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State of Industry R&D in India

An R&D investment and disclosure analysis of Indian and global firms in six key strategic sectors

Aerospace and Defence

Foundation for Advancing Science and Technology India

FAST India

in collaboration with **IIFL Securities**

This brief builds upon the findings of the State of Industry R&D report that presented overall and sector-level findings for selected firms. The present brief provides a detailed examination of the Aerospace and Defence Sector at the firm level, comparing findings of Indian and Global firms. The continuity between these reports ensures a thorough understanding of macro and micro factors influencing R&D in Indian Aerospace and Defence sector firms.

First published in 2024
by Foundation for Advancing Science and Technology (FAST India)

Authored by
Avinash Koli (avinash@fast-india.org)
Vibodh Nautiyal (vibodh@fast-india.org)
Ayushee Thukral (Ayushee@fast-india.org)
Harleen Kaur (harleen@fast-india.org)
Yakshith Kiran (yakshith.k@iifl.com)

For more information and other requests, write to:
Foundation for Advancing Science and Technology (FAST India)
242, Okhla Industrial Estate, Phase III, Delhi – 110020,
India
Email: info@fast-india.org
Website: www.fast-india.org

Aerospace and Defence

Key takeaways

- Indian defence firms have a lower R&D intensity (1.2%) compared to global counterparts (3.4%).
  - Hindustan Aeronautics Limited (HAL) ranks first across all firms (Global and Indian) studied. Its R&D intensity was 9.3%, significantly higher than many global counterparts. With USD 301 MM (in FY23), it spends more than **2x** the second-highest R&D spender, Bharat Electronics Limited.
  - Bharat Dynamics ranks third across all firms for Research and Development (R&D) intensity. Its R&D intensity of 6.1% is **3.7x** times that of Sika Interplant, which ranks second within the low-revenue cluster.
- The proportion of PhD employees in Indian defence firms (0.1%) is significantly lower than the global average (0.3%).
  - Indian firms in low-revenue cluster perform well for this parameter, with Sika Interplant and High Energy Batteries getting first and second ranks.
- Indian defence firms produce more publications per USD billion revenue (88.5) compared to the global average (37.9).
  - High Energy Batteries, Bharat Electronics Limited (BEL) and Bharat Forge occupy top-three ranks in the list with 6692, 177 and 173 publications per USD billion revenue, respectively.
- Indian defence sector firms lag significantly in patent output, with 7.3 patents per USD billion revenue compared to the global average of 240.0.
  - Bharat Forge leads patent output relative to its size amongst Indian firms. However, L&T has the largest number of patents in the high revenue cluster.
  - The low revenue cluster firms lack significant patent data, with most of the firms showing zero patents.

1.1 Introduction

India is the fourth largest defence spender in the world, contributing approximately 3.6% of the global defence expenditures.[1] The spending has seen an upward trend and is forecasted to continue at an annual growth rate of 7% to 8% over the next five years.[2] Such an increase in defence spending opens significant opportunities for India's defence industry.

The financial allocation for the India's premier government defence research and development (R&D) organisation, Defence Research and Development Organisation (DRDO) has seen an increase to INR 23,855 crore for the fiscal year 2024-25, up from INR 23,263.89 crore in the previous fiscal year.[3] Within this allocation, a significant portion, amounting to INR 13,208 crore, is dedicated to capital expenditure.[4] The increase in funds aims to enhance DRDO's capacity in developing new technologies, with a particular emphasis on basic research and supporting private entities through the Development-cum-production partner program.

The private sector's involvement in defence R&D is gradually expanding, driven by government policy initiatives. To promote R&D within the industry, by startups, and by academia, the Ministry of Defence (MoD) has introduced three schemes so far—Innovations for Defence Excellence (iDEX), Technology Development Fund (TDF), and Make in India categorisation. 'Make' category of capital acquisition in Defence Procurement Procedure is aimed to foster indigenous capabilities in defence manufacturing and R&D.[5] A boost for the private sector in R&D came in the form of the Union Budget 2022-23, where the finance minister expressed the government's intention to promote the industry's involvement "in the design and development of military platforms and equipment in collaboration with DRDO and other organisations through the Special Purpose Vehicle (SPV) model."[6]

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[1] Stockholm International Peace Research Institute (2022). "Trends in World Military Expenditure: 2022". In: *sipri.org*. URL: https://www.sipri.org/sites/default/files/2023-04/2304_fs_milex_2022.pdf.

[2] CII (2024). *CII Aerospace*. URL: https://www.cii.in/Sectors.aspx (visited on 06/07/2024).

[3] PIB Delhi (2024). *Record over Rs 6.21 lakh crore allocation to Ministry of Defence in Interim Union Budget 2024-25; 4.72% more than FY 2023-24*. URL: https://pib.gov.in/pib.gov.in/Pressreleaseshare.aspx?PRID=2001375 (visited on 06/07/2024).

[4] Samuel Rajiv and Abhay Singh (Feb. 2024). "Defence Budget 2024-25: Trend Analysis". In: *Manohar Parrikar Institute for Defence Studies and Analysis* IDSA Issue Briefs. URL: https://www.idsa.in/issuebrief/Defence-Budget-2024-25-SSC-Rajiv-ASingh-160224 (visited on 06/07/2024).

[5] Deparment of Defence Production (2024). *Make In India Defence Production: Projects | GoI*. URL: https://www.makeinindiadefence.gov.in/projects/index/1 (visited on 06/07/2024).

[6] PIB Delhi (Nov. 2022). *Ministry of Defence identifies 18 major platforms for industry led Design and Development*. URL: https://pib.gov.in/pib.gov.in/Pressreleaseshare.aspx?PRID=1805135 (visited on 06/07/2024).

We now present our findings on R&D-related inputs and outputs for aerospace and defence sector firms.

1.2 India vs. Global Comparison

For inputs, we study R&D intensity and PhD employees as a proportion of total employees. R&D intensity helps us in identifying the proportion of revenue input in R&D activities, while the PhD employee number represents an approximate number of researchers in the firm. For outputs, we present our findings on the number of patents and publications per billion USD in revenue.

Indian defence firms have an R&D intensity of 1.2%, while global defence firms have a higher intensity of 3.4%, indicating more substantial R&D investments globally.

Figure 1.1 shows the performance of firms on input-based parameters.

