feature

Impact of Technological Progress on Productivity, Usage of Spindles and Labour in Indian Spinning Sector

Jatinder S. Bedi

This study examines the impact of technological progress on productivity, usage of spindle and labour in the Indian spinning sector. The methodology used here is different from the traditional production function approach. The percentage of excess installed spindles compared to the minimum required at the latest technology available during 1996, could be explained by the underutilisation of spindles and the technological gap between the installed spindles and spindles of modern technology. The inverses of excess spindles used over time due to the technological gap shows the changes in productivity of working spindles. A similar analysis is undertaken for the excess use of labour. The indices of use of spindles and labour compared to the minimum required are used as variables to estimate the Total Factor Productivity.

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This study examines the impact of technological progress on productivity, usage of spindles and labour in the Indian spinning sector after the New Textile Policy (NTP) was introduced in 1985. The total factor productivity is estimated using the coefficients of labour and capital derived from production function analysis undertaken in other studies on the variables, such as indices of excess usage of spindles and labour over time compared to minimum required at modern technology. The period of study is 1983 and 1988-89 to 1996-97. The gap for the period 1984 to 1987-88 is due to the non-availability of data on variety-wise production/delivery of spun yarn to the decentralised sector during this period. The analysis in this study could not be extended beyond 1996-97 as data available after that year on spun yarn production in the organised sector do not contain separate information on organised and unorganised spinning sectors, while the data on other variables such as spindles installed, capacity utilisation etc. is only available for the organised spinning sector (mills).

The overall objective of this study is to analyse the structural change in the spinning industry under the impact of liberalisation, which started in 1985 and accelerated after 1991. In particular, the objective is to work out the percentage of excess spindles workers used compared to the minimum required at the latest available technology, to produce the given count composition of various fibre spun yarns over time. The excess spindles used could be attributed to idle capacity and capacity and under utilisation of working spindles in addition to the technological gap of working spindles compared to the best available technology. In case of labour force, excess usage of workers at 100 per cent utilisation of spindles is not exclusively caused due to technological gap, as is the case of spindles, but is also caused by inefficient usage of labour force. The indices

of use of spindles and labour compared to the minimum required are used as variables to estimate the Total Factor Productivity (TFP).

Review of Methodology on Measurement of Productivity

In the literature, there exist studies that use partial productivity measures and total factor productivity measures at industry level. Most of the existing studies using the partial productivity measures productivity by the output-input ratio, i.e., the output of yarn is divided by the number of spindles used (ICRA, 1994). These studies ignore the fact that neither the produce nor the spindles are homogenous. In the spinning industry, the spindles are used to produce the yarn of various counts and for each count of yarn the requirement for spindles varies. Similarly, the spindles used are not of the same vintage. Count of yarn tells about the thickness of yarn. The finer the count, the thinner is the yarn.

The total factor productivity growth (TFPG) is the difference between the growth of output and the growth of inputs (suitably weighted). Here the main problem lies in the aggregating of various heterogeneous inputs. Therefore, TFPG is measured by applying the production function using Cobb Douglas, Constant Elasticity of Substitution (CES) or Translog specifications. The production function approach could capture various parameters of technological change such as output elasticity of labour and capital, economies of scale and modernisation. The productivity growth is worked out by time (t) coefficient. In these methods, the dependent variable taken is generally the value of output or value added and independent variables are fixed capital, labour, other inputs and time.

Various studies have tried to measure productivity changes in the textile industry by using the total factor productivity measure. In this study, a different methodology was evolved keeping in mind the objective of the study to determine the excess spindles and labour used than minimum required at latest available technology. This methodology essentially consists of count-composition wise analysis to work out the impact of technological change on productivity of spindles and labour. The change in TFP is estimated by using combined indices of use of spindles and labour compared to the minimum required. The weights for inputs are derived using Kendrick method and the coefficients available from production function analysis undertaken in other studies for the entire cotton textile sector. It was not possible to fit production function directly for the spinning sector due to lack of detailed data for all India on various variables for this sector separately. The spinning sector data on value of output, value added, labour and fixed capital is not separately available, since the spinning data at the NIC three digit and four digit levels are combined with weaving and composite mills data.

Methodology Used

This study makes an attempt to find the technological change and its impact on productivity in the spinning industry by using count-composition analysis. This methodology assumes count-wise constant returns to scale over time but allows for changes in count-composition.

The norms for change in ratio of production per spindle from one count composition to another of same or different variety and Operative work Hours to produce 100 kilogram of spun yarn (HOK) and Operatives per 1000 spindles (OHS) for various counts of different varieties for a given technology are available from SITRA (1993) and other SITRA publications on *Norms for Spinning Mills* and *Norms for Productivity*. The SITRA norms at various count compositions have been evolved by it on the basis of sample survey of various mills over time.

The proper estimations of production per spindle and OHS require a detailed knowledge regarding variety of yarn, fibre composition, count composition, carded combed share, age of spindles and capacity utilisation. These factors are taken into account in detail to arrive at norms for production per spindle and operative hours of workers for a given technology spindles of say 1996. The production per spindles and operative hours of workers at various counts and varieties are applied on the count-wise spun yarn production of different varieties to estimate the norms are used to work out the minimum number of operative hours of work and spindles hours required to spun the yarn being produced over time. This is converted to number of shifts by dividing it by eight assuming eight hours per shift. This is then converted to number of workers and spindles required by dividing it by actual number of days during that year. It tells us the number of minimum workers and spindles required during a year assuming 100 per cent utilisation. This is based on the assumption that workers change during each shift and spindles are of modern technology available during 1996.

This can be expressed in equation form as follows.

Actual production at Count S_i could be produced with fixed amount of factors of production and inputs at given technology =

$$f(K_i L_i M_i) = a_i K_i + b_i L_i + c_i M_i \quad ...(i)$$

The equation (i) means a given count/count composition of specific variety yarn could only be produced with the given amount of fixed capital (say spindles), labour and inputs. This count composition represents a specific point on a given Isoquant or Production Possibility Frontier (PPF). This, however, does not mean that the substitution between various factors of production is not taking place. It is very much taking place to produce the same value added on a given production function. However for that purpose one has to move from one count/count composition to another. The decision about the count composition of various varieties of spun yarn to be produced is taken by the firm management on the basis of cost of factors of production, inputs and prices of various products.

For total production at various count compositions, this could be written as given in equation (ii)

Total Actual Production at

$$\sum_{i=1}^{n} S_i = \sum_{i=1}^{n} a_i K_i^t + \sum_{i=1}^{n} b_i L_i + \sum_{i=1}^{n} c_i M_i$$

Values of ai, bi, and ci can be different for each i. Equations (i) and (ii) do not represent any production function, but various points on production function. Si represents count of yarn.

By using the equation (ii) for the actual count composition of yarn being produced of various varieties, one could work out the minimum number of spindles (capital), labour and inputs required at latest available technology.

The minimum number of spindles and workers required for the yarn, which had been produced over time at 1996 technology, are then compared with the actual number of spindles and workers used respectively over time. The purpose is to estimate the excess spindles and labour force used over time.

The percentage of labour and spindles actually used compared to the minimum required at 100 per cent utilisation are taken as variables to estimate the TFPG. The weights for inputs are derived using the Kendrick method. The coefficients from production function analysis undertaken in other studies for the entire cotton textile sector as a whole are also taken as weights to derive TFP. The coefficients for the entire cotton textiles sector are taken, as data on value added for the spinning sector is not available separately in ASI reports.

Data Source

The data on count range-wise and fibre-wise yarn production and number of spindles installed are available from various issues of the Compendium of Textile Statistics issued by the Office of the Textile Commissioner, GOI, Mumbai and Annual Report of the Ministry of Textiles, The Indian Cotton Mills Federation (ICMF), *Handbook of Statistics on Cotton Textile Industry* and its *Annual Report*. The unpublished data on count rangewise production of various varieties of spun yarn for a few years has been obtained on special request from the respective Office concerned.

The data on gross new spindles added (expansion plus replacement) and working capacity and average hours worked per year are obtained from International Textiles Manufacturing Federation (ITMF), Zurich. Productivity norms for different counts and various fibres are obtained from SITRA publications. SITRA provides the relative productivity for various counts of yarn at a given technology. This has been used to work out the productivity of modern spindles at various counts of yarn made of different fibres. The data within count ranges is used from South Indian Mills Association (SIMA) reports.

The data from regional reports such as SIMA have been used in the absence of published data on all India level for several variables such as carded and combed ratios, count-wise production within count ranges of various varieties etc. These ratios have been used at a detailed disaggregate level. This kind of categorisation was important as there are only a few main counts produced in each count range for each variety. This categorisation could be of great help in reducing the margin of error.

The data for work hours for labour is available from Annual Survey of Industries, factory sector, various issues and unit-wise ASI data for various years.

Count Rangewise Production per Spindle and Norms for Spun Yarn

Bedi, (2004) had undertaken a detailed analysis to find the countwise production within count range of various varities of spun yarn. The countwise norms for production per spindles of 1996 technology along with count composition is used to estimate the count rangewise norms for each varity. Once the count rangewise production per spindle norms for various varieties of spun yarns are worked out, these could be applied on their respective count rangewise production to estimate the minimum requirement of spindles of 1996 technology for each variety of spun yarn. Those are added up

Table 1: Various Reasons for Operating below the Production Frontier

Year	Spindles Equivalent Installed	Spindle Worked (At 100% Utilisation)	Minimum Spindles Equivalent Required of 1996 Technology	Total Excess Spindle	Excess use due to Loss of Working hours	Excess use Due to Technological Gap	Total Spun Yarn	Productivity of Spindles Working Compared to modern
	Mn.	Mn.	Mn.	as percentage of Installed Spindles			Mn. Kgs	%
1	2	3	4	5	6	7 = 5 - 6	8	9 = ((8/3)/(8/4))
1983	23.44	13.33	9.87	57.89	43.2	14.72	1309	74.04
1988	26.61	17.34	12.60	52.65	35.1	17.55	1588	72.66
1989	26.79	17.23	12.71	52.56	35.7	16.83	1652	73.77
1990	26.98	18.16	13.68	49.30	31.3	18.01	1824	75.33
1991	27.76	18.30	13.34	51.95	34.1	17.87	1805	72.90
1992	28.705	17.68	13.74	52.13	38.6	13.55	1895	77.71
1993	28.97	18.24	14.87	48.67	37.0	11.63	2067	81.52
1994	30.17	18.40	14.73	51.18	39.0	12.16	2084	80.05
1995	32.20	19.79	17.08	46.96	38.6	8.42	2379	86.31
1996	32.985	20.31	17.60	46.64	38.6	8.06	2694	86.66

Note: Spindles installed are considered at the end of the year i.e. 31st March. These are Spindles Equivalent. This is worked out using I rotor equal to 5 spindles estimate.

Source: Derived from Compendium of Textile Statistics, Office of the Textile Commissioner, GOI, Mumbai and ITMF data and as derived by the author.

to work out the total number of minimum spindles required of 1996 technology to spin the total yarn being produced.

Comparison of Minimum Spindles Required by 1996 technology with the Actual use of Spindles Over Time

A comparison is then made with the average installed or/ and working spindles for that year to know how much the operating level is below the optimal level possible with the latest available technology during 1996. The ITMF provides data on the average working spindles, rotors and average working hours for Indian spinning sector for a long period of time. The estimates of spindles equivalent installed are worked out by assuming that each rotor is equivalent to 5 spindles. The spindles equivalent installed are then compared with the minimum spindles required at the latest available technology. The analysis has been undertaken over a period of time in Table 1.

The data in Columns 2, 4 and 5 of Table 1 shows that the numbers of installed spindles are more than double for most of the years than the minimum required at modern technology (latest available during 1996) and at 100 per cent utilisation.

The main cause of operating below the optimum level could be attributed to low utilisation of installed spindles and technological gap.

Low Utilisation

During March 1997, 9.39 million spindles were lying idle (ITMF data). Moreover, the working spindles are also not utilised at 100 per cent optimum level trhoughout the year. The underutilisation due to idle spindles and underutilsation of working spindles is added and compared with optimum utilisation level at 100 per cent. This explain the low production per spindles due to low utilisation of installed spindles.

Technological gap

After correcting for under-utilisation, the production per spindles at 100 per cent utilisation could be worked out. The production per working spindles at 100 per utilisation however is not comparable to the production of latest available technology spindle for a given count composition due to old machinery (age composition of machinery) or technological gap.

The analysis in Table 1 demonstrates that 28.48 per cent of excess capacity is explained due to existence of idle spindles and 10.10 per cent due to low average working hours of the total installed spindles. This adds up to 38.58 per cent of the idle capacity out of total

46.37 per cent excess capacity used as percentage of installed spindles. The remaining 8.06 per cent of excess spindles used as percentage of installed spindles could be explained by technological gap.

Table 2: Productivity Growth of Working Spindles during Various periods (percentage per annum)

Period	1983-90	1988-96	1990-96	1983-96
Gr Rt	0.09	2.38	2.85	1.41
R2	0.44	0.88	0.87	0.60
t statistics	0.30	7.11	5.67	3.84

Note: Productivity Growth Rates are worked out using semi log equation.

Log Y = a + b time. Here Y is values given in Column 9 of Table 1. Thus Growth rate is b.

Source: Derived by the author.

The ratio of total working spindles at 100 per cent utilsition to the minimum number of spindles required of latest technology to spin the yarn being produced tells the relative productivity of modern spindles to working spindles. The inverse of this over time explains the rise in productivity of working spindles due to technological improvement. The productivity of working spindles compared to modern improved from 74.04 per cent in 1990 to 86.66 per cent in 1996. This tells us that the gap between the actual and optimum achievable frontier is declining over time due to technological improvement (Table 1).

The growth in productivity is estimated to be 1.41 per cent per annum during the period 1983 to 1996. The growth in productivity was lower at 0.09 per cent per annum during the first phase of reforms 1983 to 1990. The growth was high at 2.85 per cent per annum during the second phase of reforms 1990 to 1996 (Table 2).

Minimum Number of Workers required to Spun Yarn being Produced Over Time

The minimum number of workers at 1996 technology are worked out from the count-wise spun yarn production in the same way as was done for working out the minimum spindles required. The SITRA, (1993) norms for Operative Hours to produce 100 kilogram of spun yarn (HOK) are available for shifting from one count composition of a particular variety to another count composition of different variety. SITRA also provide Operatives per 1000 spindles (OHS). The Operative Hours labour required to produce balance production of 1000 spindles for various counts of spun yarn for the 40s are 24.95 for 1996 technologyis also given in SITRA studies as HOK (Hours per 100 kilograms of yarn) and OHS (Operatives per 1000 spindles). These along with Norms for various counts are used to estimate the HOK for the counts being spun of various varieties of fibers. These are applied on the countwise spun yarn production to estimate the norms are used to work out the minimum number of operative hours of work required to produce the spun yarn being produced over time. This

Table 3: Various Reasons for Operating below the Production Frontier

Year	Actual Workers Mn.	Minimum Workers Workers Required Mn.	Excess as % Minimum	Excess After taking out Idle Spindles %	Excess After taking out Idle & Low Utilisation Spindles %	Excess After taking out idle
1	2	3	4 = (2-3) * 100/2	5 = 4 – Idle %	6 = 5 – Low Utilisation % in Working Mills	7 = 6 – Productivity Difference due to Technological Gap
1983	483554	35557	92.65	63.97	49.46	34.74
1988	390666	44232	88.68	67.86	53.58	36.03
1989	434354	45488	89.53	67.62	53.81	36.98
1990	446021	49713	88.85	72.25	57.57	39.56
1991	432716	48997	88.68	68.69	54.60	36.73
1992	440749	51224	88.38	62.01	49.78	36.23
1993	448780	55547	87.62	63.08	50.58	38.95
1994	435157	55701	87.20	59.06	48.19	36.03
1995	478249	63198	86.79	58.2	48.23	39.81
1996	466052	69538	85.08	56.6	46.49	38.43
1997	456090	76230	83.29			

Source: Derived from Compendium of Textile Statistics, Office of the Textile Commissioner, GOI, Mumbai and ITMF data and ASI, CSO data.

is converted to number of shifts by dividing it by eight assuming eight hours per shift. This is then converted to number of workers required by diving it by number of days in a year. It tells us the number of minimum workers required during a year assuming 100 per cent utilisation (Column 3 of Table 3) and is based on the assumption that workers change during each shift.

This data is then compared to the actual number of workers used in this industry. The data in Table 3 shows that a very high percentage of workers are used in excess than minimum required at 1996 technology. The percentage excess uses of workers than minimum required at 1996 technology is much higher compared to similar ratio for spindles (Columns 4 and 7 of Table 3). This is surprising as the technological progress taken place in spinning sector as is clear from the SITRA norms over time is of hicks neutral type. The SITRA norms for converting production or labour requirement from one count composition to another remained unchanged over time.

Thus this excess use of labour force is, however, not exclusively caused due to technical reasons such as low utilisation of machinery or technological gap, but also covers a part of inefficient use of labour force. This excess use of labour force given in column 7 of Table 3 is attributed to the followings reasons.

I. Some percentage of labour force is required for purposes other than merely for production process,

II. There is some percentage of excess use of labour force due to inefficiency of workers, inflexibility caused such as labour law constrains.

Total Factor Productivity in Spinning Sector

The changes in weighted use of spindles, labour and inputs as percentage of their respective minimum requirement could be used to work out the Total Factor Productivity (TFP) index. The excess use of labour, capital and raw material than minimum required over time is worked for the following two scenarios:

A. The total use of labour and capital employed in total mills is compared with minimum required in Scenario 'A'.

B. The actual amount of labour and capital in working mills is compared with minimum required and is taken as Scenario 'B'.

Kendrick method is used to derive weights for factor inputs to work out Kendrick Index for TFP in Indian spinning sector in this study. The coefficients taken for labour, spindles and input are worked out on the basis of their respective share and coefficient derived using production function approach. The three types of equations are used for the purpose:

a. Kendrick Method Using Coefficients for Labour and Spindles equal to their respective Shares: Labour weight taken is share of wages and provident fund and Capital weight taken is share of profit, interest, depreciation, rent etc in sum total of above two i.e in wages, provident fund profit, interest, depreciation and rent.

TFP-I = 100 X ((0.8205 × 100) + (0.1795 × 100))/

((0.8205 X Index of Actual Used K as percentage of Minimum Required) X

(0.1795 X Index of Actual Used L as percentage of Minimum Required labour)) ...(iii)

b. Kendrick Method Using Coefficients for Labour and Spindles derived from Cobb-Duglas Production Function: Mitra used Cobb-Duglas production function in the double log form for the period 1976-77 to 1992-93 for varibales capital and labour. For cotton textiles (NIC'1987 Code 23) industry, the coefficients derived are 0.776 for Labour and 0.248 for Capital and technological progress is estimated to have grown by 0.12 per cent per annum in cotton textile industry. These coefficients are applied on variables for labour and capital (derived in this study) in equation (iii) to arrive at TFP.

c. Kendrick Method using Labour, Spindles and Input coefficients derived from Translog Production Function: Cobb-Douglas production function estimate coefficients with very rigid theoretically assumptions such as constant returns to scale etc. The relaxation of these assumptions could lead to biased estimates and hence the Translog production function should be used for flexible assumptions. The problem however is that the input data is not available for the purpose. The input required per unit of output produced over time is taken constant and hence Index for inputs is taken at 100 over time both in the numerator and denominator.

TFP- II = 100 × ((0.3635 × 100) + (0.0795 × 100) + (0.557 × 100)) /

((0.3635 × Index of Actual used K as % of Minimum) + (0.0795 × Index of Actual

used L as % of Minimum) + (0.557*100)) ...(iv)

The indices for all variables in the numerator is

Table 4: Coefficients Derived by Srivastva using Translog Production Functions for Spinning weaving and Finishing of Textiles (NIC 1998 Industry Code 17)

Estimator	Ak	Al	Ar	R2	Observations	Firms
OLS	0.095 (11.76)	0.047(5.84)	0.892 (77.25)	0.93	4924	
FE	0.047(4.64)	0.350(23.62)	0.717 (56.39)	0.91	4924	463

OLS is ordinary least square and FE is Fixed Effect.

Note: A is constant; Ak is coefficient of capital, Al coefficient of labour and Ar coefficient of raw material.

Note: values in parenthesis reveal t statistics.

Source: Srivastva, 2000.

Table 5: Total Factor Productivity Estimates based on Excess use of Factors of Production Compared to Installed (Scenario 'A')

		Index Spindles	Index labour	Linear Production Function	Mitra Cobb-Douglas	Srivastava Translog OLS	Srivastava Translog FE
		Percentage per annum growth Rate in TFP using Semi-log equation					
A	1983-96	-1.62	-4.65	3.12	3.9	2.6	2.3
B	1983-96	-2.01	-5.05	3.52	4.8	2.6	2.7
A	1990-96	-1.32	-4.57	2.84	3.2	2.1	1.8
B	1990-96	-3.87	-7.12	5.39	5.7	2.8	3.2

Source: As derived by the author using Coefficients from Other Studies and index of Variables Derived in this study.

taken as 100 representing the minimum amount of resources required to produce per unit of quantity at given technology say 1996.

The coefficient in equation iv are used from Srivastava, (2000) study. Srivastava used panel data set of Public Limited Companies and covers the period 1980-81 to 1996-97. The independent variables taken for all these production functions are Capital (Ak), Spindles (Al) and Raw Materail (Ar) and dependent variable taken is Output. These relaxations could lead to biased estimates.

The TFP improved during both the periods 1983-90 and 1990-96 as shown in Table 5 using all the methodology. The lowest growth is reported by methodology using Translog production function as it also takes into account raw material usage for which no improvement in efficiency is assumed. The comparison of Scenario 'A' and Scenario 'B' indicate that the improvement in resources use was taken place at higher rate in working mills compared to total mills (Table 5).

Summing Up

The productivity of working spindles grew at a rate of 2.38 per cent per annum at 100 per cent utilisation during the period 1988 to 1996. The growth in productivity was higher during the period 1990 to 1996 at 2.85 per cent per annum. This analysis has been undertaken by working out the excess use of working spindles at 100 per cent utilisation compared to the minimum requird at modern technology. Similar analysis is undertaken for working out the excess use of workers compared to the minimum required at 1996 technology. The percentage excess uses of workers than minimum required at 1996 technology of actually used workers is much higher compared to similar ratio for spindles. These changes in excess spindles and labour are used to work out the TFP index. The TFP improved during both the periods 1983-90 and 1990-96.

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To have a very difficult illness does not necessarily mean the end of life. It simply means that this is a break or a pause, the beginning of a new step and the end of a current phase. It is simply one break in a longer life.

– Ken Watanabe

Feature

Aspects of Productivity Growth in the Indian Cement Industry

Sima Banerjee & Soumyendra Kishore Datta

The production performance of the Indian cement industry underwent severe undulations in the liberalised regime. The partial decontrol of the industry in 1982 provided impetus to the overall productivity scenario in the 1980s. However, since the full decontrol around 1989, the productivity growth scenario in the industry was rather depressing in nature, due to a recession in the initial years, together with inefficient capital use, difficulty in adopting improved technology, underutilized capacity and inefficient management. A renewed appraisal of the extent of decontrol, together with appropriate technology and management efficiency is urgently called for to resuscitate the productivity performance of the industry.

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The cement industry has an important role in the infrastructural development of the Indian economy. In India, the industry made its first appearance at Washermanpet in Madras in 1904. The industry began showing signs of growth during the period 1924-41. Domestic production was growing with severe competition amongst producers, depressing prices and profitability.

It was at this juncture that several cement companies came together to create a common identity under the Associated Cement Company (ACC). The cement industry had been under a regime of price and distribution control since the Second World War. After the war, the controls were continued in one form or the other till the industry was partially decontrolled in 1982. In 1982, with the declaration of partial decontrol, controls in price and distribution as well as the licensing of new cement units were relaxed. Since February, 1989, both price and distribution controls in the cement industry have been fully relaxed. By 1979 India was the eighth largest in the production of cement in the world. By 2006 India became the world's second largest cement producing country after China.

The industry has to its credit eight varieties of cement produced in India. They are Portland Cement, Blust Furnace Slag cement (BFS), Portland Pozzolana cement (PPC), grey cement, hydrophobic cement, oil-well cement (OWC), rapid hardening cement (RHC) and white cement (WC). The most commonly used varieties are Portland, grey, PPC and BFS cements. The choice of process technology is an important determinant of the productivity of a plant of given capacity. Two basic processes exist for cement manufacture: the wet process, a relatively older technology, in which the raw material is fed into the kiln in a slurry form, and the dry process a relatively newer technology, in which the raw material feed is dry. The dry process is clearly more efficient in the use of heat. The difference in kiln productivity is significant; it implies that a dry process plant can

install a kiln that is one-third to two-fifths the size of the kiln in a wet process plant of equal capacity, thus saving on capital costs.

The cement industry in India today is one of the oldest and largest industries employing a large proportion of people engaged in the organized manufacturing sector. In view of its nationwide importance, it is desired to delve deep into the performance trend of this industry in terms of some productivity measures, be it partial or total; for it is usually perceived that increased productivity reflective of functional efficiency of an industrial enterprise is conducive to saving resources and generating investible surplus that contributes to furthering the health of the industry. Alongside this, it is also felt imperative to study whether and to what extent changes in productivity are reflected in the corresponding economic betterment of the employees in the industry.

Trend and outcome in labour productivity, per capita emoluments and their relationship in the cement industry

The period of study is 1980-2003 and the relevant data has been collected from the Annual Survey of Industries and Reserve Bank of India Bulletin. For the purpose of study the data relating to total employees, gross value added (G.V.A), total emoluments, value of output etc. are collected from different issues of A.S.I. Since the data are expressed in current prices, a meaningful analysis calls for translating these figures in terms of some singular base year prices to allow for correction of any possible inter-temporal price changes. For this purpose the index number of wholesale prices for the industry with different base periods were collected from the RBI Bulletin. But since these indices are related to different base years, the method of base shifting has been applied in order to make the index of 1980-81 to 100 and prices for other years were changed accordingly. The figures expressed in current prices are henceforth deflated by the corresponding year's index number in order to relate them to the common base 1980-81. Figures thus derived yield themselves to easy and meaningful comparison.

From Table 1 we find a picture of the indices of labour productivity and per capita emoluments in the cement industry.

It is prominent that the index of labour productivity has increased from 94.17 in 1981-82 to 707.85 in 2001-02. The rising trend is not a uniform one; it experiences several ups and downs during the intermediate years. The index shows a fall in 1981-82 compared to the previous year and then rises for the three succeeding years. After that it revealed a more or less rising trend up to 1991-92. The undulation in the series are rather sharp after that. For the two years 1996-97, 1999-00 the indices have reached a very high level corresponding to the immediate preceding year. These uneven movements are caused by several relevant factors. The sudden decline of GVA/employee in 1985-86 and 1992-93 whereas a sudden rise in 1996-97 and 1999-00 corresponding to the respective preceding years can be attributed to the opposite movement of a different set of relevant factors. Although there was a small increase in G.V.A in 1985-86 over that of 1984-85, the price index for cement production increased substantially, resulting in a lowering of the real value of G.V.A figures in 1985-86. This was accompanied by a sharp rise in the labour

Table 1: Labour productivity and Per Capita Emoluments in the Cement Industry (in Rs)

Years	Gross value added per employee (at constant price)	Index	Per capita emoluments (at constant price)	Index
1980-81	24090.90	100.00	10341.97	100.00
1981-82	22686.90	94.17	9940.91	96.12
1982-83	40675.65	168.84	10866.43	105.07
1983-84	42347.97	175.78	11440.91	110.62
1984-85	47432.11	196.89	12425.72	120.15
1985-86	46708.70	193.88	12203.43	118.00
1986-87	41590.36	172.64	12167.28	117.65
1987-88	58767.85	243.94	11626.59	112.42
1988-89	67342.16	279.53	11493.87	111.13
1989-90	72956.68	302.84	11656.86	112.71
1990-91	102445.98	425.25	11910.20	115.16
1991-92	118401.09	491.48	12789.00	123.66
1992-93	79411.61	329.63	12688.16	122.68
1993-94	69150.19	287.03	13046.49	126.15
1994-95	82089.64	340.75	13311.18	128.71
1995-96	110171.19	457.31	13255.65	128.17
1996-97	142632.18	592.06	15885.05	153.59
1997-98	117873.80	489.29	14646.25	141.62
1998-99	126500.50	525.09	18352.42	177.45
1999-00	173343.14	719.54	19900.88	192.43
2000-01	169259.22	702.58	20568.28	198.88
2001-02	170528.75	707.85	19258.73	186.22
2002-03	148410.11	616.04	16670.75	161.19

Source: Compiled from Annual Survey of Industries (Various Issues)

employment resulting from labour capital substitution consequent to sharp rise in machinery price indices. As a result G.V.A per employee index fell to some extent in 1985-86 from its previous year. But the downward movement in 1986-87 is more prominent than that in 1985-86, which came about due to some different reasons. During 1986-87 the G.V.A decreased nearly to its 1984-85 level. At the same time labour employment surpassed the 1985-86 level due to a continuous rise in machinery price index. These factors together resulted in a further fall in per capita G.V.A. Then started the upward trend in G.V.A per employee which continued up to 1991-92. Again during 1992-93 there was a considerable fall in G.V.A per employee index resulting from a substantial rise in labour employment. The immediate following year corresponded to a further fall in G.V.A along with a slightly lower labour force resulting in an even further reduced per capita G.V.A index.

Both the years 1996-97 and 1999-00 corresponded to a substantial rise in G.V.A along with a more or less stable employment condition. The downward fluctuation of the G.V.A series in some of the intermediate years can be traced to the underutilization of capacity, input supply bottlenecks, market fluctuation etc. However the positive up-trend is evident from the trend coefficient when we seek to fit a semi log linear trend of the form $\log Y = a + bt$ to the indices of G.V.A per employee series, where Y = indices of labour productivity, a = constant, b = trend rate of growth.

For the series of labour productivity indices the growth rate is nearly 8.45% and the corresponding t = 13.039 which is significant. It is important to notice that the trend rate of growth is positive despite undulations in the intermediate years. Now it is desirable to note whether this rise in labour productivity tends to be associated with the changing real economic gain of the employed masses. Total emoluments of the employees is considered as the indicator of economic gains.

"Emoluments are defined in the same way as wages but paid to all employees plus imputed value of benefits in kind i.e. the net cost to the employees on those goods and services provided to employees free of charge or at markedly reduced cost which are clearly and primarily of benefit to the employees" (A.S.I). The emolument figures are collected from the Annual Survey of Industries (various issues) and then deflated by the respective year's consumer price index number of industrial workers in order to convert them to figures representative of real economic benefits.

The per capita emolument indices also display an increasing trend over the period 1980-81 to 2002-03 with sharp fluctuation during the span of years 1985-86 to 1991-92 and thereafter revealing a moderately steady rising trend. The correlation coefficient between per capita emolument and labour productivity comes out to be 0.91 and is significant (t_{22} = 10.06). It suggests that employees in the cement industry are paid satisfactory amounts commensurate with changes in their productivity to motivate them to sustain higher productivity.

Labour Productivity as Explained by Per Capita Emoluments and Capital Intensity

Labour productivity in a great sense depends on the amount of fixed capital used by the industry over time. So the relation between these two deserves attention. Capital is measured by considering only the value of fixed capital (working capital being left out) at constant prices. These figures are divided by the number of employees to obtain the figures of capital intensity. Like the labour emoluments, it is also surmised that capital availability per unit of labour will have influence on the changes of labour productivity. Hence it is considered

Table 2: Capital Intensity in Cement Industry (in Rs)

Year	Capital Intensity	Index
1980-81	73122.60	100.00
1981-82	84832.63	116.01
1982-83	97624.07	133.51
1983-84	129688.08	177.36
1984-85	124454.27	170.20
1985-86	167523.30	229.10
1986-87	207281.45	283.47
1987-88	228219.97	312.10
1988-89	238601.05	326.30
1989-90	219784.45	300.57
1990-91	226590.43	309.88
1991-92	207102.21	283.22
1992-93	198974.38	272.11
1993-94	249364.92	341.02
1994-95	256770.94	351.15
1995-96	258223.00	353.14
1996-97	346315.84	473.61
1997-98	398517.88	545.00
1998-99	704833.10	963.90
1999-00	711928.46	973.61
2000-01	536985.98	734.36
2001-02	739152.18	1010.84
2002-03	583005.57	797.30

Source: Compiled from Annual Survey of Industries (Various Issues)

appropriate to fit a multiple regression equation of labour productivity on per capita emoluments and capital intensity of the form: $X_1 = a + b_{12.3} X_2 + b_{13.2} X_3$ where X_1 = Gross value added per employee, X_2 = per capita emoluments, X_3 = Capital intensity. Capital intensity indices at constant prices for the cement industry are provided in Table 2.

