

Science & Technology for Make in India

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Make in India must be understood in terms of creation of an innovation ecosystem that enhances R&D and technological capabilities of Indian industries and propels the innovation process. The MSME sector requires a dependable innovation support system for the firms which is not only of problem solving type but proactive in enhancing their innovation competitiveness and is nurtured on a long-term basis. This will lead to increased manufacturing and value creation



While India's growth has emerged from a strong services sector, the manufacturing is still in a dire need of a strategic push.

Manufacturing contributed only 17 per cent to India's Gross Domestic Product (GDP) in 2013. As the government pushes for the revival of sluggish manufacturing through two of its major flagship programmes "Make in India" and the "Start-Up India", in 2015 and 2016 respectively, the step could usher a new lease of life for the manufacturing. "Make in India" has targeted major initiatives to facilitate investment, foster innovation, protect intellectual property and build best in class manufacturing infrastructure by easing out the procedures, reducing the complexities and enhancing speed and transparency in doing business besides strengthening the infrastructure including creation of clusters. Start-ups can also become important contributors to the "Make in India" programme. Both the initiatives are laudable and these can become more meaningful if steps are taken to enhance the R&D and production capabilities of production sector for sustaining manufacturing.

The Global Competitiveness Report has put India's competitive

strength as factor driven where price rather than the technological competition drives the firms (The Global Competitiveness Report, 2014-15). Indian manufacturing, therefore, necessitates a shift from complacent manufacturing to vibrant competitive manufacturing. Manufacturing capability should be seen as an integral part of the manufacturing strategy. R&D and innovation becomes a significant part of the building of manufacturing capability by instilling innovative competitiveness amongst the firms. "Make in India" can, therefore, be seen as an opportunity to revive the crumbling manufacturing sector for manufacturing cannot survive in the absence of firm competitiveness. Innovation is required for the upgradation of capabilities in firms and industries for developing existing products; for introducing new products or getting into new streams of activities. The Countries such as China, South Korea and Taiwan have grown rapidly because of their manufacturing push and also by paying attention to developing domestic capabilities of their domestic firms along with providing a dynamic innovation ecosystem. The article looks at the Science Technology and Innovation (STI) perspective of manufacturing to facilitate the "Make in India" programme and it is based on the studies done by us¹.

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The revival of manufacturing by Indian firms, for contributing to the "Make in India" programme necessitates a look at India's position in economic, S&T, manufacturing and innovation indices. This will be followed by an analysis on the STI perspective of Chinese transformation for drawing lessons. This is just to throw light on how China has emerged a world leader in manufacturing.

India's Position

While envisioning India's preparedness for plunging into manufacturing, it is necessary to assess India's position in innovation capabilities. Indian economy has emerged a major player in the global economy in the last two decades since liberalization. While India's GDP share in world has grown from 3.43 per cent in 1996 to 5.77 per cent in 2013, China's share has grown from 6 per cent to 16 per cent. India's trade balance is negative and China has maintained a positive trade balance from 1996 to 2013. The technology and skill intensity of exports from India has remained at 7 per cent from 1996 to 2013 in contrast to a leap from 12 per cent in 1996 to 26 per cent in 2013 in case of China.

The manufacturing supremacy of China can be gauged by the fact that China has topped US from top rank at 23.2 per cent of share in world manufacturing leaving US with 17.2 per cent in 2013. The other indices on Competitive Industrial Performance which benchmarks countries' ability to produce and export manufactured goods competitively ranks China at number 7 and India at number 42 in 2013.

The strengths of the production system of any economy are driven by the technological capabilities which go a long way in consolidating the production systems. The share of R&D in GDP in India has remained at less than 1 per cent in the last two decades whereas the figure grew to 2 per cent in case of China. The number of R&D personnel per million has remained more or less same in case of India but

grown 2.5 times in the same period in case of China. The involvement of various stakeholders such as business enterprise, government and higher education indicates the importance of stakeholders in supporting the production system. The share of R&D by the enterprises is still small in case of India in comparison to the government. The spending in the higher education sector in India has remained largely unchanged in the same period. This is a crucial factor in supporting innovation competitiveness.

It has been found that access to information/knowledge is found to be a major factor inhibiting innovation and there is a disconnect between the production system and innovation support system. However, a point that needs to be looked into if India wants to boost sustained manufacturing is that what is the role of innovation and innovation ecosystem in complimenting the existing manufacturing capacities and capabilities?

