

International Journal of Agriculture Extension and Social Development

Volume 7; SP-Issue 3; March 2024; Page No. 57-65

Received: 13-12-2023
Accepted: 16-02-2024

Indexed Journal
Peer Reviewed Journal

A study on intellectual property constraints faced by researchers

¹Santosh N Kunjir, ²Arpita Sharma, ³Swadesh Prakash, ⁴Vinod K Yadav, ⁵Sandesh Patil, ⁶Suhas Wasave and ⁷Shubham Soni

^{1, 2, 3, 4, 7}ICAR-Central Institute of Fisheries Education, Mumbai, Maharashtra, India

^{5, 6}College of Fisheries, Shirgaon, Ratnagiri, Maharashtra, India

DOI: <https://doi.org/10.33545/26180723.2024.v7.i3Sa.415>

Corresponding Author: Arpita Sharma

Abstract

Technological advancements in Intellectual Property Rights (IPRs) play a crucial role in driving scientific growth. While India's 40th rank in the Global Innovation Index 2023 is promising, it prompts a closer look at the challenges and constraints researchers face in safeguarding innovations through various forms of IPRs. This serves as a significant area of research interest. To delve into this matter, discussions were held with experts to identify and categorize 50 constraints encountered by researchers. These constraints were organized under seven categories: administrative, financial, technical, knowledge, attitude, skills, and aspirations (the KASA framework). Information was collected from 206 researchers to study the severity of these constraints, utilizing a five-point scale. Subsequently, the scores were normalized and subjected to statistical analysis employing the weighted average technique. The scoring range for each constraint spanned from 0 to 82.4. Constraints were classified based on severity: those scoring between 0 to 27 were deemed less severe, those between 27.1 to 54 were categorized as medium severe, and any score exceeding 54 was considered highly severe. The findings revealed that a majority of constraints fell into the medium severity category. Among these, skill-related constraints obtained the highest scores, closely followed by knowledge and financial constraints. In many organisations efforts are underway to address these challenges, with training programmes being organized for researchers. It is anticipated that over time, these initiatives will contribute to the alleviation of constraints.

Keywords: Constraints, researchers, innovation, IPRs

Introduction

Intellectual Property Rights (IPRs) play a crucial role in improving the economies of countries globally through encouraging innovation. IPRs protect the rights of an inventor in his/her innovations and at the same time facilitate social and economic growth. Without the protection of ideas, businesses and individuals would not secure the complete benefits of their innovations and would emphasize less on research and development. Generating novel ideas and transforming them into innovations is crucial for gaining a competitive edge. However, protecting innovations through IPRs faces limitations such as rules, deadlines and limited resources. The impact of these constraints on the creative process has garnered significant attention in research (Acar *et al.*, 2018) ^[1]. As per Umrez and Mossio (2013) ^[18] the term 'constraint' has several meanings in diverse scientific fields, the idea of a constraint is usually employed in relation to conceptualizations in terms of levels or hierarchies. However, Misha *et al.*, (2016) ^[13] have defined constraints as the reasons, causes or circumstances, which ultimately result in poor performance. Blind *et al.*, (2018) ^[7] examined the barriers encountered by 129 researchers at the Federal Institute for Materials Research and Testing, Germany, concerning patenting activities from December 2012 to January 2013. The research identified 12 obstacles to patenting such as patents

are time-consuming; patents are cost-intensive; low statutory remuneration for researchers; have high defense legal costs; results in the scientific field are difficult to patent; uncertainty if relevant granted patents exist; novelty is difficult to prove; integration of results in standards is preferred; uncertainty if already integrated in the standards; utility model is preferred. Bansi and Reddy (2015) ^[5] investigated the factors influencing the discrepancy between academic research and intellectual property registration at a particular institution in South Africa. The research highlighted the challenges faced by universities in intellectual property registration and commercialization efforts. The obstacles in this context include a low incidence of Intellectual Property registration due to a lack of knowledge among individuals. Moreover, there is insufficient money for intellectual property registration, along with a lack of comprehension about the stipulations in the Intellectual Property Act and the institution's intellectual property policy. Christie *et al.*, (2012) ^[8] conducted an analysis of the legal framework pertaining to patent ownership within publicly funded research institutions and found that, prior to the Stevenson-Wylder Act, three notable obstacles hindered the process of commercialising inventions originating from government research organisations. These barriers encompassed a lack of obligation on government agencies to commercialise their

