UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

DIAGNOSTIC REPORT

Enhancing Productivity in the Indian Bicycle Sector

DIAGNOSTIC REPORT

Enhancing Productivity in the Indian Bicycle Sector

Copyright © United Nations Industrial Development Organization, 2019

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialised” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

The opinions, statistical data and estimates contained in signed articles are the responsibility of the author(s) and should not necessarily be considered as reflecting the views or bearing the endorsement of UNIDO. Although great care has been taken to maintain the accuracy of information herein, neither UNIDO nor its member states assume any responsibility for consequences which may arise from the use of the material.

Designed by Athenea International/Omnilang.

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

2019

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

ACKNOWLEDGEMENTS

The 'Diagnostic Report' was drafted in the context of the UNIDO project titled 'Development and Adoption of Appropriate Technologies for Enhancing Productivity in the Indian Bicycle and Bicycle Parts Sector', supported by the Department for Promotion of Industry and Internal Trade (DPIIT), Government of India. The project was implemented by UNIDO's Department of Trade, Investment and Innovation (TII), under the directorship of Dr. Bernardo Calzadilla-Sarmiento and was managed by Mr. Farrukh Alimdjanov.

The content of the report is the work of the UNIDO technical expert, Mr. Jan Haraldsen. The results presented in this report have been reviewed and edited by Dr. Ritin Koria, Mr. Vikas Kumar and Ms. Shraddha Srikant.

Proofreading was undertaken by Ms. Lauren Cooke, and final layout and design was undertaken by Mr. Mauricio Mondragon.

Furthermore, we would like to extend thanks to the staff of the Research and Development Centre for Bicycle and Sewing Machine (RDCBSM), the All India Cycle Manufacturers' Association (AICMA) and the United Cycle and Parts Manufacturers Association (UCPMA) for their support during the data collection process and active participation in project activities.

EXECUTIVE SUMMARY

The United Nations Industrial Development Organization (UNIDO) has implemented a project titled '*Development and Adoption of Appropriate Technologies for Enhancing Productivity in the Indian Bicycle and Bicycle Parts Sector*', in collaboration with the Department for Promotion of Industry and Internal Trade[1] (DPIIT), Ministry of Commerce and Industry, Government of India.

India's bicycle industry is the second largest in the world, producing approximately 15-16 million bicycles, and accounting for approximately 10% of world production (AICMA 2017). The industry faces several challenges, such as increased competition from imports, poor manufacturing practices, the continued production of low-end ("traditional") bicycles, and the usage of dated technology. A majority of Indian bicycle manufacturers are currently unable to make and sell the type of bicycles demanded in global markets, which are aesthetically and technically superior, are made from lighter materials, allow multiple-speed settings and require several special components. There is a need to build awareness and knowledge on the latest technologies, institutional facilities for product design, processes and testing, communication/network with the international bicycle industry, global market intelligence for bicycle design and awareness of global best practices and manufacturing processes.

The project aimed to support the Indian bicycle industry by strengthening the capacity and capability of the nodal technical institution for the sector - the Research and Development Centre for Bicycle and Sewing Machine (RDCBSM) - and select industry associations - the All India Cycle Manufacturers' Association (AICMA) and the United Cycle and Parts Manufacturers Association (UCPMA) - to provide better management and technical support to the industry, with the aim to strengthen the global competitive position of the Indian bicycle sector. The project activities include a range of technical capacity building and knowledge sharing activities including: technical workshops; international study tours; fellowship training; twinning with international counterparts; training of trainers; structured expert dialogue as well as upgrading the RDCBSM's testing facilities.

The project activities were preceded by a diagnostic component, which included a diagnostic assessment of the RDCBSM and the two associations through a structured consultative process that included analysis of relevant background material, development of an interview guide and interactions with the main stakeholders of the Indian bicycle industry. This assessment was done with the aim of correlating the needs and challenges of the Indian bicycle industry with the RDCBSM's response to, and capabilities in, meeting these requirements. A number of key findings, of importance to the industry and the main beneficiary institutions, have been identified and reflected in this report.

The diagnostic assessment covered both, institutional and technical aspects, with a focus on the RDCBSM's interaction with the industry associations as well as: alignment of the RDCBSM's services to industry needs; R&D selection and priority criteria; management; organisation; skills and infrastructure; attractiveness and recruitment, and financial resources and effectiveness of its service portfolio and expertise.

[1] Formerly known as Department of Industrial Policy and Promotion (DIPP).

The key findings from the institutional assessment are as follows:

» The RDCBSM is generally regarded by the industry as a well-qualified institute with adequate professional skills among their staff for bicycle and parts testing, calibration services, training and common facilities/workshop for tooling. However, there is a need for the service portfolio and expertise offered to be upgraded in line with the changing needs of the industry, best available technologies and global best practices.

» No clear vision or strategy has been observed in order for the RDCBSM to function as a guide for the management to develop the RDCBSM in line with industry needs and expectations, other than a survival plan. In this aspect, no clear instruction and mandate for the leadership role has been observed.

» No clear description of the functioning of the management team, in terms of developing the capabilities and skills of the organization to meet future requirements from the market, has been observed. Especially the development of change and transformation skills seems to be lacking. A clear delegation of power and organisation into more autonomous teams around the individual areas of responsibility should ease this, as well as a management with clear objectives, that communicates these objectives and works closely with its clients.

» At all levels in the organization, the interaction with industry is fragmented and it appears that there could be more focus towards customer orientation driving the activities of the institute. Neither a strategy plan nor specific marketing plans have been observed. The interaction with industry to formulate project proposals and prioritization of projects seems to be limited.

» Outside the framework of the Governing Council (GC), there is no observation of regular roundtable discussions or workshops with industry management to discuss and set a common development direction for both the RDCBSM and the industry. Initiatives taken by the industry associations to upgrade, develop and qualify the vendor network in order to reposition the industry competitiveness exist. There is, however, no observation of interaction with, or involvement of the RDCBSM in these initiatives. The budget planning and process of decision-making within the GC framework appears to be unclear.

» A stop in supportive government grants and reduced financial resources have gradually limited the institute from filling up sanctioned positions of staff. Instead, the majority of positions are currently contract-based, opening up for higher flexibility in adaption to financial targets and building skills. However, an analysis of the actual and planned utilization of this flexibility better serving the industry has not been observed.

» Recruitment to positions at the RDCBSM, and to the bicycle industry in general, is challenging. However, there are few signs of common initiatives taken between academia, the RDCBSM and the industry to create more attractive career paths for new candidates.

» Fundamental career planning is not observed. A tighter collaboration and integration with academia, for example the Indian Institute of Technology (IIT), the National Institute of Design (NID) or other prestigious institutes, could open up harmonized brand building and the creation of more attractive career opportunities. The report also addresses the increased possibilities of, and impact from, mutual placement programmes being made between industry and the RDCBSM as a structured and regular mechanism.

» A positive transition of the RDCBSM to be a more market-oriented R&D institute, with a higher degree of robust and combined financial support from industry and governmental funds, is recommended and discussed in the report. This will require the upgrading of campus facilities related to more modernized and scaled up pilot plant facilities, in line with industry expectations and requests, subject to funds mobilization.

» The governance of the RDCBSM, such as the prioritization of R&D programmes and projects or approvals of budget plans, is observed to be influenced by the industry in a very limited way. A more distant control by the government is discussed, where the industry representatives are given influence in prioritization and decision-making to a much higher degree.

The recommended actions are provided and listed in Chapter 13 of the report, outlined in short, medium and long-term perspectives. The major recommendations related to our key findings are:

» Develop a clear strategy for the RDCBSM, based on a well-defined SWOT analysis, and fully supported and participated by the industry

» Develop and implement a set of key performance indicators (KPIs) to follow up and measure performance and compliance with strategies and goals

» Enable and uplift market and customer orientation as the key drivers of the RDCBSM, implying frequent and structured interaction with industry and industry associations

» Clarify and formalize the RDCBSM GC governance role and importance to create a more planned and structured initiation, definition, execution and evaluation of R&D activities

» Initiate frequent roundtable discussions with a representative sample of bicycle industry leaders, to ensure consistent compliance with industry needs and expectations

» Develop a structured outreach and market assessment programme, driving the service offering and R&D activities

» Utilize consultancy, as tools and means, to reach the industry and create a more proactive behaviour with and towards industry

» Upgrade the campus facilities and embedded design and engineering skills to comply with international standards, by working closely with industry associations and government to implement the indicated CDS supported transition of the RDCBSM

» Clear objectives for organizational and skills development, derived as a consequence of the strategy document, to comply with global competition and standards

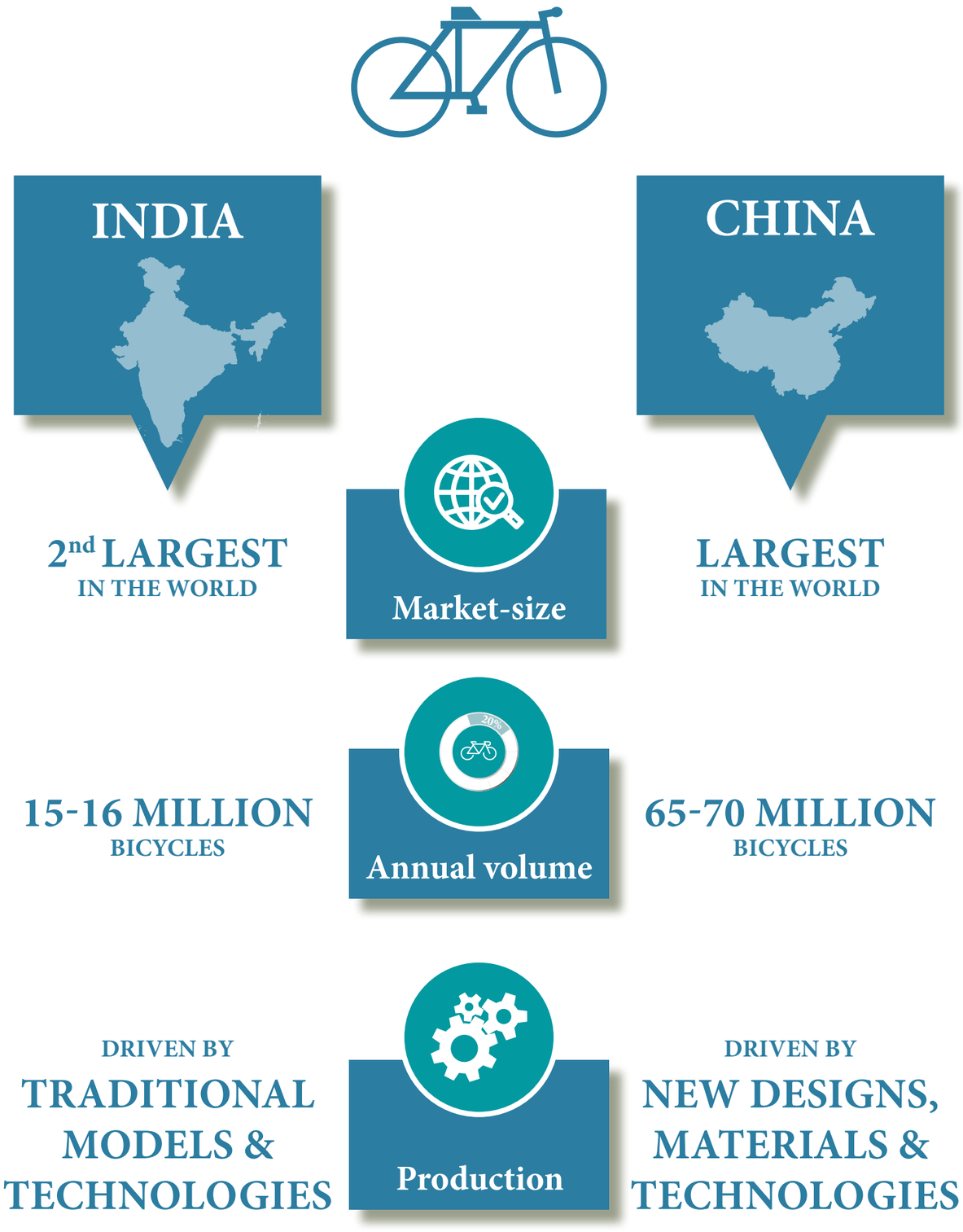
» Upgrade recruitment and career planning possibilities to ensure an attractive and dynamic work environment with compliant and requested expertise

» Implement technology and knowledge transfer from domestic and international leading institutions as a prioritized part of the RDCBSM's services and activities through structured collaboration with universities and recognized R&D institutions

» Secure the sustainability of financial resources needed to support and secure the upgrading and transition of the RDCBSM as a joint collaboration between government funding/schemes, direct industrial financial commitment, increased industry sponsored activities and academia interactions

It has also been observed that the RDCBSM faces several technical skill and knowledge gaps, and has largely stagnated in skill/ technologies development and transfer to the industry. The R&D centre hasn't necessarily kept abreast with global market developments and the associated production practices, and is therefore not in a position to provide guidance to the industry for relatively newer products and technologies or facilitate the necessary technology sharing. There is very limited research activity at present, with considerable potential in product development, trouble-shooting services, and applied research for adoption of emerging/ new technologies. Furthermore, there could also be a greater focus on activities for continuous technology development in partnership with the industry. The training areas should also be more in line with industry's needs. This is also the case with the testing services, with industry requiring increasing testing support for international and material/ component specific certifications. Overall, the skill levels of the staff must be enhanced for them to effectively assist the industry.

Based on the findings of the diagnostic assessment, several recommendations for a more robust service portfolio and areas in which capacity-building initiatives would benefit the RDCBSM personnel have been identified. The recommendations are oriented towards strengthening the RDCBSM's expertise level and service offerings, and towards making it a dynamic nodal point to coordinate and facilitate the adoption of modern manufacturing practices for an overall increase in the competitiveness of the Indian bicycle industry. For the R&D centre to be able to better support the industry in line with global market requirements, there is a clear need to build the capacity and expertise of the R&D centre in areas such as: the material behaviour of aluminium alloy and the requisite processing (e.g. extrusion, heat treatment, butting, hydroforming, permanent mould casting); material identification; composition and behaviour analyses (applicable to high-strength steel, carbon fibre, titanium, etc.); design of jigs, fixtures, dies and moulds, as applicable for different materials; PLC automation in bicycle manufacturing units; production efficiency and lean manufacturing; design competence and componentry design; the manufacturing of critical components; efficient test execution and result analysis, among others. The RDCBSM would then be in a position to deliver services such as applied R&D, product development, the operation of a pilot facility for high-end bicycles, quality testing and certification, worker training, critical consultancy services, etc. to the industry.



1 INTRODUCTION

The United Nations Industrial Development Organization (UNIDO) has implemented a project titled '*Development and Adoption of Appropriate Technologies for Enhancing Productivity in the Indian Bicycle and Bicycle Parts Sector*', in collaboration with the Department for Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce and Industry, Government of India.

The project aimed to support the Indian bicycle industry by strengthening the capacity and capability of the nodal technical institution for the sector - the Research and Development Centre for Bicycle and Sewing Machine (RDCBSM) and select industry associations - to provide better management and technical support to the industry to strengthen the global competitive position of the Indian bicycle sector. The identified industry associations were the All India Cycle Manufacturers' Association (AICMA) and the United Cycle and Parts Manufacturers' Association (UCPMA).

A technical diagnostic assessment was also conducted under the project to understand the main technological hurdles and challenges of the industry and to assess how the RDCBSM and the associations are positioned to help the industry meet these challenges, especially by focusing on the service offerings and expertise levels. This assessment also identified the main areas in which the RDCBSM and the associations would require capacity building and knowledge transfer activities. For a wholesome evaluation of the organizations, the technical assessment was underpinned and supported by a thorough diagnostic assessment of the managerial and organizational capabilities of the RDCBSM. The combined findings are reflected in this report.

The diagnostic assessment of the RDCBSM was conducted with the aim of correlating the needs, demands, expectations and challenges of the Indian bicycle industry with the RDCBSM's response to, and capabilities in, meeting these demands and expectations. A set of areas in context to the RDCBSM were assessed, which were mainly: management; organisation; strategy; competence and skills; industry interactions; governance; financial structures and capabilities; facilities and infrastructure; interaction with academia and national and international competence centres and services provided, and the R&D programmes, their selection criteria and actual impact in industry. Based on the detailed assessment, this report presents recommended actions for improvement.

The execution model of the study is based on collecting information through a semi-structured approach. The main elements of the model applied have been:

- Initial assessment of available background information, analyses, reports and market data[1]
- Based on the background material, a set of key hypotheses was developed
- A comprehensive interview guide was developed to be the basis for a number of interviews with selected key people on-site, in India[2]
- Selection of a representative sample of people for interviews, selected from the RDCBSM staff, the industry, industry associations and the Punjab state government
- Visit to India to conduct interviews with stakeholders of the bicycle industry. Altogether, 26 individual one-to-one interviews were executed
- Compilation of the different findings and observations made into a report and a presentation containing key findings and recommendations

The report is structured as follows:

The Executive Summary summarizes in brief the major observations and findings.

Chapter 1 provides an introduction to the report.

Chapter 2 presents the theoretical underpinnings for the diagnostic, particularly from the perspective of organizational innovation.

Chapter 3 presents a brief description of the status of the Indian bicycle industry as well as the status of the RDCBSM.

Chapter 4 provides an assessment of the strategic and overall drivers of the RDCBSM, in terms of its mandate and role, its key strategy, ambitions and goals. It also provides an analysis of the RDCBSM's service portfolio.

Chapter 5 discusses the governance structure of the RDCBSM and the associations.

Chapter 6 presents an analysis of the RDCBSM's orientation towards the bicycle industry.

Chapter 7 presents RDCBSM's relation to the Indian government and the Punjab state government and compares the controlling and governance structure to other equivalent institutes in other regions of the world. It also discusses the different structures and opportunities for the RDCBSM to play a dominant role in advocating industrial policies.

Chapter 8 discusses the formulation, prioritization, execution and implementation of the services provided by, and the R&D projects executed by and within the RDCBSM.

Chapter 9 presents different aspects related to the RDCBSM's observed capabilities in terms of management skills and practice, scientific and technical skills, and organisation infrastructure and facilities.

Chapter 10 assesses and discusses the defined and applied recruitment policies of the RDCBSM, as well as existing educational programmes.

Chapter 11 discusses the marketing, dissemination strategies and activities of the RDCBSM.

Chapter 12 assesses and discusses the financial base of the RDCBSM; how revenues are created, as well as initiatives for increasing revenue creation.

Chapter 13 presents the key findings from each of the sections of the assessment given in this report and provides a recommended action plan.

[1] List of documents; Annexure 1.
[2] Interview guide; Annexure 2.

> "The project aimed to support the Indian bicycle industry by strengthening the capacity and capability of the nodal technical institution for the sector - the Research and Development Centre for Bicycle and Sewing Machine (RDCBSM) and select industry associations - to provide better management and technical support to the industry to strengthen the global competitive position of the Indian bicycle sector. The identified industry associations were the All India Cycle Manufacturers' Association (AICMA) and the United Cycle and Parts Manufacturers' Association (UCPMA)."

2 THEORETICAL UNDERPINNINGS

Innovation processes are recognized to be a dynamically non-linear, complex, adaptive system and systemic process. It requires the production and transfer of knowledge through different inputs and interactions from and between actors within the system. It is therefore necessary that evidence for policy draws on the inputs of different actors and institutions. Both national and regional systems of innovation are spatially delineated; sectorial systems of innovation adopt a certain technology (spanning multiple sectors), or the sector in which it is used (including various technologies) as its system boundary. Regardless of the level of analysis (macro, meso, micro), it is clear that the presence of key nodal institutions within the system is a constant.

Consequently, it is crucial to understand the role of key nodal institutions within the context of a sectorial system of innovation, as well as understand the process of organizational innovation. The ability of an organization to innovate is a requisite for the successful utilization of resources and new technologies. Conversely, the challenges for organizations associated with the introduction of a new technology leads to changes in managerial practices and the emergence of new organizational forms. Therefore, organizational and technological innovations are clearly intertwined. Schumpeter (1950) saw organizational changes, new products and processes and new markets as factors of 'creative destruction'.

In the wide sense, 'organizational innovation' is the creation and or adoption of an idea or behaviour that is novel to an organization (Daft 1978; Damanpour and Evan 1984; Damanpour 1996). Luecke and Katz (2003) define organizational innovation as "the successful introduction of a new thing or method [...]. Innovation is the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes, or services". In an organization, innovation occurs through the application of knowledge and experience in order to generate new products and services, new insights into competitive advantage, and new systems, processes, and ways of conducting business. This requires a cultural orientation attuned to anticipating trends, generating and evaluating ideas, communicating solutions, and leadership dedicated to promoting, executing, and sustaining initiatives.

When viewed from the perspective of nodal institutions within a system of innovation, "systems centrally involve nodal points of power or influence and network connectivity between nodes" (Cooke, 2008, pg. 25). In this sense, a strong system of innovation is dependent on the ability of key nodal organizations to innovate, which in turn is closely linked to its ability to react to its environment.

Literature on this outlines three major aspects of organizational innovation, each of which will be addressed in turn:

Firstly, from the perspective of organizational design, which focuses on the link between structural forms and the ability of an organization to innovate (Burns and Stalker, 1961; Lawrence and Lorsch 1967; Mintzberg 1979). The unit of analysis is the organization and the focus of this level of analysis is to identify the characteristics of an innovative organization, which has been closely linked to the concept of technological innovation (Teece, 1998).

The second area is that of organizational learning, which is orientated at micro-level and focuses on the process of developing ideas for problem solving (Agyris and Schon 1978; Nonaka 1994), which "provides a micro-lens for understanding the capacity of organizations to create and exploit knew knowledge necessary for innovative activities (Lam, 2004, pg4).

The third aspect is orientated towards organizational change and adaption, with a means to understand how new organizational forms are created. Its main focus is to understand "whether organizations can overcome inertia and adapt in the face of radical environmental shifts and technological changes" (Lam, 2004, pg4).

Although these three approaches seem distinct there is an important overlap between the three. Studies have shown that certain structures facilitate the creation of new products and processes; this is particularly true in the case of fast changing environments.

2.1. Organizational Structure and Innovation

From the perspective of contingency theory, one can argue that the most appropriate structure for an organization is the one that best fits a given operating contingency, for instance the scale of operation (Pugh et al 1969; Blau 1970); technology (Woodward 1965; Perrow 1970) or environment (Burns and Stalker 1961; Lawrence and Lorsch 1967). However, only a few deal with the question of structure in relation to innovation.

Burns and Stalker present a polar typology of 'mechanistic' and 'organic' organizations. The mechanistic organization is found in stable and predictable environments; whereas the organic organization is more fluid in nature and is found in response to an environment of change and innovation. One should underscore that neither type is inherently right or wrong; more that environment prompts a structural response within an environment. Lawrence and Lorsch (1967) indicate that both mechanistic and organic structures can exist within different parts of an organization, depending on the differing demands on functional sub-environments (Lam, 2004). This supports the contemporary debate about 'ambidextrous organizations' that are capable of coping with evolutionary and revolutionary technology changes (Tushman and O'Reilly, 1996). Burns and Stalker (1961) posit that an organization is undifferentiated, in that it is either mechanistic or organic, which is important when trying to comprehend the movement from mechanistic to organic forms of organising, particularly in the face of environmental change and as innovation becomes a priority.

Another seminal contribution to the field of organisation is that of Minzberg (1979) who argues, in line with contingency theory, that a successful organization designs its structure to match its situation, and that effective structuring is a function of the consistency of design parameters and contingency factors. The organizational archetypes presented by Minzberg are given in Table 2.1.