Similarly India's position in Global Competitiveness Index which is defined through a set of institutions, policies and factors that determine the level of productivity of a country, conditions of public institutions and technical conditions, had although gone down from 49 in 2009-10 to 71 in 2014-15. China improved its rank to 28 in 2016.

India has shown improvement in the Global Competitiveness Index and has jumped its ranking by 16 places due to improved macroeconomic fundamentals. Yet, the fact remains that the parameters pertaining to S&T and innovation have not changed significantly.

MSMEs role in the "Make in India" STI Perspective

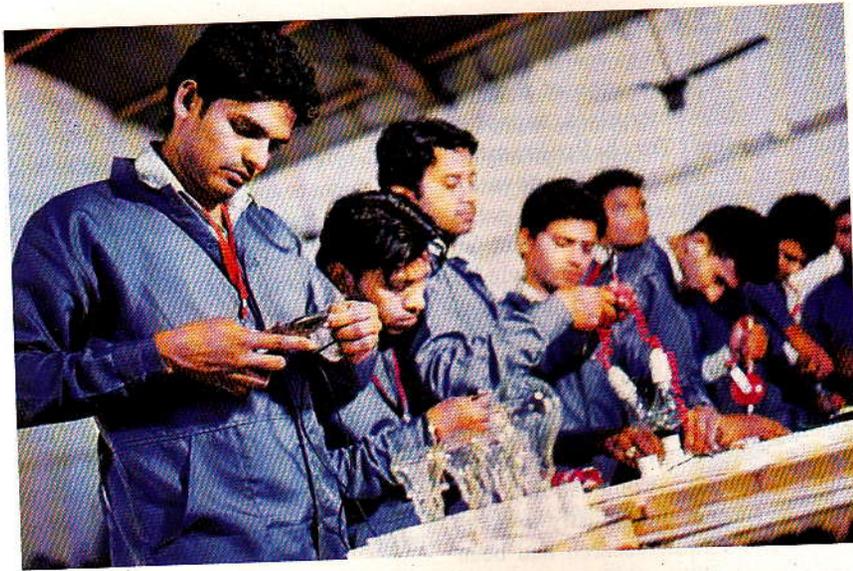
To support the Make in India initiative, there is need to strengthen the

manufacturing by the production sector which is dominated by Micro Small and Medium Enterprises (MSME) sector. MSMEs are second to agriculture in terms of GDP contribution and contribute 45 per cent of manufacturing and 40 per cent of exports. There has been a decline in the share of MSMEs towards manufacturing and exports largely because of China's emergence as a major player in the manufacturing. India is losing out to rival economies even in areas where it could have been a major player. MSMEs are facing tough cost and technological competition which can only be countered with competitive manufacturing by producing superior products with better technologies. It is well known that this sector lacks the technological capabilities to introduce superior products with cost competitiveness. For the revival of this sector for competitive manufacturing therefore, there is a need to provide them the Research and Development (R&D), technological support and non-technological support.

A study on the status of innovation based on sample of 9001 small and medium firms from all over India has shown that small firms are basically "innovation shy" and they are complacent with survival in the market rather than indulging in innovation for growth (mentioned in footnote 2). Although India has a huge network of organizations/agencies involved in promotion of innovation, very few innovative firms had ever accessed the available support system. It has been found that access to information/knowledge is found to be a major factor inhibiting innovation and there is a disconnect between the production system and innovation support system. However, a point that needs to be looked into if India wants to boost sustained manufacturing is that what is the role of innovation and innovation ecosystem in complimenting the existing manufacturing capacities and capabilities?

Lessons from China

China has toppled US from its manufacturing might and gained



the first place to lead the world in manufacturing supremacy. Although, to begin with, much of it was by the MNCs, the domestic enterprises took the lead in due course of time. The rise of China as a major economic power within a time span of around three decades is phenomenal and has been attributed to its strategic push on manufacturing. The share of China in world manufacturing was 23.2 per cent followed by the US with 17.2 per cent in 2013. China leads in indices related to manufacturing competitiveness, competitive industrial performance, and global manufacturing competitiveness besides several others. While China has been recognised as an efficiency driven economy by the Global Competitiveness Report, India is still seen as a factor driven economy (The Global Competitiveness Report 2014-15, World Economic Forum).

