

**PATENT FILING BEHAVIOR AND PATENT PORTFOLIO
MANAGEMENT: A STUDY OF INDIAN PUBLIC FUNDED
RESEARCH ORGANIZATIONS (PFROs)**

MUQBIL BURHAN



**DEPARTMENT OF MANAGEMENT STUDIES
INDIAN INSTITUTE OF TECHNOLOGY DELHI**

NOVEMBER 2014

**PATENT FILING BEHAVIOR AND PATENT PORTFOLIO
MANAGEMENT: A STUDY OF INDIAN PUBLIC FUNDED
RESEARCH ORGANIZATIONS (PFROs)**

by

Muqbil Burhan

Department of Management Studies

Submitted in fulfillment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

to the



Indian Institute of Technology Delhi

November 2014

CERTIFICATE

The Thesis entitled “**Patent Filing Behavior and Patent Portfolio Management: A Study of Indian Public Funded Research Organizations (PFROs)**” being submitted by Mr. Muqbil Burhan to the Indian Institute of Technology for the award of the degree of Doctor of Philosophy is a record of bonafide research work carried out by him under my guidance and supervision. He has fulfilled the requirements for a PhD. Degree of the institute. The research findings presented in this thesis have not been submitted anywhere else for the award of any other degree or diploma.

Prof. Sudhir K. Jain
Professor
Department of Management Studies,
Indian Institute of Technology Delhi

Dedicated
to
Abbu, who dreamed this

ACKNOWLEDGEMENT

I would like to express the deepest appreciation for Prof. Sudhir K. Jain's passion, guidance, and discipline that has been indispensable to my growth as a researcher and as a person over these years. I am especially grateful to him for his devotion to my education and success. Prof. Jain has been extremely remarkable in going out to make sure we were always ready for bigger challenges.

I am thankful to my Student Research Committee (SRC) members for their insightful reviews and suggestions, viz., Prof. S. S. Yadav (Chairman, SRC), Prof. Suneet Tuli (External Expert) and Prof. Harish Chaudhary (Internal Expert) for their inputs, particularly on the research methodology and during pre-Ph.D. seminar presentation. I am also thankful to all the Professors in the Department of Management Studies (DMS) of IIT Delhi, particularly Prof. Kanika T. Bahl (present head, DMS), for their valuable suggestions over this work from time to time and the courses I had an opportunity to attend.

I am especially indebted to Dr. Ruchi Sharma, as caretaker supervisor after Prof. Jain joined Shri Mata Vaishno Devi University, Katra (J&K) as Vice Chancellor in mid-February 2013, for her immense academic as well as administrative support. I would also like to thank Dr. Vignesh for his worthy inputs.

I would like to acknowledge the rich experience I got while working with Prof. Matthias Finger (Chair, Networking Industries) at EPFL Switzerland on an internship during Sep. to Dec. 2012. I am thankful to him for giving me the opportunity to work closely with his group in Switzerland and for all that I continue to learn from him.

The people around me during my stay at IIT Delhi provided a diverse, if occasionally tumultuous, environment that has not only contributed to the formation of me as a researcher, but also to the growth as a person. There were some very difficult times that I came across during this period and it was due to some people, with whom I share an everlasting relationship now, I learned to deal with them. Murali, Swikar, Tuhina, Sanchita, Deepali, Anshu, Sheesham, Aakriti, Anubhav, Vineeta, Yashwant

Panwar, Sunil K. Gulati, Nalin Jain, Mini, Mohita, Abhay, Anshul, Dhanya, Ajay, Amit, Abhishek, Neetu, Priyanka, Sreejith, Sumant, Krishnendu, Chitra – even a pep talk at times was meditative. Through all of the ups and downs of these years that we spend together, I wouldn't replace any of the people I have had the opportunity to work with at IIT Delhi.

I need to make a separate paragraph here for friends cum mentors: Ishita, Rohit and Thomas – for being such an inspiration and a great support. You are among those I relied and I am glad to say that I was never disappointed on knocking your doors. Fahima: I owe you special thanks and no matter how much I write I will fall short of words of praise for you.

Rajeev and Megha, I can't imagine spending these last few years of my research without you being around. You have been truly amazing friends, and I am so thankful for all the times you've scraped me off the ground and reassembled me into a human again. A part of you will always go with me wherever I go.

Amazingly, I managed to meet some people outside of the department, and it turns out that many of them have been among my most critical and constant supporters. I would not be the same person without the friendship of Athar and Naveed.

Most people are lucky to have one friend as constant and close to their heart as Prateek is to me. You remain special to me.

