Evaluation of CSIR's innovation excellence indicators

The Office of the Principal Scientific Adviser (O/o PSA) to the Government of India joined hands with the Confederation of Indian Industry (CII) and Centre for Technology, Innovation and Economic Research (CTIER) to bring out a report in two volumes on the performance of the publicly funded R&D laboratories of the country and their contribution to the R&D ecosystem (henceforth Reports). The report titled 'Evaluation of Innovation Excellence Indicators – A Report on Publicly Funded Organisations' is the first such exercise to compile data on R&D and innovation-related inputs, systems, processes, outcomes and impact using an exhaustive list of 62 indicators from 193 laboratories.

Here, we put the performance of the Council of Scientific and Industrial Research (CSIR), New Delhi, in context using four main outputs/outcomes as objectives: the publications, patents (i.e. Intellectual Property Rights), the higher education (HE) human resources developed (Ph.Ds, Master's degree and graduates) and earnings from Government and non-Government sources. For a meaningful measure of input, we can choose between a scientific workforce engaged in R&D tasks and expenditure based on budget and external funding received. In the case of the former, we are faced with the dilemma of having to choose between total staff in the laboratory, staff engaged in R&D (as collated in the Reports), or the actual permanent scientific staff on the CSIR rolls (not in the Reports but available on-line (https://onecsir.res.in/Analytics/Overview.aspx)). We chose not to use this but use the expenditure measures available in the Reports. We took this as the sum of three different heads: total budget of the institution (Rs crores), total external R&D funding amount received (Rs crores) from Government sources, and total external R&D funding amount received (Rs crores) from non-Government sources. For all these, data are available over three windows: 2017–18, 2018–19 and 2019–2020.

The data was curated manually using Excel sheets available to the author. We will summarize the results in four charts corresponding to the four main outcomes, as shown in Figure 1. Since IPR data for each window is disaggregated into three categories: filed, granted and licensed out, we have used a weighting in the ratio 1 : 2 : 4 to arrive at an aggregated IPR score. Of course, one can experiment with different weighting schemes, but this is not shown here.

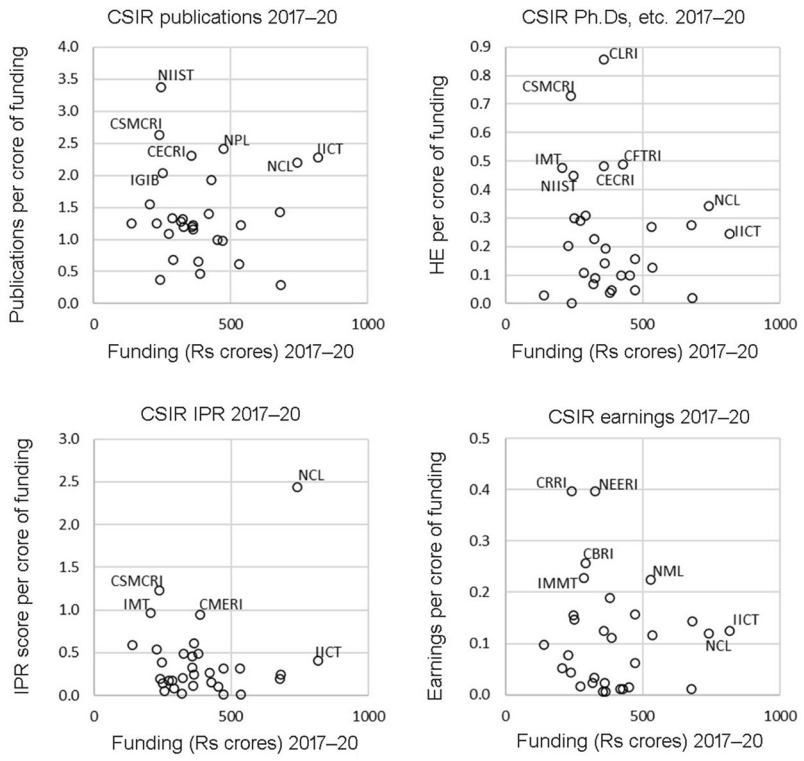

Figure 1. Two-dimensional maps of the four main outcomes versus funding in CSIR, over three years, viz. 2017–20.