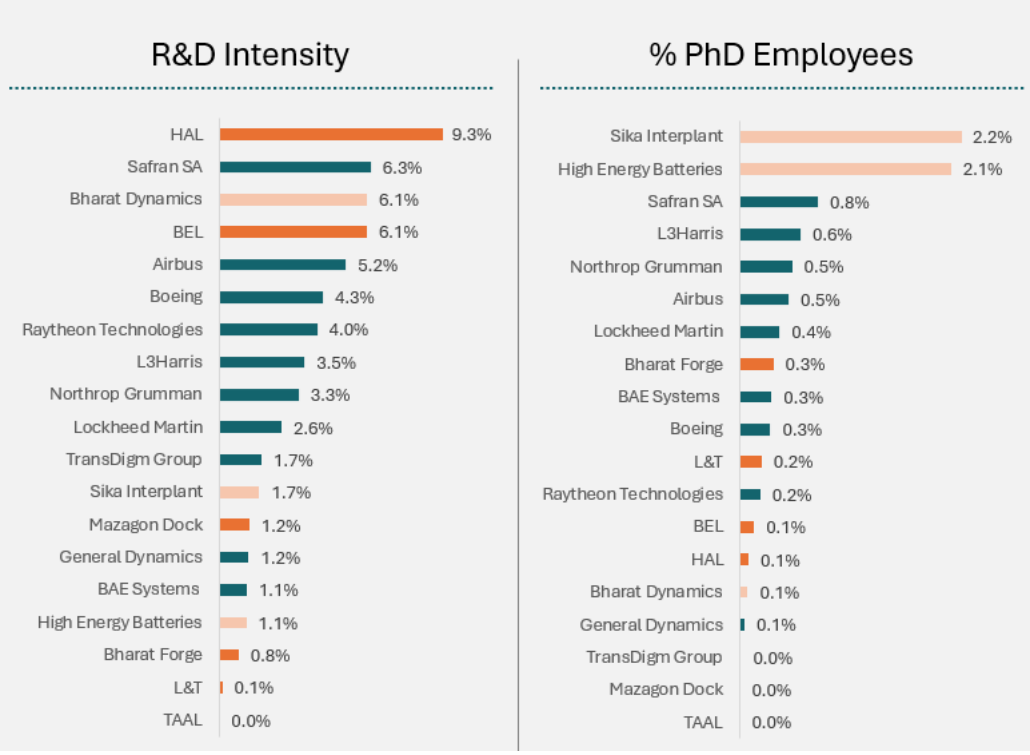


Figure 1.1: India vs. Global Defence Sector Firms Comparison on R&D intensity and proportion of PhD employees

Hindustan Aeronautics Limited (HAL) stands out with the highest R&D intensity amongst all firms studied, at 9.3%. This indicates HAL's commitment to research and development relative to its revenue. Bharat Dynamics and BEL also rank well - third and

fourth of all firms studied for their R&D intensity.

Indian defence firms have 0.1% PhD employees, while global defence firms have 0.3%, a **3x** difference. However, Sika Interplant and High Energy Batteries with 2.2% and 2.1%, respectively, are amongst the top two firms for the proportion of PhD employees.

Figure 1.2 shows the performance of firms on output-based parameters. Indian defence firms have 88.5 publications per USD billion revenue, more than double the global figure of 37.9. In addition to a high focus on publications, comparatively lower revenue of Indian firms may explain the performance of Indian defence companies. Most global firms including major players like Safran SA (122) and Airbus (91), have considerably lower publications per USD Billion revenue.

Indian defence firms have 7.3 patents per USD Billion revenue compared to 240.0 for global companies, a striking **33x** difference. This highlights a significant lag in patenting efforts in the Indian defence sector. Further, Safran SA ranks first with the largest number of patents per USD Billion revenue (5,336), showcasing a strong focus on innovation and intellectual property generation.

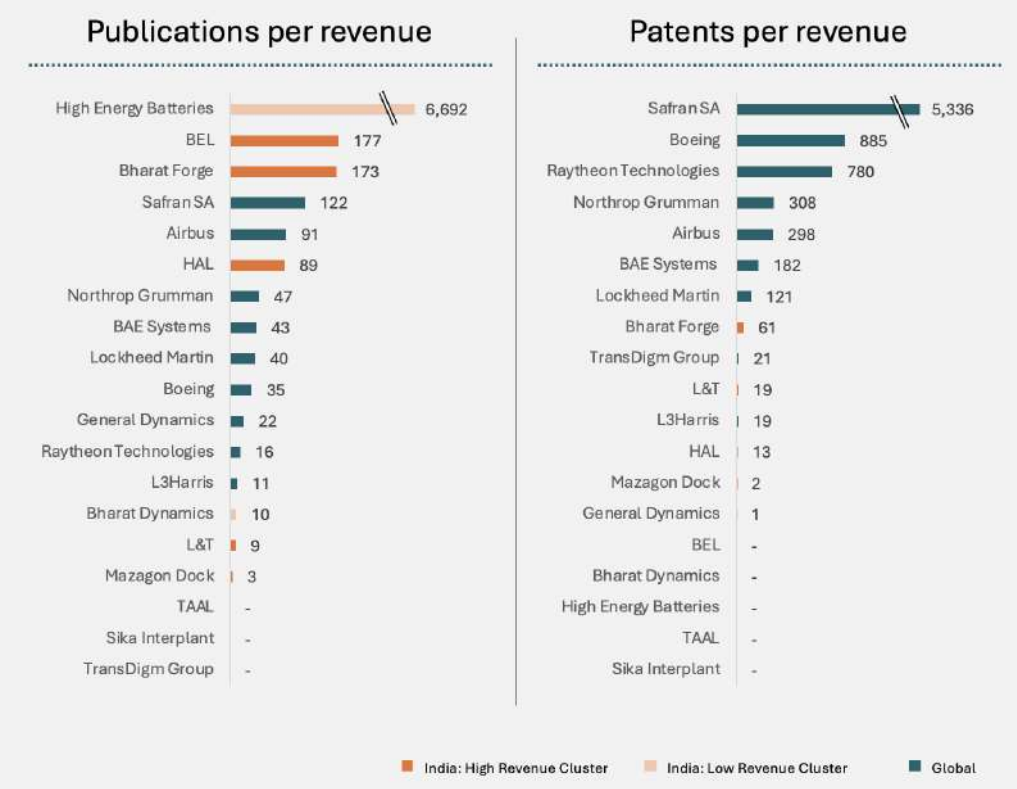


Figure 1.2: India vs. Global Defence Sector Firms Comparison on publications per USD billion revenue and patents per USD billion revenue

1.3 India Defence Sector: A Firm-Level Analysis

To enhance the depth and relevance of our analysis of the Indian defence sector, we have segmented the firms into high-revenue and low-revenue clusters. This bifurcation is based on the median of the average revenue of firms within the sector. By categorising the firms in this manner, we aim to provide a more nuanced and meaningful examination of their innovation inputs and outputs. Following is the cluster-wise firm-level comparative analysis of top market capitalisation defence sector firms in India.

