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Policy Research to Foster India's Industrial Transformation



# Towards Innovations-Driven Industrial Transformation of India

**Naushad Forbes** 

This Policy Brief is based on the **ISID Foundation Day Lecture 2023** delivered by **Dr Naushad Forbes** on October 6, 2023 at the ISID National Conference on Industrial Transformation of India: Building an Inclusive, Sustainable and Competitive Manufacturing Sector to Realize the 2047 Vision, supported by ICSSR, held during October 4-6, 2023. The Lecture was presided over by **Shri S K Misra**, Chairman, ISID and moderated by **Prof Nagesh Kumar**, Director, ISID. A video recording of the lecture is available on the ISID YouTube channel.

#### The Context

I argue in this talk that industrial transformation in India is not possible without seriously increased investment in R&D, innovation and building technological capacity. Although there is a role for changes in state R&D policy, the key role has to be played by in-house R&D in industry. Indian industry needs to become much more serious about its investment in inhouse R&D.

# Industrial Transformation of India demands serious attention for technology and innovation

Many countries around the world have prospered for decades without serious investment in in-house R&D: Japan in the 1950s and 1960s, South Korea and Taiwan in the 1960s and 1970s, China until the 1990s, and Bangladesh and Vietnam today. So why is it so critical for India to emphasise R&D at this time? India's industrial structure is more advanced than the industrial structure of countries with similar per capita income levels. One would expect a lower middle income country like India to have its industrial structure dominated by labour-intensive sectors like textiles and clothing, leather goods, and food and beverages. However, the leading sectors of Indian industry are pharmaceuticals and chemicals, automotives and auto components, engineering and capital goods which are skill and capitalintensive sectors. This industrial structure is very similar to that of more advanced countries. With an industrial structure of more developed countries, industrial advancement requires seriously increased investment in innovation.

Within the leading sectors, a shift is taking place towards more advanced technologies and increased value addition. In automotives, there is a shift towards higher-tier auto components where a lot of technology tends to reside. Similarly in pharmaceuticals, there is a focus on higher value addition. In engineering and capital goods, more innovative firms with a focus on proprietary technologies and higher levels of value additions are emerging. Given this context, increased R&D efforts at the enterprise level are critical for the industrial transformation of India.

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#### **Dr Naushad Forbes**



Dr Naushad Forbes is the Co-Chairman of Forbes Marshall, India's leading Steam Engineering and Control Instrumentation firm. He is Chairman, Ananta Aspen Centre and was President of CII for 2016-17. He is the Chairman of Centre for Technology, Innovation and Economic Research (CTIER) in Pune and is a member of the ISID's Board of Governors.

Naushad was an occasional Lecturer and Consulting Professor at Stanford University from 1987 to 2004 where he developed courses on Technology in Newly Industrializing Countries. He received his Bachelors, Masters and PhD Degrees from Stanford University. He has recently been presented the Degree of Doctor honoris causa by the University of Edinburgh.

Naushad has long been an active member of CII and has at various times chaired the National Committees on Higher Education, Innovation,

Technology and International Business. Naushad is the author of a much acclaimed book, *The Struggle and the Promise: Restoring India's Potential*, (Harper Business 2022), which won the C K Prahalad Best Business Book Award for 2023.

#### Global R&D

R&D is a massive enterprise globally. Global spending on R&D is more than \$2 trillion which is about two per cent of global GDP. However, R&D is highly concentrated in a few countries. The United States, China, Japan, Germany and South Korea account for more than 75 per cent of global R&D spending.

R&D is also concentrated among a few sectors. Industry accounts for two-thirds of global R&D. Much of it is concentrated among four sectors – pharmaceuticals, automotive, software and technology hardware. These four sectors account for over 60 per cent of the total R&D spent by all industry worldwide.

Within sectors, R&D is concentrated among a few giant firms. The top 20 firms account for 20 per cent of R&D by all the millions of firms worldwide. Giant spenders on R&D include companies such as Alphabet, Siemens, Apple, Huawei and Samsung.