IP, a lack of administration support structures and lack of uniform licensing powers. Baldini (2011) ^[4] carried out a research on the factors influencing academics' willingness to stay away from becoming inventors of university patents in Italy between 1990 and 2002. The study discovered that individuals who were initially interested in participating in university patenting activities decided against it due to factors such as obstacles posed by patents on publications and conferences, costs outweighing benefits, patents not being relevant to academic work, limited potential for commercial or industrial use, research leading to non-patentable outcomes, and lack of understanding of the university's patent procedures. Lubango and Pouris (2009) ^[12] examined the potential impact of patenting activity on the academic performance of researchers in South African universities and identified several factors that are believed to hinder technology transfer activities. These factors include insufficient time, additional responsibilities such as teaching and administration, inadequate government support, industry's negative perception of university work, limited collaborative innovation with industry and a shortage of faculty members with prior management and business experience. Sibanda (2009) ^[16] studied the South African patenting activity and revealed a notable deficiency in patenting at universities, mostly due to a lack of awareness regarding the novelty of inventions as well as the perception among university researchers that the intellectual property process is difficult, expensive, and involves excessive administrative work. Furthermore, researchers feel that engaging in patenting activities detracts from their ability to publish their research findings. In a study conducted by Baldini *et al.*, (2007) ^[2], the challenges faced by 208 Italian professors serving as inventors for patent applications submitted by Italian universities from 1990 to 2002 were analysed. The study uncovered 12 challenges that inventors encountered during their patenting process, grouped into four categories: lack of support, commercialization issues, time constraints, and personal/cultural barriers. Moutinho *et al.*, (2007) ^[14] studied the challenges expected and faced during the patenting process by 106 scientists from nine leading Portuguese public sector research organisations (PSROs) focused on life sciences and biotechnology. The study found that scientists show little interest in participating in patenting activities. Six challenges in patenting activities include lack of knowledge about legal frameworks and institutional regulations, assessing the commercial and technological potential of research findings, obtaining information on existing patents in the same field, submitting a patent

application, interacting with patent office examiners, and securing financial resources. Renault (2006) ^[15] investigated the factors influencing the decision of professors from 12 universities in the southeastern United States not to patent their work. The study listed five factors that influenced the decision not to pursue patents, such as uncertainty about research patentability, overly theoretical or basic research, time-consuming patenting process, unsuitability for academia, and a focus solely on academic pursuits. Cloete *et al.*, (2006) ^[9] examined biotechnology patenting in South Africa and discovered a barrier to the low level of patenting by South African scientists. The study revealed that research in the nation has often lacked an emphasis on commercialization, leading to a deficiency in market orientation. Academic researchers in South Africa have often focused on publishing their findings rather than seeking patents.

Previous studies have shown that researchers in the area of innovation and patenting encounter a variety of constraints. Scientists face challenges, including negative experiences with technology transfer offices that impede future patenting endeavours and the perception that patent protections cause delays in publishing. Challenges in university-industry knowledge transfer include bureaucratic rigidity, inadequately structured reward/performance systems, and inefficient administration of technology transfer offices. Challenges include limited time, extra duties, lack of government backing, industry's negative perception and a scarcity of faculty with management experience. These constraints might together impede the commercialization of research, affecting the technological transfer and patenting activities. Thus, the present study was done with the objective of assessing the constraints faced by researchers affiliated with various organisations in filing innovations through Intellectual Property Rights.

Materials and Methods

A comprehensive review of the literature was conducted to identify constraints encountered by researchers in safeguarding innovations through Intellectual Property Rights in different domains. The expert group comprising of 5 scientist and 5 professors from various organisations. All identified constraints were listed and shared with the expert group and in-depth and detailed discussions were undertaken. The constraints suggested by the expert group were incorporated. A total of 50 constraints were then categorized under seven heads - Knowledge (10), Attitude (05), Skills (05), Aspirations (05), Administrative (10), Financial (07) and Technical (08) (Table 1).

Table 1: List of constraints faced by researchers in protecting innovations through Intellectual Property Rights

