The Leadership of Women in STEM Education: A Study of Engineering Institutions in Delhi

Ph.D. Thesis Submitted

in Partial Fulfillment of the Requirements for the

Degree of

DOCTOR OF PHILOSOPHY

in

ECONOMICS

by

Japji Kaur

(2K20/PhDHUECO/01)

Under the Supervision of

Prof. Seema Singh

(Professor of Economics)

Department of Humanities

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

Shahabad, Daulatpur, Bawana Road, Delhi-110042, India

OCTOBER, 2024

DELHI TECHNOLOGICAL UNIVERSITY
Sahbad Daulatpur, Main Bawana Road
Delhi-110042 (India)

DECLARATION

I hereby declare that the thesis work entitled "The Leadership of Women in STEM Education: A Study of Engineering Institutions in Delhi" my original work was carried out under Prof. Seema Singh's supervision. This thesis has been prepared in conformity with the rules and regulations of Delhi Technological University, Delhi, India. The research work presented and reported in the thesis has notbeen submitted either in part or whole to any other University or institute for the award of any other degree, diploma, or other qualifications.

JAPJI KAUR
Roll No: 2K20/PHDHUECO/01
Department of Humanities
Delhi Technological University, Delhi (India)

DELHI TECHNOLOGICAL UNIVERSITY
Sahbad Daulatpur, Main Bawana Road
Delhi-110042 (India)

CERTIFICATE

This is to certify that the thesis titled, entitled "**The Leadership of Women in STEM Education: A Study of Engineering Institutions in Delhi**", submitted to the Delhi Technological University, Delhi, in fulfillment of the requirements for the award of degree of Doctor of Philosophy in Economics is an original research work carried out by **Miss Japji Kaur** with roll number 2K20/PHDHUECO/01 under my supervision. To the best of my knowledge, the matter presented in the thesis has not been submitted elsewhere in part or fully to any University or Institute for the award of any degree.

Prof. Seema Singh
Professor of Economics
Department of Humanities,
Delhi Technological University
Delhi-110042 (India)
(Supervisor)

ACKNOWLEDGEMENT

I extend heartfelt gratitude to God and Guru Nanak for their blessings throughout my research. Specialthanks to my guide, Prof. Seema Singh, for her invaluable guidance, motivation, and constant support through thick and thin. I am thankful to the Humanities department and the HoD for the support. I'm also grateful to all the research scholars who have helped me every time I needed assistance relatedto my research work. My deepest appreciation to my parents, friends, colleagues, and respondents fortheir unwavering support.

Japji Kaur
Roll No: 2K20/PHDHUECO/01
Department of Humanities
Delhi Technological University, Delhi (India)

DELHI TECHNOLOGICAL UNIVERSITY
Sahbad Daulatpur, Main Bawana Road
Delhi-110042 (India)

ABSTRACT

Science and technology have been considered a male-dominated profession, with women holding fewer leadership positions. They are universally under-represented in STEM (Science,Technology, Engineering, Maths) fields. Despite comprising roughly half of the workforce, women remain a minority in many STEM disciplines, particularly at higher academic levels and leadership positions. Retaining women in education and, hence, careers in science is essential for an economy's national development as they can bring a different outlook for every sphere by making it more diverse and also lead to women's empowerment. The first objective ofthe study is to map gender of the HoD's and assess the gender. The second part of the first objective discusses the poor work-life balance (WLB) of heads. The second objective is to measure the productivity of faculty members and. it across gender, level, and branch. The thirdobjective is to investigate the effect of women's leadership on placements. The fourth objectiveis to evaluate the impact of gender of the leader on the University Social Responsibilty. The fifthobjective is to investigate the gender-wise difference of HoD's in attracting funds from the corporate and government sector. Data has been collected from 127 heads of STEM departments in 20 engineering institutions of Delhi by conducting a census and analyzed with STATA 14.0 and SPSS. The data for the second objective was collected from Google Scholar profiles of 1293 tenured faculty members. Their productivity was calculated by summating the h index, i10, and citations. We employ the probit model given that the dependent variable is binary (above the state average 1, below 0). The average is defined as the average productivity of faculty in all the engineering colleges in Delhi. For each researcher, we determine the difference between their productivity and average.

If a researcher's productivity is above the average, they receive a score of 1; if it is below the state average, they receive a score of 0. Productivity has been taken as the dependent variable, whereas gender, designation, and branch are independent variables. Further, the interaction effect of gender with the rest of the two independent variables has been studied to get a clear pictureof the research productivity in various colleges. The third objective discusses the effect of the gender of the leader on the no. of placements. An independent t-test was used to comparethe means across male and female heads.

The fourth objective discusses higher education institutions' diverse social responsibility initiatives and assesses their impact on stakeholders (present students, future students, supporters, etc.). Social responsibility emphasizes contributions to sustainable development and proactive solutions to societal and environmental challenges. Recognizing universities ascrucial pillars of society, this research explores how they foster socially responsible values in students to cultivate responsible citizenship, which, in turn, focuses on developing the next generationof leaders and industry experts.

Data was collected using semi-structured interviews with 103 heads of STEM (Science, Technology, Engineering, Mathematics) departments in 20 engineering colleges in Delhi, India. Thematic analysis was conducted using QDA Miner Lite.

It discusses the type of USR activities that the students were engaged in, challenges faced in their implementation, and collaborations with the corporates, NGOs, and universities, followed by an assessment of the progress a student undergoes after engaging in a USR activity. It highlights the potential of promoting students' participation in diverse university-based experiences, fostering community engagement, and enhancing their development as professionals and socially responsible citizens. Further, it gives recommendations to achieve environmental sustainability on the part of stakeholders.

The fifth objective discusses the ability of the leader to attract funds from the corporate and government sectors on the gender of the head. The results reveal that work-life balance is significantly different across male and female heads, and there are more male heads in all the20 engineering colleges in Delhi. The productivity differs by gender, designation and branch. It is more in the case of male heads. There are significant differences between male and female heads in the number of placements in a STEM department. The male heads are able to collaborate with the corporates and get them to the universities for placements. The male heads were more engaged into economic and environmental USR activities whereas the female heads were involved into social activities. Male heads are more able to draw funds from the govt. and corporate sector and have a better WLB than the female heads. Further, the study provides suggestions to the stakeholders for increasing more women in leadership positions, enhancingproductivity of faculty, USR activities etc.

List of Publications

1. Work-Life Balance of Women in STEM fields: A Bibliometric Analysis", JIM QUEST,
   Jaipuria Institute of Management. Published by Jaipuria Institute of Management, UGC Care Indexing. (Published).
2. Investigating Work-Life Balance of STEM Leaders in Academia: A Study of Engineering Colleges in Delhi, India", IASSI Quarterly, Institute for Human Development. Published by Institute Human Development, UGC Care Indexing (Published).
3. Factors Affecting Researcher Productivity of Public and Private Universities in the Global South: The Case of Indian Academia, J Kaur, S Singh, Naturalista Campano, 2024, Web of Science (Published).
4. A Bibliometric Analysis of Work-Life Balance in STEM Careers, Journal of Educational Planning and Administration, National Institute of Educational Planning and Administration, UGC Care Indexing (Published)

TABLE OF CONTENT

Title	**Pg No.**
Declaration	i
Certificate	ii
Acknowledgment	iii
Abstract	iv
List of Figures	xi
List of Tables	xii
List of Symbols and Abbreviations	xiii
CHAPTER-1	
1. Introduction	1
1.1 Women Leadership	1
1.2 Importance of Leadership in Women's Empowerment	1
1.3 Intervention by the United Nations for promotion of women in STEM fields	1
1.4 Status of women in STEM leadership	3
1.4.1 International	3
1.4.1.1 Status of women in STEM institutions in South Asia	4
1.4.2 India	9
1.5 Purpose and Significance of the Study	10
1.6 Organisation of the Study	10
CHAPTER-2	
2. Review of Literature	**12**
2.1 Women in STEM Leadership	12
2.2 Leadership and work-life balance	15
2.2.1 Web of Science	16
2.2.2 Scopus	18
2.2.3 Cambridge Score	20
2.2.4 Sage	21
2.2.5 Organisations and the WLB policies	23

