



**10 YEARS
OF
COMMON RESEARCH AND
TECHNOLOGY DEVELOPMENT HUB
(CRTDH)**

**EMPOWERING MSMEs
AND STIMULATING TRANSFORMATION**



**DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH
MINISTRY OF SCIENCE AND TECHNOLOGY
GOVERNMENT OF INDIA**

NOVEMBER 2023



**10 YEARS
OF
COMMON RESEARCH AND
TECHNOLOGY DEVELOPMENT HUB
(CRTDH)**

**EMPOWERING MSMEs
AND STIMULATING TRANSFORMATION**



**DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH
MINISTRY OF SCIENCE AND TECHNOLOGY
GOVERNMENT OF INDIA**

NOVEMBER 2023

CONTENTS

Message from Secretary, DSIR	i
From the desk of Head, CRTDH	ii
Acknowledgement	iv
1. Introduction	1
2. Micro, Small and Medium Enterprises: The Heroes of ‘Atmanirbhar Bharat’	3
3. Challenges Faced by MSMEs in India	6
3.1. Technological Challenges Faced by MSMEs in India	6
3.2 Research and Development (R&D) Challenges Faced by MSMEs in India	7
4. Innovation: Changing The MSME Landscape	9
5. Common Research & Technology Development Hub (CRTDH) Programme of DSIR	10
6. Pan India Presence of CRTDH	13
7. Ten Years of Nurturing CRTDH: Impact Indicators	
7.1 Built Up Area	17
7.2 Technology Development	17
7.3 Incubatee/ Start-ups	18
7.4 Patents	18
7.5 MSMEs Engaged	19
7.6 Trained manpower	19
7.7 Revenue Earned	20
8. Infrastructure at CRTDH	21
9. ‘Chintan Shivir’: A Strategic Brainstorming Session	23
10. Network CRTDH: A Networking Platform for CRTDH	28
11. CRTDH Conclave: Propelling Self Reliance in MSMEs and Start-Ups	29

12. Success Stories Made at CRTDH	32
- Research & Development Related	32
- Services Related	48
The Way Forward	54
Annexure I	56
Abbreviation	59
References	61

MAIL SCH- 17/10/2022



सत्यमेव जयते



डॉ. (श्रीमती) एन. कलैसेल्वी
सचिव
वैज्ञानिक और औद्योगिक अनुसंधान विभाग तथा
महानिदेशक

Dr. (Mrs) N. Kalaiselvi
Secretary

Department of Scientific & Industrial Research and
Director General



भारत सरकार

विज्ञान और प्रौद्योगिकी मंत्रालय
वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद
वैज्ञानिक और औद्योगिक अनुसंधान विभाग

Government of India
Ministry of Science and Technology
Council of Scientific & Industrial Research
Department of Scientific & Industrial Research



MESSAGE

The Department of Scientific and Industrial Research (DSIR) has a mandate to carry out the activities related to indigenous technology promotion, development, utilization and transfer with a mission to invigorate industrial research in the country, create an enabling environment for development, utilization of new innovations, enhance innovations through its resources and channelize benefits thereof, to the people.

To fulfill its mission, DSIR has been implementing various schemes. Common Research and Technology Development Hub (CRTDH) scheme is one of them which strengthens the R&D infrastructure in Public Funded Research Institutions (PFRIs) and aims to encourage Micro, Small, and Medium Enterprises (MSMEs) for undertaking industrial R&D/innovation activities. This programme recognizes the importance of MSMEs in the overall economy of India and therefore, focuses on creation of R&D infrastructure for driving scientific advancements, technological innovations and socio-economic development. CRTDHs established by DSIR offer hands-on training, skill development programmes and research resources to MSMEs in addition to its research and technology development infrastructure. Founded in 2014-15, CRTDH initiative has entered the 10th year of successful implementation, with 18 CRTDHs across the country. Each CRTDH has remarkable achievements along with success stories of some of the stakeholders associated with them, which is truly forwarding the vision of "Atma Nirbhar Bharat" and strengthening the momentum for "Vocal for Local".

I am happy to know that DSIR has come out with a report, '*10 years of CRTDH: Empowering MSMEs and Stimulating Transformation*', which showcases the activities and noteworthy achievements of CRTDHs and its stakeholders. It is a sincere effort to highlight the department's efforts for realizing its vision in enabling India to emerge as global industrial research and innovation hub.

I congratulate DSIR team and also wish the team all the best for future CRTDH endeavors.

17 October, 2023
New Delhi

(N Kalaiselvi)

Anusandhan Bhawan, 2, Rafi Ahmed Kidwai Marg, New Delhi-110001

Tel: +91-11-23710472, 23717053, Fax: +91-11-23710618, E-mail: secy-dsir@gov.in; dgcsir@csir.res.in; Website: www.csir.res.in



दूरभाष/TEL : 26962819, 26567373
(EPABX) : 26565694, 26562133
: 26565687, 26562144
: 26562134, 26562122
फैक्स/FAX : 26960629, 26529745
Website : <http://www.dsir.gov.in>
(आईएसओ 9001:2008 प्रमाणित विभाग)
(AN ISO 9001:2008 CERTIFIED DEPARTMENT)



सत्यमेव जयते

भारत सरकार
विज्ञान और प्रौद्योगिकी मंत्रालय
वैज्ञानिक और औद्योगिक अनुसंधान विभाग
टेक्नोलॉजी भवन, नया महरौली मार्ग,
नई दिल्ली - 110016
GOVERNMENT OF INDIA
MINISTRY OF SCIENCE AND TECHNOLOGY
Department of Scientific and Industrial Research
Technology Bhavan, New Mehrauli Road,
New Delhi - 110016

From the Desk of Head, CRTDH



The Micro, Small and Medium Enterprises (MSME) sector, with more than six crore enterprises, has emerged as a highly vibrant and dynamic sector of the Indian economy, fostering entrepreneurship and generating self-employment opportunities at comparatively lower capital cost. MSMEs are the backbone of India's economy. They contribute to nearly 30% of its GDP and employ over 11 crore people. They have shown stupendous growth over the last two decades, and have shown extraordinary potential in terms of quality production, exports, innovation, product development and import substitution.

The Indian economy, according to International Monetary Fund (IMF) estimates, will emerge as the world's third largest economy by 2027, hopping over Japan and Germany, as its GDP crosses US\$5 trillion dollars. By 2047, India aspires to be a developed economy. The buoyancy in the economy instills confidence that the country, will likely achieve these goals.

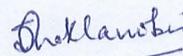
The spotlight, in this entire journey will be on India's Micro, Small and Medium Enterprises (MSMEs). They will be the key entities generating income, capabilities, capacities and ecosystem needed for sustained growth in consumption and investment that is broad-based and comes from all sections of the economy.

In today's world of global competition, R&D plays a major role in not only developing a better product but also winning the market share from the competitors. Innovative Research and Development (R&D) are keys to ensuring growth, innovation and competitiveness for any company, whether a start-up, a MSME or a large enterprise. Innovation and R&D are therefore, considered as the key factors for survival, growth and development of any business. R&D fosters

a culture of experimentation, exploration and learning, enabling MSMEs to develop novel solutions, enhance existing products, and introduce disruptive innovations. Dedicating resources and efforts to R&D, empowers MSMEs with vast possibilities thereby, driving growth and meeting evolving customer demands.

Although MSMEs want to undertake meaningful R&D to remain competitive, they are often unable to do so because of financial constraint. The Department of Scientific and Industrial Research (DSIR), through its Common Research and Technology Development Hub (CRTDH) programme is trying to help the MSMEs and start-ups in their R&D endeavors by establishing the CRDHs in Public Funded Research Institutes(PFRIs). The CRTDHs established by DSIR are provided with state-of-the-art equipment and infrastructure, which can be used by MSMEs and start-ups on a shared basis. The 18 CRTDHs established by DSIR are doing meaningful research and are also helping the start-ups and MSMEs in their R&D projects by offering the state-of-the-art equipment and infrastructure available at the CRTDHs and also by providing required intellectual inputs for these projects.

The CRTDH programme is completing ten years and therefore, it is a great time to reflect back on the accomplishments of the CRTDHs, celebrate all that the CRTDHs have achieved and set goals for the coming years. When we strive for better outcomes, it is important that we not only celebrate our successes but also reflect on our failures to determine what we could do better. Self-reflection is an important part of growth and provides opportunities for future development. It is the time that we recognize our successes, build confidence in ourselves and create positive momentum for the future. This also allows us to identify areas where we can improve and set new goals in the coming years. The current report, *“10 years of Common Research and Technology Development Hubs (CRTDHs): Empowering MSMEs and Stimulating Transformation”*, is an effort to document the journey of the “Common Research and Technology Development Hub (CRTDH)” programme of DSIR since inception.



(Dr. Sujata Chaklanobis)

ACKNOWLEDGEMENT

The journey of CRTDH programme has been a decade long and I at DSIR would like to take a moment to express our heartfelt appreciation and gratitude to all those who have been a part of our journey in bringing out this report.

I take this opportunity to acknowledge and celebrate Dr. N. Kalaiselvi, Secretary, DSIR for her unwavering commitment, exceptional leadership and ability to manage the intricate workings of the Department with utmost efficiency and professionalism. Her insight and vision for the CRTDH programme has been of paramount importance in setting and reaching our goals. As a true visionary, she has been guiding the CRTDH team for greater success in the years to come. I express my deepest gratitude and appreciation for her outstanding contribution for the programme. Her dedication is a source of inspiration and motivates us in achieving our objectives for the CRTDH programme.

I extend my heartfelt gratitude and appreciation to Dr. Sujata Chaklanobis, Scientist G & Head CRTDH programme for her exceptional leadership quality in heading the CRTDH programme Division. Her determination and dedication have greatly contributed to the expansion and progress of the CRTDH programme. Under her guidance, CRTDH Programme Division has thrived, achieved remarkable milestones and have set new standards of excellence. Her ability to inspire and motivate the CRTDH team, coupled with her strategic thinking and unparalleled expertise in programme management, has been instrumental in the success of the division. I duly acknowledge Dr. Sujata Chaklanobis for her outstanding contributions and express my deepest appreciation for her role in the growth and achievements of the CRTDH programme division.

I also acknowledge Dr. Vipin. C. Shukla, Member Secretary for the CRTDH programme, for his dedication to excellence and his ability to bring out the best in their team members. He has displayed remarkable talent for program development, execution and management. Dr. Shukla's ability to navigate complex challenges, making informed decisions has greatly motivated the team members and has been a source of inspiration. I extend my sincere heartfelt gratitude and appreciation.

The CRTDH programme has established 18 CRTDHs across the country. I would therefore, like to take a moment to express my profound appreciation to our dedicated and highly skilled Project Coordinators for their exceptional contributions to the project's success. I extend my sincerest gratitude and appreciation for the pivotal role, the Project Coordinators are playing, for seamless execution of CRTDH programme. Their ability to juggle multiple responsibilities, maintaining a positive and solution-oriented attitude and keeping everyone aligned and motivated is truly commendable.

I would like to extend my heartfelt appreciation to the diligent and dedicated finance officers of our Department, namely Shri. Chetan Prakash Jain, Joint Secretary & Financial Advisor, DSIR, Shri. Rakesh Kumar Sinha, Deputy Secretary (Integrated Finance Division) and Shri Jagdish Singh Section Officer (Integrated Finance Division) for their exceptional commitment and invaluable contributions in financial matters of the CRTDH programme. Their professionalism, financial expertise and ability to navigate the intricacies of financial management have played a crucial role in maintaining the financial integrity, budget management and resource allocation.

I would like to extend my heartfelt appreciation and gratitude to Ms. Ruchi Singh Neekhara from Delhi Pharmaceutical Sciences and Research University (DPSRU), New Delhi for her exceptional talent and creativity in crafting the captivating cover page. Her artistic vision and attention to detail have not only made a striking first impression but also perfectly encapsulated the essence of the content within.

Last but not the least, I would like to extend my sincere gratitude and appreciation to the dedicated officers of the CRTDH programme namely, Dr. Ranjeet Bairwa, Scientist-E, Dr. Kailash C. Petkar, Scientist-D and Shri Naveen Chand, Junior Analyst for their unwavering commitment and exceptional contributions. They all have consistently demonstrated an exemplary level of professionalism, diligence, and dedication to the goals and objectives of the CRTDH programme. Their unwavering commitment to their respective roles and their collective efforts in coordinating and managing the various aspects of the CRTDH programme are truly commendable.

Dr. Suman Mazumdar
Scientist - E
Department of Scientific and Industrial Research (DSIR)
November, 2023

1.0 INTRODUCTION

Micro, Small and Medium Enterprises (MSMEs) play a very significant role in the overall economy of India by promoting equitable development in India. They need to be sensitized towards translation of public funded R&D into products and processes. Their higher involvement, especially in application-oriented R&D is expected to enhance the private sector's share in national R&D expenditure. There is no doubt that MSMEs play a critical role in nation building and growth of the economy. The support to this segment is accelerated through various Government schemes, targeted towards support to MSMEs for getting technological solutions to their problems. The targeted Government policies are a major catalyst in guiding MSMEs in the desired sectors to fuel growth of the economy. The Department of Scientific and Industrial Research (DSIR) is supporting this through "Common Research and Technology Development Hub (CRTDH)" programme, by providing easy access to state-of-the art R&D equipment and infrastructure.

The CRTDH programme was launched during the FY 2014-2015. The programme focuses on creation of Common Research facilities for micro, small and medium enterprises, with an aim to enhance translational research and foster industry institution interaction targeted towards innovative product development.

DSIR extends grants to institutions for setting up of these hubs/centres, which include R&D facilities/infrastructure, analytical test facilities, design centres, pilot plant production facility, design engineering & prototype development, demonstration units and product display center etc. The facilities at CRTDHs are used by the MSMEs, Innovators and Start-ups. 18 CRTDHs have been established by DSIR, so far, in 15 states and 1 Union Territory of the Country.

Since this programme came into existence, the CRTDHs are doing meaningful translational research and helping MSMEs, Start-ups and innovators to develop new products and processes, thereby helping the society at large. Past few years have certainly been a roller coaster, with the COVID-19 pandemic continuously adding major twists and turns to our lives.

Despite the ongoing challenges, the CRTDHs established by DSIR marched ahead strongly. During the time of COVID-19 pandemic, our CRTDHs repurposed their activities and focused on developing novel technologies for the treatment and diagnosis of COVID-19. All our CRTDHs are encouraging MSMEs to engage in R & D activities and helping them by providing necessary infrastructure and also intellectual inputs. We are aiming to expand the network of CRTDHs across India to achieve our vision to enable India to emerge as global

Industrial and innovation hub. Collectively, such support will have a profound impact on the MSMEs.

The CRTDH programme is in the tenth year of its existence. This is the right time to reflect back on the last ten years and take a stock of the accomplishments of the CRTDHs and celebrate all that the CRTDHs have achieved. Self-reflection is an important part of growth and provides

opportunities for future development. It is the time that we recognize our successes, build confidence in ourselves and create positive momentum for the future. This reflection also allows us to identify areas where we can improve and set new goals in the coming years. The current report reflects upon the quantitative and qualitative achievements of the CRTDHs since inception in last ten years.

2.0 MICRO, SMALL AND MEDIUM ENTERPRISES: THE HEROES OF ‘ATMANIRBHAR BHARAT’

Since Independence, the hallmark of Indian economy has been small-scale businesses. Over the years MSMEs progressed itself into a vibrant and dynamic entity of the economy. The MSME sector is considered as pillar of India's economy due to its immense contribution to employment and income generation. As mark of its immense contribution, The United Nations General Assembly has designated 27 June as “Micro, Small, and Medium-sized Enterprises Day” (A/RES/71/279) to raise awareness of the tremendous contributions of MSMEs to the achievement of the United Nations Sustainable Development Goals (SDGs).

In India, MSME sector is a major contributor to the socio-economic development and has gained significant importance due to its contribution to Gross Domestic Product (GDP) and exports of the country. The sector has also contributed immensely with respect to entrepreneurship development, especially in semi-urban and rural areas of India. It is credited for generating ample employment opportunities and promoting equitable distribution of national income. MSMEs contribute towards exports, entrepreneurial development, upliftment of rural and backward areas and employment generation.

As per 2022-23 annual report of Ministry of MSME (MoMSME), during 73rd National Sample Survey conducted by National Sample Survey Office, Ministry for Statistics & Programme Implementation during the period 2015-16, there were 633.88 lakhs unincorporated non agriculture

MSMEs in the country engaged in different economic activities. 196.65 lakhs MSMEs are engaged in manufacturing, comprising 31% of the total MSMEs. Out of 633.88 lakhs MSMEs, 324.88 lakhs MSMEs (51.25%) are in rural areas and 309 lakhs (48.75%) are in urban areas. As per report MSME sector has created 11.10 crore jobs in the rural and the urban areas across the country, which includes 360.41 lakhs jobs in manufacturing. As per Ministry of MSME press release dated 7th August, 2023, the share of MSME Gross Value Added (GVA) in all India Gross Domestic Product (GDP) during the year 2019-20, 2020-21 and 2021-22 was 30.5%, 27.2% and 29.2% respectively. While, share of MSME manufacturing output in all India Manufacturing output during the year 2019-20, 2020-21 and 2021-22 was 36.6%, 36.9% and 36.2% respectively. As per Directorate General of Commercial Intelligence and Statistics (DGCIS), the share of export of MSME specified products in all India exports during the year 2020-21, 2021-22 and 2022-23 was 49.4%, 45.0% and 43.6% respectively. The share of MSME exports in India's total export value hovered around 49% till FY 2021. For FY 2019, the share stood at 48.10% amounting to USD 158.76 billion, as per the data shared by Minister of State for Commerce and Industry Ministry in Rajya Sabha in winter session of 2021.

Initially, the non-agricultural MSME sector were heterogeneous and consisted of traditional industries. However, in 2006, the Micro, Small, and Medium Enterprises

Development (MSMED) Act was enacted, where it incorporated all the diverse industries, the service sector and medium enterprises. The MSME sector in India is classified into 4 broad categories: the manufacturing, electricity (noncaptive electricity generation & transmission), trade and service industries (Annual Report 2022-23, MoMSME). Furthermore, the industries are classified as Micro, Small, and Medium, based on the investment made toward machinery & equipment and the annual turnover of the company.