Table 2.1: Organizational archetypes

Organizational archetype	Key features	Innovative potential
Simple structure	An organic organization, centrally controlled by one person, that has the ability to respond quickly to changes in the environment.	» Entrepreneurial and often highly innovative. » Continually searching for high-risk environments. » Weaknesses include vulnerability to individual misjudgement and resource limits on growth.
Machine bureaucracy	Mechanistic organizations are usually associated with high levels of specialization, standardization and centralized control. A continuous effort to routinize takes in mind the formalization of worker skills and experiences.	» Designed for efficiency and stability. » Good at dealing with routine problems. » Weaknesses are rigidity and an inability to cope with novelty and change.
Professional bureaucracy	A decentralized mechanistic form that accords a high degree of autonomy to individual professionals. Characterized by individual and functional specialization, with a concentration of power and status in the 'authorised experts'.	» Individual experts may be highly innovative within a specialist domain. » Weaknesses include difficulties in coordination across functions and disciplines, which impose severe limits on the innovative capability of the organization as a whole.
Divisionalized form	A decentralized organic form in which quasi-autonomous entities are loosely coupled together by a central administrative structure.	» An ability to concentrate on developing competency in specific niches. » Weaknesses include the 'centrifugal pull' away from central R&D towards local efforts and competition between divisions, which inhibit knowledge sharing.
Adhocracy	A highly flexible project-based organization designed to deal with instability and complexity. Problem-solving teams can be rapidly reconfigured in response to external changes and market demands.	» Capable of fast learning and unlearning, highly adaptive and innovative. » A weakness is that the unstable structure is prone to a short life and may be driven towards bureaucracy over time.

Adapted from Lam (2004)

Other viewpoints that relate to organizational structure and innovation are that of strategy and structure and their impact on the innovative positioning of an organization. From these perspectives, Teece (1998) suggests "both the formal (governance modes) and informal (cultures and values) structures, as well as firms' external networks, powerfully influence the rate and direction of their innovative activities" (Lam, 2004; pg. 11). To summarize, from the 'structural perspective' discussed above, innovation is treated as an output of certain structural features.

2.2. Organizational Cognition, Learning and Innovation?

In contrast to the above, another perspective is that innovation within an organization is a process of bringing new ideas together and problem solving (Amabile 1988; Kanter 1983). Phrased differently, innovation can be seen as "non-routine, significant, and discontinuous organizational change that embodies a new idea that is not consistent with the current concept of the organization's business" (Mexias and Glynn 1993; pg. 78). This perspective defines an innovative organization as one that is intelligent and creative (Glynn 1996; Woodman et al 1993), with the capacity and capability to learn (Senge 1990; Agyris and Schon 1978) and the ability to create knowledge. To add to this, Nonaka (1994) adds that it is crucial to have a prior accumulation of knowledge in order to allow innovators to assimilate and exploit new knowledge, thus it is important to have an understanding of cognition and organizational learning in order to foster or inhibit innovation.

The link between the learning capacity of an organization and its ability to innovate becomes clear. Analysis has shown that a difference in the structure of an organization can impact the way in which it learns and creates knowledge, and thus how it is able to innovate.

To quote Lam, "some researchers argue that learning is essentially an individual activity (Simon 1991; Grant 1996), most theories of organizational learning stress the importance of collective knowledge as a source of organizational capability. Collective knowledge is the accumulated knowledge of the organization stored in its rules, procedures, routines and shared norms, which guide the problem-solving activities and patterns of interaction among its members. Collective knowledge resembles the 'memory' or 'collective mind' of the organization (Walsh and Ungson 1991)." (Lam 2004; pg. 14). The subjectivity and tacitness of knowledge is recognized by Brown and Duguid (1998) who point out that its codification and transmission is not an easy process. However, key to the process is interaction and the development of relationships leading to the exchange of shared experiences and ultimately 'organizational knowledge'. This compares to the concept of organizational routines – a collective knowledge rooted in shared norms and beliefs that aid cooperative problem solving (Nelson and Winter, 1982).

A negative aspect of organizational learning is that it is difficult to unlearn past practices, leading to lock-in and 'learning myopia'. A difficulty is the need for an organization to maintain an external boundary while at the same time keeping the boundary sufficiently porous in order to enable the external flow of new knowledge, particularly as sources of innovation often lie outside an organization (Von Hipple 1988; Lundval 1992). In order to maximise on the potential of external knowledge resources in renewing and developing organizational learning, business alliances and networks, as well as the use of new personnel to graft new knowledge onto existing learning systems are crucial. With this in mind, a major organizational challenge in innovation is "not simply to maintain a static balance between exploitation and exploration, or stability and change, but a continuous need to balance and coordinate the two dynamically throughout the organization" (Lam 2004, pg. 17).

From a cognisance and learning perspective, organizations can be categorised into two types, J-form and adhocracy. J-form organizations typically excel at cumulative learning and they are able to derive their innovative capabilities from the development of specific collective competencies, shared culture and problem-solving routines. Conversely, adhocracy are organic and adaptive organizations that tend to be reliant upon individual, specialist expertise that is organised in flexible project teams. They have market orientation and are capable of speedily responding to changes in knowledge and skill.

2.3. Organizational Change and Innovation

An important aspect of understanding the relative influence of technological change on an organization's ability to evolve is linked to its aptitude to relate and adapt to its environment. This in turn can be seen to be related to whether organizations change and adapt to discontinuous environmental shifts, or whether radical change occurs at the population level (Lewin and Volberda, 1999). Broadly, there are three views on organizational adaption and change, these are: i) organizational ecology and institutional theories; ii) the punctuated equilibrium model; and iii) strategic adaption.

Organizational ecology and institutional theory focus on the way that the environment is able to select an organization and in particular how this creates change in organizational forms. Hannan and Freeman (1984) argue that inertial forces are responsible for an organization's inability to make radical changes in response to environmental turbulence. Inertial forces represent fixed repertoires of reproducible routines within established organizations. From a positive perspective, they provide an organization with a level of stability and reliability. However, they also infer a level of resistance to change, which negates the ability to rapidly respond to environmental threats and opportunities. In support of this, Nelson and Winter (1982) elucidate that there is an accumulation of know-how and tacit knowledge within the course of the development of an organization, which results in skills and organizational routines that are difficult to change. The risk that arises from this is that in the face of environmental change, new entrants within the industry/sector displace established organizations that lack the ability to react and adapt.

Contrastingly, from the perspective of punctuated equilibrium, it is argued that an organization is in a common state of stability and inertia (equilibrium periods) and as a result short bursts of fundamental change (revolutionary periods) provide a rare opportunity to break the grip of structural and cultural inertia (Lam, 2004). Transformations can include changes in strategy, structure, power distribution and control systems. Anderson and Tushman (1990) posit that these periods of radical change are initiated in terms of crisis or when an organization is confronted with disruptive environmental conditions.

Finally, theories of strategic adaption focus on the role of managerial action and strategic choice as drivers of shaping organizational change (Burgelman 1991), with particular emphasis placed on decisions and learning rather than the outcome of passive environmental selection.

To quote Lam (2004, pg. 30) "many strategic adaptation theorists view organizational change as a continuous process encompassing the paradoxical forces of continuity and change, rather than an abrupt, discontinuous, episodic event described by the punctuated equilibrium model." This level of continuity maintains a sense of identity for organizational learning (Weick, 1996; Kodoama, 2003). Burgleman (1991) infers that the process of organizational renewal is a combination of 'induced' and

'autonomous' in the development of strategy, both of which are considered vital for successful organizational transformation. Induced processes develop initiatives that build on current organizational learning and are within the scope of an organization's current strategy and hence develop continuity. Alternatively, autonomous processes emerge outside the organization and provide opportunities for change through new organizational learning.

On the back of these theoretical underpinnings the UNIDO approach has been to look at the development of critical capacities of key institutions. By strengthening the institutional innovative capacity, these nodal institutions are better able to support the system of innovation as a whole. This process is grounded on the back of a comprehensive diagnostic of the organization, followed by a programme of tailored capacity building.

2.4. Technology and Knowledge in Innovation

When defining the term 'innovation', continual reference is often given to "knowledge" and "technology". Technology can be defined as "the purposeful application of information in the design, production, and utilization of goods and services, and in the organisation of human activities." (BusinessDictionary.com). Technology can be described in a number of different ways.

Tangible technology, is for example, but not limited to, blueprints, models, operating manuals, and prototypes. Intangible technology, is in the form of consultancy, problem-solving and training methods. High technology, is entirely, or almost entirely, automated and intelligent technology that manipulates ever-finer matter and ever-powerful forces. Intermediate technology, is defined or characterized as semi-automated partially intelligent technology that manipulates refined matter and medium level forces. Low technology, is characterized by labour-intensive technology that manipulates only coarse or gross matter and weaker forces.

Knowledge can generally be defined as consisting of "truths and convictions, estimates and concepts, judgments and expectations, methodologies and know-how" (Wiig, 1993) or something that "groups perceptions, experiences and processes considered sound and true, that direct thought, behaviour and human communication (van der Spek and Spijkervet, 1997). Nonaka and Takeuchi (1995) classified accessibility to knowledge in two categories, inherent and clear, while Beckman (1997) identifies three stages of accessibility: tacit, implicit and explicit.

- Tacit (human mind, organization) is the possibility of indirect access, always with difficulty, through knowledge elicitation and behaviour observation.
- Implicit (human mind, organization) is accessible through querying and discussion, however, informal knowledge must first be located and then communicated.
- Explicit (documents, computer) is directly accessible, and is documented into formal knowledge sources that are often well organised.

According to the Frascati Manual (2015), research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge. The term R&D covers three types of activity: basic research, applied research and experimental development.

Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

Applied research is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.

Experimental development is systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes.

The increasing importance of technology and knowledge is changing the way firms compete and the sources of comparative advantage between countries. For countries in the forefront of the world economy, it is a reality that the balance between knowledge and tangible resources has shifted so far toward the former and that knowledge has become perhaps the most important factor determining the standard of living (World Bank, 1998). Today's most technologically advanced economies are truly knowledge-based. In many countries, firms invest as much in the knowledge-based assets that drive innovation, such as software, databases, R&D, firm-specific skills, and organizational capital, as they do in physical capital, such as machinery, equipment or buildings.

There are three main changes associated with the importance of knowledge as an economic driver in today's economies (ECD, 2004).

Knowledge is increasingly considered to be a commodity. It is packaged, bought and sold in ways and to levels never seen before. Secondly, advances in ICT have reduced the cost of many aspects of knowledge activity, for example, knowledge gathering and knowledge transfer. Thirdly, the degree of connectivity between knowledge agents has increased dramatically.

2.5. Internal and External Drivers of Innovation

From a strategic point of view (Schlegelmilch et al., 2003), innovation is driven in two different ways, internally and externally. From an internal perspective, senior management attitudes, marketing, information technology departments and the organization's employees drive innovation. Collaborative efforts support and facilitate the innovation management process. These are evidenced by a number of characteristics, where the majority are found to be:

- Senior management teams that devote time to investigate the future and to understand the needs of the marketplace, the resources at their disposal and the competitive business environment.
- Working environments and organizational culture that encourage creative solutions.
- Strong support for joint ventures and collaborative efforts that develop and commercialize innovative solutions.
- Good project management for the identification, development and commercialization of innovations.

From an external perspective, innovation management is driven by different knowledge-intensive organizations (for example universities or research institutions) that build knowledge as their primary value-adding process. They can be defined as organizations where employees with a high degree of knowledge are critical to the primary function of the organization. They have relatively little financial capital but instead the main assets are knowledge and the competence of their personnel (Kipping and Engwall, 2002).

The work of Utterback (1994) and Tushman et al (1997) has analysed how external environment affects business organizational dynamics and strategic change. Von Hippel

(1988, 2005) has analysed the increasing role of users in innovation diffusion processes and its impact on product development. Although it goes further, the latter could be inscribed with the open innovation model proposed by Chesbrough (2003).

This brings us to the need to differentiate between innovation at different organizational levels. Innovation is increasingly occurring between several entities in a system/network, and also cross-border. Bogers et al. (2017) has differentiated between five levels, which are:

- Intra-organizational (individuals, teams, projects, business units)
- Organizational (firm-level)
- Extra-organizational (between firms and other firms, customers, suppliers, R&D institutions etc.)
- Inter-organizational (alliances, networks, ecosystems)
- Industry, regional, innovation systems, society (industries, inter-industry, regions, nations, cross-border/international)

2.6. Innovation Management

The increasing importance of technology, knowledge and systems/networks as economic drivers has major implications for innovation management. The evolution of theories of innovation management is explained by the increasing importance of social ingredients in the explanation of innovation, which was originally based solely on tangible forms of capital. This progressive inclusion of social ingredients can be illustrated by reviewing five successive theories that have been deemed important by innovation specialists:

- Innovation derived from science (technology push)
- Innovation derived from market needs (market pull)
- Innovation derived from linkages between actors in markets
- Innovation derived from technological networks
- Innovation derived from social networks

The earlier ideas are that innovation is determined by research (technology push theory) and by unordered interaction between firms and other actors (technological networks theory). The new insight is that knowledge plays a more crucial role in fostering innovation. The growing importance of knowledge as a production factor and as a determinant of innovation can be explained by the continuous accumulation of technical knowledge over time, and by the use of communication technologies that make that knowledge available very rapidly on a worldwide scale.

The systemic approach to innovation recognizes that innovation and knowledge generation take place as a result of a variety of activities, many of them outside the formal research process (Liyanage and Poon, 2002). Knowledge is thus generated not just in universities and research institutions, but also in a very wide variety of other locations, and notably as a product (learning-by-doing) or of consumption (learning-by-using). In the current economic context, growth must mainly originate from increasing the productivity of knowledge work, and increasing this productivity is the most important contribution management can make. The most valuable assets of a 21st-century firm are its knowledge workers and their productivity. Knowledge-intensive organizations need to manage innovation processes so as to increase knowledge productivity (Drucker et al., 1997).

In comparison with traditional mechanistic command and control management, innovation management entails a fundamental change in the strategic perception of the organization, which accordingly has to consider a few major management challenges (Kemp et al., 2001):

First of all, the ability to manage human capabilities in a strategic manner. Modern management has to face the perpetual challenge to place the human being at the forefront of operations, and understand that an organization is a collection of different human beings (James, 2002). Secondly, the ability to network with internal and external partners. People have different attitudes, different customs, different professional backgrounds - management should focus on integrating the web of formal and informal relationships inside and outside the company (Ahuja, 2000). A third challenge is considered to be the ability to create adaptive and interactive organizational structures. If the organization is to remain responsive to external change, a flexible and adaptable organizational structure is a necessity (Schlegelmilch et al., 2003). Finally, the management has to be able to balance order and chaos - process efficiency versus destructive innovation - and individual and corporate motivation by developing an innovation strategic vision (Martensen and Dahlgaard, 1999).

In the following a few more ways of conducting, managing and enabling innovation to take place are discussed.

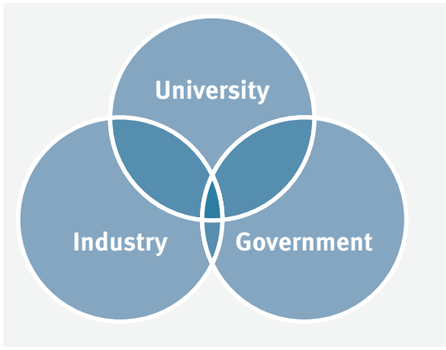
"Open innovation"

The term "open innovation" was coined by Henry Chesbrough (2003), who highlighted several factors that eroded the boundaries within which innovation takes place and catalyzed a move toward more open models of innovation. Chesbrough and Bogers (2014) redefined open innovation as "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries".

"Triple Helix innovation"

The concept of the "Triple Helix" of university/R&D – industry - government relationships initiated in the 1990s by Etzkowitz (1993) and Etzkowitz and Leydesdorff (1995), encompassing elements of precursor works by Lowe (1982) and Sábato and Mackenzi (1982), interprets the shift from a dominating industry - government dyad in the industrial society to a growing triadic relationship between university/R&D – industry - government in the new knowledge society.

Figure 2.1: The triple helix model



The Triple Helix thesis is that the potential for innovation and economic development in a knowledge society lies in a more prominent role for the university/R&D institutions and in the hybridization of elements from university/R&D, industry and government to generate new institutional and social formats for the production, transfer and application of knowledge.

2.7. Knowledge Transfer Between Research Institutions and Industry

The need for sharing knowledge between universities/research institutions and industry has become increasingly evident in recent years. Research institutions are nodal organizations with a potentially central and strategic role in knowledge creation and dissemination within an industry.

Knowledge transfer refers to sharing or disseminating knowledge and providing inputs to problem solving (OECD, 1996). In organizational theory, knowledge transfer is the practical problem of transferring knowledge from one part of the organization to another.

Knowledge transfer seeks to organise, create, capture or distribute knowledge and ensure its availability for future users. It is considered to be more than just a communication problem. If it were merely that, then a memorandum, an e-mail or a meeting would accomplish the knowledge transfer. Knowledge transfer is more complex because knowledge resides in organizational members, tools, tasks, and their sub networks (Argote and Ingram, 2000), and much knowledge in organizations is tacit or hard to articulate (Nonaka and Takeuchi, 1995).

Historically, research institutions were perceived as a source of new ideas and industry offered a natural route to maximizing the use of these ideas. However, the past decade has seen a significant change in the roles of both parties. Many companies are developing open innovation approaches to R&D, combining in-house and external resources, and aiming to maximize economic value from their intellectual property, even when it is not directly linked to their core business. In particular, they have begun to treat public research as a strategic resource.

In parallel, it has become clear that research institutions need to play a more active role in their relationship with industry in order to maximize the use of the research results. This new role requires specialist staff to identify and manage knowledge resources with business potential, i.e. how best to take a new idea to market, ensure appropriate resources (funding, support services, etc.) to make it happen, and to obtain adequate buy-in by all stakeholders.

To perform knowledge transfer activities effectively, research institutions need to have sufficient autonomy to recruit experienced knowledge transfer staff on a competitive basis. Increased mobility between the public and private sectors will help research institutions' researchers and managers identify shared needs with industry. There is also a need for existing resources to be made more accessible.

A classic challenge is that interactions between research institutions and companies mostly involve large firms. This is due to the fact that such collaborations are considered to be more durable and regular than with SMEs. However, most companies within an industry are SMEs. Evidently, SMEs are a very diverse clientele for knowledge transfer services. Manufacturing SMEs in technology sectors typically have proportionally high R&D budgets and close links to academia as a result of the very short product cycles. In more traditional sectors, the capacity of SMEs to actively engage in knowledge transfer activities is typically limited by constraints in human and financial resources. It is therefore important to encourage SMEs to absorb new and external knowledge for faster innovation.

2.8. Challenges of the New Knowledge-Driven Economy

There are a few challenges related to the new knowledge-driven economy (ECD, 2004). These include:

New characteristics of the market

The market is constantly changing, it is becoming more global and new competitors are emerging. In addition, technology complexity is increasing, product life cycles are shortening and knowledge is consolidating as a crucial input. All of these new characteristics of the market require the development of additional competitiveness from firms.

New types of innovation

Innovation takes many forms. There is technological innovation, but also innovation through new business models and new ways of organizing work, innovation in design and in marketing. Innovation can also consist of finding new uses and new markets for existing products and services. It emerges where the market offers incentives to introduce new products and production methods, and where people are willing to take risks and experiment with new ideas (Bullinger et al., 2004).

New needs of stakeholders

Customers, owners and stock markets increasingly equate an organization's worth with its ability to get winning products to market on time, every time. This is especially true in the case of SMEs (Libutti, 2000; Scozzi and Garavelli, 2005).

New approach to innovation management

Innovation management encompasses all the key areas that need to be mastered to develop successful products and services, efficiently and continuously. The capacity of a firm to implement innovation management revolves around its success in dealing with these two main challenges: top-line growth and bottom-line efficiency (Liyanage and Poon, 2002).

New technology innovation assessment skills

The rapid development of new technologies prompts firms to assess and implement the most appropriate technology according to their need to retain their competitiveness (Ram, 1996). For example, it may be difficult to distinguish between technologies that are sustaining and those that are disruptive. Furthermore, often one realizes that there is technological progress that outstrips market demand. This means companies tend to overshoot the market, giving customers more than they want or are willing to pay for. Occasionally, firms can be exposed to pressures from both customers and shareholders that influence the innovation in which firms engage.

Need for new innovation management tools (IMTs)

The development of knowledge-based innovation management requires the capacity to implement technical and relational tools. Technical tools refer to the acquisition and utilization of new information and communication technologies - they do not create a competitive advantage because they are readily available to others. The creation of competitive advantage rests in relational tools - the way of doing business, both in the internal and the external environments of firms (Lengrand and Chartrie, 1999). Moreover, technology and innovation require a holistic approach today (Butler, 1999; Martensen and Dahlgaard, 1999).

Hidalgo and Albors (2008) presented an innovation management technique/tool (IMT) typology and associated techniques and tools, some examples are market intelligence techniques, cooperative and networking tools, innovation project management techniques, business creation tools, etc. IMTs are critical to increasing competitiveness. An IMT cannot be considered in isolation. The usefulness of one IMT for a particular business challenge is normally measured in combination with other IMTs, this combination being adapted to varying degrees for each specific case. The benefit gained by the company depends on a combination of IMTs and the firm itself, and the mix of these two elements is what determines an effective outcome.

In context of the theoretical principles highlighted in this section, this report aims to assess the organizational form and function of nodal institution(s) operating in the Indian bicycle sector. Acknowledging that organizational innovation and technological advancements are interlinked, the operation of the RDCBSM and the industry associations has been analysed. This enables the identification of how design, learning and adaptation mechanisms facilitate the uptake of new production practices, leading to improved modes of operation and newer products.

The following sections provide an overview of how the industry is structured, how the nodal institutions operate within the industry and recommendations as to how innovation and technology adoption can be facilitated through a range of internal and external drivers.

3 THE INDIAN BICYCLE INDUSTRY

The Indian bicycle industry is the world's second largest, surpassed only by the Chinese industry, with an annual production of nearly 16 million bicycles. The NPC Full Report from 2015[3] provides key figures characterizing the industry, which is dominated by 4 major players, representing almost 85-90% of the annual volume of complete bicycles sold to the domestic market. The value of the total annual production of bicycles is an estimated USD 1.2 billion, where the export value is close to USD 23 million. The value of imported bicycles and parts is close to USD 30 million, and increasing.

The vast majority of bicycles manufactured in India are made from steel. Most of the manufacturers of parts, components and of complete bicycles are located in the industrial cluster of Ludhiana. The industry is highly fragmented, with almost 4,000 registered companies producing parts, components and complete bicycles in the cluster, where the vast majority are very small entities. This sector is dominated by a low degree of automation and lack of modern industrial quality standards. The larger manufacturers are pushing for higher automation and bicycle quality in compliance with the global level, especially related to materials (aluminium and aluminium alloys) and more advanced components (multi-speed transmision systems and others). The dependency on imported components and a limited knowledge around these components leaves the industry to be less competitive both in cost efficiency and in product functionality.

Currently there is a relatively weak domestic market demand for more advanced bicycles. The majority of bicycles being produced in India are classified as roadster type bicycles: low cost bicycles for the purpose of commuting and transporting goods, with dated design and functionality (similar to bicycles produced in the 1950s and 1960s). A relatively fast growing middle class, with more advanced demands for goods and services, has gradually influenced the choice of bicycles. This has driven a similar increase in imported models, as the domestic industry is only able to manufacture and support the demand in a limited way. Consequently, this gap in supply capability may further increase and seriously threaten the existence of the Indian bicycle industry.

Several initiatives related to creating improved competitiveness for the industry have been observed. The TERI Report[4] discusses and points at the importance of infrastructure and the establishment of "smart cities" with a focus on the role of the bicycle in the transformation from motorized to unmotorized transport and commuting. Today most of the Indian cities lack sufficient road quality and standards to support increased and more advanced cycling.

[3] Study on improving productivity and competitiveness of bicycle sector, including bicycle parts (National Productivity Council), 2015.

[4] The TERI report – Pedaling towards a greener India, 2014.

Furthermore, with the support from the industry associations the AICMA and the UCPMA, an initiative named "Cycle Valley of Ludhiana"[5] aims to attract investors and foreign manufacturers of parts and components to Ludhiana to build the gap and enable the industry to adapt to the more advanced technologies, materials, manufacturing standards and components.

The location, with its cluster of industries and manufacturers, is both an advantage and a challenge. The advantage obviously is linked to the potential of developing a network of tightly connected partners, in close proximity to each other and with efficent ways of collaboration. However, with long distances to technology hubs and ports of shipment to external markets, and with limitations in quality infrastructure (roads, railways, power utilities), the cost of freight and communication currently outcompetes the advantages of the cluster.