2.2.6 Research Dynamics: Insights from all four databases 24
2.3 Research Productivity 26
2.3.1 A view from studies conducted in global South 27
2.3.2 A view from studies conducted in global North 28
2.4 Leadership in academic institutions and employability of students 30
2.5 Leadership in academic institutions and USR activities 30
2.6 Leadership in academic institutions, engagement with the corporate and govt. Sector 31
2.7 Research gap of the study 34

CHAPTER-3

3. Objectives And Research Methodology 35
3.1 Introduction 35
3.2 Objectives of the study 35
3.2.1 Objective 1 35
3.2.1.1 Hypothesis 35
3.2.1.2 Variables 35
3.2.2 Objective 2 35
3.2.2.1 Hypothesis 34
3.2.2.2 Variables 36
3.2.3 Objective 3 37
3.2.3.1 Hypothesis 37
3.2.3.2 Variables 37
3.2.4 Objective 4 37
3.2.4.1 Hypothesis 37
3.2.4.2 Variables 37
3.2.5 Objective 5 37
3.2.5.1 Hypothesis 38
3.2.5.2 Variables 38
3.3 Population Description 38
3.4 Population and sample 39

3.4.1 Data Collection 39
3.4.1.1 Primary Data Collection 40
3.5 Model Specification 42
3.5.1 Objective 1 & 3 42
3.5.2 Objective 2 43
3.5.3 Objective 5 44
3.6 Reliability of data 45
3.7 Validity Procedures 45

CHAPTER-4

4. Assessing Work-life Balance and Research Productivity of Faculty 46
Objective 1
4.1 Findings 46
4.1.1 Descriptive Statistics 46
4.1.2 Inferential Statistics 46
Objective 2
4.2 Findings 47
4.2.1 Descriptive Statistics 47
4.2.2 Inferential Statistics 48

CHAPTER- 5

5. Impact of Leadership on Placement, Outreach and Corporate Collaboration 51
Objective 3
5.1 Findings 51
5.1.1 Descriptive Statistics 51
5.1.2 Inferential Statistics 51
Objective 4
5.2 Findings 52
5.2.1 Descriptive Statistics 52
5.2.2 Inferential Statistics 52

Objective 5

5.3 Findings 59

5.3.1 Descriptive Statistics 59

5.3.2 Inferential Statistics 59

CHAPTER-6

6. Conclusions and Recommendations 62

6.1 Background 62

6.2 Suggestions and Recommendations 62

6.2.1 For the Universitites 62

6.2.2 For the Policy Makers 63

6.2.3 For the Industries 64

6.3 Limitations of the Study 64

6.4 Suggestions for the Future Work 65

References 66

Appendix 72

Proof of Publications 76

Plagiarism Report 80

Brief Profile 81

Questionnaire 82

LIST OF FIGURES

S.No.	Title	Pg No.
Figure 1	Gender Composition of Science Researchers	7
Figure 2	Co-Occurrence and Keyword Analysis, Web of Science	18
Figure 3	The Cluster of Nations working on this Topioc, Scopus	20
Figure 4	Keyword Analysis of Cambridge Core	21
Figure 5	Word Chart	54
Figure 6	Distribution of Codes for the First Theme	55
Figure 7	Distribution of Codes for the Third Theme	56
Figure 8	Distribution of Codes for the Fourth Theme	57
Figure 9	Interaction Effect of Gender and WLB	60

LIST OF TABLES

S.No.	Title	Pg No.
Table 1	Percentage of female tertiary education graduated by field (WEF 2022)	5
Table 2	Average monthly earnings of employees in professional, scientific, and technical activities by gender	8
Table 3	Keywords employed in the literature search and the number of results for each database	16
Table 4	Co-authorship and country	17
Table 5	Co-authorship and countries, Scopus	19
Table 6	Keyword analysis, Cambridge core	21
Table 7	Description of variables and tools (objective 1)	35
Table 8	Dependent and independent variables (objective 2)	36
Table 9	Variable Measurement (objective 2)	36
Table 10	Description of variable and tools (objective 3)	37
Table 11	Description of variable and tools (objective 4)	37
Table 12	Dependent and independent variables (objective 5)	38
Table 13	Information of the respondents	38
Table 14	Profile of the respondents	38
Table 15	Group statistics	46
Table 16	Independent samples t-test	46
Table 17	Information of the participants	46
Table 18	Interaction effects of gender and branch	47
Table 19	Average marginal effects	48
Table 20	Descriptive statistics	48
Table 21	Effects of gender of the HoD on placement	49
Table 22	Involvement in USR activities	51
Table 23	Coding frequency	51
Table 24	Involvement in USR activities under male and female heads	52
Table 25	Approach of colleges towards fulfillment of SDGs	52

List of Abbreviations

Abbreviations

HEI'S	Higher Educational Institutions
STEM	Science, Technology, Engineering, Mathematics
USR	University Social Responsibility
WLB	Work-Life Balance
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
MDG	Millenium Development Goals
SDG	Sustainable Development Goals
UEI	UNESCO Engineering Initiative
SAGA	STEM and Gender Advancement
STI	Science, Technology, and Innovation
WIS	Women in Science Report
WFEO	World Federation of Engineering Organizations
WEF	World Economic Forum
NSF	National Science Foundation
EUA	European University Association
OECD	Organisation for Economic Co-Operation and Development
ILO	International Labour Organisation
KS	Knowledge Sharing
HDI	Human Development Index
AMS	ASEAN Member States
AISHE	All India Survey on Higher Education
HOD	Head of Department
R&D	Research and Development
MNCs	Multinational National Corporation
IP	International Property
COVID	Corona Virus Disease 2019
HCWs	Healthcare Workers
UK	United Kingdom
STS	Science, Technology, and Society
UII	University-Industry Interaction
MoU	Memorandum of Understanding

NGO's	Non-Governmental Organisation
NSM	National Solar Mission
MNRE	Ministry of New and Renewable Energy
NSS	National Service Scheme
SAGY	Sansad Adarsh Gram Yojana
SR	Social Responsibility
US	United States
IIT	Indian Institute of Technology
CE	Community Engagement

CHAPTER 1
INTRODUCTION

1.1 Women Leadership

Women represent almost half the global population and are vital human resources. They are pillars of the world economy and have contributed in virtually every sphere of life and are even leading the country (women president, speaker, etc), being a source of inspiration to many. Women leaders and decision-makers may play a critical role in advancing gender equality and furthering economic, social, and political progress of the nation. However, gender distribution in the context of leadership positions is skewed, and women are hardly represented in leadership positions in India and other parts of the world. In the case of Science & Technology, the situation is even worse. Traditionally, it has remained a male-dominated area in many parts of the globe where the top positions are still male-occupied. The presence of women in higher positions of power in this sector is still an exception. The growth in the fraction of women in Science & Technology has been slow since many decades (International Day of Women and Girls in Science). We need to understand that building scientific capacity is a shared responsibility and in this regard, there has been a serious concern raised since the 1970's for the inclusion of women and gender parity in Science and Technology under the auspices of UN seminars, conferences being organised nationally and internationally. Policy makers and planners have recognised the importance of women in leadership positions and efforts are being made.

1.2 Importance of Leadership in Women's Empowerment

Addressing gender inequality in power and decision-making across all levels is crucial for women's empowerment. Women's active participation in decision-making is not just a matter of justice and democracy; it is vital to ensure women's interests are considered and achieve goals of equality, development, and peace. Despite government commitments to promote gender equality, women's underrepresentation in leadership and decision-making roles persists in both developing and developed countries, impeding their full participation in shaping their lives and limiting societies' potential (Hoss et al., 2011). The result of this gender gap is that women's voices are not fully heard in decisions affecting their lives, and societies miss leveraging the talents and perspectives of almost half their population. Over the past thirty years, there has been a consistent rise in the proportion of women holding management positions in developed countries. While gender disparities in leadership styles are acknowledged, it remains unclear whether organizations with more women adopt distinct management practices. Senior leaders significantly shape an organization's culture and management decisions. However, as women represent a smaller portion of senior management, their influence on management practices may be limited.

