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Technology Commercialization Model for Indian Centrally Funded Technical Institutions

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Abstract

The concept of commercializing the inventions developed at university laboratories has achieved a global milestone over the past three decades. Innovations and incremental technology developments played an important part in economic development due to the major contribution to the GDP growth of many countries since 1930. There is a great emphasis on technology transfer/licensing or commercialization of technology/inventions from academia to industry. A major jump in technology transfer across the globe has been witnessed categorically from the United States, Europe, China, Japan, and Korea. However, the Indian subcontinent has been lagging far behind these countries regarding financial numbers. The academia in the Indian subcontinent has been suffering due to a lack of strategic initiatives to commercialize IP assets. Hence, the paper discloses a five-step patent commercialization model and modular framework named IBRMI, which addresses the defined problems of Indian centrally funded technical institutions (CFTIs).

Keywords

Patent, Technology Transfer, Commercialization, Infringement, Licensing

1. Introduction

It is rightly said by Eric Halber "A patent is only worth as much as its owner is willing to spend to defend it." Historians say patent legislation originated in Venice in 1474 (Alfred, 2012).

The first United States Patent Act was passed in 1790. The commercialization of inventions was initiated in the early twentieth century when US chemist Frederick Cottrell received a patent in 1908 (Patent No. US895729) for reducing industrial pollution known as electrostatic precipitator (Cottrell, 2020). In 1925, the first technology transfer office was founded globally in the US at the Univer-

sity of Wisconsin, Madison, by the Wisconsin Alumni Research Foundation (WARF) to monetize biochemist Harry Steenbock's invention of enriching the vitamin D content of foods through irradiation to treat the disease like rickets. This initiative has resulted in more than 1900 patented inventions and contributed $1.07 billion to university research, programs, and initiatives (Tenenbaum, 2011).

According to research conducted by the National Research Council US (Usselman, 2013), the percentage of publications by industry was 85%, and the academia was just 7%; however, by the end of 2006, the industry publication was just 7%, and academia publication was 93%. This was a 360-degree shift, and it was figured out that the industry was going secretive during this time, and academia was getting clueless. The cluelessness here means that academia was ignorant about the problem of the sector that the industry is trying to solve. Hence, one of the underlying issues with academia was whether they are investing in the right research so that the technology can be easily commercialized. In the Indian CFTIs context, the above-highlighted issue is the core of all challenges, which can be easily proven based on survey insights.

In Europe, patent legislation was mostly lacking until the mid-thirties. In 1936, Germany introduced a Patent Law under which IP rights belong to the Inventor. However, the law was silent on how IP rights of intangible assets would be transferred from employee to employer. Finally, Germany's Employees' Inventions Act of 1957 was passed and gave more autonomy to academic inventors, but in general, there was little interest across Europe in commercializing publicly funded research (Goddar, 2003).

By the end of 1978, it is estimated that 28,000 to 30,000 patents accrued by the US government through federally funded research, only around 1200 patents (4% - 5%) were successfully licensed, and even fewer had made it to market (McManis & Noh, 2013). The US government was motivated by the achievement, and hence, they emphasized the Bayh-Dole Act to enhance university patenting and licensing since 1980. The landmark patent legislation provided a legal framework for patenting discoveries using federal grant money. In 2013, The United States adopted a first-inventor-to-file rather than a first-to-invent structure, initiated by the 2011 Leahy-Smith America Invents Act, bringing it more in line with the rest of the world.

1948 Britain established the National Research Development Corporation for publicly funded research to commercialize innovations. Further, the British government designed a policy for moving public sector organizations into commercial private enterprise by establishing the National Enterprise Board in 1975. Later, in 1981, the National Research Development Corporation and the National Enterprise Board were merged to form the British Technology Group to increase academic and industry partnerships and boost innovation in commercial aspects (Makin & Soden, 2005).

The United States of America was successful in 2000, when the patent grant rate at the USPTO of the top fifty-eight (58) universities was 37% from 2002 to

2010, and these patents were monetized more extensively (Caviggioli et al., 2020).