3.1. The RDCBSM – A Brief Overview

The RDCBSM was established in 1983, with support from UNDP/UNIDO, with the aim to support the Indian bicycle industry to position itself as a globally competitive industry. Research and development, design, development and manufacturing of modern manufacturing tools and components and the establishment of appropriate testing facilities were among the requested and provided services. Training and education programmes, in modern bicycle engineering and manufacturing skills, developed for and directed to the workforce of the industry, and especially targeted at the small and medium-sized enterprises, were provided.[6] During the first 10 years of existence the RDCBSM received financial funding from the government of Punjab. Parallel to the development of the R&D centre, a polytechnic college was established in 2001 to support the development of the industrial skills and capabilities.

After 1994, the financial funding was stopped and the RDCBSM was redefined as a self-sustained independent R&D centre, but still with its governance controlled and chaired by the Director of Industry and Commerce, Government of Punjab.

Today, the RDCBSM offers the following services[7]:

- A diversified testing facility in accordance with NABL accreditation ISO/IEC 17025, the BIS certification according to a number of IS standards and other specific spectroscopic, chemical and material testing requirements
- Precision tooling for the manufacturing of a number of specific bicycle parts and components, including special purpose machines for tubular components, frames and forks
- Computer-aided design and development supporting its testing and tooling activities
- Mass production of specific parts, applying special purpose CNC machines
- Consultancy to the industry on subjects such as productivity and improvement, automation, material selection and optimization and resource identification
- Skill and operation training and education

A more elaborate assessment of the different services is provided in Chapter 4.3 of this report.

The discontinuation of financial funding from the government has, in practice, gradually reduced the variety of these services, and has gradually transformed the RDCBSM into being more and more a tool shop and test facility for mandatory tests according to the Bureau of Indian Standards (BIS). While the rest of the bicycle-manufacturing countries have moved to more advanced materials, technologies and practices, the RDCBSM has not managed to follow this transition, leaving the leading industry companies in India to find help and support outside India. This report will discuss this in more detail.

3.2. The AICMA and the UCPMA – A Brief Overview

The All India Cycle manufacturers' Association (AICMA) was established in 1984. Its key mandate and role is to secure and promote the future of cycling in India by addressing and catering to the terms and conditions for a competitve growth and development of the Indian bicycle industry. This is achieved through structured advocacy services towards the authorities and through the provision of a number of services to its members.

A dedicated administration office is established with a full time Secretary General (SG). The SG reports to an Executive Committee of 9 elected members, now being elected for a 2-year period, and with representatives elected from the industry members. A review and modification of the organization, during the fiscal year 2015/2016, has opened for dedicated sub-committees addressing IPR, technical matters, commerce, taxation and demand issues. The member services are channeled through these committees.

The AICMA has been increasing its focus on issues related to means of improving the global competitiveness of the bicycle industry. Special focus is being given to adjusting taxation levels, reducing impact from imports and upgrading the capabilities of the domestic industry by working with the Punjab government on the introduction of the Cluster Development Scheme (CDS) programme.[8] The AICMA is also working towards opening up for additional members[9]; it also introduced the "5 Ms to success: Manpower, Machinery, Management, Money, Material". For the needed change to take place, these 5 Ms could be key drivers for the industry as well as the RDCBSM.

Enhanced focus on building relations with similar international industry and trade associations has been observed during the past few years. The driving force for such relational development is to achieve a better understanding of the key industry issues and focuses in the global markets, thereby enabling a way to understand the gaps and what measures to take to transform the Indian industry.[10]

The United Cycle and Parts Manufacturers' Association (UCPMA) was registered in 1956, was functionally established in 1967, and currently has more than 2300 members. The UCPMA is the largest industry association in terms of members in the entire Asian region. Its key mandate and role is to support its members in improving their operation, securing their sourcing of raw material and supporting terms and conditions for competitive growth of the industry. The UCPMA works closely with its members, with the legislative authorities of Punjab state and on a national level.

The UCPMA is run by an administration of 4 staff in office, paid by the funding through the membership fee. The General Secretary is elected for 2 years, as is the Management Committee and the Executive Committee. The UCPMA provides a number of services to its members, including, but not limited to, training and education in: basic engineering and design skills in its own school room facilities; taxation policy advocacy; organising foreign study tours for its members; intermediation and support in international technology transfer, and partnering and advocacy in promotional measures towards political authorities. With regard to the Cycle Valley Project, the UCPMA has served as an intermediator with the government.[11]

[5] Cycle Valley Ludhiana – PowerPoint presentation to Government of Punjab 2016.
[6] RDCBSM – Memorandum of Association and rules and regulations.
[7] According to the organogram of RDCBSM and the brochure material and website information.
[8] AICMA Visionary Framework document.
[9] AICMA Annual report 2015-16.
[10] AICMA website ‹www.aicma.org›.
[11] UCPMA website ‹www.ucpma.net›.

THE RDCBSM – KEY FRAMEWORK OF OPERATION

4

4.1. Mandate and Role

According to the Memorandum of Association rules and regulations of the RDCBSM, the original charter and mandate of the research instuitute was to: create an R&D centre to support and enable the small and medium-sized light engineering industry to develop improved quality and productivity, with a number of specified services, including R&D, advanced tools development and manufacturing, advisory, consultancy and training. The mandate was formed in 1984, and any revisions/changes since the foundation, despite the evolution of the global light engineering industries (as in the bicycle industry) have not been observed. However, several of the rules of the memorandum contain flexibilities in the creation or development of, appropriate structures to always ensure the most efficient services to be provided to the industry. As examples, the memorandum refers to the possibility, and actual expectation of inviting and collaborating with the best available industry experts and knowledge centres in India and abroad to ensure that the most appropriate and updated knowledge is provided to the Indian industry. During the first 10 – 15 years in operation, mutual personnel exchange/ placement programmes with external technology centres regularly took place. Specifically, the collaboration with a Polish technology, engineering and consultancy institute - TKP Consulting - has been referred to, lasting for more than 15 years until around 2000. The adaptation of leading international technology to Indian demand, by the application of reverse engineering, regularly took place. However, during the past 10-15 years, technology transfer or adaptation have not been observed in any significant volume, and any discussions of these matters in the Governing Council of the institute have not been observed.

A workshop, producing small parts for regular sales to industrial clients, is operating as part of the RDCBSM. The relative share of the revenues deriving from this workshop compared with the total revenues of the institute is however marginal, but it still occupies 10 – 12 people directly involved in the manufacturing of parts and operating the special purpose machines. Benchmarked against the key challenges and issues of the industry, it is worth evaluating whether this operation is in line with the original mandate of the institute, in terms of providing services which secure global competitiveness for the industry.

The RDCBSM is organised into 5 different divisions: training and education; laboratory and testing; the tool room; design and development, and administration. A detailed assessment of the organization is found in Chapter 9 of this report. The organogram of the RDCBSM is given in Figure 4.2 below.

4.2. Ambitions, Strategy and Goals

The RDCBSM has not developed any specific strategy plan, SWOT analysis or specifications of longer term ambitions and goals. The current practice seems to be to make short-term (2-3 months horizon) action plans to ensure the survival of the institute. These action plans are regularly redefined and anchored with the core management team, and seem to run the priorities of the institute. It also appears that these action plans are the backbone and conditions according to which the annual budget is defined and decided.

With all its revenues deriving from industry orders, (i.e. no government funding; Chapter 12 of this report discusses the revenue base in more detail), one would expect a clear marketing plan and significant interaction with the industry to receive inputs for its longer-term strategy, increase its customer base and its revenue base. Such structured and systematic initiatives are not currently undertaken by the RDCBSM, and the industry interaction also seems to be highly fragmented. The action plans are dominated by activities of "more-of-the-same", dominated by the execution of mandatory testing and calibration services and the redesign, renewal and manufacturing of production tools.

Although several of the staff are aware of and highlighted the importance of more exploratory/applied R&D, execution of demonstration projects and increased advisory support to small and medium sized industries (SMEs) as ways of strengthening the nature and channels of interaction with and guidance to the industry, key management personnel do not necessarily have definitive strategies to implement the same. Being the only independent R&D centre for the Indian bicycle industry, the RDCBSM should be able to provide wide-ranging services to manufacturers. However, the institute is observed to operate based primarily on a limited scope of orders from the industry, possibly extending to trouble-shooting services as on off-shoot of such orders. The current structure consequently does not seem effective, nor designed for outreach or a more proactive type of interaction with the industry, as discussed above.

4.3. The RDCBSM Main Services and Provisions

The RDCBSM was set up in 1983 by the Government of Punjab, with the assistance of UNDP/UNIDO, with the aim of assisting the industry to adopt innovative technologies for improvements in productivity and product quality. It was fitted with modern equipment for manufacturing, testing, calibration and training activities.

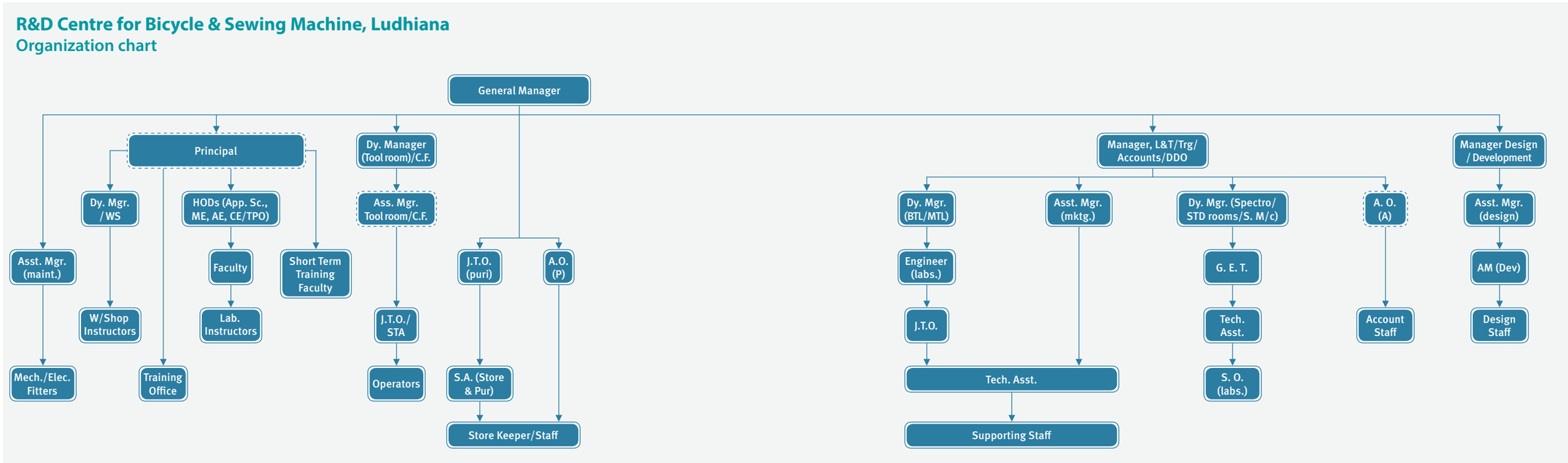
The main objectives of the centre are to:

1. Create and provide facilities for increasing and diversifying production
2. Achieve the optimum productivity levels in the manufacturing centre
3. Upgrade quality compatible with international standards
4. Provide professional and job-specific training

The RDCBSM is meant to provide services such as marketing and consultancy, product design and development, a precision tool room, testing and calibration, special purpose machine building, mass production machines and relevant training to the industry. The focus of the centre is on SMEs in the bicycle industry that need a common facility for some of these services and require technical guidance for production.

A brief description and analysis of the centre's **service portfolio** is provided below.

Figure 4.2: The RDCBSM organogram



1 Product design and development

The RDCBSM is mandated to undertake the design and development of new or modified products, jigs, fixtures, tooling and gauges, prototypes, and complete tools for the adoption of innovative and latest manufacturing. To date, the R&D centre has introduced 60 special purpose machines (SPMs), 70 testing equipment and 35 cold forging tools. They have also filed 3 patents of designs developed at the centre.

The R&D centre has a CAD section with the latest software (AutoCAD, Solidworks, Delcam, Pro-E, MasterCam, Catia, etc.) to design engineering components and sub-assemblies, bicycle parts and hand tools testing equipment, special purpose mass production machines for bicycle components and inspection gauges, fixtures and tools. Over the years, the RDCBSM has developed a range of high-utility SPMs, special test rigs and cold forging tools for the industry. Bicycle and parts companies purchase the machines, test equipment and tools that are also manufactured at the centre.

The centre has a dedicated design and development team, comprising engineers proficient in CAD/CAM. Apart from the SPMs and tools developed at the R&D centre, the design and development team also provide tailor-made solutions for jigs and fixtures based on industry requests, as and when they arise.

However, the innovative development of new products and dedicated efforts towards independent prototype development seems to be limited. Apart from the designs/SPMs developed to date, the design and development vertical of the centre should be in a position to undertake more and continuous exploratory design deliberation-based projects, to investigate and create ingenious solutions to common industry problems and manufacturing processes. This would make design and development an ongoing process and have a bearing on the nature and quantity of SPMs/tools/fixtures developed by the centre, in line with new materials being adopted, the corresponding production processes involved and the resulting requirement of tools to adopt those processes.

This process would be aided by an increased understanding of the applications of hydraulics and pneumatics, aerospace engineering, finite element analysis (and similar engineering principles) in system design. The design competencies must also be to provide such tooling/machining support for plastic components.

In a broader sense, the design and development team must also be engaged in active research of the latest bicycles (i.e. frame designs, aesthetic characteristics of bicycles sold internationally), leading to deductions as to how these geometries can be best achieved, and guiding the industry to do the same.

While the design engineers are well-versed with the design software, the staff needs a greater orientation towards, and understanding of, the real-time implications of design specifications on bicycle component quality and overall product performance. The existing design focus at the R&D centre must be to factor in optimal technical configurations for individual bicycle components, component interfaces, and metallurgy and material behaviour for bicycles/parts. This becomes increasingly relevant with the adoption of newer materials, and the associated adjustments to manufacturing processes (such as forging, casting, welding, etc.), while also keeping in mind aesthetic appeal/attractiveness of the final product. Thus, the staff would need to be able to develop superior skills in making accurate dies to provide the new varieties of required jigs and fixtures in keeping with the aesthetics/technical specifications of the final product.

Such an orientation of CAD/CAM skills would enable the RDCBSM's technology development competencies, as the staff would thus be equipped to engage with the specific challenges of bicycle/parts manufacturers and guide them through appropriate solutions. This would also enable the R&D centre to provide more well-rounded design support to SME clients.

2 Precision tool room and common facilities

The RDCBSM is equipped with high-precision CNC machines and general-purpose tool production machines. These include: a jig boring machine; cylindrical and internal grinders; surface grinders; a CNC vertical mill; a CNC lathe; tool and cutter grinders, among others. The tool room has developed 5 tools for cold forging of parts, manufacturing of 25 test equipment, 6 special purpose machines and 3 low cost automation equipment.

The workshop at the RDCBSM undertakes the manufacturing of press tools, dies, jigs, fixtures, inspection gauges, test rigs, and the reconditioning of dies for cold forging of components, not ony for the bicycle industry, but predominantly for the automotive and other engineering sectors. Thus, the orientation of the tool room and the common facilities (that include CNC vertical/horizontal milling, lathes and forging machines) to the bicycle industry could be a function of increased explorative investigation into the requirements of adapting tools and machines for aluminium and other alloys, tooling for injection moulding, forging/casting/welding needs of specific components, adoption of low-cost automation equipment for specific processes – all with direct relation to the bicycle-manufacturing units.

In the context of the industry requiring appropriate forms/shapes of newer raw materials (mostly alloys), the tool room at the RDCBSM is not equipped or sufficiently skilled to act as a facility for processes such as hydroforming, heat treatment of alloys and extrusions for production blanks at present.

It must also be considered that a majority of the equipment stationed at the tool room/common facility is largely dated (some being in operation since the early 1980s and require urgent upgradation/replacement.[12] Upgrading the equipment and management would provide an ongoing valuable service for casting, forging, etc., as per the needs of the industry.

[12] As per the provided list of equipment (with date of installation of equipment stationed in the tool room).

3 Testing and calibration

The testing and calibration facilities of the RDCBSM are duly accredited by the National Accreditation Board for Testing and Calibration Labs (NABL; ISO/IEC-17025) and the Bureau of Indian Standards (BIS). As per the NABL accreditation, the RDCBSM labs carry out mechanical testing of metals and alloys, chemical analysis (Fe, Cu and Al, base metals and alloys), calibration of measuring instruments and gauges and the testing of bicycles/bicycle parts as per ISO:4210 (parts 1-9) and ISO 8098. Under the BIS certification, the RDCBSM provides testing for bicycles and bicycle parts, household and industrial sewing machines (IS:1610 and IS:12109 respectively), zig-zag sewing machines (IS:15449) and complete testing of steel as per IS:1875. In addition, the test labs at the R&D centre provide testing facilities for spectroscopic analysis of metals and alloys and mechanical testing of tor steels, structural steels, tubular products, cold and hot rolled steels, fasteners, fixtures and assemblies.

The RDCBSM's testing and calibration facilities are one of the key services provided to the industry. The mechanical test labs, the standards room and the coordinate measuring machine also cater to the needs of automotive and other engineering industries, as is the case with the chemical/spectro analysis-based testing, where clients from the other industries outnumber bicycle/parts manufacturers.

The bicycles supplied for the government tender-based orders (for steel bicycles and components) must be certified by a third party as per IS standards, a function that the RDCBSM fulfils for the industry. Thus, the IS testing facility is a common resource for the OEMs catering to these tenders adhering to IS standards. The IS standards comprise a wide range of tests for general-purpose bicycles, most of which are aligned with the corresponding ISO tests. From this list, the R&D centre is certified to execute tests such as those for: bicycle tube valves; frames; rims; handlebars; seat pillars; pedal assembly; hub assembly (R-type); spokes; axles; cranks and chainwheels; front forks; cycle/rickshaw pneumatic tyres; steering head assembly; mudguards; reflectors; specification for padlocks; luggage carriers; steel balls and chains. The RDCBSM has recently applied[13] to the BIS for an extension of scope to include more of the component-specific tests, to now form this more exhaustive coverage of tests. An exception to this list is the code of practice for the packaging of bicycles for export under IS, that is not currently available at the RDCBSM.

The R&D centre's bicycle test labs are accredited to perform parts 1-9 of ISO tests for bicycles. These tests largely cover safety requirements for city/trekking bicycles, young adult bicycles, and mountain and racing bicycles, and test methods for braking, steering, frames and forks, wheels and rims, pedal and drive systems and saddle and seat posts. The RDCBSM now has the facility to test for lighting and retro reflective devices[14] (ISO 6742; parts 1-5). It is important to note that the scope of the tests that fall under ISO certifications include a large number that are component-specific, currently not provided by the R&D centre.

For the tests that are available at the RDCBSM's testing labs, it appears that the personnel are well versed with the ISO standards and requirements. However, there is a need for further fine-tuning in the execution of these tests (including calibration of the equipment, measurement of results and avoidance of common mistakes in test execution), to make the R&D centre staff a commanding authority of certification and validation of bicycles and parts. This fine-tuning would cover aspects such as: appropriate force application for different fatigue tests; maintaining linear/rotational degrees of freedom; how to ensure load cells are free of radial loads/shear stress/torques; verification of indications on control units, etc.[15] In addition, there is also a lack of knowledge regarding endurance testing – to evaluate the strength of tested components, beyond the levels defined by the ISO standard.

The staff also requires guidance on how to execute these safety tests for bicycle components in different materials such as aluminium alloy, (and in the future, carbon fibre, titanium and other alloys). The ISO tests are not designed for any specific material; tests must be executed cognizant of material behaviour – a skill that must be developed at the RDCBSM.

A significant requirement of the industry actors looking to enter export markets, is a facility for testing and certification against major international country-specific standards (such as EN, ASTM, DIN, JIS, BS). Currently, the RDCBSM's bicycle testing labs only provide testing for select tests from these standards, equivalent to the corresponding ISO tests. However, the bicycle testing labs are not certified for the complete suite of tests under each of these international standards. It is worth noting that the standard documents (which are to be purchased) are not available at the RDCBSM for them to provide guidance to information-seeking industry clients. As the only bicycle-focused R&D centre providing test facilities, the bicycle testing lab must not only be accredited to carry out tests for various international standards, but also provide cross-comparative analyses for these various standards.

Another aspect in equipping the bicycle industry to meet export requirements is environmental/chemical testing. While the R&D centre's labs are equipped with safety/mechanical tests, manufacturers still require facilities to conduct validation of materials used vis-à-vis determination of heavy metals (lead, cadmium, chromium VI), morphology analysis, determination of phthalates (plasticized materials) and restriction of PAH, a set of services not currently available at the RDCBSM.

In addition to the above, there are several areas for improvement in the test labs that ought to be implemented by the RDCBSM[16]: for better repeatability of test results testing machines should be fixed on the ground to ensure minimum interference/distortion; the layout of the bicycle test laboratory could be modified in line with the sequence in which various tests are to be performed; wires and chords associated with test lab equipment should be secured/covered; jigs to be utilized for testing must be stored appropriately to avoid damage and consequent interference in accuracy; housekeeping of testing equipment/lab should be done on a regular basis, and SOPs for each equipment must be displayed.

[13] In September 2017.

[14] The equipment for reflector testing has been installed under the UNIDO bicycle project (September 2017) and the application for such a certification has been submitted to the NABL (May 2018).

[15] These examples are in line with the findings of the lab session conducted at RDCBSM by Mr. Marcus Schroeder, MD – EFBE, Germany (June 23 2017).

[16] Based on an assessment by Japanese experts during a diagnostic visit to RDCBSM in February 2018.

4 Training

The RDCBSM also provides engineering and management skills training programmes for the industry.

The centre runs an R&D polytechnic college offering diploma (certificate) courses for engineering industries. These courses are certified by the All India Council for Technical Education (AICTE). The courses offered are:

- A three-year, full-time regular diploma course in a) mechanical, b) automobile and c) computer engineering. These courses are also available in a part-time, four-year format.
- A one/two-year regular certificate course, for vocational training for a) machinists, b) machine maintenance and c) quality assurance inspector.

The diploma courses offered at the R&D polytechnic college are oriented as general engineering courses. There is limited bicycle industry orientation in the courses delivered, i.e. limited coverage on bicycle engineering, component geometrics, assembly, materials and design. To supplement the engineering principles covered in the existing courses, the graduate students would benefit from a greater orientation of the syllabus towards bicycle engineering, akin to the course for automobile engineering.

Apart from the diploma/certificate courses provided by the polytechnic college, the R&D centre also provides a range of short-term skill development courses. These are either CAD/CAM courses or industry-specific industrial training courses.

The CAD/CAM training courses include software-specific courses in the areas of: CNC milling and turning; advanced CAD/CAM and CNC machines; industrial training; tool design, and advanced manufacturing processes. These are areas in which technical personnel of bicycle/parts-manufacturing companies seek additional training, and thus match the industry requirements. Other industrial short-term courses cover: GAS welding; arc welding; MIG/MAG welding; TIG welding; quality and inspection; testing and calibration, and maintenance-fitter mechanic training.

The short-term courses offered at the RDCBSM, do not necessarily cover an exhaustive range of topics pertaining to various manufacturing processes, as required by the bicycle industry. In addition, there is immense utility of developing more specialized curricula for upgrading worker skills and overall production practices, in keeping with changing trends, different materials and best available technologies for these courses to be relevant to the industry. Increased support vis-à-vis design and development of specific bicycle components (which is currently not a part of the training portfolio) using these tools would provide superior utility of these courses for the industry.

In being able to deliver the necessary training to the industry, the trainers and lecturers delivering the training must also undergo a reorientation towards bicycle engineering and production, to prepare course content and curricula in line with the bicycle industry's needs, and be equipped to deliver these courses. The skill level requisite for trainers to effectively deliver such courses to the industry is currently lacking.

5 Consultancy

The consultancy function of RDCBSM is meant to include guidance in the areas of productivity and quality improvement, low-cost automation, material selection and failure mode effect analysis (FMEA), identification of testing needs and resource identification for the industry. This function is carried out in some capacity at present, wherein the industry comes to the R&D centre for select trouble shooting assignments. However, the RDCBSM hasn't necessarily kept abreast with global market developments and the associated production practices and is therefore not in a position to provide guidance to the industry for relatively new products and technologies and facilitate the necessary technology sharing. Thus, the current skill level, as per the current market requirements and developments is lacking. As a result, the consultancy function is not a dynamic service available to the industry for manufacturers to gain direction pertaining to suitable upgrades. Services such as providing feasibility reports and similar analyses are also not provided at present (or have been discontinued). As a technical knowledge resource for the industry, and in order to be able to provide expert guidance, the staff of the RDCBSM must first become proficient in best available technologies and production processes, to inspire confidence in the industry and produce valuable guidance.