1.3 Intervention by the United Nations for promotion of women in STEM fields

The United Nations serves as a central hub for dialogue and cooperation, facilitating collective solutions. With strong member state support, it provides a clear roadmap towards a shared goal addressing global challenges and caring for our common global home. On September 25, 2015, the United Nations General Assembly adopted the 2030 Agenda for Sustainable Development, succeeding the Millennium Development Goals (MDGs) as the global framework for international development. The Sustainable Development Goals to increase the participation of women in

STEM are Goal 5 i.e. Achieve Gender equality and empower all women and girls and Goal 10 i.e. Reduce inequality within and among countries. The goal 5 talks about the significant legal and legislative reforms essential to safeguard women's rights worldwide. Despite some progress, there remains a global gender wage gap, with women earning, on average, 24% less than men in the labour market UN Women supports women in obtaining quality employment, acquiring assets, and exerting influence on institutions and public policies. It emphasizes the importance of acknowledging, reducing, and redistributing the burden of unpaid care. The goal 10 talks about how the wage gap varies between countries with women earning 24% less than men. Additionally, they are also more prone to vulnerable employment, with up to 75% of women's jobs being informal or lacking protection in developing countries (United Nations, n.d.)

Globally, 83% of domestic workers are women, and the majority lack legal entitlement to a minimum wage. Gender discrimination can intersect with other forms of discrimination, including age, disability, ethnicity, and economic status, compounding the burden of inequalities. UN Women actively addresses inequality within and among countries by advocating for decent work, social protection, and gender-sensitive economic policies globally. This includes eliminating discriminatory laws and practices and promoting appropriate legislation, policies, and actions. It advocates for employment policies that enhance labour market conditions and promote decent work for women, along with ensuring the safe migration and social protection of domestic workers (UN Women, 2013)

The aims and role of UNESCO for promotion of women in STEM include enhancing the participation, achievement, and continuity of girls and women in STEM education and careers to narrow the gender gap in STEM professions, building the capacity of countries to provide gender-responsive STEM education, focusing on teacher training, educational content, and pedagogy, raising awareness about the significance of STEM education for girls and women ("international day of women and girls in science," 2018). The UNESCO Engineering Initiative (UEI) focusses on increasing enrolment in engineering programs at the tertiary level to sustain and enhance socio-economic development thereby encouraging and inspiring the youth to address contemporary challenges and ensure an adequate supply of engineers for future sustainable development. UEI provides a platform for youth to express their views on current engineering and development issues through events like the UNESCO Youth Forum and World Science Day 2013. Some more initiatives include: 8th UNESCO Youth Forum, World Science Day 2013, World Teachers' Day 2013, Engineering Outreach Event in Nigeria, Airbus: Fly Your Ideas(United Nations, 2021).

STEM and Gender Advancement (SAGA) is a Global UNESCO project supported by Sida to reduce the gender gap in STEM across education and research levels. It identifies and addresses gaps in policy related to gender in science, technology, and innovation (STI) based on evidence, enhances capacity for data collection on gender in STEM fields, increases visibility, participation, and respect for women in STEM, improves tools for measuring the status of women and girls in science (UNESCO, 2015)

Women in Science report (UIS) data reveals that women comprise less than 30% of the world's researchers. The data also provides insights into the distribution of these women across public, private, and academic sectors, as well as their respective fields of research (UNESCO Institute for statistics, 2019).

Under L'Oréal-UNESCO For Women in Science, UNESCO and the L'Oréal Corporate Foundation aim to honour women researchers who have made significant contributions to addressing global challenges. By recognizing their work in areas such as new technologies, aging populations, and biodiversity threats, UNESCO and L'Oréal aim to acknowledge and support these women researchers, enabling them to continue their impactful contributions to science (UNESCO, n.d.)

The World Federation of Engineering Organizations (WFEO), established in 1968 under UNESCO, unites national engineering institutions from around 100 nations, representing over 30 million engineers. Its mission is to enhance engineering practice and advance the UN Sustainable Development Goals. The Paris Declaration (March 2018) reaffirms engineers' commitment to sustainable development, fostering socio-economic security, sustainable development, and global poverty alleviation through the proper application of technology. (UNESCO, 1968). The WEF Future of Jobs Report aims to analyse and offer detailed insights into the extent of emerging trends by industry and geography. It focuses on the expected timeframe for these trends to impact job functions, employment levels, and required skills (World Economic Forum, 2023).

As of November 2020, only 10 percent of UN Member States have a female Head of State or Government. The Organization for Women in Science for the Developing World is an international organization (programme unit of UNESCO) offering research training, career development, and networking opportunities for women scientists in the developing world at various career stages (UNESCO, n.d.).

1.4 Status of Women in STEM Leadership

1.4.1 International

Historically, women have been inadequately represented in Science, Technology, Engineering, and Mathematics (STEM) education, leading to a corresponding underrepresentation in the STEM workforce (Landivar L. C, 2013). As per a 2017 report by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), women account for just 30% of STEM students in higher education worldwide (UNESCO, 2017). The absence of women in STEM organizations may lead to a lack of diverse perspectives, hindering the generation of innovative ideas. Homogeneous workforce in STEM are less likely to navigate effectively in dynamic and diverse environments. Consequently, advocating for educational and career opportunities for women is viewed as a strategy to tap into the full potential of the entire pool of STEM innovators (Pearson et al., 2015). While Western countries have progressed towards more egalitarian social structures, many Asian countries still largely adhere to patriarchal social value systems (Mukhopadhyay and Seymour, 2021). Globally, efforts are underway to boost women's involvement in STEM education, civic engagement, and the STEM workforce. Notably, some Asian countries have witnessed significant strides, with women notably increasing their presence in specific STEM fields, such as computer science and computer engineering (Fan and Li, 2005). Historically, educational opportunities, especially in STEM fields, have favoured males over females. While Western countries have shifted towards more egalitarian social structures, many Asian countries still maintain predominantly patriarchal social value systems (Mukhopadhyay and Seymour, 2021). In the face of gendered challenges, numerous Asian women persist in pursuing STEM careers, navigating male-dominated work environments daily. Despite increased representation in specific STEM fields, women in many Asian countries often encounter limited access to leadership positions within these fields (Campion and Shrum, 2004). Excluding women from STEM organizations risks overlooking valuable innovative ideas. Homogeneous workforces struggle in dynamic, diverse environments. Thus, promoting educational and career opportunities for women is seen as essential to fully harness the potential of STEM innovators (Pearson et al., 2015).

According to the National Science Foundation, women make up 43% of the U.S. workforce for scientists and engineers below the age of 75. Among those under 29, women comprise 56% of this workforce. Despite this, only one in seven engineers are female. Furthermore, while women hold 58% of S&E related occupations, they represent only 28% of workers in S&E occupations. Additionally, women in STEM fields continue to face a significant wage gap, with men earning an average of $36.34 per hour compared to women earning $31.11 per hour, even when factors like education and age are taken into account (Rosser, 2020). In academia, women represent 31% of full-time faculty in science and engineering, with a majority found in the life sciences. Additionally, recent data from the National Science Foundation reveals that only 27% of STEM deans and department heads are women. A 2019 Statistics, Canada study revealed that first-year women constitute 44% of STEM students, contrasting with 64% in non-STEM fields. Those who exit STEM often transition to related areas like healthcare or finance. Additionally, research from the University of British Columbia found that merely 20-25% of computer science students across Canadian institutions are female, with just around 1 in 5 of them graduating from such programs (Statistics Canada, 2019)