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#### **R&D** in India

India's annual spending on R&D at about \$17-18 billion, is very small in comparison to \$800 billion in the United States and \$600 billion in China. Although India occupies the fifth rank in the global economy in terms of GDP, its rank is only 20 when it comes to R&D spending. The primary reason for this low spending of India on R&D is the low spending on R&D by the industry. Globally, on average, industry accounts for 70 per cent of the R&D spending whereas in India its share is less than 40 per cent. In other words, Indian industry's spending on R&D is just 0.3 per cent of India's GDP whereas the global average is 1.5 per cent. If India has to reach the global average benchmark, in-house industrial R&D needs to increase by a factor of  $5 (0.3 \times 5 = 1.5 \text{ per cent GDP}).$ 

Similarly, seven per cent of India's total R&D spending is research done in universities to a global average of 17 per cent. Research in universities is important because it creates a flow of talent from universities to industry. This flow of talent is more important than the their research output. The direct contribution of research done in higher education to a nation's GDP may not be significant but their real contribution should be measured in terms of the talent they produce. I often give the example of Stanford University, my own university, in terms of the leaders of industry in so many fields that it has produced over the years. In India one could similarly talk of the Indian Institute of Chemical Technology in Mumbai (much better



known by its original name of the University Department of Chemical Technology (UDCT)). India may be slightly worse off if it had never seen the research output of UDCT, but consider the illustrious list of graduates of UDCT which includes Ashwin Dani of Asian Paints, Anji Reddy of Dr Reddy's Laboratories, Narotam Sekhsaria of Ambuja Cements, Madhukar Parekh of Pidilite Industries, or Mukesh Ambani of Reliance Industries. India's spending on research in higher education should increase by a factor of 8 ( $0.05 \times 8 = 0.4$  per cent of GDP). The R&D spending in autonomous research laboratories (like those run by CSIR) which account for the bulk of India's R&D investment. does not provide the fundamental benefit of a flow of talent that the institutions of higher education do.

#### Why is benchmarking needed?

Benchmarking is essential for increasing awareness of the need to invest more in R&D. The industrial transformation experiences of South Korea and China provide an interesting comparison. There are two common things in the experiences of South Korea during the period between 1970 and 1990 and China between the late 1990s and now. Both experienced rapid GDP growth and a rising share of R&D in GDP. In South Korea, the share of R&D in GDP increased from 0.4 per cent to 2.5 per cent and in China from 0.6 per cent to 2.4 per cent. The share of industry in R&D also increased during this period in both countries. In South Korea, the share of industry in R&D increased from 15 per cent to 85 per cent and in China from 30 per cent to 70 per cent. What we see is a 500 fold increase in South Korea and 100 fold increase in China as compared to a 15 fold increase in India in both periods. India needs to move faster.

In both these countries, the rise in R&D spending was accompanied by a change in the industrial structure towards more

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technologically advanced areas. In South Korea, auto and auto components, consumer electronics and technology hardware became the dominant sectors. In China, consumer electronics, technology hardware, material sciences, and mining and construction emerged as major sectors with technological deepening. Half of the world's top 2500 R&D firms in material sciences, mining and construction are Chinese firms. Innovation in these sectors in China is being driven by in-house R&D, even though it is supported by the state.

# **Implications for India**

Benchmarking has two implications for India. The two sectors where India has relatively decent showing in investment in R&D are pharmaceuticals and automotives, which between them account for a major share of in-house industrial R&D in India. Globally, the pharmaceutical sector spends 16 per cent of turnover on R&D whereas in India it is 10 per cent. Similarly, in automotives, the R&D intensity in India is 4 per cent as compared to the global average of 6 per cent. The R&D intensity of India in these two sectors is somewhat lower than global standard but not too bad. But Indian firms are generally smaller than their global counterparts and are less profitable. We need to transform the overall scale of India's pharma and auto sectors and ensure higher R&D spending.

Second, some of India's most successful firms need to deepen their technology footprints. Compare the 10 most profitable non-financial firms in five countries, as summarised in *Table 1*. The Indian firms belong to oil & gas, steel & mining, consumer goods and telecom. Non-financial firms are compared as financial firms do not invest in R&D (in India and worldwide). Indian firms are smaller in size

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Country	Sales (US\$ Bn)	Profit (US\$ Bn)	Profit % Sales	R&D Spending (US\$ Bn)	R&D Spending as % Profit	R&D Spending as % Sales
USA	1700	410	24	152	37	8.8
China	1500	110	7	31	29	2.1
Japan	990	85	9	37	43	3.8
Germany	1025	96	9	53	55	5.2
India	280	43	16	0.9	2	0.3
Source: Naushad	Forbes (2023), in 1	Business Standard,	March 23, 2023.			

