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Indian Manufacturing in a Global Perspective

Setting the Agenda for Growth

A Report by the Indian School of Business, New York University,
Purdue University, and Deloitte Research

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Introduction: Setting the Agenda for Growth:

The first summit on India's manufacturing competitiveness was held August 18-19 at the Indian School of Business. The conference was co-hosted by the Operations and Information Technology Department at ISB, the Global Business Institute of the Stern School of Business at New York University, Krannert School of Management at Purdue University, and Deloitte Research.

The 2005 Summit on Indian Manufacturing Competitiveness aimed to explore the challenges and opportunities of global supply chain management in India and the secrets to success of Indian enterprises operating in global industries. All of this was intended to help chart a course to take the manufacturing industry to the next level of competitiveness. In addition, the conference focused on lessons learned from developed and emerging economies including North America, Western Europe, Central and Eastern Europe, and Asia-Pacific.

In the future, the conference will provide a continuing forum for academic and industry specific research resulting in initiatives that will augment the growth of the manufacturing sector. Leading academic researchers and industry experts from around the world will continue to share their experiences, and creative ideas, for effectively furthering India's industrial potential.



Promises and Challenges¹

It's no secret that India is an emerging manufacturing power to be reckoned with. Its manufacturing sector grew more than 10 percent in the second quarter of 2005 alone. With this growth has come a focus on operational excellence: Indian manufacturing companies rank second only to their Japanese counterparts in terms of the number of Deming awards per country. India is well on its way to becoming the premier manufacturing location for companies around the world.

Most importantly, the growth in this sector, unlike the much publicized growth of the high-tech sector of the Indian economy, has a great potential to elevate much of the Indian population above poverty by shifting much of the workforce from agriculture to manufacturing, with its opportunity for better wages.

The social and economic benefits are hard to overstate: a stable and prosperous India would attract business for generations.

Small wonder, then, that the 2005 Summit on Indian Manufacturing Competitiveness drew academicians, researchers and industry leaders from all parts of the world, and that the tone of the event was enthusiastic and upbeat. The future looks promising, both for emerging Indian multinationals and for global manufacturing companies that have begun to move sourcing, production, R&D, sales and marketing there.

Not everything is roses, however, and the conference speakers identified a number of challenges that India faces as an emergent manufacturing leader. These stem from its Third-World infrastructure, heavily regulated environment, limited domestic demand, weak currency, and the country's geographic isolation from the world's industrial centers. These challenges are more pressing in the manufacturing sector than in the high-tech sector because, unlike software, automobiles cannot be delivered via the "information superhighway." In addition, heavy manufacturing demands large capital investments, changes in custom regulations, and investments in infrastructure. Despite its promise, India has a way to go before it becomes the ideal location for such operations.

Some issues were remarkably similar to those faced by other developing and developed economies. For example, the shortage of applied, professional skills in operations and management is as common—if not more common—in India, than it is in Russia and China. Also, the education system has its shortcomings: college professors' salaries are much below the salaries of graduates in hot professions, leading the best to look for other jobs and creating a shortage of experienced professors in higher education. Many European countries have been struggling with the same problem for years.

What does it take?

Beyond India and manufacturing-specific factors, the question that permeated the conference was this: what does it take for a company to compete globally in a knowledge economy? A common theme emerged, that of competitiveness stemming from organizational capabilities to innovate across boundaries so as to increase flexibility and productivity. Representatives from such diverse companies as TATA Motors Limited, Biocon India Ltd, Deloitte Touche Tohmatsu India Private Limited, Nicholas Piramal, and General Motors shared their accounts of successful innovation across boundaries.

Whether the company was headquartered in the United States or India, it was able to:

- Engage talented people from around the world, tapping their individual comparative professional talents.
- Focus on the historically and socially unique resources of the company, industry, and country.
- Listen to and influence customers, suppliers, partners, governments, and academicians.
- Allow people to experiment and fail, within constraints.

In following these principles the companies also needed to pay close attention to the alignment of multiple components of their market and operational strategy in diverse cultures, across different product groups, and while building relationships with multiple suppliers. To do so, successful organizations focused on building a common company culture shared across contexts. These cultures often had the following attributes:

- Set seemingly “impossible” but clear goals and constraints that define the company’s identity (e.g., financial, quality and customer satisfaction targets).
- Facilitated “challenge” across supervisory levels and functional units.
- Grew boundary spanners who can build micro-communities across boundaries.
- Used information systems and a common language that connect community members and help communities reproduce over time, even when people leave.
- Focused on continuous improvement by reflecting on what they did in the face of change.

One example of successful innovation is TATA’s Indica automobile, described by Dr. Sumantran, the executive director of the company’s passenger car business. TATA Motors engineers listened to their customers, who wanted something close to impossible: a very cheap, safe car, with a roomy backseat. While innovating out of necessity, Dr. Sumantran drew on his prior experience in a multinational automotive company and his talented team to meet this market need. The next step is to market the Indica to markets similar to India, such as those in Africa.

Yet, in the last session, one of the attendees raised a concern: his family is in the business of manufacturing high-precision equipment, and foreign clients are still very cautious in giving their business to India when high quality or precision is expected in manufacturing. To address this concern, Indian manufacturing companies might learn a lesson from their high-tech counterparts. A strong industry association, which would spare no expense at marketing the Indian manufacturing brand abroad—along the lines of NASSCOM—might be the missing piece. Changing perception may ultimately be the final hurdle in realizing the full competitive potential of India’s rising power in manufacturing.