Some key contributions of MSMEs towards the nation-building process in India are:

- i. Employment Generation:** MSMEs are the largest employers in India, providing significant job opportunities, especially in rural and semi-urban areas. They absorb a substantial portion of the workforce, contributing to poverty alleviation and inclusive growth.
- ii. Entrepreneurship and Innovation:** MSMEs inspire entrepreneurship and innovation by providing a platform for individuals to start their own businesses and explore new ideas. They foster a culture of creativity and experimentation, driving economic growth and technological advancements.
- iii. Regional Development:** MSMEs are instrumental in promoting balanced regional development by setting up industries and enterprises in underdeveloped areas. They reduce the regional disparities by creating infrastructure, generating income and improving the standard of living in these regions.

iv. Contribution to GDP: MSMEs significantly contribute to India's Gross Domestic Product (GDP). Their diverse range of economic activities, such as manufacturing, services and agro-based industries, strengthens the country's overall economic performance.

v. Export Promotion: MSMEs play a crucial role in enhancing India's exports. They engage in various export-oriented activities, including manufacturing products for international markets, providing services to global clients and participating in trade exhibitions and fairs. Their participation in exports helps in foreign exchange earnings and improves the country's trade balance.

vi. Support for Large Industries: MSMEs serve as a critical link in the supply chain for large industries. They provide ancillary services, components and raw materials to large manufacturing units, contributing to the growth of the industrial sector as a whole.

vii. Inclusive Development: MSMEs empower marginalized sections of society, including women, rural communities and economically disadvantaged individuals. They create avenues for income generation, skill development, entrepreneurship, fostering social and economic inclusion.

viii. Adaptability and Resilience: MSMEs have shown remarkable adaptability and resilience, particularly during challenging times like economic downturns and the COVID-19 pandemic. Their flexibility to adjust operations, pivot business models and innovate helps in sustaining economic activities and employment.

ix. Promoting Local Manufacturing: MSMEs play a vital role in promoting domestic manufacturing capabilities. They produce a wide range of products, including essential goods, consumer goods and components, reducing dependence on imports and strengthening the country's self-reliance.

x. Enhancing Rural Economy: MSMEs have a significant presence in rural areas, contributing to the rural economy's growth and development. They provide employment opportunities, increase income levels and stimulate economic activities in rural communities thereby, reducing migration to urban areas.

xi. Fostering Innovation and Research: MSMEs often act as incubators for innovation and research. They are more agile and flexible compared to larger enterprises, allowing them to experiment with new technologies, products, and processes. Their innovative practices contribute to technological advancements and competitiveness.

xii. Social and Environmental Responsibility: MSMEs have the potential to contribute to sustainable development. Many MSMEs adopt environmentally friendly practices, promote renewable energy and engage in social initiatives like skill development, education and healthcare programme, thereby fostering a more inclusive and sustainable society.

xiii. Diversification of Industries: MSMEs play a significant role in diversifying India's industrial landscape. They engage in various sectors,

ranging from textiles, food processing, handicrafts, engineering, pharmaceuticals, and IT services. This diversification reduces dependency on a single industry and strengthens the overall resilience of the economy.

xiv. Strengthening the Informal Sector: MSMEs provide a formal platform for many informal sector activities to operate. By registering and becoming part of the MSME ecosystem, these businesses gain access to various benefits such as financial support, technology, and market linkages, contributing to their growth and development.

To realize the dream of becoming USD 5 trillion economy, it is important to strengthen the MSMEs. Thus, several policy measures have been announced to support the MSMEs. Some of the measures are to enhance competitiveness, infrastructure & cluster development, technology upgradation and MSME products procurement to boost the sector. Irrespective of the best efforts made, challenges remain in the sector like proper infrastructure, finance, and limited knowledge. As part of growing competition, it is imperative for MSMEs to have a thorough knowledge of the opportunities, challenges, in-depth know-how, trends and risks of the industry to run a successful business. Thus, right business strategy is also required to help a company scale up.

3.0 CHALLENGES FACED BY MSMEs IN INDIA

The MSMEs are vital constituents of the Indian industrial sector. They contribute significantly to the GDP and export earnings besides meeting the social objectives of developing backward areas, reducing regional disparities and providing employment opportunities to millions of people across the country.

Despite this, MSMEs in India suffer from a range of challenges. These challenges impact their growth and sustainability. Some of the broad problems faced by the MSME sector in India are access to finance, working capital management, infrastructure & technology, skill shortages, compliance burden, market access, technological obsolescence, supply chain disruptions, competition, lack of innovation, vulnerability to economic cycles and digital divide. Addressing these challenges requires a coordinated effort from the Government, financial institutions, industry associations, and the MSMEs themselves, which would bolster the MSME sector in India and contribute to economic growth and job creation.

3.1 TECHNOLOGICAL CHALLENGES FACED BY MSMEs IN INDIA

Among all other challenges faced by MSMEs in India, technological challenges are an important factor which significantly impact their growth, competitiveness and overall sustainability. Varied technological challenges include:

i. Limited Access to Technology and its High Cost. Several MSMEs have limited access to modern technology due to budget constraints. This can result in outdated machinery and processes, making them less

competitive. Acquiring and implementing advanced technologies can be expensive for MSMEs and at times not affordable.

ii. Lack of Digital Literacy: It is often observed that the owners and employees of the MSMEs are not adequately digitally literate, which can hinder their ability to leverage technology effectively. Training and upskilling is required to bridge this gap.

iii. Cybersecurity, Data Privacy and Compliance Concerns: With the advent of Industry 4.0 technologies, several MSMEs are showing interest in adopting digital tools and online platforms for business operations. However, lack of knowledge in this area makes them vulnerable to cyber threats. Protection against cyberattacks can be challenging for businesses with limited resources and expertise.

iv. Integration Challenges: Integrating new technologies with existing systems and processes can be complex and costly. Many MSMEs struggle with seamless integration, which can result in operational disruptions.

v. Internet Connectivity: In many parts of India, especially rural areas, reliable internet connectivity remains a challenge. Poor or intermittent internet access can impede the adoption of cloud-based services and e-commerce.

vi. E-commerce Adoption: While e-commerce offers significant growth opportunities, MSMEs may face barriers in setting up and managing online stores, digital payment integration and managing logistics for online sales.

vii. Supply Chain Management:

Modern supply chain management systems can help streamline operations, but implementing such systems can be resource-intensive. MSMEs may face difficulties in adopting advanced supply chain technology.

viii. Access to Research and Development:

MSMEs frequently find themselves constrained by limited resources when it comes to engaging in Research and Development (R&D) endeavors aimed at creating innovative technologies or products. As these MSMEs expand, they encounter difficulties in expanding their technological infrastructure to accommodate growing demand and the intricacies of their operations.

The technological challenges can be addressed via Government initiatives, industry associations and support organizations that provide training, access to affordable technology solutions and guidance on cybersecurity and data protection. Collaboration with technology partners and networking with other businesses can also help MSMEs overcome these hurdles and harness the benefits of technology for their growth and competitiveness.

3.2 RESEARCH AND DEVELOPMENT (R&D) CHALLENGES FACED BY MSMEs IN INDIA

The need for R&D in MSMEs is increasingly evident in today's dynamic and competitive business landscape. R&D serves as a cornerstone of innovation, allowing these enterprises to create and refine their products, services and processes. In a world where consumer preferences are constantly

evolving and technological advancements are rapid, MSMEs must invest in R&D to remain relevant and competitive. Innovation not only helps MSMEs differentiate themselves from competitors but also unlocks opportunities for market expansion. By continuously improving their offerings and introducing novel solutions, MSMEs can attract new customers and explore uncharted territories. R&D is the compass that guides MSMEs through the ever-changing business landscape, enabling them to seize new opportunities and overcome challenges with confidence. Thus, R&D plays a crucial role in the innovation capability and competitiveness of MSMEs. However, this aspect faces several challenges. Some of the challenges are:

i. Limited Financial Resources:

MSMEs typically have limited budgets and allocating funds for R&D activities can be challenging. R&D requires significant investment in research personnel, equipment and raw materials, which can strain the financial resources of small businesses.

ii. Lack of Skilled Workforce: MSMEs often struggle to find and retain skilled researchers and scientists due to competition from larger organizations. Attracting top talent with specialized skills in R&D can be difficult for smaller enterprises.

iii. Infrastructure Constraints: Access to state-of-the-art research facilities and laboratories can be limited for MSMEs. Investing in such infrastructure can be cost-prohibitive for small businesses.

iv. Intellectual Property Concerns: Protecting intellectual property (IP) rights is a concern for MSMEs engaged in R&D. They may lack the expertise to navigate the

complex process of patenting and safeguarding their innovations.

v. Market Uncertainty: MSMEs may be hesitant to invest in R&D due to uncertainty about market demand and return on investment. They often lack the market research and forecasting capabilities of larger corporations.

vi. Lack of Collaboration: Collaborative R&D efforts with research

institutions, Universities or other businesses can accelerate innovation. However, establishing and managing such collaborations can be challenging for MSMEs.

vii. Regulatory Hurdles: Complying with regulatory requirements related to R&D, especially in highly regulated industries like pharmaceuticals and biotechnology, can be challenging for MSMEs.

4.0 INNOVATION: CHANGING THE MSME LANDSCAPE

The R&D challenges of MSMEs can be addressed through various strategies, like access to low cost loan for R&D, Government grants, subsidies & incentives, fostering partnerships with research institutions, Universities, Industry associations and skilling the workforce employed in MSMEs.

In the era of globalization, there is an urgent demand for fostering a dynamic and self-sustaining culture of innovation and adopting a cluster-based approach to promote the growth of MSMEs. In today's global economy, often referred to as a "Knowledge-Based Economy", knowledge emerges as the most valuable resource and learning becomes the paramount process. Competitive advantage is no longer primarily derived from access to physical resources, rather, it stems from the capacity of organizations and societies to generate ideas and convert them into economic and social value.

Additionally, creating a culture of innovation and risk-taking within the organization or establishment of a Common Research and Development Hub for handholding their R&D needs can help MSMEs overcome some of the barriers for successful R&D activities. As a part of Science & Technology intervention, varied R&D activities like (i) Modernization of Production Processes, (ii) Development of Machinery & Equipment, (iii) Product Development & Diversification,

(iv) Development of Environment Friendly Technologies, (v) Technology transfer, Incubation, Testing & Service facilities are envisioned for the progress of MSMEs. With the right support and enabling environment, MSMEs will continue to contribute significantly to India's economic growth and development.

The Government of India has implemented several Science and Technology interventions to support Micro, Small, and Medium Enterprises (MSMEs) in the country. These interventions aim to enhance the competitiveness, productivity and innovation capabilities of MSMEs.

The Government recognizes the fact that the MSME sector continues to be a crucial driver of India's economy. Efforts are therefore underway to strengthen the sector through policy measures, science and technology interventions and adoption of effective business strategies. As part of Government of India commitment in promoting innovation, technology adoption, and competitiveness among MSMEs, Department of Scientific & Industrial Research (DSIR) under Ministry of Science & Technology is implementing a Programme "Common Research and Technology Development Hubs (CRTDHs)", which envisions to provide the right support and enabling environment for MSMEs to continue to contribute significantly to India's economic growth and development through Research, Development and Innovation.

5.0 COMMON RESEARCH AND TECHNOLOGY DEVELOPMENT HUB (CRTDH) PROGRAMME OF DSIR

Industrial clusters play a vital role in promoting economic development, fostering innovation and creating a competitive advantage for the regions in which they are located. Their significance lies in the collaborative environment they create, which allows for the exchange of ideas, knowledge and resources among firms, leading to increased productivity and economic prosperity.

The Department of Scientific & Industrial Research (DSIR) under Ministry of Science & Technology, through its Programme ‘Common Research and Technology Development Hub (CRTDH)’, initiated in 2014-15, attempts to provide MSME clusters the much-needed supportive ecosystem, which encourages and facilitates innovation essential for MSMEs. This facilitation includes access to state-of-the-art Research & Development (R&D) facilities, infrastructure, incubation centers and business development services. Apart from facilitation, MSMEs are also provided with a collaborative platform which can promote knowledge sharing, address their IPR issues, skills development, identify new market opportunities & emerging customer needs, networking avenues and collaboration among MSMEs, research institutions and other stakeholders.

CRTDH is a concept that involves establishing facilities or centers in different academic & research institutions where multiple organizations collaborate for their research and technology development activities. These hubs bring together industry,

academia and government to work on common challenges, share resources and pool expertise.

The objective of CRTDH is to foster innovation, accelerate technology development and promote collaboration among different stakeholders. By creating a shared platform, CRTDH aims to leverage collective wisdom, knowledge, infrastructure and resources to address complex problems and drive advancements in various fields. These hubs typically provide state-of-the-art research facilities, testing laboratories, prototyping equipment, training & skilling and other resources necessary for Research & Development activities. By offering such a wide range of facilities and resources, the CRTDHs create an ecosystem that supports the entire innovation lifecycle, from ideation to commercialization. They foster industry-institution interaction, encouraging collaboration and knowledge exchange between researchers and industry experts. This collaborative approach accelerates the translation of scientific knowledge and ideas into marketable products and services, contributing to technological advancement and economic growth.

CRTDHs operate on a cost-plus noncommercial basis, as they aim to recover their operational costs while ensuring that the facilities & services they provide remain affordable for the MSMEs and innovators. The focus is on fostering collaboration and innovation rather than generating profits. Through its cost-plus non-commercial approach and the ongoing efforts to achieve

self-sustainability, the programme aims to create a conducive environment for innovation and contribute to the growth of the economy.

Through this scheme, DSIR provides grants to institutions for the establishment of these hubs/centers. The grants cover various aspects such as R&D facilities and infrastructure, analytical test facilities, design centers, pilot plant production facilities, design engineering and prototype development, demonstration units and product display centers. By providing these comprehensive facilities, the CRTDHs enable researchers, innovators and Micro and Small Enterprises (MSEs) to access the necessary resources for their projects. The analytical test facilities ensure that the quality and performance of the innovations are thoroughly evaluated. Design centers help in creating and refining product designs, while pilot plant production facilities enable small-scale manufacturing and process optimization. The hubs also offer support

for prototype development, demonstration units and product display centers to showcase the innovations. Support provided by DSIR through grants for the establishment of CRTDHs facilitates the development and commercialization of innovative products across multiple sectors, thereby driving research, industry collaboration, and socioeconomic progress and most importantly, create an ecosystem that supports Cluster Development in and around the established CRTDH.

Since inception i.e. in last 10 years, CRTDH programme has established a total of 18 CRTDHs across five sectors namely, Electronics/ Renewable Energy, Affordable Health, Environmental Interventions, Low-Cost Machining and New Materials/ Chemical Processes, in Public Funded Research Institutions (PFRIs). The **figure 1** shows the CRTDHs established during last 10 years across the country.

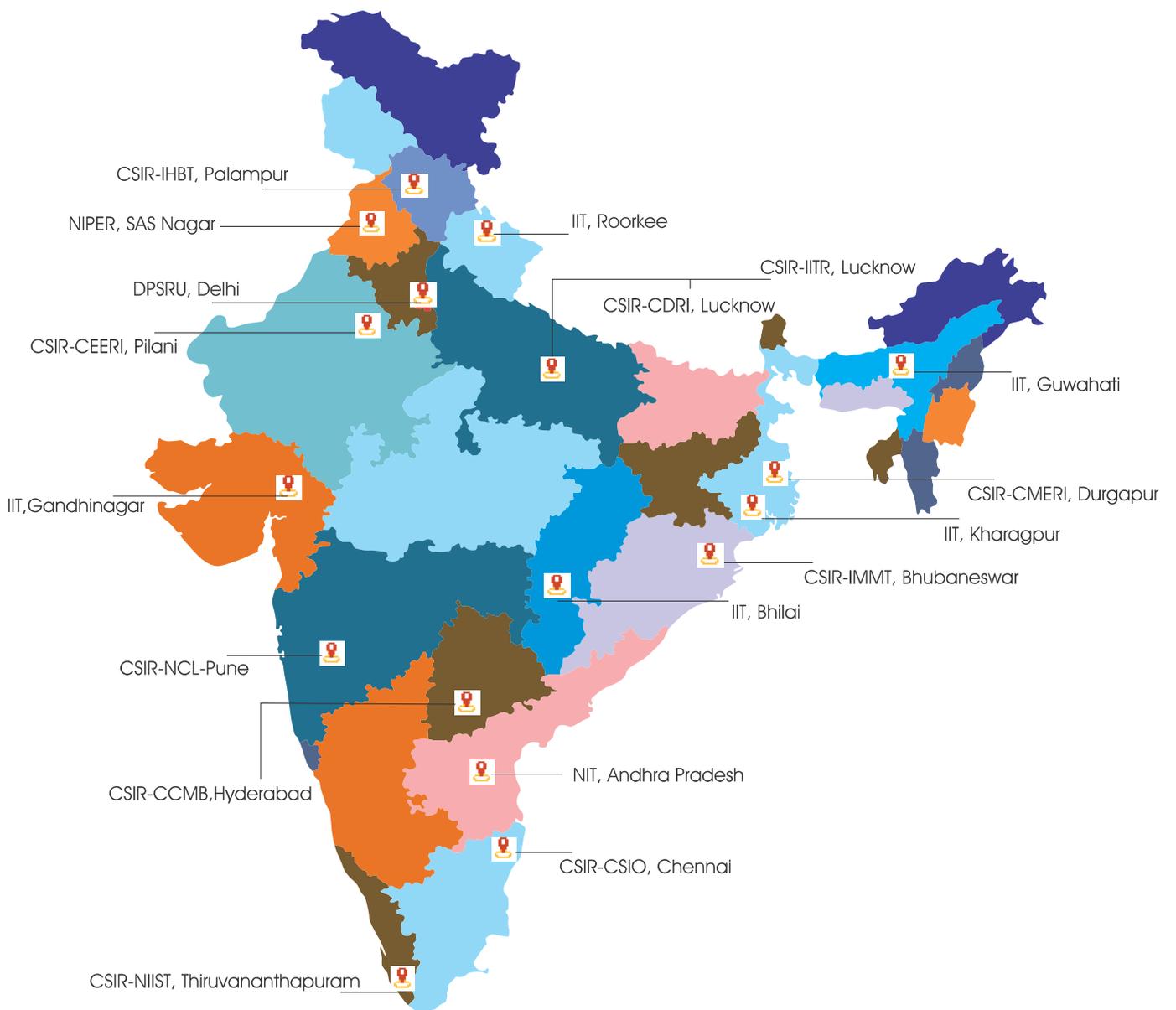


Fig. 1 CRTDHs established in India

6.0 PAN INDIA PRESENCE OF CRTDHs

The CRTDH programme was introduced in FY 2014-15 and since then Department of Scientific & Industrial Research (DSIR) has established CRTDHs having nationwide presence spanning through 15 states and 1 Union Territory. Operating within five key sectors, namely Electronics/Renewable Energy (ERE), Affordable Health (AH), Environmental Interventions (EI), Low-Cost Machining (LCM) and New Materials/Chemical Processes (NMCP), a total of 18 CRTDHs have been established within Public Funded

Research Institutions (PFRIs), in four phases. The **figure 2** depicts the number of CRTDHs established in four phases in last 10 years, while **figure 3** depicts the number of CRTDHs established in last 10 years across five CRTDH sectors.