Objective of Study

Patent commercialization strategies are a complex task for universities around the globe as universities don't manufacture the product, and the complexity of cross-domain research can be a mix of socio-economic, technological, and pandemic factors. The objective of the study is to identify approaches along success stories and challenges faced by some of the top universities around the globe, which can further lead to the next level of research to model patent commercialization model for centrally funded Technical Institutions (CFTIs) in India as Indian universities are far behind the other developed and developing countries in terms of patent commercialization. Moreover, we can identify the top technical domains where the patents are highly likely licensed or transacted. Hence, the study will be focused on Global Academia best practices for technology transfer, essentially the parameters taken into account for identifying the diamond patents for commercialization, along with major challenges faced by Indian CFTIs for patent commercialization. This study will help carry the next level of research, enabling CFTIs to overcome the obstacles if a suitable & effective framework is designed, as India doesn't have successful infringement/litigation cases.

2. Literature Review

2.1. Developed Countries Academia Patent Transactions

In 2019, the total sales and licensing revenue (**Figure 1**) for the technology transfer from the educational sectors for some of the developed countries (Tang, 2020) was as follows:

Countries	Revenues (USD) in 2019
United States of America	USD 23.5 Billion
Japan	USD 16.1 Billion
Republic of Korea	USD 6.2 Billion
Germany	USD 5.6 Billion
United Kingdom	USD 5.4 Billion

Figure 1. Total sales and licensing revenue in 2019.

The listed countries' universities' technology transfer transactions were in semiconductors, telecommunications, cancer drugs, Medical Imaging, etc.

The university's technology transfer office faces several challenges after successful patent monetization. In the United States, federal grant budgets have been reduced since 2003. In the United Kingdom, despite some capital investment, US$6.7 billion has been spent annually for the past six years (Wapner, 2016).

2.2. India's Technology Journey

The government of India shifted from the scientific policy resolution in 1958 to

the technology policy statement in 1983. The science and technology policy was implemented in 2003, but in 2013, the science, technology, and innovation policy was passed in the Indian parliament to boost public-funded projects. India has had two types of journeys in the last seven decades of independence: pre-liberalized and post-liberalized.

Pre-liberalized India adopted socialism for over four decades, i.e., till 1990, when Indians were dependent on foreign capital and technologies; still, the government encouraged local innovation, so CISR was established to spark local innovations. Moreover, during these decades, Indian industries were small, and the industry-academia didn't have many collaborations to fund the innovations. Hence, Indian innovation grew in a non-acceptable mode in pre-liberalized India. However, India developed a road map to be self-reliant by establishing BAARC, ISRO, and DRDO for its national security purposes.

Post-liberalized India, when the economy was open and foreign technology was accepted, Indian universities and companies started collaborating with foreign counterparts, and eventually, an environment of "Technonationalism" was created. India developed indigenous technologies in civil and national security sectors that are of strategic concern, such as space, defense, nuclear energy, supercomputers, and vaccine manufacturing and development (COVID-19).

In 2014, the government of India initiated "Make in India," and a five-point agenda was laid, one of which was to climb up the IPR ladder to boost innovation. In 2016, India's first national IPR policy was released to promote intellectual property awareness and encourage Indian universities, agencies, and companies to file more patents in India and globally. In 2021, the government of India even reduced the patent filing fees to 50% for Indian universities, agencies, and companies to foster innovation.

2.3. Indian Centrally Funded Technical Institutions (CFT's) Patent Portfolio Survey

The last twenty years of patent portfolio data (**Figure 2**) have been extracted for premier CFTIs, which include IITs and IISc. The total patent portfolio consists of 6545 patents and patent applications, of which only 652 PCT applications have been filled, just 10% of the total portfolio. Further, only 1692 patents are alive, 25% of the total portfolio. Moreover, the filing trends are increasing; however, the grant ratio is still stagnant.

Technology transfer will attract investors if patent families are covered, especially in US and European jurisdictions so that investors can participate. The freedom to operate (FTO) ensures that products manufactured in a particular jurisdiction can be launched without any legal threat. So, global coverage is not very attractive in attracting global partners for technology transfer (**Figure 3**). Hence, the CFTIs should pay attention to global filings, which will eventually capture the attention of investors.