Results of Fit of the Multiple Regression

A	$b_{12.3}$	$b_{13.2}$	$t_{b12.3}$	$t_{b13.2}$	R^2	F
-70512.9	10.477	0.0552	2.472	0.879	0.831	49.163
			Signi-ficant	Insigni-ficant		Signi-ficant

The above regression appears to be good fit as suggested by the value of $R^2 = 0.831$and significant F value.

Table 3: Partial Productivity and Capital Intensity (Indices)

Years	Gross value added per employee	Gross fixed capital per employee	Ratio of gross value added to gross fixed capital
1980-81	100.00	100.00	100.00
1981-82	94.17	116.01	81.17
1982-83	168.84	133.51	126.47
1983-84	175.78	177.36	99.11
1984-85	196.89	170.2	115.68
1985-86	193.88	229.1	84.63
1986-87	172.64	283.47	60.90
1987-88	234.94	312.1	78.16
1988-89	279.53	326.3	85.67
1889-90	302.84	300.57	100.75
1990-91	425.25	309.88	137.11
1991-92	491.48	283.22	188.18
1992-93	329.63	272.11	121.14
1993-94	287.03	341.02	84.17
1994-95	340.75	351.15	97.04
1995-96	457.31	353.14	129.50
1996-97	592.06	473.61	151.30
1997-98	489.29	545.00	89.78
1998-99	525.09	963.90	54.40
1999-00	719.54	973.61	73.90
2000-01	702.58	734.36	95.67
2001-02	707.85	1010.84	78.34
2002-03	616.04	797.30	77.27

Source: Compiled from Annual Survey of Industries (various issues)

About 83% of the variation in labour productivity is explained by per capita emoluments and capital intensity taken together. The remaining 17 per cent of the variation in labour productivity is possibly due to the impact of factors like size of the establishment, rate of growth of industry, trade union's impact, capacity utilisation in cement industry etc., which are left unaccounted for in the regression. The regression coefficients also suggest that per capital emoluments have a greater impact on changes in labour productivity than that of capital intensity. From the corresponding t-test it is observed that changes in per capita emolument did have a significant positive impact on influencing the labour productivity ratio, thus reflecting the efficacy of the economic well-being of the employees on commensurate skill formation and productive efficiency.

But the regression coefficient of capital intensity changes have rather a smaller impact on change in labour productivity which is firmly supported by the corresponding insignificant t-value. Hence it also seems imperative to compare the figure of labour productivity with those of capital intensity as well as capital productivity to reach some broader conclusions regarding functional efficiency of the cement industry. For this purpose we provide in Table 3 the indices of capital intensity, labour productivity, and capital productivity, the latter being measured on division of G.V.A by gross fixed capital at constant prices. The trend rates of growth were found by fitting semi log-linear trend equations to these three indices as given in Table 4.

Table 4: Time Trend of Indices

Series	Trend Coefficient	t-values	R^2	F
Labour productivity	0.0845	13.039 (0.000)	0.890	170.023 (0.000)
Capital intensity	0.0931	13.555 (0.000)	0.897	183.742 (0.000)
Capital productivity	-0.0064	-0.700 (0.492)	0.023	0.489 (0.492)

Table 4 reveals that capital intensity indices have risen significantly at the rate of 9.31 per cent. The series shows a more or less rising trend except for a few small intermediate breaks. There was a sharp rise in capital intensity during 1980-81 to 1988-89 due to sharp rise in the value of gross fixed capital (at current prices) in each consecutive year compared to the low rates of increase in both the value of employment and machinery price indices. The declining trend from 1989-90 to 1992-93 can be attributed to sharp rise in both employment and price indices of machinery despite a rise in the value of gross fixed capital. From 1993-94 onwards there was a consistently rising trend. The

capital intensity index was found to be remarkably high in 2001-02 because of a sudden rise in gross fixed capital in absolute terms compared to its preceding year, coupled with a low rate of change in employment and price index of machinery.

On the whole the capital intensity index series had increased about 6.97 times during the span of 23 years. This result is caused by two reasons. Firstly up to 1990-91 the absolute value of gross fixed capital had gone up at a rate of more than that of the increase in the rate of employment. Secondly from 1997-98 a declining trend is noticed in case of employment. So a gradual tendency towards substitution of labour by capital has set into the industry indicating a move towards some sort of modernisation. This relative capital deepening is an indication of upgradation of the technology adopted into the industry. But mere addition to capital and adoption of higher technology does not guarantee a corresponding efficient use of the capital base. Difficulties in adoption and inefficient use of the advanced technology as well as underutilisation of full productive capacity can adversely affect the productivity of capital in the industry, if not properly addressed in time. In this context it seems pertinent to consider the nature of capital that has combined with the labour and the direction of movement of capital productivity figures which are likely to be intertwined in shaping the overall factor for productivity in the industry.

Trend in Capital Productivity in the cement industry

When we focus attention on the movement of capital productivity, it reveals more or less a falling trend. From the very beginning the value of gross fixed capital at a constant price surpassed the gross value added at a constant price in most of the considered years, giving rise to an even lower value of capital productivity. After a long period of sharp undulation starting from 1997-98, the value of capital productivity index remained below 100. One may argue that the downtrend in capital productivity indicates diminishing marginal productivity of capital accompanied by increasing stock of gross fixed capital. But the diminishing marginal productivity theory is applicable when one factor is made variable and others are kept fixed. It is observed that corresponding to an increase in the absolute value of capital, the number of employees also increased. Thus what we notice here is not the movement of absolute value of capital only, but the movement relative to labour and possibly other factors of production. However, since we have explicitly focused attention only on labour, we here put attention on the movement of capital labour ratio and on the basis of the previous logic argue that capital productivity need not necessarily have fallen as a result of relative capital deepening.

So the reasons for decline in capital productivity in the last part of the 90s should be traced to some factors other than the theory of diminishing marginal productivity. Empirical investigation in some cases revealed that despite installations of newer machinery, there has often been a neglect of productivity and maintenance standard as well as improper utilization of capital which contributed in a large way towards such decline. Again renovation programme in some cases of obsolescence of fixed capital was not properly carried out. In terms of the relative performance of different types of firms within the cement industry, the big, new firms, as a group, appear to have out performed the big, old firms and the Minis. The newer ones are technologically more superior to the older ones. The big, old firms were prevented from retiring their older and more inefficient plants by exit restrictions. They were compelled to upgrade and modernize their existing plants and not to adopt advanced technologies as the big, new firms did. So the exit barriers faced by the big, old firms put them at a disadvantage compared to the big, new firms. Side by side, excepting a few, the Minis as a group were the worst performers in the industry with respect to the adoption of advanced machinery. Even they were unable to take advantage of the technology exclusively devised for them and offered through government promoted research institutions. These untoward conditions stifled the productive potential of capital that might otherwise have occurred through even scaled adoption of higher technology in all types of firms.

So on the basis of the judgment of the movement of capital productivities, we see that there need not be any sound reason for complacency which arises at the first glance of labour productivity series only. However, the partial productivity indices do hardly reflect the overall intrinsic efficiency with which the most relevant factors are combined together in the production process. Thus if we are interested in labour productivity, we often observe that there had been concurrent changes in the level of capital, percentage of its productive potential, level of technical knowledge etc. which play no less powerful a role in shaping labour productivity than the intrinsic efficiency of labour only. So it is imperative that we take into account the most relevant factors that matter, while trying to obtain a combined factor productivity series.

For the sake of simplicity of analysis we consider here only two major factors, labour and capital for which the relevant data are not difficult to obtain as it is for the others.

Trend in Total Factor Productivity in the Cement Industry

Two alternative measures of total factor productivity viz. Kendrick and Translog indices, with base year 1980-81, have been analysed for the All-India Cement Industry's performance. The Kendrick index of total factor productivity is written as:

$$A_t = Y_t / (w_0 L_t + r_0 K_t)$$

where Y_t, L_t, and K_t, refer to gross value added, number of employees and gross fixed capital at period t (expressed in base year prices) respectively while w_0 and r_0 denote the base year rewards of labour and capital respectively. Under the assumption of constant return to scale and perfect competition, A_0 is made equal to unity. Translog index of total factor productivity is expressed by the relation $A_{t+1} = A_t \exp(m_{t+1})$, where m_{t+1} is the exponential growth rate of total factor productivity between years t+1 and t. For the base year, A_t is by definition made equal to one and written as $A_0 = 1$. The most striking feature of these indices of total factor productivity is their close correspondence. The peaks and troughs synchronize virtually in all cases. Even in terms of levels, the Translog and Kendrick indices vary in closeness with each other as is evident from Table 5.

Table 5: Total Factor Productivity in the Cement Industry (indices)

Year	Kendrick	Translog
1980-81	100	100
1981-82	76.71	86.49
1982-83	149.9	141.17
1983-84	137	132.95
1984-85	160.77	138.38
1985-86	135.64	132.95
1986-87	120.3	101.49
1987-88	148.41	134.29
1988-89	151.41	141.17
1989-90	172.43	145.47
1990-91	169.02	192.48
1991-92	147.23	162.43
1992-93	247.15	184.93
1993-94	164.02	148.41
1994-95	181.27	164.02
1995-96	221.41	208.51
1996-97	284.29	225.88
1997-98	165.67	149.9
1998-99	139.77	134.29
1999-00	186.79	172.43
2000-01	376.15	314.19
2001-02	148.41	145.47
2002-03	137	123.97

Source: Compiled from Annual Survey of Industries (various issues)

There is found to be a close correspondence between these two indices as revealed by rather significantly high correlation coefficient (r = 0.85). The semi log linear trend growth coefficient appears to be 0.027 for Kendrick and 0.023 for Translog indices. It is remarkable to note that the TFP indices tally far more sympathetically with the derived positive growth trend of labour productivity indices. Like that of labour productivity indices TFP (in either index) series displayed sharp fluctuations over the considered period. The close resemblance between two different series suggests that improvement in factor productivity can largely be attributed to an increment in labour productivity. Growth in labour productivity in cement industry has outweighed the fall in capital productivity and prevailed over to promote the combined factor efficiency. Since overall efficiency is judged by total factor productivity, it is also considered pertinent to compare the total productivity performance of the states during the decontrolled regime.

Intertemporal and State-wise Variations in Total Factor Productivity

In this section an analysis has been made of the inter-temporal comparisons of total factor productivity growth rate in the cement manufacturing sector for 15 major states of India during the period 1980-2003. Again an attempt is also made to assess the impact of industrial liberalisation and policies in the decontrolled regime on productivity growth in terms of the variations in total factor productivity growth rates during two distinct sub-periods. Following the procedure adopted by Dutt (1993) and Kaplinsky (1997), the whole study period has been divided into two distinct sub-periods:-

(i) Mild-liberalisation period 1980-81 to 1990-91 and

(ii) Intensive-liberalisation period (1991-92 to 2002-03)

The TFP growth rates of cement industry (based on Translog indices) for the individual states and for India as a whole covering the period 1980-81 to 2002-03 have been estimated from the semi-log equation:

$$\log TFP = \alpha + \beta t + \varphi$$

where TFP represents the measure of total factor productivity, t represents the time.

Using a linear spline function developed by Poirier (1974) the effect of industrial liberalization and deregulatory policies has been computed for the two sub-periods.

For the two sub-periods, two equations of the following forms are formulated:

Sub-period 1:

$$\log TFP = \alpha_1 + \beta_1 t + \varphi_1 \text{ when } t < t_1$$

Sub-period 2:

$$\log TFP = \alpha_2 + \beta_2 t + \varphi_2 \text{ when } t_1 \leq t < t_2$$

where t_1 and t_2 are the points of structural breaks. In order to tackle the discontinuities in the sub-period wise growth rates, the linear spline function is reformulated as:

$$\log TFP = +_1 w_{1t} + {}_2 w_{2t} + C$$

where

$$w_{1t} = t$$

$$w_{2t} = 0 \text{ if } t < t_1$$

$$= t - t_1 \text{ if } t_1 \leq t$$

The growth rate for the i^{th} sub-period can be derived by [exp [exp $(\gamma_i) - 1$] and γ_{is} are obtained as:

$$\gamma_1 = \delta_1$$

$$\gamma_2 = \delta_1 + \delta_2$$

Before the 1980s the industry experienced lower productivity perhaps due to Government protection regarding prices and distribution, constraints in smooth plant operation and input supply bottlenecks. During the mild-liberalization period states like AP, ASS, KER, OR & UP still continued to show declining TFP per annum. All the other states experienced a positive growth. States like BI, HP, KAR, MP, MAH and TN had an average annual growth of TFP above the national level. This sudden upsurge in productivity growth in majority of the states is attributable to partial decontrol of cement sector in 1982.

In the states of AP, ASS, KER and UP the process of intensive-liberalization brought a U-turn in TFP growth behaviour in 1990s as reflected by positive growth of TFP contrary to a negative rate during the mild-liberalization period. Other states like BI, GU, HAR, KAR, MP, MAH, RAJ, TN, OR, and WB experienced a negative growth of TFP during the second phase of liberalization. The downturn in majority of the states synchronized with overall economic recession engulfing the economy.

Table 6: Average Annual Growth Rates of Total Factor Productivity in Indian Cement Industry

State	Mild-Liberalization Period (1980-91)	Intensive-Liberation Period (1991-03)	1980-03
All-India	0.062	-0.069	0.023
AP	-0.024	0.101	0.044
ASS	-0.233	0.288	0.028
BI	0.102	-0.030	0.025
GU	0.041	-0.015	0.009
HAR	0.052	-0.311	-0.186
HP	0.126	0.008	0.056
KAR	0.284	-0.020	0.097
KER	-0.035	0.056	0.015
MP	0.102	-0.022	0.029
MAH	0.236	-0.038	0.070
OR	-0.064	-0.293	-0.225
RAJ	0.025	-0.083	-0.038
TN	0.150	-0.033	0.042
UP	-0.006	0.048	0.024
WB	0.020	-0.083	-0.040

Considering the entire period, it is observed that barring the states HAR, OR, RAJ & WB all the other considered states experienced slow but positive TFP growth pattern during the period 1980-03. In brief, the results point out that the more recent phase of reforms which aimed at bringing more industrial development through transformation of India's economic policies by paying full attention to liberalisation and globalisation, has failed to yield a consistent acceleration in TFP of Indian cement industry at aggregate and state levels.

Conclusion

In this study an attempt has been made to analyse the temporal variations in partial productivity ratios in the Indian cement industry, while overall efficiency issues in production is taken care of by considering both temporal and spatial variations in total factor productivity series. The deregulatory policies imparted a pervasive positive effect on the TFP growth of Indian cement industry both at aggregated and disaggregated levels during the 1980s. The government policy of

balanced regional development thus significantly improved the productive efficiency of the cement industry in some of the industrially lagging states, especially during the mild-liberalisation period. But the intensive liberalisation period revealed that opening up of doors for multinationals and direct foreign investment could not continue the tempo of the TFP growth of the cement industry both at national as well as at the state levels. The number of states that experienced a negative growth in TFP during the intensive-liberalisation stood at ten as against five in the mild-liberalisation phase. Due to abrogation of freight equalisation, there emerged widening disparity in the price of cement across regions resulting from sharp variations in input costs with different rates of sales tax and transportation expenses. The discrepancy in regional prices had varying degree of spatial impact on the productivity and efficiency performance across the states. Besides this, under-utilization of capacity, an increasing concentration of productive potential in a few states, uncertainties in demand prospects in a highly volatile globalised scenario and poor adaptability of improved machinery explain poor total productivity performance of the industry in the intensive liberalization phase. The entire period 1980-2003 was marked by the phenomenon of capital deepening and growing capital inefficiency in the Indian cement industry.

However, during this period, rising labour productivity outweighed the impact of falling capital productivity and exerted a mild upward thrust on the overall factor productivity performance. But overall the industry failed to optimize in terms of productivity performance across the states and the expected ends of decontrol were not in agreement with decreasing returns associated with intensive capital and technology dimensions in the industry and improper capacity utilization. The extent of allowable decontrol therefore needs to be carefully reassessed together with injection of appropriate technology and management efficiency befitting with changing supply and demand vectors in a globalised scenario.

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If you are going to achieve excellence in big things, you develop the habit in little matters. Excellence is not an exception, it is a prevailing attitude.

– Colin Powell

Feature

Modeling and Simulation of Outbound Logistics of Supply Chain: A Case Study of Telephone Company

Arvind Jayant & Subhash Wadhwa

In this paper, the major problems faced by a telephone company at upper end of supply chain and sales outlets are analysed and a complete inventory analysis on one product is done by developing an inventory model for the company bound store/distribution center. Optimal inventory policy is also suggested for outbound logistics on the basis of simulation analysis. This model developed on Microsoft excel is flexible enough to respond to the market fluctuations more efficiently and effectively.

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The basis of global competition has changed. No longer are companies competing against other companies, but rather supply chains are competing against supply chains. Indeed, the success of a business is now invariably measured neither by the sophistication of its product nor by the size of the market share. It is usually seen in the light of the ability to sometimes forcefully and deliberately harness its supply chain to deliver responsively to the customers as and when they demand it. Flexible supplier-manufacturer relationship is the key enabler in the supply chain management: without the flexibility at the vendor side the supply chain can't respond fast enough. Therefore, the relationship with the supplier should be flexible enough to meets the changing market needs (Christopher and Martin, 1992).

In this paper several experiments were carried out on the model for visualizing the impact of the various decision variables on the total cost and then fixing up the values of (s) and (S). The graphs showing the impact of these parameters on the performance of the individuals and the system were plotted. Based on the system's performance under different sets of operating decisions we shall try to analyze the effect of the different parameters and see in what manner their decisions affect the performance of others across the chain. The parameters whose impact was studied are stock level (S), reorder level (s); this paper deals with the impact of increase in stock levels and reorder level of the warehouse on overall system performance (Jayant, 2002).

About the Product

Bharti Teletech is a giant in the manufacturing of all kinds of telephone sets for the Department of Telecommunication, open market and for exports. The company

share in this segment is highest in India. This company has 35 per cent share in the telephone segment in India. The company is producing the seven model of telephone, with brand name Beetal.

- The company is currently facing the problem of delivering the CORAL & MILL-I model of phones on the schedule date. Though the shortage is small but any delivery made beyond schedule will be considered as lost opportunity of sale.
- The coral is general model for the open market and its demand is highly uncertain, therefore frequent stock outs are going on at the end of bond store and warehouse side.
- The forecasts generated using the 6-month average were not giving the appropriate results.
- The warehouse was not using the inventory policy and the reorder level of the warehouse was made intuitively.
- Some of the components are required for the final assembly of CORAL–3 chip are unique and some of the sub-assembly manufactured components have very high lead time.
- In the CORAL components the import share is about 46 per cent, even the cost of the items is less than one rupees. But lead time varies from 4 weeks to 8 weeks and items are very critical also.
- There were no analysis made for the inventory management at the inbound side of supply chain.

Format of Data Collection

In the initial phase, understanding the company information and product flow was done. The working procedure of each department is understood in respect to the information and product flow. Each department has its own objectives and as a result each department treats the data according to its functional objective. For the purpose of analysis the data is collected from each concerned department. Data that were collected includes:

- The monthly demand of CORAL model
- Bill of material of CORAL model
- Identification and classification of the components, which are, manufactured in the company itself.
- Classification of items that are bought out from vendors in the final form and required no further operation.
- Classification of item that are bought from outside and requires some final operation.
- Classification of items, which goes outside the company for some operation.
- Data regarding the process time of vital item and its frequency of usage.
- Data regarding the suppliers and its lead time.
- Process plan and its corresponding time for critical components.
- The data regarding the manufacturing time, manufacturing capacity, number of workers, number of assembly lines, over production and the shift production.
- Status of average inventory of all the components and critical components were checked from the raw material stores
- The name and the number of vendors for each component with lead- times.

About the Model

At present the company is trying to determine the reorder level and maximum level for the Bound store of M.U./Warehouse, which is used for all models of phones. A model is developed which depicts the mode of operations of the two levels of the company, warehouse and the M.U. Each one is assumed to follow the (s, S) inventory policy. The transit time, this basically the transportation time, is assumed to be constant. The model allows for a certain extent of pipeline inventory i.e. when the review period is reached and current inventory level is below or equal to reorder level, the warehouse can place one more order to M.U. even though the previous order was outstanding. This assumption tries to make the model more close to the company operations (Jayant, 2002). Fore estimation of (s, S) for the company at both retailers and manufacturing level, a model is run for various values of (s, S) and analysis is done for both shortages cost and holding cost at each level. The company is trying to fix the value of (s, S) at both level and results obtained from the model would help them to take the decision. The model is developed in Microsoft EXCEL.

Parameters

The key parameters affecting the system found after studying the system are:

Controllable parameters

- Maximum stock level (S) at each level: This refers to maximum inventory stock that can be allowed at both ware house and manufacturing level at any point of time.
- Re-order level(s): This refers to the minimum inventory stock at which any level in the chain will like to operate on.

Various related costs such as, carrying cost, shortage cost: These can take any value depending on the organisation and the type of product, but with this company carrying cost is taken as 25 per cent of the product cost per year, shortage costs depend on the management how they look to shortage and thus take the value above the profit. In this model we have taken Rs. 1 as inventory cost and Rs. 4 as the shortages cost per item for the simplicity of the calculation.

Uncontrollable parameters

- Demand of the end product: This refers to the daily demand for the product at warehouse level. The forecasted demand obtained from the regression analysis is taken as the input.
- Lead times: This refers to the time which any dispatched goods lot takes to reach the immediate downstream member of supply chain. This is basically the overseas vendor lead-time, transportation time and time elapse during related activity is considered constant. In this model lead time varies from the 4 weeks to 8 weeks and random Number is generated for determining the lead-time. Distribution of Lead-time is given below:

Table 1: Lead-time distribution and random number

Lead-time		
In weeks	4	8
Probability	0.4	0.6
Cum. Probability	0.4	1.0
Random No.	00-39	40.99

Mode of Operation

All the information is shared between the warehouse and the M.U. real time basis and the M.U. receiving the order place by the warehouse and the distributors as the input for its production panning.

Warehouse

The warehouse faces the end product demands from the customer weekly. He operates under the (s, S) inventory policy to cater to customer needs i.e., he starts with a certain minimum allowable inventory (s) on the first weeks and reviews his inventory position at end of each week. The inventory position is the quantity on hand plus quantity on order. At the end of any week, if his inventory position falls below a certain minimum allowable inventory i.e. reorder point (s); he places a replenishment order such that it brings the inventory position back to the maximum allowable inventory (S). Any quantity felt sort is not back ordered and thus high shortage cost is incurred. The lead-time has been varied between 4 weeks to 8 weeks.

Different costs, which the warehouse has to face, are as follows

- Holding Cost: Since the warehouse is maintaining certain inventory levels to satisfy day-to-day customers demand, he has certain associated inventory holding cost.
- Stock out Cost: Since any quantity felt sort has a stock out cost attached to it, as such warehouse has to face associated shortage cost.
- Ordering Cost: Whenever the warehouse places a replenishment order to the higher level it has certain associated ordering cost. It has been assumed that the retailer starts with the minimum inventory position or more on the first day.

Manufacturing unit

The mode of operation of the M.U. is different from the warehouse. The M.U. is subject to the constraint on its daily production capacity. M.U. receives the orders demand from the warehouse. It has been assumed that the first day demand at the warehouse end is known to it in advance. So the M.U. accordingly sets its daily targets for coming days till it receives another demand, provided it is under its manufacturing capacity, else it operates at its maximum capacity. When it receives another demand warehouse at the end of any week, it then plans its weekly production. The daily production goes on accumulating as finished good inventory till the maximum level is reached. Whenever the warehouse places an order to M.U. it is replenished from the available finished goods inventory. On the day when an order arrives from the warehouse three cases can occur: either the M.U. may experience shortages, or it may be having excess stock after satisfying the arrived order or there can be a no-shortage and no-excess case.

In this case the M.U. samples the demand information and then accordingly does the production planning. Warehouse share demand information with the M.U. and M.U. samples the demand information. Though there is information cost associated with the information of demand being exchange with the M.U. but this cost assumed to be very small and is neglected.

Methodology of Model

The Methodology of the model is explained with the help of the flow chart Fig. 1.

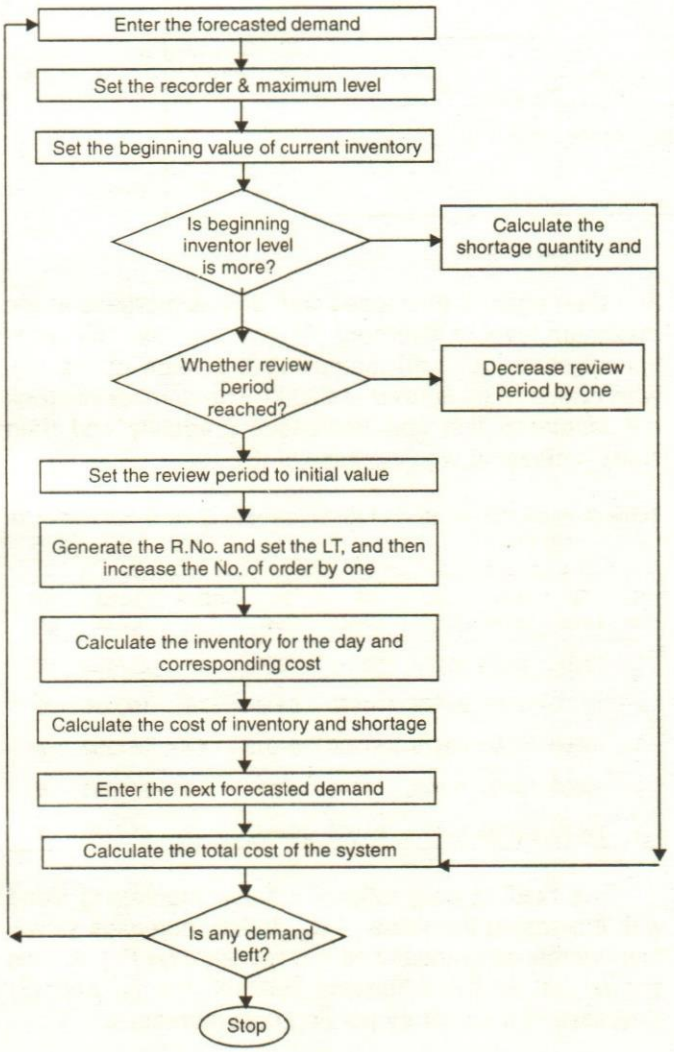

Fig. 1. Flow chart for the model

Step 1: Monthly demand of about eighteen months is taken from the marketing department. Demand forecasting analysis is done using the different forecasting techniques. The technique with minimum value of error and minimum cost is taken. At present the company is using the six-month moving average method, this method is compared with the different forecasting technique (exponential smoothing with variation in alpha & regression analysis) and on the basis of least error and less cost regression analysis is taken for forecasting the demand. Demand is forecasted for the same number of month as of actual demand.

Step 2: For estimation of reorder level the maximum level of stock at bound store of the M.U. Initially the given formula is used.

$$S = D^{*} (T+L) + ST \quad ...(1)$$

$$ST = (D_{max.} - D)$$

$$s = DLT + ST$$

where: D = mean demand (per month)
T = review period in month
L = mean lead time in month
DLT = avg. demand during lead time

$$\text{Order Quantity } (Q) = S - X \text{ if } (X <= s); \quad ...(2)$$

$$= 0 \text{ if } (X > s); \quad ...(3)$$

Then model is run using those values for eighteen months and the stock out cost, holding cost, number of orders made is monitored at M.U. and then the value of (s) and (S) are varied subsequently to find the value which gives good balance between the stock out and holding cost at the bound store.

Step 3: Then sensitivity analysis is done by fixing the value of (s) and varying the value of (S) and model is run using the different value of (S) for eighteen months and stock out cost, holding cost and orders made is monitored at M.U. and find the optimum value of (s) and (S). Now fixed the value of (S) and subsequently varies the value of (s) and run the model again and monitored the different costs and orders then find the optimum value of (s) and (S) for bound store of the manufacturing unit.

Step 4: After getting the optimum values in step 3, then compare those with each other and determine (s) and (S) on the basis of total system cost consideration. The analysis on basis of total system is done when both levels share the information (Jayant, 2002).

Assumptions

1. Production capacity of Coral model of phone is infinite.
2. Single product is taken for analysis.

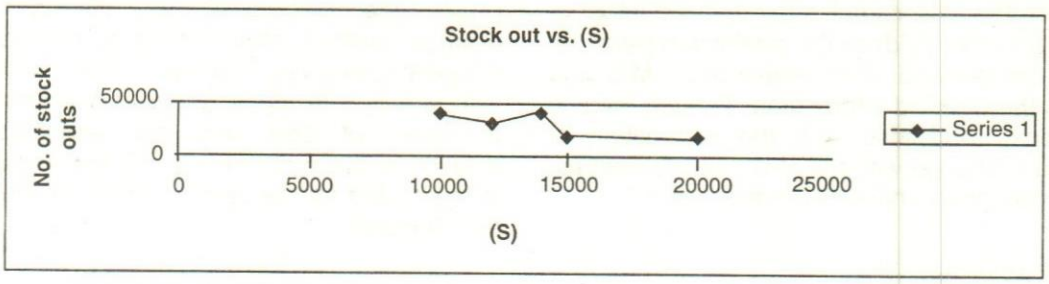

Fig. 2. Variation of stock out with increase in (S)

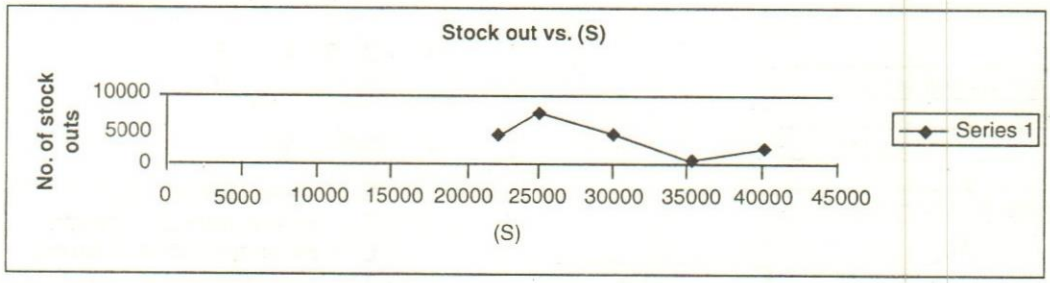

Fig. 3. Variation of stock out with increase in (S)

3. Review period is one month.
4. One month is equal to four weeks.
5. One working day equal to 8 hours.
6. Bound store and warehouse are one entity because all the information is shared real time basis.

Effect of Increase in (S) on the no of Stock out and Holding Cost of M.U.

The value of (S) is varied gradually keeping (s) constant and impact of the variation are tabulated in table 3 & Table 4. The value of holding cost is Rs. 1 - per unit per week and the shortage and Rs. 4 - per unit.

Table 2: Impact of variation of (S) on number of stock out and holding cost

S No.	R. Level	Max. Level	St. Qty.	St. Cost	H. Cost	Orders	Total Cost	St. Out
1	22000	22000	4506	18024	209064	14	246688	2
2	22000	25000	7154	28616	294803	11	338819	2
3	22000	30000	4332	17328	304765	9	334693	2
4	22000	35000	457	1828	416276	8	429304	1
5	22000	40000	2363	9492	528915	8	546767	2

Figure 2 shows the variation of stock out with increase in the value of (S), when (s) is fixed at 10000. The number of stock out decreases first and then increases and then again it decreases with a slow increase in the maximum level of inventory (S). Fig. 3 shows the variation of stock out with increasing the value of the (S), when value of (s) is fixed at 22000. The number of stock out increases first and decreases gradually and then starts increasing with increase in (S).