A Crucial Cog²

With the rapid growth in off-shoring and outsourcing across industries, India is emerging as a crucial cog in the design of high-performing global supply chains. Its fast growing local economy has positioned it favorably as a center of competitive supply, innovations in technology, design, and business processes. But the vast economic and manufacturing potential of India remains new territory. For enterprises focused on tapping this potential, learning how to match India's industrial capabilities to global supply chains is critical.

These issues are crucial for both executives of Indian companies striving to succeed in worldwide markets as well as multinational executives scouring the globe for more efficient, more innovative, higher-growth, and lower-cost locations such as China and India. While the opportunities are great, effectively accessing national and global markets, and managing increasingly complex supply chains to, from, and within India can be challenging. In addition to the cultural and organizational differences, it also involves learning the strengths and weaknesses of product and process innovation, production and logistics infrastructures, channel partnering, information systems and technological trends in the country, and how these fit into an efficient and competitive global sourcing, production and distribution system.

A forum for innovation

With the rapid growth of the Asian economies, most notably those of India and China, there is a need to focus on the strategic and policy issues, as well as infrastructure and financial issues, relating to global manufacturing and service networks. From the perspective of the Indian School of Business, its newly created Center for Global Manufacturing, Logistics, and Supply Chain Management will be at the heart of the future development of manufacturing competitiveness in India. The mission of the Center is to be the knowledge partner of choice, for government and industry, on global logistics and manufacturing strategies and policies, for companies and countries in Asia and elsewhere.

The center will conduct state of the art research and education, with focus areas including optimization issues in pharmaceutical supply chain networks, robust supply chain design for auto manufacturers, food supply chain networks, retail formats, and optimization and design of highly competitive special economic zones in India, to name a few. The center has identified very specific research projects for the first few years—projects with a very tangible, global impact. The advisory board of the center will comprise thought leaders from industry and academia who will provide guidance and a vision for its growth.

In addition to the full time faculty from ISB, the center will attract adjunct faculty from industry and appoint post doctoral researchers. The center hopes to attract research students from around the world for short periods, to work on projects of mutual interest.

One of the features of the center is the ISB Global Supply Chain Forum which provides a platform for dynamic interchange of ideas, analysis, and reflection through executive education programs and customized industry projects. The Forum will comprise members from Asian and international 3PLs, IT majors, and supply chain software companies, management consulting companies, public sector and government organizations, leading researchers and students. Under the ISB Global Supply Chain Forum we plan to organize, during 2006, a five-day course on global manufacturing strategies, two one-day courses on logistics and retail and a two-day annual conference. The five-day course on global manufacturing strategies is a unique one, exposing CEOs and the higher level management to the evolution of global manufacturing networks and international trade, economic integration issues, global logistics and IT.

The center will also publish periodically white papers on topics of widespread importance to the Asia region. Some of the white papers under preparation include: *The Imperfect Supply Chain - How Do You Deal with It?*; *Global Manufacturing Network Strategies*; and *Making India A Globally Competitive Manufacturing Hub*.

In the next couple of years, the center would like to expand its work in both the Middle East and South East Asia, particularly Dubai, Malaysia and Thailand. These are growing economies with huge trade and manufacturing bases.



A Window of Opportunity³

The Indian manufacturing sector has shown remarkable results in the recent past. It grew 10.3 percent in the second quarter of 2005, and in a recent study was identified as the second most competitive destination. In short, it is an appropriate time to discuss the future competitiveness of Indian manufacturing industry.

In the last decade, Indian manufacturers have shown they can perform on par with the best of companies and compete strongly in the global marketplace. Examples abound in terms of market shares, costs, awards and certifications demonstrating high standards of quality, global scale, adopting contemporary manufacturing practices, etc. Much of this change has come about in the very short time of about 15 years after the liberalization of the Indian economy.

It is also true that there are large sections of the Indian manufacturing industry that suffer from underutilization of technology, inappropriate scales, poor infrastructure, over-staffed operations, expensive financing and bureaucracy.

While companies from around the world are looking at India as a partner in their supply chains, is Indian manufacturing ready to integrate with the networked economy?

Achieving global competitiveness in manufacturing is vitally important to the Indian economy: this sector offers the highest employment potential. The agricultural sector is probably not in a position to absorb any more employment, and the new IT and service sectors will not address all the employment needs of rural India. It is, therefore, important to create opportunities in the manufacturing sector for the fast growing population of employable young adults.

The globalization of supply chains offers tremendous opportunities to the Indian manufacturing sector. India cannot afford to miss this window of opportunity.



Competing in Global Industries: Challenges for India⁴

Over the last decade, India's manufacturing sector has changed dramatically and emerged as the key to meeting the ambitious nine percent growth target in the Tenth Five Year Plan. Manufacturing is the logical engine to provide employment growth in India, because the work force in the organized sector—a core engine for growth—is currently only eight percent.

The challenges are significant. There are numerous constraints to growth, and India has its work cut out as it makes the transition from being an attractive labor pool to a global manufacturing power. Foremost among these are a paucity of natural resources and highly skilled manpower, and an inefficient regulatory mechanism. Beyond this, there is a shortage of faculty in higher technological institutions, which constrains India's ability to fill the skilled manpower void.

High interest and tax rates are another problem, contributing to a risk of losing employment and investment through flight of capital. There is a need for low taxes, tight fiscal policy, and monetary stability.