1.3.1 High Revenue Cluster

1.3.1.1 R&D Intensity

Figure 1.3 below compares R&D intensity, defined as the ratio of a firm's R&D expenditure to its revenue, across Indian defence sector firms forming a part of the high revenue cluster. The median R&D intensity for Indian firms stands at 1.2%, below the global median of 3.4%.

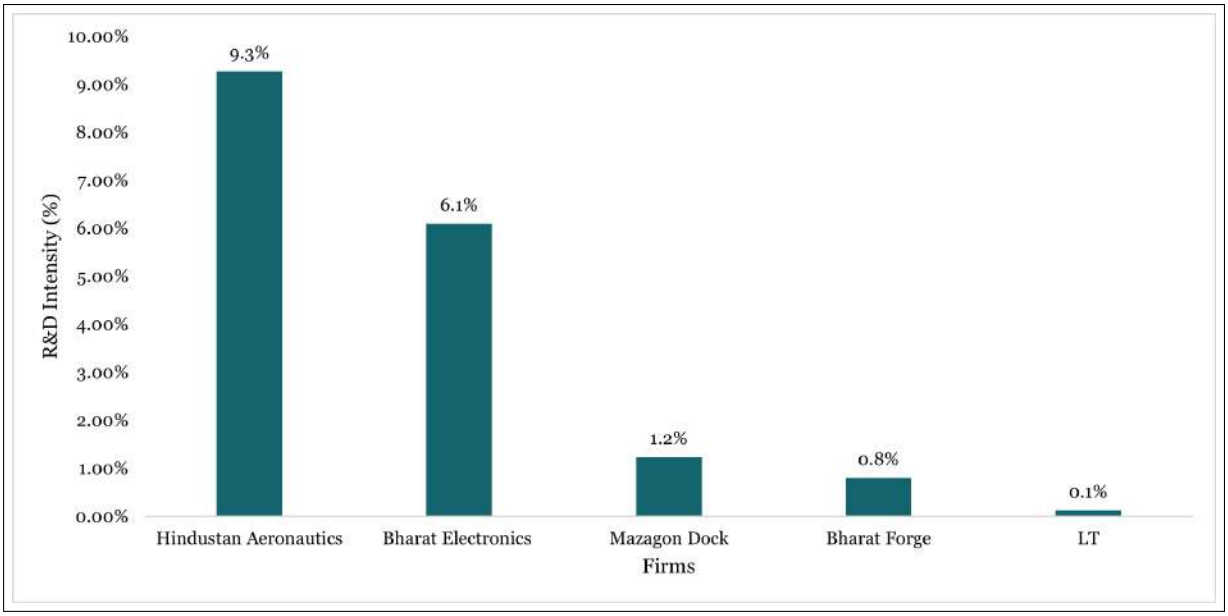


Figure 1.3: R&D intensity: High Revenue Cluster

HAL shows a notable R&D intensity, outpacing other Indian firms in the high-revenue cluster. In FY 2022-23, HAL had USD 301 MM R&D expenditure, spending more than twice in R&D as compared with the second-highest R&D spender, BEL, which spent USD 130 MM on R&D for the same year. BEL ranks second, followed by Mazagon

Dock and Bharat Forge for this parameter. L&T[7] reported the highest revenue in FY2022-23 amongst the firms studied, with more than four times the second-highest spender (HAL). However, L&T spends comparatively little on R&D, at USD 16 USD. As a result, L&T ranks last in the high revenue cluster in terms of R&D intensity.

1.3.1.2 PhD employees as a proportion of total employees

Figure 1.4 below presents the number of employees with PhDs as a percentage of the total employees attributed to various Indian defence sector firms in a high-revenue cluster.

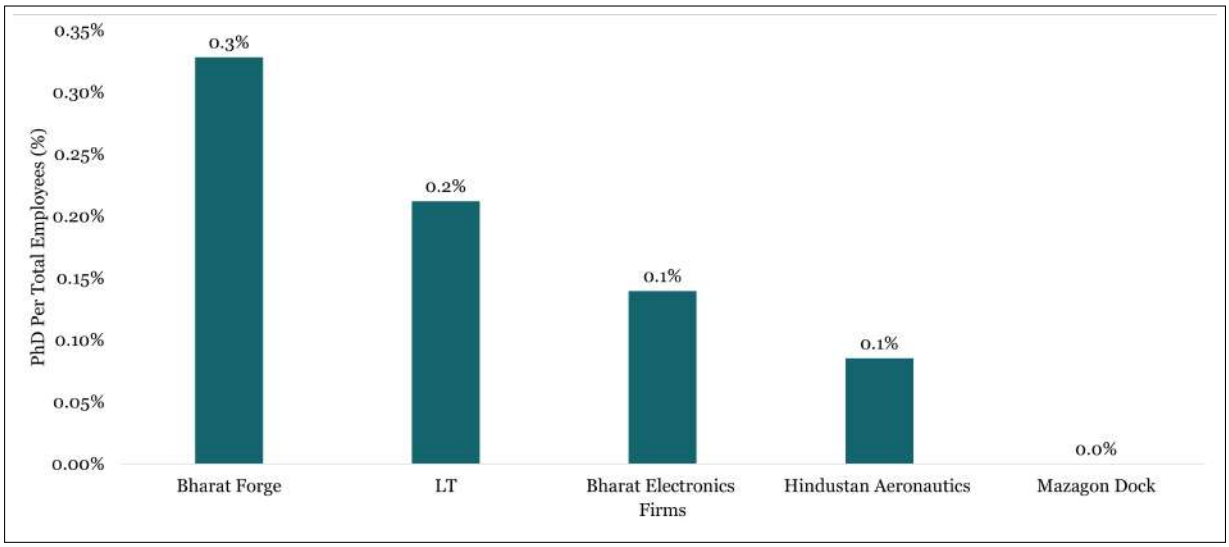


Figure 1.4: PhD per Total Employees: High Revenue Cluster

Bharat forge ranks first in terms of proportion of PhD employees. L&T has the highest number of employees, 49,039, which is more than twice the second highest on the list. It also boasts the highest number of employees with a PhD, positioning it second in the high revenue cluster. HAL, with highest intensity across all firms, ranks fourth in proportion of PhD employees.

1.3.1.3 Patents by USD billion revenue

Figure 1.5 below depicts patents per billion USD revenue for high-cluster firms. Bharat Forge performs best in this parameter, followed by L&T, HAL. Bharat Electronics has zero patents by revenue.

[7]The study has used L&T consolidated R&D figures because of the unavailability of isolated figures for its defence arm, L&T Precision Engineering and Systems. This is a significant limitation when comparing L&T with other firms in the sample.

