

India's R&D imperative

Raising manufacturing sector's share in GDP requires a fundamental change in our national innovation system and an increase in tech investments

In the quarter century since the 1991 reforms, India's growth performance of 7 per cent places us amongst the 10 best performing economies worldwide. This is no mean achievement. Manufacturing as a share of output, though, is just where it was in 1991 — at 15 per cent. The Make in India programme has provided welcome energy to drive our ambition of raising the share of manufacturing to 25 per cent (of the gross domestic product) by 2025, but the share hasn't changed. I argue that achieving this goal requires a fundamental change in our national innovation system, and an order of magnitude increase in investment in technology.

First, Table 1 notes how R&D happens globally. Global R&D is a massive enterprise, but one that is highly concentrated. Of the \$1.3 trillion that the world spent on R&D in 2016, the top five countries (the US, China, Japan, Germany and South Korea) accounted for two-thirds of the total. In-house R&D by companies accounts for 71 per cent and R&D within universities 17 per cent. India is a complete outlier — both in the share of national R&D done in-house in companies (44 per cent vs a world average of 71 per cent) and the share in universities (4 per cent vs a world average of 17 per cent).

Data on Industrial R&D by sector shows: The top five sectors (pharmaceuticals, auto, technology hardware, software, and electronic and electrical equipment) account for 70 per cent of the total; the top 300 firms account for 70 per cent and the top 20 firms for 21 per cent. (Think about it: 20 firms — of the millions worldwide — account for 21 per cent of total industrial R&D.)

So having a good showing in world R&D requires having a few giant R&D spenders, generally in the technology-intensive sectors that dominate global R&D. As Table 2 shows, the top South Korean R&D spender, Samsung, invests almost as much in R&D as all of India (every firm + government together) and the top Chinese firm, Huawei, invests more in R&D (\$11 billion) than all firms in India put together.

I started this article by repeating what we all know: Our good overall economic performance in the last 25 years has been accompanied by a stagnant share of manufacturing in the GDP. Many countries — Japan in the 1950s, South Korea and Taiwan in the 1960s and 1970s, China in the 1980s and 1990s — have grown manufacturing very rapidly without substantial investments in technology. As the economy develops, manufacturing moves into more sophisticated sectors and progressively starts investing in R&D. Why can't we follow this same pattern?

For various historical reasons, India has specialised in skill-intensive and capital-intensive manufacturing, and in services. Our share of labour-intensive manufacturing (textiles and food processing) was already lower in 1990 than South Korea and lower even than China as late as 2010.

In other words, we have long had the manufacturing structure of a skill- and capital-intensive economy.



INDIA'S WORLD?

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TABLE 1

Country	Total R&D Expenditure (\$ Billion)		Public Research	
	Corporations (% of Total)	Universities (% of Total)	Institutes (% of Total)	Universities (% of Total)
United States	513	71	12	17
China	236	77	16	7
Japan	156	79	7	14
Germany	103	68	14	18
Korea	60	78	11	11
France	55	64	13	23
United Kingdom	45	67	6	27
Canada	25	51	8	41
Australia	24	53	13	34
Russia	14	59	32	9
India	14	44	52	4
World	1,300	71	12	17

Growing output substantially in such sectors requires a transformation in our investment in R&D. The last two tables (Table 3 and 4) show what transformation looks like — in South Korea (as it transformed its national innovation system between 1970 and 1990) and in China (as it transformed its national innovation system between 1995 and 2015).

Do note what this amounts to. In South Korea a rising share, of a rising share, of a rapidly growing base means a double multiple. The industrial share of total R&D increased from 13 per cent of national R&D spending to 81 per cent, at a time when R&D increased from less than 0.4 per cent of the GDP to 1.9 per cent, during which South Korea was growing at 8 per cent a year. The same is true in China over the last 20 years: The industrial share of total R&D almost doubles, at a time of a tripling of the share of the GDP spent on R&D, while China was growing at over 10 per cent a year.

India needs to do the same. India needs a thousand multinationals, operating around the world, in every sector, building brands and reach. Our industrial structure is already concentrated in skill- and capital-intensive sectors.

Building leading international positions in engineering or machinery requires substantial investment in innovation. A hundred Indian firms must match what GE, Bosch, Cummins and Emerson do in India, each employing thousands of engineers in R&D. Our design institutes must produce world-class graduates that define new product functionality. Research-intensive higher education institutes must provide a standard of graduate education second to none. And a combination of trade policy and firm strategy must push firms overseas, deploying their technical capability worldwide. Our manufacturing companies will then deliver on India's growth aspiration. How we can do each of these things will be the subject of subsequent columns.

TABLE 2

Country	Company Name	Sector	R&D Universities (\$ million)	R&D as % of Sales
INDIA	Lupin	Pharmaceuticals & Biotechnology	429	22.9
	Mahindra & Mahindra	Automobiles & Parts	346	5.0
	Tata Motors	Automobiles & Parts	308	4.3
	Dr. Reddy's Laboratories	Pharmaceuticals & Biotechnology	216	15.2
	Reliance Industries	Oil & Gas	212	0.5
CHINA	HUAWEI	Tech Hardware & Equipment	10,881	19.2
	Alibaba Group Holding	General Retailers	2,445	10.8
	ZTE	Tech Hardware & Equipment	1,954	13.5
	Tencent	Software & Computer Services	1,698	7.8
	Petrochina	Oil & Gas Producers	1,609	0.7
	SOUTH KOREA	Samsung	Electronic & Electrical Equipment	12,762
LG Electronics		Leisure Goods	2,861	6.3
Hyundai Motor		Automobiles & Parts	1,851	2.4
SK Hynix		Technology Hardware & Equipment	1,729	12.2
KIA Motors		Automobiles & Parts	1,265	2.9

TABLE 3

	INDIA (%)					
	1970	1980	1990	2000	2010	2016
R&D as % of GDP	0.4	0.6	0.6	0.7	0.8	0.7
Share of Ind. in total R&D	15	20	25	30	33	44
	KOREA (%)					
R&D as % of GDP	0.4	0.8	1.9	2.7	3.7	4.2
Share of Ind. in total R&D	13	36	81	74	75	78

TABLE 4

	INDIA (%)				
	1996	2000	2005	2010	2016
R&D as % of GDP	0.6	0.7	0.8	0.8	0.7
Share of Ind. in total R&D	25	30	30	35	44
	CHINA (%)				
R&D as % of GDP	0.6	0.9	1.3	1.7	2.1
Share of Ind. in total R&D	43	60	68	73	77

Note: The data for India is for the year 2014 - 15.

Source: CTIER

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