How, specifically, can India improve its competitiveness? There are several priorities:

- 1. Infrastructure in various sectors:** Urban infrastructure—including power, telecommunications, ports, roads and civil aviation, and legal infrastructure—demands attention. This is not the sole responsibility of government: there is a notion in the public mind that everything is the government's responsibility, but it is essential to encourage the public and the government to think in terms of private and public partnership. Some needs are quite specific and urgent. For biotechnology, for example, common testing facilities are crucial.
- 2. Market framework regulatory environment:** India must ensure fair competition and better access to markets, conduct trade negotiations to provide a level playing field for domestic manufacturers, and reexamine the regulatory accountability, rationalization and simplification of regulatory procedures. And the patent system requires reform.
- 3. Cost competitiveness and domestic demand:** Reduction of import duties and domestic indirect taxes enhanced World Trade Organization compatibility, export incentives, facilitation and simplification of FDI and, finally, lower interest rates and labor reform could have a positive effect on India's manufacturing costs and domestic demand.

4. Educational system and skill training: Quality improvement in vocational and higher technical education is particularly necessary. The severe shortage of faculty in higher educational facilities must be addressed.

5. Innovation and technology: Industry must create more opportunities for “chance to meet the prepared mind,” according to Professor Ananth. While it is important that we prepare minds, it is equally important that there should be more exposure to the industry. Companies should invest at least two percent of their turnover on R&D. Right now it is under one quarter of one percent.

6. Benchmarking, for each sub-sector: Companies must assess technology in order to eliminate substandard technology imports. Consumers have to be educated about quality.

7. Small and Medium Enterprises and the Public Sector: “The small-scale sector in India has been very vulnerable,” Prof. Ananth said. “In the last few years, there has been an awakening and the interest rates changed, but even now it is very vulnerable. We need to do something about it because, per unit of investment, the employment is much higher in the small scale sector. There is need for greater venture financing and possibly use of the cluster approach to development.”

The top people in the private sector have often served in public sector enterprises for many years. The public sector is not able to retain them simply because of its inflexible and low salary structure. It is time, according to Prof. Ananth, that the government empowered the public sector to be able to retain its talent.

These are some of the key policy initiatives required to make the manufacturing sector not only more competitive, but also responsive to the needs of the other sectors of the economy. For India, quite a lot depends on the future trajectory of manufacturing. With the right interventions now, the potential will be immense.

Competing in Global Manufacturing: Benchmarking Indian Industry⁵

In pursuing profitable growth, manufacturing organizations worldwide create ever more complex supply chains, as well as manufacturing, and distribution systems. These complexities arise when companies attempt to reduce costs by reducing their work force or by moving production, sourcing or engineering, and when they pursue new markets and new products.

These complexities create challenges around optimization, innovation, collaboration, flexibility and risk management. Research shows that only a small minority of the companies has overcome these paradoxes and they achieve significantly higher levels of profits and growth. The key to success, despite operating in highly complex global supply chains, is their ability to develop and synchronize activities and major processes across the extended value chain.

Indian manufacturing companies are often overlooked as a competitive force in the global manufacturing arena. Typically, India is perceived as having great strength in technology skills, so that the debate on outsourcing to India is focused on technology. However, the present, preliminary research shows that industry capabilities in areas such as product innovation, manufacturing quality, and process innovation are driving the performance of Indian manufacturing companies. In fact, Indian manufacturers participating in the Deloitte Global Benchmark Survey (which to date covers more than 800 manufacturing companies and business units around the world) are outperforming their counterparts around the world in terms of gross profits (EBIT) and sales growth. With respect to operational capabilities, Indian manufacturers on average have made greater inroads in key areas, such as quality management, than the rest of the world.

Yet, this analysis also suggests that there are a number of key areas that Indian manufacturers need to address to set an agenda for growth that matches the great promise of Indian industrial development:

- Lack of investment into R&D prevents many Indian manufacturers from taking a lead in their sectors in global competition.
- Lack of financial capacity to build the production and distribution capabilities needed to sustain double-digit annual growth rates.

- Lack of scale in crucial areas of production, distribution, and marketing/sales—key capabilities needed to efficiently access nation-wide and global markets.
- Lack of capabilities and investment in technology and infrastructure to support rapidly growing domestic and international business.
- High cost of funding expansion and working capital.
- Lack of managerial talent with international exposure in the manufacturing sector to pursue international expansion opportunities.

While the challenges are many, our preliminary global benchmark research suggests that Indian manufacturers are in a position to blaze a new trail for growth in both domestic and international markets.

Economics and Indian Expansion: Lessons from the Automotive Industry⁶

There is much to cheer about in regard to the growth in the manufacturing sector in India, but also an historical context that suggests loftier aspirations. When one starts to look at what India's aspirations ought to be, it is important to view this in the context of history. Several centuries ago, India and China dominated the world's manufacturing output. From 1800 to 1900, the Western world's share of the world's manufacturing output went from 25 percent to well over 75 percent—literally in one century. Today, India accounts for only 1.7 percent of world GDP. There is no reason why, for a country of India's size and population, India cannot aspire for a larger share of global GDP and global manufacturing output.

A robust domestic market, with stable consumption trends for two-wheel, passenger and commercial vehicles, is a key to growing scale and gaining competitiveness. However, the current ownership of vehicles per capita in India is one of the lowest. Historical trends show an increase in auto ownership as country per capita GDP increases, and there is reason for optimism in India's case. The BRIC report postulates that over the next few decades India's rate of GDP growth is bound to exceed the other BRIC countries—namely Brazil, Russia and China. The logical conclusion is that, if the GDP growth continues in India, and it is stable and sustainable over a period of time, manufacturing output represented by the vehicle output or penetration is bound to grow. The bottom line is that there is good reason to expect strong potential for home market automobile demand as living standards rise in India.

