

Women and IP Commercialisation in the Asian Region: Case Study of Sri Lanka

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Executive summary

Objective

This research examines women and intellectual property (IP) commercialisation in Sri Lanka. It identifies the root causes for the under-representation of women in patenting and IP commercialisation, in general, and in both academic and business sectors, in particular. Finally, it recommends incentives and best practices to address this imbalance.

Background

Sri Lanka has a population of 21 million, approximately 50.7% of whom are women.¹ Compared with women in South Asian countries, Sri Lankan women have a high life expectancy (80.6 years) and high literacy rate (91.7%).² Although both women and men in Sri Lanka generally have equal access to opportunities such as health and education, the country's overall level of female empowerment is below that of other developing countries.³ For example, the proportion of women participating in Sri Lanka's workforce has declined, from 41% in 2010 to 34% in 2017, which is a significantly lower proportion than for men.⁴ The female labour force participation rates in other Asian countries, particularly Singapore, Japan, Thailand, China and Bangladesh, remain in the range of approximately 50–65%.⁵ In 2017, Sri Lanka ranked 109 out of 144 countries in the Global Gender Gap Index (GGGI), which places it among those countries with the largest gender gap in the labour force.⁶ In Sri Lanka, a large gender gap is also found in the proportion of women who are unpaid family workers, accounting for 20.4% of women compared to 3% of men.⁷ The estimated economically active population was about 8.5 million in the third quarter of 2017; however, from this population, only 33.4% of women contributed to the national economy.⁸

¹ Countrymeters (2018) at < http://countrymeters.info/en/Sri_Lanka>.

² Countries of the World, (2018) at https://theodora.com/wfbcurrent/sri_lanka/sri_lanka_people.html. Female life expectancy at birth in India is 68 years. As per the census of 2011, an effective literacy rate for men was 82.14% whereas for women it was 65.46%.

³ DSW Gunawardane, 'Gender Inequality in Sri Lanka' <[http://repository.kln.ac.lk/bitstream/handle/123456789/12052/journal1%20\(1\).64-81.pdf?sequence=1%26isAllowed=y](http://repository.kln.ac.lk/bitstream/handle/123456789/12052/journal1%20(1).64-81.pdf?sequence=1%26isAllowed=y)> at 65.

⁴ The World Bank, 'Women, Business and the Law' (2017) at <<http://wbl.worldbank.org/en/data/exploreeconomies/sri-lanka/2017>>.

⁵ Quarterly Report of the Sri Lanka Labour Force Survey, 'third quarter' (2017) at <<http://www.statistics.gov.lk/samplesurvey/2017Q3report.pdf>>.

⁶ Sri Lanka's position in Global Gender Gap Index announced (2017) at <<https://www.newsfirst.lk/2017/11/global-gender-gap-index/>>.

⁷ ADB, 'ADB Receives \$12.6 Million Grant from We-Fi to Promote Sri Lankan Women Entrepreneurs' (2018) at <<https://www.adb.org/news/adb-receives-126-million-grant-we-fi-promote-sri-lankan-women-entrepreneurs>>.

⁸ Quarterly Report of the Sri Lanka Labour Force Survey, 'third quarter' (2017) at <<http://www.statistics.gov.lk/samplesurvey/2017Q3report.pdf>>.

Structure

Chapter 1 presents a review of the literature on the history of innovations and female participation in science and technology in Sri Lanka. Chapter 2 discusses the data collection and methods of analyses for both the quantitative and qualitative research and explains the interpretation of findings using multiple data sources. Chapter 3 analyses the descriptive secondary statistics on gender representation in patenting in Sri Lanka. The primary data analysis is presented in Chapter 4, with the analyses of the survey and interviews used to provide rich interpretation of the findings. Chapter 5 examines why women patentees are under-represented in Sri Lanka and discusses the root causes behind the lower representation of women in patenting in general and especially in both academic and business sectors. Chapter 6 presents and discusses the reasons for lower female representation in IP commercialisation in Sri Lanka and the barriers they face in commercialising scientific knowledge. Chapter 7 provides two case studies of Sri Lankan women who have successfully commercialised their invention and creation, respectively. The final chapter proposes incentives and best practices that could be promoted to address the gender imbalance in patenting and IP commercialisation in Sri Lanka.

Findings

This study reveals a stark gender gap in patenting in Sri Lanka, where female inventors accounted for only 5% of all single-inventor patents granted for the period 2010–2017. The study also finds that Sri Lankan women are granted far fewer patents compared with men, not only in academia but also in business sector. In addition, all-male inventing teams dominated in patenting, over mixed-gender and all-female teams.

The study also examined gender representation in patent filings and demonstrates that a clear and substantial gap exists between the number of female and male patent applicants. For example, of the total 155 patent applications filed by individuals in 2015, 94% were from males. Women were also conspicuously absent from patent applications filled by academic institutions; for example, of the patent applications filed by universities in 2015, 71% were from males. The gender disparity in industrial design registration is also pronounced.

This study identifies the root causes behind the lower representation of women in patenting and IP commercialisation by empirically investigating metaphors. The main factors influencing women's under-representation in patenting in Sri Lanka in general, and particularly in the academic and business sectors, include:

- gender disparity in university admissions to engineering and technology degrees
- gender disparity in senior academic positions
- Gender disparity in enrolments by academics in higher degree courses in science, technology, engineering and mathematics (STEM) fields

- social and cultural barriers to women becoming inventors
- less research and development (R&D) investment in research
- fewer female scientists in Sri Lanka
- Complexity of patenting process and patent costs
- lack of research grants and government funding for research
- lack of mentoring, sponsoring and networking for women at both academic and industry levels
- lack of collaborative R&D activities between industry and higher education sectors
- poor intellectual property rights (IPRs) management system
- lack of awareness of patenting
- lack of clear rules on ownership of IPRs in universities and business sectors
- Teaching oriented academics with less focus on research
- lack of successful female inventors as role models
- Lack of collaborative research with male colleagues
- lack of institutional support for women
- lack of economic incentives and rewards.

This study finds that the vast majority of patented inventions remains commercially unexploited in Sri Lanka. There is a significant imbalance between the number of female and male scientists involved in the commercial use of their research, with women being significantly under-represented. The study identifies multiple barriers to research commercialisation by women in general and especially in both the academic and business sectors in Sri Lanka. They include:

- inadequate access to finance and available start-up capital for women
- socio-cultural norms and perceptions that prevent the acceptance of women as entrepreneurs
- lack of development banks and venture finance companies for women
- inadequate incentives to research commercialisation
- lack of inventor-friendly organisations or innovation hubs to boost women-led innovations
- lack of a central framework in universities and R&D institutions for research commercialisation
- lack of linkages between universities and industry
- lack of support and incentives from government to commercialise research
- legal barriers and complicated business start-up processes
- insufficient infrastructure at both academic and industry sectors for commercialisation of research
- lack of understanding of technology transfer and licensing
- lack of common understanding of the value of research commercialisation
- fear of commercialising
- lack of technical and business knowledge/experience.

Recommendations

The recommendations comprise suggestions and best practices that could be promoted to address the gender imbalance in patenting and IP commercialisation in Sri Lanka. In summary, the study recommends that:

- a ‘National Innovation Hub (NIH)’ for women monitors their progress in patenting and commercialisation
- an ‘Innovative Compensation Scheme (ICS)’ provides incentives for employee inventors
- an institutional ‘Technology Transfer and Commercialisation Unit’ (TTCU) assists researchers with handling IP and related commercial activities
- a ‘Credit Guaranteed Funding Scheme for Women’ opens up economic opportunities for women inventors
- more public funding for universities and R&D institutions boosts home-grown innovations, and commercial success of those innovations
- mentoring programs assist women researchers at academic and industry levels
- girls’ equal access to education in STEM be promoted
- annual ‘Innovation Boot Camps’ and regular ‘Innovation Trade Expos’, for women inventors to promote their inventions
- rules around universities’ regulations of IPRs be clarified
- a national reward system encourages women inventors
- a national ‘Patent Licensing Academy (PLA)’ assists individual women inventors with third-party licensing
- programs to promote the importance of IP
- secondary schools and university students be taught about IP, and its potential to generate income and economic growth
- government funding is dedicated to research equipment and infrastructure
- patent applications be streamlined, and the system better resourced
- institutions foster a research commercialisation culture
- an advisory committee of the University Grants Commission (UGC) to encourage collaboration between universities and industry
- a ‘Small Business Administration Centre for Women’ to provide financial, technical and management assistance to small companies owned by women
- the promotion of case studies of successful women entrepreneurs
- systems to facilitate women’s access to business premises.

CHAPTER 1

Introduction

Literature review

Sri Lanka's recorded history dates back more than 2,500 years. Technological inventions are deeply ingrained in its history and culture.⁹ Before the 16th century, the country's technological level was comparable to that of most developed societies at that time worldwide. For instance, referring to the status of engineering in ancient Sri Lanka, Sir James Emerson Tennent noted that 'no people in any age or country had so great practice and experience in the construction of works for irrigation'.¹⁰ Sri Lanka's 12th century irrigation technology was reported as unique, and it was not seen in the rest of the world until the 17th century.¹¹ Once it was said that:

[T]he ancient Sinhalese developed a highly sophisticated irrigation system in which technical skills of an extraordinary nature were demonstrated ... The construction of canals or channels exhibited an amazing knowledge of trigonometry and the design of the tanks a thorough grasp of hydraulic principles.¹²

Although Sri Lanka can be justly proud of its technological inventions throughout history, no evidence can be found to suggest that women were part of this process. Perhaps the reason is that no comprehensive study has examined the participation of women in the process of technological invention in Sri Lanka. The available literature indicates that women experienced a satisfactory status throughout Sri Lanka's history. For example, women were allowed considerable freedom and independence (including the freedom to choose their life partners according to their will, although subject to caste regulations); they 'played an important role even in the field of politics when the country was in danger'; and they acted as rulers in certain periods.¹³ In fact, reference to female rulers is found in the *Mahavamsa*; queens Anula, Sivali, Lilavathi and Kalyanavathi reigned over their respective kingdoms. Women 'who were well-versed even in warfare and political science' can be found in Sri Lanka's history.¹⁴

⁹ See De Silva MA, *Evolution of Technological Innovations in Ancient Sri Lanka* (Vijitha Yapa, Colombo, 2011).

¹⁰ Tennent JE, *Ceylon: An Account of the Island* (vol 1) (Longman, Green, Longman and Roberts, 1859) 468.

¹¹ Goonalitake S, 'Technology and the Societal Context' (1976) *March Engineer* 30-40; DLO Mendis, 'Technology of Development and the Underdevelopment of Technology in Sri Lanka', in *Proceedings of the 31st Annual Session of the Sri Lanka Association for the Advancement of Science* (1974).

¹² De Silva KM, 'Historical Survey in Sri Lanka', in KM de Silva (ed), *Sri Lanka: A Survey* (The University Press of Hawaii, 1977) 32.

¹³ Samarasundera N, *Women and Domestic Law and Life in Sri Lanka and the SAARC Countries* (Godage & Brothers, Colombo, 2012) 23.

¹⁴ Samarasundera N, *Women and Domestic Law and Life in Sri Lanka and the SAARC Countries* (Godage & Brothers 2012) 24.

Nevertheless, very little information is available on the knowledge and education of women during Sri Lanka's history.¹⁵ It is important to note that knowledge and education have a deep impact on the process of technological invention, as knowledge, inculcated mainly through education, is what enables people to create new inventions. Although the educational background and intellectual capacity of women have not been adequately addressed by the historical studies pertaining to Sri Lanka, 'according to the folklore, women were only supposed to accomplish the duties that had been prescribed by society, which had some limitations and educational restrictions.'¹⁶ This might be why Sinhalese society devalued female intelligence, in one proverb portraying women's wisdom as equal to the length of the kitchen spoon handle.¹⁷ Moreover, '[t]here was a strong conviction that women were not supposed to be empowered with education'.¹⁸ As has been observed, '[a]ll the foreign visitors noted the discrimination against women, highlighting the negligence of education for women and the low level of women's literacy.'¹⁹ For instance, according to Davy:

Reading and writing are far from uncommon acquirements, and are almost as general as in England amongst the male part of the population, to whom they are chiefly confined: they do not form a part of female education, and in consequence, the very few women who can read and write have taught themselves after marriages.²⁰

Although most men were observed as being able to read and write, women did not share these accomplishments.²¹ While the native people of ancient Sri Lanka were 'more continent with respect to women than other Asiatic nations, and their women [were] treated with more attention',²² it has been highlighted that 'the scattered evidence indicates that women did not have equal place with men'.²³ Thus, women were unlikely to have stood on par with men as they deployed their scientific and engineering skills in the construction and maintenance of irrigation systems, these being the core scientific and technological endeavours during this period. In fact, 'there is evidence to show men's position in the family was higher than that of females and there was a clear demarcation of work and household duties based on gender, at least around the fifteenth century'.²⁴ A woman in pre-colonial Sri Lanka 'almost never experience[d] [the] treatment of a slave but [was] looked upon by her husband, more after the European manner, as a wife and companion'.²⁵ A proverb

¹⁵ Ibid at 24.

¹⁶ Karunaratna DN, 'A Study of Female Representations in Murals of Pre-Modern Sri Lanka' (PhD Thesis, Newcastle University, 2014) 168.

¹⁷ Ibid at 168-169.

¹⁸ Ibid at 168-169.

¹⁹ Ibid at 169.

²⁰ Davy J, *An Account of the Interior of Ceylon and Its Inhabitants with Travels in That Island* (Longman, 1821) 237-238.

²¹ Cordiner J, *A Description of Ceylon* (Longman, 1807) 120.

²² Percival R, *An Account of the Island of Ceylon 1803* (2nd ed), Reprint, Tisara Press, 1975) 127.

²³ Jayawardena J, 'Cultural Construction of the "Sinhala Woman" and Women's Lives in Post-Independence Sri Lanka' (PhD Thesis, University of York, 2002) 158.

²⁴ Ibid at 158.

²⁵ Percival R, *An Account of the Island of Ceylon 1803* (2nd ed, Reprint, Tisara Press, 1975) 127.

quoted by Simon Sawers in his 'Memoranda of the Laws on Inheritance' in 1826 states that women are born to three miseries or great evils: the first is to quit the place of their birth; the second is the pains of child bearing; and the third is to be under subjection to their husbands.²⁶ The above observations indicate that the scope for women to have a role in scientific and engineering undertakings and attempts during that time would have been minimal. The practice (and the legal position) of conferring decision-making power in households to a male figure would have further restricted female participation in scientific and engineering activities. The available evidence suggests that a huge gap and inequality existed between male and female education in pre-colonial and colonial Sri Lanka. With these factors, it is plausible to assume that female participation in the process of technological invention would have been comparatively less than that of their male counterparts.

Women's entry into the scientific professions was comparatively late in Sri Lanka. Although scientific research had been carried out in Sri Lanka since the beginning of the 19th century, it was not until the early part of the 20th century that women entered scientific professions. 'Medicine was the first scientific profession followed by women',²⁷ but thereafter, 'women have been qualifying in all fields of science, including engineering. The first woman science graduate qualified from the University of Ceylon in 1945 and the first woman engineer in 1958'.²⁸ The concept of 'women's empowerment' emerged rapidly as a significant aim and slogan for the 1990s.²⁹ It is said that:

The lack of a historical perspective of the important role played by women in science has alarming consequences for humanity in general, and Sri Lankan society in particular. Even to date, society in general underestimates the potential abilities of women and their abilities to pursue an academic career. The creative contributions coming from both men and women are equally important for scientific thinking and technological advancements for the good of Sri Lankan society.³⁰

In fact, gender segregation is deeply embedded in Sri Lankan culture. For example, while '[t]he law of Sri Lanka accords the husband-father, the official status of "head of the household"', '[t]his in itself brings into the law a strongly patriarchal tone'.³¹ The husband's marital power and the head-of-household concept were entrenched by pre-colonial as well as colonial Sri Lankan laws. They appear to have had a deleterious impact on female participation in the fields of science and engineering,

²⁶ Sawers S, 'Memoranda of the Laws on Inheritance' (1826), cited in FA Hayley, *The Laws and Customs of the Sinhalese or Kandyan Law* (Navrang, 1993) Appendix 1, 7.

²⁷ Amarasuriya NR, 'Women in Science and Technology in Sri Lanka: Country Report' at <<http://thakshana.nsf.ac.lk/slsltic/NA-173/NA-173.pdf>>.

²⁸ Ibid.

²⁹ Sanjeevani KS, 'The Impact of Women Empowerment Programs on Upcountry Tea Estate Women in Sri Lanka' (2015) 2(7) *International Journal of Scientific Research and Innovative Technology* 36.

³⁰ Waisundara V, 'Women Scientists conveniently 'lost' in History' (2017) at <<http://www.sundaytimes.lk/170723/plus/women-scientists-conveniently-lost-in-history-251109.html>>.

³¹ Goonesekere S, *The Legal Status of the Female in the Sri Lanka Law on Family Relations* (Gunasena, 1980) 3.

as the male head of the household could exercise influence over the affairs of women, including management and administration of their property. In theory, the pre-colonial Sinhalese woman ‘always enjoyed the fullest rights in respect of acquisition, management and alienation of their separate property’.³² Yet, in practice, the wife’s decisions regarding her property were influenced by the choices of the husband as the head of the household. Under Roman-Dutch law, the marital power of the husband was extensive in that the wife could not ‘usually enter into a binding contract without the assistance of her husband’.³³ While some exceptions existed, ‘[h]er lack of capacity in contract was viewed as a legal protection, which would prevent her being exploited.’³⁴ Furthermore, due to the husband’s marital power, a wife could not sue or be sued, and she had to be represented by her husband in all legal proceedings.³⁵ In effect, ‘these disabilities created a situation where her capacity to engage in commercial transactions was significantly limited’.³⁶ However, the capacity of a married woman to enter into contracts was widely extended by the *Married Women’s Property Ordinance 1923*. As a result, a woman governed by the general law can now sue and be sued in her individual capacity. She has full capacity to enter into any contracts even without the assistance or permission of her husband.³⁷

However, certain special laws³⁸ operating in Sri Lanka, such as the *Tesawalamai*³⁹, continue to restrict the contractual capacity of married women governed by those laws. For instance, a wife governed by *Tesawalamai* is deemed to be subject to her husband’s marital power.⁴⁰ The effect of this contention is that ‘she would not generally be able to enter into a binding contract without her husband’s assistance. She would also have no status in litigation and would be required to be represented by him’.⁴¹ While subsequent legal reforms have conferred on a woman governed by *Tesawalamai* more powers of management and administration of her property than she had before, in terms of the disposition of immovable property *inter vivos*, she would still require the consent of her husband. Yet, in the case of movable property, the current law affords ‘a woman subject to *Tesawalamai* [the] complete power to deal with [such] property which belongs to her separate estate, without her husband’s consent’.⁴² The current position for women governed by *Tesawalamai* is that they can own property. However, to enter into contracts, the contention is

³² Ibid at 31.

³³ Ibid at 36.

³⁴ Ibid at 36.

³⁵ at 36.

³⁶ at 36.

³⁷ at 36.

³⁸ The law can be divided into two categories: the General Law and the Personal Laws. The personal laws that govern the various sections of Sri Lankan community are, Kandyan Law, *Tesawalamai* and Muslim Law.

³⁹ *Tesawalamai* is the traditional law of the Sri Lankan Tamil inhabitants of Jaffna Peninsula, codified by the Dutch during their colonial rule in 1707. *Tesawalamai* is a collection of the *Customs of the Malabar Inhabitants of the Province of Jaffna* (collected by Dissawe Isaak) and given full force by the *Regulation of 1806*. For *Tesawalamai* to apply to a person, it must be established that he/she is a Tamil inhabitant of the Northern Province. The Law in its present form applies to most Tamils in northern Sri Lanka. The law is personal in nature; thus, it is applicable mostly for property, inheritance and marriage (Wikipedia).

⁴⁰ Goonesekere S, *The Legal Status of the Female in the Sri Lanka Law on Family Relations* (Gunaseena, 1980) 38.