The key technologies for quality research and patent filing are restricted to material science, electronics/semiconductor, and healthcare. Hence, key technology

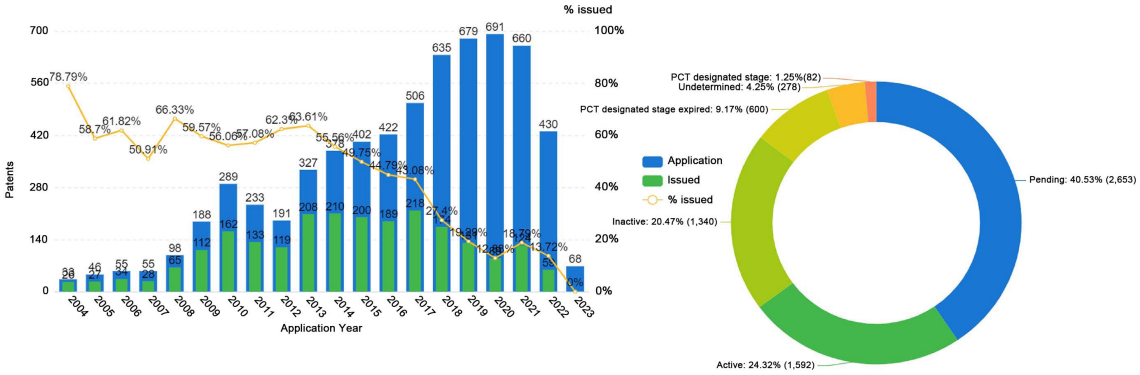

Figure 2. Indian premier CFTI's patent portfolio status report.

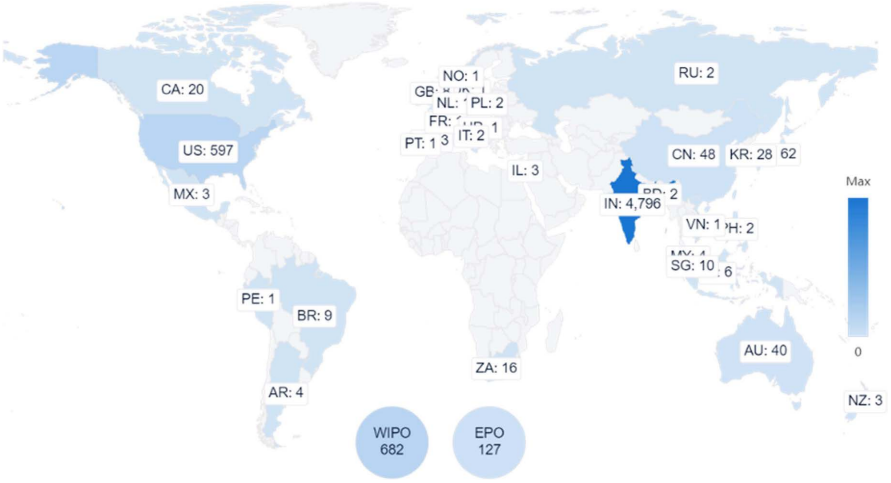

Figure 3. Indian premier CFTI's patent portfolio global coverage.

should focus more on consumer products, electronics, software, and e-commerce, where most technology transfers are successful worldwide. The below (**Figure 4**) gives an insight into key technology where the focus of premier CFTIs is concentrated.

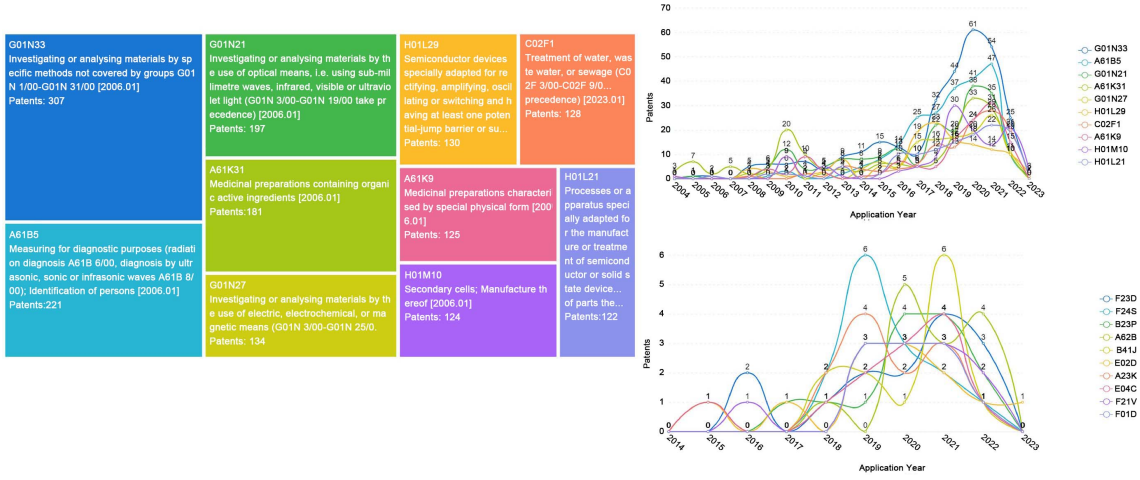

Figure 4. Indian premier CFTI's patent portfolio key technology coverage.