Category	Constraints
1) Knowledge related constraints	<ol style="list-style-type: none"> 1. Lack of or limited knowledge of basics of IPRs 2. Lack of or limited knowledge about which forms of IPRs should be filled 3. Uncertainty about which attorney to get assistance from in IPR filing 4. Lack of or limited understanding of what help should be taken from attorney in IPR filing 5. Lack of or limited understanding of whether technology is novel 6. Lack of or limited knowledge of which college/university department processes IPRs filing. 7. Lack of or limited knowledge about what to do after filling or registering of IPRs 8. Lack of or limited understanding of how to commercialize the innovation 9. Lack of or limited knowledge concerning the advantages of IPRs protection for innovation 10. Lack of or limited comprehension of Organisation / university / college level IPRs regulations
2) Attitude related constraints	<ol style="list-style-type: none"> 1. There is less/no advantage even after getting IPRs 2. Lack of or limited interest in filing of IPRs 3. Lack of or limited interest in innovations and IPRs since promotions are due since long. 4. IPRs are time consuming and will not help in career promotion 5. Lack of or limited interest and attitude to learn the details of how to file IPR applications
3) Skills related constraints	<ol style="list-style-type: none"> 1. Lack of or limited skill in writing of the IPRs document 2. Lack of or limited ability to prove novelty of technology 3. Lack of or limited expertise in writing claims etc during IPR filing. 4. Lack of or limited skills in procedure to do IPRs filing 5. Lack of or limited proficiency in accessing financial resources for IPRs filing
4) Aspirations related constraints	<ol style="list-style-type: none"> 1. Lack of or limited aspiration to get any IPRs 2. Lack of or limited aspirations including IPRs and innovations as it will not be of any help in career 3. Lack of or limited desire to be recognised for research through IPRs and innovations 4. Lack of or limited ambitions owing to better alternatives (like research papers which take less time) than IPRs to fulfil academic performance related career aspirations. 5. Lack of or limited ambition due to concerns about the uncertainty after submitting IPRs
5) Administrative constraints	<ol style="list-style-type: none"> 1. High bureaucracy and rigidity of university administrators 2. Workplace / office politics 3. Unhealthy competition in the workplace (Jealousy pertaining to improvement and self-development) 4. Less staff so lack of time to focus 5. Files taking time for forwardals 6. Demotivating attitude of the colleagues 7. Too heavy teaching duties 8. Too heavy administrative duties 9. Additional charges 10. Open science mentality of university
6) Financial constraints	<ol style="list-style-type: none"> 1. Lack of funds for IPRs application filings fees at different level 2. Insufficient funds towards renewal fee require for maintaining IPRs 3. Insufficient finances to cover the attorney fees needed to file an IPRs 4. Insufficient reward/s for protection of innovations through IPRs for researchers 5. Difficulties in evaluating the commercial potential of innovations 6. No/less commercial interest from industry toward academic research 7. No/less possibility for commercial exploitation or industrialization of innovations protected through IPRs
7) Technical constraints	<ol style="list-style-type: none"> 1. Less points on the scorecard for IPRs protection as compared to efforts made 2. Institutions not equipped to help or encourage researchers in acquiring IPRs 3. Lack of technical support in the IPR protection activity 4. Inadequate time due to priorities of institutes 5. Limited or no sources for collecting information on prior art 6. Limited or no information on existing innovation protected under IPRs 7. Less or no knowledge of recent developments in IPR in protecting innovations 8. Non-availability of Technology Transfer Office in the institute

Information regarding constraints faced by researchers affiliated to various organisations engaged in teaching/research activities was collected by using an online google form. A five point Likert scale (Likert, 1932) ^[11] was used to test the level of severity of researchers towards the respective constraints. This scale was 0 to 4, where 4 - Very severe, 3 - Severe, 2 - Medium severe, 1 - Less severe, 0 - Very less severe.

Statistical analysis

Weighted average technique

The weighted average for each constraint was calculated by multiplying frequency of each constraint with respective weight/score. The weighted values taken for calculating

weighted average were Very severe = 4, severe = 3, Medium severe = 2, Less severe = 1 and Very less severe = 0.

The formula for weighted average is as follows:

$$\text{Weighted average} = \frac{\text{sum}(X1.W1 + X2.W2 + X3.W3 + X4.W4 + X5.W5)}{\text{sum}(W1 + W2 + W3 + W4 + W5)}$$

Where,

X_1, X_2, X_3, X_4, X_5 = Frequency of the respective constraints

W_1, W_2, W_3, W_4, W_5 = Weighted values i.e., 0, 1, 2, 3, and 4

The maximum and minimum weighted score for researchers is presented in Table 2.

Table 2: Maximum and minimum weighted score for researchers

Gender	Sample size (n)	Minimum weight	Maximum weight	Sum of weights	Minimum Score	Maximum Score
A	B	C	D	E	(B x C)/E	(B x D)/E
Female	61	0	4	10	0	24.4
Male	145	0	4	10	0	58.0
Overall (N)	206	0	4	10	0	82.4

Accordingly, the constraints faced by researchers were ranked based on the scores obtained. The constraints with score between 0 to 27 were considered as less severe, score between 27.1 to 54 as medium severe and score above 54 as most severe constraints.

Friedman rank test for differences among constraints

Friedman rank test a non-parametric test (distribution-free) used to compare observations repeated on the same subjects. It was used to test if there was a significant difference between each constraint.