Table 3: Impact of variation of (S) on number of stock out and holding cost

S. No.	R. Level	Max. Level	St. Qty.	St. Cost	H. Cost	Orders	Total Cost	St. Out
1	10000	10000	38104	152416	42592	16	217408	8
2	10000	12000	28598	114392	54644	15	190036	6
3	10000	14000	40375	161500	94013	13	261232	7
4	10000	15000	16836	67344	125121	13	210665	6
5	10000	20000	15497	61988	169447	9	244035	3

The holding cost follows a linear increasing trend with increasing the value of (S). It first increases slowly than increases gradually as it is revealed by Fig. 4. This shows that as the difference between the (s) and (S) increases, the inventory holding cost increases.

The number of order follows the decreasing trend as the increase in the value of (S)

And then it remains constant even as we increase the value of (S).

The total cost doesn't follow any trend with increase

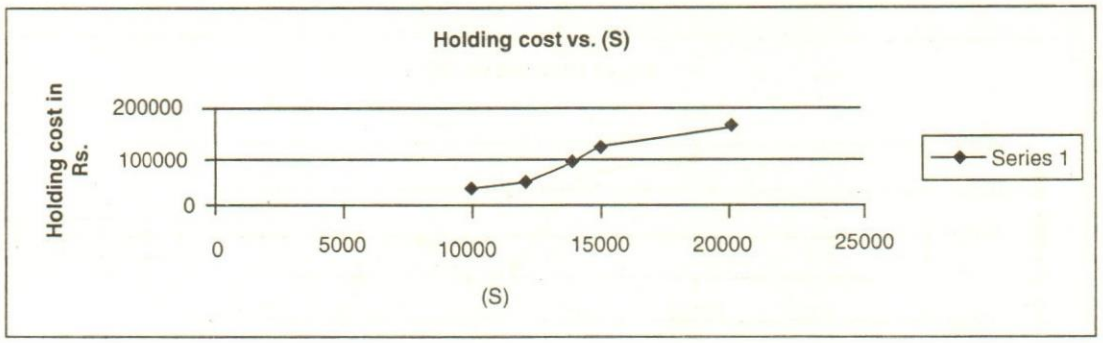

Fig. 4. Variation of holding cost with increase in (S)

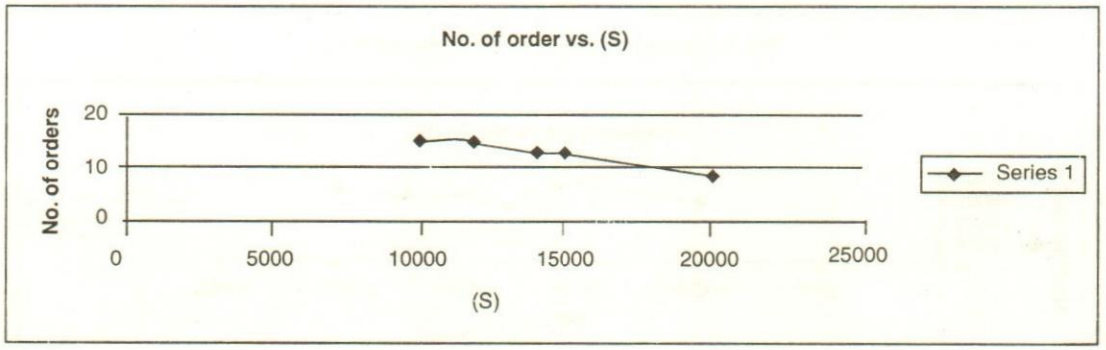

Fig. 5. Variation of no. of orders with increase in (S)

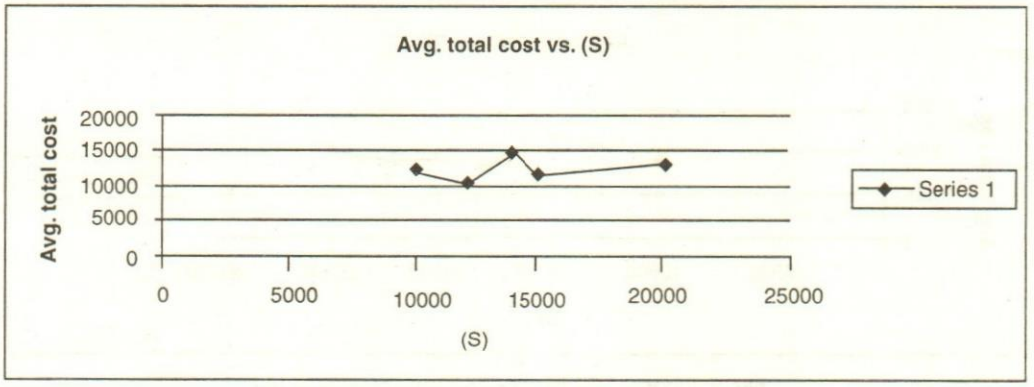

Fig. 6. Variation of Avg. total cost with increase in (S)

in (S). It first decreases marginally and then increases ten decreases and then marginally increases with increase in the value of (S). Too much variation in the cost curve is because it is includes the three costs i.e. shortages cost, holding cost and ordering cost.

Effect of increase in (s) on Stock out and Holding Cost of Manufacturing Unit (M.U.)

The effect of increase in the value of (s) on the number of stock out, holding cost, ordering cost and total cost are analyzed and tabulated in the Table 4.

Table 4: Impact of variation of (s) on the number of stock out and holding cost

S. No.	R. Level	Max. Level	St. Qty.	St. Cost	H. Cost	Orders	Total Cost	St. Out
1	10000	30000	13163	52652	272484	6	333536	4
2	15000	30000	11341	45364	371172	7	426336	2
3	18000	30000	1330	9777	275232	7	310353	2
4	20000	30000	0	0	317274	10	331274	0
5	22000	30000	4332	17328	304765	9	334693	2
6	25000	30000	0	0	360809	12	377609	0

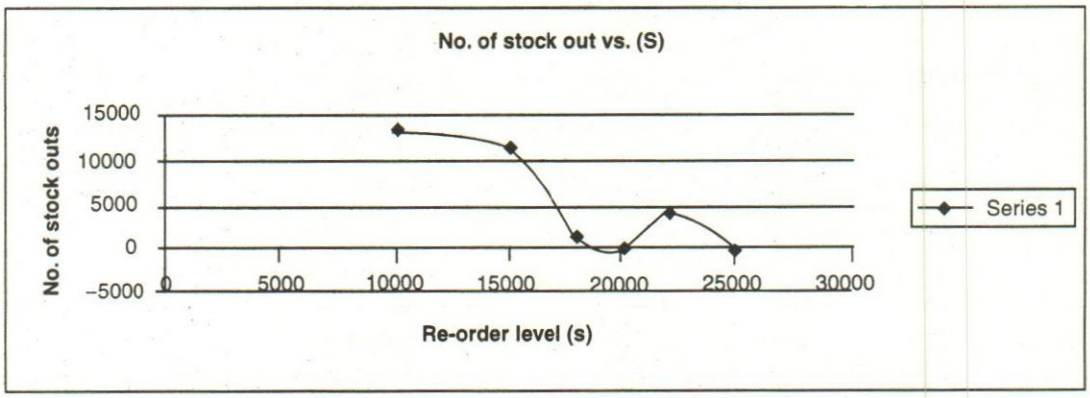

Fig. 7. Variation of stock out with increase in (s)

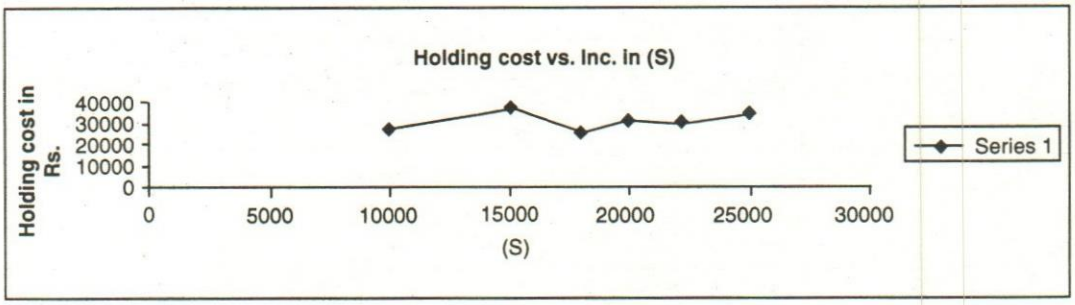

Fig. 8. Variation of the holding cost with (s)

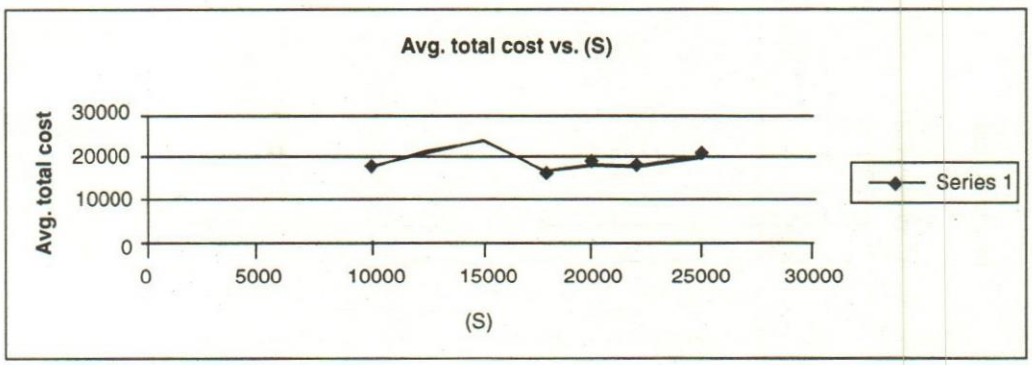

Fig. 9. Variation of Avg. total cost with increase in (s)

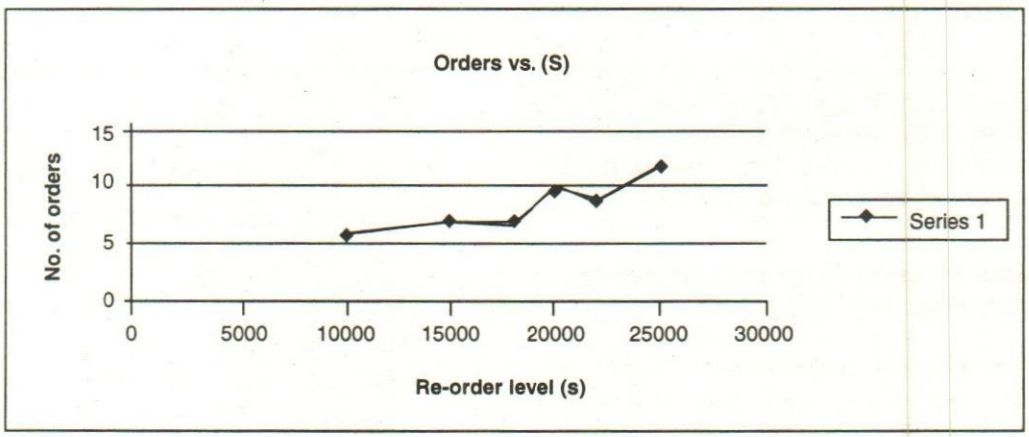

Fig. 10. Variation in order with increase in (s)

The analysis for increasing the value of (s) and fixed value of (S) is shown in Fig. 7 to 10. The model run shows by increasing the value of (s) the shortage does not follow any trend, first it decreases high in the initial stages then increases and again decreases as shown in the Fig. 7.

The holding cost also does not follow any trend with increase the value of re-order level (s). It first increases and then decreases and again increases as shown in Fig. 8.

The total cost first increases then decreases and then follows a linear increasing trend with increases the value of (s) keeping the fixed value of (S) as 30000, as shown in the Fig. 9. The total cost includes shortage cost, holding cost and ordering cost.

Number of orders increases with increasing the value of (s). Table 10 shows that as the difference between (s) and (S) decreases the number of orders increases.

Suggested value for the Bound store of M.U./ Warehouse

Table 5: Suggest value for bound store/warehouse

S. No.	R. Level	Max. Level	St. Qty.	St. Cost	H. Cost (Rs.)	Or-ders	Avg. T.C.	St. Out
1	10000	12000	1589	6356	3036	15	10558	6
2	10000	20000	867	3467	8957	9	13124	3
3	22000	22000	251	1002	11615	14	13705	2
4	20000	30000	0	0	17627	10	18405	0

And finally value of (s) and (S) is suggested which makes the best trade off between the stock out cost, holding cost, number of orders and total cost, four values are suggested. Being the giant in the telecom sector the policy of BTL is that any order not fulfills by the company on the due date is assumed as lost sales or opportunity lost of sale to the company. So it is up to the company how they look to the shortages and what value intangible cost they attach to the shortage. The value suggested above may not remain the same when the stock out cost as perceived by the company changes.

Results and Discussion

So we find that after varying the value of the both parameters, we find that the value of 10000 and 20000 gives the best trade off between the stock out cost and the holding cost. By implementing the policy with these values the stock outs will reduce and customer satisfaction will enhance and total cost will be less and company profit margin will increase as well as the paper work/manual time will reduce due to placing less number of orders.

Table 6: Final suggested value for the company warehouse

S. No.	R. Level	Max. Level	St. Qty.	St. Cost	H. Cost	Or-ders	Total Cost	St. Out
1	10000	20000	867	3467	8957	9	13124	3

In this paper single product is chosen and all the information from the respective departments is taken. The reason for selecting the CORAL is stock outs and finished good inventory in the warehouse. The experimentation and results are obtained from the model and tried to determine the value of (s) and (S). An important insight is gained that any decision whether it is strategic or tactical one like fixing the value at reorder level and maximum level interrelationship between the each level must be taken into account. As the result shows that fixing the value at any level according to ones functional objective would not necessarily result in the total improvement of the system.

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Feature

Dynamic Analysis of Bullwhip Effect in Global Supply Chain

S. Balan, Prem Vrat & Pradeep Kumar

This paper analyses a global supply chain model and the dynamic interaction between the variables affecting the bullwhip effect, using the system dynamic approach. Under different delay and risk conditions, the analysis is carried out considering various global economies and their degree of development. The research recommends some strategies for a global supply chain that could improve flexibility across the chain, reduce lead time, reduce inventory and enhance efficiency.

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Variability of demand that moves from downstream to upstream in a supply chain is called 'bullwhip effect'. The bullwhip effect is not a new concept. Though it was first documented by Forrester (1961), the term 'bullwhip' or 'whipsaw' was first coined by Lee et al. (1997a) and (1997b). According to Lee et al. (1997a), a small variance in the demands of the downstream end-customer may cause dramatic variance in the upstream supplier's side. It was also found that orders to the supplier tend to have a large variance from sales to the buyer, and distortion propagates upstream in an amplified form. This phenomenon is called the bullwhip effect.

Graves (1999) studied the bullwhip effect under a myopic base-stock when an optimal forecast is used for a particular non-stationary process, namely an Integrated Moving Average process or IMA (1, 1). Chen et al. (2000a) studied the bullwhip effect under order up to policy under two common, but simplified, forecast schemes. He explained that the Moving Average (MA) and Exponential Weighted Moving Average (EWMA) method are used for a particular stationary process, namely a first order Autoregressive Process, or AR(1) in a forward supply chain. Yao (2001) studied the bullwhip effect under different ordering policies and the way to reduce the bullwhip effect; he also studied the channel design in supply chain management. Merkuryev and Petuhova (2002) studied the bullwhip effect under centralized and decentralized information sharing strategies with min-max inventory and stock to control inventory control policies in a four stage forward supply chain problem.

Miao et al. (2003) introduced few measures to weaken the impact of the bullwhip effect. They explained a strategic alliance between the retailer, the supplier and the main forms of the alliance. Furthermore, they compared the centralized and traditional strategy of a multi-stage system to show the advantage of the centralized system in the supply chain.

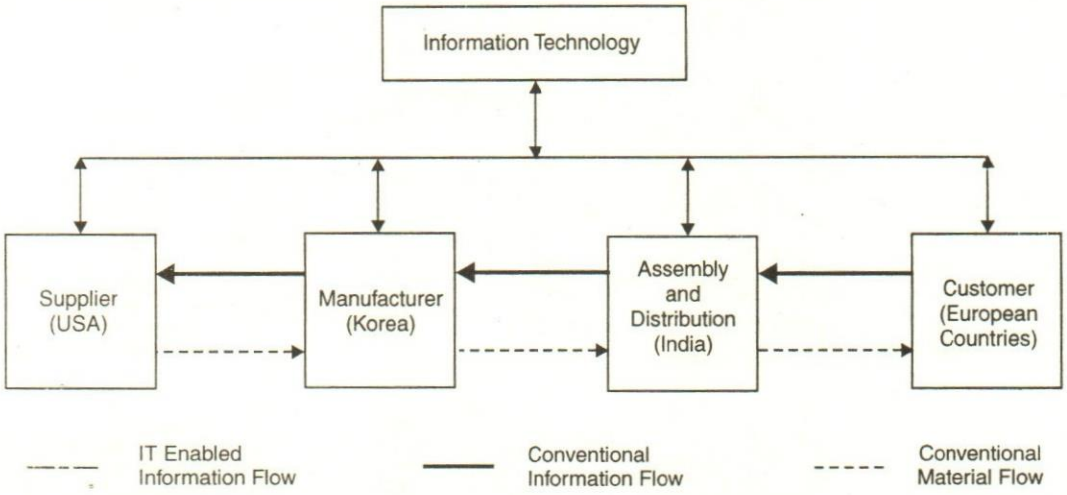

Fig. 1. Simple Information Technology (IT) enabled Global Supply Chain Structure

The information distortion and the so-called bullwhip effect has been discussed by many authors using analytical model and control theory including Reddy, (2001), Disney and Towill (2003), Carlson and Fuller (2002), Machuca and Barajas (2005), McCullen and Towill (2002) and Chatfield et al. (2004). From the literature survey, it is identified that there is a wide gap present in the bullwhip effect analysis of the global supply chain and this research work aims to carry out a thorough study of the bullwhip effect in a global supply chain using system dynamics and sensitivity analysis.

The Global Supply Chain Model

A simple global supply chain with four nodal points has been considered for analysis as shown in Fig. 1. The material transaction takes place from supplier to customer whereas the conventional information flow prevails from customer to supplier. This is connected with a common platform called e-enabled (IT) information flow where the delay between the nodes could be reduced.

The Bullwhip Effect

The bullwhip effect can be represented as an amplification of demand fluctuations from downstream to upstream. It can also be defined in many other ways. The globalisation of supply chains (SC) led to an increase in the time delays and the distances involved, and hence it further increases the bullwhip effect. Excessive inventory investments throughout the SC, poor customer service, lost revenue, variations in the logistics chain, missed production schedule and uncertainty in decision-making are the negative effects that are a result of the bullwhip effect. This effect can be reduced by implementing a good web-enabled information sharing system, just-in-time replenishment system, batch ordering policy implementation, price stabilizing and shortage gaming.

System Equations and Flow Diagram

The system dynamics Dynamo Equations (DE) have been generated for the model to represent the dynamics of the systems encapsulating the rate of change for every iteration. The dynamo equations pertaining to production capacity are represented as:

A DISRATE.K = CAPSTOCK.K/AVGLC.K (1)

L ASL.K = (DSL.JK – CORDER.JK)/SLAT.K (2)

C SLAT =1 (3)

A DSL.K = EXAQDY.K * DESAQRATE.K (4)

A DESCAP.K = CAPSTOCK.K *(1 + SFDS.K *((EPDCRATIO.K) - 1)) (5)

N EPDCRATIO.K=GRAPH(EXPNI.K,1,0.25, [0,0.1, 0.3,0.67,1,1.25,1.45,1.6,1.7"Min:0;Max:2"]) (6)

A DESAQRATE.K = MAX (0, EXDISRATE.K + ACAP.K) (7)

A ACAP.K= (DESCAP.K – CAPSTOCK.K) /CAT.K (8)

A EXAQDY.K = CAQDY.K (9)

A PRODCAP.K = CAPSTOCK.K * CAPPRODY.K (10)

N CORDER.K = CAQDY.K * DISRATE.K (11)

R CORDER.K = CORDER.J + DT*(AQRT.JK + Order_Rate.JK) (12)

N CAPSTOCK.K = (RID.K/INCAPUTN.K)/ CAPPRODY.K (13)

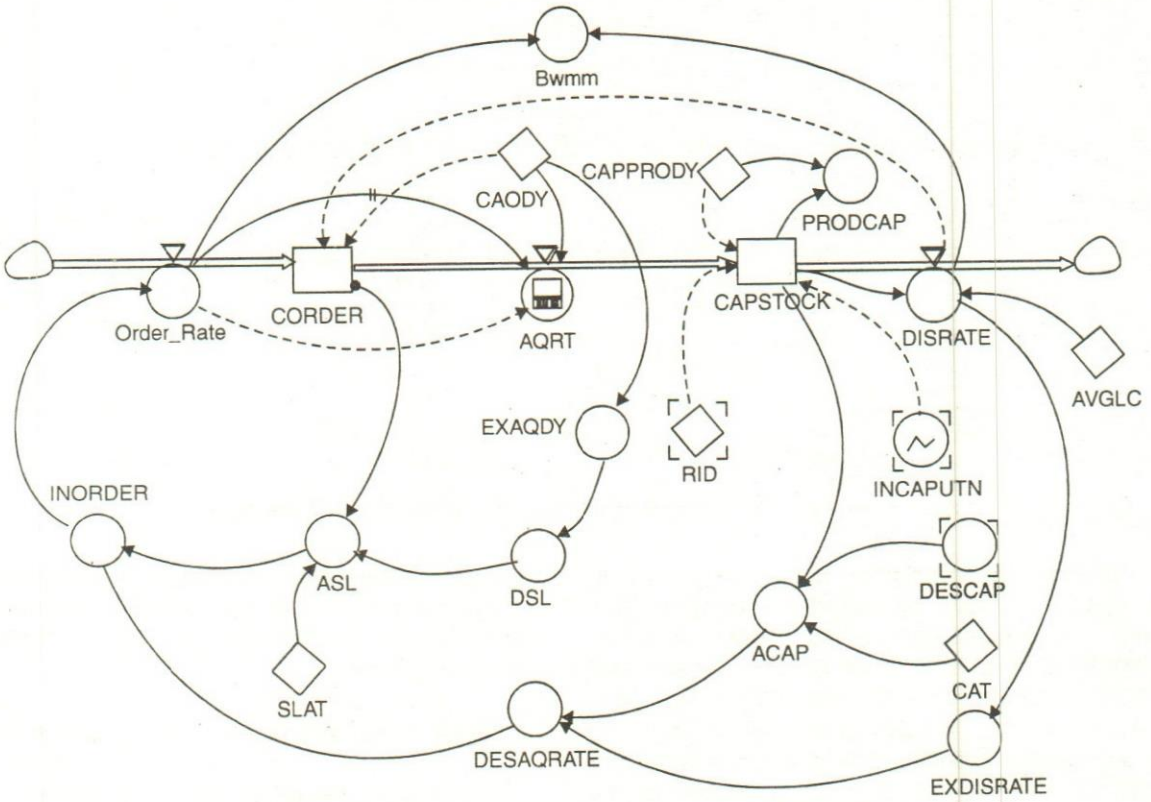

Fig. 2. Flow Diagram showing Production Distribution in a Global Scenario

C RID = 100 (14)

A AQRT.K = DELAYMTR (Order_Rate.K, CAQDY.K, 1) (15)

C CAQDY.K = 4 (16)

R DISRATE.K = CAPSTOCK.K/AVGLC.K (17)

C AVGLC = 20 (18)

A INORDER.K = DESAQRATE.K + ASL.K (19)

C AVGLC = 20 (20)

C CAT = 3 (21)

C DID = 100 (22)

DISRATE Discard Rate (Units/Week)

AQRT Acquisition Rate (Units/Week)

CAPSTOCK Capital Stock (Units)

AVGLC Average Life Expectancy (Weeks)

ASL Adjustment for Supply Line (Units/Week)

DSL Desired Supply Line (Units)

CORDER Capacity on Order (Units/Week)

SLAT Supply Line Adjustment Time (Weeks)

EXAQDY Expected Acquisition Delay (Weeks)

DESAQRATE Desired Acquisition Rate (Units/Week)

DESCAP Desired Capital (Units)

CAPSTOCK Capital Stock (Units)

EPDCRATIO Expected Profitability Desired Capacity Ratio (Dimensionless)

EXDISRATE Expected Discard Rate (Units/Week)

ACAP Adjustment for Capacity (Units)

PRODCAP Production Capacity (Units/Weeks)

CAPPRODY Capital Productivity (Unit*Unit/Week)

CAPSTOCK Capital Stock (Units)

CAQDY Capacity Acquisition Delay (Weeks)

INORDER Indicated Order (Units/Week)

CAT Capacity Adjustment Time (Weeks)

DID Desired Initial Demand (Units)

The dynamo equations of the state variables related to bullwhip effect are expressed as:

A BW.K = (ORRT.K / DISRATE.K)1 (23)

R ORRT.K = MAX(0, INORDER.K) (24)

A INORDER.K = DESAQRATE.K + ASL.K (25)

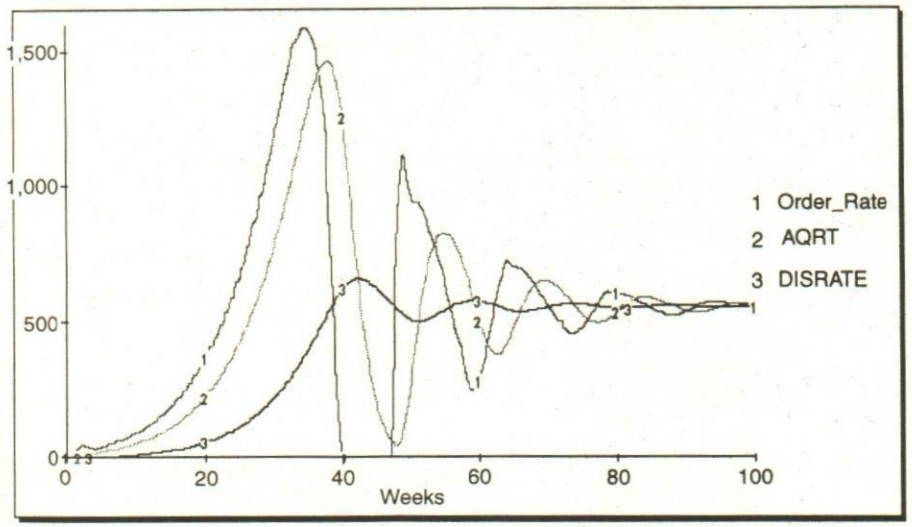

Fig. 3. Order Quantity Amplification from Downstream to Upstream in Global Supply Chain when CORDER = 100 (AQRT-Acquisition Rate, DISRATE-Dispatch Rate)

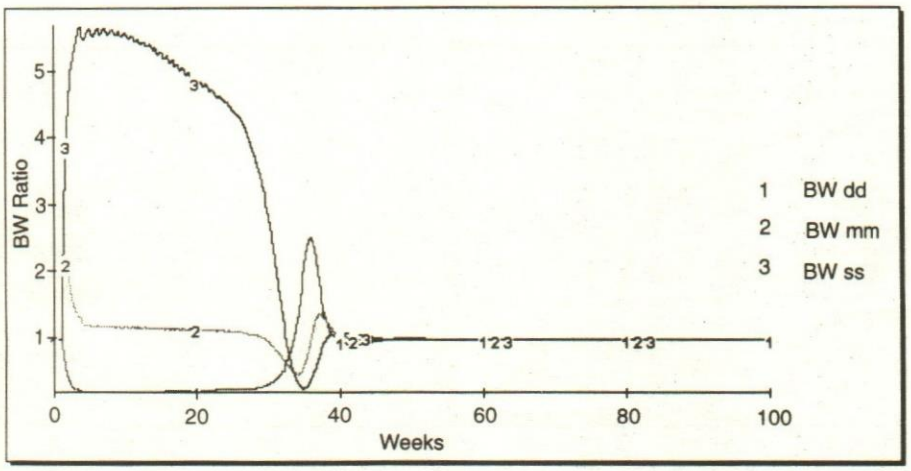

Fig. 4. Bullwhip Ratio across Global Supply Chain Members with CAQDY = 1; LTdm = 2; LTms = 3; CAPPRODY = 1 (BWdd-Bullwhip Ratio at Distributor, BWmm-Bullwhip Ratio at Manufacturer, BWss-Bullwhip Ratio at Supplier)

R DISRATE.K = CAPSTOCK.K/AVGLC.K (26)

C AVGLC = 20 (27)

BW	Bullwhip effect (Dimensionless)
ORRT	Order Rate (Units/Week)
DISRATE	Discard Rate (Units/Week)
DESAQRATE	Desired Acquisition Rate (Units/Week)
ASL	Adjustment for Supply Line (Units/Week)
AVGLC	Average Life Expectancy (Weeks)
CAPSTOCK	Capital Stock (Units)
INORDER	Indicated Order (Units/Week)

The flow diagram for the internal factors affecting global supply chain is shown in Figure 2. The diagram shows the dynamic relationship between the decision variables, rate variables and level variables. The dynamic behaviour of the model is analysed by proposing a variety of possibilities in the variations of the customer order.

The Results

One measure of bullwhip effect is the ratio of the output order rate (retailer order to manufacturer) to the input acquisition rate. In other words it could be the ratio between acquisition rate and dispatch rate of a production distribution system (Figure 3). Information and material delays are the root cause of the bullwhip effect. In case of decentralised information, the variance increase is multiplicative at each stage of the supply chain (Chen et al. (2000b)). But in the case of centralized information sharing, i.e., the entire system is fully controlled by a centralized Information Technology (IT) enabled server, the variance increase in such a case is additive. With perfect centralized information

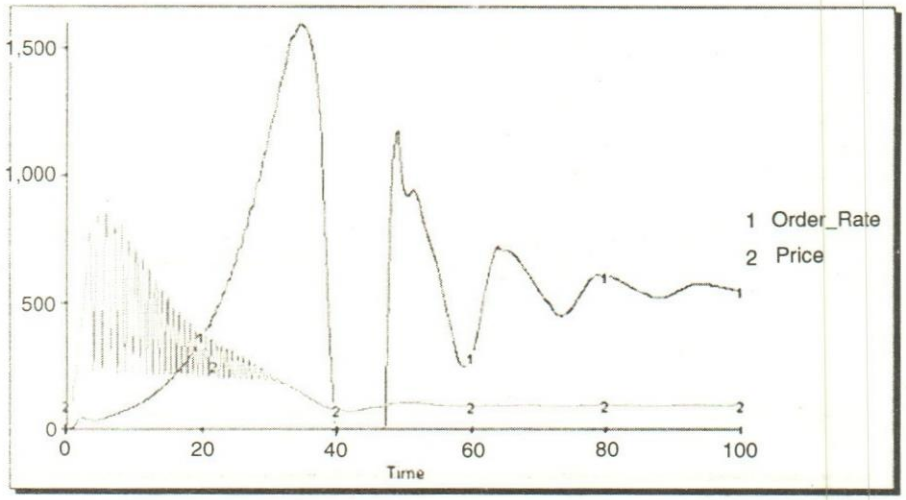

Fig. 5. Sensitivity of Price to Order Rate with Third Order Delay

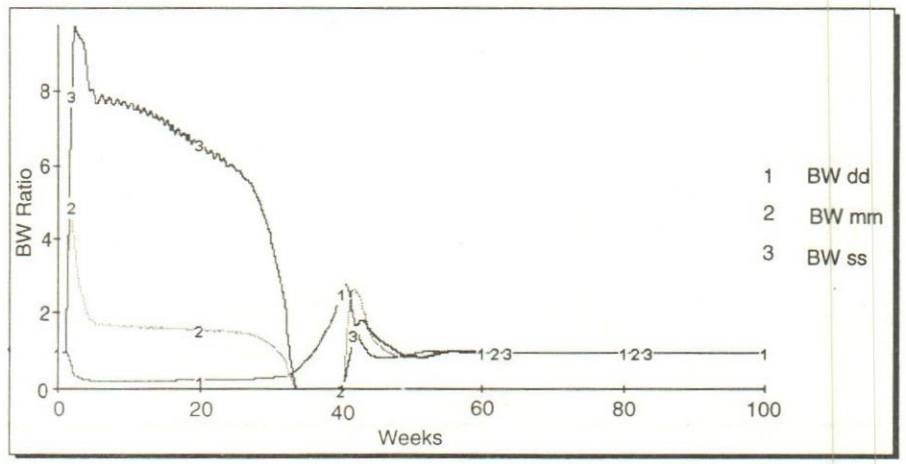

Fig. 6. Sensitivity of Bullwhip Ratio across Global Supply Chain with CAQDY = 4; LTdm = 2; LTms = 3; CAPPRODY = 1
(BWdd-Bullwhip Ratio at Distributor, BWmm-Bullwhip Ratio at Manufacturer, BWss-Bullwhip Ratio at Supplier)

sharing the bullwhip effect can be reduced but not eliminated. In Open Loop Global Supply Chain (OLGSC), the demand variance amplification is accelerated with increase in lead time between the stages.