While on the one hand, China has amassed significant capabilities in manufacturing in the last two decades and these have been supported by significant capabilities in several areas of science, technology, and innovation. China has not only boosted investments in S&T but has also taken steps to build its National Innovation System. The emergence of China as an economic power based on manufacturing therefore raises an important question on the role of Science, Technology and Innovation (STI). In the following

we will look at the STI perspective of China as a facilitator of manufacturing and lessons that can strengthen India's 'Make in India' initiative.

China has consistently improved its global ranking in manufacturing and STI and has emerged as a global player though prior to reforms since the 1980s, both China and India had similar levels of development. Chinese model of development has treated S&T as a complement to economic transformation

As a follow up of the opening up of the Chinese economy, the first directive was to boost its S&T capabilities and catch up with the world. China embarked on a series of policies and programmes in its endeavour to reach the catch up milestone. It took series of proactive initiatives in generating and augmenting its human resource by implementing a number of programmes and policies for university modernization.

Two major initiatives to revamp higher education system in China included the Project 211 and Project 985. The Project 211 was launched in 1996 aimed to strengthen about 100 higher educational institutions and key disciplinary areas as a national priority for the 21st century. These two university modernization programmes were supplemented with other programmes

to attract the best manpower from within China and abroad. The focus of the Chinese universities was changed from education to research and to commercialization from the 1980s. Universities have exhibited great potential in knowledge innovation and industrialization of high technologies since then. Chinese universities have become a major force in China's knowledge production activities as well as commercialization.

China encouraged its universities to set up of their own enterprises to counter the problems of technology markets. The practice of university affiliated enterprises is a unique feature of the Chinese innovation system. University Science Parks have been created in China to incubate spin-offs created by university professors and students.

For the transformation of government research system, the policies in China have targeted research, funding, commercialization, manpower, organizational restructuring and commercialization. The ensuing major policy initiatives targeted funding reforms; restructuring of research institutes; consolidation of links among research, academia, and industry; commercialization by the creation of 'Technology Markets, creation of S&T parks, etc. This has led to a revamp of existing structures, mechanisms and governance.

The State Council launched the Torch Programme to facilitate commercialization of research results, since the Chinese system of innovation suffered from poor translation of research into applications. The programme targeted commercialization of research results from universities, research institutes, and high tech industries.

The Chinese innovation system has emerged within a dynamic ecosystem, which is marked by the creation of S&T parks, university parks, high technology development zones, technology business incubators with necessary intermediaries support,

modernization of the higher education system along with revival of the government research system. The emergence of an innovation system in China has been a part of an organized drive, facilitated by both the centre and the local governments. The creation of S&T parks, university parks, technology business incubators, etc., has been done basically to facilitate innovation. This, accompanied with the structural reorganization of university and public research system, has been instrumental in sustaining the dynamism. The creation of intermediary structures for supporting commercialization along with a supportive policy package has been part of the innovation drive, which has helped in increasing dynamism in these geographical clusters. These parks have a mix of large and medium enterprises, small and medium enterprises and multinational corporations with linkages amongst academia, Government research institutes.

A major issue, therefore is that is it possible to support and sustain manufacturing without strengthening the institutions related to science, technology and innovation? The vision, strategies and policy initiatives taken by China suggest the necessity of a roadmap with necessary changes in all the concerned institutions with ruthless restructuring. There is connectivity and concurrence in policies which got consolidated over time. There is a rational analysis of policy outcomes and achievements which is done with a view to learn from failures. Success or failure is determined by programme/project outcomes rather than financial accountability.

When China targeted transformation it targeted the entire innovation infrastructure including research institution, universities, S&T Parks, support structures, fiscal and financial instruments, etc. The subsequent structural and organizational changes have not only led to a qualitative improvement in the institutions involved but also enhanced linkages amongst the actors of innovation. For instance, the lack of initial

success in China in creating markets for technology was followed by a structural transformation of research institutes into enterprises, supported later by the 'Torch Programme' through the creation of innovation fund and the creation of S&T parks. The research in research institutions was sharpened by the 'Knowledge Innovation Programme'. The changes were later supported by Intellectual Property Rights (IPR) laws and by having their own standards. If, despite the recurrent changes, the results were not found to be very encouraging then the indigenous innovation policy came to support the industry in areas where indigenous research had been undertaken. The different phases show a distinct movement in Chinese policy making from playing catch up to creating a national system of innovation.