The Indian market has evolved as a more natural economic

model. Most passenger car sales in India are to private individuals and private owners. Most are made through access to money from financing, or loans. Given that 85 percent of these sales are financed through loans, it indicates a widely available economic structure for buyer behavior. In contrast, in China, 85 percent of the cars sold are cash transactions, indicating that loan availability is extremely poor. This observation has caused analysts to forecast that the auto sector will grow in India over the next decade. Demand crossed a million units last year, and the expectation is that by the end of this decade, demand should be well in excess of 1.6 million.

In a sense, both countries, India and China, are proceeding along an inevitable curve in terms of vehicle ownership and per capita income. Currently, India appears to be lagging China by about 5-7 years. Compared to India's passenger car sales of one million units, China's demand is at 3.5 million.

In fact, India will need to overcome several factors to surpass China when it comes to manufacturing competitiveness. A detailed analysis of manufactured products of India and China, commissioned by the Confederation of Indian Industry (CII), points to the specifics underlying the main issue—which is that there is an advantage in China to the tune of about 23 percent. That number encompasses factors ranging from HR, energy costs, cost of the no-exit policy and engineering capability.

The auto policy enacted in China—a single-minded document aimed at fostering the creation of large multinationals in the auto sector—has played a large part in making Chinese industries competitive and has enabled them to flourish in the last few years. In India, by contrast, one of the biggest sources of the cost disadvantage facing Indian companies is the burden of cascading cumulative taxes and duties; together, these account for more than 18 percent of India's cost disadvantage. Thus, while manufacturing in India is getting competitive, there remains a long way to go in terms addressing the kinds of change and the pace China is setting.

How do companies evolve to become globally competitive?

Strategies for globalization include developing market strength based on unique customer knowledge, and then expanding to take advantage of market adjacencies by expanding into countries with similar segments and in a similar economic development cycle. A company might then develop market niches globally to access additional markets and develop future technologies. A prime example: Haier, a white goods manufacturer in China, which has evolved from a solely Chinese refrigerator manufacturer into a global player.

Tata Motors' plan to develop manufacturing competitiveness follows these strategies. For well over three decades now, the company has invested in a very capable and well staffed R&D organization—truly state of the art in most of the critical areas of activity—backed up by its optimally automated production facilities. Tata Motors is on track to become a global player, with the recent report that it had a 31.8 percent increase in worldwide sales.

The Indian auto industry enjoys a 6.1 percent benefit relative to China in costs due to its engineering capability. The typical Indian auto company will buy the skeleton of equipment and develop all the software and detailed tooling in house, in contrast to the complete turnkey purchase of all equipment and software in China. But this localization of tooling enables rapid cost reductions due to manufacturing process and engineering changes. This advantage is currently a key component of competitiveness for the Indian auto industry.



Moving up the Value Chain: Differentiation through Technology⁷

India has an established track record of manufacturing generic, chemically synthesized, pharmaceutical products. This is reflected in the large number of USFDA qualified facilities being located in India. Most of the expertise in India relates to the manufacture of bulk active ingredients and, more recently, to the manufacture of oral, solid dosage formulations.

Two of the factors that contributed to the development of the pharmaceutical industry in India were the availability of a large pool of science and engineering graduates and the legal sanction to manufacture and sell generic products in India and other countries that did not recognize product patents.

The adoption of the product patent regime, the harmonization of regulatory standards and the increasing proportion of biotech products in the basket of new approved international products, will force a re-thinking of the strategy of Indian pharmaceutical players. There will be consolidation of the fragmented industry within India with the winners amongst the large players being those that upgrade their talent pool to be able to backward integrate from a manufacturing emphasis to one that includes product development.

The attraction of India for global pharmaceutical companies is not only as a market for their products, but more importantly as a cost effective base for research, development and contract manufacturing. This will provide niche service opportunities to many of the smaller players.

The proven strength in chemical sciences has to be extended to the biological sciences. This requires a different talent pool that is exposed to the areas of protein characterization, cell culture, aseptic processing, immunology, viral validation, etc. Developing any new pharmaceutical product, not just a biotech product, is a fairly time consuming, expensive proposition, that requires a great deal of investment and staying power. Many Indian companies will need to convince investors of the need to take a long-term view.

Finally, in today's interdependent world of complex technologies and proprietary platforms, Indian companies will have to focus on the skills required to evaluate technology in order to exploit in-licensing or out-licensing opportunities or even mergers and acquisitions.

Going forward, the ability of Indian companies to exploit any cost arbitrage would increasingly depend on their credibility on matters such as respect for intellectual property, adherence to international quality standards and the depth and breadth of their talent pool.

Custom Manufacturing: The India Advantage⁸

Indian pharmaceutical companies are well positioned to grab a major part of drug manufacturing contracts within the global pharmaceutical market, currently worth around \$50 billion. Because global pharmaceutical companies must focus increasingly on R&D, in order to secure their long-term future and, at the same time, pursue brand building to achieve higher profits and growth, their best strategy today is to outsource the manufacturing of bulk drugs and formulations to lower cost locations like India and China.

Over the years, Indian companies have escalated their investments in world-class manufacturing facilities. As a result, today there are more than 70 U.S. Food & Drug Administration (FDA) approved plants in India—the highest number outside the United States. In fact, the FDA is contemplating setting up a permanent office in India in order to handle the heavy load of audits.