Across Europe, the proportion of women in full professorship positions has only marginally increased from 24.1% to 26.2% between 2015 and 2018, with men being twice as likely to hold such roles. Consequently, it is unsurprising that the European University Association reported that less than a fifth of university leaders among its 850 members are women. While some countries like Norway and Iceland have over 41% female university leaders, others such as Italy and the Czech Republic have less than 10%. Despite this, the number of women in leadership roles is growing, with female vice-rectors increasing by 24% since 2014, though they still comprise less than a third of vice-rectors in EUA member institutions (Kahn, 2022). In 2012, women comprised 47.3% of total PhD graduates, with 51% in social sciences, business, and law, 42% in science, mathematics, and computing, and only 28% in engineering, manufacturing, and construction. Specifically in computing, only 21% of PhD graduates were women. In 2013, across the EU, men scientists and engineers constituted 4.1% of the total labour force, while women were only 2.8%. In over half of the countries, women represented less than 45% of scientists and engineers. However, there has been improvement, with women among employed scientists and engineers growing by an average of 11.1% per year between 2008 and 2011, compared to 3.3% growth among men during the same period (EU publications, 2015). UNESCO statistics indicate that 30% of the Sub-Saharan tech workforce are women, a figure that increased to 33.5% by 2018. Notably, South Africa ranks among the top 20 countries globally for the proportion of professionals skilled in artificial intelligence and machine learning, with women comprising 28% of these professionals in the country (Kahn, 2022). Australia has recently intensified efforts to enhance female participation in STEM disciplines. Initiatives like the establishment of Women in STEM Australia in 2014 demonstrate this commitment. This non-profit organization strives to create a cohesive network for women in STEM fields, fostering connections and support among them (Christie et al., 2017)

1.4.1.1 Participation of women in STEM Institutions in South East Asia

Girls in primary and secondary education in numerous Asian nations outperform boys in mathematics and science but this academic advantage does not always result in pursuing further STEM education or careers. According to OECD data, about 25 percent of enrolment in STEM-related programs at the tertiary education level in Japan are women (Takuya Matsuura and Daiki Nakamura, 2021) In South Korea, the percentage of women in medicine is notably higher at 61.6% compared to engineering and other math-based STEM fields where it stands at 15.4%. Within research occupations in science, technology, and innovation, women constitute 17% of the workforce as of 2011. However, a significant portion of women in STEM are categorized as "non-regular" or temporary employees, highlighting issues with job stability in these fields (Kenneth Jones and Hite, 2020)

In Southeast Asia, although more women enrol in higher education than men do, they are significantly underrepresented in STEM disciplines. Only one in six STEM students are women, highlighting a pronounced gender gap in tertiary education (ILO, 2016). Although women constitute 39 percent of technology majors, a lower percentage compared to the 56 percent seen in other fields of study, their representation in the region's technology sector is 32 percent. This is in contrast to their overall presence in the workforce, where women make up 38 percent (Vaishali Rastogi et al., 2020).

Table 1: Percentage of Female Tertiary Education Graduates by Field (WEF 2022)

Country	**Female Tertiary Education Graduates by Field (WEF 2022), in %**		
	Engineering, Manufacturing, & Construction	**Information & Communications Technology**	**Natural Science, Mathematics, & Statistics**
Brunei Darussalam	52.26	-	73.37
Cambodia	-	8.44	34.08
Indonesia	24.92	34.67	-
Lao PDR	17.95	40.82	55.00
Malaysia	27.05	46.00	70.73
Myanmar	42.34	-	66.38
Philippines	24.48	48.13	61.97
Singapore	-	32.22	61.72
Thailand	-	47.85	70.72
Vietnam	-	-	50.59

Source: World Economic Forum 2022

In recent years, Singapore has witnessed heightened efforts from individuals, social organizations, institutions, and private companies advocating for increased representation of women in STEM (science, technology, engineering, and mathematics) fields. During 2014–2016, various local events aimed to promote women in STEM fields, including STEM Week by the National University of Singapore, STEM Workshop for Women by Singapore University of Technology and Design, a UN Women's Committee panel discussion, and the Women in Engineering, Science, and

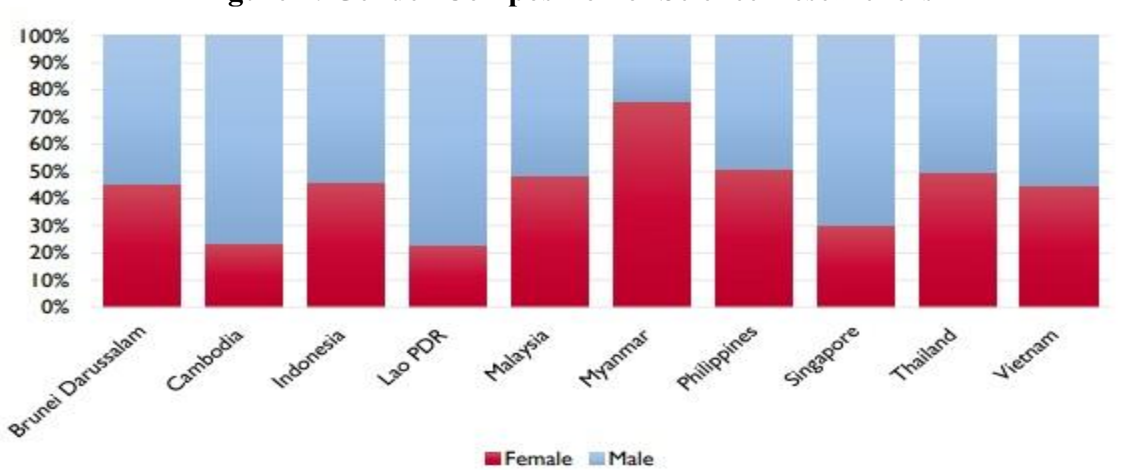
Technology symposium by Nanyang Technological University. These initiatives respond to the need to expand the labour force, addressing challenges posed by a shrinking and aging population, as per the Ministry of Manpower (2016). Encouraging women's participation was seen as a strategy to mitigate this issue (Singapore Tripartite Forum, 2022). In Singapore, while the overall gender ratio is nearly equal, the representation of females in engineering programs is less than 20% (Elaine Lee, 2017). The University of Hong Kong (HKU) leads in gender representation with 28.9% women leaders, predominantly from non-STEM backgrounds, primarily at the departmental level. HKU also excels with 14.3% female institutional leaders. National Taiwan University follows closely, boasting a notable 24.6% representation of women in leadership, showcasing significant progress in gender equality and university management among East Asian world-class universities (Hei Hang and Hayes Tang, 2019). Private institutions dominate higher education in Asia (e.g., Japan, South Korea) with up to 80% student enrolment whereas Latin America, which was historically tied to Catholic-founded private universities, now sees a shift towards for-profit institutions, indicating a growing preference for profit-driven education (Burton Bollag, 2003). Cambodia is in the midst of an economic transformation amidst the global Industrial Revolution 4.0, creating a heightened demand for STEM graduates. However, the nation encounters challenges in attracting students to STEM fields in higher education. Addressing this requires initiatives not only at the classroom level but also through extracurricular activities in upper secondary schools and broader societal efforts (Jamil et al., 2019). Cambodian private university academics note the absence of research, citing no institutional requirements. Public universities show limited, locally published research, often diminishing post-master's thesis completion(Heng et al., 2023).

Globally, there is a significant gender disparity among researchers, with men outnumbering women by a ratio of 71:29percentage. Interestingly, countries with lower research and development expenditure, such as the Philippines and Thailand, have a higher proportion of female researchers, exceeding 45% (UNESCO, 2012). Academics' research engagement and productivity are influenced by both personal and environmental factors (Kimkong Heng et al., 2020). A conducive environment grants access to essential tools and resources, enhancing productivity (Pfeffer and Langton, 1993). Management support in Malaysian public universities correlates with increased research engagement (Fauzi, 2023).