The hypothesis was as follows;

H_0 = There is no significant difference among the scores obtained for different constraints

H_1 = There is a significant difference among the scores obtained for different constraints

$$F_R = \frac{12}{rc(c+1)} \sum_{j=1}^c R_j^2 - 3r(c+1)$$

Where,

R_j = square of the total of the ranks for group j (j = 1,2,c)

r = number of blocks

c = number of groups

Based on the p-value of corresponding parameters, the decision was taken on those parameters which have p-values less than 0.05, and this led to the decision toward rejection of H_0 , suggesting a statistically significant difference and for p-values greater than 0.05, the decision was to accept H_0 .

Results and Discussions

Constraints faced by researchers of various organisations were recorded. The weighted average, severity and ranking of constraints are presented in Table 3.

Table 3: Constraints faced by researchers

S. No.	Constraints	Weighted Average (Max Score =82.4)	Severity	Rank
1.	Skills related constraints	47.3	Medium	I
2.	Knowledge related constraints	45.4	Medium	II
3.	Financial constraints	45.3	Medium	III
4.	Administrative constraints	44.3	Medium	IV
5.	Technical constraints	43.3	Medium	V
6.	Attitude related constraints	32.9	Medium	VI
7.	Aspirations related constraints	31.2	Medium	VII
	Overall score	41.4	Medium	

It can be concluded from table 3 that the overall severity of constraints among researchers was found to be medium. It is observed that the skills related constraints received higher scores with a weighted average of 47.3, followed by knowledge related constraints (weighted average 45.4) and financial constraints (weighted average 45.3). On the other

hand, aspirations related constraints have the lowest weighted average of 31.2.

Further, Friedman test was applied to test the significance among the constraints faced by researchers of various organisations of India. The result of the Friedman test is depicted in Table 4.

Table 4: Friedman test results for constraints faced by researchers

S. No	Constraints	NMS*	Mean Rank	Chi-Square Value	Decision
1	Skills related constraints	0.57	4.77	184.562	Reject H_0
2	Financial constraints	0.55	4.53		
3	Knowledge related constraints	0.55	4.46		
4	Administrative constraints	0.54	4.36		
5	Technical constraints	0.53	4.14		
6	Attitude related constraints	0.40	2.89		
7	Aspirations related constraints	0.38	2.84		

The inference drawn from the Friedman test indicates that there is a statistically significant difference in the severity scores among the constraint categories. In other words, the researchers' perceptions of the constraints vary significantly across different categories such as skill, knowledge, financial, administrative, technical, attitude and aspirations.

This suggests that certain constraints are perceived as more severe than others, highlighting areas that may require more attention and resources in efforts.

The results of individual constraints are presented as follows:

Knowledge related constraints

The knowledge related constraints faced by the researchers

included ten subcategories and is presented in table 5.

Table 5: Weighted average ranking and Friedman test results for knowledge constraints

S. No.	Constraints	WA	Severity	Rank	NMS*	Mean Rank	Chi-Square Value	Decision
1	Lack of or limited understanding of what help should be taken from attorney in IPR filing	51.7	Medium	I	0.63	6.45	110.461	Reject H_0
2	Uncertainty about which attorney to get assistance from in IPR filing	50.7	Medium	II	0.62	6.27		
3	Lack of or limited understanding of how to commercialize the innovation	48.6	Medium	III	0.59	5.97		
4	Lack of or limited knowledge about what to do after filling or registering of IPRs	46.8	Medium	IV	0.57	5.68		
5	Lack of or limited knowledge about which forms of IPRs should be filled	45.9	Medium	V	0.56	5.5		
6	Lack of or limited understanding of whether technology is novel	45.6	Medium	VI	0.55	5.51		
7	Lack of or limited knowledge of which college/university department processes IPRs filing.	42.4	Medium	VII	0.51	5.16		
8	Lack of or limited comprehension of Organisation / University / College level IPRs regulations	41.9	Medium	VIII	0.51	4.9		
9	Lack of or limited knowledge of basics of IPRs	40.7	Medium	IX	0.49	4.82		
10	Lack of or limited knowledge concerning the advantages of IPRs protection for innovation	39.8	Medium	X	0.48	4.74		
	Overall	45.4	Medium					

It is clear from table 5 that the overall knowledge constraints were of medium severity. However, the constraints with the highest weighted average were 'lack of or limited understanding of what help should be taken from attorney in IPR filing' (51.7), 'uncertain about which attorney to get assistance from in IPR filing' (50.7) and 'lack of or limited understanding of how to commercialize the innovation' (48.6) while the constraint related to 'lack of or limited knowledge concerning the advantages of IPRs protection for innovation' had a lower weighted average of 39.8.

The Friedman test revealed that there was a significant difference among the constraints at a 5% level of significance and the null hypothesis (H_0) was rejected ($p < 0.05$).