⁴¹ Ibid at 38.

⁴² Ibid at 32.

that a woman should obtain the consent of her husband. This continues to be the practice: banks, when dealing with a married woman who is under *Tesawalamai*, usually ask for the signature/consent of her husband.

Overall, women in Sri Lanka have been under-represented in inventing, patenting and other endeavours related to science and engineering for various legal, social and economic reasons. Although published statistics on the gender of the grantees of the patents are unavailable, the limited literature concerning female participation in patenting activities in Sri Lanka appears to suggest a gender bias against women.⁴³ As Sarathchandra has observed:

It is particularly hard to argue that a discussion of gender bias in science is irrelevant in a country where over a dozen inventors won presidential awards for their inventions in 2011 and 2012 - *all men!* In light of this, popular Sri Lankan science writer Nalaka Gunawardene once asked, ‘So, where are our women inventors?’⁴⁴

CHAPTER 2

Research Methodology

This research comprises the use of three principal methods: firstly, a literature review; secondly, analysis using secondary data; and, thirdly, a survey questionnaire with semi-structured interviews. The data were then analysed to report the findings.

Literature review

The review of the literature covered published academic research publications, journal articles, reports and case studies on the topic of women and intellectual property (IP) commercialisation in Sri Lanka. This review clearly showed a serious gap in the literature on female participation in science, technology and innovations.

Secondary data

For this research, the identification of the gender of inventors was very important. However, the demographic details (such as age, level of education or gender) of individuals awarded patents in Sri Lanka are not recorded. Hence, to examine female representation in patenting, the data obtained from the National Intellectual

⁴³ This situation is the same in the global context with far fewer women using the patent system than men. According to the WIPO, ‘women appeared in less than a third of all international patents applications under the Patent Cooperation Treaty’ in 2016. It has been observed that, ‘at current rates, gender parity in the use of the System will only be reached in 2076’, WIPO, ‘Boosting Women in Innovation’ at <http://www.wipo.int/women-and-ip/en/news/2017/news_0003.html>.

⁴⁴ Sarathchandra D, “‘Where are the Sri Lankan Female Scientists?’: A case of Democratizing Science’ <<https://groundviews.org/2014/07/11/where-are-the-sri-lankan-female-scientists-a-case-of-democratizing-science/>>.

Property Office (NIPO) in Sri Lanka was searched manually in the inventor registry. The inventors' gender was identified using their first name. If the gender was ambiguous, both the first and middle names were used to determine gender. As most first names in Sri Lanka are gender specific, a high level of accuracy was achieved by using this method to codify the gender of those who had been granted patents as male or female. However, a few cases had gender-neutral first names; in addition, a few inventors listed only their initials. Those patentees who had no name listed on the register were excluded from further analysis. Overall, due to the gender-neutral names, the use of initials only and the absence of some inventors' names, a small margin for error should be allowed in interpreting the findings of the study.

Patents granted in each sector were placed into a category, such as single inventors; individuals in small-group collaborations; academic (universities); IP-intensive industries or research and development (R&D) government departments; and private organisations. The gender representation in each sector was also manually examined and classified to investigate female participation in each sector in patenting. In doing so, this research attempted to identify female representation in different sectors, and to compare the average number of female inventors versus male inventors, to assess how gender disparity varies across and within sectors. In addition, this research investigated teamwork in patenting and sought to identify gender representation in teams involved in patent-incentive research. However, it should be noted that when multiple inventors produced a patent, accurately crediting the inventorship of that patent or the contribution of each inventor in team research was not possible; hence, the name listed first was regarded as the primary inventor. The study therefore identified the first-named inventor as the primary inventor in the team patents granted, as most sectors assigned the patent to the first-named inventor. This research also observed the trends in female participation rates by the field of technology, which provided a more comprehensive picture of female inventor trends and patterns.

The analysis covered only the period 2010–2017. Due to well-reported backlogs of patent examinations in Sri Lanka, the number of patents granted per year rather than the total number of patents filed per year were considered for comparison.⁴⁵ Identifying the number of patent applications filed by women compared with men was a laborious task carried out manually. Hence, the number of patent applications filed by men and women was analysed for only three years (2015–2017) simply to highlight the trend in applications filed by gender. To undertake this task, the registries provided by NIPO were analysed manually, case by case. In addition, the gender disparity in industrial design registration was examined for five years (2013–2017).

⁴⁵ Owing to the backlogs, the total number of patent applications filed per year does not match the number of patents granted or refused each year.

Primary data

The primary data sources for this research were a series of interviews and a survey questionnaire, both of which were designed in alignment with the study's defined objectives. Three structured questionnaires were developed: one for academics, one for IP-intensive industries and R&D departments, and one for female inventors who were not attached to any institution. The study covered all main national universities in Sri Lanka, with faculties in engineering, science, agriculture and computer sciences identified for this research. The survey questionnaires were distributed by email after collecting staff contact details through university websites. The surveys were emailed to selected academics and researchers from the chosen faculties of the main national universities. The survey questionnaire was also distributed to several science and technology institutions, IP-intensive industries, R&D departments and private organisations in Sri Lanka.

The survey and interviews each used a structured questionnaire, with closed-ended and open-ended questions. The closed-ended questions provided data for detailed statistical analysis, while the open-ended questions provided information for descriptive analysis. The main purpose of the primary data collection was to identify the roots cause behind the lower representation of women in patenting and IP commercialisation in general, but particularly in academic and business sectors.

It should be noted that the aim of the primary data analysis was largely to strengthen the findings of the secondary data analysis and to provide an in-depth understanding of this phenomenon. This would not have been achieved using a qualitative approach that only reviewed the available literature. Hence, the primary data survey was not used on its own to make recommendations and come to conclusions. On a positive note, the study sample covered three stakeholder groups: universities, IP-intensive industries and R&D departments of business industries, and female inventors who were not attached to any institution. The total sample size of 78 was more than twice the average sample size in these types of studies.⁴⁶ As the scope of this study was concerned only with individuals and organisations involved in patent –incentive research, this was a highly representative sample. To the researcher's knowledge, this was the first survey of its kind undertaken on women and IP commercialisation in Sri Lanka.

The draft questionnaires were pre-tested with two to four respondents from each group. The questionnaires were then revised to accommodate changes identified during the pre-test. The revised versions of the questionnaires were used for the survey, which used two approaches:

⁴⁶ It is well accepted that the recommended sample size corresponding to traditional quantitative research design is 30 (The minimum sample size, according to Central Limit Theorem is 30). See Charles CM, & Mertler CA, (2002). Introduction to educational research (Boston, Allyn & Bacon, 4th ed), Creswell JW, (2002). Educational research: Planning, conducting, and evaluating quantitative and qualitative research. Upper Saddle River, NJ: Pearson Education, Gall, M. D., Borg, W. R., & Gall, J. P. (1996). Educational research: An introduction (White Plains, NY: Longman, 6th ed).

- (a) sending questionnaires to respondents via an identified contact point. The questionnaires were self-explanatory, and respondents were asked to return the completed surveys to the contact point.
- (b) employing an interviewer to meet selected respondents to conduct interviews.

The study also conducted interviews with 11 female inventors. These individual in-depth interviews provided an opportunity to undertake a deeper exploration of the personal experiences of these women through the journey of their inventorship. Two case studies of Sri Lankan women who have successfully commercialised their invention and creation, respectively were selected as case studies to demonstrate the challenges they faced as female inventors and entrepreneurs, and the strategies they used to overcome these challenges.

Data collection and distribution list

The questionnaires were disseminated to female and male academics and scientists in the selected faculties of the chosen universities.⁴⁷ Several universities in Sri Lanka are registered under the University Grants Commission (UGC), the apex body of the university system. However, the following universities send most of the patent applications to NIPO.

- University of Moratuwa (Faculty of Engineering)
- University of Peradeniya (faculties of agriculture, engineering and science)
- University of Colombo (Faculty of Science)
- University of Kelaniya (Faculty of Science)
- University of Sri Jayewardenepura (Faculty of Science)
- University of Ruhuna (faculties of science, engineering and agriculture)
- Wayamba University (Faculty of Agriculture and Plantation Management)

The questionnaires were also distributed to the following organisations and IP-intensive industries and R&D institutions and departments in Sri Lanka.

- National Engineering Research and Development Centre (NERD)
- Farm Mechanization Research Centre, Anuradhapura Town
- Industrial Technology Institute
- National Institute of Fundamental Studies
- Sri Lanka Institute of Nano Technology (SLINTEC)
- Tea Research Institute
- Rubber Research Institute
- Coconut Research Institute.

⁴⁷ Science faculties in Sri Lankan universities have several departments and the survey questionnaires were sent only to selected departments.

To obtain data for a gender breakdown, the primary data collection and survey questionnaires sought the respondent's gender. The questionnaires were translated into Sinhalese and distributed in English or Sinhalese as required. After the survey, the data compilation process commenced. The statistical analysis used simple statistical tools, such as descriptive statistics, charts/graphs, summaries and frequency tables, to answer the research objectives. Using the primary and secondary data collected, the analysis revealed how individual and institutional factors affect the innovation and commercialisation activities of women in both academic and business sectors.

Limitations of the study

Since records of inventors' demographic details (including gender) are not kept, examining the age and level of education of female inventors was beyond the scope of this study. As the system does not record the gender of the person awarded a patent, the data analysis was limited to an eight-year period; sorting data for more than eight years within the duration of this study would have been an overwhelming task.

In addition, the contact details of female inventors were provided, but some telephone numbers were incorrect or had changed. Furthermore, a few female inventors were opposed to participating in interviews. The NIPO website's statistics for granted patents for a year differed slightly to the raw NIPO data. As advised by NIPO, the statistics on its website were not 100% accurate; for example, some foreigners who were granted patents may have been accidentally considered as locals, if they applied under a local address.

The data analysis of this report should be interpreted while allowing for a small margin for error. This is because, although the most likely gender of each name was considered, gender could not be identified for gender-neutral names. Further, a small percentage of patents did not include the inventors' full names, but only their initials, thus making it difficult to determine the person's gender. In addition, the few patents in which the inventor's name was absent were excluded from further analysis.

Ethics approval

The study received ethics approval from Griffith University, Australia. All participants were provided with an information sheet that outlined the details of the study; the benefits and risks associated with participating; that they could choose not to answer a question; and that they could end the interview at any time without needing to provide reasons. Participants were informed about the aims of the study, and their confidentiality and anonymity were guaranteed. The participant's prior consent was obtained for their interview to be audio recorded.

Duration of the study

This research was conducted over four months.

CHAPTER 3

Secondary data analysis

This chapter analyses the magnitude of gender disparity in patents granted for the period 2010–2017 in Sri Lanka. It investigates the ratio between the proportion of female inventors of patents owned by single inventors, individuals in small-group collaborations, and institutions such as the university sector, government, semi-governmental and private sectors. The chapter then scrutinises gender representation in team research and female patenting activity by technological sectors. In addition, it analyses gender representation in industrial design registrations for the period 2013–2017 in Sri Lanka. The chapter finally examines the proportion of female inventors who filed for patents in 2015–2017.

According to the data collected from National Intellectual Property Office (NIPO), of all patents granted in 2010–2017, 76% (411) of patent holders were single inventors; 10% (56) individuals in small-group collaborations; 6% (34) government and semi-governmental institutions; 5% (29) private institutions or companies; and only 2% (11) higher education institutions.

Gender gap in all single-inventor patents (2010–2017)

Figure 1 highlights the number of patents granted⁴⁸ to both men and women out of all single-inventor patents for the period 2010–2017. As depicted in Figure 1, the number of patents granted in 2010 was much higher than in any subsequent year and was nearly six times higher than the number of patents granted in 2017. This is mainly due to clearing the backlog of unexamined patent applications in 2010. However, overall, the number of patents held by female inventors is very low compared with that for men. It is surprising that no increase has occurred in patents granted to women locally over the years. The trend in 2010–2017 placed female participation at only about 2% each year.

⁴⁸ This considers the number of patent applications granted by the National Intellectual Property Office (NIPO).

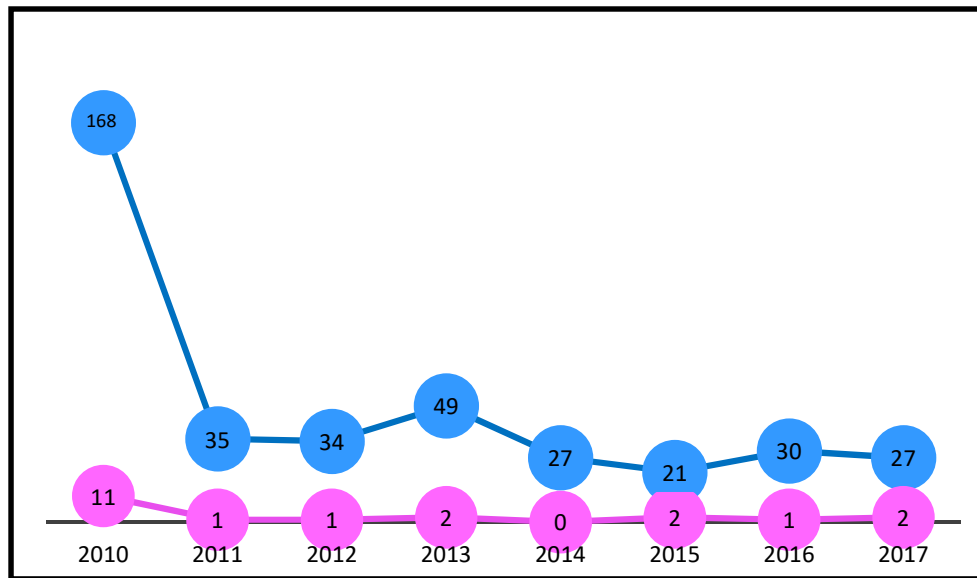


Figure 1: Number of single inventor patents granted by gender (2010–2017)

Figure 2 below highlights a significant gender disparity between men and women in patenting during 2010–2017. Female inventors accounted for only 5% of all single-inventor patents granted for the period 2010–2017, which is surprising. The proportion of female inventors is very small; the absolute numbers were also very low.

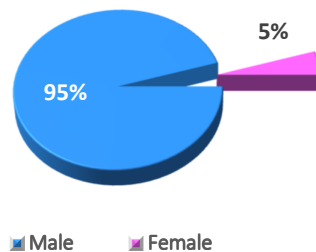


Figure 2: Proportion of single-inventor patents granted by gender (2010–2017)

Breakdown of all patents granted⁴⁹

In Figure 3 below, the pie chart highlights the breakdown of total patents granted across all sectors, including single inventors. It shows that 76% of patents were granted to single inventors, both men and women, while only 24% were assigned to other sectors. For example, 10% of patents were assigned to individuals in small-group collaborations, 2% to universities, 6% to government and semi-governmental institutions, and the remaining 5% to private-sector organisations.⁵⁰ The low percentage of patents granted to institutions, such as universities, and government, semi-governmental and private institutions highlights that those institutions conduct fewer patent–incentive research activities.

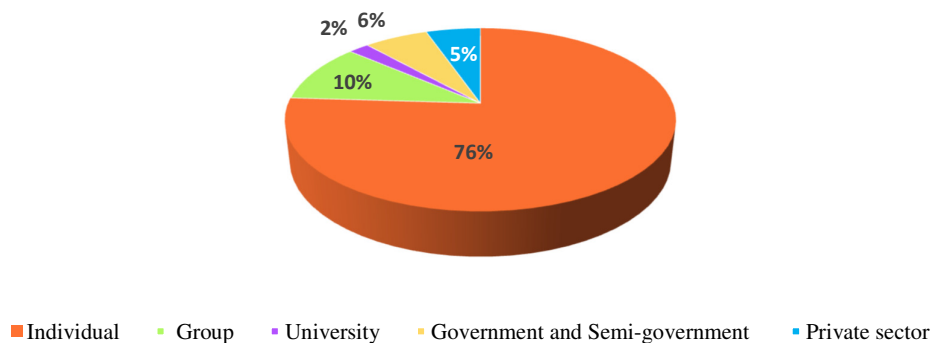


Figure 3: Proportion of total patents granted across all sectors (2010–2017)

Note: Group patents represent multiple inventors working collaboratively as part of a team.

The analysis above highlights that universities account for only 2% of patents granted, the lowest representation of all sectors. However, it needs to be borne in mind that, due to the lack of rules for intellectual property rights (IPRs) management in universities, academic inventors in Sri Lanka sometimes file patent applications in their own names. This means that patents over inventions from academic institutions are, at times, owned by individuals while, in some instances, they are in the hands of business companies or other organisations. The proportion of contributions to patenting by universities may therefore be best determined by tracking university patents by the names of academic inventors, rather than by universities. However, this task is outside the scope of this study.

⁴⁹ Compare the total trend without gender specific.

⁵⁰ Where proportions do not total 100%, this is due to rounding (e.g. 99% here).

Female representation by all patents granted

In Figure 4 below, the pie chart highlights the distribution of female participation in patenting across all sectors.⁵¹ The female patenting rates differ widely from one sector to another. This analysis demonstrates that the percentage of female inventorship is highest among female inventors who worked as individuals in small-group collaborations with no legal entities involved, showing that female inventors are more likely to work as part of a team. The female representation in patenting in government and semi-governmental institutions was equally high at 31%. The lowest female participation was for patents owned by universities and private-sector organisations.

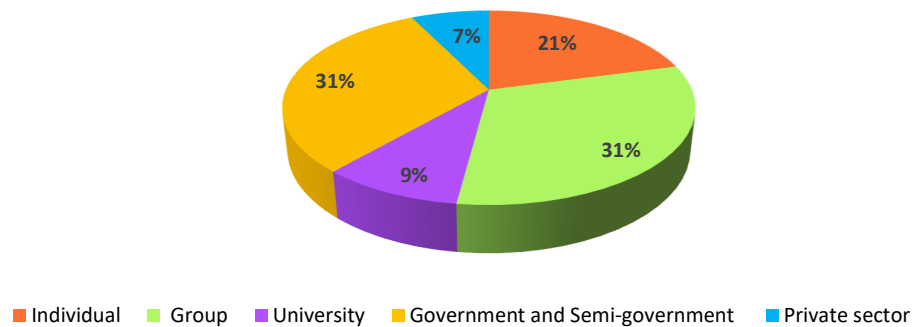


Figure 4: Female representation in total patents as a percentage (2010–2017)

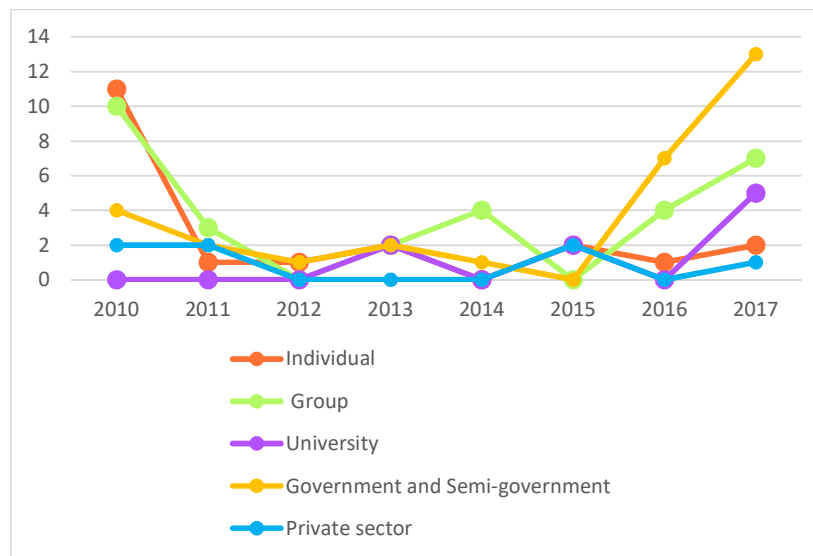


Figure 5: Trend in all sectors from 2010–2017

⁵¹ This is the female participation/contribution in total patents granted for each sector.

Gender gap among patent holders in different institutional sectors

The analysis below provides more detailed information about the gender representation of patent holders across institutional sectors during 2010–2017.