Measure of bullwhip ratio across a three echelon global supply chain (Supplier-Manufacturer-Distributor), for the capacity acquisition delay of one week and lead-times LT_{md} = 2 and LT_{sm} = 3 respectively, is shown in Figure 4. All these performance measure are obtained with customer demand 100 units and that are triggered at the start of the simulation. The bullwhip effect is unfavourable for an organization. Reduction of this effect has major benefits such as inventory reduction, cost reduction, improved supply chain performance, etc.

Sensitivity Analysis

Sensitivity analysis is used to determine how sensitive a model is to changes in the value of the parameters of the model and to changes in the structure of the model. In this research, parameter sensitivity is performed by changing the model parameter values to examine the changes in the dynamic behaviour of its structure and variables like capacity, lead-time, production, inventory, order and bullwhip effect. Figure 3 shows the measure of variables at higher order delay, CAQDY = 4 and CAPPRODY = 1.

When a higher order delay is imposed in the model, the order rate gets amplified [maximum of 1,550 units of components at time t = 35 weeks] and it takes almost 110 weeks to get dampened (Figure 5). Similarly the

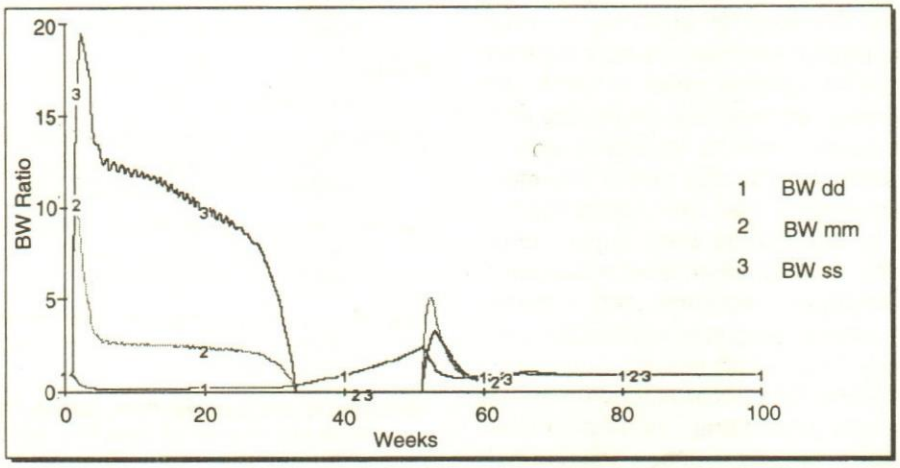

Fig. 7. Sensitivity of Bullwhip Ratio across Global Supply Chain with CAQDY = 10; LTdm = 2; LTms = 3; CAPPRODY = 1; DELAYMTR = 1 (BWdd-Bullwhip Ratio at Distributor, BWmm-Bullwhip Ratio at Manufacturer, BWss-Bullwhip Ratio at Supplier)

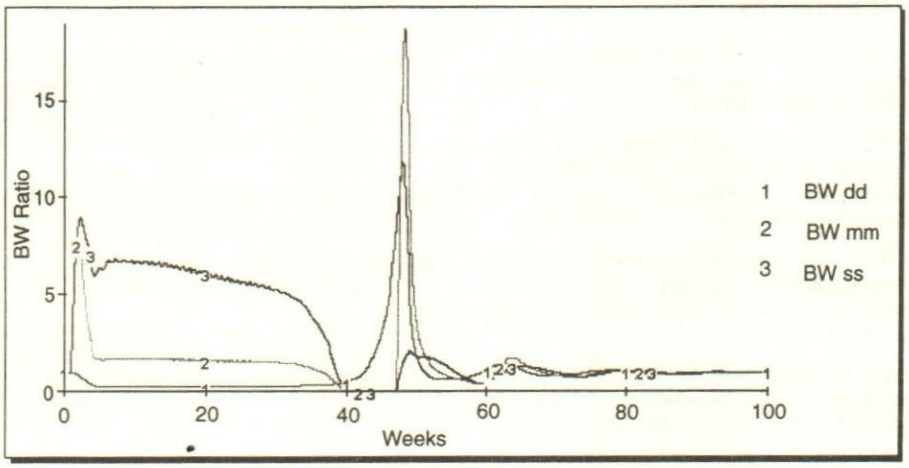

Fig. 8. Sensitivity of Bullwhip Ratio across Global Supply Chain with CAQDY = 4; LTdm = 2; LTms = 3; CAPPRODY = 5; DELAYMTR = 3 (BWdd-Bullwhip Ratio at Distributor, BWmm-Bullwhip Ratio at Manufacturer, BWss-Bullwhip Ratio at Supplier)

same SCMI parameters have been calculated for the low order delay and medium order delay functions. Demand information distortion and inventory build-up are identified as the two critical factors in a global supply chain. Increase in lead time and the smoothing factor of demand forecaster also amplifies the level of inventory and demand information distortion.

Increases in capacity acquisition delay from 4 weeks to 10 weeks [keeping constant lead-time (LT_{dm} = 2; LT_{ms} = 3) and capital productivity] tend to amplify the bullwhip effect across distributor, manufacturer and supplier (Figure 6 and Figure 7). Figure 8 examines the sensitivity of bullwhip ratio across Global Supply Chain with CAQDY = 4; LT_{dm} = 2; LT_{ms} = 3; CAPPRODY = 5; DELAYMTR = 3. Under this policy, the system simulation takes a long time (nearly 100 weeks) to become stable and it also magnifies the demand variation quantity between stages. This higher order material transaction delay magnifies the bullwhip ratio as a second hype. Hence, lesser the value of delay function, lesser is the bullwhip effect.

Increase in material transaction delay across global supply chain also accelerates the bullwhip effect. A global supply chain with IT enabled network should maintain complete information flow and material flow in order to reduce the order variability. A perfect transparent information flow also has certain disadvantages with it. Hence secured information across the global supply chain always improves the supply chain performance.

Conclusion

In the model, the simulation has been carried out for a period of 100 weeks to capture the effects of the bullwhip effect on a global supply chain. The model is tested under different economic scenarios. Sensitivity

analysis of the SD model reveals that in a developed country the information delay is of a low order in nature and hence it reduces the level of inventory at every stage, whereas for an underdeveloped country the information delay would be of a higher order in nature and would lead to an increase in inventory, order distortion at every stage from downstream to upstream, and increase in required capacity. The SD model presented here helps the organisations that are operating in a global environment to understand their supply chain variables, and from this, one could achieve reduction in its cost, inventory, wastages, lead-time and improvement in its quality of service, customer satisfaction, and supply chain efficiency. The model can be extended in many possible dimensions. One could extend the model by considering risk and uncertainty, non-cooperative condition, cooperative policy and collaborative manufacturing policy environment.

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One measure of friendship consists not in the number of things friends can discuss, but in the number of things they need no longer mention.

– Clifton Fadiman

Feature

Global Sourcing: A Case of Indian Auto Industry

Pravin Kumar, Surendra S. Yadav & Ravi Shankar

The globalisation of the economy has changed the trends in manufacturing and supply chain strategies in many industrial sectors. India has become one of the biggest global sourcing centres in the automobile industry. In this paper, issues on global sourcing have been discussed, a SWOT analysis has been used to analyse the Indian auto industry for its current status and suggestions have been made for the growth of the Indian auto component industry.

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The Indian automobile industry is currently experiencing an unprecedented boom in the demand for all types of vehicles. This boom is mainly due to two reasons: increase in disposable incomes due to a rise in the standard of living of the Indian middle class, and Government liberalization policies such as relaxation of the foreign equity regulations, reduction of tariffs on imports, and banking liberalization that has fueled loan-driven purchases.

Also, India's strategic location in South Asia has attracted many multinational automakers from Japan, USA, and Europe to enter the Indian market through joint venture with Indian firms. There are many reasons why developed countries have shifted jobs to developing or less developed countries. Shifting jobs overseas allows the company to move work to the countries that have a significantly cheaper labour force and real estate costs (Warren and Fagan, 2005). In most cases, they are not heavily taxed. The global sourcing concerns issues like manufacturing strategies, factory location, sourcing components and configuring products (Hill,1985). Slack and Lewis (2002) have characterised the location decision in two dimensions, namely, the objective of location decision and number of locations.

Sourcing

Labour cost and transportation cost play an important role in reducing trade barriers and in driving global sourcing. Zenz (1994) defined sourcing as the strategic philosophy of selecting vendors in a manner that makes them an integral part of the buying firm for a particular component that is supplied by the vendor. Sourcing can be interpreted as a strategic decision of a manufacturing company to build up a close relationship with its suppliers to get competitive advantages. The different types of the sourcing activities used in a supply chain can be explained as follows.

Outsourcing: Outsourcing has been mentioned in conjunction with global sourcing and offshoring. But outsourcing has a different meaning. It generally relates to the buying of services or products that do not represent core competencies. These may well be locally sourced, as in the case of the auto industry, where modules or systems are outsourced to local supplier parks, or sourced from abroad. Outsourcing can thus be an instigator of global sourcing, but does not necessarily require the adoption of an international sourcing strategy.

International Sourcing: This can be defined as the acquisition of raw materials, components and subassemblies from international sources for use in fabrication, assembly or for resale, regardless of whether the import source is internal or external to the company (Kotabe and Omura, 1989). In international sourcing, the retailers are more proactive in the acquisition of sources of supply and their own strategies dominate in decision making as to where, when, what, how much and from whom to buy and also, there is lack of coordination of requirements between worldwide business units.

Global Sourcing: Global sourcing may be defined as an evolution of an international sourcing strategy. There is no clear differentiation between international sourcing and global sourcing and they are frequently used for each other. However, Monczka and Trent (1991) tried to differentiate them as global souring supports integration and coordination of procurement requirements across worldwide business units, looking at common items, processes, suppliers and technologies while international sourcing does not support long term relationships, coordination and integration worldwide as a strategy. The global sourcing is concerned with the main issue related to the manufacturing strategy like, where to locate factories, where to source components from and how to configure products (Hill, 1985). A good manufacturing strategy provides a competitive advantage in terms of cost, quality, delivery, and flexibility and the location of manufacturing facility has strong implication on these terms (Skinner, 1964a; 1969b).

Offshoring: It is a creative and careful leveraging of new and available pools of skilled labour abroad, while exploiting communication technologies to link these to domestic demand (Venkatraman, 2004). In this case, manufacturing facilities are shifted out of the country to the multiple offshore destinations in place of global sourcing.

Status of the Indian auto industry

In a recent human development report of United Nation Development Programme (UNDP), the Indian auto component sector is mentioned as a powerful force in the global market. Indian companies such as Bharat Forge, Brakes India and Sundaram Clayton Limited, have moved into high value added areas of production. According to the Automotive Component Manufacturers Association (ACMA), the Indian auto component manufacturers would see an exponential growth in output over the next decade. They have become reliable suppliers to global manufacturers such as Toyota, Honda, Suzuki, General Motors, Ford, Cummins, Volvo and Daimler Chrysler. Figure 1 shows the graphical representation of the markets for Indian auto components and their percentage share are tabulated in Table 1.

Table 1: Indian Auto Component Market.

Auto components	Production (in %)
Engine parts	31
Equipments- Dashboards Headlight	10
Suspension & Breaking Parts	12
Drive Transmission & Steering Parts	19
Electrical parts	9
Body & Chassis	12
Others	7

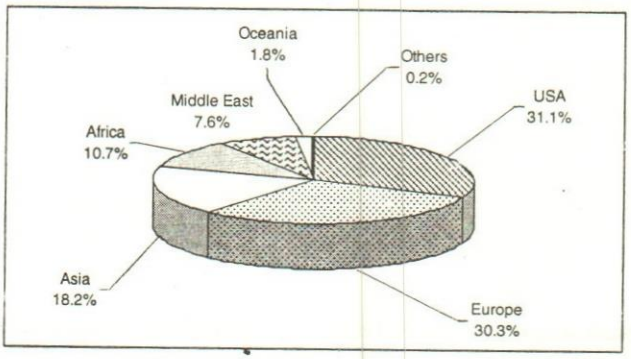

Fig. 1. Indian Auto Components Markets

India, on the other hand, is the largest three-wheeler market and second largest two-wheeler market in the world and is the fourth largest and fastest growing passenger car market in Asia. India is also the second largest producer of motorcycles in the world (5.2 million). The percentage distribution of different types of vehicles in total production (8.46 million) is tabulated in Table 2 and is shown graphically in Fig. 2.

Instead of a high production rate of the vehicles in India, the share of export in total output is low. The

Table 2: Indian Auto Production.

Type of Vehicles	Percentage Production (in %)
Two Wheelers	77
Three Wheelers	4.50
Passenger Cars	14.50
Commercial Vehicles	4

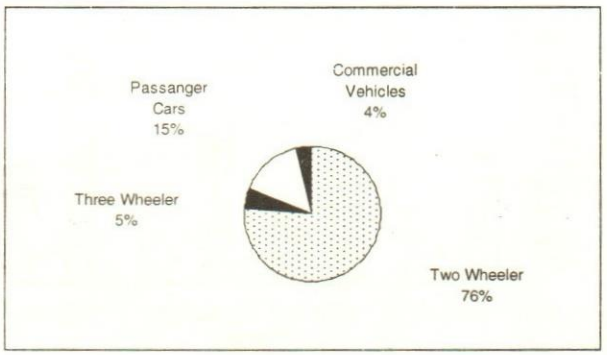

Fig. 2. Size of Indian Auto Industry (2004-5)

complete vehicle export share is lower than the auto components export. The auto component industry can be divided into six main segments:

1. *Engine parts*: These parts include core engine parts like, piston, piston rings, cylinder, and fuel delivery systems like, carburetors, diesel-based fuel delivery systems, engine valves.
2. *Electrical parts*: The main components in this category are starter motors, generators, spark plugs and distributors.
3. *Drive transmission and steering parts*: These include gears, wheels, steering systems, axles and clutches.
4. *Suspension and braking parts*: Brakes, leaf springs, shock absorbers are the components in this category.
5. *Lighting and dashboard equipment*: This includes headlights and dashboard instruments.
6. *Others*: Sheet metal components and plastic moulded parts are two of the major components in this category.

Value of these auto components produced in India in terms of dollars is shown in Table 3 and the production range of these components is shown in Table 4. These tables are graphically represented in Figs. 3 and 4 respectively.

Table 3: Auto Component Production Trend.

Years	Component Production (in $ million)
97-98	3,008
98-99	3,249
99-2k	3,894
00-01	3,965
2k-2k1	4,470
2k2-2k3	5,430
2k3-2k4	6,730
2k4-2k5	8,700

Table 4: Component Production Range.

Indian Auto Component Market	Percentage Share
USA	31.10
Europe	30.30
Asia	18.20
Africa	10.70
Middle East	7.60
Oceania	1.80
Others	0.20

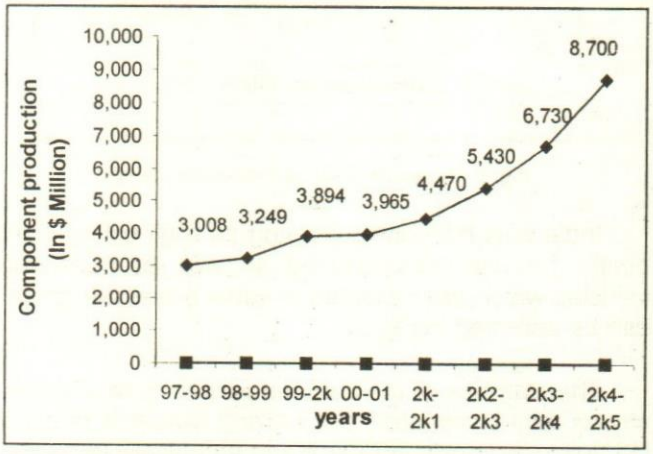

Fig. 3. Auto Component Production Trend

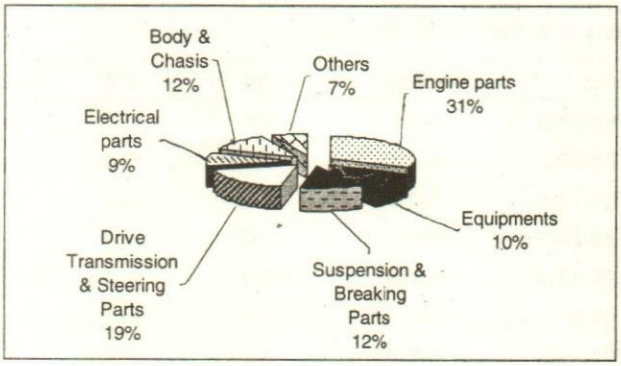

Fig. 4. Component Production Range

Table 5: Passenger Vehicle Production Trend (in '000')

Years	Passenger Cars	Multi-Utility Vehicles (MUVs)
94-95	264	49
95-96	348	67
96-97	407	134
97-98	401	134
98-99	390	113
99-00	574	123
2k-2k1	513	127
2k1-2k2	564	105
2k2-2k3	608	114
2k3-2k4	842	146
2k4-2k5	1028	182

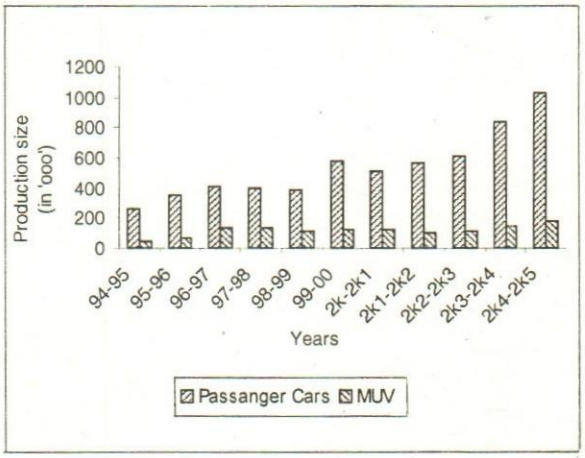

Fig. 5. Passenger Vehicle Production Trend

India is continuously growing as a global sourcing centre for car manufacturing as well as multi-utility vehicles which are tabulated in Table 5 and the growth can be analyzed in Fig. 5.

The statistics of the auto industry in India which includes total investment, output, and export in terms of US dollars is shown in Table 6 and graphically presented in Fig. 6.

Table 6: Indian Auto Industry Statistics (in $ million).

Years	Output	Export	Investment
2001-02	4470	578	2300
2002-03	5430	760	2645
2003-04	6730	1020	3100
2004-05	8700	1400	3950

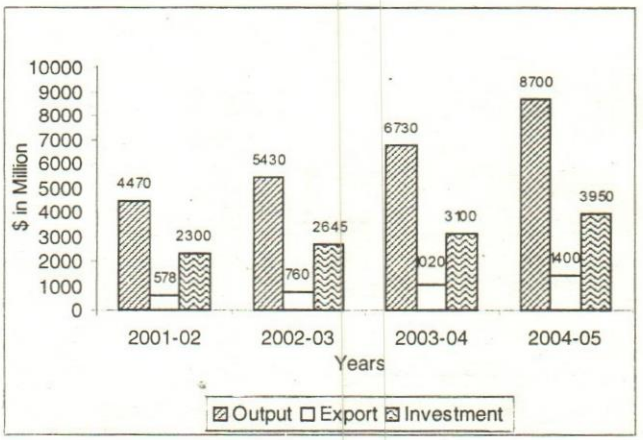

Fig. 6. Indian Auto Industry-Statistics

Future projections of the Indian auto industry

Based on general growth projections indicated by the Planning Commission of India, the automobile industry is expected to register a growth pattern as given in Table 7. The growth estimate implies certain assumptions relating to segment-wise growth rates based on a study conducted by National Council of Applied Economic Research (NCAER).

Government Policy

Before 2002, the auto policy of the Government of India was subjected to some restrictions to protect the Indian auto company. Initially it was the requirement of the country, but from 2002 the Indian market

Table 7: Demand Forecast (in '000')

Year	Cars	MUVs	LCVs	MCVs & HCVs	Scooters	Motorcycles	Three Wheelers	Tractors
2005-2006	741.5	153.5	78.0	113.1	1024.7	4233.87	358.9	260.9
2006-2007	800.8	159.6	81.1	118.7	1056.5	4995.9	398.3	283.2
2007-2008	864.8	166.0	84.3	124.7	1089.3	5895.2	442.2	307.2
2008-2009	934.0	172.6	87.7	130.9	1123.0	6956.3	490.8	333.3
2009-2010	1008.8	179.5	91.2	137.4	1157.8	8208.5	544.8	361.6
2010-2011	1089.5	186.7	94.9	144.3	1193.7	9686.0	604.7	392.4
2011-2012	1176.6	194.2	98.7	151.5	1230.7	11429.5	671.3	425.8

Source: www.unescap.org/tid/publication/part_two 2223_ind.pdf

was opened completely and the policy was made compatible with WTO. There is no restriction on FDI in the auto industry in India now. Also the minimum capital investment norm for fresh entrants has been removed. This will benefit manufacturers who are planning to enter the Indian market, particularly in the burgeoning motorcycle market. The salient features of the policy are (Annexure 3.8, Auto Policy: Government of India):

- The new policy has taken into account the need to address emerging problems and make the auto sector WTO compatible.
- The policy is also in favour of providing excise duty concessions to small cars, multi-utility vehicles and low emission vehicles. It envisages India becoming a major hub for the manufacture of small cars and a global supplier of components. The policy also includes incentives to facilitate R&D.
- Import tariffs are to be fixed in a manner so as to promote manufacturing in India, as opposed to mere assembly, without giving undue protection to the domestic industry. While ensuring a balanced transition towards open trade, the automotive tariff structure will be reviewed periodically to prevent India from becoming a 'dumping ground' for international rejections.

SWOT analysis of the Indian auto industry

There are many factors affecting the Indian auto industry which can be understood through the strength, weakness, opportunity, and threat analysis (SWOT analysis).

Strengths

- *Cost Advantage*: India enjoys a comparative cost advantage in labour as compared to developed countries. Indian manufacturers spend 3 to 15 per cent of sales on labour cost whereas global companies spend 20 to 30 per cent. For instance, cost of labour in Maruti, Ford and Hyundai is less than 2 per cent of sales while cost of labour in Daimler Chrysler in Germany is in excess of 21 per cent.
- *Technical Skill*: India has a vast pool of skilled man power and qualified engineers among the largest in the world. Table 8 shows the avail-ability of skilled labour and engineers of some developing countries on 10-point rating scale.
- *Low Cost Automation*: India has well developed software skill which can be used for better auto part design and in automation of the processes thus giving more value to the customer.

Table 8: Availability of Skilled Labour and Engineers (on 10-point rating scale)

S.No	Country	Skilled Labour	Skilled Engineers
1	India	8.5	7.4
2	Brazil	7.5	6.4
3	US	7.4	7.2
4	Germany	6.6	7.5
5	Mexico	6.6	6.3

Source: www.indiainfoline.com/bisc/ari/outs.pdf

- *World Class Manufacturers*: Indian auto component manufacturers widely use global technologies such as Japanese, American and Korean. India also has the largest number of ISO/QS certified companies. There are many Deming award winning companies in India, which are shown in Table 9.

Table 9: Deming Award Winners List (1998-2004)

Company Name	Year
Sundaram Clayton Limited, Brakes Division (India)	1998
Sundaram Brake Lining Ltd. (India)	2001
TVS Motor Company Ltd. (India)	2002
Brakes India Ltd. Foundry Division (India)	2003
Mahindra and Mahindra Ltd. Farm Equipment Sector (India)	2003
Rane Brake Lining Ltd.(India)	2003
Sona Koyo Steering System Ltd. (India)	2003
Lucas-TVS Ltd.	2004
Indo Gulf Fertilizers Limited	2004

Source: www.mgmt.purue.edu/centers/ciber/publications/pdf/India_auto_supplychains-iyer.pdf

Weaknesses

Lower Investment in Research and Development: Indian auto manufacturers have been spending less than 1.0 per cent of sales in research and development activities, while Korean and German companies spend between 7.0 to 8.0 per cent of the sales.

- *High Defect Rate and Low Labour Productivity*: Though the automobile industry matches the global standards; the same is not true for component manufacturers. The rejection rate for Indian auto components is 2900 parts per million (ppm) which is more than 12 times the world level of 240 parts per million. Also, cost advantages are nullified by the lower labour productivity in India.
- *Fragmented Component Industry*: Indian auto

component industry is highly fragmented and unable to meet the global demand of components.

- *Inadequate Growth of Domestic Market*: India's per capita income ($250) is less than China ($800) and it has to increase to compete with China.
- *Insufficient Design Capabilities*: Over the last 5 to 8 years global automakers have been passing on the responsibility of research, design, development, testing and validation to vendors. Even Original Equipment Manufacturers (OEMs) that start outsourcing from low cost countries, want to ensure that the new sources have the desired design capabilities too. India at present does not have sufficient design capabilities.

Remedies of the weaknesses

- Research and development activities should be given proper attention by increasing the investment in this field and also improving the quality of research and development in the field of automobiles. There should be proper interaction between industries and engineering institutions.
- India should adopt modern technology in manufacturing, quality and inspection, packaging, storage and transportation. To increase the productivity of labor, they should be given proper education and training in internal as well as in global companies.
- India is one of the largest auto component manufacturers in the world, but these component manufacturers are fragmented. Therefore, there is a requirement of the organisation of these manufacturers in a collective manner to show the combined and united contribution in the world car manufacturing industries. This responsibility must be fulfilled by organisations like the Auto Component Manufacturer's Association (ACMA) in India.
- There is no quick remedy to increase the per capita income in India in a very short time because it also depends on other industries like Information Technology (IT), banking, non-banking and educational industries. All these industries are interrelated to each other, therefore the per capita income and the domestic markets will grow automatically with time.
- India has very few reputed engineering institutions like IITs, NITs which cannot fulfil all the research and design requirements in auto industries. Therefore, the Government of India should open more well equipped engineering institutions, and also there should be a specific course on Automobile Engineering (AE) in all the existing engineering institutions at B.E. and B. Tech. level. To improve the design capabilities of component manufacturers, there should be an Industry Institute Partnership Cell as a separate department in each engineering institution.

Opportunities

- *Slowdown in the global automotive industry*: In recent years, the global auto industry has been going through a slowdown. As a result, companies like General Motors and Ford are continuously looking at low cost countries like India, China and Thailand for sourcing components at cheaper cost.
- *Shorter product life cycle and rapidly changing technology*: Due to shorter product life cycle and rapidly changing technology auto manufacturers are forced to involve tier 1 supplier into product design and development.
- *The UK auto industry*: The UK auto industry has identified India as a high priority country along with China, Thailand, and Brazil. India is its priority auto component market.
- *Strategic alliances*: Indian auto component industries can form strategic alliances with Chinese companies. As a result of China's commitment with the WTO with regard to tariff reduction, some Indian auto products have the opportunity to enter the Chinese market.

Threats

Competition with China, Thailand and Brazil: China and Thailand are major competitors of India. The total auto component export from China is approximately 10 times and from Thailand is three times of the Indian auto component export. To meet the threats. India should give emphasis to technology improvement so that it can produce high volume auto component at a low cost. To increase the volume of production, human resource development is also required.

Issues in Global Sourcing

Due to increase in complexity of global sourcing

strategy, successful execution of the supply chain becomes very tough. In particular, logistics, inventory management and geographical distance of the customer, among others, are major operational issues identified by both USA and foreign multinational companies engaged in global sourcing (Kotabe, 1998). Some important issues concerning global sourcing are:-

- *Transportation Cost*: Puga (2002) showed that increasing returns on scale and transportation costs encourage firms to locate close to large markets, i.e., in areas of high market potential allowing firms to concentrate and take advantage of agglomeration economies.
- *Labour Cost*: Slack and Lewis (2002) have pointed out that the labour cost has been the main driver for global sourcing and offshore manufacturing. With regard to labour, two factors can influence the cost: first, the productivity of labour employed, which on an international level is often inversely related to labour cost. This means that generally the average amount produced by each individual employed in a given unit of time is greater in countries with higher labour cost, which happens at least partly because in countries with high labour costs there is more incentive to invest in productivity-enhancing technology.
- *Rate of Exchange of Currencies:* Exchange rates may swing considerably over time, and this, in turn, changes relative labour cost, transportation cost and profits. These adjustments may exert a major influence on the decision as to where to locate, especially in industries where labour costs are a high proportion of total costs. Transportation costs are clearly spatially variable because the resources need to be transported from the manufacturing points to customers.
- *Just-In-Time (JIT) Sourcing:* Compatibility of JIT sourcing and global sourcing is an important logistic issue in global sourcing (Fawcett and Birou, 1992; Das and Handfield, 1997). The main conflict here is that of buyer-supplier proximity, since JIT sourcing places emphasis on the delivery of small quantities in frequent intervals, whereas the large distance of global sources invariably commands transportation in large batches (for example, full truck loads). The required proximity is seldom attainable for globally sourced items, which are characterized by longer, less reliable international supply lines (Fawcett and Birou, 1992). According to the view of Vickery (1989), the key factors for achieving global JIT sourcing include improved logistical and production planning and scheduling by the buyer; implementation of effective buyer-seller communication links; the development of buyer-seller long-term relationships with consequent volume and logistical economies; and expeditious clearance and movement through customs.
- *Flexibility of the Supply Chain:* Flexibility of supply chain has been an important issue in many studies (Fisher, 1997; Gilmore and Pine 1997; Lummus et al., 2003), since the understanding of the supply chain flexibility is important for several reasons: increasing demand of mass customization without increase in cost (Howleg and Pil,2001), uncertainty in demand, and rapid introduction of new product in market. The flexibility may include modification flexibility, delivery flexibility and volume flexibility.
- *Hidden Cost of Global Sourcing:* There may be several hidden costs associated with global sourcing and manufacturing, resulting from currency fluctuations to the cost of engineering support and the strategic risk of losing knowledge/technology to future competitors.

In case of India, with respect to the above issues, India itself is a big auto market due to various reasons: firstly, a large population and high rate of increasing per capita income as it is an outsourcing centre of the IT industry which has increased the source of foreign currencies. Secondly, to supply the Completely Knocked Unit (CKU) to other markets in south and south-east Asia, India has a strategic location which requires low transportation costs in comparison to European countries and USA. Thirdly, in India, there is high-productivity Japanese technology but labour costs are low due to the high rate of population growth and availability of a large number of qualified engineers and labour. This question is directly related to the demand and supply of labour.

Challenges for the Rapid Growth of the Indian Auto Industry

There are some challenges for the Indian government to turn India into a top global sourcing centre for the auto industry. These challenges are outlined in the following paragraph with suggestions to meet the challenges.

Poor Road Infrastructure & Traffic Laws: There is inadequate road facility in India which affects transportation. Most roads are single-lane ones, not properly

maintained, heavily crowded and accident prone. The Indian Government has planned to connect all the metro-cities with six-lane roads, but even this is not sufficient. The estimated cost to build up an extensive road network in India is approximately $30 billion. This can be privatised to reduce the economic pressure on the Government.

To minimise the industrial pressure and high density of pollution in big cities like Delhi, Mumbai, Chennai, Kolkata, and Ahmedabad etc, all the small towns must be provided with four to six-lane roads, rail transport and rich infrastructure like banking facilities, airport, high security, availability of land for industrial setup. To minimise the rate of road accidents the traffic laws must be well enforced.

Shortage of Component Suppliers (Size & Sophistication): The significant tariffs imposed on imported products and components combined with the vagaries of currency exchanged rates make localization an important imperative for foreign companies entering the Indian market. Firms are already making a major effort to localize rapidly; the Daewoo-DCM venture is expected to raise its local content to 90 per cent by the decade's end. One challenge to localization is a shortage of component suppliers with size and sophistication (Krishnan, 1996). The Indian Government should concentrate on preparing a sophisticated network of auto components suppliers.