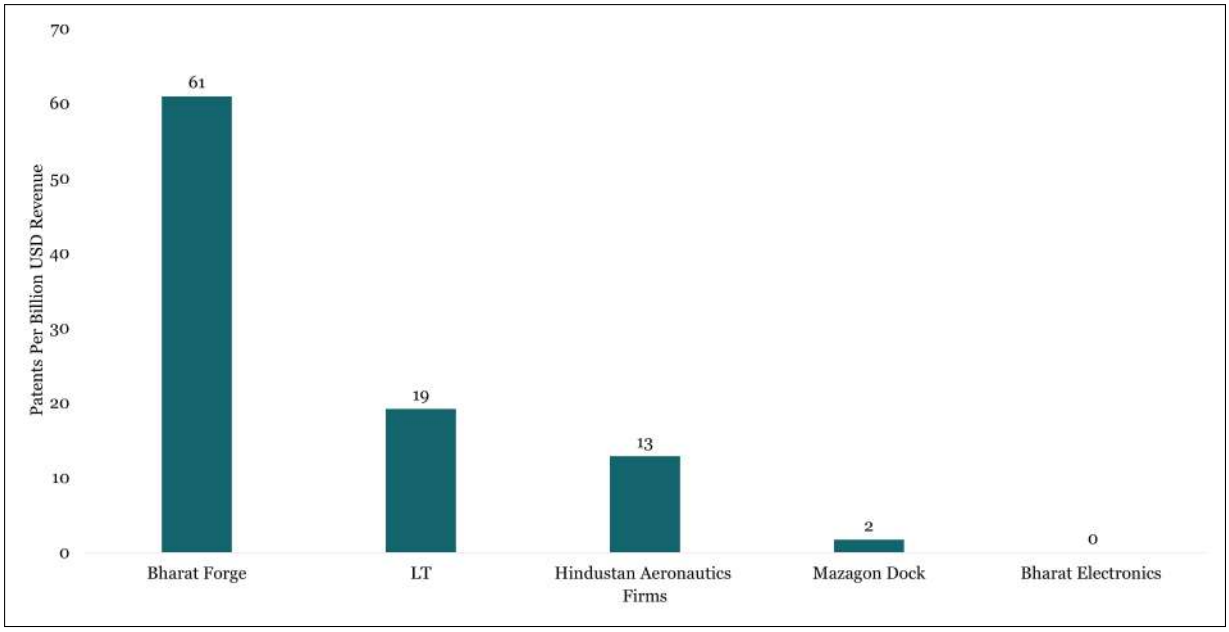


Figure 1.5: Patents by Revenue: High Revenue Cluster

L&T had the highest absolute number of patents between 2015 to 2023 in its cluster. Bharat Forge ranked second on absolute patent count. However, L&T's average revenue is almost 16 times the Bharat Forge's revenue, making the Bharat Forge's position higher as a ratio.

1.3.1.4 Publications by USD billion revenue

Figure 1.6 below presents publications per USD billion revenue of high-revenue cluster firms.

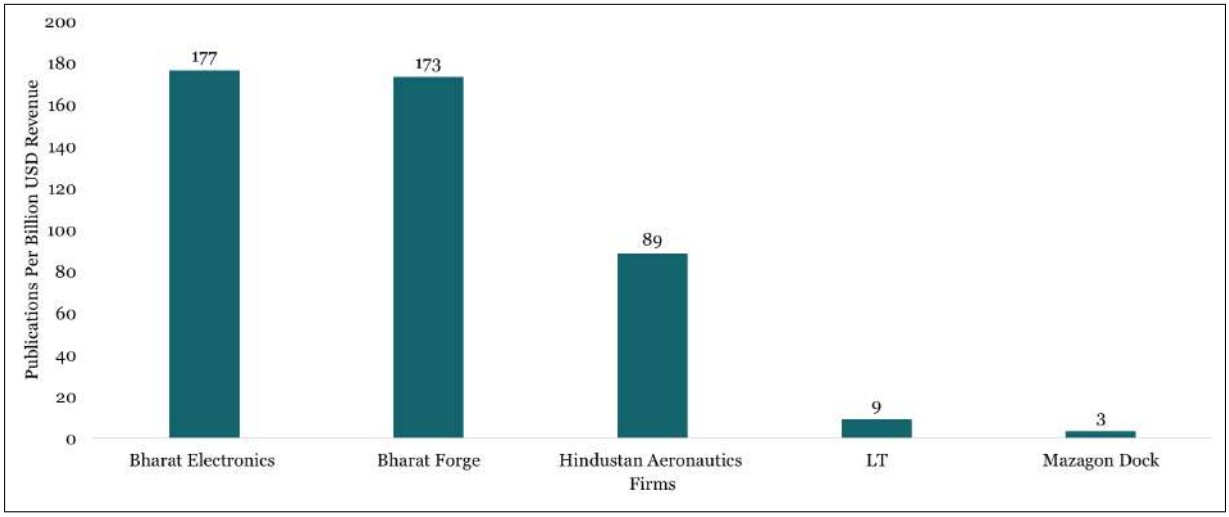


Figure 1.6: Publication by Revenue: High Revenue Cluster

BEL ranks first amongst its peers for the highest number of publications per billion USD revenue, followed closely by Bharat Forge. HAL ranks third, followed by L&T and Mazagaon Dock.

1.3.2 Low Revenue Cluster

1.3.2.1 R&D Intensity

Figure 1.7 below compares R&D intensity among the Indian defence sector firms in the low-revenue cluster. R&D intensity of Bharat Dynamics at 6.1%, is **3.7x** the firm with the second-highest R&D intensity, Sika Interplant. High Energy Batteries and Taneja Enterprises, despite having relatively low revenue of 7 USD MM and 4 USD MM (in FY23), respectively, have 1.1% and (nearly) 0% of R&D intensity, respectively. Further, these firms spent comparatively little on R&D in FY23 — 0.1 USD MM and 0 USD MM, respectively.