The results of the present study are consistent with prior studies. Baldini (2011) ^[4] mentioned 'scarce knowledge of

university's procedures on patents' as a significant constraint that restricts faculty members from becoming inventors of Italian university patents. Baldini (2009) ^[3] identified 'scarce knowledge of university-level patent regulations' as a major obstacle associated with academic patenting in Italian universities. Renault (2006) ^[15] examined the reasons behind the non-patenting behaviours of professors of U.S. universities, such as 'not knowing if their technology was patentable' and 'research that was too theoretical or basic'. Siegel *et al.*, (2003) ^[17] noted that a pervasive barrier to effective university-industry technology transfer in the United States was a lack of understanding regarding university/corporate/ scientific norms.

Attitude related constraints

The attitude related constraints included five subcategories and is presented in table 6.

Table 6: Weighted average ranking and Friedman test results for attitude constraints

S. No.	Constraints	WA	Severity	Rank	NMS*	Mean Rank	Chi-Square Value	Decision
1	There is less/no advantage even after getting IPRs	37.3	Medium	I	0.45	3.31	35.659	Reject H_0
2	Lack of or limited interest in filing of IPRs	35.8	Medium	II	0.43	3.22		
3	IPRs are time consuming and will not help in career promotion	30.8	Medium	III	0.37	2.83		
4	Lack of or limited interest and attitude to learn the details of how to file IPR applications	30.8	Medium	III	0.37	2.80		
5	Lack of or limited interest in innovations and IPRs since promotions are due since long.	29.7	Medium	IV	0.36	2.85		
	Overall	32.88	Medium					

Table 6 shows that the overall attitude constraints were of medium severity. Out of 5 subcategories i.e., 'There is less/no advantage even after getting IPRs' had a higher weighted average (37.3) whereas 'Lack of or limited interest in innovations and IPRs since promotions are due since long' had the lowest weighted average (29.7).

The Friedman test revealed that there was a significant difference among the constraints at a 5% level of significance and the null hypothesis (H_0) is rejected ($p < 0.05$).

Several studies have documented findings that are consistent with the present study. Blind *et al.*, (2018) ^[7] examined the barriers encountered by German researchers in relation to patenting activities and revealed that the most significant constraints to patenting were the 'patents are time consuming'. Renault (2006) ^[15] investigated the factors influencing the lack of patenting among professors in U.S. universities and identified 'patenting being too time consuming' as a significant constraint.

Skills related constraints

The skills related constraints faced by the researchers were

also recorded and classified into five subcategories and are presented in table 7.

Table 7: Weighted average ranking and Friedman test results for lack of / limited skills constraints

S. No.	Constraints	WA	Severity	Rank	NMS*	Mean Rank	Chi-Square Value	Decision
1	Lack of or limited skill in writing of the IPRs document	48.6	Medium	I	0.59	3.09	11.692	Reject H ₀
2	Lack of or limited ability to prove novelty of technology	48.0	Medium	II	0.58	3.05		
3	Lack of or limited expertise in writing claims etc during IPR filing.	47.7	Medium	III	0.58	3.07		
4	Lack of or limited skills in procedure to do IPRs filing	47.2	Medium	IV	0.57	2.99		
5	Lack of or limited proficiency in accessing financial resources for IPRs filling	45.1	Medium	V	0.55	2.80		
	Overall	47.3	Medium					

It can be observed from table 7 that overall skill constraints were of medium severity. However, among these constraints, 'Lack of or limited skill in writing of the IPRs document' (48.6) and 'Lack of or limited ability to prove novelty of technology' (48.0) had higher weighted averages, while 'Lack of or limited proficiency in accessing financial resources for IPRs filling' (45.1) had a lower weighted average.

The Friedman test revealed that there was a significant difference among the constraints at a 5% level of significance and the null hypothesis (H₀) is rejected ($p < 0.05$).

The findings of the present study are supported by previous studies. Daniel and Alves (2019) ^[10] noted 'difficulties in patent writing' as a barrier to patent acquisition during their

investigation of University-industry knowledge transfer: specifically, the process of commercialising patents held by Portuguese universities. Blind *et al.*, (2018) ^[7] examined the challenges encountered by researchers at the Federal Institute for Materials Research and Testing, Germany, in relation to patenting activities. Their findings revealed that one of the primary constraints faced by these researchers was 'novelty is difficult to prove'. Moutinho *et al.*, (2007) ^[14] revealed that major constraints faced by Portuguese scientists in the process of patenting were 'filing a patent application' and 'accessing financial resources'.

Aspirations related constraints

The aspirations related constraints faced by the researchers included five subcategories and are presented in table 8.

Table 8: Weighted average ranking and Friedman test results for aspirations constraints.