Proper Vehicle Retirement Programme and Reverse Logistics: A vehicle retirement programme is required which will assist not only in fleet modernization and reduction of emission, but will also provide a quantum boost to demand. Before the retirement of vehicles there should be proper arrangement of reprocessing or destruction of the vehicles to reduce the pollution and dumping space problem.

Reforms in Labour Law: Labour law reforms to facilitate better productivity and reduction in manpower costs, as has already been committed by the Government, should be expedited.

Development of R&D Centre: Research and development in the field of auto industry in India is not up to the mark. To make the nation the centre of global sourcing of automobile a strong research and development must be facilitated as in the IT industry. There should be special training institution for automobile engineering similar to the Indian Institute of Information Technology.

Conclusion

India is an emerging automobile giant. Its auto policy is becoming more global and compatible with WTO norms. But, this industry will have to meet challenges of newer technologies, alternative fuels and affordability of automobiles by people at large through constructive cooperation. There are huge challenges ahead for the Government with regard to infrastructure and facilities, which need to be solved.

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To have a harmonious family life, we must spend time with our family. There is no such thing as quality time if we can spend only a little of it with our families. Employees who are happy at home are more productive. In the end, the company profits.

– Carolyn Baytion-Sunaryo

Feature

The Current Practices of ISO 9001:2000 Certification and Its Effectiveness in Indian Tyre Industry

Rajashekara Swamy & B. Mahadevappa

This paper aims to study the motives, current practices and effects of ISO certification on the Indian tyre industry. The findings reveal that the certification has led to improved company quality image, upgradation of product, service and market share, strengthening of the quality management system, and also it helps to integrate ISO 9001:2000 with total quality management. The effects of certification include improved quality awareness, employee morale, teamwork, customer satisfaction, reduced scrap and defect levels, customer complaints and cost of quality.

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The general perspective of any organisation to introduce quality management system is to achieve higher levels of quality and thereby achieve better market share. This involves a radical change in current practices. Various management philosophers have propounded different approaches to enhance quality. One such proponent is the ISO 9000 quality management system. Moreover, the creation of a global market, invention of newer technologies, sweeping of nations' boundaries and a shift towards customer focused strategies, have resulted in more critical competition than ever before. It seems today that ISO 9000 has become an indisputable and powerful instrument for achieving better quality, which cannot be disregarded.

A major strategic change is that many organisations are striving to achieve customer satisfaction through an emphasis on quality of products and services. It is not surprising that this emphasis on quality results in achieving and sustaining global competitiveness, which depends on providing superior quality products and services to the consumers. Facing challenges and threats from global competitors, the Indian tyre industry has also adopted various quality management systems. Most of the players in the industry claim that there is a significant improvement in the quality of products after implementing these quality initiatives. This study was undertaken to investigate the current practices of ISO 9001:2000 certification and its effectiveness on quality performance in the Indian tyre industry.

Quality is of strategic importance in global competition. It must evolve into a way of life. Its success is largely dependent on how well it is integrated into the company's culture. ISO 9000 provides the first stepping stone in this intended direction (Anil Gupta 1996).

Worldwide, ISO 9000 has become the most com-

monly accepted series of quality standards, and certification to one of these standards is becoming a necessary pre-condition for a company's survival in the future. The system proposed by the standard should be implemented in the best possible way, creating a solid background for its future evolution to a total quality system. Certification is not the end; it is only the beginning of the company's quality journey (George Tsiotras & Katerina Gotzamani).

Quality has emerged as a strategic competitive tool for organisational success (Yong & Wilkinson 2002). Organisations cannot afford to ignore the strategic implications of quality for their competitive position in the local and global market. As a result of this, a large number of private and public sector manufacturing and service organisations worldwide, are implementing quality assurance systems that conform to the ISO 9000 series of standards. Certification has become a critical component for most of the manufacturing companies. However, some companies implement ISO 9000 as a tool for improving their quality system, while others use it as a requirement of surveillance.

ISO 9000 provides an appreciation of the fundamental principles of quality management system and an explanation of the terminology used in the family of standards. ISO 9001:2000 provides requirement, which if met, will enable the organisation to demonstrate the capability to consistently provide products that meets customer and applicable regulatory requirements (David Hoyle 2001).

ISO 9000 series is different from other quality standards. It develops comprehensive quality assurance system for everything from design of a product to the servicing of the customer after the product has been delivered (S. Subba Rao 1997).

Several benefits are derived from ISO 9000 registration. Implementing the ISO 9000 quality assurance system brings some internal benefits like higher employee productivity, systemisation with good documentation of data, internal auditing, clear managerial responsibility with motivated workers, quality control and increased competency in sales. As a result, product quality could be improved (Li-Hsing Shih 1996).

Certification is viewed as an opportunity to improve internal processes and systems, rather than a mechanism to get a certificate on the wall, which is likely to yield positive results (Tonvan Der & Alan Brown 1997).

Although a lot of research and surveys have been conducted on issues relating to quality management practices, there is no study that exclusively discusses the effectiveness of ISO 9001:2000 in the Indian tyre industry.

Research Methodology

The specific objectives of the study are;

- To investigate the motives for ISO 9001:2000 certification.
- To examine the extent of current practices of ISO 9001:2000 certification.
- To study the effectiveness of ISO 9001:2000 on quality performance.

To examine the effectiveness of ISO 9001:2000 certification on quality performances, the following hypotheses were formulated and tested in the study.

H_1: The greater the extent of current practices of ISO 9001:2000, the higher is the quality awareness, employee morale, teamwork, customer satisfaction.

H_2: The greater the extent of current practices of ISO 9001:2000, the lower is the customer complaints, scrap and defect levels and cost of quality.

The study was conducted on three ISO 9001:2000 certified tyre manufacturing companies in India. In these sample companies, senior, middle, lower level managers and shift engineers were randomly selected to administer questionnaires and conduct personal interviews. Table 1 provides the demographic information of the respondents that participated in the study.

Table 1: Demographic characteristics of management respondents

(n = 104)

Sex	%	Age (in yrs)	%	Education	%	Position	%
Male	98.02	21–30	18.3	Post-Graduate	29.8	Top Management	21.2
Female	1.98	31-40	32.7	Graduate	40.4	Middle Management	38.5
		41-50	33.7	Diploma	20.2	Lower Management	38.5
		51 & above	12.5	PUC/ SSLC	7.7	Missing	1.8

The Research Instrument

Structured questionnaire is the most efficient tool to elicit data from a large, dispersed population. The survey questionnaire was based on the clauses of ISO 9001:2000. It was used as a prime data collection tool. The questionnaire consists of 52 close-ended questions arranged under the Likert scale. Respondents of this study were requested to indicate the extent of current practices of ISO 9001 certification in their organisation, using the five-point Likert scale ranging from strongly disagree (=1) to strongly agree (=5). The higher the score the higher extent of current practices and vice versa.

To study the effectiveness of certification, two types of quality performance variables were applied. In the first type, quality awareness, customer satisfaction and teamwork were used. In the second type, cost of quality, customer complaints, and scrap and defects were used. To measure quality performance, the five-point Likert scale ranging from major deterioration (=1) to major improvement (=5) was used. Second category variables were reverse scaled i.e., a lesser scale score indicates a major increase in scrap/defect level, customer complaint, and cost of quality and vice versa.

Data Collection and Analysis

Primary data: The entire exercise of investigation would itself be an investigation of the investigator, in as much as it would be a measure of his judgment of people, his sense of fairness and his ability to perceive. Structured questionnaire and personal interview constituted the primary source of data collection.

As the study is mainly aimed at investigation of effectiveness of ISO 9001:2000 in the tyre industry, it is felt that any informal structured interview would help to probe and elicit reactions of the respondents. Personal interview will be considered as one of the effective tools of data collection for this study. Accordingly, a series of personal interviews were conducted after collecting and analysing questionnaires.

Secondary data: Collection of data by reviewing scholarly and professional works of ISO and TQM proponents, including research reports, journals and other published works, which formed the secondary data.

Data analysis

Considering the objectives of the study, a descriptive statistical method was employed in analysing the data. The descriptive statistical measures include mean and standard deviation. Correlation analysis was used to test the hypotheses. Statistical package for social sciences (SPSS) was used for statistical analysis.

Reliability analysis

Mean and standard deviation of each clause of ISO 9001:2000 are presented in Table 2. The reliability values for each clause based on Cronbach's alpha are also shown. Reliability is the extent of repeatable measurements measured by different individuals at different points of time or occasions (Nunally 1978). Cronbach's alpha was computed based on the set of given items and it determines the reliability based on internal consistency. It is evident from Table 2 that reliability coefficients range from 0.77 to 0.98 except in clause 20. The higher the values of alpha, the greater the reliability. The

Table 2: Results of reliability analysis

Clauses of ISO 9001:2000	No. of Items	Mean	S D	Cronbach's Alpha
1. Management Responsibility	4	4.28	0.52	0.81
2. Quality Management System	4	4.31	0.43	0.81
3. Contract Review	3	4.20	0.55	0.86
4. Design Control	4	4.16	0.53	0.85
5. Document & Data Control	3	4.25	0.52	0.85
6. Purchasing	2	4.13	0.61	0.81
7. Product Identification	2	4.26	0.60	0.79
8. Process Control	2	4.30	0.57	0.96
9. Inspection & Testing	3	4.27	0.47	0.78
10. Control, Inspection, Measuring, Testing Equipment	2	4.30	0.54	0.81
11. Inspection & Testing Records	2	4.25	0.49	1.00
12. Control of non conforming products	2	4.23	0.64	0.78
13. Corrective & Preventive Action	4	4.16	0.63	0.90
14. Storage, packing & delivery	2	4.22	0.57	0.92
15 Customer-Supply products	2	4.14	0.60	0.93
16. Internal quality audits	3	4.20	0.56	0.79
17. Control of quality records	2	4.27	0.47	0.87
18. Training	2	4.20	0.66	0.99
19. Servicing	2	4.22	0.73	1.00
20. Statistical Tools	2	4.20	0.54	0.61

coefficients, which are 0.70 or higher are considered adequate (Nunally 1998). Henceforth, the scale used is judged to be reliable.

Results and Discussion

The results of the study were presented in three sections. The first section deals with the motives for certification, second section with the current practices of ISO 9001:2000. Effectiveness of certification is studied in the last section.

Motives for ISO 9001:2000 certification

The results from Table 3 demonstrate that 56 respondents agree that ISO 9001:2000 certification improves company quality image. Quality of an organization's products or services is the primary concern. 46 respondents felt that certification upgrades product and services, and in turn increases market share. Company's procedure, processes, rules, regulations, controlling, assuring and documentation being the key elements of certification, 48 respondents strongly agree that ISO 9001:2000 certification strengthens the quality management system. Certification leads to an orderly organisation once it is implemented. Predominantly, less than 50 respondents strongly agree that certification integrates ISO 9001:2000 with total quality management.

Table 3: Motives for ISO 9001:2000 certification

Motives	Strongly disagree	Dis-agree	Neither agree nor dis-agree	Agree	Strongly agree
1. Improve company quality image	3	-	5	40	56
2. Upgrade product, service & market share	2	1	8	47	46
3. Strengthen quality manage-ment system	4	1	6	45	48
4. Integrates ISO 9001: 2000 with TQM	4	3	14	42	41

Any company can build up a quality management system without implementing or consulting ISO 9000. However, there are many advantages of establishing quality systems according to ISO 9000 norms. ISO 9000 standards challenge other well-established quality management systems (Skarabec 1995). The survey results show that the implementation of ISO 9001:2000 improves company image. The certification creates an orderly organisation once it is placed in the right direction. It is merely a tool, not an objective in itself. It helps the company develop and maintain its practices and standards, and thereby maintain its image in the industry. It should be noted that, while ISO certification signifies the presence of adequately functioning quality system, it does not guarantee the quality of products or services. It is evident from this that ISO 9001:2000 certification gives significant leverage to many factors that affect operational effectiveness, which in turn influences competitive advantage on product (demand/supply), services and product leadership (market share).

The results depict that the certification has strengthened quality management system. ISO 9001:2000 standards provide the discipline and infrastructure that are necessary to make a major improvement in a company's quality system. The system helps in improving the internal organisation, productivity and in upgrading the quality management system of the company. ISO 9001:2000 is a guide to build quality management system and a stepping stone for implementation of TQM. ISO 9001:2000 provides any company an easier transition to adopt TQM.

Extent of current practices of ISO 9001:2000 Clauses

The average scores on extent of current practices of ISO 9001:2000 clauses in Table 4 ranges from 4.14 to 4.30.

The mean value of these average mean scores is 4.22. Average mean values of nine clauses are less than 4.22. They include design control (4.17), purchasing (4.13), corrective and preventive actions (4.16), customer supply products (4.14), internal quality audit (4.20), training (4.20), storage, packaging and delivery (4.21), contract review (4.20) and statistical tools (4.20). Obviously, these ISO 9001:2000 clauses will require more attention by the management. Average mean value of the clause servicing (4.22) is equal to 4.22. Average mean scores of the remaining ten clauses are more than 4.22.

Each of the clauses are analysed as follows on basis of the responses to structured questionnaire.

1. Management responsibility

The study shows that ISO 9001:2000 certified companies in the tyre industry have a well defined, documented and disseminated customer oriented quality

Table 4: Average scores on extent of current practices of ISO 9001:2000 Clauses

Description		Mean	SD
1.	**Management Responsibility**	4.28	0.62
1.1	Has a well-defined, documented and disseminated customer oriented quality policy.	4.35	0.48
1.2	Identifies resource requirements and provides adequate resources to implement ISO 9001 quality management systems.	4.32	0.54
1.3	Appoints senior executive with clearly defined authority and responsibility to implement quality management system.	4.19	0.81
1.4	Reviews the quality management system at regular intervals to ensure its effectiveness.	4.27	0.68
2.	Quality Management System	4.30	0.53
2.1	Has a detailed quality manual that establishes documents and maintain quality systems and procedures.	4.39	0.51
2.2	Quality system procedures are consistent with the requirements of ISO standard and company's quality policy.	4.35	0.51
2.3	Defines and documents how the requirements for quality will be met through quality plans.	4.27	0.49
2.4	Defines and documents how the needs, requirements for quality will be met through quality control, inspection and testing.	4.22	0.63
3.	Contract Review	4.20	0.62
3.1	Ensures that the requirements are adequately defined and documented before entering into contract.	4.22	0.63
3.2	Defines and documents procedures used to amend contracts and communicate the changes internally.	4.20	0.59
3.3	Maintains and updates records of all contract reviews.	4.18	0.65
4.	Design Control	4.17	0.63
4.1	Establishes and maintains documented procedures to verify the design of product which meets the requirements.	4.25	0.60
4.2	Designs and documents organisational and technical interfaces between groups involved in design process.	4.14	0.65
4.3	Identifies, documents and reviews the selection of design input/output requirements for adequacy and validation.	4.17	0.64
4.4	Plans, conducts and records formal reviews of design results at respective stage.	4.11	0.64
5.	Document and Data Control	4.25	0.59
5.1	Establishes and documents procedures to control all documents and data relating to ISO requirements.	4.32	0.51
5.2	Ensures the appropriate documents are available/obsolete through the control system and provides a tracking procedure for revision.	4.22	0.63
5.3	The same functional department reviews the changes which performed the original review for approval.	4.21	0.64
6.	Purchasing	4.13	0.66
6.1	The system ensures a well defined documented procedure to select and control suppliers.	4.11	0.68
6.2	A clear procedure is documented to verify products on the supplier's premises.	4.15	0.65
7.	Product Identification	4.25	0.66
7.1	Has a documented procedure for identifying the product from receipt through production delivery and installation.	4.26	0.61
7.2	Unique identification of individual products and batches is well documented.	4.25	0.71
8.	Process Control	4.29	0.57
8.1	Identifies the production, installation and servicing processes to ensure documentation of all procedures, compliance with quality standard, monitoring of process parameters.	4.29	0.60
8.2	Plan the production, installation and servicing processes to ensure documentation of all procedures, compliance with quality standard, monitoring of process parameters.	4.30	0.55
9.	Inspection and Testing	4.27	0.56
9.1	Maintain documented procedure to ensure that incoming products conform to specific requirements.	4.33	0.60
9.2	Records the amount of control exercised at supplier's premises.	4.16	0.62

(Contd.)

Table 4: Average scores on extent of current practices of ISO 9001:2000 Clauses *(Contd.)*

Description		Mean	SD
9.3	Final inspection and testing is carried out in accordance with the quality plan and is documented.	4.32	0.48
10.	Control, Inspection, Measuring, Testing Equipment	4.30	0.57
10.1	Maintain documented procedure to control, calibrate and inspect.	4.32	0.50
10.2	Controlling, calibration and inspection is done at regular intervals and documented.	4.28	0.65
11.	Inspection and Testing Records	4.25	0.49
11.1	Documents all the inspection records	4.25	0.49
11.2	Documents all the test status of all the products	4.25	0.49
12.	Control Of Non-Conforming Products	4.23	0.71
12.1	Documents to ensure the products not conforming to requirements are not used.	4.20	0.79
12.2	Non-conforming products are reviewed, reworked or rejected.	4.26	0.62
13.	Corrective and Preventive Action	4.16	0.70
13.1	Maintains documentation to ensure corrective and preventive actions.	4.28	0.56
13.2	Corrective actions include investigation of the cause of non-conformation.	4.17	0.78
13.3	Preventive actions include application of controls to ensure the effective preventive action taken.	4.11	0.76
13.4	Procedures of corrective and preventive actions taken are reviewed by the management.	4.09	0.73
14.	Storage, Packaging and Delivery	4.21	0.59
14.1	Maintain documentation procedure for handling, storage, packaging, preservation and delivery of products.	4.25	0.57
14.2	Procedural steps are followed to prevent damage or deterioration during handling, storage and packaging to ensure conformance to specific needs of quality of products.	4.18	0.61
15	Customer-Supply Products	4.14	0.61
15.1	Establish a documented procedure for verification, storage and the maintenance of the components as supplied by customers	4.17	0.63
15.2	Maintain documented procedures for verification, storage and the maintenance of the components as supplied by customers	4.11	0.60
16.	Internal Quality Audits	4.20	0.66
16.1	Establish and maintain documented procedures for planning and implementation of internal quality audits.	4.27	0.58
16.2	Internal quality audits are scheduled on the basis of status and importance of the activity.	4.10	0.76
16.3	Results of the audits are recorded, reviewed by the management and corrective actions are taken.	4.22	0.66
17.	Control of Quality Records	4.27	0.50
17.1	Establish documented procedures for identification, collection, indexing and filing of quality records.	4.28	0.49
17.2	Quality records are maintained to demonstrate conformance to specified needs and the effective operation of quality system.	4.26	0.52
18.	Training	4.20	0.67
18.1	Establish a documented procedure for identifying the trainers and training needs.	4.21	0.66
18.2	Maintain documented procedure for identifying the trainers and training needs.	4.20	0.67
19.	Servicing	4.22	0.73
19.1	Establish a documented procedure for performing, evaluating and reviewing of service requirements.	4.22	0.73
19.	Maintain documented procedures for performing, evaluating and reviewing of service requirements.	4.22	0.73
20.	Statistical Techniques	4.20	0.62
20.1	Identify and use statistical techniques to establish, control, and verify process capability and product characteristics	4.12	0.75
20.2	Establish and maintain documented procedures for implementing and controlling the application of these techniques	4.28	0.49

policy and also that they provide adequate resources to implement ISO 9001:2000 quality management system. The average mean score of management responsibility is 4.28 which is more than the mean value. Of the four sub-clauses, the two are less than the mean value. To strengthen the implementation of ISO 9001:2000, the study demands senior executives with clearly defined responsibilities who review the quality management system at regular intervals.

2. Quality management system

The study reveals that the certified companies have a detailed quality manual that establishes documents and maintain quality system and procedures. Such procedures are consistent with the requirements of ISO standards and company's quality policy. The mean average score of quality management system is 4.30. Of the four sub-clauses, the values of two sub-clauses are less than the mean average score. 4.27 is the mean score for defining and documenting the requirements for quality will be met through quality plans, and 4.22 is for how the needs and requirements for quality will be met through quality control, inspection and testing. The system should emphasise more on these two clauses by enforcing proper communication, right instructions, personnel with legitimate authority, provide consistency and predictability in carrying out the required tasks.

3. Contract review

The average score of contract review is 4.20. Of the three sub-clauses, one is equal to the average score, second one is more than the average score and the other is less than the average score. This shows that the system ensures the requirements are adequately defined and documented before entering into a contract. It also defines and documents the procedures used to amend contracts and communicate the changes internally. However, the companies have to give more importance in maintaining and updating the records of all contract reviews, as the mean value for the sub-clause is (4.18 4.20) is less than the average score.

4. Design control

"Control of design and development does not mean controlling the creativity of the designer; it means controlling the process through which new or modified designs are produced so that the resultant design is one that truly reflects the customer needs" (David Hoyle 2001). From the analysis, the average mean score of design control is 4.16. Of the four sub-clauses two are less than the average mean score and two are more than the mean score.

Low scores of sub-clauses "designs and documents organisational and technical interfaces between groups involved in design process," and "plans, conducts and records formal reviews of design results at respective stage" indicates that when the management encounters difficulties in fulfilling their responsibility, in establishing and maintaining well documented quality system which leads to failure in design control and in turn fails to control conformity of products to quality standards.

5. Document and data control

The high mean score in document and data control (4.32) sub-clause indicates that the system has well established documents and procedures to control all documents and data relating to ISO requirements compared to the average mean score of the clause (4.25). Considerably low mean scores of two sub-clauses (sub-clause 5.2 = 4.22 and sub-clause 5.3 = 4.21) indicate that there is a draw back in ensuring the availability of documents and in providing a tracking procedure for revision and revival of any changes by same functional department which had reviewed earlier. A note of caution needs to be mentioned here, that ISO requires management to ensure appropriate documentation and control for revival within the organisation.

6. Purchasing

Though the system provides a clear procedure for verifying the products at the supplier premises (4.15 > 4.13), the system lacks in ensuring a well documented procedure to select and control suppliers (4.11 < 4.13). The system should ensure well established criteria for selection, evaluation, re-evaluation and control of suppliers. The system should emphasise for flow of the information which describes the product to be purchased and also ensures the product meets specific quality requirements.

7. Product identification

Product identification plays a major role in preventing inadvertent effects. The survey shows a significant result in having a well documented procedure for identifying the product from receipt to production, delivery, installation and unique identification of individual products and batches.

8. Process control

The study shows that ISO 9001:2000 certified companies in the tyre industry have well defined plans and procedures for identifying the production, installation

and servicing processes and ensure compliance with quality standards and monitoring of process parameters, which is enunciated by the individual scores of both the sub-clauses, which is more or less equal to the average mean score 4.29.

9. Inspection and testing

Indian tyre companies have achieved a greater excellence in maintaining documented procedure, inspection and testing within their own premises, but they have failed in exercising their managerial excellence at the supplier's premises. The lower score (4.16 <4.27) of sub-clause 9.2 depicts that the system lacks in ensuring a proper procedure to record the amount of control exercised at supplier's premises.

10. Control, inspection, measuring, and testing equipment

From this empirical study it is known that the system lacks in documentation of controlling, calibration and inspection at regular intervals, on contrary to a well maintained documented procedure to control, calibrate and inspect with high score of 4.32 to that of the average mean score (4.30). The ISO requires the management to establish procedures to control, calibrate and maintain equipment at regular intervals, which is used to demonstrate conformance to the requirements.

11. Inspection and testing records

The study shows that ISO 9001:2000 certified companies in the tyre industry have a well defined and documented inspection records and test reports of all the products, which is enunciated by the mean scores (4.25) of each individual sub-clauses. This suffices that the certified companies have significantly a strong hold in implementing this clause. It is felt that the companies are practicing this clause to a satisfactory level.

12. Control of non-conforming products

The figures in Table 4 portray that the companies have adopted better practices in reviewing, reworking and rejecting the non-conforming products, but they lack in documenting the same. The system should have a systematic documentation which ensures preventing the usage of non-confirming products and thereby achieving better quality of products.

13. Corrective and preventive action

On contrary to the clause 12, these companies ensure documentation of corrective and preventive actions. Mere documentation doesn't serve the purpose; it should be followed by the corrective and preventive action, which falls short to meet the required standard. The mean scores of second (4.17), third (4.11) and fourth (4.09) sub-clauses shows that these companies have to adopt improved corrective and preventive practices.

The high score (4.28 > 4.16) of the sub-clause 13.1 depicts that the certified companies maintains documentation to ensure corrective and preventive actions, but fails to investigate the cause for non-conformation. The reason could be due to the difficulty in corrective and prevention action caused by failures in fulfilling the design control requirements which directly affects the adherence of requirements stipulated by corrective and preventive actions. The certified companies should investigate cause of non-conformance and take action to prevent them from reoccurring in the future and review the quality management system at regular intervals.

14. Storage, packaging and delivery

The survey depicts that the system allows to maintain documented procedure for handling, storage, packaging, preservation and delivery of products (4.25 > 4.21), but it was felt that the procedural steps followed to prevent damage or deterioration during handling, storage and packaging to ensure conformance to specific needs of quality of products (4.18 <4.21) to a lower extent. These companies must establish a proper procedure at all stages to verify that the specific requirements are met.

15. Customer-supply products

The survey results shows that ISO 9001:2000 certified companies in the tyre industry have a well established documented procedure for verification, storage and the maintenance of the components supplied by customers (4.17>4.14), but lacks in maintaining documentation which is depicted by the individual mean score 4.11 in Table 4. The tyre manufacturers must have processes and systems in perfect place for storage and maintenance of all purchased products/materials and to identify and correct any problems in purchased components to meet specific requirement.

16. Internal quality audits

The purpose of quality audits is to establish unbiased factual information on quality performance. Quality audits are the measurement component of the quality system, (David Hoyle 2001). The average mean score shows that

Table 5: Effects of ISO 9001:2000 certification

Effects	Major improvement	Minor improvement	No effect	Minor deterioration	Major deterioration	Popular Rate (%)	Rank
Customer complaints	59	35	9	0	1	90	1
Increased confidence in organisation's quality management system	55	38	11	0	0	89	2
Quality awareness	32	58	12	1	1	86	3
Employee morale	38	51	11	3	1	85	4
Training & education	45	44	13	2	0	85	5
Customer relationship	45	44	14	0	1	85	6
Clearly defined responsibilities & obligations	51	35	16	2	0	82	7
Teamwork	32	52	17	1	1	80	8
Supplier's relationship	44	35	10	10	5	75	9
Cost of quality	38	41	22	3	0	75	10
Customer satisfaction	40	2	51	10	1	40	11
Scrap & defect levels	32	4	57	10	1	35	12

the system lacks in implementing the internal quality audits. The certified companies must establish and maintain a system of internal audits to verify that its activities comply with requirements and provides a feedback to the top management about its effectiveness.

17. Control of quality records

There is congruence with quality management system in establishing documented procedures for identification, collection, indexing and filing of quality records and quality records are maintained to demonstrate conformance to specified needs and the effective operation of quality system.

18. Training

Training, pervasive in nature, is intended to be an integral part in implementing ISO 9001:2000. Comparing the average mean scores of all the twenty clauses, with each other, it is felt that the average mean score for training is comparatively less. The certified companies must establish and maintain documented procedures and identify training needs, provide training for all employees performing the activities that affect overall quality management system.

19. Servicing

Indian tyre companies have clearly defined the service objectives and targets. The study decisively depicts that the procedures developed to ensure the service are being performed in true spirit as required by the customer, as the average mean score (4.22 = 4.22) is equal to the individual mean scores of the sub-clauses, which can be seen in Table 5.

20. Statistical techniques

Statistical techniques are useful to evaluate the degree of conformance in meeting the specifications. Organisations attempt to design quality into their processes which continually relies on monitoring of the inputs and outputs in producing goods and services. It is felt from the survey results that the system should identify statistical techniques which can be used to control processes, products and services. The management must establish procedures, train the personnel concerned and identify the use statistical techniques to establish, control, and verify process capability and product characteristics.

Effects of ISO 9001:2000 certification

Impact of ISO 9001:2000 certification on quality performance can be evaluated in detail with the aid of Table 5. The remarkable impact is seen in the increased level of quality awareness, employee morale and teamwork within the organisation. About 90 per cent of respondents assert that there is a positive impact. Also they claim a major improvement in customer satisfaction.

Table 5 outlines the impact of ISO 9001:2000 certification on quality performance in the Indian tyre industry. By implementing ISO, the popular rate of effectiveness of ISO 9001:2000 certification is raised from 35 per cent to 90 per cent. The popular rate of mean rank is 84 per cent. The ISO 9001:2000 certifica-

tion has made a positive impact in reducing customer complaints, increasing confidence in quality management system, quality awareness, employee morale, training and education, clearly defined responsibilities and obligations, strengthening customer relationship, and teamwork. However, the impact of ISO 9001:2000 certification in reducing scrap and defect levels, improving customer satisfaction, and cost of quality is comparatively low.

The results of Pearson's product moment correlation analysis between the mean score of independent variable consists of 52 items of ISO 9001:2000 clauses as shown in Table 2 and mean score of dependent variables such as quality awareness, employee morale, teamwork. etc., are shown in Table 6.

Table 6: Results of correlation analysis

Quality Performance Variables		r	p – value
1.	Quality awareness	0.389	0.000*
2.	Employee morale	0.427	0.000*
3.	Teamwork	0.327	0.001*
4.	Customer satisfaction	0.380	0.000*
5.	Clearly defined responsibilities & obligations	0.651	0.000*
6.	Increased confidence in organisation's quality management system	0.621	0.000*
7.	Training & education	0.668	0.000*
8.	Customer relationship	0.670	0.000*
9.	Suppliers' relationship	0.631	0.000*
10.	Scrap & defect levels	-0.310	0.001*
11.	Customer complaints	-0.377	0.000*
12.	Cost of quality	-0.093	0.346**

* p – value 0.01** p – value 0.4

The correlation coefficients of quality awareness, employee morale, teamwork, customer satisfaction, clearly defined responsibilities and obligations, increase in confidence in quality management systems, training and education, customer relationship, and suppliers' relationship are positively and significantly related with ISO 9001:2000 clauses. The positive correlation results shows that the greater the extent of current practices of ISO 9001:2000 clauses, the higher is the level of quality awareness, employee morale, teamwork, customer satisfaction, clearly defined responsibilities and obligations, increase in confidence in quality management systems, training and education, customer relationship, and suppliers' relationship. This significant correlation results support first hypothesis.

The correlation coefficients of customer complaints, and scrap and defects levels are negatively and significantly related with ISO 9001:2000 clauses as seen in Table 6. The negative correlation result shows that the greater the extent of current practices of ISO 9001:2000 clauses, the lower is the level of customer complaints, and scrap and defect levels. This significant correlation result, supports the second hypothesis partially.

However, the correlation coefficient of cost of quality is negatively but insignificantly related with ISO 9001:2000 clauses. The insignificant negative correlation result shows that the extent of current practice of ISO 9001:2000 has not resulted in significantly reducing the cost of quality. The reason could be imprecise measurement of the cost of quality.

Conclusion

ISO 9000 may be adopted in pursuit of a wide range of short and long-term business objectives and implemented in the wider framework looking at the firm's overall strategic orientation. The outcome of adoption will be more evident on specific targets and also on overall business performance. The system proposed by the standard should be implemented in the best possible approach. The major purpose of this study was to examine the extent of current practices of ISO 9001:2000 and its effectiveness in the tyre industry. Responses were collected from senior, middle and lower level managers in three ISO certified companies. The findings of this study indicate that the certification has generated a momentum in improving the image of the company followed by upgradation in quality of product, service and market share.

The results of this study also show that the sample companies have been practicing ISO 9001:2000 clauses to a higher extent for improving quality performance through effective quality management system. Without any reservation, the clauses have triggered long awaited transformation in managing the quality system in particular and overall organisational performance in general.

The study results support the first hypothesis fully and the second hypothesis partially. The ISO 9001:2000 certification improves quality awareness, employee morale, teamwork, and customer satisfaction; reduces scrap, customer complaints, and cost of quality. However, the results of this study were based on a small sample of respondents drawn randomly from three companies.