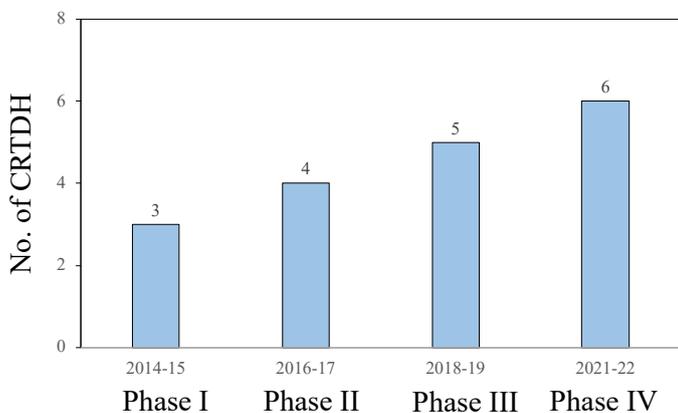


Fig. 2. No. of CRTDHs established in the four Phases.

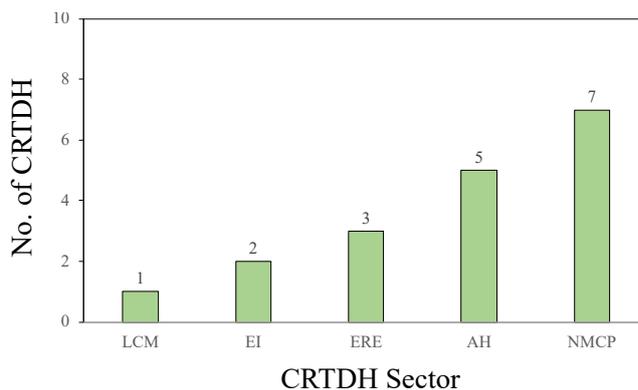


Fig. 3. CRTDHs established in different sectors during past 10 years

The support provided by DSIR for establishment of CRTDHs, fosters the development and commercialization of cutting-edge products in various industries. This, in turn, encourages research, collaboration between businesses, and socio-economic advancement, ultimately cultivating an ecosystem conducive to Cluster Development within and surrounding the established CRTDH. The clusters addressed by the CRTDHs are mentioned below:

- i. CRTDH hub at **CSIR-National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvanthapuram** was established in 2014 in the area of Environmental Interventions. The Hub was instrumental in addressing the need of fish processing cluster at Coastal Kerala, clay processing cluster at Thiruvananthapuram, rubber processing cluster at Kottayam, coir processing cluster at Allepy, rice milling & bone meal cluster at Ernakulam, mango processing cluster at Krishnagiri (TN) and coffee & cocoa processing cluster at Wayanad & Coorg.

ii. CRTDH hub at **CSIR- Institute of Himalayan Bioresource Technology (IHBT), Palampur** was established in 2014 in the area of Affordable Health. The hub has been instrumental in the development of biopharmaceutical ingredients such as black carrot anthocyanin, beetroot betaine, mango peel carotenoids. The MSMEs clusters located at Baddi food cluster and Sansarpur Terrace cluster benefitted from the hub established at CSIR-IHBT.

iii. CRTDH hub at **CSIR- Centre for Cellular and Molecular Biology (CCMB), Hyderabad** was established in 2014 in the area of Affordable Health. The hub has been instrumental in translating the ideas into products for micro & small entrepreneur/startups. Hub is catering to the needs of MSMEs in diagnostic, pharma and biotechnology for the clusters located at ICICI Knowledge Park and Shapoorji Pallonji Biotech Park in Hyderabad. Apart from that, the hub is also addressing the need of academic institutions located in Hyderabad and nearby areas.

iv. CRTDH hub at **Indian Institute of Technology Gandhinagar** was established in 2016 in the area of New Materials/Chemical Processes. This hub is catering to the needs of major dye industry clusters at Ahmedabad, Valva, Naroda, Odhav and Surat regions. The other areas being addressed is related to organic industry cluster, fine/specialty chemical cluster and pharmaceutical cluster at Sanand, Narol, Vayva, Ambawati, Anand, Mehsana, Bharuch, Ankleshwar, Surat and Valsad.

v. CRTDH hub at **CSIR- Central Electronics Engineering Research Institute (CEERI), Pilani** extension centre at Jaipur was established in 2016 in the area of Electronics/Renewable energy. The hub

is addressing the issues of automotive clusters located at Jaipur, Nimrana & green field projects in Bhiwadi, traditional art & craft cluster at Jaipur, textile cluster at Bhilwara & Jaipur, agro-processing & dairy industries cluster at Ganganagar & Jaipur.

vi. CRTDH hub at **CSIR- Central Mechanical Engineering Research Institute (CMERI), Durgapur** was established in 2016 in the area of Low-Cost Machining. The hub is catering to the demand of MSMEs regarding improvements in product design & manufacturing involving sizing & shaping, patterns & finishing, special purpose machines and CAM for ensuring product conformity and automation. This hub has been very instrumental for the MSMEs located at Bargachia cluster for metal product manufacturers.

vii. CRTDH hub at **Indian Institute of Technology Roorkee** was established in 2016 in the area of New Materials/Chemical Processes. The Hub is developing and characterizing cost-effective advanced materials and techniques that can be used for shielding the microwave radiation and for stealth applications. The hub is addressing directly to MSMEs involved in supplying materials to defense industries in India.

viii. CRTDH hub at **Indian Institute of Technology Kharagpur** was established in 2018 in the area of Affordable Health. The hub is addressing the issues related to medical devices & diagnostic, sensors materials, system modeling, technology for affordable healthcare, digital convergence in medical technology, interconnection of bio systems, system modeling etc. The hub is playing a significant role in startup ecosystem and entrepreneurship. Being a niche sector, not many MSMEs are working in this area,

thus the hub is addressing the requirement of innovation hub at IIT Kharagpur and JSV Innovation Pvt Ltd for training & skill development.

ix. CRTDH hub at **CSIR- Central Drug Research Institute (CDRI), Lucknow** was established in 2018 in the area of Affordable health. The hub is addressing the needs of pharmaceutical industry. Many Pharma clusters in Delhi-Noida-Ghaziabad-Faridabad belt and Roorkee-Haridwar-Dhampur-Kotdwar belt are approaching the hub to get their concern on process-cum-product, batches for clinical trials and varied formulation related studies getting addressed.

x. CRTDH hub at **CSIR - Indian Institute of Toxicology Research (IITR), Lucknow** was established in 2018 in the area of Environmental Intervention. The hub is addressing the requirements of MSMEs regarding clean air/water and effluent management sector to develop indigenous & effective solutions for environmental monitoring, water treatment and effluent management. The hub is targeting MSMEs clusters at Kanpur for leather, Moradabad for brass industries and other clusters located at Lucknow, Sonbhadra, Malihabad, Saharanpur, Bareilly and Varanasi. Apart from that, the hub is also catering to the environmental needs of NTPC power plants at Singrauli, Rihand, Korba, etc and private sector power plants of Torrent & Reliance.

xi. CRTDH hub at **CSIR- Institute of Minerals & Materials Technology (IMMT), Bhubaneswar** was established in 2019 in the area of New Materials/ Chemical Processes. The hub is addressing the concern of Engineering & Fabrication cluster located at Bhubaneswar, Jharsuguda, Rourkela, Rayagada and Dhenkanal. Chemical

& Chemical based cluster across the State of Odisha. Fly ash brick clusters at Balasore, Sambalpur, Dhenkanal and Talmul. Brass & Bell Metal cluster at Bolangir, Jaipur, Dhenkanal, Cuttack, Ganjam, Nayagarh, Khordha, Sambalpur and Balasore.

xii. CRTDH hub at Chennai centre of **CSIR - Central Scientific Instruments Organization (CSIO), Madras complex** was established in the area of Electronics/Renewable Energy in 2018. The hub is addressing the concern of solar photovoltaic panel, solar lantern and other renewable energy farm device manufacturers clusters at SIDCO electronic complex at Guindy, SIDCO electronic & Automotive cluster at Sriperumbudur. Hub is also having linkages with various industry association like Tamil Nadu Small and Tiny Industries Association (TANSTIA), The Coimbatore District Small Scale Industries Association (CODISSIA), Solar energy association – Tamil Nadu and The Aerospace Industry Development Association of Tamil Nadu (AIDAT).

xiii. CRTDH hub at **CSIR- National Chemical Laboratory (NCL), Pune** is being established in the area of New Materials/ Chemical Processes since 2021. The hub will be instrumental in addressing the issues in the field of chemicals, polymer additives, paints, pigments, fillers, polymernanocomposite makers and developers of coating materials for clusters located at Chakan, Kurkumbh, Rajgurunagar, Satara, Solapur, Raigad, Thane and also to GIDC areas at Vatva, Vapi, Bharuch.

xiv. CRTDH hub at **National Institute of Technology (NIT) – Andhra Pradesh, Tadepalligudem**, is being established in the area of Electronics/ Renewable Energy since 2021. The hub is going to be instrumental in

addressing the issues related to renewable energy needs of MSME's in clusters located at Vishakapatnam, Chennai industrial corridor, West Godavari, Eluru, Bhhimavaram, Tanuku, Palakol districts of Andhra Pradesh.

xv. CRTDH hub at **Delhi Pharmaceutical Sciences and Research University (DPSRU), New Delhi** is being established in the area of Affordable Health since 2021. The hub will be instrumental in addressing the issues in the field of pharmaceuticals, nutraceuticals, cosmeceuticals for clusters located at Delhi NCR and also other parts of the country.

xvi. CRTDH hub **Indian Institute of Technology Guwahati** is being established in the area of New Materials/Chemical Processes since 2022. Being a niche area of activity, the hub is addressing the Biodegradable Plastics Research and related technologies to MSMEs spread across the nation for industrial commercialization of sustainable packaging & healthcare products.

xvii. CRTDH hub at **Indian Institute of Technology Bhilai** is being established in the area of New Materials/Chemical Processes since 2022. The hub is addressing the concern of pharmaceuticals, pigments, textile, dye and dye intermediates, metal and mineral sectors in clusters located at Chhattisgarh and nearby areas.

xviii. CRTDH hub at **National Institute of Pharmaceutical Education and Research (NIPER) SAS Nagar (Mohali)** is being established in the area of New Materials/Chemical Processes since 2022. The hub would be instrumental in addressing the needs of API manufacturers, pharmaceutical companies, FMCG & Chemical companies, Herbal & Nutraceuticals companies, testing laboratories and academia located in MSME clusters at Baddi, Brotiwala, Nalagarh, Derabassi-Lalru, Chandigarh-Mohali-Panchkula, Ludhiana-Amritsar, Parwanoo, Una, Delhi-Noida- Gurugram- Rewari.

As the CRTDHs continue to evolve, they are working towards developing a self-sustainable business model, indicating that the hubs are exploring strategies and mechanisms to generate revenue and cover their expenses in the long run. This self-sustainability is crucial to ensure the longevity and effectiveness of the programme, allowing it to continue supporting translational research and industry-institution interaction in the future.

Overall, the CRTDH programme serves as a platform for MSMEs and innovators to access resources, facilities, and expertise necessary for transforming scientific knowledge into tangible products and services.

7.0 TEN YEARS OF NURTURING COMMON RESEARCH AND TECHNOLOGY DEVELOPMENT HUBS (CRTDHs): IMPACT INDICATORS

Over a span of a decade, the dedicated effort and support put into nurturing Common Research and Technology Development Hubs (CRTDHs), have yielded substantial and noteworthy outcomes, which can be evaluated through various impact indicators. These indicators serve as crucial metrics to gauge the effectiveness and success of the CRTDH programme over the ten-year period. They provide insight into the tangible and intangible benefits that have emerged from the sustained investment in these hubs. They not only showcase the immediate outcomes but also highlight the long-term contributions of these hubs to research, industry, society and the economy. As we reflect back on ten years of nurturing CRTDHs, these indicators provide a comprehensive view of the programme multifaceted impact and its ongoing importance in shaping the future of research and technology development. In the following section, we have documented some of the key impact indicators that highlight the profound influence of CRTDHs across five sectors namely Electronics/Renewable Energy (ERE), Affordable Health (AH), Environmental Interventions (EI) and Low-Cost Machining (LCM) and New Materials/Chemical Processes (NMCP).

7.1 Built up Area

The built-up area of CRTDHs encompasses the physical infrastructure and facilities that form the core of these innovation centers. The built-up area is

purposefully designed and constructed to cater to the diverse needs of researchers, scientists, engineers and industry professionals who converge within these hubs to collaborate, create and advance their respective fields. The built-up area of CRTDHs is meticulously planned and constructed to provide a dynamic and supportive environment that fosters innovation, collaboration and research excellence. It is the physical foundation upon which the intellectual and technological advancements of these hubs are built, making it a critical component in the success and impact of CRTDH initiatives. As reported by the CRTDHs, the minimum built up area for CRTDH facility is 1500 Sqft and maximum goes up to 95,000 Sqft. **Figure 4** depicts built up area for each CRTDH and **figure 5** depicts cumulative built-up areas of CRTDHs across each sector.

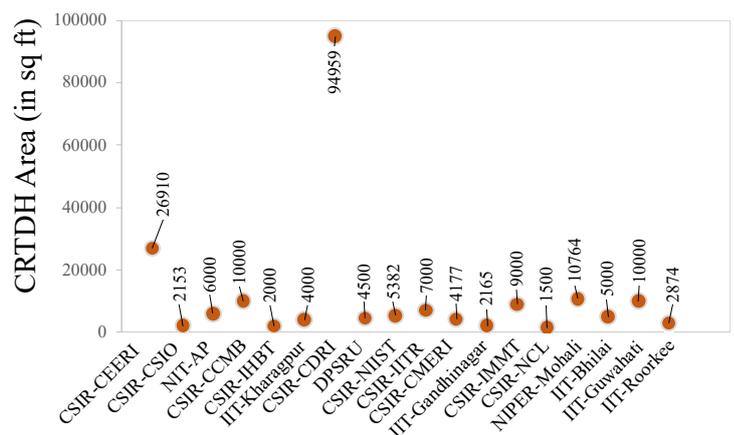


Fig. 4. Total area of the CRTDHs

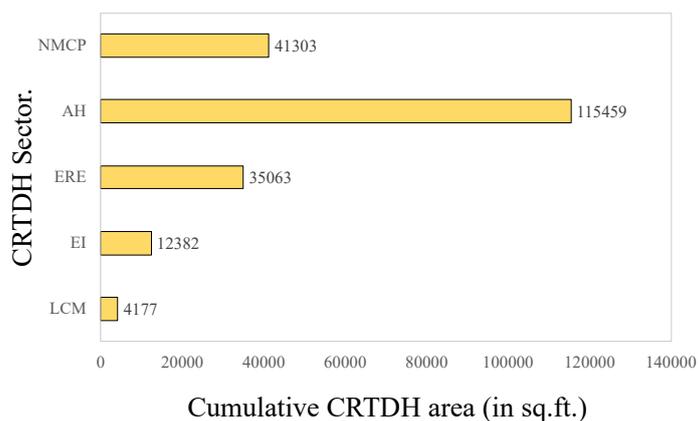


Fig. 5. Total cumulative area of CRTDHs across each sector.

7.2 Technology Development

Every CRTDH established by DSIR is playing a pivotal role in the development of technologies or knowhow based on the problem statement of MSMEs. These hubs are also helping the MSMEs by transferring / licensing the developed technologies to MSMEs or startups for commercialization. CRTDHs have been instrumental in addressing the needs of the MSME clusters regarding their R&D needs. **Figure 6** mentions the collective technologies by CRTDHs across each sector in past ten years.

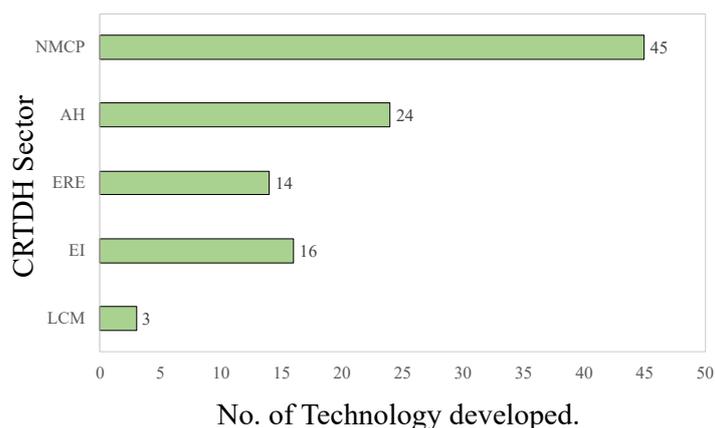


Fig. 6. Total no. of technologies developed by CRTDHs across each sector.