The Malaysian higher education landscape has transformed since the 1990s, notably in public and private sectors. However, persistent gender stereotypes contribute to a notable imbalance among senior staff in public institutions. The private sector has seen slow progress in addressing this gender disparity over the past two decades (Jamil et al., 2019). A Malaysian private university ranked second nationally in the Times Higher Education Ranking 2021, which prompted an exploration of how academics in private institutions connect to Knowledge Sharing (KS) behaviour and subsequent research engagement. In a Saudi Arabian public university, 39% of faculty acknowledged engagement in intra-institute research collaborations, but cultural identity emphasizing Islamic values hinders strong motivation for collaborative research with colleagues. As a result, faculty predominantly pursue individual research endeavours (Borg & Alshumaimeri, 2012). In Thailand, women are significantly represented in research across diverse sectors and fields. Within government, higher education institutes, public enterprises, and private non-profit organizations, they constitute a majority, accounting for 54.2% of researchers. Meanwhile, in the industry sector, women still make up a substantial portion, comprising 47.5% of researchers (UNESCO, 2018). In Myanmar and the Philippines, women stand out as the predominant proportion of science researchers compared to men as shown in the figure below. Women hold 5.7

percent of the highest research positions (typically director of research or full professor) in Brunei Darussalam, where representation of women decreases with seniority, in line with the global trend. Myanmar is the exception, where women hold 71.6 percent of the highest research positions (UNESCO, 2018).

Figure 1: Gender Composition of Science Researchers



Source: UNESCO 2020

Brunei's government has prioritized science education, allocating sufficient resources across all schools. Despite well-equipped government schools, there is a concerning trend of declining enrolment in the science stream. Additionally, examination results suggest unsatisfactory outcomes, highlighting the need for further attention to enhance science education effectiveness (Khine, 2002). Gender inequality in science education is evident in Bruneian textbooks. An analysis of textbook content reveals disparities in the representation of males and females, both in illustrations and text. This examination paints a picture of how science is portrayed, indicating the extent to which it is presented as a pursuit equally suitable for both boys and girls (Elgar, 2004).
In the Brunei civil service, women constitute about 50.4%, with a higher presence in Divisions II, III, and IV. Despite gender gaps in academic achievements favouring women, they remain underrepresented in senior-level civil service positions, where only one in five holds such a position. In STEM fields, female tertiary graduates in Brunei reached 49%, surpassing rates in Singapore and the United States between 2014-2016. However, historical trends show a preference for 'lower level, clerical jobs' among Bruneian women (Dhindsa, 2008). In Myanmar, a notable gender disparity exists in leadership positions, predominantly filled by males. While there may be some women in senior roles, this presence does not equate to gender equality. Widespread inequalities persist, encompassing areas such as political representation, societal perceptions, gender stereotypes, and access to resources (Khin Khin Mr, 2021)

While career advancement in Indonesian academia is theoretically nationally regulated to ensure equal opportunities, women in Islamic HEI (Higher Education Institutions) face disparities. They exhibit lower productivity in publications, hold lower academic ranks and leadership positions, and earn significantly less than their male counterparts earn. The suggestion is for these institutions to specifically empower women by supporting their continuing education, professional development, and career opportunities (Kholis, 2012)

In the UNDP's 2010 Human Development Index, Indonesia ranks 124th out of 187 countries, lower than Brunei (33) and Malaysia (61) but higher than the Philippines (112). Notably, Indonesia outperforms Vietnam (128) and India (134). Despite its overall ranking, Indonesia excels in expected years of schooling (13.2), surpassing most of these countries, except Brunei (14.1), and outperforming Malaysia (12.6) (Priyatna, 2013).

In a study of higher education institutions in Catbalogan City, Philippines, 30 participants shared their experiences through a validated questionnaire. The findings revealed that women respondents encountered gender biases in the workplace, particularly within the institution's regulations and procedures, despite government initiatives promoting gender equality (Irene Evangelista, 2017). In many higher education institutions in Philippines, women mostly occupy middle and senior-level positions but are less represented in the highest-ranking positions (Morley, 2014). In traditional times in Thailand, the presence of a bilateral and matrilocal kinship system and the high work participation rates among women in the modern, rapidly globalizing economy were sometimes seen as indications of minimal gender discrimination. In the 1990s, the demand for women's studies programs emerged, with both successes and setbacks. Graduates from these programs, who became leaders, have since played crucial roles in defending women's rights. A notable divide exists in Thailand between the household, where women play pivotal roles in family sustenance, and the public political culture. In the latter, women's internationally renowned 'pleasing personality' is considered a crucial element in a complex structure that often reflects subservience (Tantiwiramanond, 2007). The 2007-2009 Thai Labour Force Surveys indicate that only one-third of employed STEM graduates work in STEM occupations. While STEM degree holders in STEM fields enjoy a 30% wage premium, those working in non-STEM fields experience only a 2% premium. This suggests that STEM education yields significant returns in STEM occupations but lower, or even negative, returns in non-STEM fields, particularly for women (Jessica Vechbanyongratana and J Vechbanyongratana, 2015). The International Labour Organization (ILO) estimates that in Thailand, 44% of employment, equivalent to over 17 million jobs, is at risk of automation. Women are disproportionately employed in jobs with low STEM skills, making them more susceptible to automation. They are 50% more likely than men to face job loss as a result of automation. In the industry, 85% of total female labour holds low-skilled occupations. The ILO program aims to enhance women's acquisition of critical soft and technical STEM-related skills, addressing skills mismatches to boost productivity and enhance competitiveness in the evolving landscape (International Labour Organisation, 2020)

Table 2: Average Monthly Earnings of Employees in Professional, Scientific, and Technical Activities, by gender (in US $)

Country	Year	Male	Female
Brunei Darussalam	2014	2,214.31	1,840.24
Cambodia	2019	466.82	375.74
Lao PDR	2017	298.40	203.14
Malaysia	2020	1,110.27	799.81
Philippines	2020	544.08	488.88
Singapore	2020	4,769.73	3,815.93
Thailand	2020	780.76	751.25
Vietnam	2021	422.08	371.81

Source: International Labour Organisation

Across the professional, scientific, and technical sectors, women generally hold lower representation compared to men, with the exception being Myanmar. Clearly, there persists a significant gender pay gap. On average, women earn as little as 68 percent of what men earn in these sectors, highlighting substantial disparities in earnings based on gender.
In STEM leadership across ASEAN, women are underrepresented but generally outperform global averages. In STEM policy roles, women are still underrepresented across all government levels. For example, in 2017, women constituted 35% of permanent staff positions in Lao PDR's Ministry of Science and Technology (G. A. Lemarchand, 2018). In Malaysia, women occupied 23.7% of board seats in life sciences and healthcare companies in 2021, surpassing the global average of 21.3%. In technology, media, and communications companies, women held 7.8% of board seats in Indonesia, 20% in Malaysia, and 22% in Singapore in the same year (Deloitte Global, 2022). Women are underrepresented in executive positions, with only 14% holding chief technology officer roles in Singapore and 12% in other ASEAN Member States (AMS). Additionally, companies are recruiting women from Asia-Pacific offices for global roles based elsewhere (Helen Coult, 2020).

1.4.2 India

Developing nations, which have made commendable progress, have done it primarily through empowering women. Therefore, the full involvement of women in scientific and technological endeavours is essential for rapid national development and sustainable happiness of the people. Because of the persistent efforts by the governments of different nations, the number of women in leadership positions is on a rise from local to a global level. Despite some progress, women scientists are paid less, promoted less frequently and are more likely to quit research than men of similar qualifications (Inter-Academy Panel on ‘Women in Science in India’, 2016). India outpaces many developed countries in female STEM graduates, boasting 43% enrolment at tertiary level, surpassing the US (34%), UK (38%), and Germany (27%) (Rosser, 2020).Despite this, there is a gap in translating this into employability and leadership. While 52% enrol in STEM courses, only 29% enter the workforce, with a mere 3% reaching CEO positions in the industry, highlighting a need for enhanced opportunities for women in STEM leadership roles. Inspite of several measures taken by the government, the gender imbalance in the workforce and leadership roles is even more adverse for women. Inclusivity and diversity in leadership positions is important as it brings a fresh perspective in decision-making. Empowering not only professional women but also women in the rural and grassroot levels of developing countries is necessary. Women in the rural areas need to be valued as a precious human resource and not a liability as they can change the social stigmas of the society by their upliftment through science and technology thereby, questioning the societal norms of the patriarchal mind-set where head of the family is generally perceived to be a male, relationship between work and family which act as hurdles for women in science. As rightly said by Josh Kidney “When woman support each other, incredible things happen.” So, the privileged class of women scientists need to technologically empower and work for the welfare of the rural women and reduce their drudgery thereby getting them out of the shackles of poverty. For this educating these woman is necessary because “Educating a woman is educating a family” as rightly said by Mahatma Gandhi. It is not only important for the society but also for building a nation’s strength, particularly when they pursue science as a career. According to AISHE,2020, women’s participation in higher education has increased manifold since independence i.e. 49% but there transition to the labour market is not as proportionate i.e. 25.1% (PLFS,2020). They even join the labour market but as they move up at the organisational ladder, their number dwindles. In the