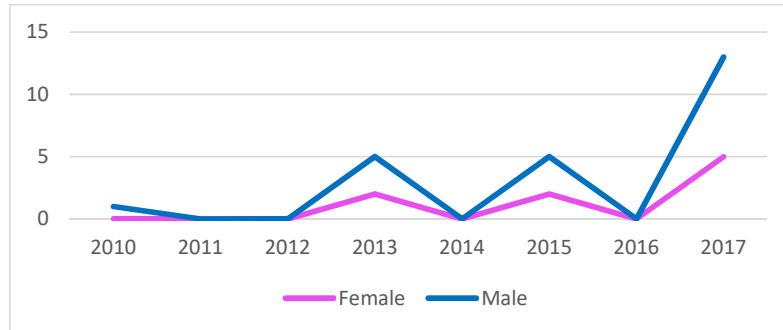


Figure 6: Gender gap between patent holders in universities (2010–2017)

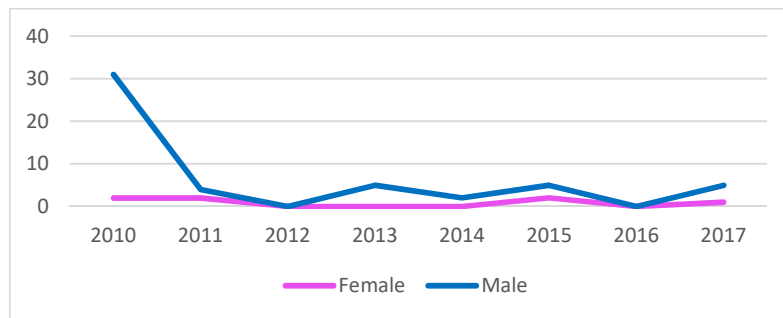


Figure 7: Gender gap between patent holders in private sector (2010–2017)

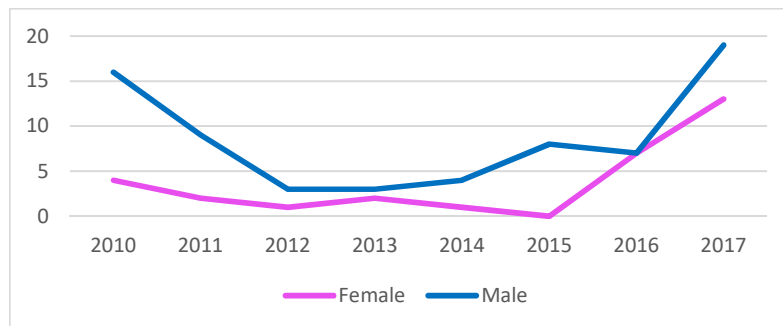


Figure 8: Gender gap between patent holders in government and semi- governmental sectors (2010–2017)

Figure 9 below further highlights the proportion of female participation and contribution to patents held by different institutions, such as universities, government and semi-governmental organisations, and private companies. As can be seen, female representation is higher in the government and semi-governmental sectors. While overall only 2% of patents were held by universities, of this small

percentage, female patent holders represented 27% of all university patents granted. Interestingly, female representation in private-sector organisations was significantly lower than that in other sectors. A significant disparity can be seen in female participation in patenting across different institutions with women contributing only 30% or less in all sectors.

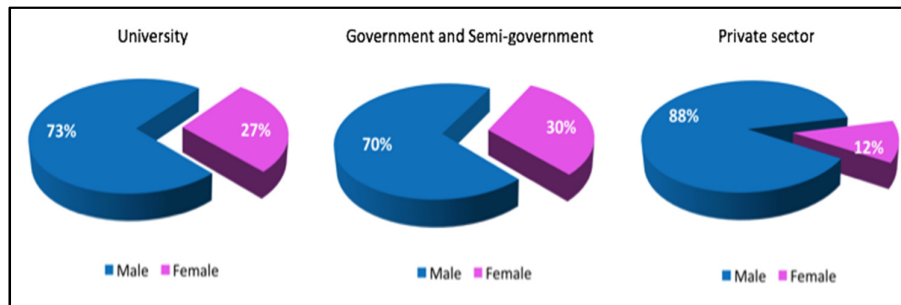


Figure 9: Proportion of female participation in patents held by institutions (2010–2017)

Gender representation of patents by team composition

In Figure 10 below, the pie chart highlights a striking gender disparity in teamwork during the period 2010–2017. Team composition is shown to be all-male, all-female or mixed-gender. The proportion of patents granted to all-male team inventors (61%) is much greater than that of patents granted to all-female team inventors during 2010–2017. Obviously, the patents from all-male team inventors are dominant numerically, while the number of patents from all-female team inventors remains very small. This demonstrates that male inventors are more likely to work as individuals but as part of an all-male team. Mixed-gender teams comprise teams consisting of at least one female and one male, and were found to hold a greater proportion (29%) of patents than patents held by all-female team inventors.

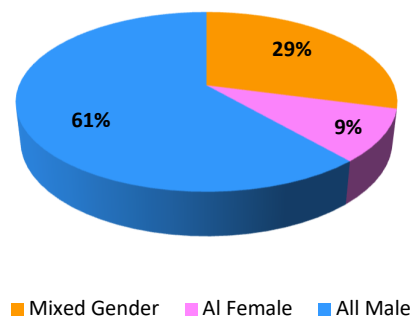


Figure 10: Gender composition of inventor groups (2010–2017)

Proportion of women as primary inventors of patents granted by sector

As shown in Figure 11 below, a large proportion of patents with a woman as the primary inventor was found in institutions (government and semi-governmental) during 2010–2017. The proportion of women as primary inventors of patents granted is also significant in group collaborations; however, this proportion is starkly reduced in the university and private sectors.

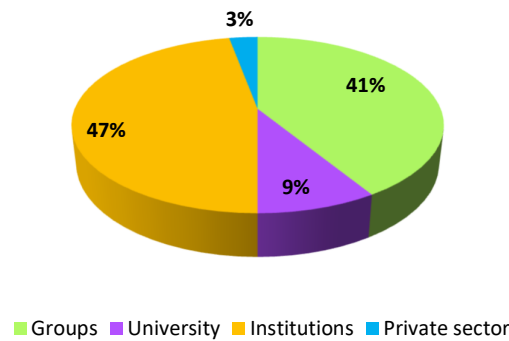


Figure 11: Proportion of women as primary inventors of patents granted by sector (2010–2017)

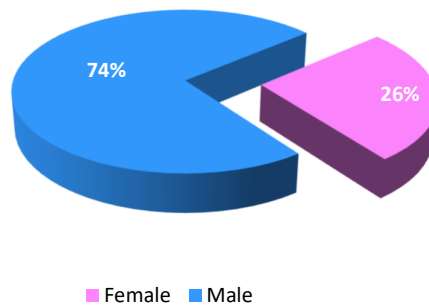
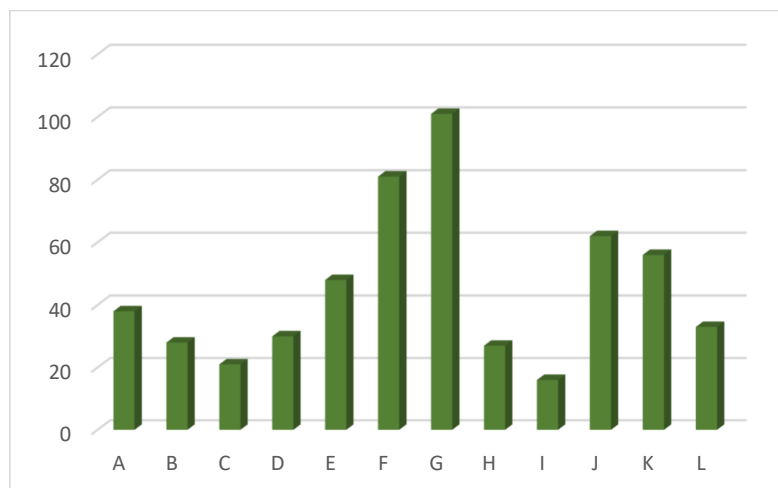


Figure 12: Decomposition of primary inventor by gender (2010–2017)

Analysis of female participation rates by field of technology

As shown in Figure 13 below, the technological areas in which female participation is much more significant in patents are: mechanical engineering and machinery; and innovation in domestic appliances or processes, or human necessities and related technologies. Female inventors also have better representation in electrical engineering and in biotechnology, medicinal preparation, devices and apparatus. However, women are very much under-represented in electronics engineering.



- A. Food and beverages, processing technologies
- B. Rubber, coconut, tea processing technologies
- C. Agriculture other than industries in category (B)
- D. Construction technology, civil engineering
- E. Manufacturing sector
- F. Innovation in domestic appliances processes. Human necessities and related technologies
- G. Mechanical engineering and machineries not classified elsewhere
- H. Information and communication technology
- I. Electronics engineering
- J. Electrical engineering
- K. Biotechnology, medicinal preparation, devices and apparatus thereof
- L. Safety measures, eco-friendly innovations and green innovation

Figure 13: Female representation by field of technology (2010–2017)

Number of patent applications filed by gender

In this section, the number of patent applications filed by men and women between 2015 and 2017 is analysed, with the results indicating a significant gender disparity. The data highlight that many more patent applications were filed by men than were filed by women in 2015–2017.⁵²

⁵² Even though the number of patent applications filed was calculated, this analysis did not consider either rejected applications or patent applications whose evaluations were still ongoing. The statistics needed to determine the number of rejected applications or pending applications were unattainable.

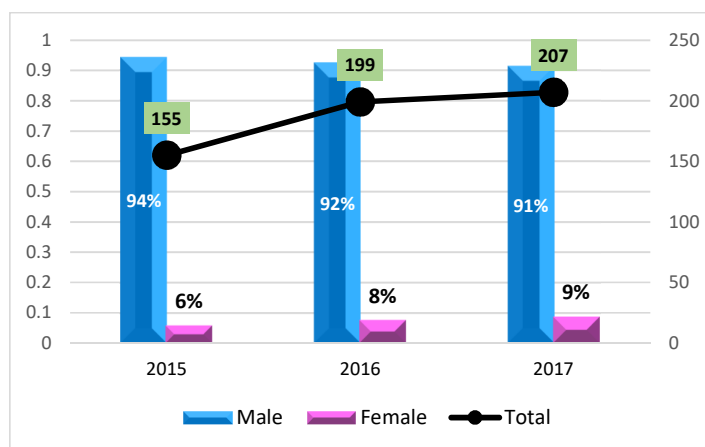


Figure 14: Number of patent applications filed by individuals (2015–2017)

As can be seen in Figure 14 above, of the total of 155 patent applications filed by individuals in 2015, male representation was 94% whereas female representation was only 6%. Similar patterns can also be seen in 2016 and 2017, evidently showing that the number of applications filed by women was very low (less than 10% each year) compared with men, although a very slight increase (1%) occurred in patent applications filed by women between 2016 and 2017.

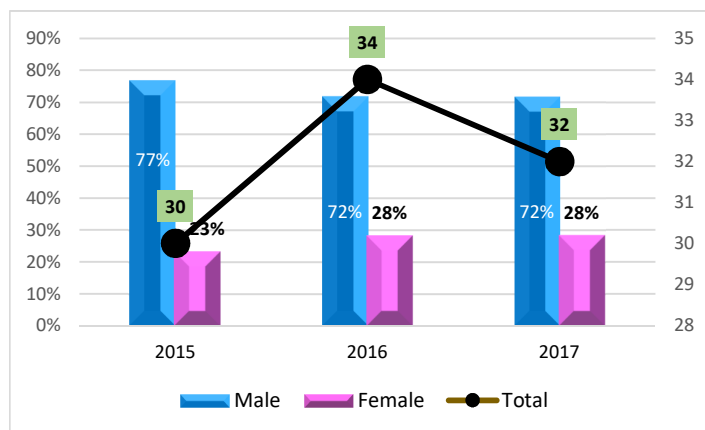


Figure 15: Number of patent applications filed by groups (2015–2017)

As shown in Figure 15 above, of the 30 patent applications filed by collaborative groups in 2015, it was noticeable that male representation was 77% while female representation was only 23%. During 2016 and 2017, female representation in the number of patent applications filed by groups slightly increased, from 23% to 28%.

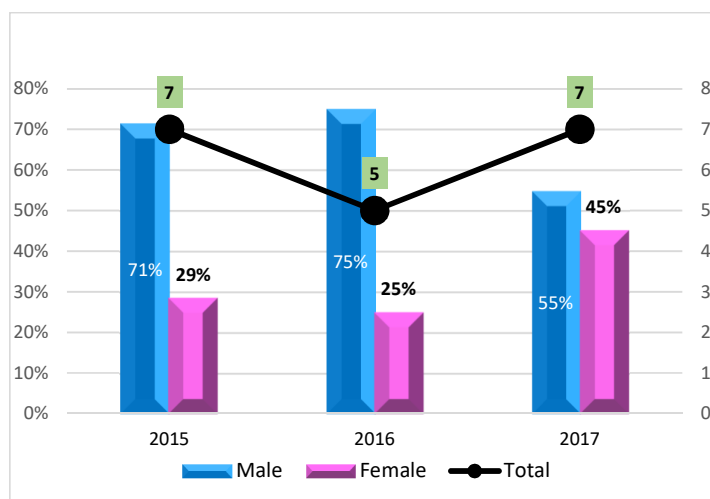


Figure 16: Number of patent applications filed by universities (2015–2017)

As can be seen in Figure 16 above, in the patent applications filed by universities in 2015, male representation was 71% while female representation was 29%. However, the university patent applications filed by women drastically increased in 2017, to 45%. Overall, the number of patent applications filed by female academics between 2015 and 2017 was higher than in any other sector.

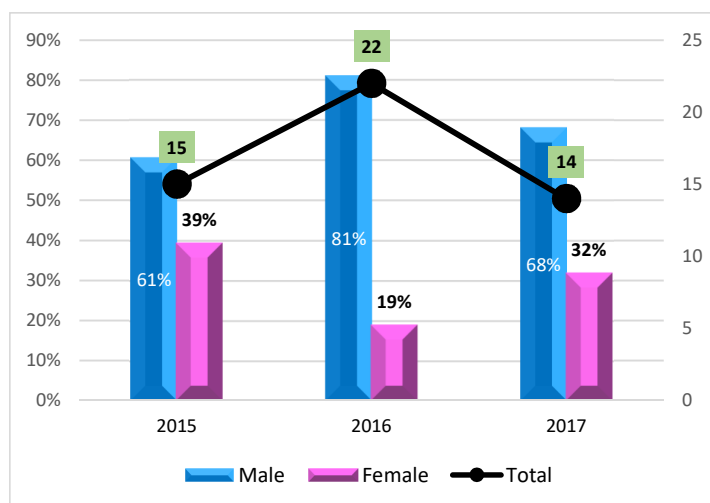


Figure 17: Number of patent applications filed by government and semi-governmental sectors (2015–2017)

It is worth mentioning (as shown in Figure 17 above) that female representation in patent applications filed by government and semi-governmental sectors was impressive in 2015, then experienced a large drop in 2016 but increased again in 2017.

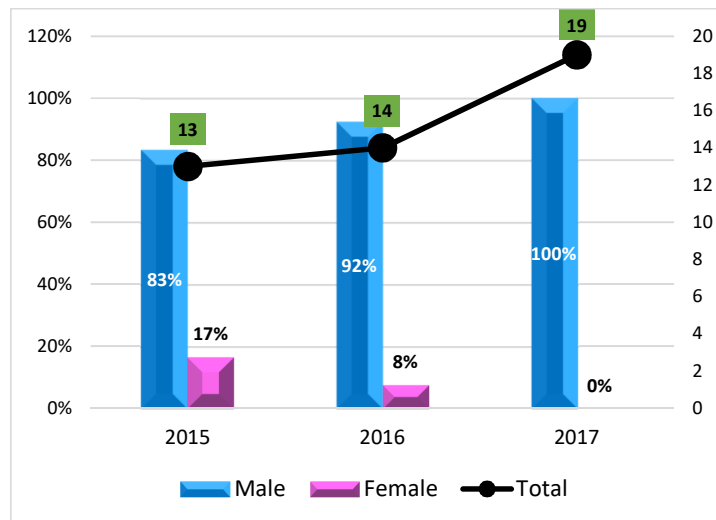


Figure 18: Number of patent applications filed by private-sector organisations and companies (2015–2017)

It is startling to see (as shown in Figure 18 above) that the number of patent applications filed by women in private-sector organisations is very low. In 2015, the proportion was 17%; this dropped to 8% in 2016; no patent applications were filed by a woman in this sector in 2017. In private companies, female participation is also low in terms of the number of patent applications filed as well as the number of patents granted (as mentioned earlier in this chapter).

Analysis of female participation in industrial design registration

As shown in Figure 19, an increasing trend was found in female participation in industrial design registration during the period 2015–2016, with a drop of approximately 3% in 2017. Similarly, male participation in industrial design registration increased during 2013–2015 but experienced a drop of approximately 30% in 2016–2017. It is interesting to see that participation by organisations in industrial design registration is the opposite to that of male participation. For example, in 2013–2015, organisation participation showed a downward trend; however, between 2015 and 2016, the initial growth in organisation participation is followed by a slight drop in the following year. This trend may be due to men being encouraged to participate via organisations rather than as individuals. Overall, the gender disparity in industrial design registration is very pronounced: female participation is very low. The number of industrial designs registered by men and by organisations has been highlighted.

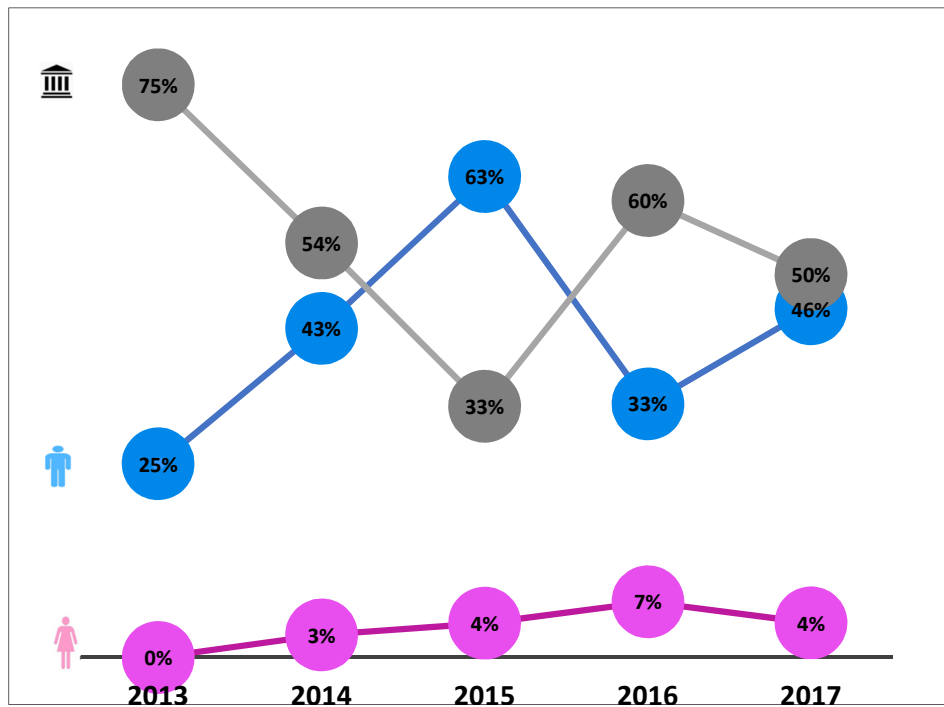


Figure 19: Gender representation in industrial design registration (2013–2017)

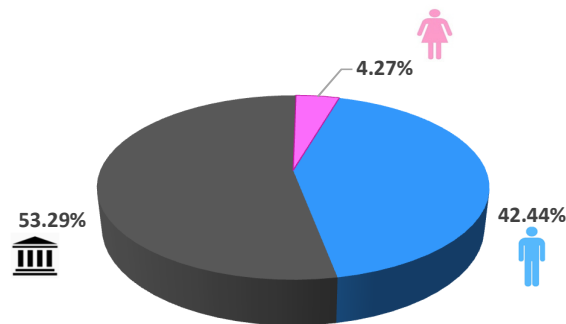


Figure 20: Gender distribution of industrial design registration (2013–2017)

As shown in Figure 20, female participation in obtaining industrial design registration in Sri Lanka was only 4.27% for the period 2013–2017, whereas male participation was 10 times higher (42.44%). More than half (53.29%) of the successfully obtained industrial design registrations for the period 2013–2017 were obtained through organisations.