The prominent high performers are listed in Table 1 and labelled in the charts in Figure 1. There are no surprises, and the results are in keeping with the overall expectations of those familiar with the CSIR system. National Environmental Engineering Research Institute (earnings 40% of total R&D funding received from all sources), Central Road Research Institute (40%), Central Building Research Institute (26%), Institute of Minerals and Materials Technology (23%) and National Metallurgical Laboratory (22%) are all engineering laboratories with a mandate to provide R&D-related services to industry and strategic sectors. National Chemical Laboratory, Central Salt and Marine Chemicals Research Institute, Institute of Microbial Technology and Central Mechanical Engineering Research Institute lead in generating IPR. National Institute for Interdisciplinary Science and Technology is the most successful at leveraging research funding into research publications (3.38 publications for every crore of rupees funding), followed by Central Salt and Marine Chemicals Research Institute (2.63), National Physical Laboratory (2.41), Central Electro-Chemical Research Institute (2.30), Indian Institute of Chemical Technology (2.28), National Chemical Laboratory (2.20) and Institute of Genomics and Integrative Biology (2.04). Central Leather Research Institute, Central Salt and Marine Chemicals Research Institute, Central Food Technological Research Institute, Central Electro-Chemical Research Institute, Institute of Microbial Technology and National Institute for Interdisciplinary Science and Technology have robust programmes in HE resulting in the award of graduate, Master's and doctorate degrees.

The present author has not seen collated data of such quality before on publically funded R&D institutions in the country. What is missing in the Reports is an analytical study that could guide future policy. The present study shows a way to use such data and is therefore a useful continuation of previous accounts in these pages[1–5] on the progress of CSIR institutions within India and globally in academic research.

Table 1. Prominent performers from the CSIR family

Institution	Code	2017–20								
		Funding	Publications	Publications/ funding	HE	HE/ funding	IPR score	IPR score/ funding	Earnings (Rs crores)	Earnings/ funding
Central Building Research Institute, Roorkee	CBRI	291.70	200.01	0.69	90.01	0.31	22.90	0.08	74.65	0.26
Central Electro-Chemical Research Institute, Karaikudi	CECRI	357.32	821.99	2.30	172.00	0.48	117.23	0.33	2.12	0.01
Central Food Technological Research Institute, Mysore	CFTRI	428.11	825.00	1.93	208.98	0.49	66.05	0.15	5.07	0.01
Central Leather Research Institute, Chennai	CLRI	359.57	428.01	1.19	308.00	0.86	165.08	0.46	44.88	0.12
Central Mechanical Engineering Research Institute, Durgapur	CMERI	387.15	181.01	0.47	17.98	0.05	364.78	0.94	43.09	0.11
Central Road Research Institute, New Delhi	CRRI	241.39	88.00	0.36		0.00	46.93	0.19	95.86	0.40
Central Salt and Marine Chemicals Research Institute, Bhavnagar	CSMCRI	238.38	627.01	2.63	174.01	0.73	292.81	1.23	10.26	0.04
Indian Institute of Chemical Technology, Hyderabad	IICT	818.39	1862.09	2.28	201.05	0.25	337.40	0.41	102.72	0.13
Institute of Genomics and Integrative Biology, New Delhi	IGIB	252.37	513.97	2.04	75.98	0.30	36.87	0.15	37.07	0.15
Institute of Microbial Technology, Chandigarh	IMT	205.48	318.01	1.55	98.02	0.48	198.97	0.97	10.58	0.05
Institute of Minerals and Materials Technology, Bhubaneshwar	IMMT	286.25	382.00	1.33	31.00	0.11	49.08	0.17	65.14	0.23
National Chemical Laboratory, Pune	NCL	741.45	1634.00	2.20	253.98	0.34	1804.84	2.43	88.09	0.12
National Environmental Engineering Research Institute, Nagpur	NEERI	327.27	391.01	1.19	29.01	0.09	160.97	0.49	129.65	0.40
National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram	NIIST	246.85	834.01	3.38	111.03	0.45	95.81	0.39	38.12	0.15
National Metallurgical Laboratory, Jamshedpur	NML	531.25	323.01	0.61	143.00	0.27	169.63	0.32	119.48	0.22
National Physical Laboratory, New Delhi	NPL	473.53	1139.99	2.41	74.01	0.16	151.30	0.32	29.62	0.06
Council of Scientific and Industrial Research, New Delhi	CSIR	12,443.51	17,163.11	1.38	2742.09	0.22	5434.89	0.44	1379.11	0.11

It is worthwhile to close the present study with the following gross takeaways for the laboratories covered in this exercise: on an average, Rs 1 crore of research funding leads to 1.38 publications, 0.22 personnel in the HE space and about Rs 0.11 crore of earnings. Note that a few CSIR institutions did not participate in the study and among those that did, some did not register an R&D presence. They have been omitted here.

1. Prathap, G., *Curr. Sci.*, 2014, **107**, 1121–1122.
2. Prathap, G., *Curr. Sci.*, 2016, **110**, 288–289.
3. Prathap, G., *Curr. Sci.*, 2016, **111**, 962–964.
4. Prathap, G., *Curr. Sci.*, 2018, **114**, 9–11.
5. Prathap, G., *Curr. Sci.*, 2019, **116**, 9–10.

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