The CFTI's Industry collaborations are majorly based on joint research or funding in the case of Material Sciences and Healthcare, that too for local needs. The below (Figure 5) depicts that the collaboration vs. key technologies vs. geographical cover is only focused on Indian jurisdiction, and limited key technology collaboration is in focus.

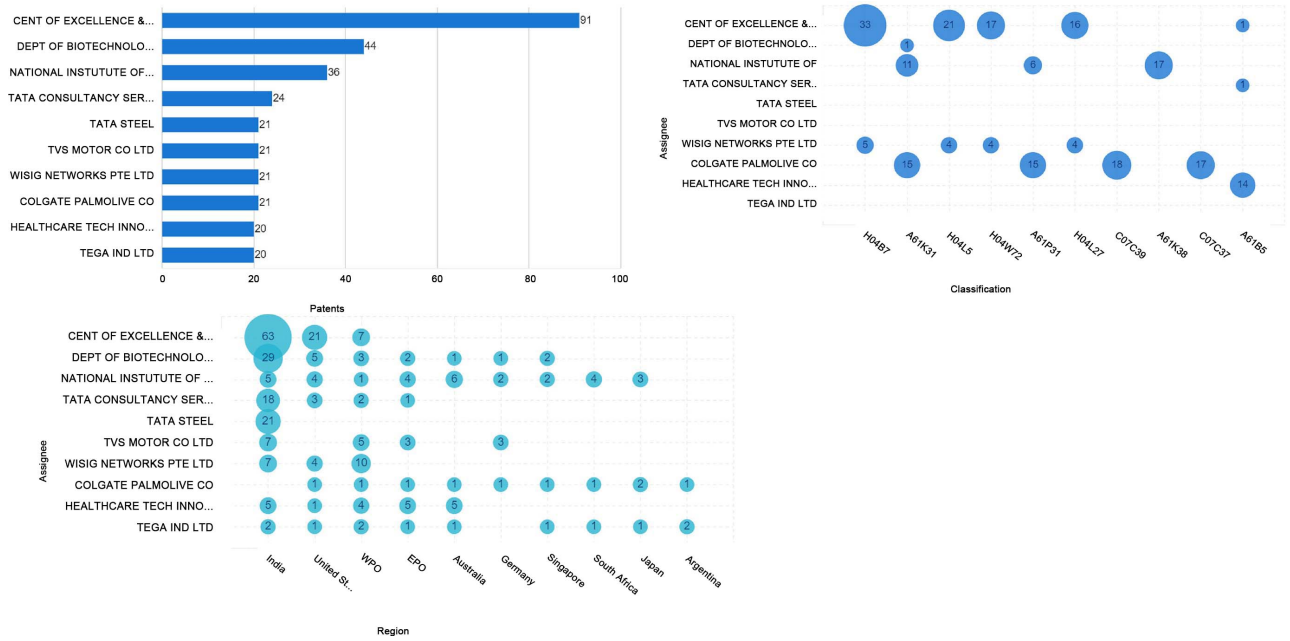

Figure 5. Indian premier CFTI's Patent portfolio key technologies industry collaborations.

The Radar Map (Figure 6) uses patent information as an indicator of portfolio strategy. The graph compares various portfolio metrics to highlight the characteristics and the strengths. The patents are focused more on Incremental research to improve the quality and tech diversification, which is a concern. Only 39 patent families work more than 300 K USD.

Total Value	Simple Family Numbers
85,103,100 (USD)	3667 (Group)