Women participation in international patenting

Share of published PCT⁵³ applications with at least one woman inventor in Sri Lanka has increased from 21% in 2014 to 64% in 2017.⁵⁴ It is encouraging that share of published PCT applications with at least one woman inventor has more than tripled from 2014 to 2017.

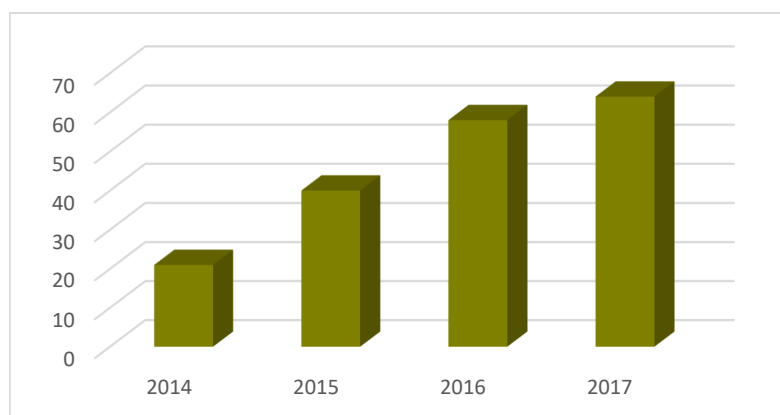


Figure 21: Share of PCT applications with at least one woman inventor (%)

In summary, this chapter reveals interesting results that provide quantitative data to provide evidence of the lower representation of women in patenting in Sri Lanka. Overall, the country had a high number of individual patents granted during 2010–2017, but women represented only 5% of patent holders. The total number of female inventors recorded in both academic and business sectors was also low. However, the number of patent applications filed by female academics in 2017 was higher, while the number of patents granted to female academics was also high during 2017. Overall, the proportion of female inventors relative to that of male inventors remains far from balanced in Sri Lanka. On the other hand, when the number of patent applications filed by men and women between 2015 and 2017 is considered, the proportion of female patent applications was markedly lower than that of male applicants.

⁵³ The Patent Cooperation Treaty (PCT) assists applicants in seeking patent protection internationally for their inventions.

⁵⁴ WIPO statistics database (Last updated, June 2018).

CHAPTER 4

Primary data analysis

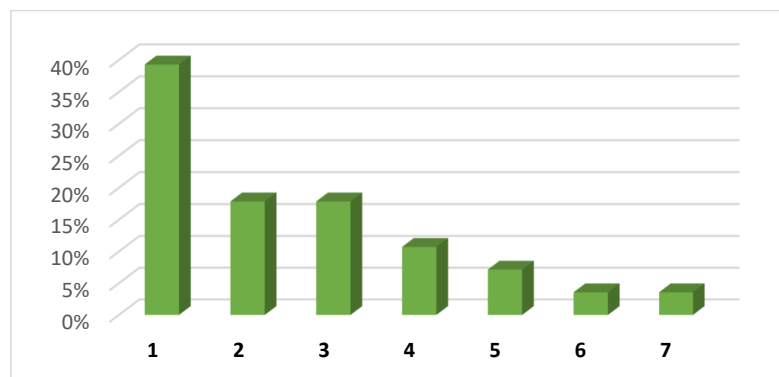
The study analysed the primary data to identify the key challenges that women face in patenting and intellectual property (IP) commercialisation. This analysis provides support for the arguments made by the researcher, as the data acquired included opinions, explanations and attitudes of individuals, academics and those in the research and development (R&D) and IP-related business sectors.

Data collected from higher education sector

This section presents a descriptive analysis that explains the levels of agreement and satisfaction of academics regarding the challenges identified in the statements.

What are the barriers to patenting your research?

Figure 21 below demonstrates that the university cohort's main barrier to undertaking patent – incentive research is a lack of research grants and government funding. Approximately 40% of respondents believed this to be the main barrier. According to academic respondents, further barriers to patenting research include complicated procedural requirements associated with patent applications; lack of mentoring in filing technical papers and patent applications; lack of economic incentives and rewards; lack of understanding of university IP policies; and cost of the patent application.



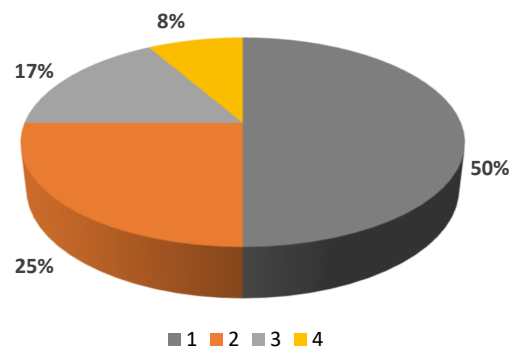
1. Lack of research grants/government funding for research
2. Complicated procedural requirements associated with patent applications
3. Lack of mentoring to file technical papers and patent applications
4. Lack of economic incentives and rewards
5. Lack of understanding of university IP policies
6. Cost of application for a patent
7. Other⁵⁵

Figure 21: Barriers to patenting research in the higher education sector

⁵⁵ Other includes: (a) lack of interest and motivation in patenting (b) keep some product formulations as trade secrets rather than obtaining patents.

Why do you think female academics have less representation in patenting their research in your institution?

From the total university sample, including both men and women, 44% of academics agreed that female academics have less representation in patenting their research in their institutions. Of those in agreement, 61% were females. As can be seen, many academic respondents (50%) believed that they have less representation in patenting mainly as they are under-represented when it comes to generating an invention. The other responses include: female academics have more interruptions in their work life than their male counterparts (domestic and care responsibilities); male-dominated academic culture in the workplace; and lack of available research funding, especially for women.



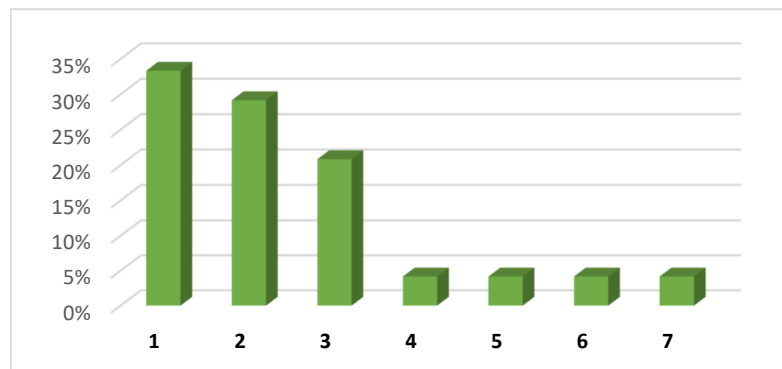
1. Female academics still under-represented when it comes to generating an invention
2. Male-dominated academic culture still presents in the workplace
3. Female academics have more interruptions in their work life than their male counterparts (domestic and care responsibilities)
4. Lack of research funding available for women

Figure 22: Reasons for less representation of female academics in patenting their research

Why do you think academics are less engaged in commercialising their intellectual property rights (IPRs)?

Most respondents (76%) agreed that academics are less engaged in commercialisation of their IP rights. As shown in Figure 23 below, respondents indicated that the main barrier for the university cohort to engage in commercialisation of their IP is that the academic culture is more focused on teaching than on the pursuit of the commercialisation of research. In addition, most respondents believed that the lack of clear procedures of universities describing how to commercialise research is one of the significant barriers to research commercialisation. Involvement in commercialisation of research was also limited by other factors, including lack of time and the burden of academic responsibilities; lack of understanding of university IP policies; lack of university encouragement

of research commercialisation; lack of knowledge of commercialisation (entrepreneurship); and lack of resources and business skills to manage commercial activities at the university level.

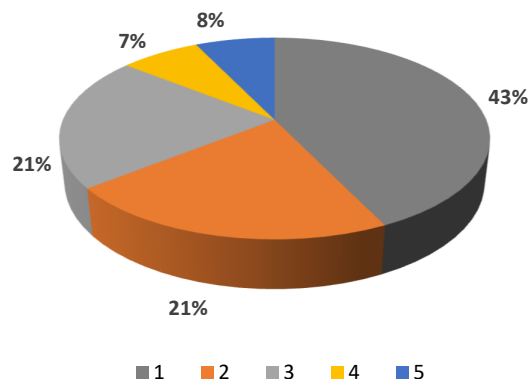


1. Academic culture is more focused on teaching than the pursuit of commercialisation
2. No clear procedures are available in the university describing how to commercialise research
3. Lack of time and burden of academic responsibilities
4. Lack of understanding of university IP policies
5. Research commercialisation is not encouraged by the university
6. Lack of knowledge of commercialisation (entrepreneurship)
7. Universities lack resources and business skills to manage commercial activities

Figure 23: Reasons academics are less engaged in commercialising their IP rights

Why do you think female academics are less engaged in commercialisation of their IP rights or patented inventions?

Many respondents asserted that the major reason that female academics are less engaged in commercialisation of their IP rights is lack of time, mainly due to family responsibilities, as well as difficulties in balancing their family responsibilities and work. In addition, many respondents strongly believed that the major obstacles to research commercialisation by women included gender-based and cultural constraints as well as lack of respect within the community for women entrepreneurs, and lack of technical and business knowledge/experience. The academic respondents believed that, among other barriers, insufficient access to finance and lack of start-up capital availability for women should be included, but they did not show strong agreement with the statements.



1. Lack of time (domestic and care responsibilities)
2. Gender-based and cultural constraints
3. Lack of technical and business knowledge/experience
4. Insufficient access to finance
5. Lack of start-up capital availability for women

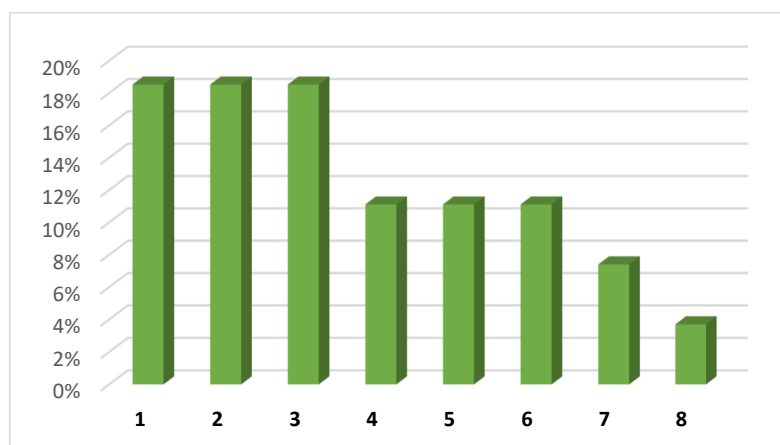
Figure 24: Reasons female academics are less engaged in commercialisation of their IP rights/patented inventions

Data collected from industry sector

This section presents a descriptive analysis to explain the levels of agreement and satisfaction shown by the industry sector regarding the challenges identified in the statements.

What are the barriers to patenting your research/inventions?

Most respondents in the industry sector agreed that the biggest barriers to patenting their research/inventions were the complicated procedural requirements associated with patent applications and lack of research grants and government funding for research. Respondents in the industry sector ranked the cost of paying for patent applications as the third highest barrier to patenting; however, it was interesting that this was found to be the smallest barrier for academics. In addition, the biggest challenges in the industry sector for patenting, which were also found to be barriers to patenting shared by academics, were: lack of economic incentives and rewards; lack of mentoring to file technical papers and patent applications; and lack of understanding of the IP policies of their institution.



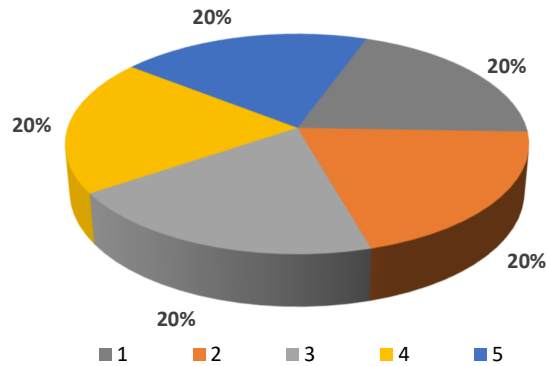
1. Complicated procedural requirements associated with patent applications
2. Lack of research grants/government funding for research
3. Cost of application for a patent
4. Lack of economic incentives and rewards
5. Lack of mentoring to file technical papers & patent applications
6. Lack of understanding of IP policies of your institution
7. Lack of encouragement from the university
8. Other⁵⁶

Figure 25: Barriers to patenting research/inventions in the industry sector

Why do you think women have less representation in patenting their research/inventions in your institution?

Many respondents in the industry sector asserted equally that women were still under-represented when it comes to generating an invention; social culture constitutes a barrier and limitation; women have more interruptions in their work life than their male counterparts; and women have a lack of interest in engaging in R&D activities, thus showing a similar trend to responses received from academic respondents.

⁵⁶ Other factors the participants mentioned include (a) negative economic policies of the country towards innovation, (b) lack of awareness of getting a patent and (c) lack of infrastructure, including high-tech equipment to conduct research.



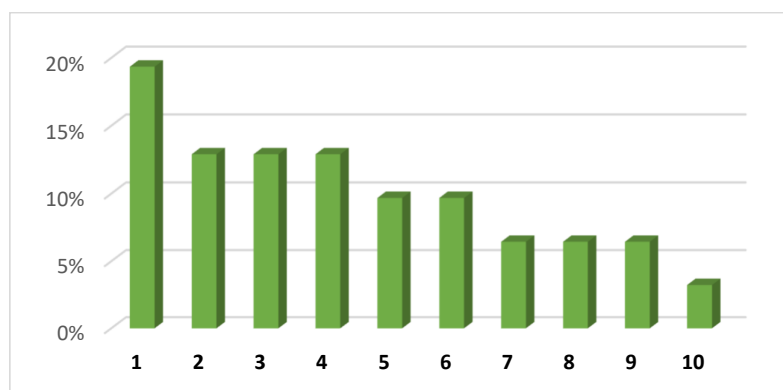
1. Women still under-represented when it comes to generating an invention
2. Social culture constitutes a barrier and limits
3. Female academics have more interruptions than their male counterparts
4. Lack of interest of women to engage in R&D and product/Process development work
5. Other⁵⁷

Figure 26: Reasons women have less representation in patenting their research/inventions in the industry sector

What are the barriers to commercialising your IP rights/patented inventions?

Many respondents in the industry sector believed that the lack of clear procedures and research commercialisation policies in their institution was the most significant barrier to research commercialisation. Furthermore, major obstacles for creating their new businesses included insufficient access to finance; lack of start-up capital; lack of understanding of IP policies of their institution, lack of encouragement from their employer for research commercialisation; legal barriers; and complicated business start-up processes. Respondents in the industry sector found insufficient access to finance and lack of availability of start-up capital to be the second and third largest barriers to commercialising their IP, while academic respondents found that these barriers were less important.

⁵⁷ Other factors include: (a) patent buyers are not honest, (b) lack of time for monitoring.



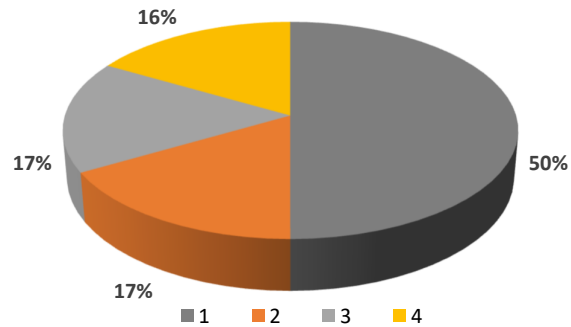
1. No clear procedures in the institution describing how to start a business and bring a product to the market (no understanding of commercialisation policies)
2. Insufficient access to finance
3. Lack of start-up capital availability
4. Lack of understanding of IP policies of the institution about research commercialisation
5. Legal barriers and complicated business start-up processes
6. Research commercialisation is not encouraged by your institution
7. Lack of technical and business knowledge/experience
8. Lack of institutional policy incentive schemes that provide rewards
9. Lack of encouragement from peers or mentors on research commercialisation
10. Other⁵⁸

Figure 27: Barriers to commercialising your IP rights/patented invention in the industry sector

Why do you think women are less engaged in commercialising their IP rights and patented inventions in your institution?

Many industry sector respondents (50%) observed that lack of time due to domestic and care responsibilities was the main barrier to women in commercialising their research. According to these respondents, the other difficulties that women confronted included: gender-based and cultural constraints as well as lack of respect within the community for women entrepreneurs, and lack of technical and business knowledge/experience of entrepreneurship.

⁵⁸ Other factors include: (a) lack of interest of women to engage in research commercialisation.



1. Lack of time (domestic and care responsibilities)
2. Gender-based and cultural constraints and lack of respect within the community for women entrepreneurs
3. Lack of technical and business knowledge/experience of entrepreneurship
4. Other⁵⁹

Figure 28: Reasons women are less engaged in commercialising their IP rights/ patented in the industry sector inventions

Data collected from female inventors

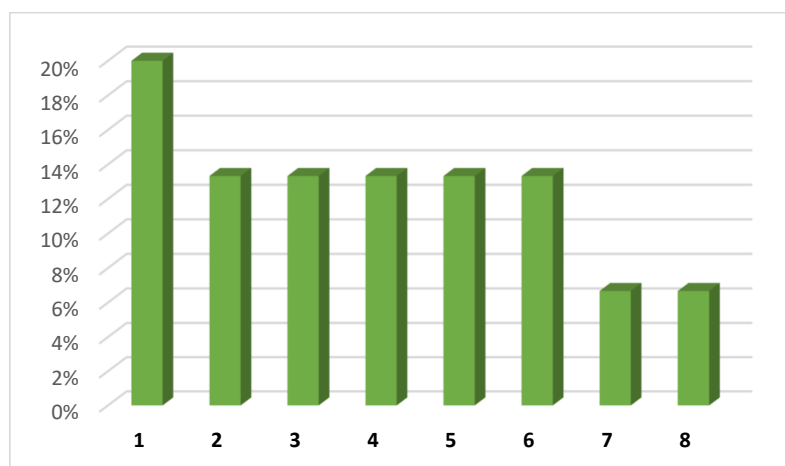
This section presents a descriptive analysis to explain the levels of agreement and satisfaction shown by individual female inventors⁶⁰ regarding the challenges identified in the statements.

What are the barriers to patenting your research/inventions?

Approximately 64% of female inventor respondents believed that women have less representation in patenting their research. As can be seen in Figure 29 below, most female inventors identified the cost of the patent application as the most significant barrier to female participation in patenting, which was also one of the biggest barriers for the industry sector, while academics asserted that it was the smallest barrier. In addition, five statements remarkably had high mean values indicating strong agreement, namely, complicated procedural requirements associated with patent applications and legal regulations; lack of rewards and economic incentives; lack of mentoring to file technical papers and patent applications; lack of social and family support; and lack of awareness of the IP system.

⁵⁹ Many women in the industry have indicated that they have lack of interest in commercialising.

⁶⁰ These female inventors are not attached to any institution.