engineering sector, the situation is even worse where the participation of women is low in education as well as employment. According to a study by Forbes, 2021 only two percent of CEOs are women. There is a gender gap when it comes to achieving higher executive roles. Women lose ground at every step of the hierarchical pipeline and specifically at the entry level. Inspite of all the hardships, women have proved themselves every time. According to another study on women in leadership, women spend more time contributing to diversity, equity and inclusion efforts; 07% of men as compared with 11% of women (Forbes, 2021).
Leadership roles for women engineers needs special attention since there exists unconscious bias, micro-inequities & bulling which restricts women's progression up the hierarchical ladder (Singh,2021). However, women leadership has been advocated and promoted in the recent years and in this regard Science, Technology and Innovation policy, 2020 specifically emphasizes on women leadership in STEM institutions (Draft of Science, Technology and Innovation Policy, 2020). Women in STEM academic leadership positions are less in number because of existence of stereotypes like 'women cannot do maths' which lowers their aspirations to move up the ladder. (McCullough, 2019). An India-centric Equity Inclusion charter has been developed for tackling all forms of discrimination, exclusions and inequalities in STI policy, which propagates proportionate representation of women in selection/evaluation committees, consideration of experienced women scientists for leadership roles, regular gender and social audits in academic and professional organizations. The involvement of women as science leaders seems to be increasing as the percentage of women leading research projects has shot up by 4 percent in the past two years. (Singh, 2022). The picture is better at the entry-level (Assistant Professors or Lecturers) but the situation is starker when one considers leadership positions such as Heads of Departments of these Institutes. In India participation of women up to Ph.D. level is about 20-25% but in the positions of Professors or Heads of departments/divisions it falls to 10-12% (Inter-Academy Panel on 'Women In Science in India', 2016). Very few number of women engineers are in the decision-making positions. The employment of women engineers has increased but they are mostly concentrated in the lower levels because they feel that the workplace is very masculine in nature and they do not feel very comfortable in an organisation. As one can see sciences account for nearly all the enrolment while engineering accounts for a much smaller fraction. Because of the trickle-down effect of few role models for women, engineering students there is a dearth of academic women engineers in visible leadership positions, which is in turn responsible for the underrepresentation of women engineers in academia, industry and government (Rohini M. Godbole, 2015).

1.5 Purpose and Significance of the Study

Women's representation in STEM is essential for addressing global challenges, empowering women, and achieving sustainable development goals by 2030. Diversity in these fields leads to better outcomes and opportunities. Despite efforts, women are still underrepresented, particularly in engineering, where there are better job prospects and returns on educational investment. There is a pressing need for further discussion and action to promote gender equality in STEM fields. Understanding the experiences of women leaders in education can provide valuable insights for improving current practices and structures, ultimately encouraging more women to pursue and succeed in leadership roles. By fostering greater equity, this understanding can lead to increased representation of women in leadership positions, resulting in positive impacts on students, faculty, staff, and the education sector as a whole. Moreover, it can contribute to a positive shift in societal norms regarding women's roles. More women in leadership roles and a better understanding of work-life balance would serve as important symbols for higher education, inspiring the development of models and structures to support future leaders, regardless of gender.

1.6 Organization of the Study

This study has been organized into five chapters. The description given in the following table:

Proposed Chapterisation of thesis

The proposed work will be divided in five chapters:

- Chapter 1: Introduction of the thesis will be an introduction to the study area and building the logic of the proposed topic.
- Chapter 2: Reviewing the literature and identifying the research gap
- Chapter 3: Defining the Objectives, Hypothesis, Methodology of the study, sample area and the variables.
- Chapter 4: Data analysis for first three objectives
- Chapter 5: Data analysis for last two objectives
- Chapter 6: Conclusion, limitations of the study and scope of future research.

CHAPTER 2
REVIEW OF LITERATURE

Extensive review has been done for review of literature. Scholarly articles were searched using the following keywords. ''Women in STEM", "Women scientists", Women in Academia", "Women leadership in STEM" etc.

2.1 Women in STEM leadership

Available information is sparse regarding women in leadership positions in the science, technology, engineering, and mathematics disciplines. The lack of literature is most likely due to the small number of women faculty in STEM and an even smaller number who have risen to leadership positions. Because of the trickle-down effect of few role models for women, engineering students there is dearth of academic women engineers in visible leadership positions that is responsible for the under-representation of women engineers in academia, industry and government. Encouraging women faculty to consider formal leadership positions and providing structured opportunities to explore those options are likely to result in that faculty member's participation as academic leaders (O'Bannon et al., 2010). The findings of a study reveal that women who work in architecture which is considered a STEM field in Germany are more likely to achieve a leadership position than women in computing or engineering and that children are not an obstacle to a woman's career path in the STEM professions and male role models act as a beneficial factor to women who seek to reach leadership positions. (Brue, 2019). The findings of another study where an NSF (National Science Foundation) ADVANCE project was held during 2009-12 named Institutions Developing Excellence in Academic Leadership (IDEAL) had lead to an increase in the number of tenured women faculty in science and engineering disciplines over three years across the six universities, and the numbers of women in faculty and administrative leadership positions. Therefore, projects like these can help retain more women faculty in STEM. (Bilimoria & Singer, 2019). The results of a study revealed that the main two types of assistance in both STEM and leadership were support from spouse and encouragement from the peers whereas the main barriers that women encountered were cultural and will took a lot of time to overcome. Also, the main assistance that women had come from people and not the training or institutional structures (McCullough, 2020). Findings from a case study of 25 faculty at a research university revealed three institutional processes that constrained their careers i.e. access career networks, distribution of labour in the department and institution, promotion and leadership. (Hart, 2016). Fourteen focus groups with female STEM faculty showed that there were core barriers to career progression like biases, stereotypes, double standards, bullying and harassment that negatively affected women's confidence and sense of belonging. Apart from this, they also face an additional biological burden of choosing between having children or a career. (O'connell & McKinnon, 2021). Women faculty in STEM perceived their academic climate as unwelcoming and threatening, and reported hostility and uncomfortable tensions in their work environment such as sexual harassment and discrimination (Casad et al., 2021). A study conducted on women STEM Leaders in Africa revealed that the education level contributed to a strong leadership position and that women experience less acceptance than males in STEM leadership as the organizational culture still devalues them (Babalola et al., 2021). A study conducted at the Midwestern research university revealed that mentoring could also be used to change the organizational structure thereby helping marginalized faculty members. Peer mentoring circles for women STEM faculty help them move up the ladder (Thomas et al., 2015). In a study which examined the factors that increase the percentage of women applicants and the likelihood that women would be among the semi-finalists and finalists in the hiring process, the findings indicate that the placement of an advertisement in a venue targeting women increased the total number of women who applied for the faculty positions (Glass & Minnotte, 2010). Strong leadership and advocacy of intersectional learning allows the space for internal growth (Iii, 2014). The results of a study which used multigroup structural equation modelling analysis showed that on an average, the role-model intervention had a positive and significant effect on mathematics enjoyment, importance attached to maths and the expectations of success in maths subject thereby positively affecting the girls aspirations in STEM and it had a negative effect on the gender Stereotypes (González-Pérez et al., 2020). In a study which attempted to study the status of women leaders in STEM (science, technology, engineering, and medicine), the results revealed that there is a major underrepresentation of qualified women in leadership roles and that women are admitted to the basements of STEM institutions where only a few make it to the top floor. Male superstars received well- deserved recognitions and advancements whereas their female counterparts were often held back or cut down by both the male and female colleagues. There was discrimination reported by women and the existence of unilateral hierarchy seemed to be the main cause of it. (Daldrup-Link, 2017). The advancement of Asian female scientists and engineers in STEM careers lags behind not only men but also white women and women of other underrepresented groups (Lilian, wu et al). Women scientists are less in number because of the existence of social norms, which are patrifocal, and are very few in the upper positions of the organisational hierarchy. (Gupta & Sharma, 2003b). A study on two private research organisations revealed that gender is embedded in the socio cultural rules of a workplace and certain practices which are biased towards men, which hinders the chances of women to get to the top.(Gupta, 2017a). A study on CSIR laboratories revealed that despite of a significant contribution by women scientists in the output, they have not been able to reach the position of an HOD because of lack of visibility in the organisation. (Namrata Gupta, 2014). Women faculty in science are at a lower level in terms of hierarchy. There are a very few women who are HOD's or chair the research committees (Gupta & Sharma, 2002). Women move up the ladder at the same place as men in spite of having the same experience as compared to their male colleagues. (Gupta, 2017b). In a study that covered the realities of four scientific organisations of Delhi revealed how men are being preferred more for the position of an HOD because the Indian culture requires women to devote time to family, making them less productive in the perception of the males working in research organisations. Women are rarely appointed as the chair of various committees or HoD's in the research institutes. They are very few at the top level of hierarchy. (Namrata Gupta, 2020a). A study on healthcare scientists revealed that men remain in the upper posts because sexism exists in the work environment and is ignored by both men and women. (Bevan & Learmonth, 2013). In a study of 208 scientists from three laboratories of research, it was revealed that women were more coordinating and the ones who shared information with all and were satiated with their current position with low expectations to move up the ladder unlike men who were optimistic. (Dhawan, 2000). Another study done on 6000 participants from 6 countries (Argentina, India, Egypt, Korea, Poland and USSR) in which research groups of scientists and engineers in academic, industrial and govt research institutions were being surveyed via questionnaires using multi-stage random sampling in which India ranked in the bottom three. The results revealed that the reason for women scientists being in the lowest levels is the inability to protest against the wrongdoing and lack of motivational factors. (Chakravarthy et al., 1988).