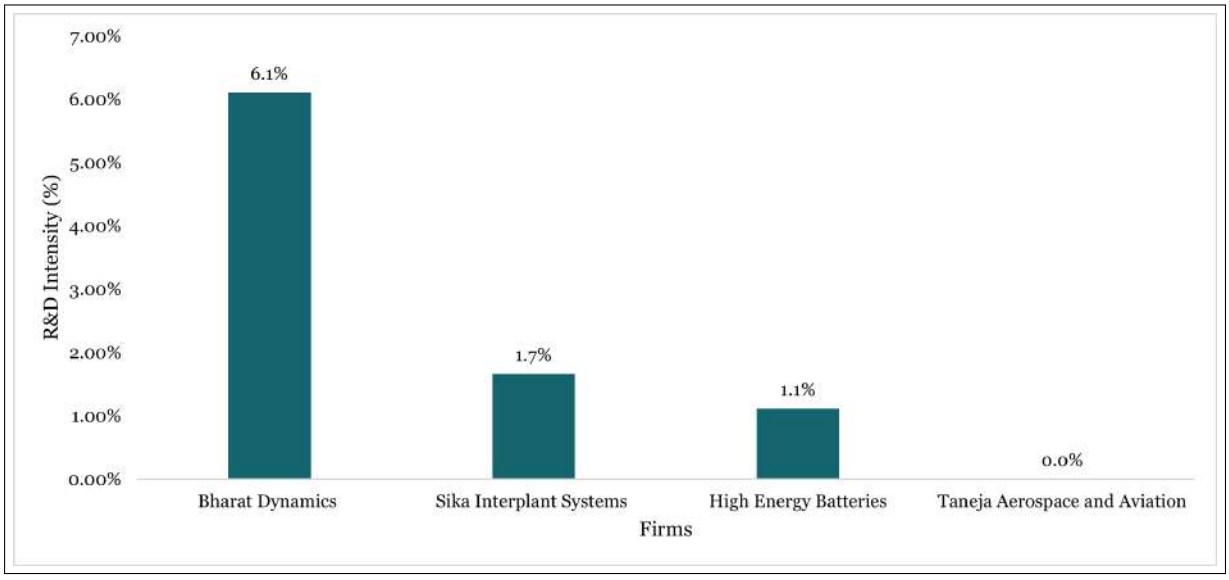


Figure 1.7: R&D intensity: Low Revenue Cluster

1.3.2.2 PhD employees as a proportion of total employees

Figure 1.8 below illustrates the percentage of total PhD-holding employees across various Indian defence sector firms in the low-revenue cluster. All firms in the low-revenue cluster have between 0 and 2 employees with PhDs. Therefore, Sika Interplant, a small firm with a total employee count of 46, tops the list with one PhD-holding employee.

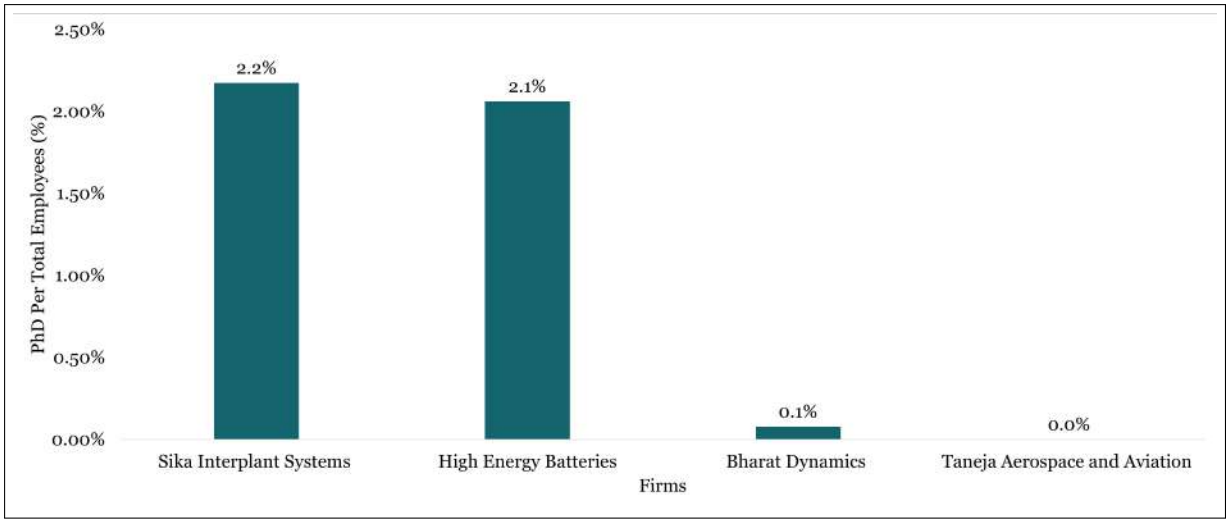


Figure 1.8: PhD per Total Employees: Low Revenue Cluster

1.3.2.3 Patents by USD billion revenue

We excluded the low cluster graphical representation because of a lack of patent data for the firms - High Energy Batteries, Taneja Aerospace, and Sika Interplant. Bharat Dynamics Limited (BDL), with zero patents, performs poorly in terms of patents per revenue.

1.3.2.4 Publications by USD billion revenue

Figure 1.9 below presents the publication per USD billion revenue of low-revenue cluster firms. For Taneja Aerospace and Sika Interplant, no publication data was available. In this cluster, High Energy Energy Batteries dominates the ranking with 49 publications and a relatively low revenue of USD 7 MM. BDL with the highest average revenue (USD 407 MM) in the cluster produced just four publications in the period studied.

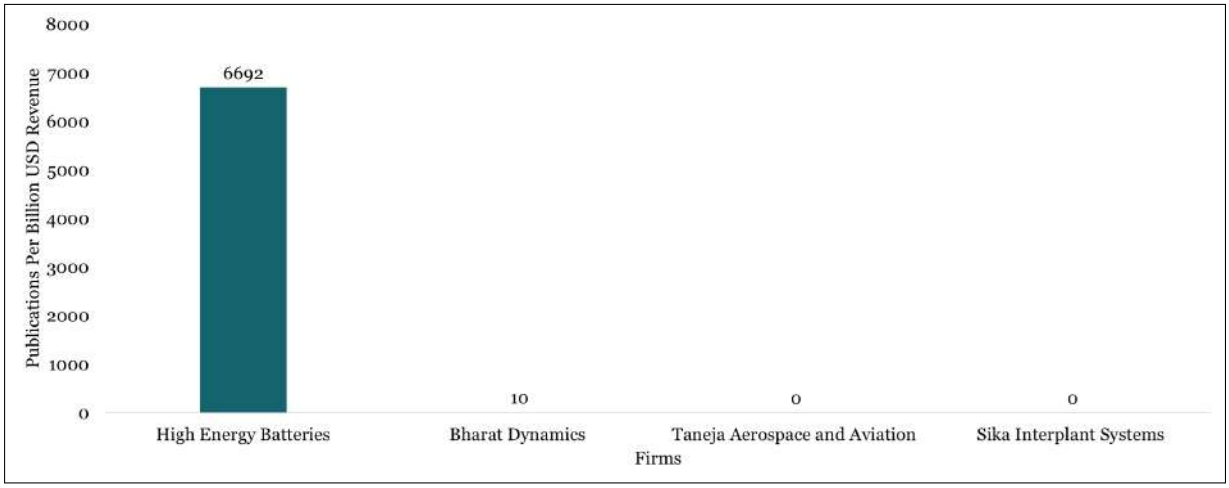


Figure 1.9: Publication by Revenue: Low Revenue Cluster

In summary, figures 1.10 and 1.11 below present a graphical representation of a firm's performance across the four parameters, R&D intensity, PhD employees as a proportion of total employees, patents and publications per USD billion revenue for high revenue and low revenue cluster firms.