4.4. Summary

The RDCBSM lacks a clear strategy that defines how it assesses and responds to the changing needs of the Indian bicycle industry. Although it is mandated to support the industry to increase its competitive position, the organization has not kept itself updated in line with changes in production practices and emerging challenges.

The institute primarily acts as a service centre for the minimum set of mandatory testing and calibration services, and short-term (2-3 months perspective) activity plans define the direction and operations of the institute. A greater orientation towards industry, allowing for a systematic and strategic selection of R&D and support programmes offered to the industry (as well as the requisite capacity to be built in-house) may be devised.

THE GOVERNANCE STRUCTURE OF THE RDCBSM AND THE ASSOCIATIONS

5

5.1. The Governing Council (GC); Role, Structure and Authority

The RDCBSM is governed by a Governing Council (GC). According to the Memorandum of Association, the GC comprises 10 members along with the General Manager of the RDCBSM. This was subsequently changed to include 15 members and the GM. The 15 members are divided in 4 members representing state or national governments, and 11 representing the industry. The Director of Industries and Commerce, Government of Punjab, is the Chairman of the Governing Council. The industry is represented by the industry associations – the AICMA, the UCPMA and the Ludhiana Sewing Machine Industries' Association - and by directly elected executives from the bicycle and sewing machine industry.

The GC is supposed to have council meetings at least 4 times a year and is responsible for ensuring that the RDCBSM is adequately equipped and organised related to the services being provided to the industry as well as approving all budgets and plans.

At present, it appears that GC plays a predominantly administrative role. There appears to be limited focus on the overall strategy of the RDCBSM, expansion of the scope of activities, deliberations over R&D proposals, capacity/skills, furthering of staff members, critical investment plans or other matters of strategic/critical importance. The GC has, during the past 3 years, (2015 – 2017) registered 6 meetings. Thus, greater frequency/regularity in GC meetings must be ensured for the requiste strategy guidance that the RDCBSM requires. In addition, the changes in government representation in the GC must be addressed by instituting a structured handing-over procedure, to ensure continuity in decision-making. Considering key industry executives and government representatives are part of the GC, this forum should ideally be used as a round table session for strategy, based on a comprehensive agenda prepared by the RDCBSM's management.

5.2. Internal Management and Governance of the RDCBSM

The RDCBSM is managed by a general manager (GM), along with a team of 4 managers/deputy managers reporting to the GM, according to their allocated departmental responsibility. The senior management is assisted by 2-3 assistant managers and other staff, in turn. It appears that there is a lack of clearly articulated roles and responsibilities of the staff members, with disorganised reporting channels. There is an incoherent approach towards the delivery of non-technical/managerial functions (human

resource management, marketing, business development, finance and accounts, etc.). The organization does not have dedicated departments for these functions, or, requires select technical staff members to perform some of these functions in addition to their main focus area. There is a need to streamline departments/personnel for specific technical and managerial areas to optimize resource utilization within the organization.

5.3. The Associations, the AICMA and the UCPMA, Interaction, Structure and Authority

The AICMA and the UCPMA organise all the leading manufacturers of complete bicycles as well as parts and components. Both associations also have some common member companies. With more than 2300 members, the UCPMA organises more than 50% of all registered manufacturers in the Indian bicycle industry and is the largest industry association in Asia. The AICMA represents the large-scale bicycle manufactures, accounting for approximately 85% of bicycle production in India.

Both associations are mandated to support the Indian bicycle industry through policy advocacy, promotion/marketing initiatives and fostering linkages with domestic and international partners to facilitate exposure to emerging technologies, and ensure suitable demand/supply conditions for bicycle production. In mobilizing technical support for manufacturers, the associations should ideally utlize the RDCBSM as a resource for R&D, certification, testing and provision of expert consultancy. However, except the involvement of the associations in the RDCBSM's GC, structured avenues of collaboration with the R&D centre appear to be limited.

The associations were established to take care of the main commercial, strategic, operational and political interests of its members, and as such represent a forum and facilitate arenas for presenting and discussing matters of common interest to the members. Furthermore, they act as intermediates and advocates on behalf of the industry members in policy issues. Consequently, in addition to keeping track of and registering, regular demand and supply of its members' products, in terms of producing statistical material, the associations initiate and facilitate conferences, roundtable discussions and issue different communication and information material on a regular basis. Regular contact with, and input to the governmental institutions related to the industry, boundary conditions and regulations for the industry are frequently on the agenda.

The AICMA has organised its services and provisions under a selected number of committees, i.e. the IPR Monitoring Committee, Technical Committee, Commerce Committee, Taxation Committee and a Demand Committee.[17] The Technical Committee has focused on visibility issues related to road safety and other technical matters involving the RDCBSM's accredited position. The Demand Committee has, among others, discussed and forwarded proposals for stimulating easier use of bicycles where such use can act both as market impetus and as demonstration arenas. Except for an area under the Technical Committee, involving the scheduled reflector lab testing facility at the RDCBSM, a continuous involvement of the RDCBSM in these committees does not seem to be present.

There are examples of initiatives taken by the associations to provide inputs to Punjab state governmental policies and regulations, and acting as advisor to the government, for instance: in the implementation of the Cluster Development Scheme; in the discussions around the Cycle Valley project, and in questions related to the impact assessments on taxations and import tariff regulations. However, initiatives in collaboration with the RDCBSM, and coordination between the RDCBSM and the associations, on issues of political and strategic importance to the industry appear to be limited.

[17] AICMA 2015/2016 annual report.

Associations' role in policy advocacy, authority in guiding and selection priorities for the industry and for the RDCBSM

It appears that the associations play a rather active role in consulting and relaying industry opinion to political authorities for key decisions of importance to the sector. Critical issues of concern for the industry have been given under Chapter 7.3 of this report. Complying with international standards and competing in export markets are sector-wide goals. This means that enhanced competitiveness should result in reduced imports, and that the domestic industry itself will need to take significant steps ahead, to enable more advanced manufacturing domestically, and move away from the influence of low cost, simple bicycle models to more advanced premium models. The associations consequently point at the need for upgrading the entire value chain, from design, material manufacturing and sourcing, tooling, automation-driven efficient manufacturing and assembly to efficient dispatch and distribution. They realize that the cluster location should be a valuable asset, but the hindrances in terms of costly and inefficient transportation and counterproductive taxation needs to be improved.

With reference to the draft industrial policy document developed by the Government of Punjab for the region, the bicycle industry is getting a visible and clear focus as a selected representative of an important growth industry for the region. It was expressed that the associations have played an important role as advocates and discussion partners for the expressed strategies. It was observed that this strategy outlined the role of a centralized technology centre to back the strategic measures needed to be taken to transform and develop the industry, and that the technology centre is assumed to be built on, and extended from, the existing RDCBSM.

5.4. Summary

Chapter 5 discusses the structure and functions of the governing mechanisms of the RDCBSM and the associations – the AICMA and the UCPMA.

It is argued that the Governing Council should take on a more strategic role in determining the RDCBSM's effectiveness in responding to industry needs. Regularity and increased frequency in GC meetings would play an important role giving the RDCBSM the necessary guidance. The chapter also argues that the management structure of the institute needs to be streamlined for optimal execution of technical and managerial functions.

The industry associations are structured to effectively perform functions pertaining to policy advocacy and lobbying of industry interests on various fora. However, it would require the associations to develop a more structured collaboration with the RDCBSM, to mobilize the requisite technical assistance for manufacturers.

THE RDCBSM'S ORIENTATION TOWARDS INDUSTRY

6

This chapter analyses the nature and level of interaction between the RDCBSM and the industry. An attempt has been made to highlight the main areas in which interaction should be the norm, such as, but not limited to, periodic visits to industry units, R&D collaboration and joint projects, common strategy developments, advisory, testing and training and technology transfer.

6.1. Regular Visits to Industry Clients

RDCBSM's interaction with industry appears to be fragmented and irregular and requires a structured approach. Platforms for structured and regular discussions with industry representatives, either with the associations or with other industry representatives, are not operational.

There is a lot of variation in the structure/size of bicycle and components manufacturers, each soliciting varying degrees of support from a technical institution such as the RDCBSM. The needs and expectations of the larger manufacturers are significantly different from the smaller and medium-sized companies. The main basis of interaction between the RDCBSM and industry is their testing and tooling services, with most companies availing 3rd party testing services as mandated by the BIS or purchasing tooling/SPMs developed at the RDCBSM. However, proactive initiations of interaction/dialogue with manufacturers are not undertaken by the RDCBSM to explore new avenues of support solicited by industry.

There are formal contact channels between top management representatives from the industry and the RDCBSM's top management through its governing structure, i.e. the GC. However, as pointed out earlier, the regularity of the GC meetings is low, and there is no time for dedicated strategy discussions during these meetings. Regular visits to, and discussions with, top executives of bicycle/parts companies are limited, resulting in limited discourse regarding industry-wide challenges/needs. Some of the reasons for this include paucity of time for such activities, and the lack of secured funding for manpower and resources to be dedicated for this, as expressed by the RDCBSM staff. From the point of view of the industry, this results in limited active involvement of the RDCBSM staff with the industry. In order to secure and develop a larger revenue base, and increase customer-oriented decision-making, the RDCBSM needs to invest time and money in regular interactions with the industry, and proactively initiate relevant technical discussions and deliberations.

As a consequence of this, it is unlikely that the RDCBSM is able to play a meaningful role in determining how the industry responds to

critical challenges, identifying key technologies and industry trends, and assisting manufacturers in becoming competitive. In turn, the organization is unable to update its own skills and capabilities.

6.2. Regular Interactions with Industry Associations

The formal channel of contact with the AICMA and the UCPMA is maintained through the the RDCBSM's Governing Council. As pointed out earlier, the regularity and frequency of the GC meetings and the agenda of the meetings[18], does not allow either the time or room for extended/elaborate interactions pertaining to industry-wide challenges. Apart from the GC, there is no regular forum in place for the industry associations to interact with the RDCBSM and express industry needs and concerns.

In terms of policy advocacy and input to the formulation of industry policy at the national and state levels, the RDCBSM and the associations should be in a position to collaborate and present unified inputs, based on continuous internal discussions for critical issues such as the availability of raw materials, strategies to compete with imported components and technologies and general support to enhance the capabilities of the Indian industry. While the industry associations are vocal vis-à-vis initiatives/schemes/views put forward to the government, participation from, and involvement of the RDCBSM appears limited. A good example of this is the initiative for a "Cycle Valley" in Ludhiana being discussed amongst the industry, the associations and state and national authorities, without any visible participation by the RDCBSM.[19] The R&D centre does, however, interact with statutory agencies such as the Bureau of Indian Standards (BIS) pertaining to technical matters and issuance of standards, and this sort of engagement should be broadened.

The AICMA has a clearly stated visionary framework, stating clear strategies towards improving vendor capabilities and qualities[20], and where a more enhanced role for the RDCBSM is discussed. However, such ideation requires active dialogue and collaborative discussions with the RDCBSM and is a good example of the type of tie-up with industry that should be actively pursued. The implications directly derived from this visionary framework could act as a guide for a further development of the RDCBSM.

As a general observation, there are no initiatives to form regular roundtable conferences between industry, associations and the RDCBSM to discuss issues of strategic, operational and political importance to the industry.

6.3. Industry Involvement in Basic and Applied R&D Projects

The R&D centre does not necessarily engage in focused, applied R&D related to the bicycle industry, as such. Globally, a number of applied research programmes are being run, mostly related to the applications and introduction of lighter material, more advanced transmission systems, electrical power-driven bicycles and aesthetic and functional design. Some of these topics are assessed by the leading companies in India, but either in their own R&D facilities or together with international partners in Taiwan, Japan or Europe. Some examples of initiating and running more advanced vendor training programmes are observed among the leading companies. The rationale for this obviously is to ensure a qualified network of local vendor partners supporting the need for transition to higher-quality manufacturing, supporting more advanced and premium bicycle qualities and models.

Due to the lack of applied R&D activities, the RDCBSM has not positioned itself to develop expertise in new and emerging areas or provide detailed guidance to manufacturers in overcoming production challenges. Cognizant of the fact that R&D requires dedicated manpower and resources, the RDCBSM should work towards mobilizing joint/collaborative projects with industry actors (at both, national and international levels), oriented around determining feasible solutions to production/quality challenges and meeting international product standards. This would not only meet industry's R&D needs, but also mobilize the necessary resources and expertise for the same.

6.4. Collaboration and Direct Sponsored Projects with Industry Clients

There are a number of directly financed activities by individual industry companies. The majority of these are related to either testing or reengineering and redesign of existing tools. To aid this, the RDCBSM should also be in a position to work together with clients to establish common technology-development projects that lead to product/process innovation, or facilitate the adoption of best practices.

The most frequent explanation for the lack of such proactive outreach is the lack of manpower and resources. However, the relevance of an R&D centre largely hinges on its ability to activitely develop and disseminate technical improvements or adoption of best practices/productivity enhancing measures, which in itself would act as a source of revenue, given the existence of requisite skills/capacity within the RDCBSM.

6.5. Reorientation of Services as Per Industry Needs

Advisory services

Consultancy and advisory services used to constitute a significant share of the charter of the RDCBSM during the first period of operation. These services included feasibility studies, technical analyses and detailed guidance to units. Such advisory services often resulted in further projects to enhance productivity by introducing more efficient tools and methods in the production-lines of its clients. At that time, the level of skills and knowledge within the RDCBSM was well adapted to and often beyond the competence request of the industry. It can be inferred that the level of interaction between the RDCBSM staff and industry clients would naturally be high in such a scenario, and that such staff frequently visited the clients and worked as experts and mentors related to implementation of efficiency measures in the production facilities of the clients.

Such services have decreased over time and some activities now seem to be totally discontinued. There is no observation of the planned and structured provision of such services. There appear to be several instances where, based on testing/tooling assignments, the R&D centre is required to provide advice or technical solutions, which solicit advanced skill or exploratory R&D efforts. The current set-up is not necessarily equipped to provide that sort of support. There are a number of areas which could benefit from improvement through guidance and advice from the RDCBSM, for example, but not limited to, logistics at the work place (work management), hygienic conditions, ergonomics, quality control, etc. Put together with the discussion under Chapter 6.3, (where the need for developing a better performing and more quality-driven vendor network, supporting the larger manufacturers is addressed), it is evident that there are huge

[18] Source. Copies of last 3 years' minutes from GC meetings and interviews.
[19] Cycle Valley Ludhiana – PowerPoint presentation to Government of Punjab 2016.
[20] Visionary framework of AICMA.

opportunities for the RDCBSM. However, this would require a more visible and proactive attitude, and a coordinated approach with the industry associations, securing a basic financing scheme. Such proactiveness has not been observed.

Testing and verification services

Today, testing, calibration and certification are the backbone services provided by the RDCBSM. The RDCBSM has accreditation from the BIS for all mandatory IS standards applicable for the Indian (tender) market, as well as a number of ISO standards applicable for export markets. The clients normally come to the RDCBSM for all relevant and mandatory tests related to the domestic market. The RDCBSM is also accredited for most ISO/IS standard testing. However, there are a number of tests related to foreign and more advanced standards (e.g. selected EU standards, Japanese standards and U.S. standards), the RDCBSM is either not accredited for, or lacks appropriate test facilities.

The application process for accreditation is biennial and entails a certain economic cost for the RDCBSM. Cautiousness and cost awareness seems to have limited the RDCBSM to take a more aggressive approach to position itself as the natural choice for executing all relevant and inclusive tests, international or domestic.

The industry also requires the adoption of formal norms for compliance to the BIS bicycle standards. It was expressed by the industry that making compliance mandatory for all products sold in Indian markets will facilitate quality assurance and avoid distortive competition. With all testing facilities in place, and with its accreditation, the RDCBSM could play a role as the inspection and certification authority towards the imported volumes.

Training, educational and placement programmes

One of the main services originally stated in the charter of the RDCBSM is training and education in light engineering topics to strengthen the skills of the work force. The polytechnic college, located within the premises of the institute, has played a vital role in this policy. The college houses nearly 700 students annually, many of them fulfilling a diploma degree in engineering. The facilities of the RDCBSM provide a practical approach to the education provided by the college, and this combination should be considered as rather special and of interest to the industry.

The students graduating from the polytechnic college are mostly recruited from the automotive/engineering industries. There doesn't appear to be a structured path of students coming out of the college moving either directly into the bicycle industry or into positions in the RDCBSM, although some placements of this nature do occur.

The RDCBSM occasionally provides lectures and training courses for the bicycle industry, but it is hard to observe any specific and planned structure in how often these courses are delivered. There also needs to be greater correlation between the critical areas where industry needs assistance/training and the courses offered by the R&D centre. A planning process with the associations could enable the polytechnic college to design and deliver dedicated and tailored training and educational programmes for the bicycle industry. Again, this could be achieved from for example, but not limited to, regular interaction and planning meetings with industry, applying structured feedback as a planning tool for setting up the right and wanted training programmes, and allying with selected academic partners with high credibility within the key topics of interest. This is further elaborated in Chapter 10 of this report.

Placement programmes, either by having the RDCBSM staff working in industry premises, or industry staff outplaced with the RDCBSM for a period, don't seem to take place at present. The value of such placement, both for creating a tighter interaction and for creating higher mutual awareness of capabilities and needs is high, and should be a source for new impulses and ideas, both for the industry and for the RDCBSM.

Technology transfer and knowledge transfer programmes with industry clients

During the initial period of operation of the RDCBSM, a number of new manufacturing tools and designs, based on reverse engineering of imported models, were provided by the RDCBSM and implemented in the local industry.

Today this flow of knowledge and technology has slowed down, and the institute, basically focuses on its tool room and testing/certification functions. Chapter 2.6 of this report describes the nature and implication of open innovation systems and how cross-border transfer of knowledge causes documented higher innovation efficiency. One of the more common models in this aspect is the Triple Helix model, as described briefly in Chapter 2.6. Chapter 2.7 of this report discusses the value of knowledge and technology transfer between research institutes and industry. In modern innovative societies, where industry is expected to play an important role, such transfer interaction is vital. Chapter 2.7, among others, states that "the need for sharing knowledge between universities/research institutions and industry has become increasingly evident in recent years. Research institutions are nodal organizations with a potentially central and strategic role in knowledge creation and dissemination within an industry." Furthermore, the growing importance of SMEs in the technology sector having frequent and deep collaborations with R&D institutes, and vice versa, and for the institute to play a dynamic and value-adding role, is discussed in Chapter 2.8 of this report,. SMEs' interaction with, and support by, the RDCBSM directly addresses the original charter of the institute.

The international bicycle industry has taken significant steps towards more advanced functionalities, materials and designs, in frequent interaction with its key R&D institutes, while the RDCBSM has not managed to follow this development, and consequently does not have adequate advice and knowledge to transfer to the industry. As a consequence, the leading industry players seek other sources of knowledge abroad.

There are fragmented examples though, where industry clients seek advice at the RDCBSM, involving redesign, modifications or even new designs of tools and parts. Such design work could even lead to filing of patents or other relevant IPR protection, which could uplift the position of the RDCBSM and its importance to its clients. The CAD/CAM Department seems to be equipped with staff and tools of both interest and value to a number of clients, and consequently could be a basis for a more structured approach and elaborate usage of this service. Furthermore, the associations and several of the representatives acknowledge that there is a growing market for more advanced bicycles at relatively reasonable prices. These models are all steel-based, and a migration into more advanced models using more advanced materials should be possible. A coordinated path with defined roles for the RDCBSM should naturally be assessed, where the existing skills and capabilites can be applied and further developed in line with the needs of the industry.

Technology transfer programmes with technology providers

Again, during the RDCBSM's initial years of operation, technology transfer from international experts took place. A Polish company, TKP Consulting, played a vital role in the construction of the centre by transferring and consulting knowledge in engineering skills. After this first period, no new initiatives have been taken by the RDCBSM to keep itself updated with the developments taking place globally. As a consequence, Indian industry players have taken up their own initiatives and formed alliances with appropriate foreign technology providers. There are several examples of alliances being formed in the automotive sector of relevance also to the bicycle industry, where technology, manufacturing practices and knowledge have been transferred to the Indian partners. The RDCBSM currently plays no role in these ventures/collaborations and risks the possibility of further distancing itself from the industry.

Some of the industry representatives listed Taiwan and Japan as technologically leading countries in bicycle engineering. Examples of cooperations with Taiwanese industries already in place have been given. An assessment of, for example, the Industrial Technology Research Institute (ITRI) and the CHC research institute, in Taiwan, to see how they interact with their industry clients, as a role model for the RDCBSM, may be valuable. A recent joint venture set up in Ludhiana between a German manufacturer of aluminium rims and an Indian component manufacturer, is an example of technology and knowledge transfer with foreign providers. Unfortunately, this collaboration has had no influence from, nor specific role for, the RDCBSM.

6.6. Dissemination Activities

There are no streamlined, structured means/activities related to the dissemination of the RDCBSM's services to industry. A set of brochures describing the service offerings from RDCBSM exists; likewise the services, organisation and technical skills are listed on the website. This documentation is not necessarily being utilized for active outreach to the market. There don't appear to be any regular newsletters being issued, and reports from industry projects and activities only exist as technical reports related to actual testing, calibration and certification of parts, components, bicycles. The majority of the reporting work also seems highly manual in its function. The training courses organised by the RDCBSM provide a possible channel for the dissemination of activities, albeit in an unstructured and informal way.

6.7. Location as a Facilitator for Interaction with Industry

As pointed out in this report earlier, Ludhiana represents a very compact and complete industrial cluster, with the majority of manufacturers located in or just around the main industrial area of the city. This factor should be an enabler and facilitator for elaborate intra-industry interaction. All theory and empiricism indicate that physical co-location is a driver for enhanced collaboration. The RDCBSM, at the heart of this industrial cluster should be able to better consolidate its level of interaction with manufacturers.

The quality and standard of the campus itself is covered in Chapter 9 of this report. Chapter 2 of this report, on innovation and innovation management, discusses, among others, how proximity, location in clusters, exchange of codified knowledge links to innovative capacity, and how succesful clusters utilize location in their innovative work. This is not observed with the interaction the RDCBSM and industry in Ludhiana have.

6.8. Summary

Various aspects of the RDCBSM's capacity to respond to industry needs have been discussed in this chapter. Though formal structures should be in place for comprehensive interaction and collaboration in many areas, it is found that there is a significant lack of interactions in practice. This is specifically related to: a lack of regular and consistent visits and meetings with industry top management; allowance for actual influence in prioritization of the institute's activities, skill building and service provisions; involvement in strategy development; lack of, or unstructured, advisory and training programmes and no visible knowledge and technology transfer to address challenges faced by the bicycle industry.

THE RDCBSM AND THE STATE/ CENTRAL GOVERNMENT

7

Chapter 7 briefly discusses the influence of, and priorities for, the Punjab state government in relation to its controlling power of the RDCBSM. The chapter provides some relevant reference examples of similar institutes in other sectors in India, and other places of the world. Finally, the need for better cross-industrial collaboration, and how the government may be instrumental in this process, is discussed.

7.1. Governance and Control

Advanced research institutes around the world may have different ownership and control structures. There are examples of both state owned/controlled institutes, institutes owned partially by foundations and those that are fully privatized. Several examples of institutes controlled by the state also exist, especially when the industries being served by the institutes are of great importance, both strategically and financially to its nation's growth and development. It is fair to consider the bicycle industry a strategic and financially important industry, especially for the Ludhiana cluster. This is argued both from the number of companies and people involved and from the fact that it is the world's second largest manufacturer of bicycles and bicycle parts and components.

Several relevant role models around the world have been analysed, within all categories of ownership/controlling structures. Among state-owned institutes, one such example is the RISE institute of Sweden, which is fully owned by the Swedish state (although it is not specifically serving the bicycle industry). After a recent merger, it consists of three previously different, independent institutes, Innventia, SP Technical Research Institute and Swedish ICT. Innventia directly services the pulp and paper sector, but through the merger with the two other institutes, the group is able to offer a wide and comprehensive set of services and knowledge to a wide range of industries, enabling new innovations and developments. It has further acquired strategic institutes in other Scandinavian countries to form a regional technology and research entity. The way the institution is organised, i.e. applying multi-skill approaches to its various fields of work, and the way the organization is being managed, may be an interesting reference model for the RDCBSM.