# Table 1: The ten most profitable non-financial firms and their expenditure on R&D (2021)

but their profitability (profits as a per cent of sales) is higher compared to their counterparts in Germany, Japan and China (the US is higher because of the dominance of its technology sector). Despite higher profitability, R&D spending of Indian firms as a proportion of profit is extremely low. The US, Chinese, Japanese and German firms invested between 29 and 55 per cent of profit in R&D, their Indian counterparts invested 2 per cent. The other

Industry in India generally has a feeling that they do a fair amount of R&D. A benchmarking with global leaders with respect to R&D intensity, number of R&D personnel and their qualifications, and new products released yearwise will make Indian firms realise where they stand and make them think of seriously enhancing investment in R&D.

differences are not great, but the difference in

# Signs of Change

R&D is striking.

Some signs of change at individual firm level are emerging. Bajaj Auto, a highly profitable firm, for instance, has built a world-class R&D facility. Companies like Godrej and BlueStar are beginning to invest more in R&D. But we need big and profitable manufacturing firms like Reliance and JSW to invest more in R&D. The software industry also needs to invest more in R&D. Although the profitability of Indian software firms is twice that of global firms, Indian firms spend one per cent of their turnover on R&D where their global counterparts spend about 11 per cent. People argue that this is because Indian software firms focus on software services while global software firms focus on software products. But in China, eight out of top 10 software firms are service firms and their R&D intensity is 8 per cent. Again, benchmarking helps us to understand where Indian firms really stand.

At the same time, the financial community needs to be educated on what investments are worthwhile in the long run. The recent case of Biocon where a perception that it was spending too much on R&D led to a fall in its share price, points to the need to better appreciate the role of investments in innovation for the long-term growth of enterprises.

# National Research Foundation

The recent announcement about the establishment of the National Research Foundation (NRF) has the potential for being transformative for two reasons. *One,* it has a substantial allocation of 350,000 core over five years to fund public research. *Two,* all funded projects require at least one academic researcher (public or private) as a partner. This

Despite higher profitability compared to peers in Germany, Japan, and China, R&D spending of Indian firms as a proportion of profit is extremely low.



is very healthy as it would potentially help in enhancing the talent flow that I earlier talked about. However, the expectation that two-thirds of the fund will come from industry makes one sceptical about the success of this initiative. We should expect the industry to spend more on in-house R&D first, which would draw on public research, before we expect the industry to invest in public research. NRF can be a gamechanger – if implemented right.

The efficiency of the innovation process is also important. In the Global Innovation Index reports, India has been ranked better in output indicators than input indicators. This indicates that India is relatively efficient in converting innovation inputs into outputs.

# Additional points that came up in the open discussion

Role of fiscal incentives for R&D: It has been found that fiscal incentives can facilitate investment in R&D. India had a very good scheme where a 200 per cent weighted tax deduction was provided for R&D spending. The weighted tax deduction was brought down to 150 per cent in 2017 and removed in 2020 (now only 100 per cent is allowed). The analysis of the impact of the 200 per cent weighted tax incentive scheme, which was applicable for several years shows that it did not have a significant impact on very large firms (the top 20 firms). But it had a significant impact on incentivising the R&D investments by medium to large and smaller firms. In the case of Forbes Marshall, the 200 per cent weighted deduction on R&D spending resulted in a 50 percent expansion of R&D. Therefore, fiscal incentives can be helpful for ramping up investments in R&D especially in pharma and auto but also in engineering and chemicals.

Indian R&D numbers do not capture the full picture: Indian official R&D statistics are really bad as they do not capture the R&D activity of all Indian firms. They leave out some of the biggest spenders on R&D like TCS and many MNC R&D centres because they are not registered with DSIR.