S. No.	Constraints	WA	Severity	Rank	NMS*	Mean Rank	Chi-Square Value	Decision
1	Lack of or limited ambition due to concerns about the uncertainty after submitting IPRs	35.1	Medium	I	0.43	3.24	25.700	Reject H ₀
2	Lack of or limited ambitions owing to better alternatives (like research papers which take less time) than IPRs to fulfil academic performance related career aspirations	32.7	Medium	II	0.4	3.11		
3	Lack of or limited aspiration to get any IPRs	30.7	Medium	III	0.37	3.02		
4	Lack of or limited desire to be recognised for research through IPRs and innovations	28.9	Medium	IV	0.35	2.83		
5	Lack of or limited aspirations including IPRs and innovations as it will not be of any help in career	28.7	Medium	V	0.35	2.8		
	Overall	31.22	Medium					

The results presented in table 8 indicate that the overall constraints related to aspirations were medium severe. Out of these constraints, it was observed that 'Lack of or limited ambition due to concerns about the uncertainty after submitting IPRs' (35.1) had the highest weighted average, while 'Lack of or limited aspirations including IPRs and innovations as it will not be of any help in career' (28.7) had the lowest weighted average..

The Friedman test revealed that there was a significant difference among the constraints at a 5% level of significance and the null hypothesis (H₀) is rejected ($p < 0.05$).

Previous research has supported the findings of the present study. Blind *et al.*, (2018) ^[7] examined the barriers encountered by German researchers in their patenting activities and discovered that researchers faced constraints such as 'MJL publication are preferred', 'uncertainty if relevant granted patents exist' and 'uncertainty if already integrated in the standards'.

Administrative constraints

The administrative constraints faced by the researchers included ten subcategories and are presented in Table 9.

Table 9: Weighted average ranking and Friedman test results for administrative constraints

S. No.	Constraints	WA	Severity	Rank	NMS*	Mean Rank	Chi-Square Value	Decision
1	High bureaucracy and rigidity of university administrators	47.9	Medium	I	0.58	6.00	75.391	Reject H ₀
2	Workplace/Office politics	47.0	Medium	II	0.57	5.89		
3	Unhealthy competition in the workplace (Jealousy pertaining to improvement and self-development)	46.8	Medium	III	0.57	5.92		
4	Additional charges	45.8	Medium	IV	0.56	5.67		
5	Less staff so lack of time to focus	45.3	Medium	V	0.55	5.67		
6	Too heavy administrative duties	45.3	Medium	V	0.55	5.61		
7	Too heavy teaching duties	44.9	Medium	VI	0.54	5.49		
8	Demotivating attitude of the colleagues	42.1	Medium	VII	0.51	5.23		
9	Files taking time for forwardals	39.6	Medium	VIII	0.48	4.8		
10	Open science mentality of university	38.4	Medium	IX	0.47	4.74		
	Overall	44.3	Medium					

However, when considering the administrative constraints, 'High bureaucracy and rigidity of university administrators' (47.9) and 'Workplace/Office politics' (47.0) were found to have a high weighted average. On the other hand, the open science mentality of the university had a lower weighted average (38.4).

The Friedman test revealed that there was a significant difference among the constraints at a 5% level of significance and the null hypothesis (H₀) is rejected ($p < 0.05$).

The findings of the present study are similar to other studies on constraints faced by university faculty in patenting activity. Daniel and Alves (2019) [10] identified university bureaucracy as a significant constraint to patent commercialization during their investigation into the constraints experienced by faculty members of Portuguese public universities. Bansi (2016) [6] identified institutional bureaucratic regulations pertaining to intellectual property

as a significant factor contributing to the limited pace of innovation commercialization in South African universities. Baldini (2009) [3] examined the constraints associated with academic patenting in Italian universities and identified major obstacles significant in patenting activities including 'Excessive bureaucracy and rigidity of university administrators', 'excessive teaching and administrative duties', 'open science mentality of the university' and 'lack of a Technology Transfer offices (TTO). Siegel *et al.*, (2003) [17] identified barriers to effective university-industry technology transfer (UITT) in the United States such as 'Bureaucracy and inflexibility of university administrators' and 'Public domain mentality of universities.'

Financial constraints

The financial constraints faced by the researchers included seven subcategories and are presented in Table 10.