As the basic agenda of China was to catch up with the developed countries and to reduce the gap between them and China, spending on R&D as a percentage of GDP grew consistently from 0.6 in 1995 to 2 in 2014. China ranks second in terms of absolute R&D spending. Chinese investments in R&D as per cent of GDP were at par with India prior to 2000 but increased by 161 per cent by 2011. China's increase has been more than 20 per cent each year while India has hardly been able to push the figures up.

Conclusion

The globalization has brought in ample opportunities and challenges for India. The issues that arise for the meaningful outcome of the "Make in India" essentially indicate that there are loose ends which need to be taken care of. Manufacturing holds the key to development and the three important pillars which sustain manufacturing are innovation competitiveness, R&D and human resource. Though India has progressed well in the last three decades but there are issues with innovation competitiveness in the manufacturing sector, which have somehow held back India's rise compared to other economies. In order

to promote competitive manufacturing what is needed is sustained initiatives for introducing efficient production processes, improving product quality and introducing new products and processes to cope up with the challenges of fast changing technologies. In the global economy, even production for the local markets requires continuous efforts in innovation. This is made possible by investing in R&D, manpower and innovation.

Public support for R&D and innovation by countries that have become manufacturing giants such as China and South Korea has ranged from up-front R&D grants; modernization of education infrastructure; creation of technology markets; promoting high tech entrepreneurship and transforming the innovation ecosystem. The process of strategization and priority setting has taken decades of planning.

Make in India must be understood in terms of creation of an innovation eco-system that enhances R&D and technological capabilities of Indian industries and propels the innovation process. The MSME sector requires a dependable innovation support system for the firms which is not only of problem solving type but proactive in enhancing their innovation competitiveness and is nurtured on a long-term basis. This will lead to increased manufacturing and value creation. Start-ups too can be important contributors to the "Make in India" programme provided they operate in the business of value creation and not in the domain of value appropriation.

There is neither a dearth of policies nor institutions to support innovation in India but there is a need to spark the dynamics of innovation in the MSME sector by making the innovation support system proactive. If India plans to increase the share of manufacturing to 25 per cent and job creation of 100 million by 2022, it requires a plan which focuses on the technology support system as well as innovation ecosystem. "Make in India" has provided an opportunity to strive for global supremacy in key areas and on a

constructive node the "Make in India" has focussed on sectors of India's competitive advantage such as pharmaceuticals, automobiles, chemicals, biotechnology, information technology, renewable energy, etc. India has developed even exports in some of these sectors by showing manufacturing competencies. Strengthening the innovation support system will, therefore add to manufacturing competitiveness and value creation.

Readings

1. Understanding Innovation: Indian National Innovation Survey, Study sponsored by NSTMIS, DST.CSIR-NISTADS, 2014.

A Comparative Study on S&T, Innovation and Development Strategies of China and South Korea vis-à-vis India, Study commissioned by the Office of the Principal Scientific Advisor to the Government of India, CSIR- NISTADS, 2012.

India's Innovation Capabilities and Capacities: A comparative Global positioning, CSIR-NISTADS, 2014

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NORTH EAST DIARY

MOBILE AIR DISPENSARY FOR REMOTE AREAS OF THE NORTH-EAST

Union Minister of State (Independent Charge) for Development of North Eastern Region (DoNER), MoS PMO, Personnel, Public Grievances, Pensions, Atomic Energy and Space, Dr Jitendra Singh has proposed "Mobile Air Dispensary" service for remote and far-flung areas of Northeast, which would envisage a mobile dispensary in a Helicopter with a doctor, necessary equipment and medicines that can fly to remote and far-flung areas on regular basis and also, as and when required. This service will particularly help in those areas from where patients find it difficult to reach a dispensary, a doctor with dispensary can reach them. The same experiment, which would possibly be the first of its kind in the country, can also be replicated in other hill States and remote areas having poor connectivity like Jammu and Kashmir, Himachal Pradesh etc.

\$48 MILLION LOAN TO IMPROVE ASSAM'S POWER DISTRIBUTION SYSTEM

The Asian Development Bank (ADB) and the Government of India have signed a \$48 million loan to help Assam continue its drive to improve access to efficient and reliable power in the State.

This is the second tranche loan of the \$300 million multi tranche financing facility for the Assam Power Sector Investment Program that was approved by the ADB Board in July 2014. The project will help Assam to enhance capacity and efficiency of its power distribution system to improve electricity service to end users. The first tranche loan of \$50 million was signed in February 2015.

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