A more directly related reference model may be the ITRI[21], Taiwan or the CHC - Bicycle Research Institute, Taiwan. The ITRI is a huge, multi-discipline research institute serving a number of different industries

[21] ‹www.itri.org›.

with both basic and applied research. The way the CHC interacts with its industry and government, and the role the government is actually playing in the governing and operation of the CHC, may be of interest to assess further. Also, the University of British Columbia (UBC) in Canada, where a tight interaction between academia, multi-disciplinary research and industrial interaction is demonstrated to the benefit of all parties and may be a good and relevant example. From the selection of privately controlled/owned institutes, SINTEF[22] Norway, a multi-discipline research institute, also serving a number of different industries with basic and applied research, may also be analysed.

In the case of the RDCBSM and India, it may be both a necessary and strategically correct solution to keep the control of the institute within the Punjab state government. In this way, the control of further developments and innovations deriving from the research work is retained.

However, what is clearly observed from the examples provided is that they have a strong focus and attention to their clients' needs. The different institutes of RISE actively work with, and orient towards their clients to identify, formulate and define areas of strategic research and development, and work with them in the implementation stages of the projects. The role of the state is more of an aggregate controller of strategies being set and followed and approving the shares of the funding needed for supporting the activities. In reality, the industry clients, with the assistance of the institute, set the agenda and the priorities.

In addition, especially in the Nordic countries, the Triple Helix model[23] is largely applied in R&D-related work. The model is characterized by tight collaboration and shared financial funding between industry, research institutes and academia under commonly defined and approved research programmes. The required financial resources are often derived both from the state, through different suitable financial instruments, and from the industry itself, both as direct financial resources and in-kind contributions by industry. In this way one secures the state's control with, and support of, the activity, but also ensures a satisfactory and significant ownership and commitment from the industry involved. Chapter 2, especially Section 2.6, discusses and outlines the principles of the Triple Helix model.

This report has discussed, what seems to be a lack of customer and client orientation in much of the work being done at the RDCBSM. The uncertainty in what actually drives and prioritizes the choices of the services being executed has been highlighted, indicating that the industry involvement in this prioritization seems low. Although the RDCBSM is financially self-sustaining, there are few or no indications that these services are driven by the critical needs and demands of the industry, but rather that most of the services can be defined as basic/minimum and mandatory. The lack of clear selection criteria for the projects being executed and an unstructured approach to project selection has been highlighted. The introduction of a market orientation and the definition of a marketing strategy, as earlier commented, may be a start to turn the prioritization of the institute towards its clients. An ownership and execution model as applied in the Nordic countries, and especially related to the RISE Group and Innventia, may be a way of supporting and developing a much closer interaction with the clients.

[22] ‹www.sintef.no›.
[23] Chapter 2 of this report.

7.2. Financial Funds and the Importance for Setting Direction for the RDCBSM

The analysis of the revenue stream of the RDCBSM has been discussed in Chapter 12 of this report. Currently no share of the regular funding is derived from governmental programmes, except from specific applications for investment support under specific government programmes. The government articulates a clear vision for the bicycle industry and the subsequent role of a strong supportive technology centre, as expressed in the new industrial policy under release.[24] However, as explained in Chapter 10, a transformation of the RDCBSM to such a role will require significant investment. Consequently, predictability in budgets and financial resources will be critical for a successful transition. With the Director of Industries and Commerce (Government of Punjab) as Chairman of the RDCBSM's GC, and with all key members of the industry on the council, one should assume that a firm, long-term strategic funding plan should be possible to pave out, setting the direction of the RDCBSM.

The RDCBSM seems to have significant needs for upgrading the facilities and reposition its capabilities in serving the industry. This requires thorough and detailed planning, assumes strong support and commitment from owners and clients and will take time. The observed unpredictable background in revenue creation and fundraising is not what the RDCBSM needs in such a situation.

Several parallel examples of funding arrangements can be drawn from other industries. With respect to the sugar, pulp and paper and rubber industry for example, it used to be standard practice to collect 'Cess funds', derived from a small fee on all sold products. Another example is the Sugar Development Fund, established for the aim of providing soft loans to the industry for technology upgrading, adopting clean technologies and carrying out research projects aimed at the promotion and development of any aspect of the sugar industry. A part of the fund went to the National Sugar Institute.[25] Feasibility of such alternative revenue streams for the RDCBSM may be explored. However, a need for a period of joint financial aid, in line with the key interests and requirements of the industry, is strongly advised, at least for a period allowing the transition to take place.

[24] To be released in November 2017.

7.3. Interaction and Coordination with Other Relevant Government Ministries to Assess Efficient Cross-Industry Collaboration

Several reports received as background information, indicate a strong need for a significant improvement of infrastructure to promote the transition from motorized to non-motorized transportation.[26] This may be an issue concerning multiple ministries, which would benefit from collaboration involving other similar publicly controlled R&D institutes. A stronger collaboration across different industries with identical objectives may help both the bicycle industry and the R&D centres implied, to create a stronger and more visible position.

Another example of potential collaboration is in the area of packaging for the bicycle industry. Standard practices for packaging of bicycles and parts have remained

[25] Sugar Development Fund ‹http://dfpd.nic.in/sugar-devlopmentfund.htm›.
[26] The TERI Report – Pedaling towards a greener India.

mostly stagnant over the past 40-50 years This could be a potential area of collaboration with the pulp and paper industry, and the corresponding R&D centre the Central Pulp and Paper Research Institute (CPPRI). A possibility to create a collaborative and cross-functional project, at the same time as striving for mutual learning between the two institutes, should be assessed.

7.4. The RDCBSM as a Policy Advocate

This section discusses the different ways and structures that enable the RDCBSM to play an influential role in advocating for industry policy making. The RDCBSM needs strong links to both industry, and technology and knowledge providers to be able to function as a policy advocate for the government, and vice versa. The Triple Helix model (Chapter 2.6) is illustrative of the need for such a collaborative dialogue. The R&D centre should know the needs of the industry during dialogue with the government to facilitate appropriate policy responses. This will reduce barriers to innovation for the industry and this chapter points at enablers and disablers for such advocacy to take place.

The RDCBSM's participation in or membership of relevant working groups and committees

As the nodal technical institution for the sector, the RDCBSM is uniquely positioned to influence the direction of the development of the Indian bicycle industry and provide important advisory services to the government in providing the requisite policy support and formulation of regulatory frameworks. In performing this function, the RDCBSM is rendered a neutral broker, providing technical inputs to and participating in deliberations of appropriate statutory bodies, working groups, government departments and relevant technical committees. This would involve active dialogue and network-building with these stakeholders, as well as discussions with industry actors for an understanding of the on-ground scenario.

The RDCBSM's engagement with statutory bodies and policy formulation boards

There are examples of statutory boards and committees relevant to the Indian bicycle industry. A prime example of this is the the Bureau of Indian Standards (BIS). The RDCBSM and the associations interact with the BIS on a regular basis. The GM of the RDCBSM is also the Chairman of the Bicycles Sectional Committee (Transport Engineering Division) of the BIS. In line with this model of interaction/cooperation, the RDCBSM personnel should participate in different forums and working groups. For example, the AICMA has a set of committees within its organization (technical, commerce, taxation, demand, IPR, etc.) Although not currently the case, the RDCBSM should be involved in the deliberations of these committees, providing insights into tecnological developments to manufacturers.

The RDCBSM should also partake in industry-wide discourse and policy deliberations. For example, representing the bicycle industry in the National Road Safety Council should be an action point for the RDCBSM, as well as the industry associations. Furthermore, the AICMA has developed a proposal for the formation of a 'Bicycle Development Council', which would act as a coordinating body for the industry, and the RDCBSM should play a central role in such a council.

In addition to providing industry inputs to regulatory/statutory bodies and other policy-related organizations, the RDCBSM should also be in a position to guide manufacturers in meeting regulatory requirements and standards specifications, as defined by such standard-issuing bodies. This advisory service is key in assisting the industry in meeting quality/product requirements.

7.5. Summary

This chapter has briefly discussed the RDCBSM's relation to the Punjab state government and compares the controlling and governance structure to other equivalent institutes in other regions of the world. Furthermore, it has discussed the transition needed for the industry and the RDCBSM, to comply with competitive requirements and benefit from the growth potential over the recognize. It has aldo pointed at a need for strong and predictable support by the government to succeed in this transition. Different funding and collaboration schemes have been discussed, amongst others the Triple Helix model was discussed, as well as how this model welcomes and assumes both public and private funding and participation. This chapter also discusses the current potential role of the RDCBSM in policy advocacy for the bicycle industry. Since the RDCBSM falls under the Government of Punjab, it is well-connected to state government to put forward the needs of the industry. However, in order to effectively represent the industry with government/statutory bodies/regulatory authorities, there needs to be a greater level of collaboration with industry and industry associations in general, specifically for policy issues. The RDCBSM can leverage its position as a neutral broker and put forward balanced and technically sound views to relevant stakeholders.

R&D PROGRAMMES AND SUBSEQUENT PROJECTS

8

Manufacturing enterprises, especially the SMEs, have limited capacities to carry out R&D activities for themselves, and look for guidance for the adoption of better manufacturing practices and efficient operations. The R&D centre must be in a position to provide such support to the manufacturers, and devote time to such investigations and deliberations. As pointed out earlier in this report, there is essentially no R&D activity in the RDCBSM currently. Consequently, this chapter discusses these topics from a different approach, to assess how R&D work could be more visible within the operational frame of the institute.

8.1. Criteria for Selection and Priorities for Deciding on R&D Programmes and Direction

There are a number of areas in which the Indian bicycle industry faces challenges in operations and knowledge/skill deficiencies, as expressed during the many interactions held under the diagnostic assessment. Examples of this include, but are not limited to, life cycle assessment, skill development in assembly, material knowledge and management (especially related to aluminium and aluminium alloys), process flow/production planning, tig welding, painting, product design using 3D platforms from concept to realization and fast prototyping using 3D printing technologies, among others.

A coordinated approach, primarily initiated by the RDCBSM management and anchored with the GC, should make it possible to define the criteria for selection of such topics for R&D, and set the priorities and consequences for execution. In addition, when manufacturers come to the RDCBSM for testing or other projects, topics that solicit further investigation or trouble-shooting come forward as potential R&D projects. At present, the RDCBSM does not carry out applied research activities. This, combined with unstructured interaction with the industry, has led to a gradual inconsistency between the RDCBSM's expertise levels and subsequent relevance to the changing requirements of industry.

8.2. Industry Interaction and Influence on R&D Selection Criteria

In the absence of applied R&D as a core focus of the organization, interactions with the industry, as in the GC meetings of the R&D centre, do not translate into active research efforts at the RDCBSM. By focusing on strategy-level discourse at the GC meetings, a guiding tool for prioritization of

applied research areas can be generated, and GC will have the authority to decide on how the RDCBSM engineers can engage in the requisite R&D activities for the benefit of the industry. The RDCBSM should also consider initiating bringing together industry actors, on a common platform, to discuss their R&D needs, and hear directly from a large set of companies.

In addition, cross-functional areas could be explored with other manufacturing sectors for potential collaborations and technology sharing/process collaborations. One such example to be considered could be the development of new packaging solutions for the bicycle industry in collaboration with the pulp and paper industry. UNIDO's engagement with such sectors through various projects could be a potential channel for such tie-ups.

8.3. The Process of Undertaking R&D Projects

The current typical process for undertaking a (if any) R&D-related project, starts with a problem being presented by a client, as a 1:1 problem/request for guidance. There appears to be a culture of wide and complementary discussions, involving a multi-disciplinary team of participants, thereby allowing for open and result oriented processing. The results of these processes are mostly implemented in the industry client involved, and owning the problem. This open culture provides good conditions for a more elaborate and advanced R&D environment, in the sense that multi-disciplinary team discussions and processes are frequently applied. However, taking this platform to a more general level, describing a model of how R&D and innovation is stimulated, initiated, organised, executed and delivered by and within the institute, has not been observed. Essentially, and pointed out earlier in this report (Chapter 2), a general strategy for knowledge management and innovation is missing.

8.4. Interaction with Universities and Academia

Structured and continuous collaboration with universities or colleges of specific relevance and interest to the bicycle industry has not been observed. However, individual faculty staff at the polytechnic college do give occasional lectures at local external colleges. A bi-directional exchange of knowledge with academia will ensure a means to keep updated on external knowledge and technology developments of interest and relevance to the industry, e.g. 3D printing or design. A few relevant schools have been mentioned as targets for such collaboration, such as the National Institute of Design (NID), Ludhiana College of Engineering and Technology and the Indian Institute of Technology (IIT). No initiative is observed to have taken place. One way of approaching this may be to invite individual representative(s) from academia as members of the GC.

The fact that there is a polytechnic college under the RDCBSM, and that a significant number of staff are functioning as lecturers at the college, is a good basis for such interaction. However, our observation is that the topics being taught at the college only form a platform for basic, mandatory skills at the R&D centre and industry level, and may even be misaligned with the expressed industry needs.

It is also observed that in general, the bicycle industry has its challenges in attracting young and talented students, where other light engineering industries, such as automotive, seem to be more attractive. In this aspect the RDCBSM should benefit from working actively with the industry and academia to develop new programmes and work in coordination with visualizing potential education and career paths from universities through R&D to industry.

8.5. Summary

This chapter discusses the current status of research activities at the RDCBSM, and the implications of the absence of a core research focus vertical in the organization. Various modalities of initiation, formulation, prioritization, execution and implementation of R&D projects in relation to the RDCBSM's operation have also been discussed. The formal structures for establishing good processes and procedures for R&D are not in place. Both the actual interaction and collaboration with industry/academia and the lack of definition and implementation of efficient processes for initiation, execution, monitoring and correcting R&D projects, have resulted in a limited R&D focus.

THE RDCBSM; MANAGEMENT, ORGANISATION, SKILLS AND INFRASTRUCTURE

9

This chapter discusses different specific aspects related to the RDCBSM's management skills and practices, scientific and technical skills, organisation, infrastructure and facilities.

9.1. Role and Expectations for the General Manager Position, and Criteria for Selection

The GM plays a very active role in managing and guiding the R&D centre's activities. The GM is seen to be involved in essentially all significant activities of the institute, as well as being responsible for a majority of the external activities involving interactions with clients, associations and authorities. There comprises a team of deputy and assistant managers in the main departments; however, the reporting structure is not streamlined, indicative of one-to-one decision-making between the GM and key staff, and with no clear, formal role of the management team as a unit.

The criteria needed to qualify for the position of General Manager of the RDCBSM is reflected in the advertisement for recruiting a new GM.[27] A professional background in research and/or industrial management within the light engineering industry is a requirement, as well as a high-level educational qualification. The management of an institute such as the RDCBSM requires a thorough understanding of the functioning of a technical organization, and that the head of such an institution displays corresponding technical and managerial capabilities required for the optimal management of such an organization. The RDCBSM is currently facing several challenges, vis-à-vis its in-house expertise levels, exposure to best available technologies and best practices and the need for increased structured interaction with the industry. Addressing these challenges will require a substantial overhaul of organizational processes, skills, expertise levels, the types of functions carried out and modalities of working with its clients. Therefore, the management team, specifically the GM, need to display documented skills and experience in the management of complex organizations in transition, capable of formulating a concrete strategy towards creating a more dynamic organization and mobilizing the necessary resources to achieve the identified goals. This would not only involve internal strengthening of skills and services, but also increased engagement with clients and industry. At present however, outreach capabilities and skills and an interest in marketing are limited at the RDCBSM. It would therefore be useful for the eligibility criteria for the position of General Manager and all senior management positions to include management skills (in addition to technical qualifications).

[27] RDCBSM advertisement for recruiting new General Manager.

9.2. Focus Areas and Time Dedicated for Key Tasks for the General Manager and Management Staff

The RDCBSM was analysed vis-a-vis the degree of focus and time spent on the different key tasks under the mandate of the institute (with a focus on the GM and the management team). It appears that manual administrative work and reporting, numerous 1-to-1 meetings and detailed operational control of the activities within the departments take significant time for staff members. As a result, less time is devoted to managing applied R&D, structured marketing, consultations with industry, etc.

Given the absence of an organizational strategy and analysis of market demand, the RDCBSM is not necessarily working towards furthering services that would enhance its relevance to the bicycle industry. The management appears to be confident that sufficient market demand exists for the services of the institute. However, the management of the organization must give emphasis to the following:

- Work closely with key clients and key stakeholders to ensure a clear strategy with related key goals and activities to be established
- Communicate strategy and goals across the organization
- Develop and ensure that the organization is equipped, funded and in a position to operationalize the strategy
- Follow up and motivate the organization to meet its expectations, alternatively correct and modify the progress

These key areas will involve, among others, active delegation and mobilization of responsibilities, active marketing, communication and interaction with key clients and stakeholders, motivation for internal organizational development in terms of promotion schemes, sharing key information within the organization, mentoring, stimulating and promoting internal talent and actively working on external brand building and recruitment. Despite several departments displaying examples of working with clearly defined goals, delegation of responsibilities and sharing of information, this culture needs to be adopted across the RDCBSM.

9.3. Divisional Structure of the RDCBSM, and Relevance for Industry Priorities

The organogram of the RDCBSM, as provided in Figure 4.2, reflects more or less the same organizational division as originally developed when the institute was established in the early 1980s. There appears to be little modification or adaptation of the skills employed and the areas of activities, in line with the changing needs of the bicycle industry. As a result, the RDCBSM's ability to react to sector needs is limited.

The RDCBSM also lacks a clear distinction between the structural set-up for technical and managerial functions. Core technical services (strengthened with dedicated, structured leadership and enhanced expertise) to support areas in which manufacturers need assistance should be aided with organization-wide dedicated departments for functions related to HR management, finance and accounts, business development and marketing, etc.

9.4. The Number of Staff Divided in the Different Categories

Currently, the total number of staff at the RDCBSM is 103, divided into permanent and contractual assignments, with a majority of contractual staff. The 103 positions are subdivided into 5 managers/deputy managers, 5 assistant managers, approximately 20 engineers/technical officers, approximately 30 related to teaching/education, 20 within administrative functions and the remaining 20-25 being shop-floor operators. There are 4 employees in the Design and Development Department, 16 organised under the lab and Testing Department and 22 in tool room facilities.

Over the years, the number of sanctioned permanent positions has decreased, and the number of contractual assignments has increased. To date, the majority of senior engineers and management have, or soon will be, retired. This underlines a critical need for the recruitment of new employees for knowledge management and retention of in-house expertise, providing an opportunity for the RDCBSM to recruit the skills needed for effectively serving the industry.

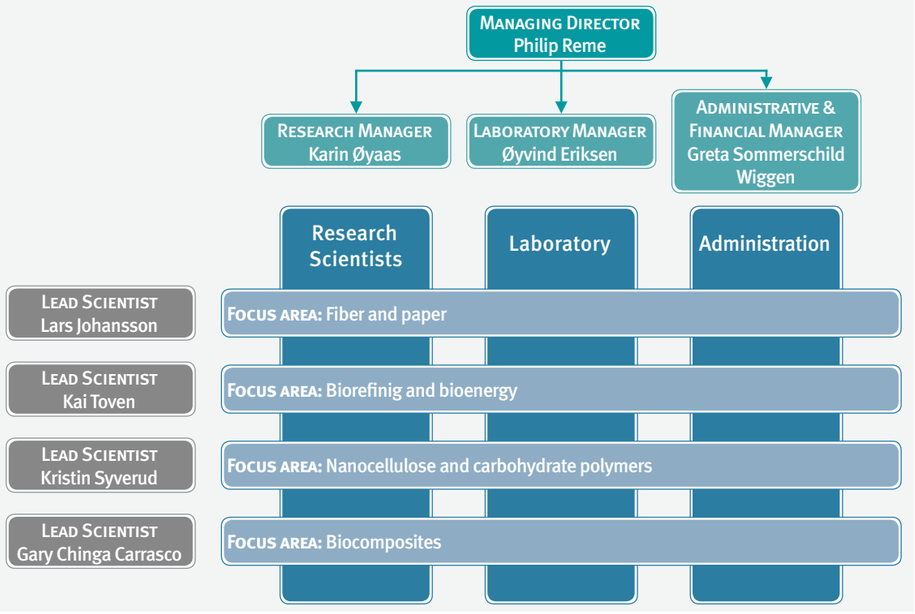
9.5. Technical Staff: Capacity and Estimated Time Spent on Scientific Work

It was observed that most of the management and senior engineering staff are involved in the technical services and activities. However, the degree of detailed involvement combined with basically manual office support tools and methods, leave little or no time for more future-oriented R&D and scientific work. There is an expressed shortage of manpower to expand the RDCBSM's scope of work beyond its current functions. As highlighted in Section 9.2 above, the way the institute is organised and how resources are prioritized and allocated have a bearing on this. A distinction between technical and managerial departments, and a reorientation of technical services with dedicated personnel will help overcome this issue. A reference example, the Norwegian branch of RISE PFI is shown as organogram in Figure 9.3 below.[28] Despite being an institute serving a completely different industry, it gives an idea of an organization divided into 4 application areas (horizontal) and 3 occupational areas serving all 4 applications (vertical). These applications and occupations obviously need to be defined in relevance with the bicycle engineering needs. A minimum of administrative staff is allocated, and most resources are allocated as operational staff. In this way, mobilization between application areas may be secured on a project-by-project basis. No individual marketing department is allocated and the CEO of the institute dedicates much of his time for client interactions and marketing-related work, as well as the management team (being both occupational and application).

With reference to the upcoming possible flexibility and degrees of freedom because of the shift and changes in assignments, there are several possibilities to redesign the organization. A reorganisation should specifically address and respond to the need for increased innovation capabilities and to fast reactions to expressed needs and requests from the market. A reference in this aspect is RISE Fire Research, www.risefr.com, where the organization has been made according to applications and knowledge.

[28] Paper and Fibre Research Institute (PFI), 2014. *New Organisation at PFI*. [Online] Available at: ‹http://www.pfi.no/Info-Center/New-organisation-at-PFI/› [Accessed on 7 April 2017].

Figure 9.3: PFI organogram



9.6. Overview and Assessment of Formal and Practical Skills

A brief analysis of the list of the key 25 employees[29] was conducted, to analyse the qualifications of personnel vis-à-vis funtions carried out by them in the organization. Of the 25 staff profiles, the following degrees are registered:

- MBA: 2
- M.Sc/M.E/M.Tech: 3
- B.Tech, Production or Industrial Eng: 2
- B.Tech, Mech. Engineering: 7
- Dipl. Mech. Engineering: 14
- Dipl. Automotive Engineering: 1

[29] List of employees with technical and/or managerial responsibility.

Most of the university/college degrees are obtained as general and basic educational degrees. Based on the feedback from the industry as well as an assessment of the general profile of the RDCBSM staff, the organization needs to update its technical skills and expertise in line with the changing profile of the bicycle industry. The more advanced and specialized skills needed to support the industry, such as material technologies and science, industrial design, process automation and advanced mechanical engineering seem to be missing as formal skills within the institute. The RDCBSM also needs to develop new in-house capacities in areas such as mechanical engineering, electrical engineering, industrial design, automation engineering, etc. In addition, there also appears to be a need to build soft skills at the RDCBSM for internal management and efficient service delivery.

9.7. Reward and Motivation Programmes for Staff

The RDCBSM has implemented a system for monitoring and developing individual and departmental skills and performance. The system lists a number of defined areas of responsibilities and skills, related to the defined targets and objectives for the department, and to the employee's work topics. Examples of criteria being monitored include communication skills, knowledge related to work topics, leadership, work organisation, etc. Performance indicator charts are used and these charts are followed up between manager and subordinates.[30] The system has been implemented throughout the organization, however, the follow-up mechanism of this system (i.e. corrective measures and consequential management) is less clear. In addition, the application of this system for retention of skilled human capital and the development of individual career paths is also limited. As the organization is currently dominated by contractual assignments with much higher flexibility in terms of terminations and changes in assignments, a more dynamic appraisal system could result in more effective HR and knowledge management strategies.