The authors opine that higher level of qualitative performance can be achieved by integrating ISO with

TQM concept. ISO certifications can act as a springboard in implementing total quality management. Structured documentation process supports the cultural transformation of organisations towards total quality management.

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When you write down your ideas, you automatically focus your full attention on them. Few if any of us can write one thought and think another at the same time. Thus a pencil and paper make excellent concentration tools.

– Michael LeBoeuf

Feature

Economics of Broiler Farming in Maharashtra

Sangeeta Shroff & S.S. Kalamkar

Poultry farming provides an effective source of subsidiary income to the rural sector. This paper studies poultry development and total broiler meat production in the state. It was found that feed accounted for much of the variable costs. Increase in maize yields will help to drive down feed costs and thus give a competitive advantage to the poultry industry.

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Maharashtra, like all states in India, is predominantly an agricultural economy especially with respect to workforce. A comparison of the state with the national figures shows that at the all-India level, 59 per cent of the workforce (2000-01) is employed in agriculture, while the corresponding figure for Maharashtra is 55 per cent. Although the share of workers in agriculture is lower in Maharashtra as compared to India, a district-wise analysis presents a different picture. If we exclude the workforce in Mumbai, which is the commercial capital of India, from the total workforce in the state, it is observed that almost 20 out of 34 districts had more than 70 per cent of their workforce engaged in the agricultural sector, while 29 districts had more than 60 per cent in agriculture. These figures are more than the national average. Thus although agriculture emerges as a key sector in the state in terms of economic activity of the workforce, the contribution of this sector with allied activities to state domestic product declined from 28 per cent in 1980-81 to 14 per cent in 2000-01.

Agriculture in Maharashtra is mainly rain fed and barely 16.4 per cent of the gross cropped area is irrigated. This to a large extent explains the low productivity in agriculture in the state where the cropping pattern is dominated by low value coarse cereals, leading to low income of the farmers. In order to supplement their incomes, farmers have been resorting to allied activities such as poultry farming. Accordingly, poultry rearing which was a backyard venture in the 1960s, became commercial since the 1970s and is now poised for a dramatic growth with tremendous potential.

Significance of Broiler Farming in the Economy

The importance of poultry is viewed from several angles. Poultry farming provides an effective source of subsidiary income to the rural sector. Further, it provides quality diet in the form of animal proteins which can help to solve the problem of malnutrition in the country.

Amongst farm animals, poultry is one of the quickest and most efficient converters of plant products into food of high biological value and broiler meat is the most widely accepted meat in India and cheaper than mutton or goat meat. Poultry litter is also an important source of organic fertilizer. The requirement of small space, low capital investment, quick returns from outlay, and well-distributed turnover throughout the year, make poultry farming remunerative in both rural and urban areas. Poultry rearing can also be adopted to suit a wide range of climatic conditions and can be combined with other farm activities. As rearing of poultry birds had several advantages, this sector which was hardly commercial in the 1960s, showed signs of dramatic growth since the 1970s (see Table 1).

Table 1: Indicators of Broiler Development in India

Particulars	1970-71	1980-81	1990-91	1995-96	2000-01	2001-02	ACGR
Broiler production (million)	4	30	190	275	700	800	18.64
Poultry meat output ('000 tonnes)	86	120	334	479	575	975	8.15
Chicken availability/ person (g/yr)	220	266	521	707	827	830	4.38
Human population (million)	541	679	839	928	1019	1037	2.12

Note: ACGR-Annual Compound Growth Rate (per cent per annum) for the period 1970-71 to –2001-2002

Sources: AIPBD (2003); CMIE (2004) and Chawla, et al. (2004).

The production of broilers, which was 4 million in 1970-71 increased to 800 million in 2001-02, an increase at the rate of 18.64 per cent per annum. The output of poultry meat and chicken availability per person has also increased markedly. The average live weight of broilers of eight weeks has increased from 1 kg to 1.7 –2 kg. A network of hatcheries, feed plants, pharmaceuticals and equipment industries has taken the country near self-sufficiency in case of almost all inputs needed for this sector. The state governments in the initial stages (during seventies) when the poultry sector was just picking up, provided veterinary care services to farmers. However, the entry of private sector and their role in breeding, production of vaccines and animal health products and other drugs required by this sector has been prominent which has promoted growth in this sector.

Present Crisis in the Broiler Industry

While the poultry industry has the potential to catalyse the development of the economy, it is at the same time fraught with several challenges and is also facing crisis. The key to success of the poultry sector is to reduce the cost of inputs, which are very high in India. Maize or corn, the key input in poultry is a marginal crop in India and constitutes barely 6 per cent of the area under foodgrains (2002-03) and 3.54 per cent of the gross cropped area in 2000-01. India ranks 5th in area, 6th in production and 95th in productivity of maize in the world. The price of maize has been rising faster than the price of cereals. The index number of wholesale prices of maize was 193.6 in 1999-2000 (1993-94 = 100) and 181.2 in 2003-2004. In case of cereals, however, the index number of wholesale prices during the corresponding period was 177.8 and 176.3 respectively. The yield of maize in India is about 1806 kg/ha, while the world average is about 2.45 times that of India. In USA and China, the yield of maize is 4.8 and 2.7 times more than that of India.

The status of poultry, like other commodities is likely to undergo changes with the Uruguay round, in which a new climate for world trade is created. While trade agreements by member nations aim at integrating the developing countries more effectively into the world trading system, these commitments may not always lead to a level playing field. For example, if the aggregate measure of support (AMS) exceeds the committed level, the country has to reduce its domestic support levels. But, in case of many developed countries, as AMS is very high, even after reduction, it is above permissible limits.

Further, there are also some subsidies that are exempt from reduction commitments. They fall under two categories: the Blue Box measures and Green Box measures. These subsidies are considered to be either none or minimally trade distorting. The Blue box measures include programmes that are production limiting. These measures encourage countries to produce less and avoid creating conditions of glut in the market. They are direct payments to farmers in the form of income support. The Green Box measures essentially involve measures of the nature of funding of research, pest and disease control, trading services, extension, and advisory services, payments for relief from natural disasters and similar forms of support. This wide range of support which is exempt from reduction commitments, provides scope for developed countries to shift support from market support price to direct payments and other blue box measures. Developing countries hardly have any market support, but developed countries have very high market support even after reducing and this can make even the most inefficient farmers competitive. They are thus in a position to export at a lower price and thus outbid other competitors.

The new regime also leaves countries on an extremely uneven field in the area of using export promotion measures as countries not using any subsidies in the base period (1986-90) are prohibited from using export subsidies under the new dispensation. The ability of developing countries like India to be export competitive is greatly restricted. Developed countries, however, provide high level of export subsidies for their agricultural products. Another important commitment out of the GATT agreement for agriculture is the agreement for Sanitary and Phytosanitary measures (SPS). These measures aim at safeguarding human, animal and plant life and health. The SPS measures can create substantial barriers to trade in the agricultural and allied sector. Problems can also arise where different countries use different measures to guard against the same Sanitary and Phytosanitary risk.

As per the assurance given by the Government of India to WTO, quantitative restrictions on poultry produce have been lifted and shifted to the OGL category since April 2001. In liberalizing trade and removing quantitative restrictions, the local poultry industry will have to face a serious challenge from the developed world, which as mentioned earlier, subsidise their agriculture. Another anticipated problem by the poultry industry is the large-scale exports of chicken legs by developed countries into Asian markets. The poultry processors in these countries earn their profit on the sale of breast meat, while the leg portions considered to be dark meat are not preferred in their local markets. In countries like India, however, there is a ready demand for the leg portion of the chicken. Developed countries can therefore find an outlet for their chicken portions, which are unwanted and are treated as a by-product. These by-products can be exported at much lower rates than the cost of full chicken or the breast meat. This is so because the exporters have already earned their profit on the sale of breast meat in their home markets and also due to subsidies, which they possibly receive from their Government. The poultry economy of Sri Lanka was severely threatened by such imports into its economy by developed countries. The Government of India has announced bound rates of 100 per cent on imported poultry meat with a view to providing a level playing field for the domestic industry.

Another point to be noted is that in developed countries such as USA, there is complete automation in poultry farming. Also, in developed countries that have prosperous broiler farming, major share is accounted for, by a handful of companies. For example, in Thailand nine integrators accounted for 80 per cent of the country's production, while Brazil's five largest countries accounted for over 90 per cent of output. In USA, the broiler production is in the hands of just 56 integrators. As against this, India has about 1 lakh poultry farms, mostly concentrated in villages and on a small scale with most operations manually performed. Hence, even if we have a comparative cost advantage in the international market, our exports may receive a set back due to non-compliance of SPS measures.

Overall, it appears that an important constraint facing the poultry sector is the high feed costs due to low yields in maize as compared to the world. There are also seasonal fluctuations in the price of maize and any sharp increase can force poultry operators to close down. Besides, many poultry operators produce feed by mixing ingredients in the farm itself. In this case, farmers have to be ensured of regular availability of feed ingredients. Further, in India most poultry growers operate at sub scale and hence are not in a position to invest in the facilities necessary to lower mortality rates and enhance Feed Conversion Ratios (FCR).

The significant achievement in poultry development has come from the initiatives taken up by the private sector for commercial pure-line breeding. However, despite the huge investment made, mostly by the private sector, the poultry-processing sector is incurring losses. While broiler production has shown a phenomenal increase from 11 million in 1970-71 to 800 million in 2001-02, i.e. rate of growth is 18.64 per cent per annum, this sector is not able to achieve its potential due to production and market risks. Seasonal fluctuation in prices acts against the producer. Markets are thin and largely unregulated, often to the disadvantage of producer/sellers. If there is excess production or fall in demand, prices tend to fall. High feed cost, non-availability of credit and lack of marketing support, also lower profit margin. But these inferences are not based on scientifically conducted studies. A very few studies (Mishra and Sethi, 2002; Shrivastava, et al., 2002; Halim, et al., 2002) have been conducted to assess the production and cost aspects of broiler farming, which are also one way or the other suffering from some methodological problems. Some of the questions such as: What is the total broiler meat production in the state; What are the major costs in boiler poultry farming; What are the production and marketing constraints in broiler meat production, are important and require empirical analysis. Keeping this in view, an attempt is made in this paper to analyse the production and cost estimation of broiler meat in Maharashtra State.

Data and Methodology

This study has been carried out using both primary and secondary level information. The secondary level information has been used to study the poultry develop-

ment and total broiler meat production in the state and primary data collected from the field survey has been used to study the costing of broiler meat production in the state. The secondary data has been mainly compiled from various issues of *All India Livestock and Farm Equipment Census - Maharashtra State* (Department of Animal Husbandry, Maharashtra State, Pune); All India Poultry Business Directory (Year Book) 2003-2004, Economic Survey of Maharashtra and India, various documents published by the Ministry of Agriculture, Government of India, New Delhi and related websites. The recent data on Maharashtra's poultry development has been directly collected from the Office of Commissioner Animal Husbandry, Government of Maharashtra, Pune. The primary data has been collected from the broiler units.

For estimating the total broiler meat production in the state, the data on the number of broiler birds has been collected from Statistical Section (Poultry Wing), Office of Commissioner Animal Husbandry, Pune. The next step was to estimate the live weight of the bird from which wastage has been deducted, in order to arrive at meat weight. The live weight of the bird was obtained from the sample farms in our field survey. We obtained two types of wastage estimates from 20 shops selling broilers. The two types were one with skin and the other without skin. These two wastage estimates give two estimates for meat production i.e. meat production with skin and meat production without skin. The average meat weight of the bird multiplied by number of birds produced enabled us to obtain total meat production.

The primary data on cost of broiler meat production and constraints of broiler farms has been collected from selected sample broiler farms. A two-stage random sampling technique has been used for drawing representative sample of broiler farms with district as a primary unit and the broiler farm as the ultimate unit. At the primary stage, the selection of the district was made according to the probability proportional to its share in the total poultry population in the state. Nashik and Pune districts have been selected as two clusters as high concentration of poultry around the city. These two districts account for about 27 per cent of total poultry population and 66 per cent of broiler population of the state in 2001. The farms located around the city have been selected. At the second stage, the farms in each of the selected clusters were then stratified into three strata viz. farms with size less than or equal to 2500 birds (small farm), farms with 2501-5000 birds (medium farm) and farms with more than 5000 birds (large farms and from these three strata a total of 30 farms have been selected in each district). Thus, a total of 60 farms have been selected from the two clusters and from each of the selected farm the required data has been collected by canvassing a pre-designed schedule covering one year. The reference period for the study is November 2003-October 2004. In our sample, all units were reared in the All-in-All Out system of deep litter type wherein one batch was reared together until the cycle was complete and a new flock of fresh birds was to be introduced only after disposing off the previous batch that was already reared.

Results and Discussion

Socio-Professional Characteristics of Sample Broiler Farms

From our sample of 60 farms, it was observed that only 5 per cent of the farmers were illiterate, while 28 per cent were graduates or above. Further, 63.3 per cent of the farmers were less than 30 years of age. Only 4 farmers in our sample belonged to backward class. It was observed that none of the farms were situated near the towns and 90 per cent were located 10 kms beyond the nearest town. In about 72 per cent of the cases, the nearest residential area was beyond 2 kms and in about 52 per cent of the cases, the distance from the highway was more than 10 kms. One broiler cycle was about 40 days and each bird consumed on an average 3 kg of feed. Most farmers had contract with feed suppliers and readymade feed was also available in the market. In case of all farms, the mortality rate was observed to be about 5 per cent.

Production and Productivity of Sample Broiler Farms

The data collected from a sample of 20 shops selling broilers revealed that the average meat production with skin was 68.46 per cent and without skin it was 61.22 per cent. On an average, across all farms the average live weight per bird was 1.74 kg and meat production after removing wastage (with skin) was 1.19 kg. After obtaining the data on district wise broilers produced and the meat production per bird in kgs, we have obtained district-wise the amount of meat production in the state. It was observed that total number of broilers produced in Maharashtra was 56.68 lakhs. Nasik and Pune were the major districts producing broilers and together they accounted for 66 per cent of the broiler production. The meat production for the state is estimated to be 67.68 lakh kgs with skin and 60.52 lakh kgs without skin (Table 2).

The rearing of broilers which leads to meat production, which is an important source of protein, also creates an important by-product in the form of manure. Poultry house litter can be used as a balanced organic fertilizer, containing nitrogen, phosphorous and potash.

Table 2: Districtwise Broiler Meat Production in Maharashtra -2001

Sr No	District	Broiler Population		Meat Production (in kgs)	
		Population	% to Total	With skin	Without skin
1	G. Mumbai	6137	0.11	7327	6552
2	Thane	446759	7.88	533405	476994
3	Raigad	568230	10.02	678434	606686
4	Rantnagiri	45045	0.79	53781	48094
5	Sindhudurg	26546	0.47	31694	28343
6	Nashik	1969010	34.74	2350885	2102266
7	Dhule	0	0.00	0	0
8	Nandurbar	0	0.00	0	0
9	Jalgaon	23259	0.41	27770	24833
10	Ahmednagar	192370	3.39	229679	205389
11	Pune	1766144	31.16	2108674	1885671
12	Satara	207358	3.66	247574	221391
13	Sangli	28748	0.51	34323	30694
14	Solapur	9992	0.18	11930	10668
15	Kolhapur	46702	0.82	55759	49863
16	Aurangabad	0	0.00	0	0
17	Jalana	3567	0.06	4259	3808
18	Parbhani	3886	0.07	4640	4149
19	Beed	31109	0.55	37142	33214
20	Latur	153000	2.70	182673	163355
21	Nanded	5601	0.10	6687	5980
22	Hingoli	304	0.01	363	325
23	Osmanabad	7392	0.13	8826	7892
24	Amaravati	30688	0.54	36640	32765
25	Akola	44143	0.78	52704	47130
26	Washim	0	0.00	0	0
27	Buldhana	0	0.00	0	0
28	Yavatmal	6788	0.12	8104	7247
29	Nagpur	0	0.00	0	0
30	Wardha	24087	0.42	28758	25717
31	Bhandara	6599	0.12	7879	7046
32	Gondiya	11748	0.21	14026	12543
33	Chandrapur	0	0.00	0	0
34	Gadchiroli	2995	0.05	3576	3198
	Maharashtra State	5668207	100.00	6767513	6051813

Note: The total meat production (with and without skin) is calculated by using the wastage percentage obtained from the meat shops.

Sources: Calculated by using the data from 17th Livestock Census (Provisional), Poultry Wing, Office of Commissioner Animal Husbandry, GOM, Pune and Meat shops.

With organic farming gaining importance, manure from poultry farming can serve to be very useful to meet the fertilizer needs of various crops. Our field survey showed that in small farms 1246 quintals of manure were produced, while it was 2337 quintals and 4847 quintals in medium and large farms respectively.

Per Bird per Batch Cost of Production

The total costs in broiler farming include fixed and variable costs. The per bird per batch cost of production as indicated in Table 3 reveals that across all batches, the average fixed cost per bird was Re 1/-. The highest fixed cost per bird was in case of large units having above 5000 birds and amounted to Rs 1.16/- per bird. The site value and cost of construction of sheds for large units was much more as compared to small or medium units.

The variable cost per bird was however lowest in case of large units while the small units had highest variable costs. It was also observed that out of total costs, variable costs accounted for 98 per cent while fixed costs formed 2 per cent of total costs. The main variable costs were Day-old Chick (DOC) and feed. Other expenses included labour charges, vaccination and medicines, litter, etc. The cost of DOC on an average across all units was Rs 11.56/-, which accounted for 24 per cent of the total variable cost. The major item of variable costs was however feed which accounted for as much as 65.6 per cent of the variable costs. Thus, DOC plus feed accounted for almost 90 per cent of variable costs. Labour costs accounted for approximately 5 per cent of variable costs. As poultry rearing is a risky business, it was expected that most of the farmers must have insured their flock and shed. However, it was observed that insurance was not covered in respect of birds and poultry shed. It was further observed that the average cost per kg of live weight across all farms and for all batches on an average was Rs 28.18 per kg/-.

From the net returns from broiler farms, it was observed that the average net returns per bird increased with increase in the size of the farm. The average net returns per kg of live weight was Rs 2.11/- incase of small size of farms, while it was Rs 3.25/- and Rs 3.76/- per kg of live weight respectively for medium and large farms. The average net returns per bird was Rs 4.17/-, Rs 6.28/- and Rs 6.91/- for small, medium and large farmers respectively. On an average across all farms, the average net returns per kg of live weight was Rs 3.35/- while net returns per bird was Rs 6.33/- (see, Table 4).

A broiler farmer normally rears 6 batches in a year.

Table 3: Per Bird per Batchwise Costs of the Sample Broiler Farms (Rs. per bird)

Batch No.	Day Old Chick (DOC) Cost	Feed Cost	Vaccination/ Medicines Cost	Labour & Other Services Cost	Electricity Cost	Litter Cost	Transport Cost	Miscellaneous Cost	Variable Costs	Fixed Cost	Total Cost (Fixed + Variable)	Live weight of bird (kg)	Cost/ kg. of live weight (Rs./bird)
						Small							
I	11.96	32.24	0.9	2.87	0.39	0.48	0.02	1.47	50.33	1.00	51.33	1.75	29.30
II	11.97	32.27	0.97	2.87	0.39	0.48	0.02	1.47	50.45	1.01	51.46	1.75	29.46
III	11.98	32.11	0.95	2.87	0.39	0.48	0.02	1.47	50.27	1.00	51.27	1.75	29.23
IV	11.96	32.08	0.96	2.87	0.39	0.48	0.02	1.47	50.22	1.01	51.23	1.77	28.97
V	11.96	32.36	0.97	2.95	0.39	0.43	0.03	1.52	50.61	0.91	51.52	1.78	28.94
VI	11.93	31.88	0.96	3.26	0.43	0.5	0.03	1.42	50.40	0.97	51.37	1.78	28.89
Av.	11.96	32.17	0.95	2.93	0.39	0.47	0.03	1.47	50.37	0.98	51.35	1.76	29.12
						Medium							
I	11.93	32.00	0.87	2.44	0.27	0.58	0.02	0.93	49.03	0.71	49.74	1.76	28.22
II	11.91	31.96	0.87	2.44	0.27	0.58	0.02	0.93	48.98	0.71	49.69	1.75	28.40
III	11.92	32.00	0.87	2.44	0.27	0.58	0.02	0.93	49.02	0.71	49.73	1.78	27.99
IV	11.71	31.89	0.87	2.44	0.27	0.58	0.02	0.93	48.71	0.71	49.42	1.74	28.34
V	11.51	31.98	0.87	2.49	0.28	0.58	0.02	0.89	48.62	0.71	49.33	1.73	28.49
VI	11.67	31.63	0.86	2.33	0.3	0.61	0.02	0.86	48.27	0.62	48.89	1.76	27.75
Av.	11.78	31.92	0.87	2.43	0.27	0.58	0.02	0.92	48.79	0.70	49.49	1.75	28.21
						Large							
I	11.88	31.28	0.85	2.11	0.21	0.63	0.05	0.77	47.78	1.12	48.90	1.72	28.47
II	11.88	31.25	0.85	2.11	0.2	0.63	0.05	0.77	47.73	1.12	48.85	1.74	28.04
III	11.98	31.25	0.85	2.11	0.21	0.63	0.05	0.77	47.86	1.12	48.98	1.73	28.33
IV	11.46	31.25	0.85	2.11	0.2	0.63	0.05	0.77	47.32	1.12	48.44	1.73	28.00
V	10.08	31.40	0.86	2.14	0.21	0.64	0.04	0.71	46.08	1.16	47.24	1.73	27.36
VI	10.46	31.89	0.86	2.28	0.22	0.71	0.04	0.5	46.96	1.37	48.33	1.69	28.61
Av.	11.34	31.36	0.85	2.14	0.21	0.64	0.04	0.72	47.30	1.16	48.46	1.72	28.13
						All							
I	11.91	31.64	0.86	2.33	0.25	0.59	0.04	0.93	48.54	0.99	49.53	1.74	28.40
II	11.90	31.61	0.88	2.33	0.25	0.59	0.04	0.93	48.53	0.99	49.52	1.75	28.36
III	11.97	31.60	0.87	2.33	0.25	0.59	0.04	0.93	48.57	0.99	49.56	1.75	28.27
IV	11.61	31.56	0.88	2.33	0.25	0.59	0.04	0.93	48.19	0.99	49.18	1.75	28.14
V	10.79	31.72	0.88	2.37	0.26	0.59	0.03	0.89	47.53	1.00	48.53	1.75	27.79
VI	11.04	31.81	0.88	2.45	0.28	0.65	0.03	0.75	47.90	1.09	48.99	1.74	28.11
Av.	11.56	31.65	0.87	2.35	0.26	0.6	0.03	0.9	48.22	1.00	49.22	1.75	28.18

Source: Field Survey Data.

But the point to note is that poultry production is a delicate business dealing with tender birds. While a farmer may have a good crop in one cycle, his flock may get diseased in another, thus disrupting his annual flow of income.

Constraints in Broiler Farming

In broiler production, companies commonly known as integrators combined different degrees of activities. In some cases, they maintained grandparent stocks, parent birds and maintained hatcheries. They also supplied day old broiler chicks to the farmers along with feed and medicine for the entire production cycle at regular intervals. After six or seven weeks, when the bird gained weight, the company lifted the birds. The farmers were paid for their labour and investment in the business.

Table 4: Net Income from Broiler Farms

(Figures in Rs)

Item	Batch I	Batch II	Batch III	Batch IV	Batch V	Batch VI	Total
			Small				
Average Sale Price per kg. Live Weight	31.38	31.05	31.68	31.16	31.34	30.77	31.23
Average Cost per kg. of Live Weight	29.30	29.46	29.23	28.97	28.94	28.89	29.12
Average Net Returns per kg. of Live Weight	2.07	1.59	2.44	2.19	2.40	1.89	2.11
Average Net Returns per Bird	4.10	3.25	4.75	4.34	4.73	3.80	4.17
			Medium				
Average Sale Price per kg. Live Weight	31.56	31.67	31.57	31.61	31.22	31.13	31.46
Average Cost per kg. of Live Weight	28.22	28.40	27.99	28.34	28.49	27.75	28.21
Average Net Returns per kg. of Live Weight	3.34	3.27	3.58	3.27	2.73	3.38	3.25
Average Net Returns per Bird	6.47	6.29	6.94	6.27	5.29	6.54	6.28
			Large				
Average Sale Price per kg. Live Weight	30.35	31.07	31.55	32.35	33.05	32.94	31.89
Average Cost per kg. of Live Weight	28.47	28.04	28.33	28.00	27.36	28.61	28.13
Average Net Returns per kg. of Live Weight	1.88	3.03	3.22	4.35	5.69	4.33	3.76
Average Net Returns per Bird	3.67	5.73	6.01	7.97	10.26	7.75	6.91
			All				
Average Sale Price per kg. Live Weight	31.10	31.26	31.60	31.70	31.87	31.63	31.53
Average Cost per kg. of Live Weight	28.40	28.36	28.27	28.14	27.79	28.11	28.18
Average Net Returns per kg. of Live Weight	2.70	2.91	3.33	3.56	4.08	3.52	3.35
Average Net Returns per Bird	5.18	5.55	6.32	6.70	7.60	6.61	6.33

Source: Field Survey Data.

In our sample, 85 per cent of small farmers, 65 per cent of medium farmers and 35 per cent of large farmers had contract with chick suppliers (on an average 61.67 per cent of all farmers had contract with chick suppliers). In fact almost all of these farms had contract for supply of chicks, feed and vaccines on credit, provision of veterinary services and purchase of the product.

Poultry farmers often operated in contract arrangements since all inputs were provided by the company. The inputs were also available in time and were of good quality. The medium farmers sometimes experienced time lag in getting supply of day-old chicks and could hence rear less batches in a year. In contract farming, there were some farms in the sample which had problems in the execution of the contract. Overall, 20.45 per cent faced delay in lifting the produce, 13.64 per cent faced delay in payment, 18.18 per cent farmers faced delay in getting low price and 2.27 per cent felt their produce was rejected on quality grounds.

Rearing of poultry birds can cause environmental pollution in several ways. In developed countries environmental pollution is caused as most poultry units use massive energy to provide heating for which ammonia and other gases are used. The processing units of chicken also produce plenty of polluting elements. In India, however, these issues are not critical as poultry units are located mostly in rural areas. From our field survey, it was observed that about 13.3 per cent of the farms received complaints about odour fom the public. The method of complaint was only an oral representation. In case of mortality, some farmers stated that they threw the dead birds in nearby hills and some of them buried the birds. None of the farmers in the sample had any equipment for treating dead birds. The manure created in poultry rearing was immediately sold.

Policy Implications

The key for success in the poultry business is to reduce feed costs. Feed is very expensive in India and our study showed that feed accounted for as much as 65.6 per cent of the variable costs. The main ingredient in poultry feed is maize, which is characterized by unstable domestic production. Maize in India is a relatively small crop and constitutes barely 6 per cent of the area

under foodgrains and 3.54 per cent of the gross cropped area. Further, the area under maize is essentially rainfed and barely 20 per cent of the area under this crop is irrigated. This largely explains for low productivity and seasonal fluctuations in the availability of feed ingredients. The world average yield of maize is about 2.45 times that of India.

While the maize crop is characterized by low production and productivity, this crop has competing uses. It is used for human consumption, poultry consumption and also for industrial purposes in the manufacture of starch. This explains the continuous rise in the price of maize. The index number of wholesale prices of maize (1993-94 = 100), which was 138.6 in 1994, increased to 184.8 in 2004 i.e. an increase of 33 per cent. In contrast, the price of broiler meat which was 109.7 in 1994 (1993-94 = 100) declined to 83 in 2004 i.e. a decline of 25 per cent. While the growth rate in the price of maize during the period 1994-2004 was 2.92 per cent per annum (significant at 5 per cent) the growth rate in price of broiler meat in the corresponding period was negative (2.03 per cent per annum, significant at 10 per cent). Thus, the rise in price of feed was very fast while broiler price showed decline in price, which leads to lack of competitive advantage for poultry units.

The most important policy implication that emerges is that extension services must be provided to give farmers better quality breeds and train them in the most scientific growing techniques. Increase in maize yields will help to drive down feed costs and thus give a competitive advantage to the poultry sector. The government must therefore focus on maize development schemes and make concerted efforts to improve the yield of maize which will increase its availability and thus lead to fall in price. This will increase the profitability in the poultry industry.

As maize prices are crucial for the growth of the poultry sector, major poultry units who produce their own feed can integrate with maize farmers or enter into contract agreements with them. The poultry units can control costs by providing farmers with whom they have contract, with high yielding varieties of maize seeds. Other support to enable them to improve their farming practices, such as ensuring the correct seed rate/plant to plant spacing and necessary leveling of fields, will help to improve yields. Thus, if poultry units tie up with maize farmers and are able to obtain the major feed ingredient at a low cost, they will be more competitive.

In our study, about 73 per cent of poultry farms in our sample had entered into some kind of contract with companies commonly known as integrators. Most of them were the small units and under this arrangement contract for supply of day old chicks, feed, vaccines and other veterinary services was made. After about 42 days, the company lifted the bird. Timely availability of inputs was the main reason for poultry units entering into contracts. Thus, integrators have an important role to play in poultry industry. The integration process can include hatching, growing and production of feed, providing veterinary services and distribution of the produce. Integration across all these major processes will make the units low cost producers in the industry. Backward and forward integration will help to reap economies of scale and make the poultry industry competitive. A handful of integrated companies dominate the market share in countries such as USA and New Zealand. In India most units are small in size and the biggest challenge to be successful in the poultry sector is through integration.

It was also observed in our study that broiler units were very close to each other. The concentration is mainly due to marketing advantages of concentration. This can lead to the problem of bio-security. If units are located in close vicinity, a disease in one farm can spread very rapidly to other farms as chicks are very sensitive to diseases. Thus concentration of poultry units may be harmful for the industry as there are negative externalities, although it has marketing advantages.

In India, there is mainly a wet market demand for poultry and processing of chicken is virtually negligible. There is demand potential for processed poultry and retailers must play the role of driving demand in this sector. The sick birds should be removed from poultry shed and dead birds and dressing waste should be disposed properly by the farmers and retailers; otherwise it will create problem of bio-security.

Our study observed that on an average the Feed Conversion Ratio (FCR) was 1.75. It was noted in a study (Mckinsey & Company, 1997) that the FCR of Indian Poultry are currently 6 to 14 per cent lower than those in U.S. or Thailand with the result that poultry in India has to consume greater quantities of feed to put on the same amount of weight. Best breeds of birds should therefore be used so as to obtain a higher FCR as any increase in FCR would help to increase the profitability per unit and thus the profitability of the farm.

At present there is no market interventions or price support measures by government agencies for purchase of broiler meat during distress conditions. National Agricultural Cooperative Marketing Federation of India Ltd. (NAFED) intervenes occasionally and to a limited extent, which is hardly of any help to the farmers.

Thus, minimum support price scheme should be applicable to the poultry sector.

The status of poultry sector whether in agriculture or industry is not well defined. Administratively, it is under Department of Animal Husbandry, Ministry of Agriculture, both in central and state governments. NABARD and Nationalized Banks recognized it as an agricultural activity; however, most of the benefits/concession available to agriculture such as concession in electricity tariff, subsidized water are not extended to the poultry sector. Also, income from poultry is fully taxable. This ambiguity has lead to the poultry sector not being entitled to various benefits applicable either to agriculture or industry. Therefore, there is need to define the status of poultry as a part of agriculture. The recommendations of the Working Group on Animal Husbandry and Dairying, Government of India (2002), that poultry establishment with less than 10,000 birds should be treated as agricultural activity for the benefits of the poultry farmer and extend the same benefits/incentives/concessions to this sector as applicable to agriculture, must be implemented. For the units having a capacity of more than 10,000 birds, it should be treated as industry with all the benefits extended to industry.

Overall, it appears that the poultry sector has tremendous potential to grow. Although, no attempt was made in our study to estimate the price and income elasticities, however, other studies (Mckinsey & Company, 1997; Mehta, et al., 2002) indicate that poultry is sensitive to income and price levels. Increase in incomes, especially in rural areas and reduction in prices of poultry meat will lead to a rise in demand for poultry products. With economies of scale and fall in feed costs, it is possible that prices of broiler meat will fall. The demographic profile of the population also supports the increase in demand for poultry products. India has a huge youth population in the 5-19 years age group and as more of this population is converted to non-vegetarian, the demand for broiler meat will rise. Controlling costs and integration of the production process is vital to the success of this industry.