7.3 Incubatees / Start-Ups

Incubatees/ Start-Ups within CRTDHs represent a vital and dynamic facet of the innovation ecosystem. These entrepreneurial ventures, often in their early stages, are nurtured within the supportive environment of CRTDHs to foster their growth, development, and ultimate success. These incubates are provided with resources, mentorship, office space and networking opportunities to help them grow and develop their ideas into viable, sustainable businesses. Incubates benefit from the guidance of experienced mentors and access to a supportive community of entrepreneurs and R&D facilities of CRTDH. Their presence reflects the hubs commitment to promote a culture of entrepreneurship, supporting emerging talent, and ultimately accelerating the transformation of groundbreaking ideas into tangible products and services that benefit industries and society at large. **Figure 7** mentions the total number of Incubatees/ Start-Ups in last ten years at CRTDHs across each sector.

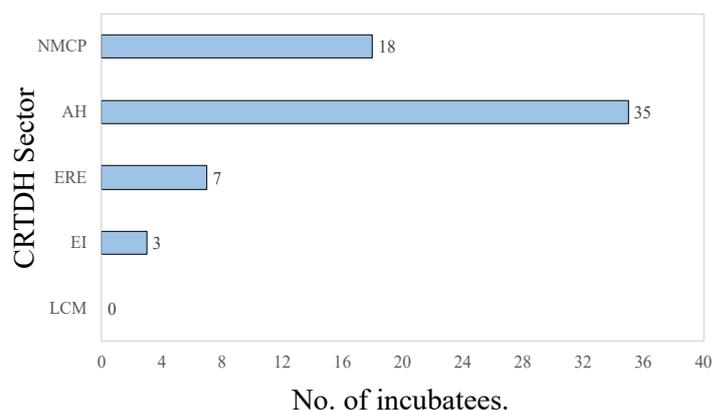


Fig. 7. Total no. of incubatees in CRTDHs across each sector

7.4 Patents

Patents act as motivators for innovation, granting inventors a competitive edge and the chance to recover their investments in Research and Development.

Patents are indispensable for safeguarding intellectual property and fostering continuous progress in technology and various industries. The presence of CRTDHs across five sectors have played a major role in generation of patents. **Figure 8** mentions the collective patents (filed/granted) in past ten years at CRTDHs across each sector.

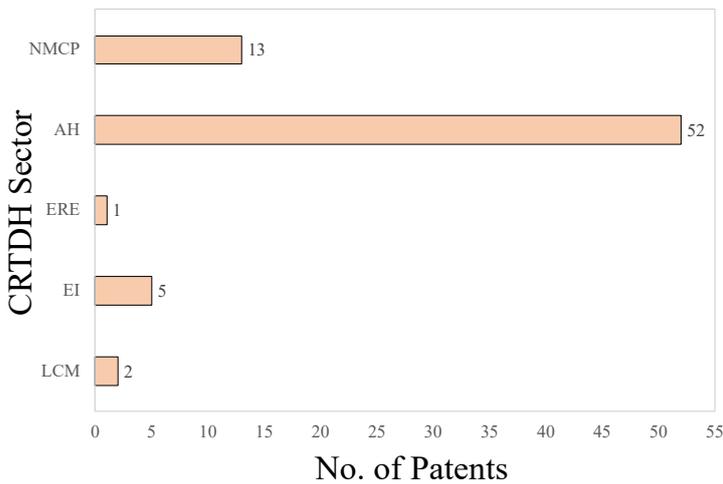


Fig. 8. Total no. of patents across each sector

7.5 MSMEs Engaged

MSMEs engaged at CRTDHs represent a crucial and dynamic component of the innovation ecosystem. Engagement with MSMEs promotes innovation, job creation, driving economic growth, diversification, and contributing to the vibrancy of CRTDHs. All the CRTDHs are meaningfully engaging with the MSMEs. A small push by the CRTDHs can help the MSMEs grow. **Figure 9** mentions the collective MSMEs engagement in past ten years at CRTDHs across each sector.

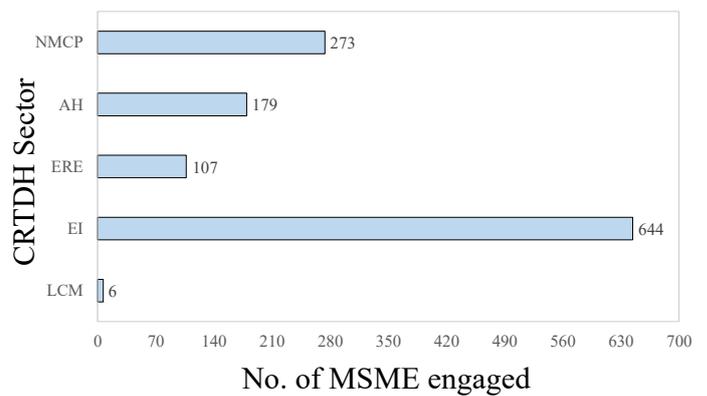


Fig. 9. Total no. of MSMEs engaged by CRTDHs across each sector

7.6 Trained Manpower

The CRTDHs are committed towards skilling industry responsive manpower for MSMEs. All the CRTDHs have been instrumental in imparting technical training to the manpower employed in MSMEs. Trained manpower is a cornerstone of a productive and competitive workforce. These CRTDHs have been serving as center for specialized training and promote quality development. **Figure 10** mentions the collective trained manpower in past ten years at CRTDHs across each sector.

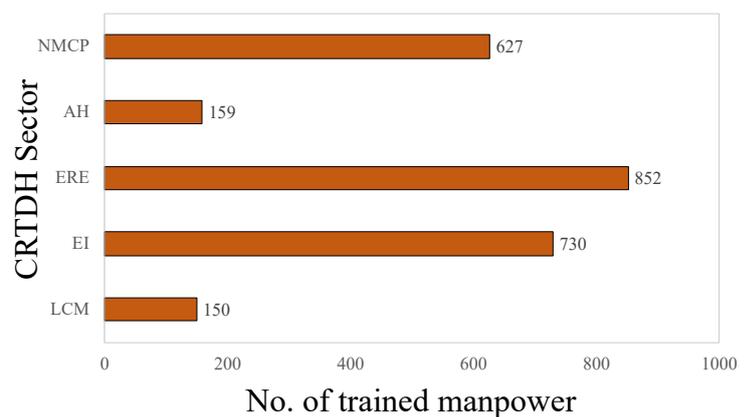


Fig. 10. Total no. of trained manpower in CRTDHs across each sector

7.7 Revenue Earned

CRTDHs operate on a cost-plus nonprofit basis, prioritizing affordability for MSMEs and innovators while fostering collaboration and innovation rather than profit generation. This approach aims to create an innovation-friendly environment and contribute to economic growth. Most of the CRTDHs have been successful in generating revenue. **Figure 11** mentions the collective revenue earned in past ten years at CRTDHs across each sector. **Figure 12** mentions the share of revenue earned (%) in last ten years at CRTDHs across each sector.

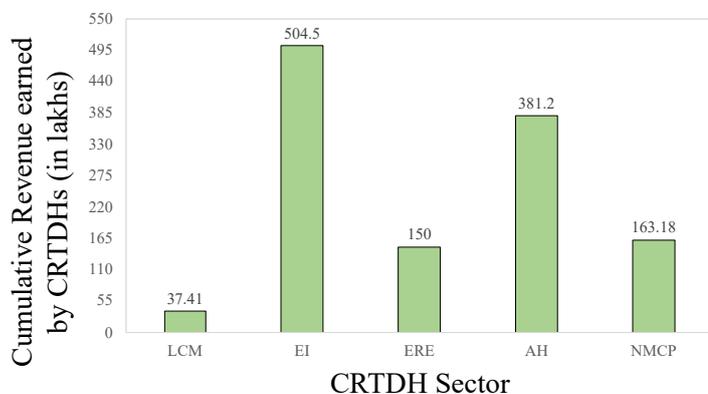


Fig. 11. Total cumulative revenue earned by CRTDHs across each sector

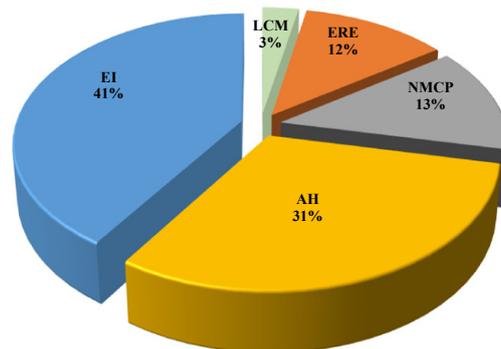


Fig. 12. Share of revenue earned by CRTDHs across each sector.

8.0 INFRASTRUCTURE FACILITIES AT THE CRTDHs

The infrastructure facility at ‘Common Research and Technology Development Hubs (CRTDHs)’ is the physical foundation and backbone that enables these innovation centers to fulfill their mission of advancing research, fostering innovation and driving technology development. The infrastructure is designed to support a wide range of activities, from basic research and experimentation to technology development, collaboration and knowledge dissemination. The infrastructure within CRTDHs serves as a cornerstone for research, innovation and technology development. It is meticulously planned and constructed to create a dynamic and supportive environment that fosters creativity, collaboration and progress. The state-of-the-art facilities and resources provided by CRTDHs are instrumental in driving scientific advancements, technological breakthroughs and economic growth. In the past 10 years, CRTDHs have made remarkable progress in establishing state-of-the-facilities. The following section gives a glimpse of the infrastructure facilities within the CRTDHs:

i. Advanced Laboratories: CRTDHs house state-of-the-art research laboratories equipped with cutting-edge equipment. These labs provide researchers with the necessary facilities to conduct experiments, analyze data, and develop innovative solutions. The technologies / products developed at the CRTDH are for the benefit of MSMEs.

ii. Specialized Equipment: The hubs invest in specialized equipment and facilities to support diverse research areas, such as biotechnology, drug development, water

analysis, wastewater treatment, metal coating, metal alloys, testing equipment, materials science and many more.

Access to state-of-the-art equipment is crucial for conducting in-depth research and development work. Specialized equipment like NMR X-ray crystallography, GC-MS, HPLC, injection molding etc. are a few equipment available at the CRTDHs established by DSIR. All the CRTDHs established with the support of DSIR have uploaded the details of the equipment available at the CRTDHs on the Indian Science and Technology Map (I-STEM) website (<https://www.istem.gov.in>), so that users may get to know about them and seek access in a systematic and transparent manner under one roof. I-STEM is a national web portal launched by the Government of India. IISc Bangalore has been entrusted with the responsibility of maintaining the I-STEM portal to achieve optimum utilization of all the scientific (technical/analytical) research equipment/ facilities established by the funding of Govt. of India. A few notable equipment available with each CRTDH is placed at **annexure – I**.

iii. Cleanrooms: Many CRTDHs working in the field of pharmaceutical sciences, medical diagnostic/ devices and printed circuit boards harbor cleanrooms to facilitate research in highly controlled environments. These cleanrooms are essential for applications in electronics, pharmaceuticals and other fields where contamination control is critical.

iv. Prototype Development Facilities: CRTDHs often include areas dedicated to prototyping and technology development. These facilities allow researchers and entrepreneurs to build and test physical prototypes of their innovations. Several CRTDHs established have prototyping facility.

v. Collaborative Workspaces: The hubs feature collaborative workspaces that encourage interdisciplinary collaboration and exchange of ideas. These spaces are designed to promote creativity and facilitate discussions among researchers and innovators.

vi. Workstations and Data Centers: Research and Development often require computational resources. CRTDHs provide high-performance workstations and computing clusters to support simulation, modeling, and data analysis activities. Workstations are available at all the CRTDHs. However, in the age of big data and digital research, CRTDHs maintain advanced data centers equipped with high-performance computing infrastructure. These centers support data-intensive research and analysis.

These facilities are available with the CRTDHs which are working in the field of bioinformatics, pharmaceutical sciences, medical diagnostic, etc.

vii. Meeting room facilities: To facilitate discussions, presentations, and knowledge sharing, CRTDHs feature meeting rooms of varying sizes. These spaces are vital for hosting seminars, workshops, conferences and demonstration. Most of the CRTDHs have meeting rooms.

viii. Incubation Facilities: CRTDHs offer incubation spaces for startups and emerging businesses. These facilities provide resources such as offices, laboratories and access to mentorship and networking opportunities.

The infrastructure within CRTDHs stands as the bedrock for research, innovation, and technology development. It is carefully designed and built to establish a vibrant and nurturing setting that encourages ingenuity, cooperation and advancement. The cutting-edge equipment, amenities and infrastructure offered by CRTDHs play a crucial role in propelling scientific progress, pioneering technology and fueling economic expansion.

9.0 CHINTAN SHIVIR: A STRATEGIC BRAINSTORMING SESSION

As the CRTDH programme is completing ten years, the Department of Scientific and Industrial Research (DSIR) intends to reimagine its role in providing right support and an enabling environment for MSMEs and setting exemplary standards of offering access to state-of-the-art facilities and resources. The Department plans to organize ‘*Chintan Shivirs*’ in all the 18 CRTDHs established by DSIR with an objective of exploring the ideas for better implementation of the CRTDH scheme, identifying the challenges ahead and coming out with ideas for making the scheme more relevant and vibrant, thus ensuring ease of doing research for MSMEs and ease of implementation by the project coordinators.

‘*Chintan Shivirs*’ explored the possibility for enhanced use of Artificial Intelligence for the betterment MSMEs and the possible role that the CRTDHs can play. Experts were invited for sharing their valuable inputs to align the discussion with the latest developments across the world for the progress of MSMEs. The discussions held at the ‘Chintan Shivar’ would help in better planning and coordination of CRTDH scheme for greater reach & impact.

During the ‘*Chintan Shivirs*’, participants explored and discussed the challenges confronted by the MSMEs, with a strong emphasis on fostering research and development as tools for problems-solving. The purpose is to generate new ideas, insight and perspectives that can contribute to the development & implementation of policies, programs and initiatives aligned with the goals of the Government. The ideas and

outcomes generated during the ‘*Chintan Shivirs*’ would be translated into concrete action plan. These action plans intend to outline the steps, strategies and timelines for the time-bound implementation of the proposed initiatives.

By facilitating these ‘*Chintan Shivirs*’, the Department harnessed the collective wisdom, knowledge and expertise of the officials and stakeholders. It enabled comprehensive discussions, critical thinking and strategic planning to drive effective policy formulation and execution. This inclusive approach ensured that various perspectives and inputs are considered, leading to well-informed decisions and efficient implementation of programs and policies for the benefit of the nation.

The Department plans to organize ‘*Chintan Shivirs*’ in all the 18 CRTDHs established by DSIR. In Phase I, five ‘*Chintan Shivirs*’ were organized during the period 27th July to 13th October, 2023 at IIT Kharagpur, CSIR-IITR, Lucknow, CSIR-CMERI, Durgapur, CSIRIMMT, Bhubaneswar and DPSRU, New Delhi. All the ‘*Chintan Shivirs*’ began with a tour of the CRTDH facility, followed by inauguration, thematic session and ‘Samvad’, which broadly focused on the challenges encountered by MSMEs, startups and innovators and explored potential solutions with the CRTDH coordinators. A brief description of each ‘*Chintan Shivar*’ is given below:

A. The first ‘*Chintan Shivar*’ was organized at **IIT Kharagpur** on 27th July, 2023. The key takeaways were

announcement regarding multiple membership opportunities targeting MSMEs, Start-ups, and entrepreneurs. The event involved the identification of five major challenges faced by MSMEs, with accompanying discussions on potential solutions. In a broader context, there was an emphasis on strengthening collaboration between academia, industry and Government bodies, with a focus on joint research and innovation. Additionally, the pivotal role of MSMEs in the innovation ecosystem was highlighted, showcasing how CRTDH could help in their R&D efforts and product market entry. Furthermore, the gathering underscored the importance of affordable healthcare solutions, demonstrating how collaboration could lead to the development of cost-effective point-of-care options, especially relevant in rural areas. Finally, the event gave special attention to import substitution and the "Make in India" initiative, emphasizing the need to develop in-house products and indigenous healthcare technologies to replace imported devices for point-of-care applications.



Tour of the CRTDH facility by CRTDH coordinator at IIT Kharagpur



Participation of stakeholder at Chintan Shivir at IIT Kharagpur

B. The second '*Chintan Shivir*' was organized at **CSIR-IITR, Lucknow** on 24th August, 2023. The shiviremphasized the CRTDHs commitment in actively supporting MSMEs. The CRTDH at CSIR-IITR, Lucknow achieves this by providing MSMEs access to cutting-edge technologies and innovations, as well as offering valuable training and mentoring.

The '*Chintan Shivir*' event proved to be a significant platform, uniting MSMEs, startups, innovators, and representatives from the Chamber of Commerce/Industry Association. The event facilitated the exchange of ideas and insights among participants and fostered valuable networking opportunities. During the event, the challenges faced by MSMEs were openly discussed, with a focus on the role that CRTDH can play in addressing these challenges.

A panel discussion at the event delved into the five grand challenges that often confront MSMEs. This proved to be particularly insightful, as participants gained a deeper understanding of how the CRTDH can actively assist MSMEs in overcoming these hurdles. The '*Chintan Shivir*' event served as a valuable opportunity for MSMEs to acquaint themselves with the latest

technologies and innovations that have the potential to enhance their business operations. In doing so, they not only improve their own enterprises but also positively impact the overall growth and development of the MSMEs sector within the region.



Dr. Vipin C. Shukla hosting the Samvad session CSIR-IITR, Lucknow.



Participation of Stakeholders at Chintan Shivir At CSIR-IITR, Lucknow.

C. The third ‘*Chintan Shivir*’ was organized at **CSIR-CMERI, Durgapur** on 12th September, 2023. The ‘*Chintan Shivir*’ at CSIR-CMERI Durgapur was a platform where participants and stakeholders actively engaged by providing valuable suggestions and feedback related to low-cost machining. Notable highlights from this event encompassed diverse areas where announcements were made to publish Government-related information that could benefit MSMEs, Startups and Entrepreneurs

directly on the CRTDH-CMERI website. This initiative is poised to enhance transparency and provide easy access to crucial information.