Apart from this, India ranks third in the world with regard to chemistry skills, ranking behind only Belgium and Germany. Every year, Indian institutes and universities churn out approximately 12,000 pharmacy graduates, 10,000 chemistry postgraduates and 1000 PhDs in chemistry. Beyond talent, India offers a consistent 30-40 percent cost reduction in pharmaceutical manufacturing, while adhering to world class manufacturing standards. The newly established product patent regime and other patent regulations in India favor the innovators by ensuring that the innovator gets a stay over the patent infringer: it is the patent infringer, who has to prove that he/she has not infringed. The opposite situation applies in China, where it is the innovator who has to prove that his product/process has been infringed upon.

China, India's chief competitor for low-cost manufacturing, is at least 5-7 years behind India in the pharmaceutical sector in terms of technology and process innovations. But China is closing this gap, and India is well advised to expand its manufacturing market share before then. The boon to India's economy may be much broader than the selective prosperity brought by manufacturing in the information technology area. In that case, benefits reached only the middle class urban population. The trend towards manufacturing outsourcing, however, may well affect the masses.

Auto Supply Chains at the Crossroads⁹

The focus here is on the Indian auto component industry. The obvious questions are: Is there money to be made? Is it more important to focus on auto components or on cars?

In terms of manufacturing volume, the real boom is in auto components. The global industry for auto components is \$737 billion, whereas Indian industry as a whole in 2003 was \$7 billion and rising. In terms of percent, that seems small. However, what gets everybody's attention is the growth rate, which for India has been huge, with a compounded growth rate of 20 to 25 percent from 1993 through 2003. Several global OEMs that have entered the Indian auto market have local content of their models that vary from 50 to 90 percent. The sourcing question, in many cases, is a component story, even if the objects of our analysis are completed cars. And when it comes to components and sourcing, the most revealing story is the Deming Prize.

There are about 13 firms that have won the Deming Prize in India. This is remarkable, as it is the largest number outside Japan, and raises the question of whether there is a big role being played by the so-called Japanese manufacturing techniques. Several of the firms have ISO certification.

This study focused on external validation of changes in quality—such as certifications and awards—and their impact on firm productivity, and used the PROWESS database, provided by the Center for the Monitoring of the Indian Economy (CMIE) as the basis for an empirical productivity analysis. For each year, over a ten year period, this research team separated out technical change from productivity change and computed the change in relative efficiency for each firm by using a Data Envelopment Analysis approach. They then used statistical methods to study the impact of certification and quality awards on productivity gains, controlling for factors such as age, export orientation, and firm size.

Firms that won awards showed an increase in relative efficiency over the period compared to firms that achieved quality certification. These award-winning firms also showed better improvement in productivity from the first five year period (1993-1997) than in the second period (1998-2003) and showed a higher profitability over the entire period than the rest of the industry. In contrast, firms with ISO certification did not show any significant advantage over non-certificate firms.

With regard to productivity and net profit, there are operating profit differences between Deming and other award winners versus non-award firms of about 2.22 percent, which is significant.

Lastly, productivity improvements for firms with higher levels of exports were not statistically significantly higher than firms with lower levels of exports.

It is an incredible experience to visit these Deming Award-winning facilities. From prior experiences, there is an incredible transformation going on, and one could argue that everything that we teach in class shows up in the plant next to each machine. Manufacturing goes beyond making things—it involves making, controlling and modifying, and the use of online data in actual practice is quite exciting.

This suggests a possible path to transformation. Targeting quality improvements, through prizes such as Deming, translated into significant productivity improvements which in turn led to profitability. However, the Indian auto components industry is now at a crossroad, trying to identify how best to fit into the global auto supply chain.

Much of the success in the Indian auto industry is a Korean story. Hyundai has very successfully leveraged the Indian market, pushing exports and announcing that it will move small car manufacturing to India. The data show that significant change is happening, and significant change results from the ability to absorb technology in order to improve productivity.

What is the difference between winning these awards and being certified? The ISO certification process does not necessarily certify a level of quality. It verifies that a company has the documents to justify what it does. Does certification suggest anything beyond this? These findings indicate that the certified firms did not show any advantage over non-certified firms. Deming and other award winners, on the other hand, have shown significant improvements in productivity, and OEMs have not seemed to drive down the supplier margins. Happily, this suggests that the rewards for this achievement go beyond having another trophy on the shelf.

Uncertainty and Responsiveness in the Indian Auto Components Industry¹⁰

The Indian auto component industry is going through a restructuring as the major automakers discover the advantages it provides for global supply chains. However, the process is incomplete, and there are still structural inefficiencies stemming from various entrenched factors. Nitin Agarwal's work explores the connection between responsiveness and uncertainty in auto supply chains.

Some researchers have proposed a strategic model for the design of supply chains that involves the relationships between demand uncertainty faced by the supply chain and the responsiveness it then should seek to provide. Other researchers have extended that to include supply uncertainty as well. While they all propose that the relationship between the uncertainty faced and responsiveness provided should be linear, very few researchers have verified whether this is indeed the case.