Ishaq, Saqib, Ayaz and Tariq: you showed me the world outside is more beautiful. Baba ji, I see the beauty of His creation in the hearts that He instills in people like you. Arshi and Muzamil, thank you for being a faith that I have in friends.

Finally, to thank the people who shaped me into who I am. No matter how strong linguistically I pretend to be, words will always fall short and emotions overwhelming when I wish to tell outside world about the contribution of Abbu (father) in building me. I wish, one day, I am a father like you.

I find this a great opportunity to tell my mother something which I never did. I am sure my thesis is more special to her than anyone else. She will read this, no matter if anyone does. You are an inspiration to me. Your strength and faith can move mountains. Your prayers have taken me out of most difficult times.

Asgar and Zahid, for being there without even the need to ask. I can't thank you enough. Iram (sister) – your name is enough to bring a smile on my lips. You are amazing. *Jiji, Bojan, Chachu, Brotherji, Aani, Papa* and Mummy – thanks for being a support. Saadat and Rafia: I wish someday I get a chance to pay you back all the care and love you gave me.

Irfana, Asfar bhai, Shazul, Ameer bhaiya, I wish you all the happiness and adventure that you have ensured this opportunity for me to experience. You have all contributed irreversibly to the person I have become. I cannot thank you enough. *Irfana and Shazia*: you mean everything to me. Aaban, Alayna and Azeen: I see in you what I always wished to be. You are my hope and dream and I am thankful to you for being a beautiful reality of my life.

Last but not the least, I would like to thank my wife, Safura for being what she means to my life.

MUQBIL BURHAN

ABSTRACT

India is fast growing as technology hub and one of the largest economies in the world. 2013 economic growth is expected to yield R&D spending growth of about 12.2% over that spent in 2012. In India, 70-80 per cent of the R&D expenditure is spent by Government sources in comparison to 20-25 per cent by private sector. Technology is a key driver of India's growth and competitiveness. India is fast growing as a knowledge hub, and Public funded research holds key to its transformation to a knowledge economy in the near future, riding on the knowledge generated from its Publicly Funded Research Organizations (PFROs) and human capital. There is a marked increase in patent filing post product patent regime in India. PFROs are leading the patent filing trend. Several PFROs have featured among top patent filing organizations. Patents are taken as important indicators of innovation capacity. Patent system, the original purpose of which was the temporary protection of organization or individual's knowledge base, is used by organizations for various strategic motives (Blind et al., 2009). Patent strategies have changed over time and become more complex and comprehensive, leading to an expansion of patent applications (Blind et al., 2004). Moreover, a new legislation introduced by Indian Union Ministry of Science and Technology in the Indian parliament for enactment seeks patent protection and commercialization of the intellectual property by any recipient of government grants for R&D.

As per the DSIR Directory (2007), there are 559 research institutions and universities in India where a great amount of research and development (R&D) activity is taking place. Over the last few years, PFROs and University interest in the protection and commercialization of new technologies within India and abroad has increased considerably. As a result, there is a growing focus on the need for these organizations to serve a third-mission of contributing to local economic development and self sustenance. This change has spawned a focus on protection and diffusion of technology developed from Public Sector Research. The Scientists at PFROs no longer are satisfied with displaying a certain number of annual scientific publications meant to highlight their expertise and know-how.

In recent years the relevance of public funded research to the needs of society has been increasingly challenged, and the benefits of results from research, also in the short-range perspective, have been given higher priority. While general agreement exists about the role of the PFROs as centre for fundamental basic research, a stronger interest has been expressed for proper follow-up of ideas from PFRO research which may lead to applications of industrial significance (Roberts, 1991). From this point of view, improved knowledge is needed about PFRO activities in the direction of Patent portfolio management and technology transfer. Demands for increased relevance of PFRO and university research to society needs have stimulated interest in inventions at these institutes and raised questions about the proper protection and diffusion of technologies disseminated from them.

In view of the above, it is imperative to examine the management of intellectual property, particularly patents, being generated from PFROs in India and the factors affecting them. India spends much less than an average spending of over 2% of GDP on R&D by developed countries. Major portion of this is spent by government. Industry spending on R&D is far less. In such scenario, there is a need for industry-PFRO R&D collaborations and technology transfers, which appear to be much less than expected. Moreover, high social expectations and emphasis on self sustenance of PFROs makes a study on patenting and transfer of technology from PFROs important both for industry and PFROs as well as policy makers.