The event effectively identified and addressed five major challenges confronting MSMEs, fostering constructive discussions on potential solutions and encouraging innovative problem-solving. Collaboration was a central theme, with an emphasis on the importance of strengthening ties between academia, industry and Government bodies. The ‘*Chintan Shivir*’ also spotlighted the potential for collaborative efforts to drive the development of cost-effective manufacturing solutions. These solutions are envisioned to address the challenge of making manufacturing accessible and affordable, particularly in remote and unreached areas.

Finally, the event featured a distinct emphasis on import substitution and the "Make in India" initiative. In this way, the event contributed to the broader goals of promoting self-reliance and enhancing domestic manufacturing capabilities.



Inauguration of Chintan Shivir by Dr. Sujata Chaklanobis, Head CRTDH, DSIR at CSIR-CMERI, Durgapur.



Samvad session in progress at CSIR-CMERI, Durgapur.

D. The fourth ‘*Chintan Shivir*’ was organized at **CSIR-IMMT, Bhubaneswar** on 15th September, 2023. During the ‘*Chintan Shivir*’, suggestions and feedback were obtained from the participants / stakeholders. The ‘*Chintan Shivir*’ emphasized effective tackling of the identified issues and strengthened connections with MSMEs to address their technological requirements. Bolstering integration among academia, industry and Government entities for collaborative research & innovation and courses & training programs meticulously crafted to cater to the distinct demands and prerequisites of MSMEs were other key takeaways.



Dr. Sujata Chaklanobis Head CRTDH, DSIR addressing the Chintan shivir at CSIR-IMMT, Bhubaneswar.



Dr. Ramanuj Narayan, Director CSIR-IMMT, Bhubaneswar explaining the exhibit at CRTDH at CSIR-IMMT, Bhubaneswar.

E. The fifth ‘*Chintan Shivir*’ was organized at **Delhi Pharmaceutical Sciences & Research University (DPSRU), New Delhi** on 13th October, 2023. The Shivir placed a strong emphasis on the challenges confronting the healthcare industry while simultaneously acknowledging the invaluable contributions of research institutions actively dedicated to fostering innovation and addressing the specific needs of MSMEs, start-ups and innovators. The ‘*Chintan Shivir*’ delved into strategies to enhance Research & Development, the obstacles & opportunities in manufacturing, considerations related to intellectual property, regulatory obstacles and the crucial role of collaboration between academia and industry in the healthcare sector. The key takeaways from the ‘*Chintan Shivir*’ at DPSRU included a focus on tailored training and facility upgrades to enhance collaboration between the industry and academia. Additionally, the event emphasized the importance of technology adoption and the integration of cutting-edge technologies like AI, machine learning and generative AI to support MSMEs in their Research and Development efforts.



Inauguration of Chintan Shivir at DPSRU, New Delhi



Participation of stakeholder at Chintan Shivir at DPSRU, New Delhi



Samvad session in progress at DPSRU, New Delhi.

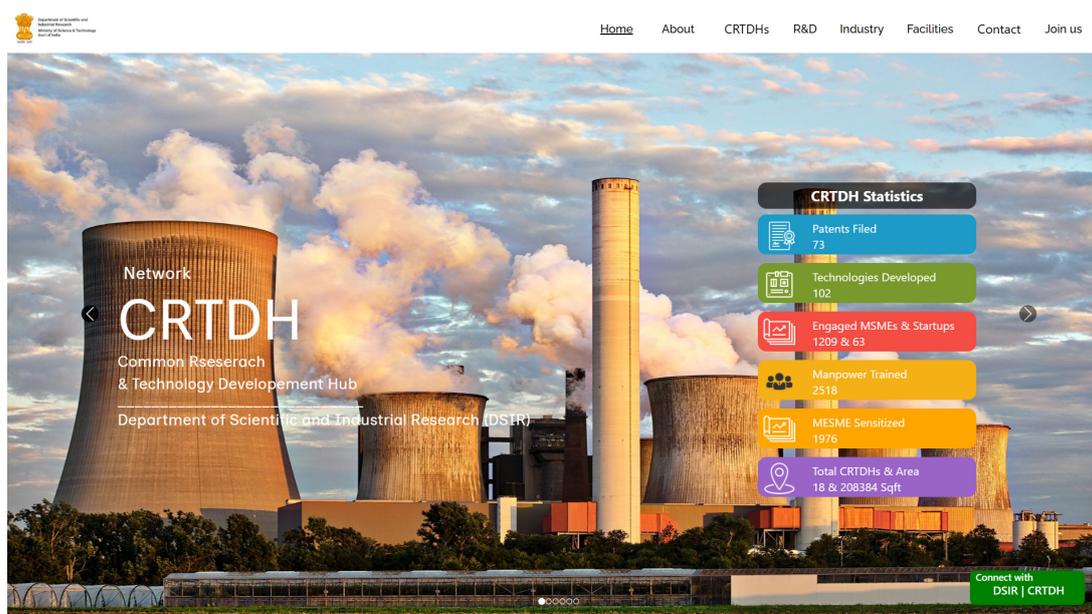
10.0 “NETWORK CRTDH”: A NETWORKING PORTAL FOR CRTDHs & MSMEs

Over the last decade, DSIR has established a total of 18 CRTDHs across India. While each of these CRTDHs has developed its own dedicated portal to disseminate information and resources, there emerged a compelling need for a centralized platform that comprehensively details each CRTDH’s capabilities & offerings and also serve as an effective platform for providing solutions to the technical needs of the MSMEs. Such a centralized portal would serve as a unifying force, promoting enhanced networking and collaboration not only among the CRTDHs but also with the Micro, Small and Medium Enterprises (MSMEs) they serve.

This envisioned network portal stands to address several critical objectives. It will act as a central hub where information, expertise, and resources from all CRTDHs can be readily accessed. This promises to streamline communication, foster greater inter-CRTDH cooperation and provide MSMEs with a one-stop destination to explore the collective knowledge and capabilities of these centers. Further, this

centralized platform is poised to offer a more efficient and effective means of collectively tackling the challenges and problem statements faced by the MSME sector from anywhere within the country. By consolidating resources and expertise, it empowers these centers to address MSME needs more comprehensively, ensuring a holistic approach to problem-solving and innovation. The development of such a network portal not only promotes better collaboration and knowledge sharing among CRTDHs but also significantly enhances the capacity to serve and strengthen the MSME sectors across India.

In this regard, CRTDH at IIT Gandhinagar, Gandhinagar has developed a web portal ‘Network - CRTDH’ to create networking among the CRTDHs and its stakeholder. The portal can be accessed at <https://ncrtdh.in>.



Home Page of “Network CRTDH” Portal

11.0 CRTDH CONCLAVE: PROPELLING SELF RELIANCE IN MSMEs AND START-UPS

‘Common Research and Technology Development Hubs (CRTDHs)’ programme has been in existence for last 10 years and this period has been marked by rapid technological advancements and global challenges, thus importance of fostering innovation and collaboration in Research and Development (R&D) has never been more significant. The Department of Scientific and Industrial Research (DSIR) first decided to have a CRTDH-Conclave in the year 2019 at CSIR-CCMB, Hyderabad on 8th and 9th November, 2019. The Conclave was organized to understand, highlight and discuss the issues that influence MSMEs in various dimensions. The Conclave was designed as a platform for deliberations on upcoming or existing challenges and their possible solutions. It was decided to organize such Conclave every year. However, due to COVID-19 pandemic, Department could not organize Conclave during the years 2020 and 2021. After the world came back to normalcy, DSIR decided to have the Conclave as a yearly event and therefore, the second DSIR-CRTDH Conclave was held on 17th and 18th November, 2022 at CSIR-IITR, Lucknow. This year Department is having the third DSIR-CRTDH Conclave on 6th and 7th November at IIT Gandhinagar, celebrating Ten years of the CRTDH programme.

The CRTDH-Conclaves are vital events to establish dialogue among all key stakeholders of the CRTDHs established by DSIR, giving shape to the vision and aspiration behind creation of such hubs. The Conclave provides a platform for in-depth discussion on the

R&D ecosystem in India and the on-going global trends and what needs to be done to improve the situation. A brief glimpse of the past Conclaves is given below:

i. 1st DSIR-CRTDH conclave at CSIR-CCMB, Hyderabad.

The first DSIR- CRTDH Conclave was held on 8th& 9th November, 2019 at CSIR – CCMB, Hyderabad as a knowledge sharing workshop to mark the 5 years of the programme. The Conclave was inaugurated by Dr. Shekar C. Mande, then Secretary, DSIR on 9th November, 2019. In his address, he lauded the efforts of the CRTDH scheme in facilitating the small scale and medium scale entrepreneurs and innovators to take up research & technology development activities. He also highlighted a greater need for faster and smoother commercialization of technologies from public funded laboratories. Director, CSIRCCMB outlined the success of the program and how the CRTDH at CSIR-CCMB, Hyderabad, was well on its way to become self-sustainable in terms of revenue generation. The Conclave deliberated upon the progress of CRTDHs since their inception in 2014, expected outcomes, state-of-the-art facilities created, learning from the various models of engagement and self-sustainability models of the CRTDH. The conclave also emphasized that 12 CRTDHs were located in CSIR institutes and IITs.



Technology showcase by startups & MSMEs incubated at CSIR-CCMB, Hyderabad.



Conclave in progress at CSIR-CCMB, Hyderabad

ii. 2nd DSIR-CRTDH Conclave at CSIR-IITR, Lucknow

The second DSIR-CRTDH conclave was organized at CSIR-Indian Institute of Toxicology Research (IITR), Lucknow on 17th & 18th November, 2022 showcasing the technological insight of varied supported sectors by the Public Funded Research Institutes (PFRIs). The Conclave was inaugurated by Dr. N. Kalaiselvi, Secretary, DSIR. In her address Secretary, DSIR emphasized that MSMEs are the backbone of the nation and have the potential to catalyze a revolution that extends beyond major industry players. She also emphasized the importance of making science and technology accessible to all industrial sectors, enabling the broader commercialization of research-derived technology with significant societal implications. Dr. Bhaskar Narayan, Director, CSIR-IITR, Lucknow in his

address said that MSMEs, individual entrepreneurs and the different CRTDHs should also create alliances amongst each other so as to be able to meet diverse requirements of industries outside their own domain areas. He further mentioned that, leveraging existing technologies to tackle the present-day needs of the industry is the way forward. The Conclave was attended by highly eminent scientists, industry representatives and MSMEs. The Conclave highlighted the achievements made and benefits drawn by MSMEs & other stakeholders and the continued commitment of DSIR for MSME. The Conclave witnessed IIT Guwahati and CSIR-IITR Lucknow signing of MoUs with different industries. Achievements made by various CRTDHs were also showcased in the exhibition during the Conclave. DSIR also released a Compendium on CRTDH scheme that has comprehensive details of all 18 CRTDHs.



Unveiling of DSIR-CRTDH Compendium at DSIR-CRTDH Conclave at CSIR-IITR, Lucknow



Dr. N. Kalaiselvi, Secretary, DSIR addressing the DSIR-CRTDH Conclave at CSIR-IITR, Lucknow

iii. 3rd DSIR-CRTDH Conclave at Indian Institute of Technology Gandhinagar

The third DSIR-CRTDH conclave is scheduled to be organized at Indian Institute of Technology Gandhinagar on 6th & 7th November, 2023. The conclave would be inaugurated by Dr. N. Kalaiselvi, Secretary, DSIR and it is anticipated that many Senior. Govt. officials, representatives from

MSMEs, Start-Ups and Industry association are expected to attend the Conclave. The Conclave would many technical session and invited keynote talks. Conclave would also showcase the technology developed at various CRTDHs. During the Conclave, new portal for better networking among CRTDHs would be unveiled. The Conclave is also slated to release a publication on 10 years of CRTDH and compilation on 'Chintan Shivirs' organized by the Department. In this year DSIR-CRTDH Conclave various pre-conclave workshops and post session workshops relevant to MSMEs engaged chemicals are planned. It is envisioned that DSIR-CRTDH Conclave 2023 would unite researchers, industry leaders, policymakers and entrepreneurs and that Conclave 2023 would play a vital role in advancing Science and Technology for larger benefit.

12.0 THE MSME CHRONICLES: SUCCESS STORIES

Success stories of CRTDHs are a testament to the significant impact these innovation centers have on research, technology development, and innovation. These hubs serve as catalysts for groundbreaking research, fostering collaboration, and driving economic and societal progress. These success stories underscore the far-reaching impact of CRTDHs on research, technology development, and innovation. They demonstrate how these hubs contribute to scientific progress, economic growth, and improvements in quality of life, and serve as models for the transformational potential of collaborative research and development initiatives. Success stories of CRTDHs can be attributed in two ways (a) by Research & Development and (b) by services provided. Here are a few illustrative success stories that showcase the influence of CRTDHs:

A: RESEARCH & DEVELOPMENT RELATED

1.MEDICAL GRADE ULTRA PURE WATER AND HEMODIALYSIS UNIT

i. Company name: M/s Althion Tech Innovations Private Limited, Hyderabad

ii. CRTDH with which the Company associated: CSIR-CCMB, Hyderabad

iii. Product or technology developed at/ with the CRTDH

M/s Althion Tech Innovations Private Limited, a pioneering health-tech startup, specializes in the creation of domestically manufactured medical and healthcare equipment and devices tailored for the Indian market. Althion has acquired the licensing rights to a patented technology originally conceived by the CSIR Indian Institute of Chemical Technology (IICT) in Hyderabad. Leveraging this innovative foundation, they have successfully introduced two groundbreaking products to address unmet needs in the field of Type-1 ultrapure water and hemodialysis.

In the biotech and pharmaceutical sectors, Althion has designed cutting-edge Type-1 and Type-2 ultrapure water table-top units, catering to the specific requirements of research institutes and companies in the biotech and pharmaceutical industries.

Additionally, in the realm of hemodialysis, Althion has engineered a state-of-the-art, low-maintenance, IoT-connected pure water system that allows for remote monitoring.

The Medical RO plant for kidney dialysis centres and portable Home & ICU dialysis ensures the proactive detection of potential issues, preventing unexpected breakdowns and safeguarding patient care.

iv. Role of CRTDH

M/s Althion Tech Innovations Private Limited was earlier incubated at DSIRCRTDH at CSIR-CCMB, Hyderabad. During this period, CRTDH was instrumental in handholding the incubate in connecting with sister CSIR laboratories across India to help validating the table top laboratory products. DSIR-CRTDH at CSIR-CCMB, Hyderabad assisted M/s Althion Tech Innovations Private Limited in setting up a demo unit at its premises. Apart from receiving handholding and networking, M/s Althion Tech Innovations Private Limited has taken the benefit of varied instrumentation for its studies and other equipment for prototyping.

v. Impact of the product or technology developed

M/s Althion Tech Innovations Private Limited conceptualized a demo unit for Type-1 and Type-2 ultrapure water at DSIRCRTDH at CSIR-CCMB, Hyderabad. The company's primary mission was dedicated to the development of domestically manufactured medical and healthcare equipment and devices tailored specifically for the Indian market, offering a viable alternative to imported products. The products developed by the company had a significant societal impact, with installations in numerous hospitals serving as RO plants for kidney dialysis centers and also as portable units suitable for home use and ICU settings. Althion's Type-1 and Type-2 tabletop units for ultrapure water serve as excellent substitutes for imported options and cater precisely to the unique needs of research institutions and companies within the biotech and pharmaceutical industries.



Type-1 and Type-2 ultrapure RO water unit developed by M/s Althion Tech Innovations Private Limited at DSIR-CRTDH at CSIR-CCMB, Hyderabad

2. BIO-THERAPEUTIC PROTEINS

i. Company name: M/s Oncosimis Biotech Pvt Ltd., Hyderabad

ii. CRTDH with which the Company associated: CSIR-CCMB, Hyderabad

iii. Product or technology developed at/ with the CRTDH

M/s Oncosimis Biotech Pvt. Ltd. is a start-up biotech company dedicated to develop and produce bio-therapeutic proteins for cancer, diabetes and for other diagnostic & industrial applications at affordable cost. The company has developed bio-therapeutic proteins using two proprietary technology platforms, AcceTT® and BacSec® which provide a distinctive advantage to manufacture biosimilar at affordable costs. The company has filed/received 30 patents and is recognized by DSIR, DPIIT & MoMSME and is an ISO 9000:2015 certified company. The technology developed is extendable for applications in vaccine, nutraceuticals, veterinary products and proteins for diagnostic and other industrial applications. They are also supporting pharma industries in developing biocatalyst intended to reduce manufacturing cost. The company is about to commercialize two products namely, nuclease for vaccine industry and a recombinant protein based cream for wound healing.

iv. Role of CRTDH

M/s Oncosimis Biotech Pvt. Ltd. was incorporated in the incubator facility of the DSIR-CRTDH at CSIR-CCMB, Hyderabad. The company is privileged to be one the very first incumbents at the DSIR-CRTDH incubator facility of CSIR-CCMB, Hyderabad. DSIR-CRTDH at CSIR-CCMB

provided the company with all the available infrastructure in helping them establish proof of principle studies and setting up of the work protocols. The CRTDH were very supportive in their endeavors and extended full cooperation in terms of training and expert deliberation from the CSIR-CCMB faculties. Being incubated in CSIR-CCMB enabled them in getting recognized by DSIR, which further enabled them in completing Biotechnology Ignition Grant (BIG) of DBT and NBM grant of DBT-world bank. M/s Oncosimis Biotech extended their gratitude to DSIR-CRTDH and DSIR for their continuous encouragement and support.

v. Impact of the product or technology developed

Being a startup company incubated earlier at DSIR-CRTDH at CSIR-CCMB, Hyderabad, it has made great leap in biotech sector in a short time. The technology developed for production of bio-therapeutic proteins for cancer, diabetes and for other diagnostic & industrial application is having a great societal & industrial impact, in minimizing import and manufacturing it at affordable costs in India. The products developed by the company are providing an alternative to the existing therapeutics. It is among the few companies which is working in a niche area of bio-therapeutic proteins.