Structural Equation Modeling is a confirmatory approach to data analysis requiring a priori assignment of inter-variable relationships. It tests a hypothesized model statistically to determine the extent the proposed model is consistent with the sample data. Structural Equation Modeling incorporates observed (indicator) and unobserved (latent) variables. Observed variables are those that can be measured, while unobserved variables cannot be directly measured and must be inferred or hypothesized from the observed variables. The measurement models specify how the latent variables are measured in terms of the indicators as well as address the reliability and validity of the indicator variables in measuring the latent variables or hypothesized constructs. The structural equation model provides an assessment of predictive validity, specifies the direct and indirect relations among the latent variables, and describes the amount of explained and unexplained variance in the model.

Although use of Structural Equation Modeling (SEM) techniques for empirical modeling and verification in supply chain research is not very common, researchers are increasingly adopting the methodology. Wisner, for example, modeled the relationship between supply chain strategies and firm performance using SEM. Garver and Mentzer stressed the growing role of Structural Equation Modeling in logistics research and laid down the process, specific techniques and acceptable standards for testing construct validity.

Agarwal used an SEM methodology to test the hypothesis that demand uncertainty and supply uncertainty influence responsiveness of the supply chains. Demand uncertainty, supply uncertainty and responsiveness are the latent variables, which are measured using indicator variables. Towards this, he surveyed the members of Indian auto component supply chains and collected information on various indicators using a five-point Likert scale. Then, he developed measurement models for all three latent variables, which were tested for construct validity using criterion developed by Garver and Mentzer. Finally, the relationship model was developed indicating the relationship between demand uncertainty, supply uncertainty and responsiveness.

Agarwal's key finding is that for the Indian auto component sector, while supply uncertainty influences responsiveness of the supply chains, demand uncertainty has no impact. The survey also revealed that:

- Regarding customers: Supplying in time is a critical challenge faced by the surveyed group. Customers are not as price-sensitive as is generally assumed. Industry still relies on channels for understanding of the market demand. And supply chains are relatively long, as end-users have to go via channel to buy products.
- Regarding suppliers: While supplier breakdowns are a common occurrence, those involved in auto component industries feel that the supplier quality is reasonably good. Despite their limited capacity, suppliers are able to provide volume and product-mix flexibility, and cope with changes required during new product introduction. However, suppliers are not able to deal with large volume changes without some delay. Multiple suppliers are a common occurrence in the industry, although that trend is declining. Supply base consists of reliable but moderate size suppliers who are often located nearby and able to supply in small lead times.

This research did not address why the Indian auto component manufacturers designed for supply uncertainty rather than implied demand uncertainty. Certainly, follow-up research through interviews as well as discussion with suppliers and OEMs can clarify this issue. Also, actual measurement of responsiveness and uncertainties can shed light on performance as a consequence of these choices.

The Myth of Low Cost: R&D in the Global Automotive Industry¹¹

General Motors is investing heavily in India operations from many perspectives, such as supplier development, R&D and engineering staff, and manufacturing facilities. The company will be introducing quite a few products in the next few years, and the recently launched multi-utility vehicle Tavera has been sourced up to 95 percent from India. It has a manufacturing facility at Halol, near Baroda, in the Western State of Gujarat. Two years ago, it has set up a GM Technical Centre in Bangalore where they conduct both engineering and R&D activities for its regional and global operations.

Why India? There are three basic reasons. First: the talent base. Innovation and technology are core assets for GM. GM is a global company and needs to attract and tap into the global market of high technology talent. India is in the forefront of this market.

Next, the Asia-Pacific market is the fastest growing in the world, and will remain so in the foreseeable future. GM has a presence in Asia-Pacific markets and in India and will continue to grow here.

Finally: new technology development. A lot of technology which goes into the vehicles is not the just vehicle technology, but a combination and integration of electronics as well. Where does the talent come from for vehicle technology, software development and IT, smart vehicles? India.

What is missing here – intentionally missing? Low cost. GM is not in India for low cost. Today's low cost markets can be high cost markets tomorrow, making this an unsustainable rationale for building our presence in India. The reasons may be different from the manufacturing perspective than from a technology or R&D perspective, but the need for a talent base is common to all companies. Low cost has nothing to do with it. If GM is in India for low cost, like many companies, the R&D organization is going to get into trouble as it attempts to develop into a sustainable viable organization and become a part of the global R&D organization. If the sole objective is cost, then one needs to question the original rationale.

Global technology challenges: What does it take to make it work? GM has developed hundreds of engineers in the Bangalore facility, and will ramp up the research staff significantly by the end of 2005. It's probable that the

numbers will continue to grow in the coming years as well. There is an enormous amount of talent here. How do you make this talent focus on the right things? That can be difficult.

There are also cultural challenges, and it would be a common mistake to assume this refers to India's culture, or even China's culture. The culture challenge is General Motors' culture. There are two perspectives, the first being General Motors perspective – i.e., how does this company open up and learn from the organizations it creates? On the other side, the cultural challenge is assumed largely by the people of GM. They have automotive experience and now they have General Motors experience. The company needs to meet the career aspirations of the people in Bangalore as much as those in Detroit. To make this happen, the people in Bangalore must know customers' businesses as well as they do. That should drive the research agenda, and lead to innovation within the R&D organization. This is a difficult thing to achieve. This is sustainability.

The future of the automobile, as it appears today, is largely directed by electronics. That's an opportunity for GM as it globalizes its R&D. One of GM's goals is to help its research team develop not only technologies that are integrated worldwide, but developed specifically for certain markets. A lot of technology growth, such as new production technology, will happen here. That is itself a reason to have an engineering facility here.

If GM works right, works harder, and addresses the issues, the result will be a global flexible manufacturing company – and a real competitive advantage.