**R&D activity in South Korea**: South Korea has emerged as the world's top spender on R&D, spending just under five per cent of GDP on R&D. The big shift came in the 1970s when auto Establishment of the National Research Foundation (NRF) has the potential for being transformative.

companies like Hyundai became significant R&D investors in Korea. Samsung, which started as a textile and woollen fabrics company shifted its attention to consumer electronics and then into semiconductors. These activities demand massive R&D activity. Samsung today spends roughly US\$ 20 billion on R&D annually which is more than all of India including the government laboratories, and all public and private companies.

R&Dactivity in government laboratories versus industry: Much of the R&D activity in India is conducted in government laboratories like those run by DRDO, DAE, ISRO, and CSIR. They assume a linear model of innovation where research leads to development which leads to production and then marketing. However, the model of innovation that works the world over is the chain-linked model which starts with the market and ends with the market. CSIR has struggled to connect with the market and industry. The proportion of its revenue that comes from industry remains under 20 per cent, in spite of creating another institution to specifically link it with industry in NRDC. The other countries where CSIR organisations were set up around the same time as India - the UK, South Africa and Australia - have since moved on and have reformed them.

Focus on global markets to tap economies of scale in R&D: South Korea being a relatively smaller country compared to India consciously focused on the global markets. But even China, which is a huge market, did not restrict itself to domestic demand. We need to look at the world as our market to exploit the economies of scale inherent in R&D (and marketing). R&D activity offers increasing returns to scale, as a lot of work done on it has shown.

Indian pharmaceutical firms have the potential to emerge as dominant players with enhanced emphasis on R&D: The Indian



pharmaceutical industry is third largest in terms of volume globally but only 11<sup>th</sup> or 12<sup>th</sup> by value. The gap between the two rankings is essentially a technology gap.

India needs both technology-intensive and labour-intensive industrialisation: In a large labour-abundant country like India, employment generation, economic well-being and long-term growth considerations make labour-intensive industries essential. Hence, it is not an either-or question. However, different policy mechanisms are needed to foster labourintensive industrialization than the PLI type of industrial policy being adopted for promoting technology-intensive ones.

MNC Development Centres should inspire local firms to exploit India's advantages in R&D: Three-quarters of the top 500 MNCs of the world have established development centres in India. There is no issue with MNCs setting up their technology development centres (the so-

called GCCs). However, beyond providing good jobs to our engineers, one cannot expect much from them in terms of meeting our technology needs or contributing to local technological capability. But, Indian firms need to see the same availability of abundant talent available in the country which is attracting MNCs to establish the GCCs in India. If GE can hire 5000 chemical engineers and chemistry PhDs in India for their R&D activity, why can't Reliance; if Bosch can invest in 20,000 Indian engineers for its R&D facilities world-wide, why can't L&T? So again it is not an either-or question. We should continue to encourage MNCs to set up their development centres in India but Indian firms should also exploit our talent for boosting their R&D activity. Despite all the talk of globalization of R&D, it remains highly concentrated in the countries of origin. So German companies do most of their R&D in Germany, Americans in the US and so on. It should apply to Indian firms as well.

#### **ISID Foundation Day Lectures**

The ISID Foundation Day Lecture Series celebrates the establishment of the Institute in October 1986 as a society registered under the Indian Societies Act of 1860 which started effective functioning in May 1988, after recognition by ICSSR. It also celebrates the memory of its founder, Late **Prof S K Goyal**.

The Lecture Series has grown in stature over time, with lectures delivered by several eminent speakers including **Dr Manmohan Singh**, former Prime Minister of India; Late **Shri Mohan Dharia**, former Commerce



Minister; **Mr Yashwant Sinha**, Former Finance Minister; **Prof C H Hanumantha Rao**, **Prof G S Bhalla**, **Shri Nitin Desai** former members of Planning Commission; **Dr Rajiv Kumar**, the then Vice-Chairman of NITI Aayog; **Mr R C Bhargava**, Chairman, Maruti-Suzuki India Limited; **Mr N K Singh**, Chairman of Fifteenth Finance Commission. The 2022 Lecture was delivered by the **Mr Gerd Muller**, Director-General of UNIDO.

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#### Institute for Studies in Industrial Development

An institution of Indian Council of Social Science Research (Ministry of Education) 4 Vasant Kunj Institutional Area, New Delhi - 110070, India