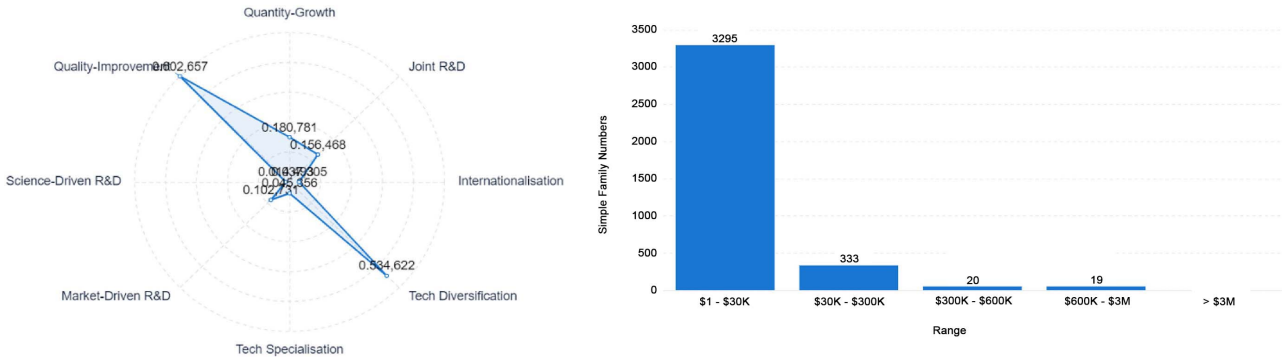

Figure 6. Indian premier CFTI's patent portfolio valuation in USD.

3. Technology Transfer Models from Academia to Industry

Technology Transfer (TT) is the process of licensing potential technologies to another group that manufactures products or services. Technology Transfer is a complex issue (Lipinski et al., 2008) as it depends on a university or institution's objective and goal.

Technology Transfer is based on qualitative and quantitative approaches. Qualitative and TT models were first disclosed by (Singh & Aggarwal, 2010; Wahab et al., 2009; Ramanathan, 2011). Based on various studies conducted, the Bar-Zakay model, Behrman & Wallender model, Dahlman and Eestphal model, Schlie, Radnor and Wad model, Chantrramonklasri model, etc., were discussed. However, none of the models discloses qualitative studies to rank/score the patent based on technical, legal, or bibliographic parameters, detectability, claim strength, and business Impact of technology in the market in a single platform or tool, which could be a logical and simple tool to access the strength of the patents.

Marie Godar designed a model that discloses the complete process of TT from the University Technology Transfer Office (TTO) to the industry (Godar, 2016). Another TT model proposed by (Bradley et al., 2013) is based on model funding sources that were added, such as federal funding, banks, and Investors, and the model remains almost the same if compared with (Godar, 2016). A Quantitative and Qualitative approach was proposed by (Kashyap & Agrawal, 2019) concerning higher educational institutes (HEIs) in India to maximize the economic value of the patent portfolio.

A detailed study of various patent commercialization models of top universities of different continents has been discussed by (Ramya & Janodia, 2020), and below are the key focus areas.

United States: Stanford University of the United States has a very detailed technology licensing process at each level from level 1 to level 10. The university has focused on IP licensing since filing the patent by determining the IP valuation of each patent. Further, to attract investors, US universities invest in marketing technologies through various means.

Israel: The proposed model of Tel Aviv University, Israel, accessed the commercial value and then prepared a suitable marketing strategy to identify potential Licensees. Further, the university focused on quality patents rather than quantity of patents and licensed the patents based on fair royalties to boost research.

Japan: Japanese universities are focused on creating start-ups instead of licensing out technologies (there is no focus on licensing out). Kyushu University, Japan, works on Industrial demand, focusing on the local region and researching to fulfill societal demand by focusing on quality research.

India: A case study of IIT Bombay has been discussed, and the observations are below.

1) Focus on research infra to faculty, students, and alums.

2) Focus on attracting sponsored projects.

3) IP generation from master thesis

4) Marketing Focus

5) More dependent on advertisement

6) Promoting IP through Tech Connect fest

Based on the above pointers, the IPR cell is focusing on ornamental requirements of IP commercialization; however, from the IP strategy point of view, there is no stepwise actionable plan to execute IP commercialization in a well-designed workflow.

Problems with Context to CFTI's

Based on the above patent portfolio survey and IIT Bombay case study, CFTIs are not focusing on the Initial investigation of IP assets, patent quality evaluation, potential marketing strategy, potential Infringer Evaluation, Patent validity check evaluations, and Easy design around the possibility evaluation of technology for successful TT from Academia to Industry.

Most CFTIs have had an IP cell established for a decade, but no strategic TT process is defined. Although R&D expenditures are substantially increased in CFTIs due to industry collaboration, CFTIs still lag behind other developed countries.

4. Proposed Model for Indian CFTI's

The proposed Indian CFTI's IP Commercialization Model involves a systematic evaluation of the intellectual property that a CFTI owns and utilizes for TT. The purpose is to commercialize the IP assets by mitigating risks, addressing issues, and implementing optimal practices in IP asset management. The various problem addressed in Section 3 in context to Indian CFTIs the proposed model and framework addresses the said challenges.