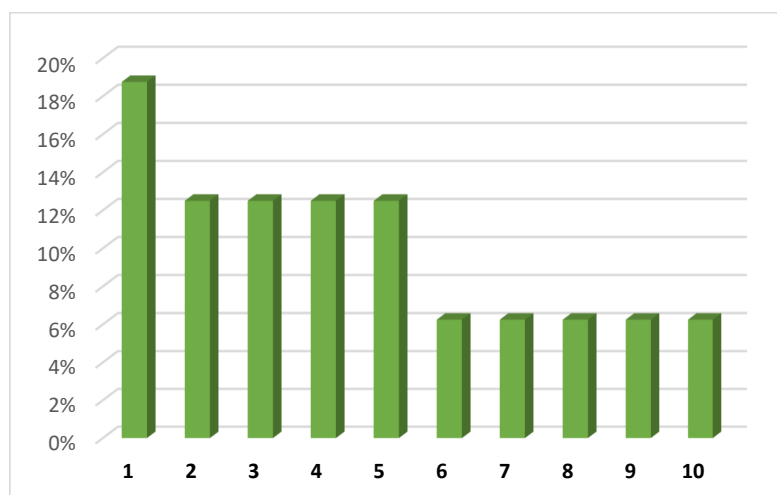
1. Cost of application for a patent
2. Complicated procedural requirements associated with patent applications/legal regulations
3. Lack of rewards and economic incentives
4. Lack of mentoring to file technical papers and patent applications/lack of centralised government body from where women can get support for applying for a patent
5. Domestic and care responsibilities
6. Lack of incentives from the government
7. Lack of awareness of IP system
8. Other⁶¹

Figure 29: Barriers to patenting research/inventions, female inventors

What are the barriers to commercialising your IP rights?

The main obstacles encountered by female inventors in relation to IP commercialisation were other factors such as lack of sponsorships and media facilities through which to promote their inventions. In addition, they identified that lack of access to financial resources, lack of start-up capital, and gender-based and cultural constraints were major constraints to the growth and uptake of their entrepreneurship.

⁶¹ Other factors include (a) delay in receiving a patent licence.



1. Limited access to new market within competitive business environment and lack of market channels
2. Insufficient access to finance/it is too stressful to get a loan
3. Lack of start-up capital availability
4. Gender-based and cultural constraints and lack of respect within the community for women entrepreneurs
5. Lack of support from the government
6. Legal barriers and complicated business start-up processes
7. Lack of technical and business knowledge/experience
8. Lack of family support/men prevent their wives from going into business
9. Lack of policy incentive schemes that provide rewards
10. Other⁶²

Figure 30: Barriers to commercialising IP rights, female inventors

In summary, this primary data analysis sought to determine the key challenges faced by women in general and, specifically, in both the academic and business sectors in patenting and IP commercialisation.

⁶² Other factors include: (a) no spare time to spend on commercialisation (b) lack media publicity on a product due to the cost of advertising and (c) lack of shop facilities to start up a business.

CHAPTER 5

Barriers to patenting

Chapter 5 investigates the factors influencing women's under-representation in patenting in general, particularly in both the academic and business sectors. The discussion highlights the reasons women have lesser representation in patenting and the factors that lead to the inefficient use of female innovative capacity in Sri Lanka.

Gender disparity in university admissions to engineering and technology

According to 2013–2016 university admission data released by the University Grants Commission (UGC)⁶³ (see Figure 31), women in Sri Lanka remain significantly under-represented, particularly in engineering. For example, the admissions rate of women to engineering degrees are substantially lower (less than 20%) than for men, while women's admission rates to the technology field are also comparatively low. This is also due to female inventors being heavily concentrated in science fields, which have lower patent rates, whereas male inventors are far more common in mechanical and electronic engineering fields, which produce more patents. Undeniably, the leaks in the engineering and technology pipeline ultimately lead to the lack of women in research and innovation.

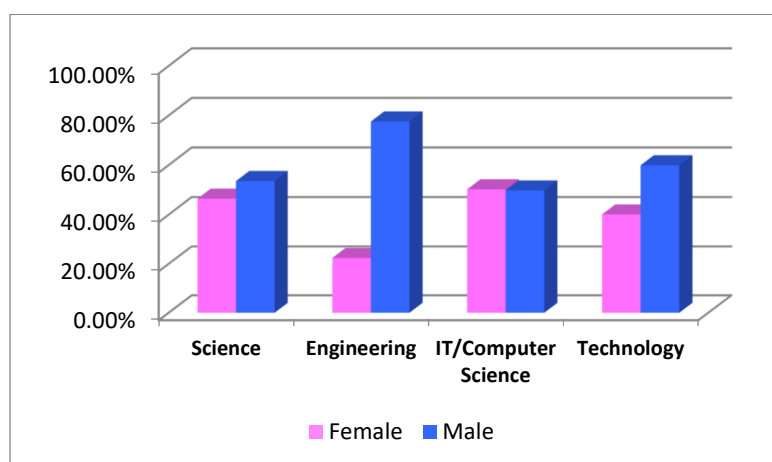


Figure 31: Gender breakdown of university admissions in STEM education 2013–2016

Furthermore, in 2016, the total output of engineering graduates (at Bachelor degree level) in Sri Lanka was 1,617, of which only 388 (24%) were women.⁶⁴ In addition, the total output of engineering postgraduates in 2016 was 360, with only 90 (25%) females graduating at this level.⁶⁵

⁶³ The seven main universities in Sri Lanka have been considered for the analysis (Universities of Colombo, Moratuwa, Sri Jayewardenepura, Paradeniya, Kelaniya, Ruhuna and Jaffna).

⁶⁴ UGC statistics (2016) at <http://ugc.ac.lk/downloads/statistics/stat_2016/Chapter%204.pdf> at 85.

⁶⁵ UGC statistics (2016) at <http://ugc.ac.lk/downloads/statistics/stat_2016/Chapter%204.pdf> at 85.

One of the main reasons for women in Sri Lanka having such a small share of the overall number of patents is their significant under-representation in admissions and outputs in patent-intensive fields such as engineering. On the one hand, the widespread cultural perception in Sri Lanka is that certain fields are masculine (i.e. leading to more difficult jobs), and the consequence is that females are in the minority in the field of engineering. On the other hand, as this perception starts at an early age, parents show their lack of understanding and encouragement of what an engineering career involves, thus having a significant impact on the secondary school subject choices made by girls. These perceptions reinforce women's lower representation in fields such as engineering, which, in turn, is likely to lead to fewer female inventors seeking patents in Sri Lanka.

Gender disparity exists in senior academic positions and in enrolments by academics in higher degree courses in STEM fields

The gender imbalance in senior academic positions in STEM fields in the Sri Lankan higher education sector also results in female academics comprising a small portion of patent holders. As shown in Figure 32, fewer women occupy senior academic positions, with most women located at the bottom of the institutional status hierarchy. Despite women having greater representation than men at the lowest level, they are under-represented at senior levels.

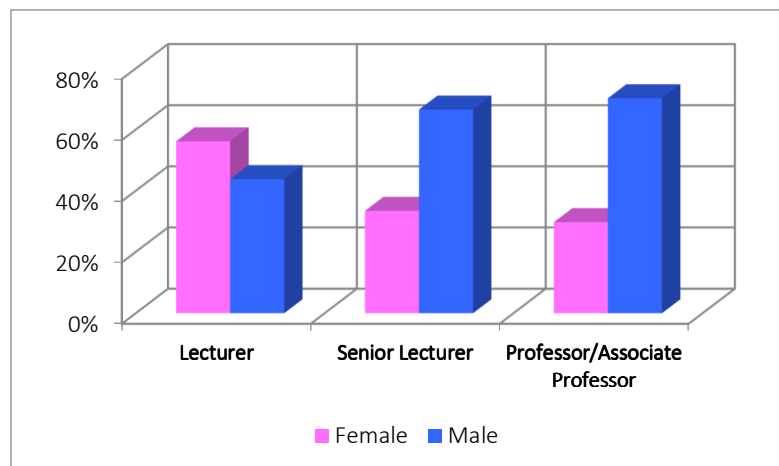


Figure 32: Women's representation in senior academic positions in STEM education (2016)

Source: Data from University Grants Commission (UGC), Sri Lanka.

At the same time, enrolment in advanced degrees by female academics in Sri Lanka is also significantly lower than for male academics even though women have greater representation than men at the lowest hierarchical level. Figure 33 below demonstrates the gender patterns of doctoral completion by female academics in the higher education sector, with fewer women holding PhDs as their careers progress. Conversely, men are more likely to hold doctoral qualifications as they make progress in their own academic careers.

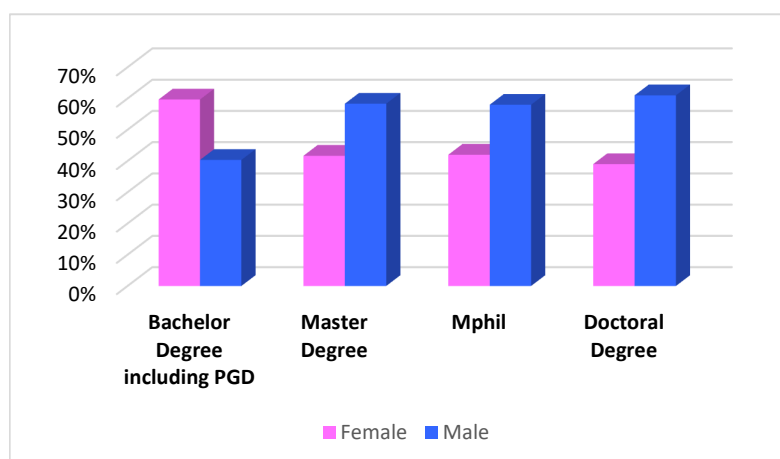


Figure 33: Teaching staff by academic qualifications and gender (2013–2015)

Source: Data from University Grants Commission (UGC), Sri Lanka.

Note: PGD=postgraduate diploma

The under-representation of women in senior academic positions and higher degree courses evidently indicates that women experience barriers to progressing their careers to achieve success. Innovations and patents are generally driven by advanced education. Researchers are defined as ‘professionals who engage in the conception or creation of new knowledge, products, processes, methods and systems as well as the management of these projects’.⁶⁶ To meet these conditions, an academic generally needs to acquire advanced degrees. Specifically, senior researchers lead more inventions and patent applications in the higher education sector. They have more time to develop broad professional networks with potentially more opportunities for routine interaction or collaboration with industry and, hence, the production of viable research.⁶⁷ However, female participation in these areas is lacking in the higher education sector with the result that less research is produced by women and, consequently, fewer inventions and fewer patent applications are made by female academics in Sri Lanka.

Social and cultural barriers to women becoming inventors

As evidenced by the findings of the primary survey, one of the most significant challenges faced by women in all studied sectors in conducting patent–incentive research and having their inventions patented and commercialised is the inability to stabilise their work–life balance. Sri Lanka is inherently a male-dominated society

⁶⁶Women in Science, (2015) at <<http://unesdoc.unesco.org/images/0023/002351/235155E.pdf>> at 4.

⁶⁷ Perkmann (et al.) 2013. ‘Academic engagement and commercialization: a review of the literature on university–industry relations’, quoted in Margaret E. Blume-Kohout, ‘Understanding the Gender Gap in STEM Fields Entrepreneurship’ (2014) at <<https://pdfs.semanticscholar.org/bcff/f0334d935079f4d50a82784d38c5a9d04939.pdf>>.

with women viewed primarily as care-givers.⁶⁸ Women are expected to marry, raise children and manage a household. As a result, unequal gender roles in the domestic division of labour persist, with women still expected to maintain the greater responsibility for most household tasks, including the care of children, even though they now also work full-time. The retention by women of the major responsibilities for caring and domestic work while pursuing full-time careers decreases the preparedness of female researchers to be involved in patent-incentive innovations. In fact, it has been identified that most female scientists at the outset of their careers find it difficult to achieve their research targets, which include scientific publications and patent filing ‘as they have to divide their time between their family and their career’.⁶⁹

In addition, social barriers play an adverse role in relation to the potential and career prospects of female scientists in Sri Lanka. In particular, as ‘their male counterparts have more freedom to move in the scientific community’, ‘they can easily form links with other parties that assist them to climb up their social ladder, while a large proportion of women scientists lack this opportunity.’⁷⁰ As a result, female scientists who ‘happen to do it in their own time and the hard way’, take a longer time to reach the same level as their male counterparts.⁷¹ Traditional and cultural ethics in Sri Lanka also hinder women from taking part in research projects that involve extensive fieldwork and laboratory work at late hours.⁷² The unequal participation of women in scientific research due to the social and cultural barriers they face is a driver for the lesser representation of women in patenting in Sri Lanka, providing one of the most intuitive explanations of the gender disparity in patent inventors.

Less research and development investment in research

A strong correlation is evident between research and development (R&D) inputs and patents. Even 70 years since gaining independence, Sri Lanka, in comparison to other neighbouring countries that were also colonies of the British Empire, still lags far behind in innovations than its more dynamic South Asian counterparts. For example, Sri Lanka was ranked 90th of 128 countries in the Global Innovation Index (GII) in 2017, a drop of five places compared with the GI in 2015.⁷³ Sri Lanka’s gross expenditure on research and development (GERD) is low compared to many countries in the world (Figure 34).

⁶⁸ Hutchings K (et al), Examining Sri Lankan Professional Women’s Perceptions of their Opportunities to Undertake International Careers: *Implications for diversity among cross-cultural managers* (2016) *International Journal of Cross Cultural Management* 16 (1) 77, 82.

⁶⁹ National Science Foundation, The Current Status of Women Scientists in Sri Lanka (NSF, 2010) 8.

⁷⁰ National Science Foundation, The Current Status of Women Scientists in Sri Lanka (NSF, 2010) 9.

⁷¹ National Science Foundation, The Current Status of Women Scientists in Sri Lanka (NSF, 2010) 9.

⁷² National Science Foundation, The Current Status of Women Scientists in Sri Lanka (NSF, 2010) 9.

⁷³ The Global Innovation Index 2017: Innovation Feeding the World at < http://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2017.pdf>.

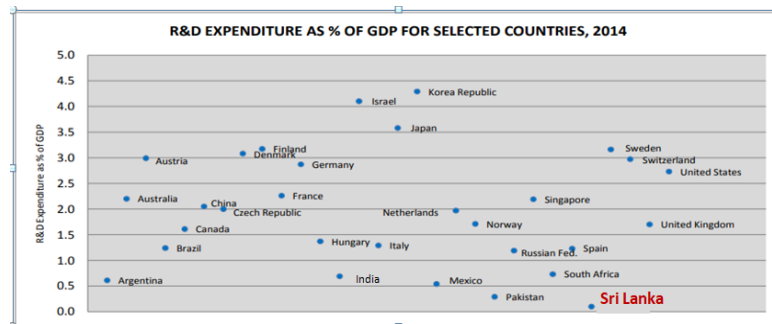


Figure 34: R&D expenditure as percentage of GDP for selected countries (2014)

Source: adapted from National Science and Technology Management Information System (NSTMIS)⁷⁴

The GERD, as a percentage of the gross domestic product (GDP), has declined over recent years. For example, the rate of R&D activities remains very low in Sri Lanka, with only 0.1% of GDP being invested in R&D in 2014, the lowest recorded in Sri Lanka since independence.⁷⁵ Of this 0.1%, only around 11% was spent by universities, while the rest was spread equally between government research institutions and businesses.⁷⁶ Figure 35 below highlights that, in Sri Lanka, the allocation of GERD as a percentage of GDP has been declining over the years from 1996–2014.

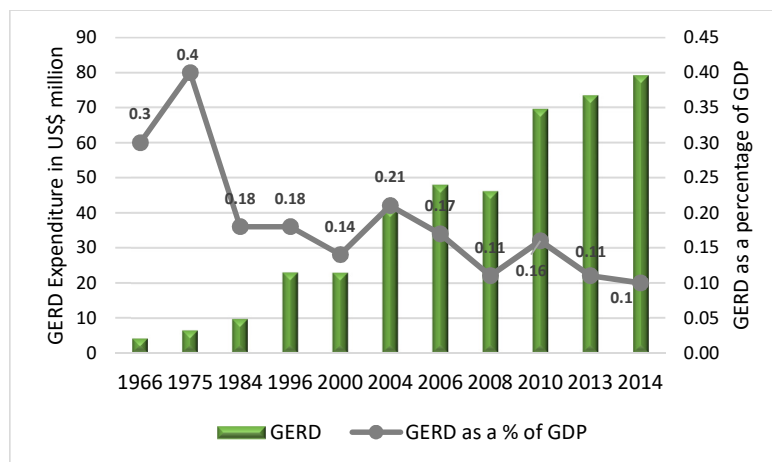


Figure 35: GERD spending (1996–2014), Sri Lanka

Source: Adopted from National Science Foundation (NSF) (2014) (latest report)

Innovation is generally driven by funding. The lack of R&D funding to universities and other sectors that continue to comprise only a small portion of the total R&D

⁷⁴ The WIRE, India's R&D Spending Up but It is Not All That Matters' at <<https://thewire.in/science/indias-rd-spending-not-matters>>.

⁷⁵ Sri Lanka Science, Technology and Innovation, Statistical Handbook, (2014) at iv.

⁷⁶ Getting R&D right at <<http://www.ft.lk/ft-view/Getting-R-D-right/58-640902>>.

investment certainly leads to fewer patents. In fact, universities having no dedicated budget for research is one of the major problems for the higher education sector in Sri Lanka. Of the recurrent allocations to universities, it is noted that:

around 75% is spent on remunerations including salaries and overtime; around 15% on public utilities such as water, electricity and telecommunication. Another 5% is spent on security, postage and the like. Thus only 5% of the recurrent vote is available to support academic programs, which leaves hardly any funds for research.⁷⁷

Women's powers of innovation in Sri Lanka are certainly not reflected in the number of patents granted. The lack of R&D investment in research excludes women from developing their careers and thereby from the contribution they could make to the industrial research carried out in universities and research institutions.

Fewer female scientists in Sri Lanka

According to the 2010 National Science Foundation (NSF) statistical handbook, of 2,140 full-time researchers in Sri Lanka, only 39% were women. Among full-time and part-time researchers, the NSF identified 3,256 male and 1,906 female R&D scientists.⁷⁸ According to the *2014 Sri Lanka Science, Technology & Innovation Statistics*, the number of male R&D scientists was 2,945, while the number of female R&D scientists remained at 2,479.⁷⁹ Although this difference does not appear to reflect a gender bias against women, the disparity between male and female R&D scientists in the disciplines of engineering and technology calls for more attention. As stated in the *2014 Sri Lanka Science, Technology & Innovation Statistical Handbook*, the number of male R&D scientists in the engineering and technology disciplines was 713, while the number of female R&D scientists in these fields was only 334, not even half the number of male R&D scientists.⁸⁰ The significant gender disparity that exists among scientists in the engineering and technology disciplines in Sri Lanka has resulted in lesser representation of women in patenting.

⁷⁷ Senaratne R, 'Creating Vibrant Research Culture and Rich Intellectual Ambience in SL Universities', *The Island*, 10 March 2015.

⁷⁸ Sarathchandra D, 'Where are the Sri Lankan Female Scientists?: A case of Democratizing Science' <<https://groundviews.org/2014/07/11/where-are-the-sri-lankan-female-scientists-a-case-of-democratizing-science/>>.

⁷⁹ National Science Foundation, *2014 Sri Lanka Science, Technology & Innovation Statistical Handbook* (NSF, 2017) 21.

⁸⁰ National Science Foundation, *2014 Sri Lanka Science, Technology & Innovation Statistical Handbook* (NSF, 2017) 21.