Table 10: Weighted average ranking and Friedman test results for financial constraints

S. No.	Constraints	WA	Severity	Rank	NMS*	Mean Rank	Chi-Square Value	Decision
1	No or less possibility for commercial exploitation or industrialization of innovations protected through IPRs	46.3	Medium	I	0.56	4.18	11.031	Reject H ₀
2	Insufficient reward/s for protection of innovations through IPRs for researchers	45.9	Medium	II	0.56	4.07		
3	No or less commercial interest from industry toward academic research	45.6	Medium	III	0.55	4.12		
4	Lack of funds for IPRs application filings fees at different level	45.5	Medium	IV	0.55	3.95		
5	Difficulties in evaluating the commercial potential of innovations	44.8	Medium	V	0.54	3.91		
6	Insufficient funds towards renewal fee required for maintaining IPRs	44.7	Medium	VI	0.54	3.91		
7	Insufficient finances to cover the attorney fees needed to file an IPR	44.3	Medium	VII	0.54	3.86		
	Overall	45.3	Medium					

Table 10 indicates that the severity of overall financial constraints was medium, with a weighted average of 45.3. Out of all constraints, it was observed that the constraint 'No or less possibility for commercial exploitation or industrialization of innovations protected through IPRs' had the highest weighted average of 46.3. This was followed by the constraint 'Insufficient reward/s for protection of innovations through IPRs for researchers', which had a weighted average of 45.9. While the constraint 'Insufficient finances to cover the attorney fees needed to file an IPR' had the lowest weighted average of 44.3..

The Friedman test revealed that there was a significant difference among the constraints at a 5% level of significance and the null hypothesis (H₀) is rejected ($p <$

0.05).

The result of present study meets the results reported by other researchers. Daniel and Alves (2019) [10] examined the barriers encountered by faculty members in patent applications within Portuguese public universities. They found that one major constraint was the limited commercial interest exhibited by industry towards academic research. The limited market applicability of university-developed technologies was a contributing factor to this phenomenon. Blind *et al.*, (2018) [7] examined the barriers to patenting encountered by researchers of Germany and revealed that the most significant constraints to patenting were the 'low statutory remuneration for researchers' and 'patent have high defense legal costs'. Baldini (2011) [4] highlighted

significant reasons that contribute to faculty members' reluctance to become inventors of Italian university patents. These factors include 'scarce possibility for commercial exploitation or industrialisation' and 'the research leads to non patentable results'. Baldini (2009) ^[3] identified the most relevant financial obstacles suffered during the patenting process in Italian universities such as 'Lack of funds to cover patenting costs', 'Insufficient reward for researchers', 'Scarce prospect for commercial exploitation or industrialisation', 'Difficulties in evaluating the commercial potential' and 'Scarce interest from industry towards

academic research. Moutinho *et al.*, (2007) ^[14] revealed that identifying the commercial and technological potential of research results was the major constraint faced by Portuguese scientists in the process of patenting. Siegel *et al.*, (2003) ^[17] discovered that 'the insufficient rewards for university researchers' was a major obstacle to effective university-industry technology transfer in the United States.

Technical constraints

The technical constraints faced by the researchers included eight subcategories and are presented in table 11.

Table 11: Weighted average ranking and Friedman test results for technical constraints

S. No.	Constraints	WA	Severity	Rank	NMS*	Mean Rank	Chi-Square Value	Decision
1	Inadequate time due to priorities of institutes	46.5	Medium	I	0.56	4.53	303.484	Reject H ₀
2	Limited or no sources for collecting information on prior art	44.9	Medium	II	0.78	6.79		
3	Lack of technical support in the IPR protection activity	43.9	Medium	III	0.53	4.30		
4	Limited or no information on existing innovation protected under IPRs	43.9	Medium	III	0.53	4.10		
5	Less or no knowledge of recent developments in IPR in protecting innovations	43.4	Medium	IV	0.53	4.20		
6	Less points on the scorecard for IPRs protection as compared to efforts made	42.5	Medium	V	0.52	4.13		
7	Institutions not equipped to help or encourage researchers in acquiring IPRs	42.0	Medium	VI	0.51	4.05		
8	Non-availability of Technology Transfer Office in the institute	39.4	Medium	VII	0.48	3.89		
	Overall	43.3	Medium					

Based on table 11, it was determined that technical constraints had medium severity, with a weighted average of 43.3. Of all the constraints, the constraint 'Inadequate time due to priorities of institutes' had the highest weighted average of 46.5 followed by the constraint 'Limited or no sources for collecting information on prior art', which had a weighted average of 44.9. Conversely, the constraint 'Non-availability of Technology Transfer Office in the institute' had the lowest weighted average of 39.4.

The Friedman test revealed that there was a significant difference among the constraints at a 5% level of significance and the null hypothesis (H₀) is rejected ($p < 0.05$).

Bansi (2016) ^[6] also noted 'lack of support from university administration in relation to intellectual property' as a notable constraint encountered by intellectual property and technology transfer managers and individual inventors at South African universities. Moutinho *et al.*, (2007) ^[14] examined the difficulties encountered by Portuguese scientists in the patenting process and highlighted the main obstacle of 'accessing information on existing patents in the same area'. Siegel *et al.*, (2003) ^[17] revealed that 'insufficient resources devoted to technology transfer by universities' and 'Poor marketing, technical or negotiation skills of university technology transfer offices' were the main obstacles to successful university-industry technology transfer in the United States.