An interview of female authors of Molecular Oncology from diverse career stages revealed that how inspiration from seeing women on top in science fields inspires them too to achieve success. (Blaszczak et al., 2022). In a comparison of chair holder and non-chair holder scientists in the nations of the U.S., Canada, and South Africa, it was revealed that chairs with the same academic rank, gender and seniority as that of the non-chairs in the same dept. were more productive in terms of research attributing to the access to material resources which came with the power and position. (Creso Sa´ ID*, 2020). Unconscious gender bias existed in institutions when women who were well accomplished asked for laboratory space, financial resources and awards to be granted based on merit. (Holliday et al., 2015). The results of a study revealed that in the middle ranks, women are more productive than men are, whereas in the lower and higher ranks, they are less productive than men, which indicated that lower ranks tend to lower productivity. The study also revealed that social and cultural background of the women determines their entry into science. The more educated parents with higher incomes encourage women's entry into male dominated fields like science, but in the latter stages of a women's career, these variables do not affect in any way (Kumar, 2001). Many women researchers in STEM distance themselves from other women at workplace whom they feel are over reactive to gender bias issues or who counter them because these women feel that because of countering the conflicts it rather leads to their exacerbation and not resolution of those issues. (Rhoton, 2011). In a qualitative study of 30 women, the results revealed how family, gender ideology, and HR organisational practices determine the employment relationship and can help women in S&T to grow in their careers (Valk et al., 2014). In India unlike other nations, there is a belief that women are equally capable of doing science. In fact, if we look at the no. of publications, women are no behind than men, but in spite of this, the workplace is gendered. (Gupta, 2016). The research productivity of women tends to be higher after they reach 50's as now they have their children grown up and are free to devote time to research. (Gupta & Sharma, 2003a). It is because of the informal interaction that is missing b/w men and women researchers, which could undo the hierarchy in the organisation and make the socio cultural environment of the place fruitful for research. Because of the belief that women face a dual burden of work because of their homely responsibilities, they are considered less productive at the workplace. This could be because of the total time devoted which could be reduced due to family responsibilities or staying back at odd hours etc. it was found that younger male scientists did support their wives who were also scientists in sharing of the household responsibilities & taking care of the family but they did accept that in spite of their changes in thinking, the stereotypes still exist at the workplace. In scientific research organisations, the socio cultural context plays a crucial role in determining the level of gender bias. Because of women unable to socialize and form informal contacts with those in power, they are discriminated when it comes to their promotions. This has been evident mainly in the case of junior women scientists. (Gupta, 2016). Women in academic science are less as compared to men in terms of faculty. There are more women than men in the position of assistant professor but very few in the post of professors as compared to men. Women tend to stay in the same rank for a very long time, which points out to the gender discrimination while trying to make it to the top of the hierarchical ladder (Kumar, 2001). In a study conducted in the US, the results of an interview and survey data of three R& D units revealed how transformational leadership is very important for the success of an R& D project but only at a level above that of a project leader indicating that women being in the lower ladder don't get the opportunity for being the successful face of an R& D project. (Waldman &

Atwater, 1994). According to a study on the R&D done by MNCs, the weaker the IP are in a developing nation, the more preference will be for a modular hierarchical structure that is decentralized in order to be safe from the risks of free riding of an innovation done by it. (Quan & Chesbrough, 2010). A survey had been carried out in order to study women in technical and scientific fields; the results revealed the workplace environment being supportive to the needs of women, fewer differences remaining in interpersonal communication and adoption of certain strategies by women to work effectively in the male-dominated organisations. (Boiarsky et al., 1995). According to a study in which data from scientists and engineers in 24 R&D corporates was collected through a survey revealed how differences in the structural position of group affected the productivity. A total of 8 demographic groups had been studied in which the status & competitiveness of every group based on factors like its representation in positions of management , achievements like (doctorates, patents, no. of publications & its proportion in the workforce and the duration since the time it had been inducted in the technical workforce.

Men and women were ranked on two dimensions i.e. task and social dimension. Men rated more on innovative & promotable into management than women who were more into social dimension in terms of performance and less on the task dimension. Overall, the findings reveal that the structural position of men in the organisation has given them the benefit of the doubt when their project proposals are considered for evaluation, unlike women who are considered more warm than competent & not being considered innovative. Therefore, the outcome of the project proposal evaluation depends on the structural position of the group in an R& D organisation. (DiTomaso et al., 2007). The study of biotech firms reveals that women are 8 times more likely to reach leadership or supervisory positions than in other sister disciplines like science and engineering, if the organisational form of networking exists as opposed to hierarchy or bureaucracy that exists in other disciplines. Entry of scientists in biotech firms is not related to gender but the rank of the university from which they did their PhD, which is positively related to a scientist being employed in a biotech firm. The results also revealed that the no. of years from PhD is positively related to achieving a leadership position for both men and women, which implied that there exists a friendly environment in biotech firms for women scientists and less gender inequality as compared to other science disciplines.(Smith-Doerr, 2004) .Women in the pharmaceutical industry with hierarchy being the organisational form differ in terms of productivity related to patenting with women working women in the biotechnology sector with the network form. Women scientists in government sector, which includes non-profit research hospitals, hold less patents than men. The reason that women patent more than men in network-based industry settings is the fact that they get more incentives/ guidance or are encouraged via mechanisms so as to have more desire to patent (Kjerston Bunker Whittingon and Laurel Smith-Doerr, 2008).