Specific and structured plans to reward and motivate talent and good achievements by individuals or teams would need to be instituted. Some examples of this are systems for developing and monitoring individual objectives as well as achievements, career planning and planned rewards and promotions, planned deployment mechanisms across departments and services, etc. Different exchange programmes for scientific staff internally, externally and within industry, would also act as both skill development exercises and feed into reward and performance incentive schemes. There are examples of exchange on an individual basis with respect to internal exchange, where individual employees gain experience from more than one department and activity, and consequently achieve knowledge and understanding of cross-border activities. However, direct measuring of, and building on, impacts from such exchange to develop the knowledge, level of services and attractiveness of the institute appear to be limited. Exchange/discourse with other research institutes, national or international, does not occur. Internally, exchange and deployment materialize when vacancies occur, and not as a function of career planning and the planned development of the organization.

[30] RDCBSM performance appraisal form.

9.8. Infrastructure of the RDCBSM

9.8.1. Status of laboratory facilities, tool room and workshop and design facilities.

The laboratories were assessed in terms of equipment, functionality of equipment, relevance and applicability, and state-of-the-art in relation to the needs and demands from industry. The RDCBSM was set up equipped with top-class equipment of relevance to the industry. This, among others, relates to CAD/CAM, testing jigs and equipment, CNC tooling machines and bicycle-testing facilities. The testing and calibration facilities have been frequently upgraded in line with its accreditation and in line with the NABL/ISO requirements, and are effective in meeting industry's mechanical testing needs. However, much of the equipment in the tool room and workshop is dated and is due for replacement as well as an update/expansion in line with industry's requirements for tooling, jigs, fixtures components in new materials and special components. In order to sustain the support provided to industry

vis-à-vis tooling and related workshop functions (e.g. cold forging), an upgrade and reinvestment in new equipment will be needed accordingly. A specification of the most critical equipment will need to be worked out in collaboration with industry and relevant experts, and additional facilities to provide fast prototyping services could be considered. With its background in toolmaking, and CAD/CAM, the provision of fast prototyping will enable the RDCBSM to work towards co-development of technology with the industry.

9.8.2. The RDCBSM campus

The RDCBSM campus is ideally located centrally to the Ludhiana bicycle cluster, spread over a large area. All the technical personnel as well as the polytechnic college are located in its premises. With respect to the overall appearance of the RDCBSM's facilities, it was observed that the building and related infrastructure is rather old and worn out. In order to position itself as a premier technical institute for the industry, the management must also pay attention to the quality of infrastructure (buildings, offices and classrooms, entry roads, and other aesthetic aspects of the campus) that may have a bearing on the image of the organization to external visitors.

9.8.3. Support infrastructure, e.g. IT network and support

In terms of the general functioning of the RDCBSM, it was observed that the functionality of IT networks and digitalized channels of communications/filings was rather limited, with manual handling of files/documents. There is no clear ICT strategy and structure in place, apart from the computer-driven and aided design tool work environments. This unnecessary load of manual work puts an extra burden on the staff, and also consumes more time needed for communication/discussions/decisions.

9.9. The RDCBSM Work Environment, Standard Operating Procedures and Efficiency

The RDCBSM does not function with a structured set of standard operating procedures (SOPs)[31] for its various operations. In terms of standard documentation, there are no official records reflecting specific job descriptions/roles and the responsibilities of various posts other than examples of appointment letters, where the specific details of the job descriptions are not revealed. However, there is an informal understanding (at least in a verbal form) of the responsibilities of various positions. Combined with the implemented performance charts, there is an active job performance monitoring in place. However, an institute such as the RDCBSM ought to have specific written job descriptions for all employees for clear demarcation of roles, reporting channels and the defined goals to be achieved. Given the situation of impending retirement of senior permanent staff in the coming few years, as well as the increase in contractual staff members, such formalized and documented SOPs will facilitate the continuity of operations, ensuring and verifying that work is carried out in accordance with the overall strategy to be developed for the institute.

9.10. Internal Flow of Communication and Information

There does not appear to be a clear framework for the internal flow of communication and information. Instead of a sequential reporting channel, there are many examples of one-to-one communication and sub-meetings. This is also observed to be valid for the interactions with clients, given the lack of an organization-wide marketing and outreach strategy. Consequently, there is no organised information sharing process/platform within the organization. If such information sharing is facilitated, the various departments can work in greater coordination, and will also make employees feel more involved in the organization's overall functioning. Consequently, a policy identifying rules of information sharing, reporting and forums for discussions related to the services provided by the RDCBSM should be considered.

[31] References are made during interviews of existing and applied SOP's.

9.11. Summary

Chapter 9 has assessed and discussed the RDCBSM in terms of: its management practice and skills; scientific and technical skills; organizational structure; capabilities; infrastructure and facilities. Several areas with potential for improvement and change have been highlighted, related to: management and practice and organisation; management performance monitoring; criteria for selecting top management; delegation of power; communication; collaboration and interaction with its external environment and the status of its infrastructure and facilities.

RECRUITMENT POLICIES AND HUMAN RESOURCE MANAGEMENT

10

With respect to the HR management of existing personnel, a majority of (senior) permanenent staff are nearing superannuation. This will lead to a gap in knowledge management and the continuity of operations, unless measures such as the conversion of select contractual positions into fixed/permanent positions, establishment of training/orientation programmes for increased exposure to new/young personnel and an organised handing-over process are put in place. There is also no formal career development programme within the organization, and so the matching of the skills/experience of staff with the positions held is not accurately done.

10.1. Assessment of Recruitment Policies and Criteria for Recruitment

There is no formal/structured recruitment policy document maintained by the RDCBSM. Recruitment against vacant positions is done through newspaper advertisements and subsequent interviews. In terms of an organised outreach to attract new talent, dialogue with leading universities/ technical institutions of the country, participation in education/career fairs and similar initiatives is not the current practice. In the absence of written job descriptions, roles and responsibilities are communicated by the departmental managers and by GM to the individual appointees.

10.2. Internal Promotions and Deployments

The RDCBSM has implemented a system for monitoring and developing individual and departmental skills and performance. However, the extent to which these simplistic score charts are used for furthering personnel profiles/skills, supporting a career planning scheme and individual promotions is limited. A uniform, delivery-based performance assessment and promotion system must be put in place and linked to specified job descriptions, KPIs and a periodic evaluation of technical and managerial competencies. While seniority-based promotions as well as skills-based recruitment occur at the RDCBSM (on a case-to-case basis), a clear employment and promotion guideline must be established. Resulting in a visible correlation between strategy, staff development and the career planning of staff.

10.3. Placement Programmes for Knowledge Exchange

Mechanisms to facilitate the exchange of personnel between the RDCBSM and the industry are not currently in existence. Placement programmes, designed to allow for shop-floor/technical personnel from bicycle companies to work on specific projects, will allow for greater dialogue with

industry and opportunities for co-development of technologies. An additional benefit of such a system would be the availability of additional manpower for technical projects. To complement this, placement programmes for the RDCBSM staff at the shop-floor of industry units must also be in place. This will provide junior and mid-level engineers with an operational understanding of the production processes and will allow for a collaborative consulting process to be initiated with the plant team. Such placements need to be continuously updated, both nationally and internationally, and perhaps organised as joint projects to ensure mutual commitment.

10.4. Recruitment Programmes in Collaboration with Universities and Technical Institutes

The RDCBSM has been unable to attract high-level, skilled human capital to expand its technical manpower. In response to the needs of the industry, individuals with qualifications in advanced engineering, design, etc. must be recruited. Apart from general recruitment advertisements, the RDCBSM needs to adopt a more proactive strategy in seeking new recruits. One way of doing this is to collaborate with universities and technical institutions to enrol fresh graduates from these institutions as graduate trainees/interns or entry-level positions at the RDCBSM. Such a mechanism could also be extended to technical/vocational institutes.

There are frequently students, especially from the polytechnic college, but occasionally also from other colleges, working as trainees in the RDCBSM. There are, however, no clear indications that these placements cause regular recruitment to the RDCBSM or to the bicycle industry upon completion of the studies. Nor does it seem that there is any correlation between the recruitment practice of the RDCBSM in general and these educational and placement programmes.

Like most institutes similar to the RDCBSM, one should assume that it keeps track of its former students through an alumni network. There does not appear to be such an active use of, and interaction with, its alumni network. If these individuals forming the alumni network end up in industry, a natural link will be formed for the RDCBSM to utilize.

10.5. Summary

Chapter 10 assesses and discusses the recruitment policies and HR management policies of the RDCBSM. The assessment points at significant potential for improvement, in terms of formalizing job descriptions, stimulating a more open and performance-related promotional programme and in developing closer collaborations and integrations with educational institutions to attract young graduates.

MARKETING AND DISSEMINATION 11

This chapter discusses the marketing and dissemination strategies and activities of the RDCBSM. This includes, but is not limited to, how the RDCBSM presents itself to the industry and other actors, the publication of papers and, in general, the achievements and other activities involving the flow of communication and information.

11.1. Assessment of the RDCBSM Marketing Strategy

The RDCBSM does not appear to have any clear marketing strategy or marketing plan. The institute has a marketing department, but the department's role and obligations, are not defined and streamlined. Given the lack of a clear strategy, marketing activities are more ad-hoc, and oriented around the on-going specific services provided by the institute, either directly one–to–one or as part of training programmes and workshops related to specific projects.

11.2. Customer Differentiation and Valuation Programmes, e.g. Key Accounts for Regular Clients, Industry, Government, National and International R&D Centres

The RDCBSM does not appear to implement key-customer account programmes or customer validation programmes. With reference to industry clients, national or international R&D centres, or other regular clients, special alliances or services have not been designed and offered to maintain a customer base and cement partnerships. However, the RDCBSM has initiated the process for the institution of a membership system. Membership (with differential fees) will give industry actors a range of benefits and special treatment, such as training sessions, testing, calibration and certification services, and special attention in cases of

trouble-shooting and follow-up. The institution of such a system would greatly benefit the degree of engagement with clients, and also provide an additional revenue base.

A basic monitoring system is in place, evaluating clients' feedback after the provision of specific (e.g. testing) services. The forms are to be filled in manually and ask the client to fill in performance-related grading, suggestions for improvements and requested services. Structured follow up and the utilization of suggested ideas for additional services based on this feedback seem to be limited. Despite being quite simple, the feedback forms represent actual potential and possibilities for added services and business. Consequently, it is recommended that the RDCBSM utilize these feedback forms for a structured plan of action. Apart from this, it may be difficult to know how the RDCBSM is perceived and rated among its clients, and consequently it is not likely that the needs of, and the feedback from industry clients actually drive the services of the RDCBSM.

11.3. Documented Dissemination of the RDCBSM Achievements

The systematic/structured dissemination of the RDCBSM's services and achievements appears to be limited. There is no regular publication of newsletters or annual reports (beyond the mandatory annual profit and loss statement and balance sheet); neither does the RDCBSM publish any technical publications in technical magazines for increased visibility. The services of the centre are reflected in a brochure, but broader marketing/outreach efforts, wherein these brochures are used to highlight the RDCBSM's services, are not defined. The brochures themselves need to be updated vis-à-vis design and that they also include a description of the services no longer being offered on a regular basis. The services of the RDCBSM are reflected on the website, but apart from this, the achievements and skills of the centre may indirectly be disseminated through interactions that occur during college lectures and occasional industry training lectures.

This report has, in several different contexts, reflected on a need for a joint effort among industry, the RDCBSM and possibly academia in building up the image and reputation of the bicycle industry. In this direction, a strong and recognized research institute, attractive to students and young aspiring scientists, could play an important role. However, the RDCBSM is not positioned to play such a role in the current context.

Similarly, there are no observations of systematic marketing of its own unique and core competence areas to gain a stronger position with its clients. As there is no strategy plan driving its activities, and consequently no structured awareness of its specific areas of unique expertise, there is no systematic work in this direction.

The RDCBSM does have its own website, but it is not used as a dynamic tool for brand building and outreach. The website contains a description of all relevant services being provided, and could be leveraged to promote its services, key staff and skills.

Another observation regarding the branding of the R&D centre is that the name of the institute may be slightly misaligned. If the key mandate is to support and serve the bicycle industry, it could be considered that the name of the institute reflects only that. Renaming to a more bicycle-focused title, and actively using the new name in brand building of the institute may be considered. The Indian bicycle industry exports products to select markets in Africa, Asia and to some extent Europe. Apart from testing and certifying the products for the selected export markets, the RDCBSM's support towards facilitating exports appears to be limited. The RDCBSM should focus not only on supporting its clients in entering export markets, but also expanding its client base to international companies, as it does not have any clients located abroad.

11.4. Placement Programmes with Industry

The lack of structured placement programmes, of both the RDCBSM staff in industry and of industry clients in the RDCBSM, is an important activity that must be reinstated. Closer interactions and collaboration through such placements would increase industry awareness of the RDCBSM's achievements and increase the general reputation of the RDCBSM amongst its clients. In addition, such placements will serve as a way to address the skill gaps and also act as a marketing and outreach tool.

Regular collaborations with leading international institutes (including the exchange of human resources and installation of pilot technologies) will also be instrumental in building visibility and networks for the RDCBSM. Not only would the RDCBSM benefit from increased exposure, but also from strategic partnerships for the overall benefit of the industry.

11.5. Summary

The different marketing and dissemination activities of the RDCBSM are described in this chapter. A specific marketing strategy is lacking, and the external dissemination and communication activities are fragmented and unstructured. Newsletters or similar alternatives of regular dissemination do not exist. A form of customer satisfaction or customer evaluation programme exists, but it is unclear how it is applied in the development of the RDCBSM. The lack of specific attention to brand building causes relatively low awareness of the RDCBSM's capabilities and skills.

FINANCING AND REVENUE CREATION

12

This chapter assesses and discusses the financial base of the RDCBSM - how revenues are created as well as the potential for increasing revenue creation. Budget figures and revenue have been analysed by department and by client-industries.

12.1. Overview of Different Sources of Revenues

The RDCBSM's profit and loss (P&L) statements for the fiscal years from 2012/13 to 2016/17, and the budget figures for the fiscal year 2017/18 reflect that all registered revenues are generated from services provided to the industry. The total revenues of the RDCBSM have grown from Rs 491 Lacs in 2012/'13 to Rs 735 Lacs in 2017/'18. An average compound annual growth rate (CAGR) in total of 8.5% is registered from 2012/13 P&L statement through to the budget figures for 2017/18, with relative CAGRs for the main departments as follows: Workshop 19.8%, Training and Education 2.7% and Labs and Testing 20.4%.

It is not clear what criteria are being applied when setting and approving the budgets and the budget profiles. Defined prerequisites or action plans behind the different budget figures and the relative growth figures per department are not expressed. For example, why Labs and Testing has budgeted a negative growth of almost 20% from 2016/'17 to 2017/'18 is not explained, as all other departments budget a positive growth.

As per the percentage distribution of revenues per department over the period 2012/'13 to 2017/'18[32], the relative importance varies slightly. Training and education traditionally has been the relatively large generator of revenues, representing 53-59% of the revenues, followed by labs and testing, varying between 23 and 44% of the revenues. During the past 2 fiscal years, the importance of training has slightly degraded, while labs and testing has increased its relative importance. However, the diploma programmes of the Training and Education Department has shown quite a steady level.

Regarding the profitability by department, the picture is more complex to discuss. Staff expenses are by far the largest individual expenditure item, on average representing 83% of the annual cost of the RDCBSM. However, the staff expenses are not distributed over the different departments in any report. Only the registering of employees gives the distribution in headcount, but without financial implications. The two major departments in terms of revenue creation, that is Labs and Testing, and Training and Education, also have the majority of staff expenses, observed from the number of head count, which gives an indirect indication. It is recommended that the RDCBSM should establish a P&L measurement per department.

[32] Revenue distribution per department and per industry.

12.2. Relative Split Between Different Sources and Mechanisms to Secure the Different Funding Schemes

Based on an analysis of the sources of revenues of the RDCBSM over the past 3 years, Labs and Testing and Training and Education have been the 2 dominating revenue creators, together representing 75 – 85% of the total revenues during this period. An interesting observation is that design work, excluding CAD/CAM training, in the same period only represents less than 1%.

An observation from the split between different revenue sources, is that services provided to industries other than the bicycle industry, primarily being automotive and other light engineering industries, are relatively dominant for the 2 larger departments. For Labs and Testing, especially related to sub services (i.e. mechanical test lab, standards room, CMM and chemical/spectro analysis), other industries (apart from the bicycle industry) represent 60-85% of the revenues. Only the bicycle test lab is 100% dedicated to the bicycle industry. For Training and Education, 85% of the revenues are generated from non-bicycle industries, with the diploma courses representing a majority of this department's total revenues.

Based on these observations, there is immense potential for the RDCBSM to generate more revenues from the bicycle industry.

12.3. Assessment of Specific Initiatives to Expand and Secure the Revenue Base

In the context of the RDCBSM's fragmented interaction with industry, the lack of structured marketing towards industry and a general lack of closer collaboration with the industry associations, there are limited efforts towards securing greater revenues from the industry. The lowest hanging fruits will most probably be related to activities already offered, or that used to be offered by the RDCBSM but at a premium rate. This could mean more advanced testing and certification activities, more proactive consulting and skill development services for subcontractor/vendor network development, as earlier commented in this report. However, such increased activities will need to be executed at a much higher and more frequent level, and in a sustainable and structured manner.

There are currently several initiatives and schemes that the government offers to meet industry's needs. One such example is the Cluster Development Scheme (CDS), for which the bicycle cluster in Ludhiana is a viable beneficiary/applicant. This should generate significant opportunities for the bicycle industry and especially for the RDCBSM to avail the requisite funding. There is no indication of any ongoing initiative by the RDCBSM management to position itself into this programme, neither individually nor in collaboration with the industry and its associations.

12.4. Assessment of Monitoring and Valuation Schemes for Measuring the Impact of the Different Revenue Sources

The diagnostic assessment attempted to identify specific monitoring procedures in place to evaluate the efficiency and outcome of the different streams of revenues. Apart from the P&L statements, with revenues and expenditures per department, there are no other such reporting mechanisms in place. Consequently, no specific measure directed towards the efficiency and quality of the provided services seems to exist.

12.5. Summary

The RDCBSM's different sources of revenue creation and the dependence on directly sponsored services from industry clients, and the consequent vulnerability of sustained business with these clients given the lack of marketing strategies, have been discussed. Specifically, an increasing and accumulating relative revenue creation from industries other than the bicycle industry has been the trend. Potential avenues for expansion of the revenue base have also been highlighted. It has also been observed that monitoring and valuation schemes for evaluating the efficiency of the different streams of revenues do not exist.

RECOMMENDATIONS 13

13.1. Institutional Recommendations

The following section comprises the key findings from each of the sections of the assessment given in this report and corresponding recommended actions in the short term (6-24 months), medium term (24-48 months) and long-term (5-10 years). The recommendations provide an indicative framework, to be taken forward by industry leaders and the RDCBSM management.

Table 13.2: Recommendations - The RDCBSM's framework of operation

The RDCBSM's framework of operation			
Observation	**Recommendations**	**Timeframe**	**Comments**
» Lack of clear strategy and direction » Lack of understanding of industry needs » Low degree of industry influence on the RDCBSM's priorities	The RDCBSM to indicate quarterly consultation meetings and roundtable conferences with associations and select industry representatives.	**Short**	To start involving industry of influence on the capabilities and decision-making and show evidence of change. Ensure market-oriented decision-making; ref Chapter 4.3
	Systematically structure the use of customer feedback forms to build a clear list of priorities for services requested	**Short**	To build a fact-based decision-making and priority-making process
	Develop a brief SWOT analysis to back the creation of a strategy plan and direction for the institute	**Short**	Ensure right and honest factors driving the change and the action plans of the institute
	Devise an annual strategy document listing priority areas and key technology focus areas, aligning corresponding services to these areas	**Short**	Ensuring an industry-driven strategy as a driver for the RDCBSM
	Build on quarterly meeting structure with industry to form annual strategy revision conferences	**Medium**	Ensuring an industry-driven strategy as a driver for the RDCBSM
	Review and operationalize SWOT analysis during the annual strategy revisions with industry	**Medium**	See comment 4
	Allow the strategy plan to guide the selection of projects and R&D programmes, and ensure a close link to the decision-making in GC	**Medium**	A consequence of the structure built by recommendation number 4
	Develop a set of key performance indicators (KPIs) to validate the efficiency and impact of strategy/plan	**Medium/Long**	Will link performance and perceived value to plan

Table 13.3: Recommendations - The RDCBSM's governance structure

The RDCBSM's governance structure			
Observation	**Recommendations**	**Timeframe**	**Comments**
Need for orientation of GC towards overall strategy rather than day-to-day management of the RDCBSM.	Within the GC, industry representatives and the RDCBSM to take the lead on discussions pertaining to strategy and research priorities; Government to assume an overall sanctioning role in relation to national/state priorities	**Short**	This would provide a more coherent response to sector needs in line with the Triple Helix model approach
Irregularity in meetings	Commit to a minimum of 4 GC meetings per year » Format should include an action-oriented agenda with defined follow-up actions and minutes from the meeting » Core focus areas should include evaluation of new proposals, assessment of milestones/indicators against approved projects and general/ new opportunities for programmatic funding	**Short**	» The time reserved should be at least a half-day meeting » The minutes of meetings should be used as an indicator for evaluation of the RDCBSM interventions
Ad-hoc preparation of GC meeting agenda by GM	Preparation of agenda items and cases by the RDCBSM senior management team (including department heads) and submission with due lead time (minimum 2 weeks for review and comments by all participants) prior to the GC meetings	**Short**	Will allow for better ownership of the agenda by the management team and provide a structured framework for discussion
Disruption in GC decision-making due to frequent changes in government representation	Due to the frequent turnover of the Director of Industries (i.e. government representation) as the Chairman of the GC, a structured handing-over process should be put in place	**Short**	This will enable continuity in actions/interventions; Should be linked to minutes of previous meetings

Table 13.4: Recommendations - The RDCBSM's interaction with industry; irregular, fragmented and unstructured contact with industry

The RDCBSM's interaction with industry; irregular, fragmented and unstructured contact with industry			
Observation	**Recommendations**	**Timeframe**	**Comments**
» Irregular, fragmented and unstructured contact with industry » Lack of customer-oriented decisions in the RDCBSM	» The RDCBSM should initiate: • Half-yearly meetings with manufacturers/units (coordinated through industry associations) for focused discussions on operational issues • Quarterly meetings with industry associations to focus on technology and strategy » Action-oriented task force teams should be established to pursue identified priorities	**Short**	Will allow for better information exchange and orientation of services; this would also build consulting capabilities
	Initiate industry-placement programmes for the RDCBSM staff	**Short**	Will enable the RDCBSM personnel to gain shop-floor experience; This provision should be included in the job descriptions/contracts of employed personnel
	Technical personnel from industry should be brought in as faculty members on a rotational basis at the R&D polytechnic college (based on strategic thematic needs)	**Short**	This would allow for practical exposure for trainees
	Initiate regular technically-oriented workshops on thematic needs of manufacturers (small, medium and large)	**Short/ Medium**	This would address production-related issues faced by manufacturers
	Organise a bi-annual conference/symposium to bring together industry and knowledge-based institutions	**Medium**	This will enable wider knowledge sharing, development of potential common projects and access to skilled human capital
	Establish a review mechanism (such as feedback forms) for all services	**Short**	This will provide an understanding of the quality of services provided as well as other needs of the industry
	Establish dialogue and partnerships with international industry actors and technology providers	**Medium/ Long**	This will provide a global perspective of developments in the bicycle sector

Table 13.5: Recommendations - The RDCBSM's interaction with industry/associations

The RDCBSM's interaction with industry/associations			
Observation	**Recommendations**	**Timeframe**	**Comments**
The interactions are too irregular and fragmented	Start regular work sessions to set common priorities and agendas for clarifying a more visible position for the RDCBSM	**Short**	The relationship with the associations should be a two-way conduit for knowledge and information exchange providing the requisite market and sector-level information to the RDCBSM
	The RDCBSM should work with the associations in design and delivery of focused knowledge dissemination programmes/bespoke courses (for example course delivery at the UCPMA's ITI)	**Short**	This effort could be linked with other Indian technical institutions for curricula development

Table 13.6: Recommendations - The RDCBSM's interaction with knowledge-based institutions

The RDCBSM's interaction with knowledge-based institutions			
Observation	**Recommendations**	**Timeframe**	**Comments**
Linkage with other knowledge-based institutions is truncated	Implementation of knowledge exchange programmes with national and international partners (industry and knowledge-based institutions, academia, and technology providers)	**Medium**	This would result in updated skills and knowledge; would also reduce the burden for recruitment
	Formalized linkages with national technical institutions (e.g. the IITs, NITs)	**Short**	This would require an increase in the profile of the RDCBSM but would enable wider skills/expertise with low cost implications

Table 13.7: Recommendations - The RDCBSM and government interaction

The RDCBSM and government interaction			
Observation	**Recommendations**	**Timeframe**	**Comments**
Linkage with government is truncated (i.e. other than administrative issues)	Initiate a proactive dialogue with the government regarding key issues pertaining to the bicycle industry	**Short/ Medium**	This will re-establish the RDCBSM as a resource for policy deliberations
	Start strategy planning with the state government regarding the establishment of Cycle Valley	**Short/ Medium**	The RDCBSM should be a source of technical expertise
	Assess and join efforts with other similar state controlled central R&D institutes in India, for mutual learning and potential new service provisions	**Short/ Medium**	May open for mutual learning, co-development of programmes and relationship building
	With specific reference to the proposed material bank (for aluminum), utilize the RDCBSM's connection to government to initiate dialogue for potential partnerships with key state-owned enterprises (such as the NALCO) to provide necessary support.	**Short/ Medium**	This could potentially result in ease of access to raw material and associated support services.
The RDCBSM, as a recognized neutral broker, plays a limited role in policy advocacy	Work in coordination with the advocacy arms of industry associations, in order to validate the needs of the industry, from a technical perspective	**Short**	This would provide government with a balanced input to sectoral policy-related issues
	Identify, conceptualize and propose key schemes/ initiatives for implementation by government, to support the sector (for example material bank and infrastructure incentives)	**Short/ Medium**	This would establish the capacity for policy-advisory services within the RDCBSM

Table 13.8: Recommendations - R&D and innovation

R&D and innovation			
Observation	**Recommendations**	**Timeframe**	**Comments**
Absence of R&D activities at the RDCBSM	Establish applied R&D as a core activity of the RDCBSM	**Short**	This would require dedicated manpower, time and resources
	Initiate dialogue with industry to identify research areas leading to applied research	**Short**	This would bolster technical advisory capabilities and capacity; this would also directly address industry gaps
	Learn from external role models and institutions how innovation processes are initiated and managed	**Medium**/ **Long**	This would facilitate transfer of best practices
	Undertake joint R&D projects with national technology-focused institutions (for example the IITs, NITs and institutions from allied sectors such as the ICAT)	**Short**	This would facilitate linkages for knowledge transfer and exchange
	Explore potential joint R&D projects with international technical institutions (such as the ITRI, CHC, etc.)	**Medium**	
	Formulate a clear mechanism for the marketization of R&D (this would include technology development and demonstration facilities at the RDCBSM, unit-level deployment of applied research ideas, etc.)	**Medium**	This would foster innovation.