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Would you want to do business with a person who was 99 per cent honest?

– Sydney Madwed

Feature

Promotion of BT Cotton in India

Nazli Bano & Akram A. Khan

Development of cotton varieties with resistance to pests can enhance the welfare of farmers, while helping both the Indian economy and its environment. The area under BT cotton is projected to increase rapidly in coming years. This paper aims to assess the importance of BT cotton in terms of yield, profitability, economic viability for small and marginal farmers vis-a-vis big farmers. It also aims to examine how sustainable this is within the environment and why there is such a low adoption rate in India.

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Science can be an ogre or an angel, depending on how one looks at it. The Green Revolution, for example, is not without its detractors, who argue that it promoted the overuse of water, pesticides and chemical fertilizers, making poor farmers dependent on these inputs and in some cases seriously damaging the environment in the process.

Some types of biotechnology have been around since ancient times, and probably began when our ancestors used micro-organisms to make bread, wine and cheese. The current era of modern biotechnology was made possible by the use of molecular techniques to "cut and paste" genes from one cell to another. Biotechnology, broadly defined, includes any technique that uses living organisms, or parts of such organisms, to make or modify products, to improve plants or animals or to develop micro-organisms for specific use. Modern biotechnology should be seen as an integration of new techniques with the well-established approaches of traditional biotechnology such as plant and animal breeding, food production, fermentation products and processes, and production of pharmaceuticals and fertilizers (Doyle and Persley, 1996).

Significance of BT cotton in India

The Green Revolution of the 1960s and 1970s boosted crop yields and helped save millions of people from poverty. But today many small-scale farmers remain trapped in subsistence agriculture. There are serious constraints to productivity in Indian agriculture because the 'Green Revolution' is showing signs of fatigue and farm productivity is now decreasing. Most of the hungry people live in marginal lands and depend upon agriculture for their livelihood. For many of these people, food security will only come through increased agricultural production and income. Biotechnology can overcome production constraints that are more difficult or intractable with conventional breeding. "Reducing poverty by half by 2015 is an imperative moral obligation and is one of the most formidable challenges facing

the world today, to which biotech crops can make a vital contribution," (James 2004).

With no more arable land available for agricultural expansion in India, enhancing stress tolerance in crop plants will permit productive farming on currently unproductive lands. "Biotechnology continues to be the most rapidly adopted technology in agricultural history," (James 2002). Biotech crops can significantly alter the lives of these farmers, limiting the time they must spend in the field and helping alleviate poverty. A revitalised Indian agriculture can be the engine of growth and biotechnology can provide the needed fuel (C S Prakash 2000).

Biotech crops are contributing to a reduction in pesticide usage, a positive step towards environmental protection because it makes possible the reduction of the insecticide load in the environment and reduces the handling of such chemicals by farmers. BT cotton alone is estimated to eliminate the need for 33,000 tons of insecticide globally, or 40 per cent of the current global use (ISAAA 2002). Although cotton occupies only 5 per cent of the country's land, nearly 50 per cent of all pesticide used in India is bought by cotton farmers alone at a staggering cost of Rs 16 billion annually and with incalculable impact on the environment and human health.

"Biotech crops have increased the income of 7.7 million resource-poor farmers in China, India, South Africa, Philippines and seven other developing countries, helping alleviate them from abject poverty," (James 2004). By 2005, the report predicts the global market value of biotech crops will reach $ 5 billion, up from approximately $ 4.25 billion in 2002 and $ 3.8 billion just a year before. While insect resistance and herbicide tolerance are the only traits currently available in biotech cottons, a broad range of other traits are under development using modern biotechnology. These may impact agronomic performance, stress tolerance, fibre quality and yield potential directly.

Cotton Production and Productivity in India: Low Yield of Conventional Cotton Makes BT Cotton Important

India is an important cotton grower on a global scale. It ranks third in the global cotton production after the United States and China. Cotton is a very important cash crop for Indian farmers. India plants more farmland with cotton than any other country – 25 per cent of the world's cotton acres are in India – yet produces just 16 per cent of the world's cotton. India has an estimated 4 million cotton farmers, and some 60 million people depend on cotton and the textile industry to make a living. Textiles, in fact, are India's number one export, accounting for about $ 8.5 billion in revenue, and contribute about 30 per cent of the gross domestic product of Indian agriculture (James, Clive; December 2002).

As with many cotton growing areas of the world, India is at number 3 although the productivity is substantially low (see table 3). The major reason for this low productivity is insect/pests, especially the bollworms notably *Helicoverpa armigera*, commonly referred to as American Bollworm. Sucking pest such as aphids (Aphis gossypii), jassids (Amrasca Bigutulla) and whiteflies (Benisia tabaci) are also a problem in terms of direct damage to the plants and the transmission of viruses. For years, bollworms had been damaging small crop, sometimes devouring up to 80 per cent of the cotton. In 2003 India's President has called for a "second Green Revolution," which includes the use of biotechnology, to help feed the people and help the economy grow.

Table 1: Share of India in the Total Cotton Production

2004-2005 Production Est.	Million. Bales	% of World cotton production	Total cotton area(million hec) 2004
China	29	24%	5.6
USA	23	19%	5.5
India	19	16%	9.0
World	120	100%	32

Source: Dailyfutures.com

Table: 2 Cotton Yields in Different Countries of the World.

Country	Yield (Kg/hec) 2003-04	Yield (Kg/hec) 2004-05	Yield (Kg/hec) 2005-06
USA	818.16	958.05	931.34
China	950.16	1109.68	1118.52
India	399.50	459.64	455.02
Pakistan	545.72	771.26	673.92
Brazil	1190.57	1096.06	1152.67
Uzbekistan	623.81	777.59	840.87
World	643.85	731.69	711.32

Source: Production Estimates and Crop Assessment Division, FAS, USDA Feb. 2006

China is the world's number one producer of cotton, producing 24 per cent of world cotton, while the USA and India produce 19 per cent and 16 per cent respectively. However, areas under cotton growth in China are far less than India and only 0.1 per cent more than in USA. India's cotton yield is only 455.02kg/hec

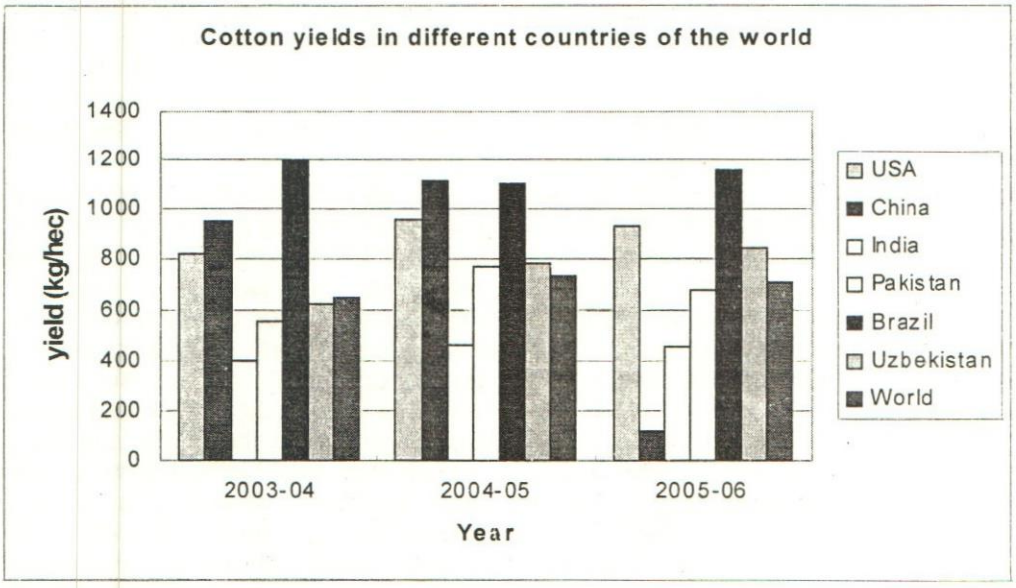

Fig. 1. Cotton yields in different countries of the world

Source: Production Estimates and Crop Assessment Division, FAS, USDA Feb. 2006

which is far below the world average of 711.32 kg/hec. If we compare with other countries like China, USA and Brazil we find that India's productivity is very poor. (See Table 2 & Fig. 1)

Table 3: Trend of cotton production in different countries of the world (Million Tonnes)

Country	2001-02	2002-03	2003-04	2004-05	2005-06
China	5.32	4.9	5.2	5.60	5.90
US	4.42	3.73	3.7	3.90	4.00
India	2.69	2.30	2.8	2.90	3.00
Pakistan	1.80	1.60	1.8	1.85	1.90
Brazil	0.75	0.85	0.9	0.95	0.95
Uzbekistan	1.06	1.00	0.9	0.95	0.95
Others	5.48	4.67	4.8	5.25	5.30
Total	21.52	19.05	20.1	21.40	22.00
% change	10.60	-11.50	5.5	6.50	2.80

Source: World Commodity Forecast (2005)

Significance of Bt. Cotton in India: Improvement in Yield and Reduction in Chemicals Use

Independent assessments indicate that millions of farmers in China, South Africa and India have derived substantial economic, environmental, health and social benefits from biotech cotton. A large number of farmers in China have already adopted BT cotton and reported a rise in income, besides health benefits due to the lower use of pesticides. This has resulted in control of American Bollworm, fall in the use of pesticides and a rise in farm income, especially with the small farmers up to $ 107 per hectare. Yield differences between BT and non-BT cotton under field condition is not significant, about three tones of seed cotton in both cases. However, the cost of production has come down drastically for BT cotton producers, leading to a rise in profit from $ 360 to $ 600 per hectare in 2002-03.

That such benefits can be realised elsewhere seem highly likely, but the decision to grow biotech cotton requires an initial careful analysis of the local need for biotech solutions, followed by deployment strategies that ensure farmers have the information and educational support to maximize their benefits from the technology (Report of the Second Expert Panel on Biotechnology of Cotton 2004). Numerous studies have documented the economic and environmental benefits of growing BT cotton. A recent nationwide survey of more than 3,000 farmers by AC Nielsen found that for biotech cotton farmers in India profit increased 78 per cent on average over farmers who planted traditional varieties. Yield increased by 29 per cent on average and pesticide use declined by 60 per cent on average (Council for Biotechnology information, 2004).

Other field trial studies in India have found yield advantages for Bt cotton ranging from 24 per cent to 56 per cent (average 39 per cent) for the years 1998/99 and 2000/01 (ISAAA 2002b). BT cotton farmers were paid 8 per cent more for their yields that have more than doubled – from about 1,320 pounds per acre using conventional cotton to 3,306 pounds per acre using

Table: 4: BT cotton results from kharif 2002 season, June-December (yield in quintals).

State	Non-Bt yield	Bt yield	Yield increase with Bt	Non-Bt sprays	Bt sprays	Spray reduction with Bt	Economic benefit per hectare*
Andhra Pradesh	14.42 (5-25)	20.52 (12.5-32.5)	6.10	4.81 (1-8)	2.08 (0-4)	2.73	Rs.16,747
Gujarat	19.80 (3.7-37.5)	28.35 (10-44)	8.55	3.42 (1-7)	2.09 (0-5)	1.33	Rs.18,430
Karnataka	10.50 (1.3-30)	17.82 (7.5-40)	7.32	2.53 (0-6)	1.00 (0-3)	1.53	Rs.16,170
Madhya Pradesh	15.00 (10-50)	25.82 (35-62.5)	10.82	3.29 (1-9)	0.93 (0-3)	2.36	Rs.24,000
Maharashtra	14.47 (2.5-45)	20.82 (2.5-62.5)	6.35	2.78 (0-7)	0.99 (0-4)	1.79	Rs.14,490
Tamil Nadu	–	–	–	–	–	–	–
Total	13.25	21.35	8.10	3.10	1.17	1.93	Rs.18,130

Source: Maharashtra Hybrid Seed Company, India. Agbioforum 2004. Volume 7 Number 1 & 2 Article 4

* Economic benefit per hectare was calculated on the basis of an average cotton rate of Rs.2,000/q and an average cost of each bollworm complex spray of Rs.1,000/ha.

biotech varieties. Bt Cotton provides control against the American Bollworm, Spotted Bollworm, Spiny Bollworm and Pink Bollworm. Also, the average use of chemical sprays has decreased from 9-12 units to 0-2 units. Because of its potential to improve yield which further led to increase in income level and living standards, several groups support the commercialization of BT cotton, including the Indian Council of Agricultural Research, India Environment Ministry and the Federation of Indian Chambers of Commerce and Industry (FICCI 2002).

The data in Table 4 shows that in addition to the substantial increase in yield, there is a significant decrease in the number of insecticide sprays associated with the use of BT cotton. The overall average indicates a yield increase of 8.1 quintals of cotton and a reduction of 1.93 sprays. These two factors add to the total economic benefit. There is an average additional income of more than Rs.18, 000/ha for BT compared to non-Bt cotton.

Current Technological Trends: Global Status of Biotech Crops In 2005

Over the last decade, farmers have consistently increased their biotech crop planting by double-digits since biotech crops were first commercialised in 1996. Adoption of biotech cotton varieties has been rapid, increasing from 6.8 million hectares in 2002 to the total global area of biotech cotton reaching 9 million hectares in 2004. A historic milestone was reached in 2005 when 21 countries grew biotech crops. The most recent survey estimates that the global net economic benefits to crop biotech farmers in 2004 was $ 6.5 billion, and $ 27 billion ($ 15 billion for developing countries and $12 billion for industrial countries) for the accumulated benefits during the period 1996 to 2004. There is cause for cautious optimism that the stellar growth in biotech crops, witnessed in the first decade of commercialisation, 1996 to 2005, will continue and probably be surpassed in the second decade 2006-2015.

Table 5: Global Area of GM crops

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Million acr.	4.2	27.2	68.7	98.6	109.2	130	145	167.3	200	222

Source: ISAAA 2005

Table 6: Growth of Bt. Cotton: Adoption Rate of BT Cotton in Different Countries. (2004)

Country	Total BT. Cotton area (m.h.)*	Total cotton area (m.h.)	Bt. Cotton adoption rate
USA	4.2	5.5	76
China	3.7	5.6	66
India	0.5	8.9	5.6
Australia	2.5	3.1	80
S. Africa	30 hec	35-45 hec	20-25
Argentina	25 hec	100-125 hec	20-25
Total	9.0	32	28

Source: ISAAA 2004

* Million Hectares

Growth of BT. Cotton in India: Inadequate

Bt crop has already been commercialised in several countries such as the United States (1996), Australia (1997), South Africa (1997), Argentina (1998), Mexico (1996), China (1998), Indonesia (2000), Columbia (2002) and in India (2002). Since its introduction in 1996, cotton has been one of the leading crops to be genetically engineered and biotech cotton has been one of the most rapidly adopted technologies ever. Nine countries representing 59 per cent of world cotton area allow biotech cotton to be grown: Argentina, Australia, China (Mainland), Colombia, India, Indonesia, Mexico, South Africa, and United States.

Bt. Cotton is the first and only transgenic crop approved initially for commercial cultivation in India in six states namely Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu in March 2002 for three Bt. Cotton hybrids (Bt. MECH 162, Bt. MECH 184, Bt. MECH 12) for a period of three years. The variety of BT cotton with Government approval now stands at 20, up from four varieties in 2004, and the area sown with BT cotton seed is expanding. But if we see India's adoption rate of BT cotton the situation is very grim. Of the total cotton area India uses only 5.6 per cent in the production of Bt. cotton. In USA 76 per cent and in China 66 per cent of cotton area is used in the production of BT cotton although total cotton area in China is less than in India. China is the largest producer of cotton in the world and more than half of China's cotton farmers planted biotech cotton.

Table 7: Trend of growth of BT. Cotton in India

Year	Area (hec)	% change
2002	40,000	–
2003	100,000	150
2004	500,000	400
2005	1,30,0000	160

Source: AgBioForum, 2004

Table 8: Statewise BT cotton Production in India 2004-2005

State	2004 (Ha)	2005 (Ha)	Rank (2004)	Rank (2005)
Maharashtra	200,000	590,000	1	1
Gujarat	130,000	150,000	2	3
M.Pradesh	85,000	145,000	3	4
A.P.	80,000	280,000	4	2
Karnataka	18,000	30,000	5	6
Tamil Nadu	10,000	25,000	6	7
North Zone	N/A	60,000		5
Total	500,000	13,00,000		

Source: ISAAA 2006

BT cotton acreage in India grew by an impressive 160 per cent in 2005 as acreage rose to 1.3 million hectare in 2005 from 500,000 hectare in 2004. Ninety percent of the Indian farmers, who have experienced the benefits of biotech cotton in the past, intend to plant the enhanced seeds again this year (Nationwide Survey, March 26, 2004). The BT cotton variety is likely to account for 20 per cent of the cotton production (Bhagirath Choudhary 2004).

Maharashtra, taking the lead, recorded a 195 per cent increase in BT cotton acreage to 590,000 hectares in 2005 from a mere 200,000 hectares in the previous year. Similarly, Andhra Pradesh recorded a 250 per cent increase in acreage from 80,000 hectares to 280,000 hectares. In Gujarat, BT cotton acreage rose by 130,000 hectares to 150,000 during the review period. "The impressive acreage increase in Andhra Pradesh points to higher adoption of BT Cotton variety in the state,". (Bhagirath Choudhary, 2005).

Conclusion and Remedial Measures

BT cotton was cultivated in over 1.3 million acres of land in 2005, an increase of 400 per cent, leading to increased production and reduced costs in an environmentally favourable manner. This is a good performance at least in absolute terms, considering the fact that the crop was allowed for commercial production in April 2002.

The benefits of BT cotton in India are in line with those enjoyed by farmers worldwide who have cultivated BT cotton. This will positively affect the livelihood of millions of small farmers by improving their net incomes. In fact, the use of BT cotton is a positive step towards environmental protection because it makes possible the reduction of the insecticide load in the environment and reduces handling of such chemicals by farmers. Efforts are being made to incorporate another gene (Bollgard II) to improve efficacy and postpone possible resistance problems. As newer products are approved in the regulatory system, it is likely that farmers will have greater choice to plant hybrids according to market quality requirements. The complicated bureaucratic process is responsible for the failure of India to adopt GMOs (Genetically Modified Organisms) crops on a vast scale. There are serious inadequacies in GMO regulations. Testing and approval have a poor track record. Private and public sectors conflicts block the former at the entry point. Large-scale public funding disfavours private investment and prioritisation by R&D in the public sector is unresponsive to market needs.

Changing Regulations

The regulatory system is evolving but the evolution is too slow. The regulatory system is unable to do anything about the spread of the illegal BT cotton, which is spreading at an unabated and alarming rate. The inexplicable and inordinate delays by the regulatory system in releasing the technology in good hybrids have led to the mushrooming of illegal BT cotton. In fact, today in the country illegal BT cotton occupies more area (about 25 per cent of total hybrid cotton area) than the legal version (about 10 per cent of total hybrid cotton area). The unauthorised cultivation of BT cotton is bad for the future of GM crops in the country in several ways. It will encourage similar misadventure in other parts of the country and thus give a new whip for the NGOs (non-government organisations) to ridicule the regulatory measures and GM crops; and it will further delay the introduction of GM crops into India by generating fresh controversies.

Containing the spread of illegal BT cotton should have been the priority of the regulators, however, nothing is being done in this regard. It is widely felt that deregulation of transgenic technologies like Bt cotton (Cry1 A(c) gene in cotton) where bio-safety is proven and approved for commercial use, as it is the case in countries like the US and Australia, is the solution for several of the regulatory problems with transgenic crops like Bt cotton in India. The major reason for the inordinate delay in technology being available to the farmer in good hybrids is the current regulatory system. "The current regulatory system is releasing every hybrid on a case-by-case basis after two-three years of mandatory testing for assessing purely the agronomic potential of the hybrid," (Dr P Sateesh Kumar, director, Prabhat Agri Biotech Ltd. 2005).

The emergence of India as a global player in the biotech sector requires the government to play the role of a champion and foster an international competitive environment for investment and enterprise development. India's strategy must be to get more value from its R&D investment and from IPR generation. The biotechnology sector has in recent years witnessed accelerated growth. India has to develop its own biotechnological products to ensure quality and affordability for global trade.

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Feature

Marketing of Pineapple in Assam – An Economic & Efficiency Analysis

C. Hazarika, H. Gogoi & A. Hussain

Pineapple is an important and widely cultivated fruit crop of Assam. However, the major marketing channels are deficient and pineapple production does not meet its full potential in the state. The present study was conducted to identify the major marketing channels and price spread analysis. Altogether six marketing channels were identified. Five major marketing middlemen were involved. The marketing costs incurred by various middlemen and also by the producer were calculated to estimate the marketing efficiency. The effectiveness of all the channels was also estimated. Channel III (Producer – Wholesaler via Commission Agent – Retailer – Consumer) was found to be highly efficient though its effectiveness is very low.

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India has made remarkable progress in the horticultural sector in recent years and has become the largest producer of fruits and the second largest producer of vegetables in the world. Its share in the world production of fruits and vegetables is 11.00 per cent and 7.00 per cent respectively. In spite of this, the fruits and vegetable marketing system is mainly characterized by unorganized marketing practices, very low share of producers price in consumers rupee in the major consuming centres, frequent occurrence of glut situation forcing distress sale, low quality etc.

Assam, with a wide diversity in topography, rainfall, soil type and climatic conditions, has immense potential for growing a wide range of tropical and sub-tropical fruits. However, cultivation of fruits in the state is carried out mostly on small farms without any organized back up for packaging, storage, transport and marketing. Most of the agri-horticultural commodities are produced in such interior areas that the farmers cannot sell their marketable surplus in an easily accessible market. Such a situation is very common in the hilly areas of the state, where there are large concentrations of producers without well-developed roads and transport, as well as minimum storage facilities.

Due to the underdeveloped marketing system, the state is experiencing a great problem in channelizing the marketable surplus of agri-horticultural produced. Bora (1983) observed that marketable products are carried out by the growers to the nearby local markets (weekly or bi-weekly) where the traders from the towns and cities purchased the products at a price which is usually unremunerative to the growers. Agrawal (1995) reported that the rural markets are dominated by the traders who siphon off much more from the farm producers than what they pay in return. These evidences are sufficient to state that for the majority of farm producers, the agricultural marketing system in the state is exploitive and highly unsatisfactory. This is be-

cause the farmers are a comparatively weaker section of the society and their illiteracy, ignorance as well as inadequate infrastructure facilities, result in the whole agricultural marketing system being defective and exploitive.

The performance of NERAMAC that was established for the purpose of organizing, processing, marketing and sales promotion of agri-horticultural produce in the NE region is not satisfactory (Sarkar, 1992). Due to lack of market regulation and control over midway margin makers, middlemen's share as commission appears to be as high as 80-90 per cent of the retail price of the horticultural produce (Ghosh, 1985). Likewise due to low per capita availability of roads/railways, the transportation cost often seems to be 43-85 per cent of the total marketing cost. Although there exists over 1100 primary and about 30 secondary markets in NE region, their coverage is very poor (Shadeque et al, 1995). The entire regional market is highly imbalanced with deficit as well as surplus zones of agricultural produce (Pandey, 1993).

Pineapple is an important fruit crop of Assam covering an area of about 14.0 thousand hectares (17.90 per cent of All India average), which produces about 216.1 thousand MT (17.69 per cent of All India average) of pineapple during the year 2001. In Assam an efficient marketing system is of crucial importance for commercial production of horticultural crops. Development of a new marketing system supported by cost effective, properly designed storage facilities with optimum storage conditions are the need of the time to lower down the post-harvest losses. It has been an open secret that due to the unavailability of proper storage facilities, majority of fruit and vegetable growers in the state, sell their produce immediately after harvesting. Taking the advantage of this situation, the market intermediaries irrespective of their levels, undoubtedly offer a very unremunerative price for most of the produces. Inadequate storage facilities not only affect the supply and demand position but also lead to a fall in prices of produce.

Not much work has been done so far to study the efficiency of marketing of perishable agricultural commodities in Assam. So, an intensive study on marketing of pineapple has been taken out to formulate a strategy for development of marketing infrastructure in the state of Assam. This study will be certainly useful for the academicians, researchers, planners, policy makers and the state government for taking policy decisions. The main objective of the study was to study the existing market structures and to suggest future improvements.

Methodology

Kamrup, Nagaon, Karbi Anglong and N. C. Hills are the four major districts of Assam that produce around 80 per cent of pineapple in the state. These four districts were selected purposively for the study. To select the sample farmers, five highest pineapple growing villages were identified in the respective districts in consultation with the State Department of Agriculture. A list of farmers with area and production of pineapple has been collected from the district and sub-divisional agricultural offices of the respective districts. A total of 200 sample farmers were selected. Besides this, 80 market middlemen were interviewed to collect the information on the market structure, efficiency and the pattern of disposal of the commodity.

Marketing channels

Marketing channels are the paths through which the commodities are moved from the initial point of production till it reaches the hands of the ultimate consumer. It involves various middlemen who facilitate the flow of goods and services from producer to consumer. The channels are also the chains of intermediaries involved in the smooth distribution of products from producers to consumers. The length of the channels varies from commodity to commodity, depending upon the quantity to be moved, nature of consumers' demand and degree of regional specialization in production.

Results and discussion

It is found in the study that the marketing channels of pineapple consists of middlemen like retailers (R), wholesalers (WS), wholesalers via commission agents (WS via CA), wholesalers cum pre-harvest contractor (WS-C-PHC) and the pre-Harvest Contractor (PHC).

Retailers (R): This type of middlemen are actually the local retailers who purchased pineapple from the producer in the market day or from the production point and sold this in the same market or nearby markets on the same day or on the subsequent market day.

Wholesalers (WS): The wholesaler purchased pineapple directly from producer and sold to the retailer in the wholesale market or distant markets.

Wholesalers (via Commission agents): The commission agent (CA) purchased the produce directly from producer on behalf of wholesaler on commission basis from the remote/interior area and the wholesaler sale the produce to the retailer in the wholesale or distant markets.

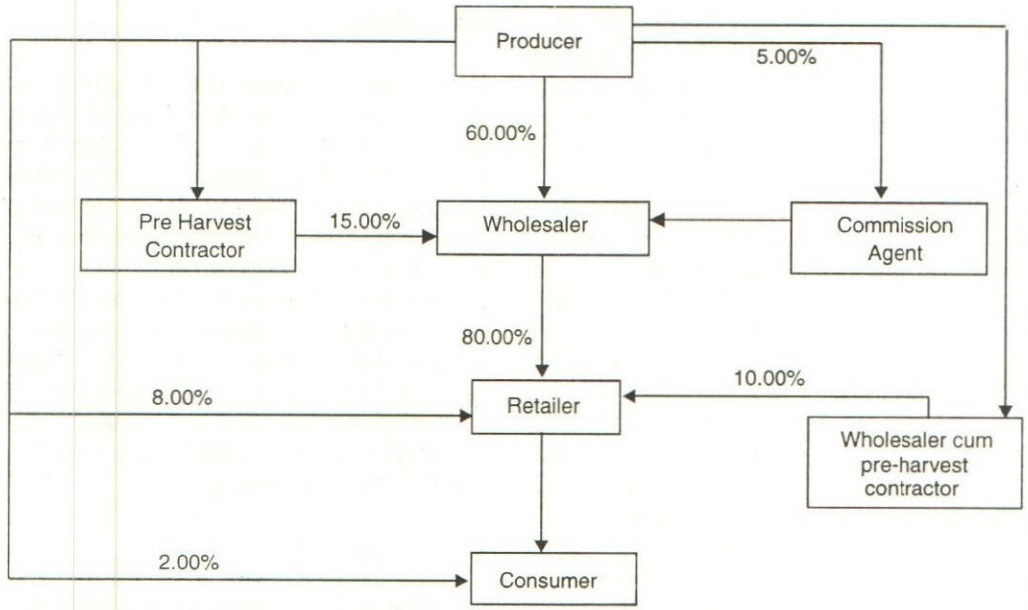

Fig. 1. Major Marketing Channels of Pineapple In Assam

Wholesaler cum Pre-Harvest Contractor (WS-C-PHC): This type of middlemen purchased the whole pineapple garden before 2 to 6 months of harvesting and also purchased directly from producer in a pre-determined price. Then they sell the produce to the retailer in the nearby or distant markets.

Pre-Harvest Contractor (PHC): Pre-harvest contractor purchased the pineapple gardens from the farmers before harvesting of the produces or at the time of flowering of the crop at a pre-determined price and after harvesting, they sell the quantity to the wholesalers in the harvesting site itself or in the wholesalers/distant markets.

Table 1: Marketing Channels of Pineapple

	Channels	P.C. of Qty.Transacted
1.	Producer – Retailer – Consumer	8.00
2.	Producer – Wholesaler – Retailer – Consumer	60.00
3.	Producer – Wholesaler (via Commission Agent) – Retailer – Consumer	5.00
4.	Producer – Wholesaler –Cum-Pre-Harvest Contractor – Retailer – Consumer	10.00
5.	Producer – Pre-Harvest Contractor – Wholesaler – Retailer – Consumer	15.00
6.	Producer – Consumer	2.00

Table 1 and Fig. 1 shows the flow of pineapple from the producers to the consumers level through different intermediaries. Six major marketing channels of pineapple in Assam were identified which were discussed below.

(i) Producer – Retailers – consumers.

(ii) Producer – Wholesalers – Retailers – consumers.

(iii) Producer – Wholesalers (via Commission agents) Retailers – consumers.

iv) Producer – Wholesalers cum pre harvest contractors – Retailers – consumers.

v) Producer – pre-harvest contractors – Wholesalers – Retailers – consumers

vi) Producer – consumers.

Producer – Retailers – consumers

It is evident from the Table 1 and the Fig. 1 that a small amount of pineapple was transacted through this channel which is around 8 per cent of the total pineapple production of the state. This channel was found to be one of the efficient channels of pineapple marketing with the marketing efficiency of 3.58 per cent next to the channel–III.

Producer – Wholesalers – Retailers – consumers

From the table, it was found that about 60 per cent of the total pineapple production was transacted by the middlemen through this channel. The wholesalers directly purchase the produce from the producers and sell it to the retailers in the wholesale or distant markets.

Table 2: Details of Marketing Expenses incurred by the Pineapple Producer in the State of Assam

	Items of cost	Marginal		Small		Medium		Large		Total	
		Qty (No)	Cost (Rs/100 Fruits)	Qty (No)	Cost (Rs/100 Fruits)	Qty (No)	Cost (Rs/100 Fruits)	Qty (No)	Cost (Rs/100 Fruits)	Qty (No)	Cost (Rs/100 Fruits)
1.	Drying										
2.	Cleaning										
3.	Grading	10530	1.41	26845	1.62	60195	1.52	47700	1.47	145270	1.51
4.	Packing/ Bagging										
5.	Transportation (Loading + Unloading)	26444	30.87	84814	28.59	103497	30.87	129365	28.79	344120	29.53
6.	Storage										
7.	Wastage/Spoilage	2.84	11.79	3.80	15.58	4.93	19.77	4.19	16.55	4.22	17.13
8.	Commission										
9.	Market Fees	34184	1.22	103609	1.20	142430	1.19	141315	1.14	421538	1.17
10.	Octroi/Tax										
11.	Miscellaneous	34184	2.82	103609	2.76	142430	2.76	141315	2.74	421538	2.76
	Total		48.11		49.75		56.11		50.69		52.10

This channel was found to be the most effective channel through which all categories of farmers transacted most of their commodities. The efficiency of the channel was estimated to be 2.89 per cent.

Producer – Wholesalers (via Commission agents)-- Retailers – consumers

It is observed from the Table 1 that a small quantity (5 per cent) was transacted through this channel. The commission agents purchased the produces for the wholesalers and the wholesalers sell it to the retailers in wholesale/distant markets. Though, the efficiency of the channel was found to be the highest (3.60 per cent), the effectiveness of the channel was very low implying that this channel is socially not so popular among the farmers.

Producer--Wholesalers cum Pre Harvest Contractors – Retailers – Consumers

It is also found from the Table-1 and Fig. 1 that 10 per cent of total quantity of produce flowed through this channel. The efficiency of the channel was found to be 3.46 per cent. The channel was observed to rank third in relation to marketing efficiency next to channel–I and channel–II.