The proposed model's objective is to thoroughly examine CFTI's IP portfolio, which often requires further assessment of related IP agreements, relevant policies, and compliance procedures. The proposed model (**Figure 7**) aims to uncover assets that are either unused or underutilized, identify potential threats to CFTI's financial performance, and empower CFTI's IPR cell to develop well-informed strategies for both Technology Transfer (TT) and intellectual property (IP). These strategies are designed to uphold and enhance the CFTI's IPR strength in the relevant markets.

Based on the above-proposed IP commercialization model for CFTIs, a detailed CFTI module-wise IBRMI framework (**Figure 8**) has been designed with appropriate pointers and a detailed approach. The below IBRMI framework will enable CFTIs to execute the IP assets management in a strategic way by creating value at each step.

5. Conclusion

The proposed five-step model and modular framework will enable Indian CFTIs to identify unidentified gems of IP assets. The stepwise actionable items

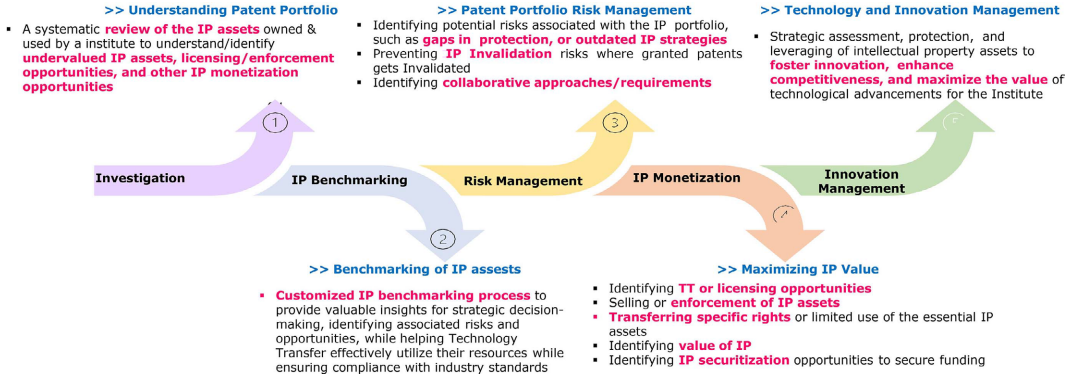

Figure 7. Proposed patent commercialization model for CFTI's.

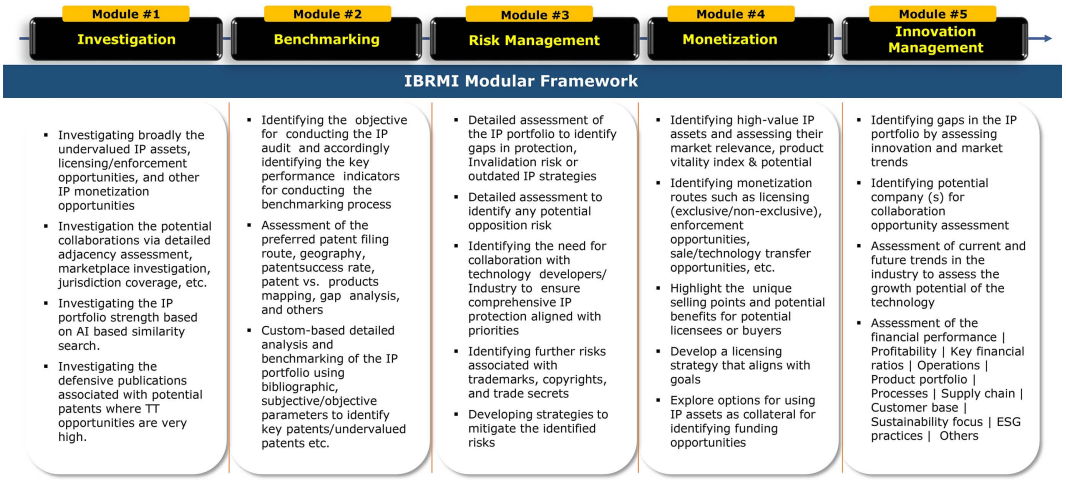

Figure 8. Proposed IBRMI modular framework for CFTI's.

associated with each module are strategically driven based on strategic initiatives defined in the IBRMI modular framework. The proposed model and IBRMI modular framework will help Indian CFTIs identify the right value of IP assets by identifying the underlying risk. Further, the proposed model and farmwork will help design the right marketing strategy and identify the right collaborators and partners for the successful technology transfer of IP assets.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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