Complexity of patenting process and patent costs

A large percentage of survey respondents in this study indicated that the complexity of the patenting process and patent costs were one of the largest barriers they faced in patenting their innovations.⁸¹ The National Intellectual Property Office (NIPO) of Sri Lanka is entrusted with the task of granting patents in response to applications by the inventors or owners of the inventions. However, this involves a lengthy and complex process.⁸² The inventor needs a detailed technical understanding of their invention and to provide NIPO with a full, clear, exact description of the invention particularly highlighting and distinctly identifying what the inventor believes they have invented. For example, granting a patent involves the following multifaceted procedure.⁸³ A patent application must be made to the Director General of NIPO in the prescribed form as stipulated in Regulation No. 32(1). This includes preparing the patent application and associated paperwork, that is, drafting the patent application; the client's disclosure; patent drawings; a power of attorney/declaration of inventorship form; an information disclosure statement (if required); and filing the application and associated papers. The entire process is a specialised task that requires both legal and scientific skills. It is very difficult for a layperson to draw a patent specification in a science field without field-specific scientific knowledge.⁸⁴ The underlying complexity of both the technological and legal processes in the patenting process poses many challenges to applicants. It has been said that, while 'Sri Lanka will over time evolve to similarly having specialist patent lawyers with qualifications in both a field of science, and law, and experience in both areas', 'in the meantime, Sri Lanka needs to address its lack of patent drafting skills'.⁸⁵

Not surprisingly, these complicated procedures lead inventors to face the prospect of whether they should hire a patent practitioner. If the applicant seeks the assistance of a patent attorney, even though this can certainly reduce the risk of serious mistakes, it adds substantially to the cost of a patent application. Sri Lanka has approximately 200 patent attorneys, who usually charge a minimum of Rs100,000–Rs150,000 (approximately US\$600–\$1,000) depending on the invention's complexity and the size of the entity filing the application. In addition, in accordance with the *Intellectual Property Act 2003*, if the patent grant application is by a student of a school, a technical or other similar college or a university undergraduate, the prescribed fee is usually about Rs1,000. When the application is by any other individual, the prescribed fee is about Rs2,500; if it is by other entities, the prescribed fee is about Rs6,000. The patent amendment fee is about Rs1,000. Most survey respondents, especially in the industry sector, believed that the cost of

⁸¹ They were one of the largest barriers faced by all groups consulted during the survey and interviews, irrespective of the respondent's gender.

⁸² While Chapter XIII of the *Intellectual Property Act No.36 of 2003* deals with the 'Requirements of Application and Procedure for Grant of a Patent', the Regulations made by the Minister under section 204 of the Act deal with the prescribed form, fees and other requirements pertaining to application and grant of a patent.

⁸³ Karunaratna DM, *Elements of the Law of Intellectual Property in Sri Lanka* (Sarasavi Publishers, 2010) 147.

⁸⁴ Mendes P, Integrating Intellectual Property into Innovation Policy Formulation in Sri Lanka (WIPO, 2015) 34.

⁸⁵ Ibid at 34.

a patent application was one of the major barriers to patenting; it is highly likely that they were also referring to the patent attorney's fee.

The complexity of the patenting process and patent costs create a less than hospitable environment for inventors seeking patents in Sri Lanka. Female inventors face a lack of knowledge and lack of organisational help in navigating the patent process, whereas male inventors either have the knowledge to do it themselves or receive advice through their networks. The complexity associated with the patenting process, the patent costs and the lack of a centralised government body through which women could obtain support in applying for a patent act as barriers for female inventors.

Lack of research grants/government funding for research

Securing research grants for scientific research has become one of the major barriers faced by all researchers and scientists in Sri Lanka, irrespective of their gender. A large percentage of male and female survey respondents from both academic and industry sectors indicated that they lacked research grants and government funding to carry out patent-incentive research. This impediment was identified by survey respondents, both academics and scientists in the industry sector, as the first and second barrier, respectively. More importantly, without funding, women were more reluctant to engage in risk-taking innovation activities than their male counterparts. In particular, some female academics indicated that, although they have various innovative ideas, many have failed due to lack of funding. In addition, female respondents claimed that they were less likely to be awarded research funding when applications were assessed, especially in scientific/engineering grant applications. For example, with disproportionate numbers of female academics remaining in low-level positions, there are fewer grants for which they can apply and receive than for those at the academic level. Moreover, as women have long been under-represented at the senior level of scientific research in the industry sector, obtaining research funding is additionally difficult for them. The lack of research grants thus leads to fewer women participating in patenting.

Lack of mentoring, sponsoring and networking for women at both academic and industry levels

Most female survey respondents felt that having a mentor would make a difference in overcoming the challenges they faced along the way from developing a successful innovation through to patenting their invention. However, the female scientists in both academia and industry indicated that they have greater difficulty in acquiring mentors and sponsors to the same extent as their male colleagues. As previously discussed, female academics continue to be under-represented in senior positions and in completing higher degrees at higher rates than their male counterparts; therefore, female academics are at a disadvantage when it comes to accessing high-level mentorship and sponsorship. On the other hand, the industry sector in Sri Lanka is dominated by men, with fewer women in decision-making

positions in scientific organisations, thus preventing women from wielding greater influence with their seniors to develop networks and make industrial contacts.

Lack of collaborative R&D activities between industry and higher education sectors

Collaboration between universities and industry is critical for R&D, access to funding, patenting and commercial activities. In 2005, the UGC introduced a commission circular promoting university–industry collaborations in which it granted one-year’s leave to senior university academics to work in any industrial establishment.⁸⁶ In 2014, the government of Sri Lanka introduced a mechanism of a triple tax deduction for an industrial organisation if it collaborated with universities in conducting research.⁸⁷ However, as highlighted in Figure 36, those in the industrial sector have mainly engaged only with their own company, with some collaborations with their parent company. Collaboration with other institutions, including universities, was relatively infrequent.

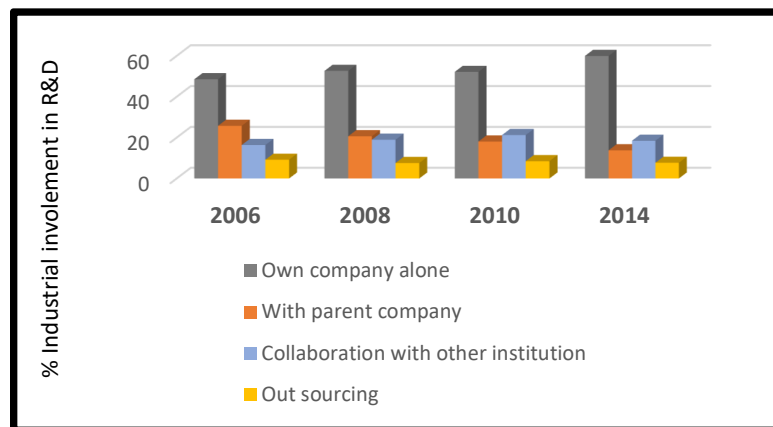


Figure 36: Industrial sector involvement with other institutions in conducting R&D and innovative activities (2006–2014)

Source: Adapted from National R&D surveys in Sri Lanka (2014)

The Global Competitiveness Index of the World Economic Forum 2018 ranks Sri Lanka behind other countries in university–industry collaboration in R&D.⁸⁸ De Silva argues that it has been difficult to promote university–industry collaborations in Sri Lanka, partly due to the absence of an overall university policy or support mechanisms to promote academic entrepreneurship.⁸⁹ Hence, ‘the majority of existing links between Sri Lankan universities and companies are short-

⁸⁶ Malik K & Wickramasinghe V, ‘Initiating University-Industry Collaborations in Developing Countries’ at <https://www.researchgate.net/publication/289368026_Initiating_university-industry_collaborations_in_developing_countries>.

⁸⁷ University Grants Commission – Sri Lanka at <www.ugc.ac.lk/>.

⁸⁸ World Economic Forum, ‘The Global Competitiveness Report 2017–2018’ Insight Report at 272–273.

⁸⁹ Malik K & Wickramasinghe V, ‘Initiating University-Industry Collaborations in Developing Countries’ at <https://www.researchgate.net/publication/289368026_Initiating_university-industry_collaborations_in_developing_countries>.

term, informal interactions with low direct transfer of knowledge and innovation'.⁹⁰ Collaborative research activities with industry are vital for any researcher, in general, and for women, in particular, as women in Sri Lanka have lower levels of engagement in formal technology transfer, and in patenting their inventions than their male colleagues.

Poor intellectual property rights management system

Obtaining a patent through NIPO consumes a great deal of time – approximately two to four years, or more. Lack of resources at NIPO contributes to the delay in granting patents. While the office 'employs approximately 60 staff, almost half of which are engaged in the trade mark area', '[o]nly 6 members of staff are engaged in the patent area'. Of those six staff members, 'the number of examiners ranges at different times from two to three'.⁹¹ Furthermore, a former Director General of NIPO has stated that, while NIPO is doing its best, it is 'not equipped to meet the needs of all the areas of technology'.⁹² As the office facilities 'are comparatively bare,' '[i]t is not fair to compare the offices such as the US and UK with those of Sri Lanka or of the countries of the level of development similar to Sri Lanka'.⁹³ In addition, it should be noted that NIPO does not have an online application mechanism; applicants are encouraged to submit in person, although applicants can be submitted by post. As can be seen, the procedure adopted for granting patents in Sri Lanka suffers from several defects and drawbacks. It has been observed that:

in practice the patent system [in Sri Lanka] is quite underdeveloped compared to other developing countries in the region. For example, the applicability of the substantive examination is not in line with other jurisdictions. Also, it does not entertain pre-grant or post-grant opposition as in many other developing patent systems.⁹⁴

Unfortunately, the long delays in obtaining approvals for patent rights for their products has put Sri Lankan innovators at a disadvantage, allowing overseas competitors to obtain patents for inventions for similar products before they are able to do so.⁹⁵ One survey respondent, a Sri Lankan inventor from the higher education sector, argued that 'I have about 18 inventions and only a few have got patent rights. It takes years to develop a product, but it takes more time to get the patent rights. Often by the time we get the patent, the invention is not an invention any more'.⁹⁶ The growing backlog of unexamined applications and inordinate delays in granting

⁹⁰ Larsen K (et al), *Promoting University-Industry Collaboration in Sri Lanka: Status, Case Studies, and Policy Options* (World Bank Group, 2016) 37.

⁹¹ Mendes P, *Integrating Intellectual Property into Innovation Policy Formulation in Sri Lanka* (WIPO, 2015) 26.

⁹² Sirimanna B, 'National Intellectual Property Office Has Limited Resources to Grant Patents', *The Sunday Times*, 07-08-2011.

⁹³ Ibid.

⁹⁴ Perera A, 'Administration of the Patent System in Sri Lanka: A Critical Appraisal' (2014) 43 *Comm L World Rev* 344, 375.

⁹⁵ Warakapitiya K, 'Inventors Losing Patience over Patents' (2015)

at <<http://www.sundaytimes.lk/151004/news/inventors-losing-patience-over-patents-166776.html>>.

⁹⁶ Ibid.

patents pose obstacles for Sri Lankan inventors and discourage those who wish to patent an invention.

Lack of awareness of patenting

Many respondents to the survey felt that they lacked knowledge on obtaining intellectual property rights (IPRs) for their inventions. Of the survey respondents, 66% from both the academic and industry sectors asserted that they knew very little about IPRs and intellectual property (IP) commercialisation (see Figure 37).

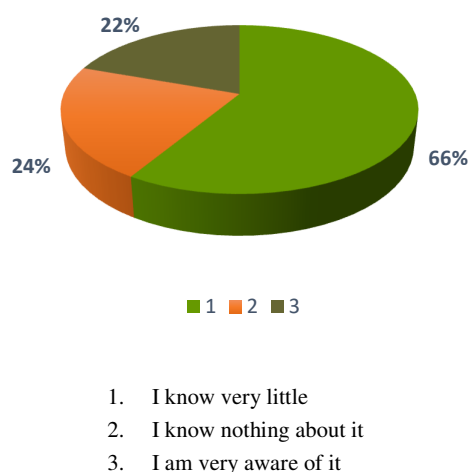


Figure 37: Knowledge of IPRs and IP commercialisation

The lack of awareness of the value of patents is a significant challenge faced by many Sri Lankan inventors in general, but especially Sri Lankan women inventors, as it restricts them from gaining patents for their inventions. Female survey respondents indicated a lack of knowledge of key patent information such as patent disclosure, changes in patent ownership, patent licensing and technology transfer. This is evident because very few female inventors and proprietors of small and medium-sized enterprises (SMEs) are focused on generating licensing revenues in Sri Lanka. In addition, most small inventors, such as SMEs, do not see the benefit of using the IP system.

Lack of clear rules on ownership of intellectual property rights in universities and business sectors

An institutional IPR framework is essential in acknowledging and recognising how the ownership of research conducted by staff is distributed between various individual staff members and institutions. As universities have no clear rules on the ownership of IPRs at their institution (i.e. individual ownership or organisational ownership), university inventors can apply for patents by themselves (individually).

The main reason is that Sri Lankan universities do not provide clear guidance or impose obligations on their employees for how the ownership of patent rights and IPRs developed in the course of their employment is to be distributed. As found in this study's analysis, the higher education sector in Sri Lanka had the lowest representation in patenting, in part due to the lack of emphasis placed on the rules for IPRs ownership in academia. The absence of a clear set of rules at the institutional level for inventors' IPRs, for the benefits from research results and for inventors' responsibilities to respect confidentiality where appropriate, also discourages collaborative research with industry partners where ownership of rights is crucial.

Teaching oriented academics with less focus on research

All academics in Sri Lankan universities are required to carry out both research and teaching; however, Sri Lankan universities have always had a low level of R&D and commercialisation activities. One of the main reasons for this is that the primary duty of these institutions is teaching rather than research.⁹⁷ The perception of the university academics, too, is that, while teaching is their priority, research and commercialisation of such research are only of secondary importance.⁹⁸ Also, human capital at Sri Lankan universities 'is overstretched to teaching undergraduates who are admitted to the university system in large numbers year after year without improving educational facilities.'⁹⁹

Academics in Sri Lanka usually undertake 5–10% of research of their academic workload. The Sri Lankan Ministry of Higher Education officially recognises 15 universities as being under the control of the UGC, with these universities having a total academic staff strength of about 8,000,¹⁰⁰ including around 625 professors (only 186 of whom are women) and approximately 3,000 senior academics.¹⁰¹ Nevertheless, in 2014, only 841 peer-reviewed journal articles were published by the higher education sector in Sri Lanka (54 were published in local journals and 787 in international journals),¹⁰² a level of publication which is abysmally low. To be specific, only 10 academics in every 100 published one article per annum. In contrast, the total number of academics in a developed country such as Australia usually publish around 20,000 journal articles per year. The research output can

⁹⁷ Larsen K (at el), Promoting University-Industry Collaboration in Sri Lanka: Status, Case Studies, and Policy Options (World Bank Group, 2016) 4.

⁹⁸ Mendes P, Integrating Intellectual Property Into Innovation Policy Formulation in Sri Lanka (WIPO, 2015) 28.

⁹⁹ Wijewardena WA, 'SME: Universities, Research Institutions as Catalysts of an Innovation Economy' <<https://www.colombotelegraph.com/index.php/sme-universities-research-institutions-as-catalysts-of-an-innovation-economy>>.

¹⁰⁰ This includes Professors, Associate Professors, Senior Lecturers, Lecturers and other academic staff, both permanent and temporary academics.

¹⁰¹ UGC data.

¹⁰² Sri Lanka Science, Technology & Innovation, Statistical Handbook (2014), All the departments and faculties in the Sri Lankan state university sector; 15 national universities with 80 faculties, 3 campuses and 494 academic departments were taken for the assessment, see Thuraiyappah Pratheepan & W. A. Weerasooriya, 'The Publication Output and Impact of various Faculties in Sri Lankan Universities: a Scientometric Assessment and Policy Implications' (2015) 19 (1) Journal of the University Librarians' Association of Sri Lanka 54-70.

certainly be considered as a valid and useful tool in the evaluation process of university R&D performance.¹⁰³ Moreover, in Sri Lanka in 2010, only 11% of R&D expenditure was carried out by universities, compared to 45% by government research institutions and 44% by business enterprises.¹⁰⁴ Academics in Sri Lanka have become so disinterested in research that most do anything but R&D.¹⁰⁵ The lack of a research culture in the Sri Lankan higher education sector is often an influence on the scarcity of female participation in patents, as the amount of research undertaken affects the number of women who are involved in inventing. Innovation is difficult to measure at the individual level, and scholars use patents as a proxy.¹⁰⁶

Lack of successful female innovators as role models

The lack of successful female innovators as role models in Sri Lanka is also a factor in female under-representation in engineering and technology. Sri Lanka has a small pool of successful female innovators to act as role models for younger women to inspire them to be successful in innovation. The specific trend in Sri Lanka is that many women choose medical sciences as opposed to physics or engineering, due to their early childhood dreams of becoming doctors, as well as negative stereotypes, cultural perceptions and societal expectations. Female role models would certainly encourage women to pursue careers in the male-dominated engineering and technology fields in Sri Lanka.

Lack of collaborative research with male colleagues

As shown in the data analysis undertaken in this study, the proportion of patents granted to all-male teams of inventors (61%) is far greater than that of patents granted to all-female teams or mixed-gender teams, with only 29% and 9%, respectively. Obviously, the driver for male inventors to work as members of all-male teams leads to less female participation in collaborative research. In any attempt to improve female involvement in innovation activities, a higher level of male–female inter-gender collaboration in research is important.

Lack of institutional support for women

Female academics who participated in the survey especially had the view that they lacked support within their workplace institution, indicating that this had a strong negative effect on their ability to enrol in higher degrees and to move up the academic ladder with a focus on research. A similar pattern was also experienced by female respondents in government, semi-governmental and private-sector institutions. The lower representation of women in patenting does not necessarily equate to attrition but is partly due to the non-provision of an environment that is

¹⁰³ Weerasooriya WA, 'The Publication Output and Impact of various Faculties in Sri Lankan Universities: a Scientometric Assessment and Policy Implications' (2015) 19 (1) *Journal of the University Librarians' Association of Sri Lanka* 54, 56.

¹⁰⁴ Larsen K (et al) 'Promoting University-Industry Collaboration in Sri Lanka Status, Case Studies, and Policy Options' (2016), The Report Prepared for The World Bank at 4.

¹⁰⁵ Getting R&D Right at <<http://www.ft.lk/ft-view/Getting-R-D-right/58-640902>>.

¹⁰⁶ Hunt J (et al), 'Why Don't Women Patent?' (2012) Discussion Paper 6886 at 2.

supportive of higher female involvement in patent activities. Whittington and Smith-Doerr found that women are more likely to patent their inventions in more flexible network-based organisational structures than in hierarchical organisations in both academia and industry.¹⁰⁷ The productivity among women in academia who are mothers, especially, depends not on individual dedication but on factors that vary from institution to institution.¹⁰⁸ Studies have suggested that, when mothers are given supportive structural opportunities, they can produce at the same rate as women without children.¹⁰⁹ In Sri Lanka, traditional and cultural aspects related to women are rooted deeply in people's minds, with many institutions lacking gender sensitivity, which is also an impediment to women's progress in innovations.

Lack of economic incentives and rewards

A large percentage of survey respondents in both the academic and industry sectors strongly asserted that economic incentives and rewards are not provided either by the government or by their employers to encourage innovations. This was viewed as a disincentive for innovators to engage in innovating, since inventors are unable to recover their own costs of innovation, such as R&D costs. No formal mechanism is available in Sri Lanka to reward innovators, which is a further factor in dissuading them from innovating.

CHAPTER 6

Barriers to intellectual property commercialisation

The process of commercialising intellectual property (IP) involves bringing the innovation (the product) and its inherent IP to the market so it can be commercially exploited. In broad terms, this process comprises two stages: (1) invention and (2) innovation. In the first stage (i.e., invention), a scientist or researcher comes up with a prototype of a new product or service; in the second stage (i.e., innovation), an enterprising person (entrepreneur) converts that prototype into a commercially viable product or service.

No research studies in Sri Lanka have specifically examined women's participation in IP commercialisation process. However, in general, studies of women's involvement in the fields of science and technology, and enterprise reveal that their active participation in entrepreneurship is relatively low. This is well evidenced by the observation that most of the patents granted to women inventors have never

¹⁰⁷ Whittington and Smith-Doerr, 'Gender and Commercial Science: Women's Patenting in the Life Sciences' (2005) 30 *Journal of Technology Transfer* 355-70, quoted in Colette Henry, Teresa Nelson, Kate Lewis, The Routledge Companion to Global Female Entrepreneurship.

¹⁰⁸ Henley MM, 'Women's Success in Academic Science: Challenges to Breaking through the Ivory Ceiling' (2015) 9 (8) *Sociology Compass* 668-680.