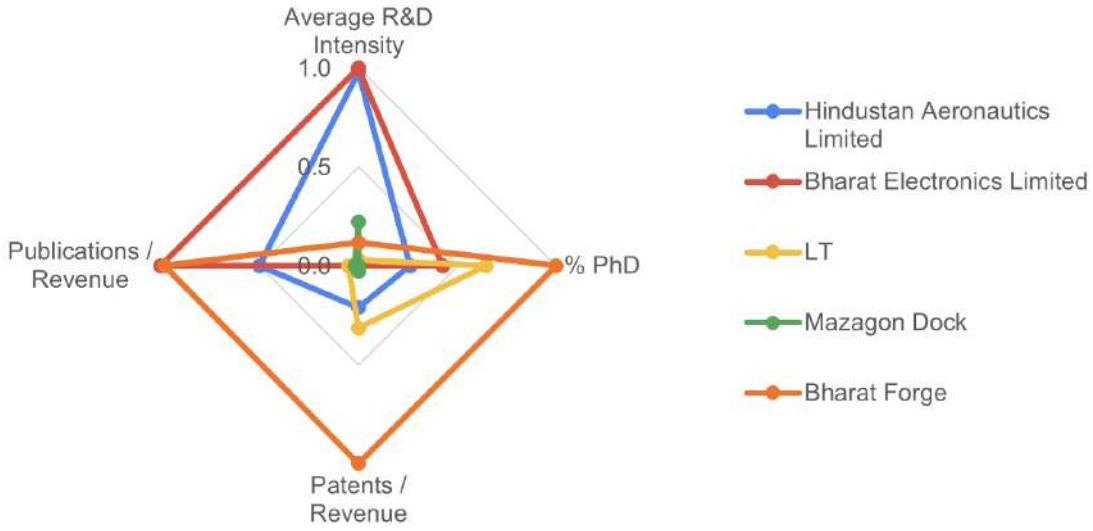


Figure 1.10: Indian Defence Sector Firms performance in the High Revenue Cluster

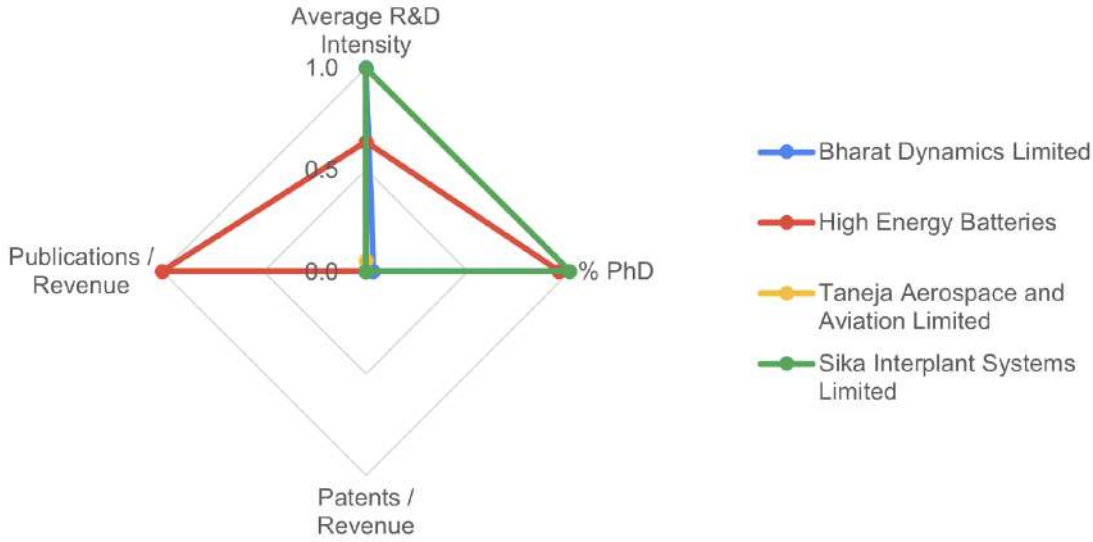


Figure 1.11: Indian Defence Sector Firms performance in the Low Revenue Cluster

1.4 Conclusion

The high revenue firms demonstrate a higher commitment to R&D with Hindustan Aeronautics Limited (HAL) leading at 9.3% R&D intensity. In the low revenue cluster,

Bharat Dynamics Limited (BDL) leads with an R&D intensity of 6.1%, considerably higher than the next firm in the cluster, Sika Interplant. Overall, low-revenue firms have a mixed performance with significant variation in R&D investment. In terms of proportion of PhD employees, firms in the low revenue cluster generally have fewer PhD employees, with Sika Interplant topping the list with only one PhD employee among 46 total employees.

For patents per revenue, L&T leads with 193 patents, followed by Bharat Forge with 39 patents, in the high revenue cluster. However, when adjusted for revenue, Bharat Forge demonstrates a stronger patent output relative to its size. The low revenue cluster firms lack meaningful patent data, with many firms showing zero patents.

High revenue firms in the Indian aerospace and defence sector generally show stronger commitments to R&D and have more PhD employees, indicating a greater focus on advanced research and development. They also produce more patents and publications, although there are exceptions based on individual firm strategies. In contrast, low revenue firms show varied performance with some excelling in specific areas such as publications (e.g., High Energy Batteries) but generally lagging in patents and advanced research personnel.

Annexure

Table 1.1: Firms included in the study

No.	Firm	Market Cap (USD Bn)	Avg. Standalone Revenue (USD MM)	Revenue Cluster
1	Larsen & Toubro (L&T)	38.0	10,063	High
2	Hindustan Aeronautics Limited (HAL)	12.1	2,564	High
3	Bharat Electronics Limited (BEL)	9.5	1,495	High
4	Bharat Forge	4.3	640	High
5	Mazagon Dock	1.8	591	High
6	Bharat Dynamics	2.2	407	Low
7	High Energy Batteries*	0.04	7	Low
8	Sika Interplant*	0.03	7	Low
9	Taneja Aerospace and Aviation Limited* (TAAL)	0.04	4	Low
	Median	2.2	591	

Note:

- *High Energy Batteries, Taneja Aerospace and Aviation Limited, and Sika Interplant Systems Limited replaced the firms ranking higher in market capitalisation due to missing data or incomplete reporting.
- We limited the list of Indian firms to nine because of the minimal number of firms in the defence and aerospace sector on the list. Furthermore, we avoided newly featured firms in the top market capitalisation companies list.
- Market Capitalisation data obtained from https://www.capitaliq.com/ as of May 2023. Revenue data for the latest year as obtained from Company Annual Reports and Bloomberg.