Table 13.9: Recommendations - The RDCBSM management functions

The RDCBSM management functions			
Observation	**Recommendations**	**Timeframe**	**Comments**
Lack of clearly articulated roles and responsibilities of staff	Define clear job descriptions, roles and responsibilities for all positions	**Short**	This would ensure streamlined operations and avoidance of overlap/redundancies
	Devise a more structured performance appraisal system based on KPIs for promotion and career planning	**Short**	Will contribute to higher internal motivation, better utilization of skilled human capital, and increased recruitment potential
	Define stringent and clearly defined criteria for recruitment	**Short**	This will ensure recruitment of specialists
	Job descriptions should provide a clear time allocation for each activity to be undertaken by staff members (for example, hours per week dedicated to delivering training, research, etc.)	**Short**	This would enable optimum utilization of HR
Organization and structure			
Current organizational structure doesn't allow the the RDCBSM to react to sector needs	Establishing the RDCBSM as a 'machine bureaucracy' (ref Table 1)	**Short**	Characterized by high levels of specialization, standardization and centralized control
	Move from functioning as a 'machine bureaucracy' towards a 'simple bureaucracy'	**Medium**/ **Long**	This would mean functioning as an organic unit, centrally controlled by one person with the ability to respond quickly to changes in the environment
Lack of structured leadership for core technical services	Dedicated leadership for the following technical service verticals, avoiding assignment of multiple departments to one individual: » Testing » Training » Tool Room » Design and Development	**Short**	There will always be a need for cross-departmental communication, however, this action would reduce functional overlap and optimize the use of skilled human capital
Incoherent approach to delivery of non-technical functions	Create organization-wide dedicated departments for the following core areas: » Human Resource Management » Finance and Accounts » Business Development and Marketing	**Short**	This would enable improved administrative functioning and delivery of services
Disorganised reporting structure	Streamline reporting channels to GM by reducing one-on-one consultations	**Short**	This would improve the decision-making process
	Facilitate delegation of authority and increased team autonomy	**Short**	This would facilitate greater ownership of projects and the ability to react industry needs
Skills			
Lack of up-to-date technical expertise (hard skills)	Update technical skills and knowledge in current areas of operation	**Short**	This would raise the current skills level to the expectations of industry
	Develop new capacities in areas such as mechanical engineering, electrical engineering, industrial design, automation engineering skills and material science and technology skills	**Short**	This would entail contracting external experts for a fixed period, to work with the RDCSM personnel through a learning-by-doing and hands-on training mechanisms, alongside the external experts; The outcome of this should be embedded capacity within the RDCBSM
	Implementation of knowledge exchange programmes with national and international partners (industry and knowledge-based institutions, academia, and technology providers)	**Medium**	This would result in updated skills and knowledge; It would also reduce the burden for recruitment
Lack of soft skills for internal management and service delivery	Engage leading business schools for bespoke management training for the key RDCBSM staff	**Medium**	This will help in the uptake and implementation of enhanced marketing, general management, knowledge management skills and fostering the development of tailored consultancy services
Infrastructure			
Out-dated facilities, equipment and infrastructure	Refurbish campus facades, room facilities, class room facilities and entrance area, including outdoor areas	**Medium**	Improved image and branding
	Upgrade test lab facilities, including new requested equipment and fast design and prototyping capabilities	**Medium**	This would strengthen the response to industry demands and to keep up with international trends/standards
	Develop and update the RDCBSM's website and internal ICT networks	**Short**	This will facilitate external outreach
	Digitize current records (files, publications, etc.) and maintain a digital knowledge management system	**Short**	This will facilitate exchange of knowledge and information between departments

Table 13.10: Recommendations - Recruitment and human resources

Recruitment and human resources			
Observation	**Recommendations**	**Timeframe**	**Comments**
Majority of permanent staff are nearing retirement	Normalize consultant contracts into fixed/ permanent positions	**Short/ Medium**	This would require the mobilization of additional funds
	Establish focused training and orientation programmes for new recruits	**Short**	This would ensure continuity in institutional memory
Lack of a career development programme; Skills and experience of staff are often not aligned with position held	Establish a merit and delivery-based promotion system linked to job descriptions, KPIs and periodic evaluation of competencies	**Short**	This would facilitate healthy competition among staff and lead to better performance
	Reorient outreach and recruitment policies tapping into external technical and professional networks/service agencies	**Short**	This would widen the recruitment pool
Inability to attract high-level, skilled human capital	Establish a structured alumni network	**Short**	
	Develop new innovation and technology programmes needed by industry and regarded attractive to new recruits and students		Will enforce visibility and awareness to new recruits and students, and build on recommendations outlined in Chapter 2 of this report

Table 13.11: Recommendations - Marketing and dissemination

Marketing and dissemination			
Observation	**Recommendations**	**Timeframe**	**Comments**
Limited and fragmented visibility of achievements, skills and offerings from the RDCBSM	Develop a concrete and coordinated marketing strategy	**Short**	This would result in better visibility and outreach leading to increased revenues
	Correlate and coordinate marketing activities with industry associations	**Short**	
	Develop systematic monitoring and customer satisfactory surveys, starting from the existing customer base	**Short**	This would enable modification of services in line with industry needs
	Evaluation of current and potential client base and establish key-customer account programmes	**Medium**	This will enable enhanced customer management
	Identify new channels service portfolio expansion (e.g. actions linked to inputs from feedback forms, assessment of non-returning clients)	**Short**	
	Develop a dissemination strategy including: » Active use of the current website » Publication of annual and technical reports (digital and print) » Updated brochures » Social media	**Short/ Medium**	
	Consider renaming the institute in line with key strategy and targets	**Short**	If sewing machines do not constitute a core part of the RDCBSM's activities, this could be dropped from the title; This would allow for repositioning with industry

Table 13.12: Recommendations - Financing and revenue creation

Financing and revenue creation			
Observation	**Recommendations**	**Timeframe**	**Comments**
Static/stagnating sources of income	Structured initiative for increasing revenue base from existing services (testing, advanced testing, training, consultancy)	**Short**	Utilize feedback forms, enhance external activity, assess non-returning clients
	Work closely with industry associations to increase share of industry-funded projects and services	**Short/ Medium**	Will enable access to project-specific funding
	Increased triangulation with key stakeholders to access funding schemes (such as CDS)	**Short/ Medium**	Formalized institutional linkages and networks as a requisite to facilitate this
	Introduce the RDCBSM as a mandatory certification body for all suppliers of bicycles to the Indian market	**Short**	Additional revenue base and a service to verify that all imported bicycles are in line with quality regulations

13.2. Service-Specific Recommendations for the RDCBSM

The Indian bicycle industry is uniquely positioned in having a nodal technical agency, the RDCBSM, dedicated to the sector and acting as an instrument for R&D as well as for the provision of the relevant support services required by the industry. Especially for the Ludhiana cluster, the centre acts as a centralized focal point to provide valued services such as testing, tooling and training. This is increasingly relevant for the segments of the industry that are not able to invest in independent exploratory R&D, large-scale equipment, or for industry-wide needs that solicit a common facility.

There are several shortfalls in the service portfolio of the RDCBSM, and several areas in which the technical knowledge and proficiency of personnel require strengthening to truly be considered a resource as per the changing needs of the industry. Such strengthened capacity, combined with appropriate collaborations with leading technical experts and international technical institutions will facilitate the requisite technology and knowledge transfer that manufacturers, especially the SMEs, need.

This section lists recommendations to constitute a more robust service portfolio for the RDCBSM. The recommendations highlight the possible roles the RDCBSM could play, additional services the organization should be providing to effectively support the industry and the additional skills/ capacities that will be required to effectively deliver these services.

Table 13.13: List of KPIs

	Audit Items	Evaluation Criteria	China	MANN
Quality	Defect rate level	» Assy defect rate ‹ 0.1% » Part defect rate ‹ 1%	5/6	1.0
	Inspection system level	Good inspection performed. Good inspection tool control	5/6	1.0
	Standardization level	Q-standard visualized and worker respects its standard	5/6	1.0
Cost (Productivity)	Machine utilization level	Main machine is running constantly	5/6	2.0
	Labor performance level	All workers are working hard without waiting time loss	4/6	2.0
	Layout	Straight line and no transportation wastes	5/6	1.0
Deliver	On time defivery level	OTD rate › 99%	4.5/6	2.5
	Stock level	» Product stock ‹ 3 days » Parts stock ‹ 7 days	4/6	0.5
	Synchronization level	WIP stock between processes is very smal	5/6	2.0
Technology	Automation level	Automation level to the main machine is good	4.5/6	0.5
	IT utilization level	Computer and IT equipment is used efficiently	4.5/6	0.5
	MC maintenance level	All machines are like new due to good maintenance	5/6	1.0
Work Site Management	5S level	» Sorting, » Set in order » Shining level is high	5/6	1.0
	Visualization level	Prod-progression status to the plan is visualized	4.5/6	1.0
	Improve activity level	KAIZEN target and its action is visualize	4.5/6	1.0
Training Leadership	Discipline level	All workers put on safety uniform & greet to visitors	4/6	1.5
	Work site atmosphere	Good atmosphere in the work site and very active feeing	4/6	1.5
			78.5/100	21

Strengthened consultancy services

1. Engagement of external experts

The R&D centre should be a knowledge resource to support the industry develop and produce bicycles and components in superior materials, as per exportable standards and desirable designs as well as to achieve production efficiency. In order to effectively provide such expert guidance and technical assistance to manufacturers, there is a need to **engage external, qualified experts with relevant manufacturing experience** in certain key areas at the R&D centre, as the requisite expertise is currently lacking. These experts could be deployed at the centre for a fixed initial period (6 months - 1 year) to provide handholding and consultancy support to manufacturers, and the RDCSBM engineers would thus simultaneously receive on-the-job training from these experts. The required experts could be specialists in: TIG welding; weld inspection; PLC automation; advanced coating (painting) systems; low-pollution bright plating; polymer identification; injection moulding defects; die design (injection moulding, extrusion, hydroforming, permanent mould casting, forging); aluminium extrusion; permanent mould casting and heat treating; component interface; production layout, and total quality management, etc.

2. Expertise building and knowledge transfer

For the RDCBSM to provide technical guidance to the industry, there is a need for capacity building and skills development of the engineers working across various departments. This training-of-trainers process will enable the RDCBSM to in turn, effective guide the industry and facilitate the necessary knowledge transfer. Some of the key areas in which the RDCBSM would require training are:

- Material behaviour of aluminium alloy and the requisite processing (e.g. extrusion, heat treatment, butting, hydro-forming, permanent mould casting)
- Material identification, composition and behaviour analyses (Applicable to high-strength steel, carbon fibre, titanium, etc.)
- Design of jigs, fixtures, dies and moulds, as applicable for different materials
- PLC automation in bicycle manufacturing units
- Production efficiency and lean manufacturing
- Design competence and componentry design
- Manufacturing of critical components
- Efficient test execution and result analysis

Areas for general manufacturing support could include roll forming of new tubular cross-sections, the interaction of a steel weld seam with tube forming, precipitation hardening of aluminium alloys, cold forging of higher-strength materials, quality of plastic injection moulding, quality of paint finishes, less-polluting bright plating, and the specification of motors and batteries for electric-cycle functionality.

3. Audits and quality-related performance assessments

The RDCBSM should be in a position to conduct on-site assessments of production operations of bicycle manufacturers and provide efficiency and production improvement guidelines. The RDCBSM's skills vis-à-vis 5S, total quality management, kaizen, etc. would have to be strengthened for it to subsequently support the industry. An indicative set of KPIs[33] that could be used for such services is given in Table 13.13.

[33] This list of quality/efficiency-related KPIs was provided by the two Japanese experts (From the Japan Management Association Consultants and O&M Inc. Ltd.) who visited the RDCBSM and select manufacturing units in the Ludhiana cluster in February 2018.

Testing

1. The bicycle testing lab must be accredited to perform all tests as per various international standards. As discussed earlier, some of the important international (country-specific) certification systems include[34] JIS (Japan); EN (Europe); DIN (Germany); ASTM (United States); BS (England) and AS/NZS (Australia and New Zealand). As expressed by various industry representatives during the diagnostic assessment, certifications that would qualify them to enter export channels (with a special expressed focus on European markets) would enhance the RDCBSM's utility for local component manufacturers. Towards this, necessary steps would include:
   - » Purchase of country-specific standards documents
   - » Submission of applications for necessary accreditations as per international accreditations
   - » Cross-comparison of requirements across each of the standards (for effective guidance to manufacturers)
2. The RDCBSM is equipped for parts 1-9 of ISO 4210 tests for bicycles. 'Part 10' (currently under development) for electrically power assisted cycles (EPACs) is to be included upon finalization. Thus, it is suggested that the RDCBSM facilities are equipped with the necessary electrical tests for such EPACs. These could include water/dust proof tests, electrical and battery safety, electromagnetic compatibility, etc.[35] In preparation for this addition, it is recommended that the test lab personnel undergo training in the inspection and testing of EPAC components.
3. While the RDCBSM is relatively well equipped for the mechanical/safety testing of bicycles, chemical and environment test facilities (mainly for tyres and tubes) must be established in order to assist manufacturers to meet product requirements for European/American markets. For the development of premium bicycles with rubber and plastic components, testing facilities for the ROHS (restriction of hazardous substances)/REACH (registration, evaluation, authorisation and restriction of chemicals) compliance is vital. This would involve detection of heavy metals (lead, cadmium, chromium VI), morphology analysis, determination of phthalates (plasticized materials) and restriction of polycyclic aromatic hydrocarbons (PAH). Competency in chemical testing for aluminium tube material characteristics would also enable manufacturers in identification and utilization of correct grades of alloys.
4. Reflector testing: Since the use of reflectors on bicycles has been mandated by the Indian government, establishing a reflector testing facility would be useful to the industry, that currently uses automotive research/testing labs. The R&D centre would be an ideal location for the establishment of a testing facility specific to configurations required for fixing reflectors on bicycles. It is recommended that the test lab staff undergo additional training in the photometric testing of bicycle reflectors, sheets and tapes. It is suggested that the RDCBSM establish a knowledge sharing partnership with other laboratories such as the International Centre for Automotive Technology (ICAT) that is already engaged in reflector testing.
5. In keeping with international trends, the specialized testing for certain accessories could improve the service offerings of the RDCBSM's test labs. An example of this is bicycle helmets, for which regulatory standards (as per the PPE Directive 89/686/EEC) exist in the USA, Australia, Canada, Japan, Europe and Great Britain.
6. The RDCBSM test lab personnel require expertise in conducting tests for specific components. The ISO system comprises a range of such tests that are currently unavailable at the RDCBSM. It is recommended that the test lab personnel undergo training at leading international test labs to observe the configuration and execution of such component-specific tests (e.g. cranks, handles and handlebars), as well as execution of tests for components of different materials.
7. In addition, the test lab personnel require expert handholding/for optimal calibration of equipment, measurement of results and avoidance of common mistakes in test execution.
8. Non-destructive bicycle testing (such as ultrasonic testing, magnetic particle inspection, die penetrant testing (DPT), radiography, fractography, etc. is also an area in which the RDCBSM requires expert guidance.

[34] This is not an exhaustive list.
[35] ‹https://www.sgsgroup.us.com/-/media/local/usa/documents/flyers-and-leaflets/cts/sgsglobal-services-for-bicyclesa4en10v1.pdf›.

Development of bicycle quality tests for benchmarking of high-quality parts and quality certification

1. The existing bicycle standards are largely related to the safety requirements of bicycles. The ISO (4210) system, for example, outlines a process for testing the fatigue strength of components. Its testing requirements are built on three pillars: fatigue (caused by recurring loads); overloading; and impacts (which are less frequent events) (Zedler, 2017). While such an approach ensures a certain level of operational safety, there are several aspects that fall outside the purview of these tests. These tests consider very specific conditions, and solicit extra testing for parts that don't fall within these defined categories. Aspects such as durability, functioning, precision or comfort are not measurable by safety tests.

   Therefore, while the safety tests provide a solid foundation, final product quality must be measured factoring in a bike's intended use. It is recommended that **new tests measuring functionality and durability be developed at the RDCBSM** so as to be able to benchmark top-quality bicycles and components, and subsequently define a novel set of quality standards as a notional target for Indian manufacturers.

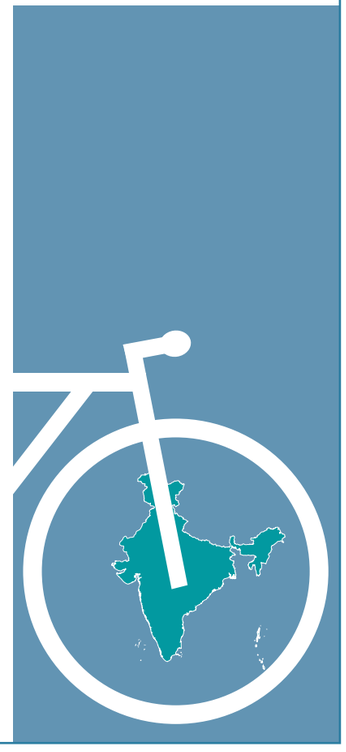
   To illustrate, these could be conceptualized as roughly corresponding to:

   Level 1, the best Shimano[36] products (suited for $2000 bicycle);
   Level 2, medium Shimano products suited for $800 bicycle; and
   Level 3, the lower-end Shimano products suited to $250 bicycle; and so on.

   Among the tests could be tyre rolling resistance, seat and handle compliance, chain friction, ramp fatigue of load-bearing components, shifter repeatability, balancing ease, bearing life, spoke life, wheel buckling strength, wet braking, etc. Although this recommendation appears purely technical, in fact it should have a wider scope and impact. Quality tests and marks will only make a difference if the majority of the manufacturers employ them, if their application is rigorously controlled, and if all players publicize their significance internationally.

   The standards will first be used to provide feedback in product development, especially in collaboration with cycle engineering skills. It would also allow display of rigorously controlled 'quality marks' on compliant Indian products, and support unified international marketing efforts to solidify faith in these markings. These quality tests would support Indian components and bicycles to rapidly develop an international reputation for quality (consistency), performance and attractiveness.

   In order to develop such tests, the need is for scientifically trained, qualified engineers (areas such as aerospace engineering would be desirable) to begin to learn the needs, using existing equipment in innovative ways to begin benchmarking the durability of world-class cycles. This consultative process could occur at the RDCBSM facilities, embedded within the needs of the manufacturers to meet export requirements.
2. Component-specific quality benchmarks: Based on the quality tests developed in the recommendation above, the RDCBSM should be able to determine and share the performance parameters of various top-quality components. This would provide manufacturers with the necessary benchmarks, and reference the quality of their own products.
3. Subsequently, the developed tests would allow for the establishment of a quality certification mark (with appropriate legal and personnel structure) to administer a quality regime, allowing manufacturers to certify products as meeting strict standards, i.e. the quality standards established in the preceding recommendations. The requisite guidance to help manufacturers meet these standards must also be provided.



[36] This is just an illustrative brand example; the benchmarking would be of several premium, high quality brands.

Design

1. The design and development team must undergo comprehensive training in component geometries and interfaces. While the staff are proficient in using the various software, the application of software to bicycle design (frame building, wheel building), component design (production parameters, joining and combinations with other components, component interfaces) and overall bicycle performance must be enhanced.

2. It is advised that the design and development team undergoes further proficiency training in 3D CAD software, to facilitate product development projects.

3. The RDCBSM should engage in prototype production services. This would involve prototyping bicycle parts, tooling mock-ups and related accessories such as helmets. 3D printers deploy different types of technologies such as fused deposition modelling or stereolithography, with different implications with respect to precision, finish, cost and final usage. It would be useful for the RDCBSM to house a rapid prototyping facility with such 3D printers, serving both experimental product development and mass production purposes.

4. The design and development staff must also develop expertise in analysing existing patent documents to establish production parameters for various components, and to advise manufacturers accordingly. The assistance of resource centres such as the Patent Information Centre, Punjab[37] could be sought in this direction.

[37] Under the Patent Facilitating Centre (Technology Information Forecasting and Assessment Centre), Government of India.

Pilot facility

It is recommended that a small-scale **pilot manufacturing facility** be established at the RDCBSM, to produce/assemble complete bicycles of various categories. The main goal of such a facility would be to provide the RDCBSM staff greater functional exposure to the bicycle production process and to better understand component interfaces, design implications, material behaviour, product performance as well as a practical understanding of different types of bicycle models. The facility could be housed at the the RDCBSM premises and would also serve as a demonstration site for various modern production processes that the Indian bicycle industry is yet to adopt. This would also enable real-time demonstration of PLC automation measures applicable in the Indian context.

This proposed pilot facility could also be the test-bed for the production of certain critical components, which has not taken place in India due to a lack of technology or know-how. Components such as derailleurs and gear-shift levers are critical components for high-end bicycles, and the RDCBSM can use the pilot facility to demonstrate production techniques through appropriate technology sharing mechanisms with international companies, reverse engineering exercises, etc.