¹⁰⁹ Whittington 2011; Whittington and Smith-Doerr 2008, quoted in Henley MM, 'Women's Success in Academic Science: Challenges to Breaking through the Ivory Ceiling' (2015) 9 (8) *Sociology Compass* 668-680.

been commercialised. The main reason is that women patent holders face numerous barriers to the commercialisation of their inventions. The next section presents examples of barriers that prevent inventions patented by women from leading to commercially feasible enterprises.

Inadequate access to finance and available start-up capital for women

In this study, most female survey respondents stated that finding access to finance was, without doubt, one of the major reasons that there were fewer women involved in IP commercialisation in Sri Lanka. Women's access to finance is significantly constrained, and this barrier is higher for women establishing a new business. To provide credit to businesspeople and entrepreneurs seeking loans, commercial banks often demand collateral. This requirement is one of the most common practices amongst banks, and it has been conveniently carried forward over time.¹¹⁰ Without collateral, it is difficult for banks to assess the applicant's financial records;¹¹¹ as a result, commercial banks often refuse loan finance to female inventors.

Land is the most commonly offered form of collateral for loans to small to medium enterprises (SMEs) in Sri Lanka.¹¹² However, in Sri Lanka, as most family properties are registered in men's names, it is difficult for women to provide personal security for a bank loan for a business. Further evidence comes from Sri Lanka's Women's Chamber of Industry and Commerce, which reported that a critical constraint faced by some women entrepreneurs was their inability to secure personal security for bank loans. Further, guarantors were often not willing to sign on their behalf.¹¹³ In addition, many of the female inventors interviewed stated that financial institutions had the perception that women would fail and be unable to repay the loan from their income-generating activities. For example, the female entrepreneurs interviewed reported that, when they formally approached banks for financing, bank officials tended to ignore them in meetings; they also refused to accept other women as guarantors. The women inventors who have participated in this study believe that financial institutions lack the appetite to support businesses owned by women.

¹¹⁰ Nanayakkara G, 'Enhancing the Capacity of Banks to Shaping Development of SMEs' (2011) *Studies Postgraduate Institute of Management* 35, 35-36.

¹¹¹ Nanayakkara G, 'Enhancing the Capacity of Banks to Shaping Development of SMEs' (2011) *Studies Postgraduate Institute of Management* 35, 35-36.

¹¹² Gamage P, 'Bank Finance for Small and Medium-Sized Enterprises in Sri Lanka: Issues and Policy Reforms' *Studies in Business and Economics* (2015) at 37.

¹¹³ Women's Chamber of Commerce and Industry, 'Fostering Women's Entrepreneurship in the SME Sector in Sri Lanka (2015) *Policy Advocacy Working Paper*.

Socio-cultural norms and perceptions that prevent the acceptance of women as entrepreneurs

Most women inventors in Sri Lanka have not commercially exploited their patented inventions. The country's societal values emphasise women as primary carers and inspire women to focus on family needs. For example, marriage and family commitments necessitate women distancing themselves from economic activities, such as commercialisation of research and successful entrepreneurship. In fact, despite a woman's professional, educational and social status, the choices of her family or spouse often limit her opportunities to act on her individuality and ambitions.¹¹⁴ In certain instances, religious beliefs and views also prevent women from actively participating in financial, political and economic systems.¹¹⁵ Overall, acceptance of women as entrepreneurs, and confidence in their abilities, is still low in Sri Lanka, where women are less likely to engage in entrepreneurial activities.

Lack of development banks and venture finance companies for women

Another barrier to IP commercialisation by women is a lack of development banks and venture finance companies that provide microfinance facilities to women inventors. As observed earlier, women inventors often face considerable challenges in gaining access to financial resources. While costly and limited financial access is a common phenomenon for all small- and medium-scale entrepreneurs in Sri Lanka, especially in the case of rural entrepreneurs, almost all the investment finance comes from internal sources – private commercial banks play a very limited role.¹¹⁶

As research at the international level has identified, '[a]ccess to capital is a critical issue for women-owned small businesses. Without sufficient capital, small firms are unable to develop new products and service or grow to meet demand.'¹¹⁷ While insufficient liquidity is a frequently cited cause for small business failure, unlike larger publicly held firms, small firms typically cannot access the traditional capital markets.¹¹⁸ As a result, 'small firms are heavily dependent on bank loans, trade credit, and "informal" sources of financing such as personal savings, credit cards, home equity loans, and loans from family and friends'.¹¹⁹ While acquiring capital and dealing with financial institutions is particularly difficult for women business owners, the reasons for this situation include factors such as the small size of most

¹¹⁴ Randika D, 'Young Sri Lankan women need to take the lead in the economy', available online at <<http://www.ft.lk/article/474091/Young-Sri-Lankan-women-need-to-take-the-lead-in-the-economy>>.

¹¹⁵ Ibid.

¹¹⁶ Pretheeba P, 'Creating a Conducive Environment for SME's in Sri Lanka' 3(2) *Wayamba Journal of Management* 44, 50.

¹¹⁷ Lee SS & Denslow D, 'A Study on the Major Problems of US Women-Owned Small Businesses' (2004-2005) *Journal of Small Business Strategy* 77, 78-80.

¹¹⁸ Ibid at 78-80.

¹¹⁹ Ibid.

women-owned firms,¹²⁰ lack of financial sophistication,¹²¹ risk aversion,¹²² and possible discrimination.¹²³

Due to the inadequacy of the traditional banking system to cater to the equity and liquidity needs of female entrepreneurs in the SME sector, to succeed in commercialisation of their inventions, the women entrepreneurs in this sector will inevitably have to resort to providers of microfinance and venture capital facilities, such as development banks and venture finance companies. There are very limited development banks and venture capital companies in Sri Lanka,¹²⁴ however, these organisations are inadequate to serve the demand for their services.

Inadequate incentives to research commercialisation

The lack of sufficient incentives and support leads to innovation leakage and a lack of interest from researchers, especially from women. Although women make up 57% of the total estimated population (21 million) in Sri Lanka, female labour force participation (FLFP) was 36% in 2016 (down from 41% in 2010), resulting in Sri Lanka having the 14th-largest gender gap in labour force participation globally. Men's participation remained above 75% during the same period.¹²⁵ Of the economically inactive population in 2017, 26.2% were males and 73.8% were females.¹²⁶ It is clear that there is an extreme necessity to provide sufficient and appropriate encouragement for women, via incentives for women to actively participate in the economy by commercialising their research. However, survey respondents in this study stated that, although women inventors might gain honour and recognition for their inventions through awards and other forms of appreciation from various quarters, no effective incentives or rewards exist – from either the government or non-government sector – to encourage women inventors to commercialise their inventions.

Lack of inventor-friendly organisations or innovations hubs to boost women-led innovations

Research commercialisation is a complex process. Patented products in particular must be continuously improved to become economically marketable. While a couple of organisations have been established to support Sri Lankan inventors (e.g., the Sri Lanka Inventors Commission), their focus is inventors in general rather than women inventors in particular. It is important to note that women inventors encounter peculiar issues and problems which could be different from those

¹²⁰ Ibid.

¹²¹ Ibid.

¹²² Ibid.

¹²³ Ibid.

¹²⁴ Central Bank of Sri Lanka, 'Guidelines on Opening of New Banks in Sri Lanka' (April 2018) 3, see also Atapattu A, 'State of Microfinance in Sri Lanka' (Institute of Microfinance, 2009) 28.

¹²⁵ Unlocking Women's Potential in Sri Lanka's Labor Force, (2017) at <<http://www.worldbank.org/en/news/feature/2017/11/15/unlocking-womens-potential-sri-lankas-labour-face>>.

¹²⁶ Sri Lanka Labour Force Statistics Quarterly Bulletin (2017) at <http://www.statistics.gov.lk/samplesurvey/LFS_Q3_Bulletin_WEB_2017_final.pdf>.

encountered by male inventors. For example, the socio-cultural boundaries prevent the majority of women from participating in industries and commercial enterprises. Moreover, some survey participants in this research believe that being a woman is itself an obstacle in the process of invention, not just the commercialisation of the invention. Most women in Sri Lanka are lacking relevant technical, scientific, business, academic and industry networks, which are significant factors in successful commercialisation. The absence of inventor-friendly organisations or innovations hubs in Sri Lanka specifically devoted to helping women inventors to identify and facilitate the commercial viabilities of their research and development (R&D) projects, and to feed women's findings into the market, is identified as a further barrier to women commercialising their research.

Lack of central framework in universities and research and development (R&D) institutions for research commercialisation

Universities all over the world, as part of their role in producing and disseminating knowledge, are expected to play a larger role in industrial innovation.¹²⁷ This expectation remains far from the reality in Sri Lanka. One key reason for that outcome is that policymakers and planners in Sri Lanka have not paid sufficient attention to formulating policies, plans and procedures to commercialise research and introduce research outcomes to the market.

While all universities in Sri Lanka recognise the importance of research and commercialisation of the research output, particularly the commercialisation of intellectual property rights (IPRs), the legal framework governing universities in Sri Lanka has created uncertainty as to whether the universities have a proper legal mandate to engage in such activities. In addition, it is also uncertain whether universities in Sri Lanka can set up a company and seek the capital to run it.¹²⁸ Ambiguity pertaining to IPR regulations and ownership rules in relation to commercialisation is one of the major factors affecting research commercialisation in Sri Lanka. In particular, the *Universities Act No. 16 of 1978* (as amended) which deals with the establishment, maintenance and administration of universities and other higher educational institutions, does not explicitly refer to R&D activities or research commercialisation. Although it may be possible to argue that universities have the power to engage in R&D under section 29(t) of the act (which gives them the mandate to do all such other acts and things that are incidental to the powers conferred by the act) and commercialise IPRs under section 28(1) of the act (which confers them with separate legal personality, together with broad powers to acquire and dispose of property that will encompass the power to enter into commercialisation contracts, particularly licensing of intellectual property), many have pointed out that ambiguity remains. For example:

¹²⁷ Etzkowitz H (et al), *The Future of the University and the University of the Future: Evolution of Ivory Tower to Entrepreneurial Paradigm* (2000) 29 *Research Policy* 313–330

¹²⁸ Ibid at 30.

In Sri Lanka, there is uncertainty as to whether universities have the legal right to commercialize intellectual property rights. The University Act of 1978, section 29, stipulates that the main mission of universities is teaching and education. The act hardly mentions university research activities, and nothing is included about research commercialization.¹²⁹

It is evident that there is no uniform comprehensive university policy that deals with IP and research commercialisation, although few institutions have recently come up with their own individual policies.¹³⁰ In addition, there seem to be conflicting policies with regard to ownership of IPRs, particularly amongst government agencies and research-funding institutions. For instance, while the 'National Science Foundation reports that its grant conditions vest the ownership of intellectual property arising from research it funds, in the grantee', the 'Ministries of Higher Education and Health report that the intellectual property arising from research they fund, vests in the Ministry itself'.¹³¹ As has been observed, '[n]urturing an innovation system is hindered if policies amongst different Ministries and government agencies are not uniform and consistent, acting together to achieve the common objective'.¹³²

Lack of linkages between universities and industry

The linkages between universities and industry in Sri Lanka are woefully inadequate with regard to research commercialisation. Several factors have contributed to this situation. One of the main reasons is that, as indicated earlier, the *Universities Act No. 16 of 1978* (as amended) is too vague on IP commercialisation. Also, as discussed above, another uncertainty that affects universities' linkages with industry is whether universities can set up a company and seek the capital to run it.¹³³ Further, it is also considered that university research centres do not conduct in-house R&D activities that attract the support of industry. Limited research collaboration between universities and industry has negatively affected researchers' ability – regardless of their gender – to establish contacts in their efforts to commercialise.

¹²⁹ Larsen K (et al), Promoting University-Industry Collaboration in Sri Lanka: Status, Case Studies, and Policy Options (World Bank Group, 2016) 29.

¹³⁰ The University of Moratuwa (UOM) is 'one of the few universities in Sri Lanka that has an Intellectual Property Policy and a Commercialization Policy'. The Intellectual Property Policy of the University of Moratuwa approved by the Council at its 346th meeting held on 06-01-2010 (annexed) deals with important matters regarding IPR in general and patents in particular, such as ownership, disclosures, IP protection, technology transfer, revenue sharing, infringements and liability, and, the process and policy on resolution of any dispute, see P Mendes, *Integrating Intellectual Property Into Innovation Policy Formulation in Sri Lanka* (WIPO, 2015) 46, also see their Policy on Product Commercialisation at <<https://www.mrt.ac.lk/web/sites/default/files/ipac/files/Commercialization%20Policy.pdf>>.

¹³¹ Mendes, *Integrating Intellectual Property Into Innovation Policy Formulation in Sri Lanka* (WIPO, 2015) 32.

¹³² Ibid.

¹³³ Larsen K (et al), Promoting University-Industry Collaboration in Sri Lanka: Status, Case Studies, and Policy Options (World Bank Group, 2016) 30.

Lack of support and incentives from government to commercialise research

One of the main contributors to women not commercialising their research in Sri Lanka is that the government provides no concessions, exemptions, incentives or encouragement for them to do so. This is particularly the case in the academic and business sectors. Although government has recently taken quite a few initiatives to support inventors in general to commercialise their research, these are applicable to all inventors, not just women; they are too general, and inadequate. For instance, as per para 216 of Budget Proposal 2017, the government has allocated budgetary provisions to the Sri Lanka Inventors Commission for the establishment of the Innovation Accelerator Funding Mechanism to assist in the commercialisation of inventions which are capable of contributing to the growth of the national economy.¹³⁴ Although government institutions provide various types of support services to entrepreneurs in the SME sector, along with other administrative functions, the government's overall institutional framework does not provide adequate support for women in particular. The absence of a clear-cut policy and strategy on SME development at the national level has contributed to the poor quality of institutional support for women to commercialise their research.

Legal barriers and complicated business start-up processes

Legal barriers and complicated business start-up processes in Sri Lanka also adversely affect IP commercialisation in the country. Critical to research commercialisation is the market entry stage, in which each step and procedure must comply with the complex laws and regulations. The time and cost involved in the overall business start-up are also key to a smooth and effective market entry, which in turn has an impact on the enterprise's potential to commercialise research outcomes. It has been stated that an entrepreneur in Singapore can start a business within '03 days with 03 procedures'; however, an entrepreneur in Sri Lanka needs 35 days for such a start-up.¹³⁵ The main reason for this delay is that Sri Lankan authorities (e.g., Central Government, provincial councils and local authorities), tax regulations at the different levels of government, government bureaucracy and strict labour regulations pose increasing challenges and delays for start-up businesses in Sri Lanka.

Insufficient infrastructure at both academic and industry sectors for commercialisation of research

As shown from the secondary data analysis in Chapter 3 of this report, the total number of patents granted in Sri Lanka between 2010 and 2017 was less than 550, with research institutes generating only 13% of the total patents. The inadequate laboratory facilities and infrastructure at academic and industry sectors have

¹³⁴ Sri Lanka Inventors Commission at <<http://slic.gov.lk/en/>>.

¹³⁵ Pretheeba P, 'Creating a Conducive Environment for SME's in Sri Lanka' 3(2) *Wayamba Journal of Management* 44, 46.

become a major constraint to IP commercialisation and opportunities for collaborating with industry.¹³⁶ In the 2015 Study on University Industry collaboration in Sri Lanka, more than 70% of surveyed academics stated that ‘the facilities available in their departments – particularly laboratory facilities – are inadequate for research.’¹³⁷ Despite many universities having purchased equipment utilising funds made available through two projects funded by the World Bank (Improving Relevance and Quality of Undergraduate Education, or IRQUE, and the Higher Education for the Twenty First Century Project, or HETC Project), the situation seems to have deteriorated further, partly due to the lack of financial resources to repair and maintain laboratory equipment.¹³⁸ The lack of infrastructure for commercialisation of research is predominantly apparent in both academic and industry sectors.

Lack of understanding of technology transfer and licensing

This study discovered that very few individuals have engaged in research commercialisation. In particular, academics are completely separate from commercialisation of their research. The main reason for this situation is that the majority of the research initiated or carried out in Sri Lanka is not viable or relevant for commercialisation, mainly because of a lack of understanding of industry requirements:

Many reasons can be attributed for there being no takers for this industry relevant research ... [t]he most important of course, is that the majority of Sri Lankan enterprises with their meager resources similar to those in other developing countries are not willing to gamble with new, untested developments. Even large industries with unlimited finances may prefer to obtain research developments from their international collaborators or from other foreign sources.¹³⁹

Although technology transfer and licensing would contribute to solving this issue, there is an acute lack of understanding of technology transfer and licensing amongst the researchers in Sri Lanka, particularly women inventors.

Lack of common understanding of the value of research commercialisation

Most researchers and inventors in Sri Lanka lack a common understanding of the value of research commercialisation. Some are even unaware of the importance of obtaining IP rights. It has been said that ‘due to the lack of knowledge on the importance of obtaining IP rights for inventions and innovations great deal of local

¹³⁶ Larsen K (at el), *Promoting University-Industry Collaboration in Sri Lanka: Status, Case Studies, and Policy Options* (World Bank Group, 2016) 15.

¹³⁷ Ibid at 38.

¹³⁸ Ibid at 11.

¹³⁹ Pieris NM, ‘Commercialization of Research, Fact or Fancy? – The ITI Story’, Proceedings of the National Seminar on Intellectual Property Rights and Commercialization of Research (Colombo, 24 November 2000) 2.

inventions have been commercialized in other countries without paying any Royalty to the inventors.’¹⁴⁰ Most of the time, scientists and researchers in Sri Lanka invent to gain honour and fame, rather than with the goal of becoming entrepreneurs who commercialise their inventions. This is particularly so amongst women inventors. As the survey revealed, excepting women inventors who were already entrepreneurs when they made their inventions, most women did not make use of their inventions in any commercial enterprise. Most fail to appreciate that, for their invention to be used effectively, it needed to be commercialised, which required entrepreneurs to use the invention in their commercial enterprises. As the survey revealed, excepting women inventors who were already entrepreneurs when they made their inventions, most women did not make use of their inventions in any commercial enterprise. Most fail to appreciate that, for their invention to be used effectively, it needed to be commercialised.

Fear of commercialising

As the existing research in the field has identified, female participation in entrepreneurship is substantially lower than male participation.¹⁴¹ Recognising that women have less propensity to engage in entrepreneurship, a ‘key contributor to one’s propensity for entrepreneurship is [the] self-confidence levels in entrepreneurial abilities (entrepreneurial self-efficacy).’¹⁴² As Fielden et al. submitted, ‘a lack of confidence is perhaps the greatest barrier to women’s progression into micro and small business ownership, which inhibits all aspects of their entry into business.’¹⁴³ While it has been highlighted that:

Men tend to be more confident than women across a number of fields and in various research settings’, with regard to ‘entrepreneurship specifically, men have historically had a stronger career preference for entrepreneurship, although this may be changing over time with increasing numbers of women now starting businesses.’¹⁴⁴

In Sri Lanka, many women refrain from attempting to commercialise their inventions, because they believe that being a woman is a barrier to such endeavours. This lack of confidence in women inventors – who may also suffer from a ‘fear of failure’ mentality – impedes risk-taking, a key element of entrepreneurship. Fear also manifests as a barrier amongst academics – irrespective of their gender – who

¹⁴⁰ Tillekeratne LMK, ‘Intellectual Property Rights and Commercialization of Local Inventions and Innovations’, Proceedings of the National Seminar on Intellectual Property Rights and Commercialization of Research (Colombo, 24 November 2000) 1.

¹⁴¹ Kirkwood J, ‘Is a Lack of Self-Confidence Hindering Women Entrepreneurs? (2009) 1(2) *International Journal of Gender and Entrepreneurship* 118-133.

¹⁴² Ibid at 118-133.

¹⁴³ Fielden SL (et al), ‘Factors Inhibiting Economic Growth of Female Owned Small Businesses in North West England (2003) 10(2) *Journal of Small Business and Enterprise Development* 152, 166 in Kirkwood J, ‘Is a Lack of Self-Confidence Hindering Women Entrepreneurs? (2009) 1(2) *International Journal of Gender and Entrepreneurship* 118-133.