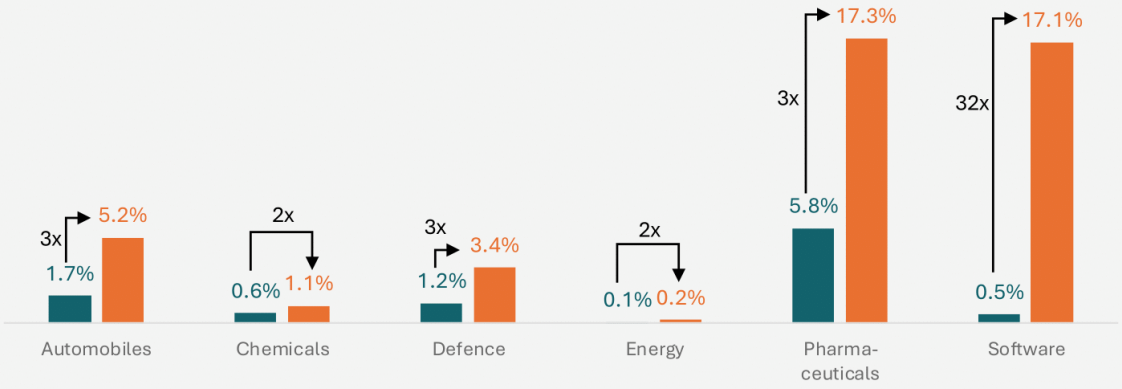
Table 1.2: Firms excluded from the study and rationale

No.	Firm	Region	Rationale for exclusion
1	Data Patterns	Indian	2021 IPO; Only FY22, FY23 annual reports and prospectus available
2	Garden Reach Shipbuilders and Engineers Limited	Indian	No R&D data found in annual report
3	Paras Defence and Space Technologies Limited	Indian	No R&D data found in annual report
4	DCX Systems Limited	Indian	2023 IPO; Only FY23 annual report and prospectus available
5	Apollo Micro Systems Limited	Indian	No R&D data found in annual report
6	Krishna Defence and Allied Industries Limited	Indian	No annual reports prior to FY19

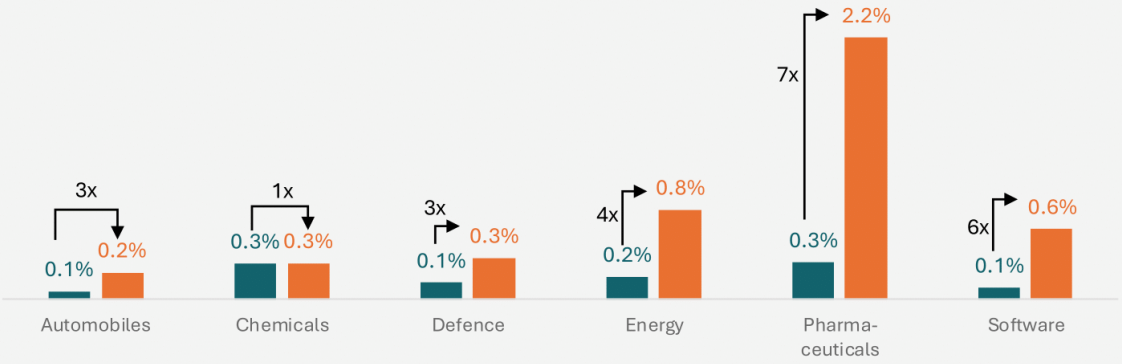
Note: Due to availability of the required data no global firms were excluded.