3. DIAGNOSTIC KIT FOR AQUACULTURE

i. Company name: M/s Bioartis Life Sciences Private Limited. Hyderabad

ii. CRTDH with which the Company associated: CSIR-CCMB, Hyderabad

iii. Product or technology developed at/ with the CRTDH

M/s Bioartis Life Sciences Private Limited is a pioneering biotech start-up that specializes in the development of diagnostic kits tailored for the aquaculture industry, with a primary focus on shrimp farming. One of their flagship products is the BioArtis WSSV PCR Detection kit, designed to identify the White Spot Syndrome Virus (WSSV). This virus is notorious for causing widespread mortalities and substantial production setbacks in shrimp farming across various nations. The BioArtis WSSV PCR Detection kit plays a critical role in screening shrimp seeds, significantly mitigating the risk of crop failure. With its high sensitivity and specificity, this kit enables the early detection of WSSV infections.

In addition to their WSSV detection kit, M/s Bioartis Life Sciences Private Limited offers the BioArtis EHP PCR Detection kit. This kit is instrumental in identifying *Enterocytozoon hepatopenaei* (EHP), an emerging microsporidian parasite that affects penaeid shrimp. EHP has been linked to growth stunting and significant losses in shrimp farming, particularly in Asian regions. The BioArtis EHP PCR Detection kit boasts exceptional sensitivity and specificity in pinpointing the specific EHP target, aiding in its timely detection.

The company's third product, the 'BioArtis IHHNV Detection kit,' is an in-vitro amplification test designed for the quantitative detection of Infectious Hypothermal and Hematopoietic Necrosis Virus (IHHNV) DNA in shrimp samples. This test is conducted both before and after the cultivation of penaeid shrimp (Penaeidae) to assess the risk of white spot syndrome infection. It also facilitates prompt treatment, thereby minimizing economic losses.

M/s Bioartis Life Sciences Private Limited has played a pivotal role in meticulously designing and manufacturing these in-house-developed kits for detecting WSSV, EHP and Vibrio para. Their commitment to precision and reliability ensures unparalleled accuracy in aquaculture diagnostics.



Diagnostic kits developed by M/s Bioartis Life Sciences Private Limited for the aquaculture industry at DSIR-CRTDH at CSIR-CCMB, Hyderabad

iv. Role of CRTDH

The journey of M/s Bioartis Life Sciences Private Limited commenced within the premises of DSIR-CRTDH at CSIRCCMB, Hyderabad. With generous support and abundant resources from DSIR-CRTDH at CSIR-CCMB, Hyderabad, BioArtis has emerged as a prominent player in the field of biotechnology.

They have established a spacious 6000-square-foot manufacturing facility, complete with a class 1000 clean room. This substantial progress stands as a testament to the remarkable collaboration between BioArtis and CRTDH-CCMB.

CRTDH-CCMB has provided BioArtis access to a diverse range of cutting-edge instruments and technical expertise, all conveniently housed under one roof. This ecosystem offers an ideal environment for translating innovative concepts into tangible products. The ability to experiment and adapt swiftly, especially in situations where conventional methods prove inadequate, has played a pivotal role in BioArtis' journey of product development.

Amid the challenging times brought about by the COVID-19 pandemic, CRTDH-CCMB extended extraordinary support to BioArtis. This included exemptions from rent and the recognition of BioArtis as an essential service provider. These measures were instrumental in ensuring the uninterrupted operation of the company during trying circumstances. Such support underscores the exceptional partnership between BioArtis and CRTDH-CCMB, where the latter actively seeks ways to facilitate the success of its incubated ventures. Therefore, the symbiotic relationship with CRTDH-CCMB has been a crucial catalyst in BioArtis' growth and evolution.

v. Impact of the product or technology developed

Shrimp farming plays a pivotal role in generating income for rural economies throughout Asia and serves as a significant export commodity for many Asian nations. However, the susceptibility of shrimp culture to various diseases poses a considerable risk to farmers, potentially leading to severe financial losses. M/s Bioartis Life Sciences Private Limited recognized this challenge within the shrimp farming industry and developed a range of diagnostic kits to aid farmers in the timely detection of critical issues.

These diagnostic kits are designed to identify the White Spot Syndrome Virus (WSSV), the microsporidian parasite known as '*Enterocytozoon hepatopenaei* (EHP),' and Infectious Hypothermal & Hematopoietic Necrosis Virus (IHHNV). Importantly, Bioartis manufactures these kits at affordable rates, making them accessible to a broader segment of shrimp farmers.

4. PAPER BASED DIAGNOSTIC KIT

i. Company name: M/s Smart QR Technologies Pvt. Ltd., Pune.

ii. CRTDH with which the Company associated: IIT Kharagpur

iii. Product or technology developed at/with the CRTDH

CRTDH at IIT Kharagpur has pioneered a paper microfluidics-based technology for detecting various blood parameters. M/s Smart QR Technologies Pvt. Ltd., which was incubated at CRTDH, obtained the technology license for commercialization from IIT Kharagpur. Through close collaboration with IIT Kharagpur, M/s Smart QR Technologies Pvt. Ltd. further enhanced and diversified the technology's capabilities to target a range of blood parameters.

The company diligently transformed these technologies into market-ready products, leading to the successful acquisition of manufacturing licenses from CDSCO for four distinct detection kits: HemoQR for Blood Hemoglobin detection, GlucoQR for Plasma Glucose detection, PapQR for Vaginal pH detection, and UroQR for Urine Glucose detection. These microfluidic detection technologies are entirely device-free, requiring only the kit itself and a smartphone with the corresponding app, readily available for download on the Play Store.

Thus, stemming from a single platform technology developed by CRTDH at IIT Kharagpur, M/s Smart QR Technologies Pvt. Ltd. was able to create four commercially viable products.

iv. Role of CRTDH

M/s Smart QR Technologies Pvt. Ltd, initially incubated at CRTDH, acquired the technology license and secured the platform technology for detecting various blood parameters. This technology utilizes paper-based microfluidics in conjunction with AIML-driven colorimetric detection for commercialization. Throughout its journey, CRTDH at IIT Kharagpur has played a pivotal role in supporting M/s Smart QR Technologies Pvt. Ltd, offering access to laboratory facilities, specialized instruments, research and development consultancy, licensing opportunities, and incubation support.

This collaborative effort bore fruit in the form of four distinct products stemming from the same platform technology, resulting in the filing of joint patents. Further, both teams continue to collaborate on the codevelopment of additional diagnostic kits, underlining their enduring commitment to advancing healthcare technology.

v. Impact of the product or technology developed

These low-cost microfluidic diagnostic kits, designed to target various serious diseases in primary care and public health, hold immense potential to revolutionize healthcare, particularly for underprivileged communities. These kits meet a critical need, especially for remote populations lacking access to advanced medical infrastructure. Their simplicity, requiring only a smartphone and the respective kit, democratizes diagnostic capabilities, ensuring that even remote areas can access essential health monitoring.

By simplifying and downsizing the diagnostic process, these products have the potential to reduce healthcare costs and transform the industry, making routine health monitoring more accessible and cost-effective. This innovation not only aligns with India's drive for self-reliance but also has the potential to significantly lower national healthcare expenditures.

The collaborative partnership between the CRTDH and industry exemplifies the power of public-private collaborations in driving innovation and transforming laboratory prototypes into market-ready solutions. These joint efforts not only showcase India's growing strength in technology-driven healthcare solutions but also set a precedent for future innovations in this platform technology.



Paper based Diagnostic kits developed by M/s Smart QR Technologies Pvt. Ltd based on microfluidic detection technologies developed at DSIR-CRTDH at IIT-Kharagpur

5. OROSCAN DEVICE FOR EARLY SCREENING OF ORAL CANCER

i. Company name: M/s Mouthwise Diagnostics Private Limited, Kolkata.

ii. CRTDH with which the Company associated: IIT Kharagpur

iii. Product or technology developed at/ with the CRTDH

M/s Mouthwise Diagnostics Private Limited, incubated at the CRTDH licensed the technology from IIT Kharagpur and has successfully developed Oroscan. Oroscan, a device designed for risk categorization and early screening of oral cancer and other diseases. This innovative device seamlessly integrates the necessary sensors and AI-driven algorithms into a self-contained unit for assessing superficial blood perfusion.

The company has transitioned from a laboratory prototype to a market-ready product, with ongoing rigorous testing and optimization of the algorithm. Data collected from over 3,000 patients is being utilized to create a clinical algorithm-driven risk assessment scoring system, particularly for oral diseases such as oral cancer.

Oroscan's user-friendly design empowers healthcare practitioners to position the device with precision, guided by real-time imaging. It captures both normal and thermal images of the target area while collecting temperature and humidity data. This data is then transmitted to the accompanying app, where the thermal image is transformed into a blood perfusion image. Utilizing the

metadata and blood perfusion image, the algorithm provides an assessment of the risk for oral cancer, enhancing early detection and risk management

iv. Role of CRTDH

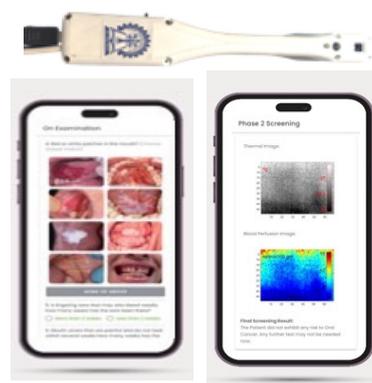
M/s Mouthwise Diagnostics Private Limited was incubated at the CRTDH and licensed its Oroscan technology. The company received comprehensive support from CRTDH throughout its journey. The CRTDH actively facilitated the startup by offering access to essential facilities, specialized instruments, research and development consultancy, validation assistance, and incubation support.

Notably, CRTDH at IIT Kharagpur played a pivotal role in transitioning the lab prototype into a market-ready product. This transformation included rigorous testing and optimization of the algorithm, involving the collection of data from over 3,000 patients, ensuring Oroscan's readiness for the market.

v. Impact of the product or technology developed

Oral cancer stands as a significant contributor to both morbidity and mortality among Indian males. Approximately 90% of oral cavity cancers can be attributed to the use of tobacco and excessive alcohol consumption. This handheld device, powered by artificial intelligence, presents a viable solution for mass screening, aiding in the early detection and risk categorization of oral cancer. This technology combines the ease of use of a portable device with AI-driven algorithms, offering a dual-layered screening approach that doesn't rely on sophisticated laboratories or extensively trained personnel. It has the potential to address India's pressing issue of high oral cancer prevalence,

primarily linked to tobacco usage, alcohol consumption, and inadequate oral hygiene. By enabling early diagnosis through real-time imaging and data-driven assessments at the point of care, this homegrown technology has the capability to significantly reduce morbidity and mortality rates by facilitating early screening for oral cancer.



Hand held Oroscan device and phone app for assessment commercialized by M/s Mouthwise Diagnostics Private Limited based on the technology developed at DSIR-CRTDH at IIT-Kharagpur

6. COMPOSTABLE PRINTABLE FLEX

i. Company name: M/s Hengul Biotech Pvt. Ltd., Kamrup.

ii. CRTDH with which the Company associated: IIT Guwahati

iii. Product or technology developed at/with the CRTDH

Billboards, advertising boards, and flexes are mainly made from PVC, which is harmful to the environment as it doesn't biodegrade and emits toxins when burned. Additionally, PVC is not recyclable, leading to significant landfill waste. To combat this problem, Hengul Biotech Pvt. Ltd. has created compostable printable flex materials for display media and laminated bags. These eco-friendly flexes can naturally compost when disposed of correctly, reducing environmental impact.

iv. Role of CRTDH

IIT Guwahati has provided technical know-how for the lamination of Jute fabric with compostable Plastics. The prototype were developed at IIT Guwahati for further commercial utilization of such fabrics for Printable Flex by the Industry.

v. Impact of the product or technology developed

The adoption and use of compostable printable flex materials have significant impact on society, the environment, and the nation as a whole. Its usage reduces plastic pollution and typically has a lower carbon footprint contributing to reduced greenhouse

gas emissions. Adoption of compostable printable flex materials can lead to cleaner and healthier communities with reduced plastic litter and pollution and can create job opportunities in the green technology and manufacturing sectors. Its adoption lowers costs for waste management and landfill operations and can drive innovation in materials science and technology, potentially leading to new industries and economic growth. The product developed by using compostable printable flex can have far-reaching positive impacts on society, the environment, and the nation by reducing plastic pollution, fostering sustainability, and promoting innovation in materials and waste management practices.

7. BIODEGRADABLE CUTTLERY, SPOONS, CARYBAGS, TRAYS

i. Company name: M/s Trans Virtual Pvt. Ltd. (TVPL), Guwahati.

ii. CRTDH with which the Company associated: IIT Guwahati

iii. Product or technology developed at/ with the CRTDH

M/s Trans Virtual Pvt. Ltd. (TVPL) would be commercializing the biodegradable cutlery, spoons, Cary bags, trays developed by CRTDH at IIT Guwahati. Company intends to supply these products to hotels/ food industries, which holds significant implications for various stakeholders and sectors.

iv. Role of CRTDH

TVPL's collaboration with CRTDH at IIT Guwahati highlights the importance of industry-academic partnerships in fostering innovation and technological advancements. IIT Guwahati developed the compostable technology for semi-rigid packaging and it proved to be a sustainable alternative. This collaboration can lead to further research and development initiatives aimed at creating sustainable solutions.

v. Impact of the product or technology developed

The use of biodegradable cutlery and packaging materials can significantly reduce the consumption of traditional plastic products in the hotel and food industries. This reduction contributes to a decrease in plastic pollution. As hotel & food industries are increasingly prioritizing sustainability, thus by offering biodegradable products, TVPL can help these businesses align with environmental responsibility and

sustainability goals. TVPL's entry into the biodegradable products market can open new revenue streams and market opportunities, as the demand for sustainable alternatives is on the rise. The production and distribution of biodegradable products can create jobs, thereby contributing to economic growth. TVPL's commitment to supplying biodegradable products demonstrates corporate responsibility and a commitment to sustainable business practices. This can inspire other companies to follow suit and contribute to a broader shift toward eco-friendly alternatives.



Demo biodegradable cutlery developed by M/s Trans Virtual Pvt. Ltd. (TVPL) at DSIR-CRTDH at IIT-Guwahati

8. SMART pH ELECTRONICS

i. Company name: M/s Toshniwal Instruments Manufacturing Pvt Ltd., Ajmer

ii. CRTDH with which the Company associated: CSIR-CEERI, Jaipur Campus.

iii. Product or technology developed at/ with the CRTDH

The technology entails the precise measurement of extremely low currents in the microampere range. To facilitate this current measurement, a dedicated PCB was designed, equipped with cutting-edge features such as wireless communication, battery charging and fuel gauge functionality, storage capabilities and an android application. This sophisticated hardware is capable of pH value measurement using an ion-selective electrode and communicates the data via BLE. Furthermore, the hardware supports a USB 2.0-based charging mechanism, providing two charging modes: fast charge and slow charge, with charging capacities ranging from 500 to 1000 milliampere-hours. The device also possesses the capability to store the collected data in its onboard EEPROM for subsequent analysis. To interact with the device, a dedicated Android application has been developed, enabling seamless communication and control.

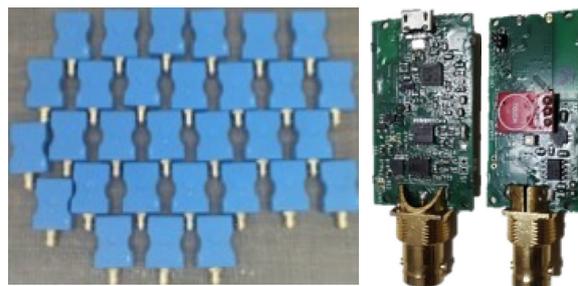
iv. Role of CRTDH

The contribution of CRTDH at CSIR-CEERI Jaipur has been pivotal in enabling the technologies and services used in the development of this device/technology, particularly design engineering services and Surface Mount Technology (SMT) services. CRTDH played an important role in simulation and CAD-based design of the

PCB, followed by its fabrication and assembly utilizing SMT methods. The establishment of the PCB assembly line at CRTDH, CSIR-CEERI Jaipur, plays a crucial role in achieving precise positioning of a diverse array of electronic components, including capacitors, resistors, and integrated circuits/surface mount devices, onto printed circuit boards. This equipment has been meticulously crafted to meet the demands of low and medium volume assembly, rendering it suitable for a wide spectrum of entities, ranging from startups and established businesses to Universities.

v. Impact of the product or technology developed

The developed device is designed to serve two primary application areas: industrial (specifically pharmaceutical) and societal (focused on water distribution). It is versatile enough to be employed in laboratory settings as well as for on-site measurements. The products developed by the company is providing an alternative to the existing pH measurement device at an affordable cost in India.



PCB designed at DSIR-CRTDH at CSIR-CEERI, Jaipur extension centre for pH measurement using SMT for M/s Toshniwal Instruments Manufacturing Pvt Ltd., Ajmer

9. BIOREMEDIATION OF INDUSTRIAL WASTEWATER

i. Company name: M/s Yash Pakka Ltd., Yash Nagar, Ayodhya.

ii. CRTDH with which the Company associated: CSIR-IITR, Lucknow.

iii. Product or technology developed at/with the CRTDH

CRTDH at CSIR-IITR, Lucknow devised a technology using consortia of five lignolytic bacteria for bioremediation of waste water from paper & pulp industry at lab scale bioreactor of 200L. As part of the collaboration between CRTDH at CSIR-IITR, Lucknow, an agreement has been established with M/s Yash Pakka Ltd. in Ayodhya. This agreement aims to achieve real-time optimization of a bioreactor developed by CSIR-IITR for treating effluent generated by the paper mill. A pilot-scale 2000L bioreactor plant has been deployed at M/s Yash Pakka Limited in Ayodhya to address the treatment of effluents from their pulp and paper mill. A non-disclosure agreement was executed between M/s Yash Pakka Limited and CSIR-IITR for the purpose of optimizing the newly developed bioreactor at Yash Pakka Limited's site. The collaboration between CSIR-IITR and M/s Yash Pakka Ltd. in Ayodhya for bioremediation technology to treat paper mill effluents was further formalized through a memorandum of understanding (MoU) signed between the two entities.

iv. Role of CRTDH

CRTDH at CSIR-IITR, Lucknow, has played a pivotal role in both the development and subsequent transfer of technology to MSMEs for practical implementation. The dedicated faculty members have actively applied their

expertise to cater to the technology-related requirements of MSMEs, particularly in the areas of environmental and health-related concerns.

v. Impact of the product or technology developed

CRTDH at CSIR-IITR, Lucknow has achieved noteworthy success in offering technological solutions and support to various industries, focusing on environmental and health-related concerns. The development of technology for industrial effluent treatment aligns with the Government's initiatives such as Swachh Bharat and Swasth Bharat, representing a small but significant step in this direction.