Making India a Globally Competitive Manufacturing Hub¹²

Manufacturing is the backbone of every economy. Its global competitiveness is important for creating employment and to nurture the agriculture and service industries including food processing and defense. India's manufacturing accounts for 25 percent of its GDP and India has a sound manufacturing base that is growing at six to eight percent per year. It is also a preferred destination for the manufacture of auto components, bulk drugs and producer services such as software, finance and several others.

The issue of competitiveness of Indian manufacturing has been the subject of much economic debate and has recently received a lot of business press. One can look at competitiveness at various levels—at the individual corporate firms' level, at the industry level and at the national level. Of course, these three are not independent but highly correlated. This analysis considers the competitiveness of industries from two angles: export competitiveness and domestic competitiveness. The former relates to a scenario where the domestic manufacturer is competing with global manufacturers for an increased share of the foreign market. The latter relates to a scenario where the domestic manufacturer is competing against the local and foreign manufacturers in the domestic markets. Similarly, industrial growth can be viewed from domestic markets as well as from the export markets.

Manufacturing Growth Strategy

It is beyond doubt that India must increase its manufacturing share to 40 percent to create employment for its millions of people, while concurrently attracting MNCs and encouraging local manufacturers to become MNCs. The main question, however, is in what sectors and what is the strategy for each sector. Traditionally, the manufacturing sector includes automobiles, chemicals, oil and its derivatives, electronics and so on. There are other sectors such as food processing and retail and producer services—also called after-sales—in which India can lead the world. The former falls in the domain of agriculture, the latter into services.

Each sector demands different growth strategies and approaches. In saturated sectors such as automobiles, chemicals, pharmaceuticals and oil, where several advanced countries are leaders and competing for market share, India should follow lean manufacturing and mass production strategies to meet the domestic demand. In sectors where Indian companies are component suppliers to global supply chains, they should take steps to move up the value chain to become contract manufacturers and product design manufacturers. In evergreen sectors such as food processing, where India has huge natural resources and possible productivity improvements, the country should pursue aggressively export oriented growth strategies.

Sectors with Huge Growth Potential

Retail is the tail end of any manufacturing activity, and the face that manufacturers present to the end consumer. This is a US\$200 billion market, and one that is currently highly fragmented and inefficient. Restructuring this activity to increase its efficiencies and encouraging organized retailing through technology-based mass production would trigger huge benefits for all the three sectors of the economy. Food, textiles, leather goods, and personal hygiene products must

be mass produced to attain a cost advantage. Currently this sector suffers from several regulatory obstacles in land holding, agri-marketing and price controls that inhibit its growth. The small scale sector needs to be integrated in to the global retail networks. There is a huge opportunity for India to provide leadership in lean retailing.

In producer-related services India likewise has a vast opportunity to become a global leader. Currently, companies providing solutions rather than products are the winners. Leaders in this area include aircraft manufacturers such as Boeing, computer manufacturers such as IBM, wireless phone manufactures and a host of others. India is already a destination for R&D and a supplier of components to the global supply chain. If, in addition, India develops capabilities for repair and maintenance, and also the fast delivery logistic required for these services, there are immense growth opportunities in aircraft servicing, computer server maintenance, medical equipment maintenance and a host of other life critical MRO applications.

Strategic Global Logistics Infrastructure Development

Manufacturing is not an isolated function. It is part of a supply chain cluster that consists of suppliers, logistics, transportation, airports, seaports, financial and insurance agencies, services such as power, water and construction and, more importantly, the knowledge suppliers: educational institutions. Currently

the Indian government is concentrating on building critical infrastructure such as airports, highways, and shipping ports to foster the country's growing economy. In addition to expanding the hard infrastructure, the other network components, such as efficient customs clearance and quality trucking services, can have a strong impact on GDP. Automation of global trade documentation and streamlining the goods and documents flow through the customs at the airports and seaports could result in huge cost savings. Also attracting the third party logistics companies to India will benefit the manufacturing, retail and the after sales services.

Conclusions

A huge increase in the manufacturing sector workforce is essential for India's welfare. Agriculture, supporting 60 percent of the working population, contributes only 22 percent of its gross domestic product. This mismatch between distribution of workforce and value added in agriculture is one of the main reasons for the large number of poor, and this trend is expected to further widen in the coming decades. Only a large shift of workforce from agriculture to manufacturing will help improve rural incomes and reduce poverty levels. Further if India is to achieve an overall growth of 8 percent per annum, it is essential that both manufacturing and services grow at more than 11 percent even when agriculture growth picks up to close to 4 percent.

Appendix: Speaker Roster from the 2005 Summit on Indian Manufacturing Competitiveness

Nitin Agarwal, Professor, Indian Institute of Management, Indore

M. S. Ananth, Professor and Director, Indian Institute of Technology, Chennai; and Board Member, National Manufacturing Competitiveness Council

Arun Chandavarkar, President, Operations and Technology, Biocon India Ltd.