The sample focus of our study is public funded autonomous institutes and laboratories (referred as PFROs in this study) in India. This study begins by examining the patent filing behaviour of scientists at PFROs using negative binomial regression and probit models. Various patent filing motives of scientists at PFROs is studied and compared with those of firms and individual inventors. We focus our study on scientists working in different PFROs in India, since they are the innovators with autonomous nature of work and involved in decision making in the process of patent filing to commercialization of their innovations in PFROs.

Patent filing and patent portfolio maintenance is a costly affair. Large maintenance fees need to be paid to keep it enforceable. If the patent is deemed not valuable, the owner may decide to abandon it by stopping paying the maintenance fees to reduce the cost. Firms strategize their plan of maintaining their patent portfolios based on traditional or strategic importance of inventions protected by the patents. In this study, various factors that influence maintenance of patents, granted to PFROs, are studied. Further, Using Tobit model, impact of various factors on patent maintenance at PFROs is analyzed.

PFROs are not in the business of producing goods and services based on their inventions (Shane, 2004) and, consequently, the commercialization of these inventions typically involves the transfer of knowledge and intellectual property rights to these inventions across organizational boundaries. Cuts in research unit budgets and increased government pressure pushes the researchers towards collaborating with external organizations for generating more funds. This is necessary to the economic survival of PFROs (Coccia & Rolfo, 2008). Moreover, inventions arising from public research are rarely ready for immediate conversion into commercial products or services (Rogers, 2003). We, therefore, study various factors that affect technology transfer from PFROs to firms. We use negative binomial regression to analyse the effect of these factors on technology licensing. In addition, we also explore various barriers to transfer of technologies from PFROs to firms based on perspectives of PFRO scientists, firms and IP managers from PFROs and external patent facilitation centres (Ex. PTFCs).

A case study based on India's premier PFRO, CSIR, is taken up to presents an example of management of patent portfolios and technology transfer in PFROs. The dynamics presented by CSIR explain the patent filing behavior in Indian PFROs and their subsequent technology transfer. The study draws its observations based on technologies licensed from CSIR laboratories.

CONTENTS

	Page No.
Certificate	i
Acknowledgement	iii
Abstract	iv
Contents	ix
List of Exhibits	xi
List of Tables	xii
List of Abbreviations	xiv
1. INTRODUCTION	
1.1 R&D Investment in the Indian Economy	5
1.2 Patent Filing Trends in PFROs	10
1.3 About the Present Study	15
1.4 Organisation of the Thesis	19
2. LITERATURE REVIEW, OBJECTIVES AND HYPOTHESES	
2.1 Review of the Literature	21
2.2 Research Gaps	49
2.3 Scope of the Study	50
2.4 Objectives of the Study	51
2.5 Research Hypothesis	52
3. METHODOLOGY	
3.1 Flow Diagram of Research Methodology	56
3.2 Data Requirement & Sources of Data: Three Studies	58
3.3 Research Design for Study 1: Patent Filing Behavior of PFROs	64
3.4 Research Design for Study 2: Maintenance of Patent Portfolios by PFROs	72
3.5 Research Design for Study 3: Technology Transfer from PFROs	76
3.6 Methodological Limitations	77
3.7 Softwares used	77
4. PATENT FILING BEHAVIOUR OF SCIENTISTS IN PFROs: EMPIRICAL ANALYSIS	
4.1 Patenting by PFROs in India	82
4.2 Patent Filing Behavior of PFROs	90
4.3 Concluding Remarks	104

5. MAINTENANCE OF PATENTS BY PFROS: EMPIRICAL ANALYSIS	
5.1 Patent Maintenance Trends in India	106
5.2 Patent Portfolio Maintenance by PFROs	109
5.3 Concluding Remarks	116
6. TECHNOLOGY TRANSFER FROM PFROs: EMPIRICAL ANALYSIS	
6.1 Quantitative survey of Commercialization Activity	118
6.2 Technology Transfer from PFROs	121
6.3 Barriers to Technology Transfer	125
6.4 Concluding Remarks	129
7 MANAGEMENT OF INTELLECTUAL PROPERTY AND TECHNOLOGY TRANSFER: A CASE STUDY	
7.1 Introduction	131
7.2 Intellectual Property Management	132
7.3 Technology Management	135
7.4 Value Generation through Intellectual Property	136
7.5 Concluding Remarks	147
8. CONCLUSIONS	
8.1 Major Findings of the Research	150
8.2 Recommendations	159
8.3 Research Contributions of the Study	161
8.4 Limitations of the Study	162
8.5 Scope for Further Research	162
Select Bibliography	164
Annexures I – VII	189-205
Brief Curriculum Vitae	206