The bioremediation technology designed for treating effluents from paper mills is a cost-effective method with exceptionally high removal efficiency. It operates in a decentralized manner, requiring minimal installation space. Beyond its cost-effectiveness, this technology offers significant social benefits as it is environmentally sustainable, producing no foul gases and resulting in minimal pollution discharge.



A 200L lab scale bioreactor and pilot-scale 2000L bioreactor plant deployed at M/s Yash Pakka Limited in Ayodhya based on the technology developed at DSIR-CRTDH at CSIR-IITR, Lucknow

10. BIOCHAR FROM WASTE BIOMASS

i. Company name: M/s Indian Plant Feeds, Cuttack.

ii. CRTDH with which the Company associated: CSIR-IMMT, Bhubaneswar.

iii. Product or technology developed at/with the CRTDH

M/s. Indian Plant Feeds, located in Cuttack, is a manufacturer specializing in organic fertilizers. The company recently entered into a licensing agreement for technology transfer and the demonstration of Nutrient-Enriched Biochar Production from Waste Biomass. M/s. Indian Plant Feeds has successfully established a production plant, and their product is already on the market. The procedure for producing potassium-enriched Biochar was developed by CRTDH at CSIR-IMMT using selected banana plant waste biomass through a pyrolysis process. This product offers the additional advantage of serving as a liming agent due to its highly alkaline nature. This innovative approach has the potential to carve out a niche in the organic-based manure and fertilizer industries. M/s Indian Plant Feeds has collaborated with CRTDH to receive further technical and analytical support, with the goal of bringing more scientific rigor to the organic fertilizer sector.

iv. Role of CRTDH

The CRTDH facility at CSIR-IMMT has played a pivotal role in addressing the issue of waste in banana plantations and supporting local MSMEs involved in organic fertilizer production. Through extensive research efforts, CRTDH has devised a pyrolysis process for the creation of potassium-enriched biochar. The CRTDH team has

meticulously developed the experimental methodologies and subsequently licensed this technology for broader utilization. Within the framework of CRDTH, there are plans to extend efforts towards developing similar marketable products in the coming years. Additionally, CRTDH aims to provide technical and analytical support to further enhance the scientific foundation of the organic fertilizer sector. Moreover, CRTDH has proven to be an invaluable asset to MSMEs by offering educational workshops and promoting partnerships for upcoming research and development initiatives.

v. Impact of the product or technology developed

Banana plantations represent a significant source of income for numerous MSMEs, but they also come with the challenge of managing banana waste. The CRTDH facility at CSIR-IMMT saw this challenge as an opportunity and developed biochar technology. This innovation not only offered the plantation industry an extra source of revenue from waste management but also expanded the product range for local organic fertilizer MSME manufacturers, contributing to their company's growth. This technology effectively addressed both waste management and income generation concerns, while concurrently creating additional employment opportunities within the local community.



Demonstration of K enriched biochar from banana plant waste based on the technology developed at DSIR-CRTDH at CSIR-IMMT, Bhubaneshwar

11. BRASS MELTING FURNACE

i. Company name: M/s Aquatic Industries Private Limited, Bhubaneswar.

ii. CRTDH with which the Company associated: CSIR-IMMT, Bhubaneswar.

iii. Product or technology developed at/ with the CRTDH

Traditional artisan furnaces have a rich cultural and historical legacy, known for their ability to craft exceptional, one-of-a-kind products. However, despite their centuries-old use and undeniable merits, they do come with certain disadvantages, including inefficiency, limited scalability, inconsistent results, environmental impact, laborintensity, and skill dependency. Addressing some of these challenges, the CRTDH at CSIR-IMMT, Bhubaneswar, in collaboration with CSIR-NML, Jamshedpur, has jointly pioneered a breakthrough technology for a "Brass Melting Furnace". This innovative development was licensed to M/s Aquatic Industries Pvt. Ltd., Pipili, to facilitate its commercial production. The newly developed Brass Melting Furnace boasts several significant advantages, including a remarkable 20-40% reduction in energy consumption, a 20% decrease in melting time, reduced pollution, and an impressive 30% increase in productivity.

iv. Role of CRTDH

The furnace was established at the CRTDH Centre within CSIR-IMMT, Bhubaneswar. Subsequently, the furnace underwent further development, accompanied by a demonstration for the industry. The company's officials received training and were guided through the demonstration by CRTDH.

Additionally, CRTDH played a crucial role in facilitating the technology transfer, overseeing furnace installation and construction, and conducting on-site demonstrations at the company's premises.

v. Impact of the product or technology developed

The development of the enhanced furnace technology was driven by a genuine concern for the well-being and progress of artisans engaged in the intricate craftsmanship of brass and bell metal in remote village communities. These artisans have long been integral to their local economies, crafting exquisite pieces of art that are not only culturally significant but also represent their livelihoods. The primary objectives behind this technological advancement were manifold. Firstly, it aimed to ameliorate the working conditions of these artisans, by introducing the improved furnace, which made their workspaces safer, more comfortable, and conducive to their creative process. The technology sought to enhance productivity among these artisans. With more efficient heating and metalworking capabilities, they could produce their exquisite pieces at a faster pace while maintaining the high level of craftsmanship for which they were renowned.

Perhaps most importantly, the introduction of this furnace technology was a testament to its societal impact. It was specifically designed to empower and uplift disadvantaged communities without imposing significant changes to their existing practices. It respected their traditions while providing tangible benefits in terms of safety, productivity, and income generation.

CRTDH effort for improved furnace technology represented a holistic approach to advancing the lives of artisans working with brass and bell metal in remote villages. It addressed various aspects of their craft, from the working environment to product quality and market reach, all while honoring their traditions and empowering them to thrive in an ever-changing world.



Brass Melting Furnace at DSIR-CRTDH at CSIR-IMMT, Bhubaneswar was licensed by M/s Aquatic Industries Pvt. Ltd., Pipili, based on the technology developed at DSIR-CRTDH at CSIR-IMMT, Bhubaneswar and CSIR-NML, Jamshedpur.

12. INCENSE MAKING FROM RICE HUSK

i. Company name: M/s Sandhya Agarbatti Ltd., Adaspur.

ii. CRTDH with which the Company associated: CSIR-IMMT, Bhubaneswar.

iii. Product or technology developed at/with the CRTDH

CRTDH at CSIR-IMMT in Bhubaneswar has achieved a significant technological breakthrough through the utilization of crude thermal pyrolysis for the production of charcoal. This innovative process utilizes locally available paddy husk as the primary raw material. Recognizing the potential of this technology, M/s Sandhya Arati Private Limited, an MSME based in Khorda, embraced this innovation as a means to enhance their production of Agarbatti, which can significantly improve the quality and efficiency of their incense stick production. To facilitate the seamless integration of this new technology into their operations, CRTDH at CSIR-IMMT has actively engaged with M/s Sandhya Arati Private Limited.



Brass Melting Furnace at DSIR-CRTDH at CSIRIMMT, Bhubaneswar was licensed by M/ s Aquatic Industries Pvt. Ltd., Pipili, based on the technology developed at DSIR-CRTDH at CSIR-IMMT, Bhubaneswar and CSIR-NML, Jamshedpur.

iv. Role of CRTDH

CRTDH has played a pivotal role in developing the most efficient process for creating charcoal from rice husk, specifically tailored for incense production. Additionally, CRTDH has conducted a skill development programme focusing on charcoal production, specifically targeting 50 women leaders affiliated with a women's NGO. This initiative has the potential to ripple benefits through the community, reaching many more farmers in the downstream. By equipping these women leaders with essential skills, CRTDH is promoting self-reliance and economic empowerment among a broader segment of the population.

v. Impact of the product or technology developed

The development of charcoal from rice husk, customized for incense production, carries significant implications at both societal and economic levels. It not only promotes responsible utilization of paddy-related waste but also yields substantial benefits. Technological advancements in biochar production for incense making have had a positive impact on approximately 1000 farmers and several self-help groups within the industry.

CRTDH has taken proactive steps by conducting a skill development programme aimed at enhancing charcoal production. This initiative is specially designed for 50 women leaders associated with a women's NGO. The ripple effect of this programme has the potential to extend its benefits throughout the community, reaching an even broader group of downstream farmers. Equipping these women leaders with essential skills not only fosters self-reliance but also empowers them economically.

Moreover, CRTDH's commitment to capacity building extends to the training of 30 Self Help Group Leaders (SHGL) from Khorda District. This training focuses on Agarbati manufacturing using the innovative Charcoal technology derived from locally available rice husk. It's worth noting that these 30 SHGLs represent an extensive network of 1000 groups comprising 15,000 women actively engaged in Agarbati manufacturing.

B: SERVICES RELATED

1: SERVICES OF ADVANCED ANALYTICAL FACILITY AT CRTDH

i. Company name: M/s Neurochem Laboratories Pvt. Ltd, Lucknow.

ii. CRTDH with which the Company associated: CSIR-CDRI, Lucknow

iii. Services availed at CRTDH

M/s. Neurochem Laboratories Pvt. Ltd., Lucknow is a manufacturer of pharmaceutical & veterinary products. As demand for Glycerin IP was increasing in the domestic market, M/s. Neurochem Laboratories Pvt. Ltd too ventured into this market and got a sample of Glycerin IP tested at advanced analytical facility at CRTDH at CSIRCDRI, Lucknow

iv. Role of CRTDH

As part of offering R&D services, consultations, troubleshooting and handholding to pharmaceutical MSMEs, CRTDH at CSIR-CDRI, Lucknow received a glycerin IP sample which was clearing all the test in the analytical facility of the company as a borderline case. However, upon testing in CRTDH, it was found that sample passed the purity test but subsequent test by Infrared spectroscopy and Gas chromatography & mass spectroscopy confirmed the presence of diethylene glycol. In its report, CRTDH informed company about the significant amount of diethylene glycol which has potential to harm human, if ever used as an ingredient.

V. Impact of the product or technology developed

M/s. Neurochem Laboratories Pvt. Ltd., Lucknow acknowledged the presence of advanced analytical facility for the benefit of MSME as most of the MSMEs operate on a tight budget and cannot afford to have high end expensive equipment in their analytical facility. The detection of ethylene glycol and diethylene glycol has avoided the potential tragedies like the 'Cough syrup' tragedy in Africa. Also, presence of impurities prevented wasteful expenditure on an unacceptable quality. Company appreciated the high standards of professionalism maintained by DSIRCRTDH at CSIR-CDRI, Lucknow for the clients, which greatly benefits the business-to-business collaboration among the MSMEs sector.

2. SOLAR GRID TEST FACILITY

i. Company name: M/s Surya Power Technologies, Phatak.

ii. CRTDH with which the Company associated: CSIR- CEERI, Jaipur Campus.

iii. Services availed at CRTDH

The CRTDH facility located at the CSIR-CEERI Jaipur campus has successfully established a ` to aid MSMEs involved in the solar inverter and renewable energy sectors. This facility holds accreditation from the MNRE, being one of the nine recognized centers in India for testing solar products. M/ s Surya Power Technologies requested CRTDH hub, for testing the inverter for its utility interface characteristics, as the system was failing in the real-world scenario. The characteristics for the utility interface for inverters got tested as per IEC61727:2004 on varied parameters. M/s Surya Power Technologies received the tested results as an accreditation guideline.

iv. Role of CRTDH

The CRTDH, situated at the CSIRCEERI Jaipur campus, played a pivotal role in establishing an NABL-accredited testing facility dedicated to grid-tied inverters. By doing so, CRTDH at CSIR-CEERI has effectively responded to the requirements of indigenous manufacturers, particularly MSMEs, who seek to assess their products in accordance with nationally and globally recognized standards. This initiative serves as a catalyst for fostering the production of high-quality products. Notably, this facility specializes in characterizing 6KW inverters, further enhancing its significance in the industry.

v. Impact of the product or technology developed

This facility serves as a crucial hub for supporting MSMEs involved in the electronics and renewable energy sectors, providing essential assistance and resources to advance their products and technologies. Specifically, it aids MSMEs in thoroughly analyzing inverters across a spectrum of load and supply conditions. In essence, this facility empowers MSMEs to enhance their competitiveness by effectively promoting their products to diverse end users and facilitating their participation in tenders. As a result, it significantly amplifies their sales and fosters growth. Moreover, MSMEs can have their products rigorously tested at cost-effective rates by certified centers adhering to international standards.



NABL accredited solar grid testing facility for MSMEs at DSIRCRTDH at CSIR-CEERI, Jaipur extension centre.

3. HEAVY METAL ANALYSIS

i. Company name: M/s Accumax Lab Devices Pvt Ltd. Gandhinagar

ii. CRTDH with which the Company associated: IIT Gandhinagar

iii. Services availed at CRTDH

M/s Accumax Lab Devices Pvt Ltd stands at the forefront of the industry, specializing in the production of laboratory liquid handling instruments, laboratory plastic consumables, and laboratory benchtop equipment. As part of its strategic expansion beyond national borders, the company has introduced innovative offerings, including centrifuge tubes, HDPE, and PP bottles. In pursuit of uncompromising product quality, M/s Accumax Lab Devices Pvt Ltd engaged with the esteemed CRTDH at IIT Gandhinagar for meticulous heavy metal content analysis. The company further collaborated with CRTDH to establish a comprehensive analytical testing methodology for its diverse range of products.

iv. Role of CRTDH

The CRTDH facility at IIT Gandhinagar has set up advanced equipment to assist MSMEs. This center has been instrumental in aiding the growth of M/s Accumax Lab Devices Pvt Ltd by conducting international standard tests for heavy metal content in their products. Accessing the CRTDH facility is convenient, and the CRTDH team proved to be cooperative in devising experimental methodologies and enhancing product quality. Furthermore, CRTDH has been a valuable resource for MSMEs, providing educational workshops and fostering collaborations for future research and development endeavors.

v. Impact of the product or technology developed

Every MSME aspires to achieve global recognition by aligning their product line with international standards. However, it often becomes financially unfeasible for MSMEs to procure specialized analytical equipment. M/s Accumax Lab Devices Pvt Ltd overcame this challenge by leveraging the expertise of CRTDH to conduct heavy metal analysis on their product. This decision greatly benefited the company, ensuring that their product met the requirements for international exports. By manufacturing their product cost-effectively, Accumax Lab Devices Pvt Ltd contributed to the generation of foreign revenue, thereby making a significant national impact. The company's approach and products serve as a remarkable source of inspiration for others looking to emulate their path towards becoming global players.

4. VALIDATION AND PRODUCT OPTIMIZATION

i. Company name: M/s Arun Industrial Products. Kheda

ii. CRTDH with which the Company associated: IIT Gandhinagar

iii. Services availed at CRTDH

M/s Arun Industrial Products is a prominent manufacturer and exporter of AHC (Aluminium Hydroxide Chloride), paper sizing chemicals, water treatment, and food chemicals. The introduction of AHC product faced initial obstacles due to the absence of a validated method and product optimization for diverse sewage treatment plant (STP) waters. M/s Arun Industrial Products got its comprehensive feasibility study of our AHC products for sewage treatment and developed R&D trials and scale-up studies at CRTDH facility at IIT Gandhinagar. Company got its doses of AHC optimized in liter scale (200 L and 400 L) for various STP effluents. Optimized AHC solutions were later put to the test at IIT Gandhinagar's sewage treatment plant, demonstrating their effectiveness and reliability in real-world applications. M/s Arun Industrial Products greatly benefitted upon having the proper validated data for making sales in the market.

iv. Role of CRTDH

M/s Arun Industrial Products received comprehensive support from CRTDH in getting the feasibility report on the product which it intent to sell in market. CRTDH actively facilitated by conducting varied R&D trials and scale-up studies at CRTDH facility. CRTDH even went further in seeking permission from GPCB in letting IIT Gandhinagar STP being used for trial run. CRTDH at IIT Gandhinagar played a pivotal role in providing detailed report to the company which enabled the later in making sales in the market and for the growth & credibility of the company. Such was the cooperation and contribution of the CRTDH in the validating the product, that same product was available in the market and giving good business. As part of appreciation, company gifted CRTDH a 1000 L STP skid-mounted wastewater treatment plant for the benefit of other MSME members.

v. Impact of the product or technology developed

AHC (Aluminum Hydroxide Chloride) assumes a pivotal role in the purification of industrial wastewater, ensuring the removal of pollutants and contaminants prior to its safe release into the environment. While M/s Arun Industrial Products stands as the foremost producer of AHC, the introduction of this critical product to the market initially encountered obstacles due to the absence of validated methodologies and product optimization strategies tailored to various types of sewage treatment plant (STP) water. Upon receiving the essential optimization data and successful validation, M/s Arun

Industrial Products was able to bring this product to the market, subsequently experiencing robust business growth. This development marks the successful release of a product into the market, supported by thorough validation. Having such validated product holds a significant environmental implication and serves as a catalyst for positive environmental impact.