Sectoral Comparisons: Inputs & Outputs

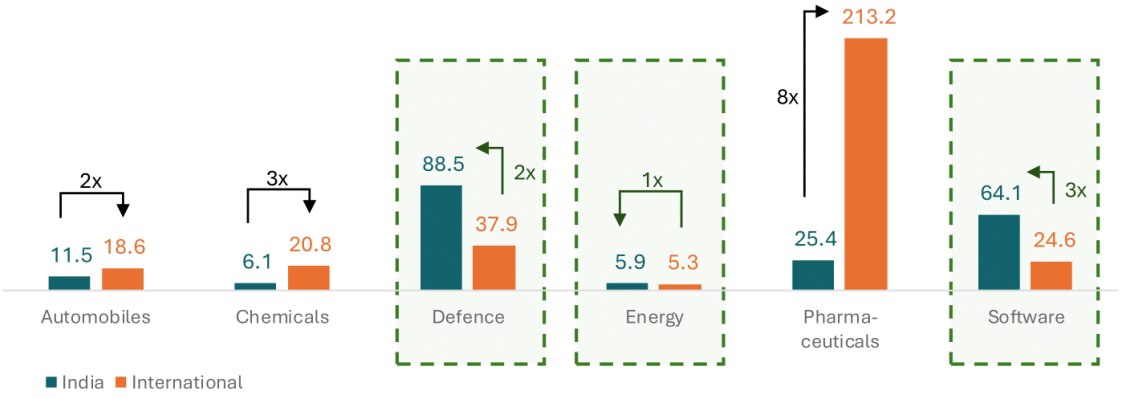
R&D Intensity



% PhD Employees

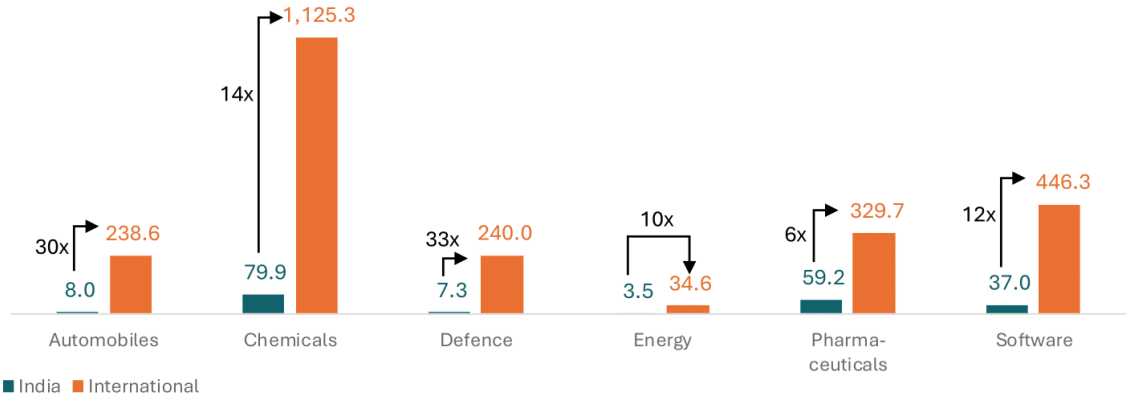


Publications per revenue

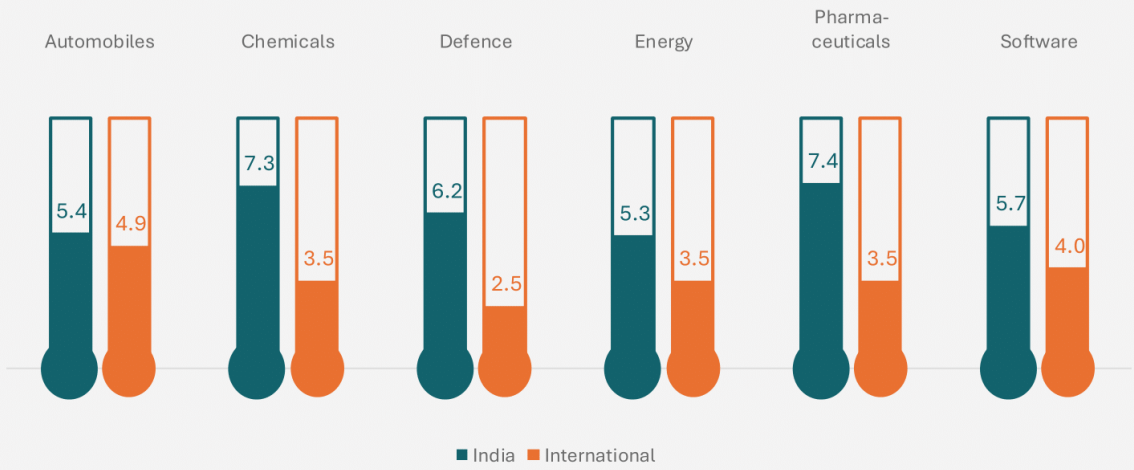


Sectoral Comparisons: Inputs & Outputs

Patents per revenue



R&D Disclosures



Notes:
1. % PhD Employees is the number of PhD employees as a proportion of total employees.
2. The publications per revenue metric indicates the number of publications in the study period per billion USD revenue.
3. The patents per revenue metric indicates the number of patents published in the study period per billion USD revenue.

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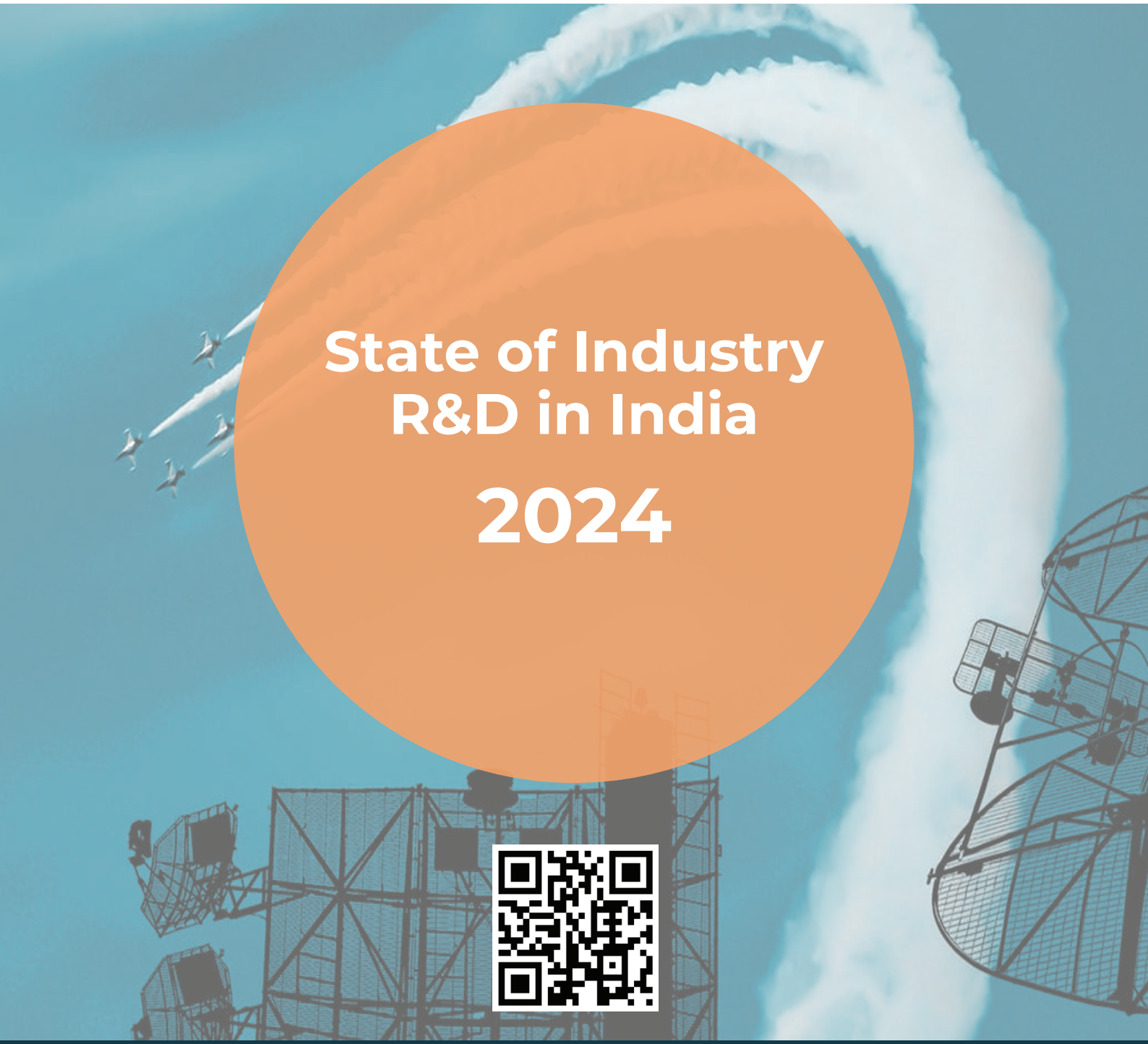

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242, Okhla Industrial Estate, Phase 3,
Delhi – 110020, INDIA

info@fast-india.org

www.fast-india.org