Conclusions

In conclusion, the study highlights the diverse constraints encountered by 206 researchers in protecting innovation through IPRs. Notably, skill constraints emerged as the most significant barrier, closely followed by knowledge and financial constraints. The Friedman test underscored the presence of a statistically significant difference among these

constraints, signifying the multifaceted nature of the challenges faced. The findings pinpoint specific areas of concern within each constraint category. From lacking an understanding of legal assistance in IPR filing to grappling with attitudes towards post-IPR outcomes, researchers confront a spectrum of obstacles. Skill deficits in crafting IPR documentation and aspirations hindered by uncertainties post-submission were particularly notable. Recognizing and actively addressing these challenges is needed. In many organisations efforts are underway to address these challenges, with training programmes being organized for researchers. Indian Patent Office and The Rajiv Gandhi National Institute of Intellectual Property Management, Nagpur also have a number of classroom and online training programme (One week / 2 days/3 days) on patent prior art search, patent specification/claims writing, patent filing, design filing, trademark filing, copyright filing, IP commercialization etc. These steps are very encouraging. So, it is anticipated that over time, these initiatives will contribute to the alleviation of constraints.

References

1. Acar OA, Tarakci M, Van Knippenberg D. Creativity and innovation under constraints: A cross-disciplinary integrative review. *J Manage.* 2019;45(1):96-121.
2. Baldini N, Grimaldi R, Sobrero M. To patent or not to patent? A survey of Italian inventors on motivations, incentives, and obstacles to university patenting. *Scientometrics.* 2007;70(2):333-354.
3. Baldini N. Implementing Bayh-Dole-like laws: Faculty problems and their impact on university patenting activity. *Res Policy.* 2009;38(8):1217-1224. <https://doi.org/10.1016/j.respol.2009.06.013>
4. Baldini N. University patenting: patterns of faculty motivations. *Technol Anal Strateg Manage.*

- 2011;23(2):103-121.
5. Bansi R, Reddy K. Intellectual property from publicly financed research and intellectual property registration by universities: A case study of a university in South Africa. *Procedia-Social and Behavioral Sciences*. 2015;181:185-196.
 6. Bansi R. Commercialization of university innovation in South Africa (Doctoral dissertation). Durban University of Technology, South Africa; c2016. p. 453.
 7. Blind K, Pohlisch J, Zi A. Publishing, patenting, and standardization: Motives and barriers of scientists. *Res Policy*. 2018;47(7):1185-1197.
 8. Christie AF, Gaita KL, Howlett MJ, Webster EM, D'Aloisio S. Analysis of the legal framework for patent ownership in publicly funded research institutions. Canberra: Commonwealth Department of Education, Science and Training; c2003. p. 153.
 9. Cloete TE, Nel LH, Theron J. Biotechnology in South Africa. *TRENDS in Biotechnology*. 2006;24(12):557-562.
 10. Daniel AD, Alves L. University-industry technology transfer: the commercialization of university's patents. *Knowl Manag Res Pract*. 2020;18(3):276-296. <https://doi.org/10.1080/14778238.2019.1638741>.
 11. Likert R. A technique for the measurement of attitudes. *Archives of psychology*. 1932;22(140): 1-55.
 12. Lubango LM, Pouris A. Is patenting activity impeding the academic performance of South African University researchers? *Technol Soc*. 2009;31(3):315-324.
 13. Misha MM, Tardev VJ, Patil SS. The constraints faced by the extension personnel in transfer of technologies. *Int J Agric Sci*. 2016;8(13):1998-1202.
 14. Moutinho P, Fontes M, Godinho M. Do individual factors matter? A survey of scientists' patenting in Portuguese public research organisations. *Scientometrics*. 2007;70(2):355-377.
 15. Renault CS. Academic capitalism and university incentives for faculty entrepreneurship. *J Technol Transfer*. 2006;31:227-239.
 16. Sibanda M. Intellectual property, commercialization and institutional arrangements at South African publicly financed research institutions. *The economics of intellectual property in South Africa*. 2009;113-145.
 17. Siegel DS, Waldman DA, Atwater LE, Link AN. Commercial knowledge transfers from universities to firms: improving the effectiveness of university-industry collaboration. *J High Technol Manage Res*. 2003;14(1):111-133.
 18. Umerez J, Mossio M. Constraint. In: Dubitzky W, Wolkenhauer O, Cho KH, Yokota H (eds) *Encyclopedia of Systems Biology*. Springer, New York, NY. https://doi.org/10.1007/978-1-4419-9863-7_56.