Trail runs of AHC products of M/s Arun Industrial Products for sewage treatment at 200 L and 400 L scale at DSIR-CRTDH at IIT-Gandhinagar

5. PRODUCT VALIDATION & TESTING

i. Company name: M/s Royal Enterprises, Chennai, Tamil Nadu

ii. CRTDH with which the Company associated: CSIR-CSIO (Madras Complex)

iii. Services availed at CRTDH

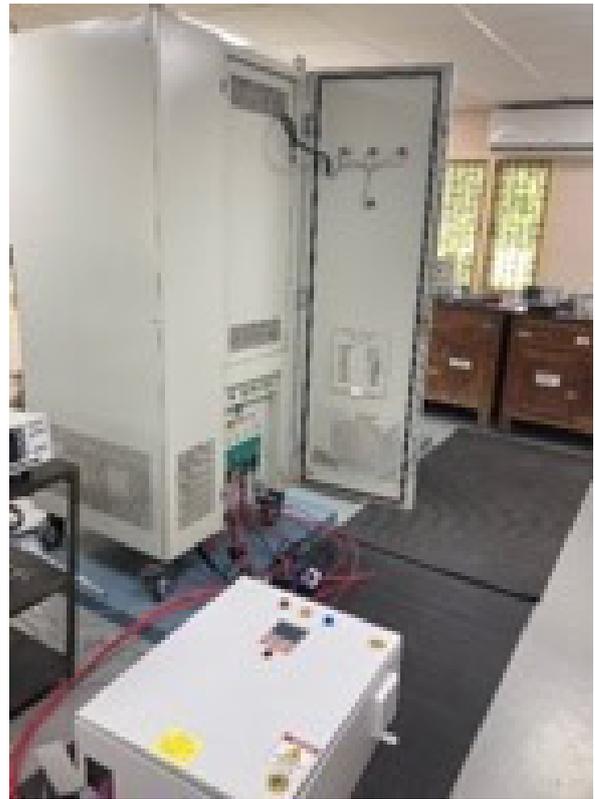
M/s Royal Enterprises has successfully engineered an Automatic Power Factor Controller (APFC) Unit, and before commencing sales, the company meticulously subjected it to a battery of tests and assessments. These evaluations encompassed a wide array of parameters, including Performance Verification, Energy Efficiency, Safety, and Regulatory Compliance, all of which were conducted at the prestigious CRTDH facility located within the CSIR-CSIO (Madras Complex). By collaborating with the CRTDH facility at CSIR-CSIO (Madras Complex), M/s Royal Enterprises was able to conduct an exhaustive feasibility study tailored to their APFC product.

iv. Role of CRTDH

M/s Royal Enterprises received comprehensive support from CRTDH in getting the test report on the product developed. CRTDH at CSIR-CSIO (Madras Complex) has the requisite infrastructure which actively facilitated in conducting Performance Verification, Energy Efficiency, Safety, and Regulatory Compliance test. This strategic partnership proved immensely beneficial, as it provided Royal Enterprises with the indispensable validated data necessary for launching the product and achieving successful market penetration.

v. Impact of the product or technology developed

In-house R&D of M/s Royal Enterprises has developed an indigenous Automatic Power Factor Controller (APFC) Unit, which intends to manage and optimize the power factor of an electrical system. Having received assistance from CRTDH at CSIRCSIO (Madras Complex) in terms of robust performance metrics and safety assurances, Royal Enterprises was well-positioned to introduce its APFC Unit to the market and embark on a successful sales journey. This cooperation with CRTDH marks the successful release of the product into the market, supported by thorough inspection. Having such thoroughly examined product holds a significance towards 'Atmanirbharta' and duly supports 'Make in India' initiative and 'Zero Defect Zero Effect' (ZED) practices.



Test setup for APFC for the benefit of MSMEs at DSIR-CRTDH at CSIR-CSIO, Madras complex.

THE WAY FORWARD

To realize India's ambitious goal of becoming a \$5-trillion economy, the vital role of the MSME sector cannot be overstated. Strengthening this sector is essential for achieving self-reliance, self-sufficiency, and addressing various challenges. The path to a self-reliant nation lies in the development led by innovation. Government and policymakers have consistently emphasized the need to boost the contribution of MSMEs across sectors by creating a conducive innovation ecosystem. The sector has faced its share of challenges, including demonetization, implementation of GST, COVID-19 pandemic etc. The pandemic in particular, has led to the closure of numerous MSME units.

A lot has changed during the last ten years, in every aspect of our lives. The world is rapidly evolving with emerging technologies like Artificial intelligence, Machine Learning, Augmented Reality, Blockchain, Internet of Things (IoT), Robotics, etc. and are making their way into every aspect of business operations. MSMEs and start-ups have a tremendous opportunity to leverage these advancements for their growth and success and need to adopt new technologies to stay relevant with time. By incorporating innovative tools and digital solutions into their operations, MSMEs can streamline processes, enhance productivity, and improve efficiency. Technology adoption enables them to automate tasks, manage inventory, track sales and customer data and optimize supply chain management.

Embracing technology opens doors to new market opportunities by expanding MSMEs reach through e-commerce platforms and digital marketing strategies. It not only enhances their overall competitiveness but also enables them to adapt to changing market dynamics, stay ahead of the competition and fuel sustainable growth in the long run. Recognizing the significance of technology, actively adopting it has become a strategic imperative for MSMEs aiming to thrive, in the modern business landscape. However, lack of awareness and accessibility are the biggest obstacles, hindering adoption of futuristic technologies by the MSMEs and start-ups. The CRTDHs can play a very important role in this direction and can help MSMEs to adopt the new and futuristic technologies in their work place.

To compete effectively in the global market, MSMEs must focus on implementing modern technology, developing indigenous technology and collaborating with global partners. Research & Development is essential in helping MSMEs to be competitive in the market. A technology-enabled sector levels the playing field to a significant extent between MSMEs and their global counterparts. The rapid pace of change is bringing customers, businesses, and technology firms closer, with disruptive technological changes like social media, mobility, analytics and cloud computing, creating new opportunities.

Regarding indigenous technology development, various stakeholders, including industry bodies, academia, government, and large enterprises, need to collaborate across sectors such as IT, Electronics, Manufacturing, Pharmaceuticals, and Biotechnology. Together, they can elevate MSMEs in the value chain, encouraging innovation and automation. Local institutions and academia can establish cluster-specific incubation centers to provide guidance on technology

implementation, development, and scaling up. They should also partner with the industry, especially MSMEs, on research initiatives and offer technology support to commercialize innovative products and services. This collaborative effort will empower MSMEs to thrive in a technology-driven landscape and contribute significantly to India's economic growth.

In conclusion, MSMEs are the backbone of the Indian economy and to make them globally competitive a multifaceted effort which relies on the collaboration of various stakeholders is required. Thus, Government, industry associations, educational institutions and financial entities need to work in harmony in a way that the innovation potential of India's MSME sector can be fully unleashed. This, in turn, would propel economic growth and competitiveness, not only within India but also on the international stage, positioning India as a hub for innovation and technological advancement.

NOTABLE EQUIPMENT AVAILABLE WITH EACH CRTDH

CSIR-CCMB, Hyderabad

i. Microarray; ii. Proteomics Facility; iii. DNA Sequencer; iv. Advanced Microscopy; v. Electron Microscopy; vi. X-Ray Crystallography; vii. Bioinformatics; viii. NMR; ix. Realtime PCR; x. Spectrophotometer; xi. Nano fibre electrospinning unit; xii. HPLC; xiii. Fluorimeter; xiv. 3D Printer.

CSIR-CDRI, Lucknow

i. HPLC; ii. NMR; iii. LC-MS/MS; iv. FTIR Spectrometer; v. UV-visible Spectrophotometer; vi. Digital flame photometer; vii. Polarimeter; viii. Gas pycnometer; ix. Microplate Reader; x. Rapid Mixer; xi. PCR; xii. Capsule filling machine; xiii. Ball mill 2L; xiv. Fluid bed processor; xv. granulator; xvi. GMP-compliant R&D scale pharmaceutical manufacturing equipment; xvii. BSL-3 Microbiology/ Tissue Culture lab.

CSIR-CEERI, Pilani (Jaipur Campus)

i. Grid Simulator (30 kVA); ii. PV array simulator (4* 15 kW); iii. Smart RLC load; iv. SMT Pick & Place Machine; v. UV-Vis-NIR spectrometer; vi. FTNIR Spectroscopy.

CSIR-CMERI, Durgapur

i. Debinding furnace; ii. Sand testing Equipments; iii. Drying Oven; iv. Sigma Blade mixer; v. Brinell hardness Tester; vi. Vicker's hardness Tester; vii. Vacuum sintering furnace; viii. Micro Feed Hydraulic Surface Grinder; ix. Hydraulic Press Brake with NC System; x. Injection moulding machine; xi. Dewaxer; xii. Heat treatment furnace.

CSIR- CSIO, Chandigarh (Madras Complex)

i. 30 kVA Solar Inverter Test Facility; ii. Solar Photovoltaics (SPV) Test Facility; iii. Electronic Design & Development Facilities.

CSIR-IHBT, Palampur

i. Viscometer; ii. Encapsulation unit; iii. Vacuum packaging machine; iv. Pulveriser wet/dry; v. Rotary evaporator; vi. Centrifugal separator.

IIT Gandhinagar, Gandhinagar

i. ICP-MS/OES; ii. Fluorescence Spectrometer; iii. Plate Reader; iv. GC; v. Fermenter; vi. HPTLC; vii. 1000 L ETP & STP; viii. 1000 L MBR; ix. 50L CSTR.

IIT Kharagpur, Kharagpur

i. Pilot plant for manufacturing for paper-based diagnostic kits; ii. Data Science R&D unit; iii. Device prototype fabrication unit; iv. Lateral flow strip manufacturing unit; v. Bio-Safety labs (L2); vi. Rapid prototyping unit; vii. Microfluidic cell culture and analysis unit; viii. Imaging

lab; ix. Laser Cutter; x. 3D Printer; xi. PCB printer; xii. LFA manufacturing device; xiii. Injection Moulding; xiv. 5 axis CNC

IIT Roorkee

i. Free Space Measurement for Transmission and reflection loss of EM wave in microwave region; ii. Radar Cross Section (RCS) measurement; iii. EM radiation level from different communication devices; iv. Thermal absorption of camouflage network and Radar Imaging; v. Vector Network Analyzer Measurement of complex- Coaxial Waveguide; vi. Coaxial Probe Liquids & Rectangular Waveguide.

CSIR-IITR, Lucknow

i. LC-MS; ii. GC-MS; iii. Gas Chromatography; iv. HPLC; v. Atomic Absorption Spectrophotometer; vi. Atomic Florescence Spectrophotometer; vii. FTIR Spectrometer; viii. ZetasizernanoZS; ix. IPC MS/AFM-Raman; x. Electron Microscope; xi. Atomic Force Microscope; xii. 3-D Printing, Spectrophotometer; xiii. Electrospinning Coater; xiv. Flue gas Analyzer; xv. Portable Fine Dust Aerosol Spectrometer; xvi. Colorimeter; xvii. Bioreactor

CSIR-NIIST, Thiruvananthapuram

i. GC-MS/MS; ii. Nitrogen Generator; iii. Flue Gas Analyzer; iv. Dynamic Olfactometer; v. UV-Vis Spectrophotometer; vi. ICP-MS; vii. Drum mill; viii. Continuous Flow Auto Analyzer; ix. Stereomicroscope,

NIPER, SAS Nagar (Mohali)

i. SS Reactor 100L – 1000L; ii. Nauta Dryer; iii. Vacuum tray dryer; iv. Multi- mill; v. Sifter; vi. Drum blenders; vii. SS 316 Nutch filter; viii. HPLC system; ix. Spectrophotometer; x. GC system,

NIT-AP, Tadepalligudem

i. Micro Grid Setup consisting of solar, wind and energy storage technologies.; ii. FPGA based hardware in loop real time controllers for rapid prototyping; iii. Solar and Wind energy emulators; iv. Programmable high precision AC/DC power sources; v. Programmable AC/DC electronic loads; vi. Three phase power quality analyzer and insulation.

CSIR-IMMT, Bhubaneshwar

i. Universal Testing Machine (UTM); ii. Tribometer; iii. TGA-DTA; iv. Furnace; v. RF power supply; vi. Semi automatic variable speed polishing machine; vii. Precision Cutting Machine; viii. 1000 kN Computerized Servo-controlled UTM

DPSRU, New Delhi

i. Pilot-scale GMP manufacturing, ii. Imaging facility (In vivo & In vitro); iii. Product characterization & evaluation facility; iv. IVIS (Small Animal In vivo imaging system); v. Hot Melt extruder; vi. Differential scanning calorimeter (DSC); vii. HPLC; viii. Fourier transform

infrared (FT-IR); ix. Malvern Zetasizer; x. Particle size Analyzer; xi. Rheometer; xii. Microfluidizer; xiii. Nano Spray Dryer; xiv. UV Spectrophotometer.

IIT Guwahati

ICP-MS/ Shed For Translational Research

IIT Bhilai

i. ICP-OES; ii. Glove Box with Cold Well Material Characterization Laboratory

CSIR-NCL, Pune

i. Solvent purification system; ii. Gas-purification system; iii. Initiator synthesis system; iv. Skid for polymerization; v. Rotavap for solvent recovery.

ABBREVIATION

AH	Affordable Health
AHC	Aluminum Hydroxide Chloride
AI	Artificial Intelligence
APFC	Automatic Power Factor Controller
BIG	Biotechnology Ignition Grant
CAM	Computer Aided Manufacturing
CCMB	Centre for Cellular and Molecular Biology, Hyderabad
CDRI	Central Drug Research Institute, Lucknow
CDSCO	Central Drugs Standard Control Organization
CEERI	Central Electronics Engineering Research Institute, Pilani
CMERI	Central Mechanical Engineering Research Institute, Durgapur
COVID	Corona Virus Disease
CRTDH	Common Research and Technology Development Hubs
CSIO	Central Scientific Instruments Organisation
CSIR	Council of Scientific & Industrial Research
DGCIS	Directorate General of Commercial Intelligence and Statistics
DNA	Deoxy-ribo Nucleic Acid
DPIIT	Department for Promotion of Industry and Internal Trade
DPSRU	Delhi Pharmaceutical Sciences and Research University
DSIR	Department of Scientific and Industrial Research
EHP	<i>Enterocytozoonhepatopenaei</i>
EI	Environmental Intervention
ERE	Electronics/Renewable Energy
FY	Financial Year
GC-MS	Gas chromatography–Mass spectrometry
GDP	Gross Domestic Product
GPCB	Gujarat Pollution Control Board
GST	Goods and Services Tax
GVA	Gross Value Added
HPLC	High Performance Liquid Chromatography
I-STEM	Indian Science, Technology, and Engineering facilities Map
ICU	Intensive Care Unit
IHBT	Institute of Himalayan Bioresource Technology, Palampur
IHHNV	Infectious Hypothermal and Hematopoietic Necrosis Virus
IISc	Indian Institute of Science, Bangalore
IIT	Indian Institute of Technology
IITR	Indian Institute of Toxicology Research, Lucknow
IMMT	Institute of Minerals and Materials Technology, Bhubaneswar
IP	Intellectual property
LCM	Low Cost Machining
ML	Machine Learning
MNRE	Ministry of New & Renewable Energy

MoMSME	Ministry of Micro, Small, and Medium Enterprises
MoU	Memorandum of Understanding
MSME	Micro, Small, and Medium Enterprises
MSMED	Micro, Small, and Medium Enterprises Development
NABL	National Accreditation Board for Testing & Calibration Laboratories
NCL	National Chemical Laboratory, Pune
NGO	Non Governmental Organization
NIIST	National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram
NIT-AP	National Institute of Technology– Andhra Pradesh
NMCP	New Materials/Chemical Processes
NML	National Metallurgical Laboratory, Jamshedpur
NMR	Nuclear Magnetic Resonance spectroscopy
PCR	Polymerase Chain Reaction
PFRI	Public Funded Research Institutions
pH	potential of Hydrogen
PSA	Principal Scientific Advisor
R&D	Research and Development
RO	Reverse Osmosis
SDGs	Sustainable Development Goals
SHGL	Self Help Group Leaders
SMT	Surface Mount Technology
STP	Sewage treatment plant
USD	United States Dollar
WSSV	White Spot Syndrome Virus
ZED	Zero Defect Zero Effect

REFERENCES

1. Resolution adopted by the General Assembly on 6 April 2017, United Nations (A/RES/71/279)
(<https://documents-dds-ny.un.org/doc/UNDOC/GEN/N17/095/09/PDF/N1709509.pdf?OpenElement>)
2. Annual report 2022-23 of Ministry of MSME (MoMSME).
(<https://msme.gov.in/sites/default/files/MSMEANNUALREPORT2022-23ENGLISH.pdf>)
3. Role of MSME Sector in the Country.
(<https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1946375>)
4. Rajya Sabha Unstarred Question No. 1505 'Measures to Improve MSME Sector Exports'.
(<https://pqars.nic.in/annex/255/AU1505.pdf>)

Editorial Team



Dr. Sujata Chaklanobis
Chief Editor



Dr. Vipin. C. Shukla
Associate Editor



Dr. Suman Mazumdar
Content writer & Editor

CRTDH Team at DSIR

1. Dr. Sujata Chaklanobis, Scientist G & Head CRTDH
2. Dr. Vipin C. Shukla, Scientist F and Member Secretary CRTDH
3. Dr. Ranjeet Bairwa, Scientist E,
4. Dr. Suman Mazumdar, Scientist – E
5. Dr. Kailash C. Petkar, Scientist -D

CRTDH Coordinators

1. Dr. A Vijaya Laxmi, CSIR-CCMB, Hyderabad
2. Dr. Amit Misra, CSIR-CDRI, Lucknow
3. Dr. Amol Kulkarni, CSIR-NCL, Pune
4. Dr. Anand V. P., CSIR-CSIO (Madras Complex), Chennai
5. Dr. K. P. Prathish, CSIR-NIIST, Thiruvananthapuram
6. Dr. Mahesh Gupta, CSIR-IHBT, Palampur
7. Dr. Maneesh, NIPER, SAS Nagar (Mohali)
8. Dr. R. Parthasarathi, CSIR-IITR, Lucknow
9. Dr. Sai. K. Veddadi, CSIR-CEERI, Pilani (Jaipur Centre)
10. Dr. Sanjib Banerjee, IIT Bhilai
11. Dr. S. Y. Pujar, CSIR-CMERI, Durgapur
12. Dr. V. Sandeep, NIT-AP, Tadepalligudem
13. Dr. Yatendra S. Chaudhary, CSIR-IMMT, Bhubaneswar
14. Prof. Chinmay Ghoroi, IIT Gandhinagar
15. Prof. Dharmendra Singh, IIT Roorkee
16. Prof. Geeta Aggarwal, DPSRU, New Delhi
17. Prof. Suman Chakraborty, IIT Kharagpur
18. Prof. Vimal Katiyar, IIT Guwahati

**DEPARTMENT OF SCIENTIFIC & INDUSTRIAL RESEARCH
MINISTRY OF SCIENCE & TECHNOLOGY
GOVERNMENT OF INDIA**