¹⁴⁴ Ibid.

are concerned that taking a commercial interest in their research will jeopardise their career, since commercial interests are not encouraged by universities.

Lack of technical and business knowledge/experience

Many survey respondents – irrespective of gender – indicated that one of the biggest barriers to research commercialisation is that they do not have the technical and business skills and experience to facilitate commercialisation. As the World Bank has noted in its report on ‘Building the Sri Lankan Knowledge Economy’:

Sri Lanka’s researchers do not have the expertise to commercialize their research findings. When Sri Lankan researchers publish their works, nothing is done to commercialize them. Some of these findings could potentially be developed into commercial products but because of a lack of entrepreneurial skills and drive, ‘thousands of valuable findings in many disciplines that could have given birth to new enterprises promoting industrial growth and economic development in the country, are gathering dust on the shelves of libraries’.¹⁴⁵

Commercialising research requires entrepreneurship, the success of which more or less depends on business acumen. It has been stated that ‘knowledge or invention alone is a lame duck incapable of delivering prosperity. For knowledge to be effectively used, there should be entrepreneurs who would use that knowledge in viable commercial enterprises.’¹⁴⁶ While the task of inventing essentially requires technical knowledge, putting that invention to industrial use and making it a viable commercial enterprise also requires business knowledge. In fact, one key reason for most of the patents in Sri Lanka, particularly those granted to women inventors, not being commercialised is that the inventions lack technical sophistication, which makes them unworthy of commercialisation. Technical and business skills are required throughout every stage of the commercialisation process:

commercialization of research is a difficult and steep process with many travails along the way. These can only be overcome if the right mix of requirements is in place from the very beginning where the research idea is conceived right up to the point of commercialization and conversion to a marketable product.¹⁴⁷

Obviously, in creating this mix, it is essential to have a sound knowledge of the inherent technical and business elements. As revealed from the survey, this, indeed, is what most women inventors and entrepreneurs in Sri Lanka seem to lack.

¹⁴⁵ The World Bank, Building the Sri Lankan Knowledge Economy (World Bank, 2008) 48.

¹⁴⁶ Wijewardena WA, ‘SME: Universities, Research Institutions as Catalysts of an Innovation Economy’, available on line <<https://www.colombotelegraph.com/index.php/sme-universities-research-institutions-as-catalysts-of-an-innovation-economy/>>.

¹⁴⁷ Pieris NM, ‘Commercialization of Research, Fact or Fancy? – The ITI Story’, Proceedings of the National Seminar on Intellectual Property Rights and Commercialization of Research (Colombo, 24 November 2000) 3.

CHAPTER 7

Case studies

This chapter presents two case studies of Sri Lankan women who have successfully commercialised their invention and creation, respectively. The case studies illustrate the particular challenges and barriers these women faced, as discussed in Chapter 6, and the strategies they used to overcome them.

Case study 1: Anusha¹⁴⁸

Ms Anusha is a Sri Lankan woman inventor who created a mixture for decorating cake structures, for which she obtained patent rights from the National Intellectual Property Office (NIPO) in 2013. While traditionally icing sugar is the main ingredient in cake decorations, Anusha, after an eight-year experimentation phase, invented a sugar-free mixture that uses cornflour as the main ingredient.

Anusha had identified certain problems associated with the traditional method of sugar-based cake decorations. One of the major issues was the damage that the different weather conditions could cause to these decorations. In particular, during the rainy season, variations in room temperature could cause the decorations to get wet and become spoiled. In dry or sunny weather conditions, they would dry out and tend to break. Anusha's invention is not prone to these problems. Cornflour-based decorations can be safely used during both the rainy and dry seasons, without being damaged, with the result that they last longer – which also makes her product more environmentally friendly than its traditional alternative.

Another problem with traditional sugar-based decorations is their potential to attract insects such as flies, ants and even cockroaches, and their vulnerability to damage when this occurs. Further, during the rainy season, the icing sugar mixture can give rise to a bad odour – particularly if it comes in contact with insects. According to Anusha, these problems were her major motivation to find an alternative. She said:

My husband and children persuaded me to find something new, mainly because, during the rainy season when the icing got wet, there was a bad smell all over, and all sorts of insects like ants, flies and cockroaches came into my house as a result. It was so difficult for all of us to bear with this smell.

Anusha went on to say, 'We had to heat the decorations during the rainy season and they were also needed to be stored in proper places like cupboards, which took a lot of space in our house.' This has had an impact on her electricity bill, as the decorations had to be kept at a stable temperature. Overall, the creation of sugar-

¹⁴⁸ A pseudonym has been used.

based cake decorations was a costly affair for which a solution was urgently needed: ‘these problems called me to think of something new which could be used instead of icing sugar.’ Hence Anusha’s cornflour-based invention, which is produced at a lower cost than its traditional sugar-based alternative.

Anusha, aged 52, was born in Galle and moved to Kandy after her marriage. Her husband is a retired army officer, and she is the proud mother of two adult daughters. She completed her secondary education at Southlands College in Galle, and attended the University of Sri Jayewardenepura. Anusha won several national and international awards in recognition of her invention, including the national Sahasak Nimavum Award in 2014, the President’s Award in 2016 and the Silver Medal at the Geneva Salon International des Inventions in 2016. The International Federation of Inventors’ Associations stated that ‘though the world has widely used icing sugar mixed flowers and creations to decorate cake structures, now it has become a global trend for this special corn flour mixed decorations without icing sugar which was introduced by her innovative talents and skills.’¹⁴⁹

Even prior to her invention, Anusha was a small-scale entrepreneur. She started her business of making cake decorations at a micro level, at the time using the traditional icing sugar mixture. The business grew as she began to make wedding cake structures, train others in making cake decorations, and participate in cake-decorating competitions. Although Anusha’s invention provided impetus and scope for the development of her enterprise, it still operates as a sole-proprietor small-scale business. Anusha’s initial capital investment was about Rs.250,000, obtained as an interest-free loan from the Regional Development Bank under the sponsorship of the Government of Sri Lanka. After settling this loan, she obtained another, of Rs.500,000. The business does not own expensive physical assets: vehicles are hired to transport and distribute the cake decorations, as needed. However, the Regional Development Bank has advised Anusha that she could ask for a loan of up to Rs.8 million, and intimated that it would be prudent for her to purchase a vehicle for business use.

Although Anusha’s invention, and the patent in respect of that invention, brought her invaluable advantages and benefits both economically and socially, they appear to have also helped her to overcome barriers to the expansion of her business. Anusha remarked that she received economic benefit from her invention and patent. For example, her cornflour-based icing sugar mix is more cost-effective than the sugar-based alternative; it creates savings of about 90% of the cost of cake-decorating, as its production cost is much lower. Socially, the invention and the patent brought her honour and recognition, nationally as well as internationally. She says that ‘being an innovator is an honour. People honour me when they identify me as an inventor.’

¹⁴⁹ Sri Lankan Women Inventors, Innovators and Entrepreneurs at <<https://www.ifia.com/news/sri-lankan-women-inventors/>> (22 June 2018).

However, according to Anusha, because of the patent, she is unable to involve more people in her business, as she has to run it as a sole proprietorship: 'I cannot get other people into my business because there is a patent. If other people would get [to] know about it, I would not be able to get the benefits of it.' Anusha's misunderstanding is an example of the barriers discussed in Chapter 6, such as lack of understanding of IP rights, licensing, and lack of technical and business knowledge.

As a woman, Anusha faced problems and obstacles in the process of inventing, patenting and commercialising her new cake-decorating mixture. The experimentation that culminated in her invention began in 2005. While she invested considerable time in the experimentation phase, her lack of English fluency was a burden – she used dictionaries to help her understand the information she found on the internet and from other sources. Although Anusha's application for the patent in respect of her invention was lodged with the NIPO in 2010, it was not granted until 2013. While her family members, particularly her husband and mother, helped her immensely in the process of obtaining the patent, she received little support from other stakeholders. She did not consult a lawyer on her patent application, since the fees were exorbitant for her: the applicable lawyer fees at the time were around Rs.60,000 (approximately US\$400).

Other issues Anusha faced in her business include acts of unfair competition and threats from rival businessmen. At the time of writing, she was not selling her cake decorations to shops, due to a threat made by a businessman – however, she did intend to resume. According to Anusha, a Sri Lankan academic has tried to pay her out, offering to purchase her patent for Rs.50 million. While Anusha wants to expand her business to the international markets, there are obstacles. She said she does not have the necessary capital, investment and resources to carry out an export business. Although she has sought help and assistance from offices of the Government of Sri Lanka to capture international markets with her invention, so far she has not received any positive responses. She said:

I have sent products manufactured through the use [of] my invention to France, on my own initiative. But I need help to do it as an export business. I am also sending my products to the United Kingdom through my sister who is living there. Although I [would] like to export my products, I cannot do that because there are rules and regulations. I do not have the necessary expertise nor the competencies to conduct an export business. But I [would] love to do that.

Anusha is of the view that, if somebody were willing to take her invention to the international market, she would be willing to sell her patent to them. Commenting on the plight of women as inventors and entrepreneurs, Anusha states that 'being a woman is the biggest issue'. She further opines:

I am hoping to sell my business someday rather than let my daughters to continue with it because I know as a woman what I had to face and undergo. I do not want my daughters to face what I had to face.

Anusha's story is evidence of the barriers discussed in Chapter 6; for example, Anusha would have benefited from initiatives or organisations to support women to commercialise their inventions. To conclude, if Anusha's daughters do indeed take a similar road, it could well be made easier if the barriers their mother faced were addressed first. The establishment of incentives and programs to encourage women inventors and help them to build their knowledge and confidence; helping women to establish networks; and making it simpler for women to access legal and other assistance at the start-up stage may contribute to their success – and challenge the socio-cultural norms that prevent women from becoming entrepreneurs.

Case study 2: Padma¹⁵⁰

Ms Padma, aged 51, created a novel infant garment used to weigh infants at clinics. A widow with three school-aged daughters, Padma gave up her job in private enterprise to care for her mother. Padma had studied commerce and had always had a knack for business, and an interest in starting her own. Unsatisfied with her work making children's clothes, Padma realised the worth of an infants' garment that a midwife had commissioned her to make. She had initially made the garment for free, as a community service. After the birth of her first daughter, she realised that the few garments the hospital had were being shared amongst all the infants who needed to be weighed. Concerned for the babies' hygiene and safety, Padma had the idea to produce more of the garments, this time for sale.

With the help of several midwives, she produced a few garments, which led to orders from other midwives. In this way, the venture took off – Padma's orders increased, and she now employs two part-time staff members. In the operation of her business, Padma came to realise that others had duplicated her product but made mistakes in the production that made the garment unsafe to use. Deciding that her product needed to be manufactured appropriately, Padma sought some type of licence or authority for her creation. One of her schoolmates was a deputy director in the Ministry of Health (MOH) in Kegalle, and helped Padma to obtain a design registration from NIPO. Padma began by indicating to the MOH that she wanted to apply for an industrial design registration to protect her product, which had a commercial use, from being copied. The MOH, in turn, drafted a letter acknowledging the product's usefulness and value. Padma delivered this letter to NIPO, which assisted her to obtain the registration for her design. With NIPO's friendly assistance, she submitted her application 2009 and received her registration in 2012. The process to obtain the registered design had taken some time. She had to travel to Colombo (a three-to four-hour bus ride from her home) about three times

¹⁵⁰ A pseudonym has been used.

to check the status of her application. Padma believes that the approval process should have been faster.

Padma is a member of the Industrial Development Board and the Sri Lanka Chamber of Small and Medium Industries. From what she has seen and experienced to date, no one has been able to help her to promote the use of her registered product in Sri Lanka. In Padma's opinion, even though her product is registered, she received no assistance to commercialise her product on a large scale. If she did, her small-scale business would be able to move forward.

Padma has faced a few challenges. She obtained the necessary start-up capital through personal loans from local money lenders, who charged interest. Banks rejected her loan applications. Padma faces other financial difficulties, such as balancing her small-scale production – that is, she needs to purchase and store enough supplies to meet her orders, but she does not always receive timely payments for her invoices. Payment delays that lead to delays in her ability to buy supplies can adversely affect the delivery of subsequent orders. Padma also faces the challenge of other people trying to copy her product and take over her business.

Padma received no training, from either the Sri Lankan government or private institutions, in relation to her garment production. The design was her own. Padma started the business, her only source of income, and is running it as a solo enterprise. She uses the income to manage her daily expenses and her children's expenses, and to fund the community work that she undertakes. She has not received any awards or wider recognition for her creation. Padma believes her product is beneficial to the community. Her methodical production of the weighing garment ensures the safety of infants. She has received many positive product reviews and is happy and content with her product's reach. Her friends commend her for supporting her family in the face of adversity. However, Padma has made many sacrifices to get to where she is now and believes that, had she received the necessary support, she would have been able to contribute to society on a better and larger scale.

CHAPTER 8

Recommendations

Recommendation 1

Establish a government 'National Innovation Hub (NIH)' for women to monitor their progress through patenting to commercialisation. The hub should be staffed with expert helpdesk personnel who can freely assist women researchers and entrepreneurs to address the key challenges involved in filing for patents, and transforming patents into novel market-ready products, processes or services. The hub, by identifying new projects and developing proposals, would also assist

women scientists to transform innovative ideas into tangible outcomes, and help women innovators to convert concepts into economically viable products.

Recommendation 2

Initiate an ‘Innovative Compensation Scheme (ICS)’ to provide an incentive for employee inventors through the granting of financial and non-financial benefits to those who develop or successfully market a new concept, product, process or procedure. Benefits could include (a) monetary compensation, such as increasing the inventor’s annual salary by a nominal percentage, or providing a lump sum payment, (b) benefits and perks, such as career advancement/promotions, research allowances, commercialisation sabbaticals, or overseas research-related training, or (c) recognition of successful innovations by prestigious national awards.

Recommendation 3

Build in an in-house ‘Technology Transfer and Commercialisation Unit (TTC Unit)’ at each university and research and development (R&D) institution that can assist its researchers with handling intellectual property, licensing institutional innovations to the commercial sector, sharing royalties, and establishing relationships with industries. The TTC Unit would encompass a mandatory supervisory panel of experts who ensure that research projects with commercial potential in their institution have every opportunity to move through the commercialisation process. The panel should also work with industry partners to convert research outcomes into marketable products or services while promoting researchers’ endeavors. The TTC Unit can likewise provide technical and legal assistance for researchers, especially for women researchers at institutional levels, in drafting and filing patent applications. Particularly, first-time applicants should be given assistance to increase their chances of success, as most scientists in both academic and industry sectors indicated that they lacked patent drafting and filing skills.

Recommendation 4

Establish a ‘Credit Guaranteed Funding Scheme for Women’ backed financially by the government to open up economic opportunities for women inventors who are largely deprived of support from formal-sector financial institutions. The scheme would introduce collateral-free loans, micro-credit loans and low-or no-interest loans for women inventors, the majority of whom do not have access to credit facilities. It would over-ride discrimination against women in formal credit markets. The overarching aim of the Credit Guaranteed Funding Scheme for Women would be to assist women to obtain loans for research commercialisation for which they may not otherwise qualify.

Recommendation 5

Allocate more public funding to both universities and R&D institutions to boost home-grown innovations, and for those innovations to become commercially successful. The lack of public funding to both universities and R&D institutions represents the biggest barrier to patenting in Sri Lanka. An increase in investment in public funding in science and R&D (the current level of total investment in R&D is 0.1% of GDP) is essential to effectively stimulate innovation in Sri Lanka and to translate research into commercial products, irrespective of the researcher's gender.

Recommendation 6

Introduce mentoring programs for women researchers at both academic and industry levels, to assist women to succeed in patenting and commercialising. The mentors would facilitate expert advice, networking opportunities, collaborative research opportunities and sponsorships, and especially encourage women scientists to build self-confidence. Cross-gender and cross-organisation mentoring should be encouraged. Mentoring programs must also facilitate capacity-building programs for women scientists and innovators, to provide technical skills and training in product development and marketing.

Recommendation 7

Launch career counselling programs in schools, to help promote girls' equal access to education in science, technology, engineering and mathematics (STEM). Career counselling and mentoring programs to encourage girls to study STEM subjects at schools and universities, and/or to take up apprenticeships in STEM professions, would address Sri Lanka's gender gap in STEM fields, and, in turn, in patenting.

Recommendation 8

Promote annual 'Innovation Boot Camps' and regular 'Innovation Trade Expos' for women inventors to spread the word about their inventions and find sponsors to launch their inventions into the market. The boot camps would assemble teams of experts who can develop a platform for women scientists, innovators and entrepreneurs to nurture their best ideas for innovative and commercial opportunities. The boot camps should also feature expert presentations on fundamental entrepreneurship skills, including identifying opportunities. Trade expos would provide women with the chance to demonstrate their ideas and present products to potential investors and licensing companies.

Recommendation 9

Amend the *Universities Act No. 16 of 1978* to uniform universities' regulations on intellectual property rights (IPRs), including IPR ownership, revenue sharing, licensing and technology transfer. This would address the lack of clarity around whether the legal framework gives academics the mandate to engage in research

commercialisation, and around academics filing for patents as individuals rather than as representatives of their institutions. Universities should also introduce mandatory assignment of inventions, in which scientist employees must agree to disclose all potentially patentable inventions. The changes should also remove the red tape on income generating commercial activities undertaken by the research staff of universities. Clear and uniform IPR guidelines would promote the recognition, protection and exploitation of potentially valuable intellectual property produced by its researchers, including women.

Recommendation 10

Establish a national ‘Patent Licensing Academy (PLA)’ for women in Sri Lanka, to assist individual women inventors to license their patented products to a third party who would be responsible for the cost of manufacturing and marketing the products, on agreed terms. The PLA would assist the women patent holders who lack knowledge of licensing, and the time and money required to license a product. The academy would also assist women inventors to identify potential licensees, and negotiate the terms of a licence.

Recommendation 11

Provide incentives for women inventors through a national reward system. Government policies must support women’s innovations by providing rewards that have the potential to encourage and motivate women towards creativity, innovation and entrepreneurship.

Recommendation 12

Run programs, workshops and seminars at both academic and industry sectors to promote the importance of intellectual property (IP) in fostering a creative and innovative culture. Greater awareness of IP and entrepreneurship would encourage women innovators in Sri Lanka, and help them to develop the necessary skills and mindset to commercialise their inventions. The similar programs can also be conducted by the NIPO for women.

Recommendation 13

Teach secondary school and university students about IP, and its potential to generate income and economic growth. IP education could be incorporated into existing curricula or form a completely new subject. It would foster creativity and innovation spirit among young people, irrespective of their gender.

Recommendation 14

Enable more government funding for cutting-edge research equipment and infrastructure and to upgrade laboratory facilities, to develop R&D, science, technological and innovative development.

Recommendation 15

Streamline the patent applications system, employ a greater number of qualified patent officers, and develop an online application system, to decrease the examination backlog and processing delays for patent applications, which would prevent patent holders from missing opportunities while they wait for their request to be granted. Applications should be approved within six to 12 months (as opposed to three to four years).

Recommendation 16

In both universities and R&D institutions, foster a strong culture of research commercialisation, develop entrepreneurial capacity in the research staff, and build pathways to convert ideas into enterprises. This would address the lack of institutional support given to innovators' commercialisation activities.

Recommendation 17

Establish an advisory committee at the University Grants Commission (UGC). The committee should comprise experienced personnel with industry experience, involve all stakeholders, enable close collaboration between universities and industries, measure the level of engagement between universities and industries, and develop a measure of research that leads to commercialisation.

Recommendation 18

Establish a 'Small Business Administration Centre for Women' to provide financial, technical and management assistance to small companies owned by women. The centre would also provide business counselling, marketing and promotional assistance, capacity-building, and networking opportunities with like-minded entrepreneurs and women business leaders.

Recommendation 19

Publish and disseminate case studies of successful women entrepreneurs who have turned their inventions into marketable products, who could also serve as role models or ambassadors for other women inventors.

Recommendation 20

Establish a government-designed and-funded platform to facilitate women's access to business premises.

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