Ananth Iyer, Professor, Krannert School of Management, Purdue University

Ira Kalish, Director of Consumer Business, Deloitte Research

Ajit Kambil, Global Director, Deloitte Research

Kumar Kandaswami, Country Manufacturing Industry Leader, Deloitte Touche Tohmatsu India Private Limited

Peter Koudal, Director of Global Manufacturing, Deloitte Research

Natalia Levina, Stern School of Business, New York University

M.R. Rao, Professor and Dean, Indian School of Business

Jagdish C. Saigal, Executive Director (International), Nicholas Piramal India Limited

Trilochan Sastry, Professor, Indian Institute of Management, Bangalore

Udayan Sen, Joint Managing Partner, Deloitte Haskins & Sells, India

Sridhar Seshadri, Toyota Professor of IOMS Department, Stern School of Business, New York University

Milind Sohoni, Professor of Management Science, Indian School of Business

Mr. V. Sumantran, Executive Director, Passenger Car Business Unit and ERC, Tata Motors

Jeffrey Tew, GM Technical Fellow and Group Manager, R&D and Planning, General Motors

N. Viswanadham, Professor and Deputy Executive Director Logistics Institute—Asia Pacific, National University of Singapore

End Notes

- ¹ From a panel discussion titled “Setting the Agenda for Growth: What’s Next for Indian Industry?” chaired by Ajit Kambil, Global Director, Deloitte Research, and including the following panelists: Ira Kalish, Director of Consumer Business, Deloitte Research; Natalia Levina, Stern School of Business, New York University; Trilochan Sastry, Professor, Indian Institute of Management, Bangalore; and Sridhar Seshadri, Toyota Professor of IOMS Department, Stern School of Business, New York University.
- ² From the welcome speeches by Professor M. Rammohan Rao, Dean, Indian School of Business, and Ajit Kambil, Global Director, Deloitte Research; and remarks by Professor Milind Sohoni, Indian School of Business.
- ³ From the Inaugural Speech by Udayan Sen, Joint Managing Partner, Deloitte Haskins & Sells, India.
- ⁴ From a presentation by Professor M.S. Ananth, Director, Indian Institute of Technology, Chennai, and Member, National Council for Manufacturing Competitiveness.
- ⁵ From a presentation by Kumar Kandaswami, Manufacturing Industry Leader, Deloitte Touche Tohmatsu India Private Ltd.; and Peter Koudal, Director of Global Manufacturing, Deloitte Research.
- ⁶ From a presentation by Dr. V. Sumantran, Executive Director, Passenger Car Business Unit and ERC, Tata Motors.
- ⁷ From a presentation by Dr. Arun Chandavarkar, President—Operations & Technology, Biocon India Limited.
- ⁸ From a presentation by Jagdish C. Saigal, Executive Director (International), Nicholas Piramal India Limited
- ⁹ From a presentation by Ananth Iyer, Susan Bulkeley Butler Chair in Operations Management, Krannert School of Management, Purdue University; and Sridhar Seshadri, Toyota Professor of Information, Operations and Management Science, Stern School of Business, New York University.
- ¹⁰ From a presentation by Nitin Agarwal of the Indian Institute of Management, Indore, India.
- ¹¹ From a presentation by Jeffrey Tew, GM Technical Fellow and Group Manager, R&D and Planning, General Motors.
- ¹² From a presentation by N. Viswanadham, Professor and Deputy Executive Director Logistics Institute—Asia Pacific, National University of Singapore.

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Indian School of Business

The Indian School of Business symbolizes the vision of the School's founders. The School evolved from a need for a globally top-ranked and distinctive business school in the Asian region dedicated to providing the best management education. The School is the dream of some of the best minds from the corporate and academic world. Their aspiration in creating the ISB is to establish an internationally top-ranked, research-driven, independent management institution that grooms future leaders for India and the world. The School's Governing Board comprises business leaders, entrepreneurs, and academicians from some of the world's leading business and management education institutions. Our partnership with the Kellogg School of Management, The Wharton School, and London Business School makes the ISB one of its kind in Asia. Our vision is to become an internationally top-ranked, research-driven, independent management institution that grooms future leaders for India and the world. The ISB's aspiration to groom tomorrow's leaders is grounded in the belief that leadership skills can be learned and that successful leaders must take charge of their own development and growth to achieve their true potential. However, it is our strong belief that whatever your model of leadership, it should be grounded in a strong foundation of core values.

Global Business Institute, Leonard N. Stern School of Business, New York University

The Stern Global Business Institute (GBI) was established in 2003 to consolidate an array of long-standing academic activities and create a coherent platform for their future development. Stern was one of the first institutions to emphasize the international dimensions of business over three decades earlier, spanning first-rate applied research, an extensive list of undergraduate and MBA course offerings, and a doctoral specialization in the international dimensions of academic disciplines to develop the next generation of professorial faculty. The School launched an academic International Business initiative long before international and global business aspects were formally built into the curricula of any of the other major business schools. This 30-year "first mover" history is now capitalized in the franchise value of the School. Each of the international activities has been firmly rooted in the academic key disciplines, so that both faculty and students combine discipline-based rigor with ample opportunities to focus on the international dimensions. Throughout this period, the Stern School was consistently rated among the top-five institutions focusing on international business worldwide. This remains so today. The Stern Global Business Institute is charged with taking this evolution to the next level, leveraging the School's growing research strength in core disciplines into the global arena and providing consistent academic oversight and support for the School's extensive activities in global business education.

Global Supply Chain Management Initiative, Krannert School of Management, Purdue University

Many of today's most successful firms attribute their success to a strategically managed global supply chain. The complexities of coordinating and collaborating within a global network of designers, manufacturers, distributors and retailers grow as businesses seek to attain a competitive advantage through carefully formulated strategies for managing flows in physical, informational and financial channels. The Global Supply Chain Management Initiative gives current and future managers the opportunity to be on the forefront of emerging ideas and technologies that promise to provide a differentiating advantage to businesses in the future. This initiative offers a broad-based, global approach to taking your business skills global through a variety of programs, including conferences and events for executives, students and faculty.

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