Training

1. The training function of the RDCBSM is a centralized resource for capacity building and knowledge transfer for the industry. While the centre currently delivers short-term training courses (as previously outlined) for the industry, it is recommended that a wider range of worker training courses be developed and delivered, in keeping with emerging processes and production methods such as:
   - » Advanced TIG/MIG welding
   - » Advanced coating methods/ surface finishing/plating
   - » Injection moulding
   - » Painting (automated disc painting, effective manual painting, etc.)
   - » Wheel assembly
   - » Bicycle assembly
   - » Stickering process (automated/water-based, etc.)
   - » Bicycle maintenance
2. It is also recommended that the RDCBSM work towards developing a diploma course tailored towards bicycle engineering.
3. The RDCBSM should also conduct component-specific training sessions for component manufacturers; i.e. knowledge dissemination forums for manufacturers of a particular component to discuss global best practices, common hurdles and challenges and production processes. It is recommended that leading bicycle manufacturers and relevant technical experts conduct these sessions to maximize exposure.
4. For these proposed courses to be delivered to the industry, it is recommended that appropriate curricula be developed in consultation with leading R&D institutions (such as the CHC Taiwan), international experts in each of the mentioned areas and relevant bicycle training academies from across the world.
5. It is also recommended that an industry-wide survey/poll be executed to understand the training requirements of the industry.

Upgrading of common facilities/mass production machines/tool room

1. To support the bicycle industry in adopting production in aluminium, the R&D centre's common facility should be upgraded to include facilities/equipment for producing production blanks and supporting services for processing aluminium. Aluminium components go through the various shaping and joining processes which start with the extrusion process to make the tubes to construct the frame, butting to form the ends of the aluminium tubing, hydroforming to get the tubing into the required shapes of the frame, welding to assemble the frame, and then heat treatment to further change the physical properties of the aluminium. This would mean that the workshop at the R&D centre should be to include:
   - » An extrusion press
   - » Permanent mould foundry
   - » Heat-treatment facility
   - » Hydroforming facility

   Analogous to the current cold forging production facility at the RDCBSM, an extrusion/casting/ heat-treatment facility for aluminium would position the R&D centre as a common facility for the industry, not necessitating major capital investments by the SMEs, at least as they initiate alloy-based production.
2. The general-purpose tool production machines and related equipment are a source of income for the R&D centre, but are dated and need to be upgraded/replaced. This applies specifically to the CNC machines, such as the horizontal machining centre, cold forging machinery, etc.
3. The RDCBSM tool room personnel solicit training in how to make accurate dies for different moulds, jigs and fixtures for different materials (especially aluminium and plastic). This would entail training and expert guidance in tool design for the RDCBSM's design and development team.

Increased R&D function and technology development

1. Applied research

Given the level of operation and technology of the Indian bicycle industry, R&D does not necessarily allude to the invention or origination of new, alternative, cutting edge technologies/methods, but more pertaining to the adoption of globally adopted best practices, methods and processes into the Indian context. Most medium and small-scale manufacturers are largely unaware of what new methods are prevalent worldwide and how they can adopt them, without having the necessary resources/ wherewithal to engage in such research themselves. This opens up an important service avenue for the R&D centre to investigate and analyse what the best available production processes are, what they entail and how they can be adopted in the industry. This could focus on material behaviour, component interface, stress analysis, optimal configurations for specific components, etc. Applied research would also be useful for trouble-shooting and fault correction in components and bicycle performance. When manufacturers bring testing samples to the R&D centre test labs and do not meet performance criteria, this would bring up pertinent topics and areas in which investigative research could be undertaken in line with the applied research mentioned above.

» The R&D centre can explore the application of **advanced engineering processes** to provide feedback to any product development effort, using finite element analysis, structural dynamics, structural stability, fracture mechanics, service-load measurement, bearing life data, etc. While the bicycle-plus-rider system is complex, the engineering approach is the quickest route to sensible improvements, and will shortcut years of wasted development effort. The primary aim would be to provide rapid engineering services (stress calculation) and consulting (recommended dimension change) so companies can rapidly upgrade and certify their bicycle components and frames to world-class standards. It should be recognized that cycle engineering is not only applicable to premium products: the same advanced techniques will also lead to better and cheaper 'tender bikes' and cycle rickshaws. But another important goal would be to teach engineering methods to any manufacturer or employee who wants that expertise. It is recommended that engineers with an MS level background in fields such as aerospace engineering could be engaged at the R&D centre for such exploration.

» **E-bikes and electric assist hardware**: According to Navigant Research, the global e-bike market is projected to grow at a 0.4% compound annual growth rate (CAGR) over the forecast period (2016-2025). Western Europe and other markets in Asia Pacific such as Japan and Vietnam, are expected to be major markets. In the coming years, e-bikes in Europe are expected to evolve from a specialty commuting or recreation device to a standard bicycle form that is accessible to nearly all bike consumers (Citro & Gartner, 2016). This is going to be a boom sector, which will allow the cycle industry to retain riders who might otherwise invest in motorbikes, and will assist cycle-transporters to travel faster with less effort.

Thus, the global e-bike market is well-positioned for continued growth, primarily in the lithiumion battery segment. Improving lithium ion (Li-ion) battery technology is resulting in e-bikes that are lighter, lower in cost, and remarkably similar to traditional bicycles. They are seen to have environmental and performance advantages over the traditional sealed lead-acid batteries (SLA).

There is tremendous potential in **economical electric assist hardware** that can be fitted onto any existing bicycle/tricycle/ rickshaw, thus increasing the ease of its absorption in the market. It may include components such as a custom motor, closed loop controller with power electronic drive elements for the motor, battery pack with custom battery management circuitry, and torque and rotary position encoders (Petron, 2008). This is a relatively new product segment and can be explored for its applications to Indian-produced bicycles. Thus, this segment holds tremendous potential in developing a cost-competitive, environment-friendly product.

2. Market research

The R&D centre would be providing a valuable resource to the industry by investigating what types of bicycles/components are being produced in various parts of the world, what materials are being used necessitating what types of processing technologies, what designs are being targeted, and what new practices are emerging. With a more market-oriented view, such research could also be extended to industry sales trends, prospects and potential markets – applicable to both domestic and global bicycle producing/purchasing regions - as a resource for manufacturers looking to venture into newer market segments.

REFERENCES

Argyris, C. and Schon, D. (1978). Organizational Learning: A Theory of Action Perspective. Reading, MA: Addison-Wesley.

Amabile, T.M. (1988). 'A Model of Creativity and Innovation in Organizations', in N.M. Staw & L.L. Cummings (eds.). Research in Organizational Behaviour. Greenwich, CT: JAI Press, 10: 123-167.

Anderson, P. and Tushman, M.L. (1990). 'Technological Discontinuities and Dominant Designs: a Cyclical Model of Technological Change'. Administrative Science Quarterly, 35/4: 604-633.

Blau, P.M. (1970). '*A Formal Theory of Differentiation in Organizations*'. American Sociological Review, 35, 2, 201-218.

Brown, J.S. and Duguid, P. (1998). 'Organizing Knowledge'. California Management Review, 40/3: 90-111.

Burgleman, E.A. (1991). 'Intra-organizational Ecology of Strategy Making and Organizational Adaptation: Theory and Research'. Organization Science, 2/3:239-262.

Burns, T. and Stalker, G.M. (1961) The Management of Innovation. London: Tavistock.

Cooke, P. (2008). Regional Innovation Systems, Clean Technology & Jacobian Cluster Platform Policies. Regional Science Policy & Practice, 1(1), 23-45.

Daft, R.L. (1978). 'A Dual-Core Model of Organizational Innovation'. Academy of Management Review, 21, 193-210.

Damanpour, F. (1996). 'Organizational Complexity and Innovation: Developing and Testing Multiple Contingency Models'. Management Science, 42/5: 693-716.

Damanpour, F. and Evan, W.M. (1984). 'Organizational Innovation and Performance: The Problem of Organizational Lag'. Administrative Science Quarterly, 29: 392-402.

Glynn, M.A. (1996). 'Innovative Genius: A Framework for Relating Individual and Organizational Intelligence to Innovation'. Academy of Management Review, 21/4: 1081-1111.

Grant, R.M (1996). 'Toward a Knowledge-Based Theory of the Firm'. Strategic Management Journal, 17: 109-122.

Hannan, M.T. and Freeman, J.H. (1984). 'Structural Inertia and Organizational Change'. American Sociological Review, 49/2: 149-164.

Kanter, R.M (1983). The Change Masters. New York: Simon & Schuster.

Kodama, M. (2003). 'Strategic Innovation in Traditional Big Business: Case Studies of Two Japanese Companies'. Organization Studies, 24/2: 235-268.

Lam, A. (2004). Organizational innovation. Brunel University, Brunel Research in Enterprise, Innovation, Sustainability, and Ethics. Uxbridge, West London. Working Paper No. 1

Lawrence, P.R. and Lorsch, J.W. (1967). 'Differentiation and Integration in Complex Organizations'. Administrative Science Quarterly, 12:1-47.

Lewin, A.Y. and Volberda, H.W. (1999). 'Prolegomena on Coevolution: a Framework for Research on Strategy and New Organizational Forms'. Organization Science, 10/5: 519-534.

Luecke, R. and Katz, R. (2003). Managing Creativity and Innovation. Boston, MA: Harvard Business School Press

Lundvall, B-A (ed.) (1992). National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning. London: Pinter.

Mezias, S.J. & Glynn, M.A. (1993). 'The Three Faces of Corporate Renewal: Institution, Revolution, and Evolution'. Strategic Management Journal, 14: 77-101.

Mintzberg, H. (1979). The Structuring of Organization. Englewood Cliffs, N.J.: Prentice Hall.

Nelson R. R. and Winter, S.G. (1982). An Evolutionary Theory of Economic Change. Cambridge, M.A.: The Belknap Press of Harvard University Press.

Nonaka, I. (1994). 'A Dynamic Theory of Organizational Knowledge Creation'. Organization Science, 5: 14-37.

Perrow, C. (1970). Organizational Analysis. London: Tavistock.

Pugh, D.S., Hickson, D.J. and Hinings, C.R. (1969). 'The Context of Organization Structures'. Administrative Science Quarterly, 14: 47-61.

Schumpeter, J. (1950). 'The process of creative destruction', in J. Schumpeter (ed.). Capitalism, Socialism and Democracy, Third Edition, London: Allen and Unwin.

Senge, P. (1990). The Fifth Discipline: the Art and Practice of the Learning Organization New York: Doubleday.

Simon, H.A. (1991). 'Bounded Rationality and Organizational Learning'. Organization Science, 2: 125-134.

Teece, D.J. (1998). 'Design issues for Innovative Firms: Bureaucracy, Incentives and Industrial Structure' in A.D. Chandler, Jr., P. Hagstrom, and O. Solvell (eds.). The Dynamic Firm, Oxford: Oxford University Press.

Tushman, M.L. and O'Reilly, C.A. III (1996). 'Ambidextrous Organizations: Managing Evolutionary and Revolutionary Change'. California Management Review, 38/4: 8-30.

Von Hippel, E. (1988). The Sources of Innovation. New York: Oxford University Press.

Walsh, J.P. and Ungson, G.R. (1991). 'Organizational Memory'. Academy of Management Review, 16: 57-91.

Weick, K.E. (1996). 'The Role of Renewal in Organizational Learning'. International Journal of Technology Management, 11/7-8: 738-746.

Woodman, R.W. Sawyer, J.E. and Griffin, R.W. (1993). 'Toward a Theory of Organizational Creativity'. Academy of Management Review, 18/2: 293-321.

Woodward, J. (1965). Industrial Organization, Theory and Practice. London: Oxford University Press.

ANNEXURES

Annexure 1: List of all documents received and studied as background material

1. **AICMA** – Background documents (List of members; list of publications; AICMA committees; organogram)
2. **NPC** – Full Report 2015: "Study on improving productivity and competitiveness of bicycle sector, including bicycle parts" (National Productivity Council) 2015
3. **TERI Report** – Pedalling towards a greener India, 2014
4. **Cycle Valley** – Ludhiana power point presentation (by AICMA and UCPMA; 2015)
5. **RDCBSM** – Memorandum of Association
6. **AICMA** – Visionary Framework
7. **AICMA** – Annual report 2015 – 2016
8. **RDCBSM** – Brochures
9. **RDCBSM** – Governing Council minutes of meetings 2013 – 2016
10. **RDCBSM** – General Manager recruitment advertisement
11. **RDCBSM** – List of employees and list of key employees
12. **RDCBSM** – Performance appraisal form
13. **RDCBSM** – Sample of a neutralized employment letter
14. **RDCBSM** – Sample of actual recruitment advertisement
15. **RDCBSM** – Sample of testing service feedback form, neutralized
16. **RDCBSM** – Annual profit and loss and balance sheet for period 2012 – 2018 (budget)
17. **RDCBSM** – Revenues distribution per department and per industry segment

Annexure 2: Interview guide applied for the interviews with the RDCBSM, AICMA and UCPMA representatives (institutional diagnostic)

Revised list of questions for the RDCBSM-AICMA-UCPMA interviews, 28 Aug-08NSep 2017 (Delhi and Ludhiana)
Date: 2017-08-24

Hypotheses derived from observations after reading NPC Full Report, from 2015.

1. Indian bicycle industry playing a vital role in Indian manufacturing industry (light engineering); more than 90% of all components being produced domestically; world no.2 producer next to China in volume. Despite this:
   - » Very low foreign investment level in Indian industry
   - » Low attention to technological upgrade and improvements
   - » Old fashioned material and technological level in design, engineering and production
   - » Mainly producing and selling low-end products to the market (both domestic and selected export markets) at much higher cost than competition (reported 15-20%)
   - » Technology transfer and foreign collaboration seem to have degraded and almost disappeared over the past 30 years
   - » An incentive programme from government to utilize and strengthen the position of the industry does not seem to exist, as compared to other bicycle producing countries where 5 of the 10 most important issues listed for competitive advantages are related to financial and/or governmental incentives

2. Top 4 manufacturers represent 90% of volume
   - » No sign of taking advantage of position to structure industry and acting as role model for new technologies and designs being implemented/developed
     - No backwards integration of skills, technology and practices towards vendors seem to be implemented
     - Fragmented R&D initiatives to develop competitive position
   - » Bicycle parts manufacturers subdivided into 3 categories
     - Organised, large entities, tending to develop into integrated enterprises, producing bicycles for private label and for foreign brands
     - Smaller manufacturers, producing few or single parts, primarily tied up to larger component manufacturers
     - Tiny sector, producing a number of simple parts
   - » Most of the industry is located in and around the Ludhiana region, which could open up for close strategic and structural collaboration to develop the industry into modern and cost-efficient standards; there is little sign of such organised collaboration

3. The RDCBSM does not seem to play a vital role in paving the future road for industry
   - » An opportunity to take a lead position in improving production technologies and industrial design and engineering; current status is inadequate; might both be a severe threat and an opportunity to develop collaboration between industry, the RDCBSM and universities
   - » The SWOT analysis in the NPC Full Report opens up a number of opportunities for the RDCBSM, as stated there is a lack of, but need for, innovation and R&D in nearly all aspects (trends/design, material technology/new materials, process design and manufacturing technologies, logistics and handling)
   - » There do not seem to be any incentive schemes in place to bring industry up to international competitive level
     - The RDCBSM interaction – industry associations – government does not seem existent; incentives to be combined with forced restructuring of industry into fewer and more powerful units to be considered (JVs, R&D collaboration, parts and components manufacturing collaboration, technology and knowledge transfer)? **Check correlation with questions on incentive models and restructuring**
     - Training and education programmes in parallel with improvement programmes in industry, and as incentives to attract job applicants?
     - Incentives for factory owners to invest in more efficient and productive production facilities? Could the RDCBSM take a position and a role as advisor, tutor and training body for the implementation of planning, structure, SOPs and loyalty mechanisms to such a structure? Especially with a focus on simple PLC-based automations schemes. **Check correlation with questions on incentive models and restructuring**

4. Need for being competitive in domestic markets; high degree of imports of parts and bikes
   - » Import duty on products from China, does not create a sustainable barrier, as products are being rerouted and channelled through other countries, like Sri Lanka and Bangladesh
   - » Financial counterproductive mechanisms are introduced, causing actual available working capital for industry to be constrained
     - Examples like advanced consumption duty, factory renewal charges and 4-stage VAT refund schemes
   - » Many references to high steel prices in India, compared to the competition
     - Steel is a globally traded product; such price differences are not understood

5. Strategy work may have been implemented in individual companies, but hard to observe as industry wide implementation
   - » Processes derived from SWOT analyses seem to be absent in industry scale
   - » Short-term and longer-term aspects of ambitions and goals are not expressed; for example, from stopping and turning the import growth to develop means to position the industry for the high-end export markets
   - » Use SWOT conclusions as guiding tool: develop arguments for why foreign industries should invest in Indian industry; shorter and longer-term goals

6. Implement the key inputs from technical assessment of industry status and initiatives (separate document)
   - » Centralized bank for components/parts
   - » Special purpose vehicle of advanced expertise
   - » Upgrade the RDCBSM to provide more advanced and complete testing capabilities and new welding skills related to aluminium
   - » More teaching and consulting type work of relevance to industry

1. Questions on mandate, role, authority, ambitions, strategy and goals

» What is the given mandate of the RDCBSM/AICMA/UCPMA, and how is it conducted?
» Which role(s) do(es) the RDCBSM/AICMA/UCPMA undertake towards the government and towards industry?
  • Especially, elaborate on the level of interaction with the industry, and between industry, industry associations and the RDCBSM
» Opinion on the RDCBSM/AICMA/UCPMA activities and roles to support industry needs and opportunities?
  • Especially, elaborate on possible opportunities in taking a lead position in turning the industry into a new era (RDCBSM)
  • In which areas could the RDCBSM/AICMA/UCPMA make a difference, and what are the main priorities, short-term and long-term?
» The NPC Full Report from 2015 gives an elaborate picture of opportunities and threats/challenges for the industry; in what way does this report form the backbone for the strategy work in the RDCBSM/AICMA/UPCMA?
» Are ambitions, goals and strategy plans for the RDCBSM and the associations supported by, and anchored within, the industry?

2. Questions on governance and the roles of the RDCBSM

» Describe the governance and potential control committees in terms of constitution, mandates, power of attorney
» What is the regular meeting frequency of the committees?
  • Are protocols from meetings regularly produced and distributed as guiding and governing tools?
» What influence do these committees have on the priorities and execution of the RDCBSM strategy, working plans and activity plans?
» What is the actual industry impact on the priorities behind strategic and operational decision-making?
» Do you feel that the current governance and administrative structure of the RDCBSM is effective?
  • If no, would you recommend an alternative model/approach?
» Recommendations for improving the functioning and working of the institution.

3. Questions on industry interaction

» What is the level of industry interaction, in terms of:
  • Regular visits to industry clients/associations?
  • Involvement by industry in the RDCBSM projects and activities?
  • Collaboration projects that aim at company implementation?
  • Counselling and advising services?
  • Training and tutorial programmes and placement programmes?
  • Technology transfer and knowledge transfer programmes?
  • Educational programmes?
  • Dissemination activities?
  • Testing and verification type activities?

4. Questions on the RDCBSM/AICMA/UCPMA's role in policy advocacy for supporting and promoting technological advancement as well as sustainable development of the sector

» The RDCBSM's engagement with/participation or membership in various working groups/committees, statutory bodies and policy formulation boards?
» Influential roles in advocating incentive programmes to lift industry's competitive position?
» We assume that the NPC Full Report has been read and digested
  • What reflections have been drawn on the claims, observations and recommendations being presented in the report?
  • How could these recommendations form a guide for improvement in industry, and what roles could the RDCBSM/AICMA/UPCMA take in such transformation?
» Taking the NPC Full Report into account, especially focusing on the SWOT analysis and the comparison of competitive advantages impacts with other countries, how could the RDCBSM/AICMA/UCPMA influence a redirection of the course of the industry into a more competitive development?
» We observe that the bicycle industry is listed as a vital and important industry for India;
  • How could the RDCBSM/AICMA/UPCMA influence the creation of national strategic developments (R&D, innovation, national arenas, etc.)?

5. Questions on financing and revenue creation, and incentive programmes

» What are the different sources of revenue for the RDCBSM?
» What is the relative split between the different sources of revenue?
» Are specific initiatives to expand the revenue base taken?
  • If yes, please elaborate on the individual initiatives
» How could the RDCBSM, together with the AICMA and the UCPMA, influence a more productive incentive programme to boost and develop the Indian bicycle industry for meeting global competition?
  • Would it be realistic to work together within the RDCBSM/AICMA/UCPMA – collaboration to form a common strategy with the objective of involving governmental aids to transform Indian industry into a global player?
  • Is it realistic to modify and improve the industry structure to form competitive units, for example related to the sourcing of components and parts (investments, training and education, industry restructuring, infrastructure and logistics, technology, others…)?
» Is there an existing specific system to evaluate and monitor the relative impact of the different revenue initiatives?

6. Questions on R&D programmes and projects

» What are the selection criteria for deciding on R&D programmes and direction?
  • Are these criteria in line with the expressed needs of the industry and verified by the industry?
  • How is R&D funding secured and decided?
» How elaborate is the level of R&D, and is it R&D that actually supports the improvement and positioning of the industry in the global competition?
  • Has the RDCBSM/AICMA/UCPMA made any SWOT analysis (or similar), and if so, how does this analysis influence and drive the R&D work?
» Elaborate on the process from a project that has been approved through execution to implementation
  • What is the structure of evaluation during execution?
  • What is the rate of implementation into actual operation in plants, and are there examples of reported return on investment?
» What is the thinking about the need for innovation, related to products and product design, manufacturing processes, work processes and methods, etc.?
  • How is innovation organised, managed, highlighted?

7. Questions on management capabilities, organisation, skills and infrastructure, related specifically to the RDCBSM

» What are the typical areas of attention for the RDCBSM management and relative split between these areas in terms of the time consumed?
  • Especially time spent with questions related to strategy development, support to industry development and marketing/client related activities will be interesting to assess
» What is the total headcount, divided into:
  • Highly skilled scientists
  • Engineers and technical staff
  • Administrative staff
» What is the policy for recruitment, succession/career planning, and training and skill development of employees?
» What is the typical split in time consumed between scientific work and administrative work related to the scientific staff?
» How is the assessment of staffing done across various levels? Is there a rewarding/employee motivation programme in place?
» Are any exchange programmes with international leading R&D, technology or design centres organised for the scientific staff?
» What is the mechanism followed to deploy employees across various services/activities such as R&D, consultancy services, conducting and participating in training programmes/workshops, etc.
» In what way do the available skills and know-how match the needs of the industry, and how is this applied in practice towards the industry?
» What is the perception of the lab facilities and scientific and technical infrastructure of the RDCBSM related to the requests and needs of the industry?
  • Especially, are there defined needs of investments in new lab or pilot facilities?

8. Questions on recruitment and education

» List of educational and training programmes directed to the industry, provided by the institute.
» Is there any collaboration with leading technical universities in place?
» What interaction and collaboration exists with relevant students?
» Are any placement facilities provided to the students?
» How does the RDCBSM engage with its alumni, if existing?
» What role(s) could the RDCBSM play in upgrading the educational programmes at university level and making these programmes attractive to students?
» How could a collaboration with industry help the creation of incentives and attractiveness for the bicycle industry-related educational programmes?
  • Especially, elaborate on how a closer collaboration and integration between academia, the RDCBSM/AICMA/UCPMA and industry could streamline such programmes
» Is the issue of location and regional representation an issue to ease the question of recruitment and education?

9. Questions on marketing and dissemination

» Does the RDCBSM/AICMA/UCPMA have a marketing strategy?
» Is there a file of the most valued customers (key accounts)?
  • If yes, please elaborate on the content and value of such key accounts related to the R&D work being executed
» What is the system for valuation of the services offered by the RDCBSM?
» In what ways are the results achieved from the R&D programmes disseminated?
» Elaborate on the activities of submitting newsletters, publications, papers?
» How is the RDCBSM's know-how and expertise being marketed in the industry, and in what way is this know-how and expertise appreciated in industry?
» Are there examples of placement programmes (2-ways) with the industry?
» Are there examples of placements internationally (2-ways) to secure alliances with leading international technology centres?
» Is there any benchmarking on and towards international leading technologies, design and practices?
  • If yes, how is this benchmark being utilized and implemented for the benefit of the Indian industry?

Images and illustration copytights ©

SHUTTERSTOCK: Kruub.
AETHEREAL SOLUTIONS: otherwise.

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Vienna International Centre · P.O. Box 300 · 1400 Vienna · Austria
Tel.: (+43-1) 26026-0 · environment@unido.org
www.unido.org