Producer–Pre Harvest Contractors – Wholesalers – Retailers – Consumers

Table 1 and Fig. 1 revealed that only 15 per cent of total produce was transacted through this channel. This is the longest channel the pineapple marketing in Assam. This channel is the least efficient (2.68 per cent) compared to the other channels

Producer – Consumers

It is the shortest channel in the marketing of pineapple in Assam. The producers directly sell the produce to the consumers. It was found that only 2 per cent of total pineapple production flowed through this channel. This channel was unpopular amongst the farmers and confined to local consumers only.

From the analysis it was observed that channel–II was the most popular and effective channel through which the producers disposed off maximum quantity of their produces. On the other hand, channel–III was found to be the most efficient channel among all the channels, but it was not socially popular among the farmers.

Marketing expenses incurred by producer

Table 2 depicts the marketing expenses incurred by the producers in Assam. The overall marketing cost per 100 numbers of pineapple for all the categories of farmers was found to be Rs 52.10 with the highest (Rs 56.11) and lowest (Rs 48.11) in the medium and marginal farms respectively. Total marketing cost was found to be highest for the medium farmers due to higher transportation cost and wastage/spoilage cost. The major components contributing to marketing costs were

observed to be transportation (including loading and unloading) and wastage/ spoilage cost that contributed Rs. 29.53 and Rs. 17.13 respectively to the total cost. Among the various categories of farmers, the distribution pattern of marketing cost was found to be more or less similar i.e. major share by transportation followed by wastage/spoilage. Grading, marketing fees and miscellaneous cost shared a negligible percentage to the total cost. Transportation cost per 100 numbers of fruits was observed to be maximum (Rs 30.87) in the marginal and medium farms and minimum (Rs 28.59) in the small farm respectively. The wastage/spoilage cost found to be highest (Rs. 19.77) and lowest (Rs. 11.79) in the medium and marginal farms respectively.

Table 3: Marketing cost of pineapple incurred in Channel-(1) P -R-C

Sl. No.	Name of functionary/ Item of cost	Rs/100 no	% Share in consumer rupee
A.	Gross price to the producer/Whole sellers Purchase Price(PP)	425.00	
B	Cost incurred by producer		
	Grading	1.51	0.23
	Transportation	29.53	4.55
	Loading/Unloading	-	-
	Storage	-	-
	Wastage	17.13	2.64
	Market fee	1.17	0.18
	Misc.	2.76	0.43
	Net Price received by Producer	372.90	57.37
C	Cost incurred by retailer		
	Grading	1.35	0.21
	Transportation	20.35	3.13
	Loading/Unloading	6.65	1.02
	Storage	23.50	3.62
	Wastage	32.00	4.92
	Market fee	2.65	0.41
	Misc.	3.35	0.52
D	Retailers Margin	135.00	20.77
E	Retailer's Sale Price (SP)/ Consumer's Purchase Price	650.00	100.00

Table 3 revealed the marketing expenses incurred by different middlemen involved in the marketing of pineapple in the channel–I. The table shows that the net price received by the producers was found to be 57.37 per cent in consumers rupee, while the cost incurred by the retailers was 13.83 per cent in consumers rupee, out of which wastage accounted for the highest cost (4.92 per cent) followed by storage (3.62 per cent), transportation cost (3.13 per cent) respectively. Retailers margin was found to be 20.77 per cent of consumers' rupee.

Table 4 revealed the marketing expenses incurred by different middlemen involved in the marketing of pineapple in the channel–II (P-WR-R-C). In this channel the producers total marketing cost per 100 number was Rs 52.10. Out of this total cost the transportation cost was found to be maximum (Rs.29.53) which contributed 3.78 per cent to the consumer rupee. It was followed by

Table 4: Marketing cost of pineapple incurred in Channel-(1I) P-WS-R-C

Sl. No.	Name of functionary/ Item of cost	Rs/100 no.	P.C. Share in consumer rupee
A.	Gross price to the producer/ Wholesaler's purchase price	415.00	
B	Marketing cost of producer		
	Grading	1.51	0.19
	Transportation	29.53	3.78
	Loading/Unloading	-	-
	Storage	-	-
	Wastage	17.13	2.20
	Market fee	1.17	0.15
	Misc.	2.76	0.35
C	Net Price received by Producer	362.68	46.50
D	Cost incurred by Wholesaler		
	Grading	3.58	0.47
	Transportation	28.25	3.62
	Loading/Unloading	8.07	1.04
	Storage	6.40	0.82
	Wastage	15.65	2.02
	Market fee	5.00	0.64
	Misc.	4.15	0.54
E	Margin of the wholesaler	94.90	12.17
F	Wholesaler's sale price/Retailers Purchase Price	581.00	
G	Cost incurred by retailer		
	Grading	1.01	0.13
	Transportation	15.35	1.97
	Loading/Unloading	3.35	0.43
	Storage	22.05	2.83
	Wastage	31.35	4.02
	Market fee	2.70	0.35
	Misc.	1.75	0.22
H	Margin of the retailer	121.44	15.56
I	Retailers Sale price/ Consumers Purchase price	780.00	100.00

wastage cost (Rs 17.13) with the share of 2.20 per cent to the consumer rupee. Net price received by producers shares was 46.50 per cent in the consumer rupee in this channel. On the other hand, wholesalers total marketing cost per 100 number was found to be Rs 71.10, out of which the transportation cost ranked top (Rs 28.25) with a share of 3.62 per cent in consumer's rupee followed by wastage cost (Rs 15.65) with the share of 2.02 per cent in the consumer rupee. Thus the wholesaler was found to earn a margin of Rs 94.90 accounting for 12.17 per cent share in the consumer's rupee. The table also shows that total marketing cost incurred by the retailers was Rs 77.56 per 100 number of pineapple. The wastage cost was observed to be Rs 31.35 followed by storage cost (Rs 22.05) with share of 4.02 per cent and 2.83 per cent in the consumer rupee respectively. In this channel the retailer's margin was estimated to be Rs 121.44 accounting for 15.56 per cent share in the consumer's rupee.

Table 5: Marketing cost of pineapple incurred in Channel-(1II) P — WS(CA)– R - C

Sl. No.	Name of functionary/ Item of cost	Rs/100 no.	% Share in consumer rupee
A	Gross price to the producer/ Wholesaler's purchase price (CA)	430.00	
B	Marketing cost of producer		
	Grading	1.51	0.18
	Transportation	29.53	3.52
	Loading/Unloading	-	-
	Storage	-	-
	Wastage	17.13	2.04
	Market fee	1.17	0.14
	Misc.	2.76	0.33
C	Net Price received by Producer	377.90	44.99
D	Cost incurred by Wholesaler (CA)		
	Grading	3.55	0.59
	Transportation	22.00	0.42
	Loading/Unloading	6.50	2.62
	Storage	7.50	0.77
	Wastage	10.00	0.88
	Market fee	4.50	1.18
	Commission	5.00	0.54
	Misc.	3.50	0.42
E	Margin of the wholesale (CA)	97.45	11.60
F	Wholesaler's (CA)e price/ Retailer's purchase price	590.00	
G	Cost incurred by Retailers		
	Grading	1.25	0.15
	Transportation	12.00	1.42
	Loading/Unloading	4.00	0.47
	Storage	21.00	2.50
	Wastage	25.50	3.03
	Market fee	2.55	0.30
	Misc.	1.50	0.18
H	Margin of the retailer	182.20	21.69
I	Retailers Sale price/ Consumers Purchase price	840.00	100.00

Table 5 depicts the marketing expenses incurred by different middlemen involved in the marketing of pineapple in the channel–III [P-WS (CA)-R-C]. The total marketing cost of producers was accounted to be Rs 52.10 per 100 number of pineapple. Here also transportation cost accounted for Rs 29.53 with the maximum share followed by wastage cost (Rs 17.13) respectively. Wholesalers' total marketing cost was Rs 62.55 per 100 number of pineapple, out of which transportation cost (Rs 22.00) shared maximum amount followed by wastage (Rs 10.00). The retailer's cost shared 8.05 per cent in consumers' rupee and margin shared 21.69 per cent, respectively. The above analysis indicated that net price received by the producers was 44.99 per cent in consumers' rupee followed by the margin of retailers (21.69 per cent) and the wholesalers (11.60 per cent) respectively in the state of Assam.

Table 6 represents the marketing expenses incurred by different middlemen involved in the marketing of pineapple in the channel–IV (P-WS-C-PHC-R-C). In this channel the producers did not incur any cost for marketing of their produce as the gardens were leased out to pre-harvest contractor at the time of flowering at a pre-determined price. The net price received by the producers was 45.06 per cent in the consumers rupee and the marketing cost of the WS-C-PHC shared 10.12 per cent in the consumers' rupee, out of which the share of transportation cost was observed to be 4.41 percent. It was also observed that retailer's cost contributed 11.19 per cent in the consumers' rupee, while the share of wastage and storage costs were found to be 4.41 per cent and 3.14 per cent respectively. The margin of WS-C-PHC and retailers accounted for 18.05 per cent and 14.48 per cent, respectively. It can be concluded that the producer's net price shared the highest in consumers' followed by the margin of wholesalers and retailers.

Table 7 reveals the marketing cost incurred by the middlemen in channel–V (P-PHC-WS-R-C). The net price received by the producers per 100 numbers of pineapple was estimated at 315.00, which shared 36.63 per cent in consumers' rupee. The highest marketing cost in this channel was incurred by PHC (Rs 94.82) followed by the retailers (Rs 75.20) and the wholesalers

Table 6: Marketing cost of pineapple incurred in Channel-(1V)P – WS –c- PHC – R–C

Sl. No.	Name of functionary/ Item of cost	Rs/100no.	P.C.Share in consumer rupee
A	Gross price to the producer/ Wholesaler cum pre-harvest contractor's purchase price	310.00	
B	Marketing Cost of the producer		
	Grading	-	
	Transportation	-	
	Loading/Unloading	-	
	Storage	-	
	Wastage	-	
	Market fee	-	
	Misc.	-	
C	Net Price received by Producer	310.00	45.06
D	Cost incurred by WS-cum-PHC		
	Grading	0.00	0.00
	Transportation	30.35	4.41
	Loading/Unloading	8.08	1.17
	Storage	10.85	1.58
	Wastage	12.00	1.74
	Market fee	4.50	0.65
	Misc.	5.00	0.73
E	Margin of the WS-cum-PHC	124.22	18.05
F	WS-C-PHC's sale price/ Retailer's purchase price	505.00	
G	Cost incurred by retailer		
	Grading	1.15	0.16
	Transportation	20.00	2.92
	Loading/Unloading	6.45	0.94
	Storage	21.59	3.14
	Wastage	30.35	4.41
	Market fee	2.50	0.36
	Misc.	1.35	0.20
H	Margin of the retailer	99.61	14.48
I	Retailers Sale price/ Consumers Purchase price	688.00	100.00

(Rs 63.90) respectively. The major contributing factor to the marketing cost of PHC and retailers was found to be wastage, which accounted for 4.36 per cent and 3.49 per cent respectively, while for the wholesalers transportation appeared as the major factor sharing 2.95 per cent in consumers rupee. The margin of the PHC, WS and retailers was observed to be 17.46 per cent, 10.44 per cent and 8.27 per cent respectively.

Table 7: Marketing cost of pineapple incurred in Channel-(V)P – PHC-WS-R-C

Sl. No.	Name of functionary/ Item of cost	Rs/100 no.	P.C.Share in consumer rupee
A.	Gross price to the producer/ Pre-harvest contractor's purchase price	315.00	
B	Marketing Cost incurred by producer		
	Grading	-	
	Transportation	-	
	Loading/Unloading	-	
	Storage	-	
	Waste	-	
	Market fee	-	
	Misc.	-	
C	Net Price received by Producer	315.00	36.63
D	Cost incurred PHC		
	Grading	3.28	0.38
	Transportation	22.65	2.64
	Loading/Unloading	7.50	0.87
	Storage	18.22	2.12
	Wastage	37.52	4.36
	Market fee	3.65	0.42
	Misc.	2.00	0.23
E	Margin of the PHC	150.18	17.46
F	Pre-harvest contractor's sale price/Wholesaler's purchase price	560.00	
G	Cost incurred by wholesaler		
	Grading	3.50	0.41
	Transportation	25.35	2.95
	Loading/Unloading	6.55	0.76
	Storage	6.50	0.75
	Wastage	14.50	1.69
	Market fee	4.25	0.49
	Misc.	3.25	0.39
H	Margin of the WS	71.10	8.27
I	Whole seller's sale price/Retailer's purchase price	695.00	
J	Cost incurred by retailer		
	Grading	1.10	0.13
	Transportation	14.25	1.66
	Loading/Unloading	4.50	0.52
	Storage	21.35	2.48
	Wastage	30.00	3.49
	Market fee	2.50	0.29
	Misc.	1.50	0.17
K	Margin of the retailer	89.80	10.44
L	Retailer's sale price/ consumer's purchase price	860.00	100.00

Table 8: Marketing Costs, Margins and Price Spread

Sl. No.	Particulars	Channels				
		I	II	III	IV	V
1	a) Price received by Producer	425.00	415.00	430.00	310.00	315.00
	b) Marketing Cost of the producer	52.10	52.10	52.10	–	–
	c) Net Price received by producer	372.90	362.68	377.90	310.00	315.00
2	a) PHC'S Purchased Price					315.00
	b) Marketing Cost					94.82
	c) Sale Price					560.00
	d) Marketing margin					150.18
	e) Margin as P.C. of P.P.					47.67
3	a) WS-C-PHC's Purchased Pricet				310.00	
	b) Marketing Cost				70.78	
	c) Sale Price				505.00	
	d) Marketing margin				124.22	
	e) Margin as P.C. of P.P.				40.07	
4	a) WS(CA') Purchased Price			430.00		
	b) Marketing Cost			62.55		
	c) Sale Price			590.00		
	d) Marketing margin			97.45		
	e) Margin as P.C. of P.P			22.66		
5	a) WS's Purchased Price		415.00			560.00
	b) Marketing Cost		71.10			63.90
	c) Sale Price		581.00			695.00
	d) Marketing margin		94.90			71.10
	e) Margin as P.C. of P.P		22.87			12.69
6	a) Retailer's Purchased Price	425.00	581.00	590.00	505.00	695.00
	b) Marketing Cost	89.85	77.56	67.80	83.39	75.20
	c) Sale Price	650.00	780.00	840.00	688.00	860.00
	d) Marketing margin	135.00	121.44	182.20	99.61	89.80
	e) Margin as P.C. of P.P	31.79	20.90	30.88	19.72	12.92
7	Total Marketing Cost	141.95	200.46	182.45	154.17	233.92
8	Total Marketing Margin	135.00	216.34	279.65	223.83	311.08
9	Price Spread	276.95	416.80	462.10	378.00	545.00
10	Producers share in consumers rupee	65.38	53.20	51.19	45.06	36.62
11	Marketing Efficiency	3.58	2.89	3.60	3.46	2.68
12	Effectiveness	8.00	60.00	5.00	10.00	15.00

Table 8 depicts the marketing cost, margin, price spread, producers' share in consumers rupee, marketing efficiency and effectiveness of various channels for pineapple marketing. From the comparison of the channels, it is seen that highest cost was incurred by the channel V (Rs 233.92) and the lowest in the channel-I (Rs 141.95) respectively. The marketing margin and price spread also showed similar pattern. The marketing margin and the price spread was more in the channel V due to involvement of more number of middlemen. However, producers' share in consumers' rupee was highest (65.38 per cent) in channel–I and the lowest (Rs 36.62 per cent) in channel–V. In regards to marketing efficiency and effectiveness, although channel-III exhibited highest marketing efficiency (3.60 per cent), its overall effectiveness was found to be only 5 per cent. On the other hand, although the marketing efficiency of the channel–II was found to be low, effectiveness of the channel was the highest (60 per cent) among all the channels, which indicated the popularity of the channel among the growers. The channel–III was economically most efficient but it was socially not so popular among the growers as indicated by the lower percentage of effectiveness.

Conclusion

It was observed from the study that the most effective channels were not always the most efficient chan-

nels. The efficiency of all the channels are found to be very low. The marketing cost were very high. In the light of the above, there is an urgent need for better post-harvest management of perishable agricultural commodities like pineapple is Assam. The establishment of scientific storage structure, efficient transport network, establishment of processing and semi-processing industries in the state may help the farmers to a great extent in efficient disposal of their commodities.

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□

I have a very simplistic concept for evaluating risk. I first analyze the downside. What's the worst thing that can happen if the project or enterprise fails? How much money can be lost? Image destroyed? Careers shattered? Empires lost? And if the analysis isn't too grim, we proceed.

– Jay Chiat

Notes & News

Knowledge Economy

The Knowledge Assessment Methodology 2006 (KAM) is an interactive benchmarking tool created by the Knowledge for Development Program, World Bank to help countries identify the challenges and opportunities they face in making the transition to the knowledge-based economy. The KAM consists of more than 80 structural and qualitative variables to measure countries' performance on the four Knowledge Economy (KE) pillars: Economic Incentive and Institutional Regime, Education, Innovation, and Information and Communications Technologies. Variables are normalised on a scale of zero to ten relative to other countries in the comparison group. The KAM also allows to derive country's overall Knowledge Economy Index (KEI) and Knowledge Index (KI).

The KAM Knowledge Index (KI) measures a country's ability to generate, adopt and diffuse knowledge. This is an indication of overall potential of knowledge development in a given country. Methodologically, the KI is the simple average of the normalised performance scores of a country or region on the key variables in three Knowledge Economy pillars – education and human resources, the innovation system and information and communication technology (ICT).

The Knowledge Economy Index (KEI) takes into account whether the environment is conducive for knowledge to be used effectively for economic development. It is an aggregate index that represents the overall level of development of a country or region towards the Knowledge Economy. The KEI is calculated based on the average of the normalized performance scores of a country or region on all four pillars related to the knowledge economy - economic incentive and institutional regime, education and human resources, the innovation system and ICT.

For the purposes of calculating KI and KEI, each pillar is represented by three key variables

The Economic Incentive and Institutional Regime

- Tariff & Nontariff Barriers
- Regulatory Quality
- Rule of Law

Education and Human Resources

- Adult Literacy Rate
- Secondary Enrollment
- Tertiary Enrollment

The Innovation System

- Researchers in R&D
- Patent Applications Granted by the US Patent and Trademark Office

Scientific and Technical Journal Articles

These three variables are available in two forms: scaled by population and in absolute values. Thus, both KE and KIE are also available in "weighted" and "unweighted" forms. In innovation, absolute size of resources matters, as there are strong economies of scale in the production of knowledge and because knowledge is not consumed in its use.

Information and Communication Technology (ICT)

- Telephones per 1,000 people
- Computers per 1,000 people
- Internet Users per 10,000 people

The normalization procedure used in the KAM is as follows:

Table 1: Global Ranking of Knowledge Economies

Rank	Country	KEI	KI	Econ. Incentive Regime	Innovation	Education	ICT
1	Denmark	9.23	9.37	8.82	9.42	9.20	9.48
2	Sweden	9.22	9.49	8.41	9.72	8.98	9.77
3	Finland	9.12	9.24	8.79	9.71	9.16	8.84
4	Iceland	8.83	9.03	8.25	9.07	8.78	9.24
5	Norway	8.80	8.89	8.54	8.86	9.21	8.59
6	United States	8.74	8.90	8.26	9.42	8.38	8.91
7	Australia	8.74	9.02	7.89	8.82	9.15	9.11
8	Netherlands	8.73	8.80	8.51	8.63	8.67	9.08
9	Canada	8.68	8.73	8.51	9.05	8.52	8.63
10	United Kingdom	8.67	8.77	8.36	8.62	8.44	9.25
11	Switzerland	8.65	8.67	8.61	9.41	7.42	9.16
12	New Zealand	8.56	8.73	8.07	8.78	8.84	8.56
13	Germany	8.48	8.57	8.19	8.80	8.07	8.85
14	Japan	8.42	8.60	7.88	9.27	8.15	8.36
15	Austria	8.39	8.34	8.51	8.48	8.07	8.48
16	Belgium	8.28	8.38	7.98	8.52	8.65	7.97
17	Ireland	8.27	8.24	8.36	8.10	8.54	8.06
18	Luxembourg	8.21	8.00	8.84	8.51	6.11	9.38
19	France	8.21	8.34	7.81	8.46	8.44	8.13
20	Singapore	8.20	7.71	9.65	9.20	4.92	9.01
21	Estonia	8.13	8.22	7.86	7.58	8.32	8.76
22	Taiwan, China	8.12	8.31	7.58	8.97	6.95	8.99
23	Slovenia	8.04	8.28	7.33	8.04	8.56	8.23
24	Spain	7.93	7.95	7.88	7.75	8.41	7.69
25	Israel	7.87	8.05	7.33	8.43	6.78	8.93
26	Hong Kong, China	7.85	7.31	9.47	7.59	5.18	9.18
27	Italy	7.66	7.85	7.07	7.14	7.84	8.58
28	Korea, Rep.	7.60	8.23	5.70	8.30	7.57	8.82
29	Czech Republic	7.57	7.64	7.35	7.34	7.55	8.04
30	Lithuania	7.39	7.45	7.23	6.88	8.30	7.17
31	Portugal	7.29	7.11	7.81	7.14	6.84	7.37
32	Hungary	7.28	7.25	7.40	7.10	7.60	7.04
33	Latvia	7.18	7.23	7.02	6.20	8.33	7.15
34	Greece	7.11	7.10	7.15	6.95	7.52	6.82
35	Slovak Republic	7.10	7.08	7.15	6.84	6.85	7.56
36	Cyprus	7.10	6.85	7.83	6.32	6.50	7.74
37	Barbados	7.06	7.46	5.85	6.95	7.78	7.65
38	Poland	7.04	7.11	6.82	6.44	8.08	6.80
39	Chile	6.86	6.20	8.84	5.82	6.18	6.59
40	Croatia	6.43	6.67	5.72	6.75	6.14	7.13
41	Bulgaria	6.13	6.58	4.79	6.12	7.41	6.21
42	Uruguay	5.99	6.03	5.87	5.14	7.17	5.78
43	Russian Federation	5.98	7.07	2.70	7.52	7.71	5.98
44	Kuwait	5.85	5.74	6.18	5.17	5.19	6.85
45	Qatar	5.83	5.76	6.02	5.47	5.23	6.59
46	Malaysia	5.69	5.52	6.20	5.14	4.36	7.05
47	United Arab Emirates	5.69	5.53	6.15	6.39	3.33	6.88
48	Costa Rica	5.61	5.41	6.23	5.36	4.50	6.37
49	Ukraine	5.55	5.95	4.33	5.86	7.66	4.34
50	Lebanon	5.44	5.83	4.27	6.43	5.52	5.54

(Contd.)

Table 1: Global Ranking of Knowledge Economies *(Contd.)*

Rank	Country	KEI	KI	Econ. Incentive Regime	Innovation	Education	ICT
51	Argentina	5.41	6.15	3.19	6.15	6.71	5.59
52	Armenia	5.40	5.34	5.56	6.06	6.17	3.81
53	Trinidad and Tobago	5.38	5.23	5.82	5.12	4.81	5.77
54	Romania	5.37	5.72	4.31	5.17	5.94	6.05
55	Bahrain	5.23	5.11	5.60	2.71	5.74	6.87
56	Turkey	5.22	4.90	6.19	4.97	4.31	5.42
57	Belarus	5.20	6.52	1.26	6.03	7.65	5.87
58	South Africa	5.19	4.93	5.95	5.69	4.19	4.93
59	Jordan	5.12	5.30	4.58	5.89	5.30	4.71
60	Brazil	5.10	5.45	4.03	5.17	5.57	5.61
61	Mexico	5.04	5.02	5.09	4.96	4.38	5.72
62	Saudi Arabia	4.95	4.91	5.08	5.36	3.57	5.80
63	Jamaica	4.90	5.19	4.01	4.94	4.12	6.51
64	Serbia and Montenegro	4.89	5.75	2.31	5.83	5.85	5.57
65	Thailand	4.88	4.88	4.87	4.47	5.17	4.99
66	Macedonia, FYR	4.61	4.87	3.83	4.39	5.17	5.05
67	Georgia	4.48	5.20	2.29	6.03	6.19	3.39
68	Moldova	4.42	4.56	4.00	3.92	5.77	3.98
69	Mongolia	4.42	4.37	4.56	2.42	6.22	4.49
70	Mauritius	4.38	4.23	4.83	2.19	3.99	6.50
71	Kazakhstan	4.35	4.92	2.62	4.05	7.61	3.11
72	Botswana	4.30	3.09	7.93	2.75	2.94	3.57
73	China	4.26	4.32	4.10	4.78	3.93	4.24
74	Tunisia	4.20	4.39	3.64	4.70	3.88	4.58
75	Peru	4.18	4.43	3.45	3.33	5.30	4.65
76	Bosnia and Herzegovina	4.16	4.37	3.52	2.96	5.98	4.17
77	Oman	4.08	3.82	4.88	3.19	3.78	4.48
78	Philippines	4.03	3.82	4.66	2.38	5.05	4.02
79	Colombia	4.00	4.15	3.55	3.31	4.48	4.64
80	Venezuela, RB	3.85	4.81	1.00	4.59	4.93	4.90
81	Sri Lanka	3.82	3.47	4.86	3.46	4.52	2.44
82	Azerbaijan	3.79	4.08	2.91	4.16	4.94	3.14
83	Egypt, Arab Rep.	3.77	3.99	3.14	4.30	4.35	3.31
84	Kyrgyz Republic	3.64	3.99	2.59	2.90	6.34	2.74
85	Bolivia	3.57	3.73	3.09	2.64	5.36	3.18
86	El Salvador	3.52	3.00	5.09	1.71	3.04	4.25
87	Iran, Islamic Rep.	3.44	4.17	1.24	4.13	3.74	4.63
88	Namibia	3.33	2.66	5.34	1.60	2.58	3.80
89	Uzbekistan	3.21	3.75	1.60	3.23	5.79	2.23
90	Dominican Republic	3.13	3.07	3.30	2.05	4.14	3.03
91	Morocco	3.10	3.16	2.90	3.58	1.85	4.06
92	Ecuador	2.98	3.34	1.91	2.27	3.63	4.13
93	Indonesia	2.96	2.96	2.96	2.34	3.59	2.93
94	Guatemala	2.94	2.75	3.50	2.66	2.18	3.42
95	Nicaragua	2.93	2.56	4.03	1.98	2.99	2.70
96	Algeria	2.73	2.91	2.18	3.08	3.44	2.22
97	India	2.71	2.58	3.11	3.64	2.11	2.00
98	Albania	2.70	2.78	2.46	1.56	4.71	2.07
99	Vietnam	2.69	2.82	2.28	2.31	3.40	2.75
100	Honduras	2.65	2.61	2.75	2.37	3.08	2.38
101	Paraguay	2.64	2.75	2.31	0.80	3.99	3.48

(Contd.)

Table 1: Global Ranking of Knowledge Economies *(Contd.)*

Rank	Country	KEI	KI	Econ. Incentive Regime	Innovation	Education	ICT
102	Kenya	2.62	2.76	2.21	4.18	1.83	2.28
103	Syrian Arab Republic	2.47	2.76	1.62	2.24	2.80	3.23
104	Zimbabwe	2.37	3.14	0.08	3.57	2.44	3.41
105	Tajikistan	2.26	2.30	2.15	1.30	5.06	0.53
106	Senegal	2.08	1.52	3.76	1.09	0.79	2.67
107	Madagascar	2.05	1.11	4.89	1.60	1.13	0.60
108	Uganda	1.97	1.29	4.00	1.90	1.11	0.87
109	Ghana	1.97	1.47	3.47	1.45	1.32	1.63
110	Tanzania	1.84	1.40	3.15	2.28	0.79	1.13
111	Mauritania	1.64	1.07	3.32	0.38	0.96	1.87
112	Cote D'Ivoire	1.58	1.78	1.00	2.13	1.20	2.00
113	Nigeria	1.57	1.94	0.45	2.51	1.82	1.48
114	Zambia	1.53	1.17	2.60	1.07	1.18	1.26
115	Pakistan	1.51	1.48	1.60	2.10	1.04	1.30
116	Haiti	1.42	1.24	1.98	0.08	0.98	2.65
117	Yemen, Rep.	1.41	1.55	0.99	1.25	1.67	1.73
118	Cameroon	1.37	1.53	0.88	1.26	1.71	1.61
119	Malawi	1.32	0.80	2.89	1.26	0.89	0.25
120	Sudan	1.30	1.65	0.23	1.37	1.51	2.08
121	Benin	1.26	0.94	2.20	1.18	0.73	0.92
122	Bangladesh	1.20	1.35	0.76	1.63	1.57	0.83
123	Mali	1.15	0.45	3.27	0.50	0.45	0.41
124	Burkina Faso	1.07	0.47	2.87	0.73	0.24	0.46
125	Nepal	1.05	0.92	1.44	0.85	1.36	0.57
126	Mozambique	1.04	0.54	2.52	0.42	0.28	0.93
127	Angola	1.02	0.98	1.16	1.29	0.74	0.91
128	Djibouti	0.88	0.86	0.93	0.00	0.87	1.71
129	Lao PDR	0.85	0.91	0.66	0.15	1.86	0.72
130	Ethiopia	0.72	0.51	1.37	0.61	0.81	0.10
131	Eritrea	0.72	0.58	1.14	0.23	0.87	0.64
132	Sierra Leone	0.44	0.29	0.89	0.27	0.34	0.27

Table 2: G7 Countries

Overall Rank	Country	KEI	KI	Econ. Incentive Regime	Innova-tion	Educa-tion	ICT
6	United States	8.74	8.90	8.26	9.42	8.38	8.91
9	Canada	8.68	8.73	8.51	9.05	8.52	8.63
10	United Kingdom	8.67	8.77	8.36	8.62	8.44	9.25
13	Germany	8.48	8.57	8.19	8.80	8.07	8.85
14	Japan	8.42	8.60	7.88	9.27	8.15	8.36
19	France	8.21	8.34	7.81	8.46	8.44	8.13
27	Italy	7.66	7.85	7.07	7.14	7.84	8.58

1. The actual data (u) is collected from World Bank datasets and international literature for all the variables and countries.
2. Ranks are allocated to countries based on the absolute values (actual data) that describe each and every one of more than 80 variables (rank u). Countries with the same performance are allocated the same rank. Therefore, the rank equals 1 for a country that performs the best among the countries in our sample on a particular variable (that is, it has the highest score), the rank equals

Table 3: Select Asian Countries

Overall Rank	Country	KEI	KI	Econ. Incentive Regime	Innova-tion	Educa-tion	ICT
20	Singapore	8.20	7.71	9.65	9.20	4.92	9.01
28	Korea Rep.	7.60	8.23	5.70	8.30	7.57	
46	Malaysia	5.69	5.52	6.20	5.14	4.36	7.05
65	Thailand	4.88	4.88	4.87	4.47	5.17	4.99
69	Mongolia	4.42	4.37	4.56	2.42	6.22	4.49
73	China	4.26	4.32	4.10	4.78	3.93	4.24
78	Philippines	4.03	3.82	4.66	2.38	5.05	4.02
81	Sri Lanka	3.82	3.47	4.86	3.46	4.52	2.44
93	Indonesia	2.96	2.96	2.96	2.34	3.59	2.93
97	India	2.71	2.58	3.11	3.64	2.11	2.00
99	Vietnam	2.69	2.82	2.28	2.31	3.40	2.75
115	Pakistan	1.51	1.48	1.60	2.10	1.04	1.30
122	Bangladesh	1.20	1.35	0.76	1.63	1.57	0.83
125	Nepal	1.05	0.92	1.44	0.85	1.36	0.57
129	Lao PDR	0.85	0.91	0.66	0.15	1.86	0.72

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to 2 for a country that performs second best, and so on.

3. The number of countries with worse rank (Nw) is calculated for each country.
4. The following formula is used in order to normalize the scores for every country on every variable according to their ranking and in relation to the total number of countries in the sample (Nc) with available data :

   Normalized (u) = 10*(Nw/Nc)

5. The above formula allocates a normalized score from 0 to 10 for each country.

Table 1 showing the global ranking of knowledge economies is sorted by the Knowledge Economy index (KEI) index. In the weighted comparison, the key innovation variables are weighted by population.

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□

Democracy is based upon the conviction that there are extraordinary possibilities in ordinary people.

– Harry Emerson Fosdick

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