2.2 Leadership and Work-life balance

Past literature focussed on persistent gender biases and stereotypes, lack of role models, unconscious biases in hiring and promotion processes, societal expectations etc. WLB was positively associated with job and life satisfaction.WLB was negatively related to anxiety and depression (Haar et al., 2014). Life satisfaction, job satisfaction, and work engagement, can strengthen teachers' work engagement by respecting employees as actors in other roles and supporting work-family balance in the form of family-friendly policies and practices (Žnidaršič and Marič, 2021). The results of the study imply that work-family conflict is an important concern for individuals and organizations alike because of its negative consequences leading to reduced job satisfaction as well as family satisfaction and hence to reduced life satisfaction (Ahmad, 1996). Work life balance also was being studied since mid 1800's and also many theories existed but there is a dearth of theories focussing on WLB of women in STEM careers, which lead us to do further research on it.

Information on the topic 'Work life balance AND STEM careers' has been scrounged from four databases which include Web of science, Scopus, Cambridge Core and Sage for conducting a thorough examination of WLB in STEM careers. In the Web of Science Core Collection, we searched for ALL = (Work life balance AND STEM careers) and 48 results appeared for 22 nations from 2007 to 2024 without any filters. All books, editorials, articles etc were included. Using, Mendeley, we found no duplicate records in the above. The highest papers were in the category of management (6 papers, 13.043%) whereas the lowest were in economics (1 paper, 2.124%). In Scopus, 84 documents appeared after searching for TITLE; ABS; KEY (Work AND life AND balance AND stem AND careers) AND (LIMIT TO (LANGUAGE, "English")) from 2008 to 2024 with filters being limited to the inclusion of English language. A total of 70 documents were in English language and only one was in Russian, which had been excluded. No duplicates were found in the database. All books, editorials, articles etc were included. In the Cambridge Core, we searched for 'Work life balance AND STEM careers' and limited the search to articles and further to Cambridge prisms under the collections which left us with 111 records from 2014 to 2024 for the bibliometric analysis. Cambridge prisms is a series of open access journals. Duplicates were screened in Mendeley and zero records found. In advanced search of the Sage database, after searching for "Work life balance AND STEM careers" and limiting to the subject area of education and research articles from 2005-2024, we found 452 records. Education had been selected in the subject area because the focus was to find out how work and life balance is managed in STEM academia. All the four datasets were exported to VOS viewer software separately to construct, visualize and analyse the bibliometrics.

Table 3: Keywords employed in the literature search and the number of results for each database

Keywords	Scopus	Web of Science Core Collection	Cambridge Core	Sage
Work life balance AND STEM careers	84	48	111	452
Duplicates	1	0	0	0
Total (net of duplicates)	83	48	111	452

Source: Made by the authors

2.2.1 Web of Science

Co authorship and countries

On the basis of co authorship and the unit of analysis being countries, out of 22 countries 7 met the threshold criteria having a minimum of two documents in which USA was at the top with a total of 987 citations and India in the bottom with only one citation. USA had connections with four nations i.e. England, Spain, Australia and Czech Republic where work was mainly carried out in 2018 whereas India, Sweden and Spain had no clusters. The research works done by the cluster of developed nations focussed on the position of women in the academic science (Ceci et al., 2014), the intersection of race or ethnicity and gender of women in STEM and how their career-work life experiences are different from those who fit in with the norms well (Kachchaf et al., 2015), WLB and the challenges faced by faculty in STEM to overcome it and their tolerance to facing gender bias in their respective departments (Beddoes & Pawley, 2014; Giakoumi et al., 2021; Turner et al., 2018;,Minerick et al., 2013; Hooker et al., 2017) methods for managing the career barriers and employing coping strategies (Amon, 2017; Graves et al., 2021; Adamowicz, 2017), Research collaboration (Carr et al., 2019), Policies for work life balance by the employer and its effect on productivity (Feeney et al., 2014), Preconceived nations or factors affecting a STEM career (Tan-Wilson & Stamp, 2015; Howe et al., 2022).The intervention by an accelerator to improve the WLB by female faculty (Villablanca et al., 2013), suggestions to balance the gender ratio in STEM (Barabino et al., 2020), work-family conflict (Pitt et al., 2021; O'Neal, 2019). Clearly, the developed nations are working on these topics and developing nations like India who have a higher gender imbalance are not conducting more researches. .

In India, a single piece on work existed on the challenges faced by women scientists and engineers and the role that the scientific institutions can play to help them in overcoming it. (Kurup and Raj, 2022)and another one focussed on the women entrepreneurs who have emerged as a result of career breaks and dealt with work life balance issues (Sharma, 2022). The entry of women in workforce in USA started in the 1970's whereas in India it happened after the LPG, which might be a major reason for the different career trajectories of women in STEM and their current status.

Table 4: Co authorship and country, Web of Science

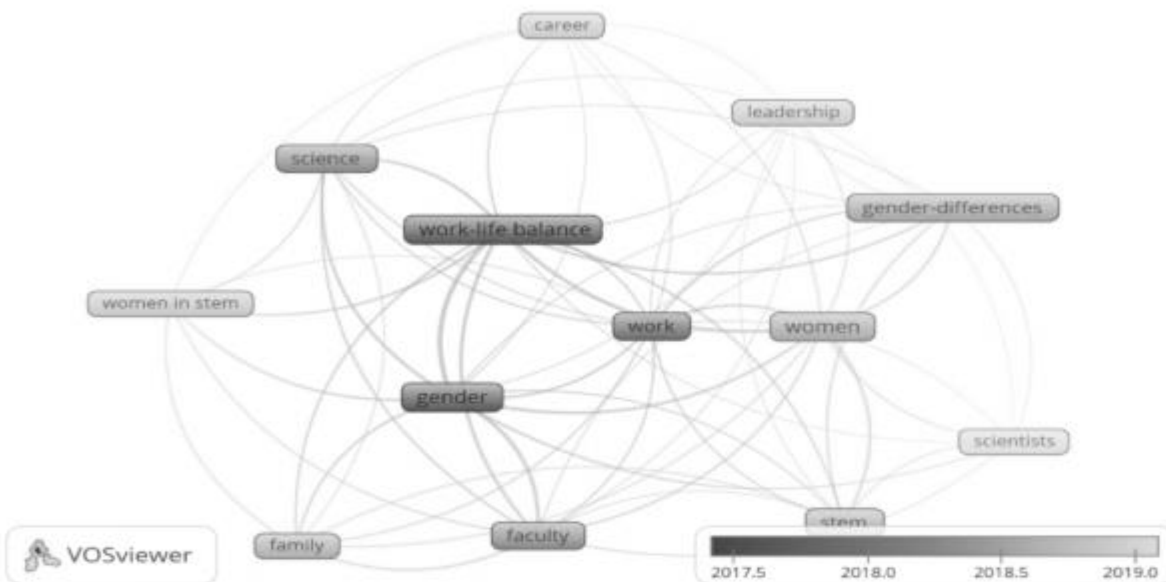
Country	Documents	Citations	Total link strength
Australia	3	34	6
Czech Republic	2	15	3
England	2	25	6
India	2	1	0
Spain	2	23	3
Sweden	2	24	0
USA	35	987	6

Co-occurrence and keywords

Based on co-occurrence of all the 361 keywords, with minimum occurrence of a keyword being two, the highest occurring was "work life balance" with 15 occurrences and the highest linkage strength of 82. The second highest was "women", 14 occurrences and a total linkage strength of

77. Work life balance and its integration with gender, career and leadership was studied in mid 2017 whereas in the mid 2018, the research shifted to the intersection of women with faculty, STEM, science, family, gender difference as shown by the cluster and in the mid 2019, the research had a new direction focussing on scientists and its intersection with women, gender differences, STEM, faculty. On the basis of co-occurrence and all keywords, out of 189 keywords with the minimum no. of occurrences of a keyword taken as 5, the maximum no. of occurrences was of ‘work life balance’, followed by ‘women in stem’, ‘leadership’ and ‘stem’ whereas on the basis of co-occurrence and keyword plus, out of 203 keywords with the minimum occurrence taken as five, ‘women’ had the highest no. of occurrences i.e. 11, followed by ‘gender’which had occurred 9 times.

Figure 2: Co-occurrence and keyword analysis, web of science



Source: Vos Viewer

2.2.2 Scopus

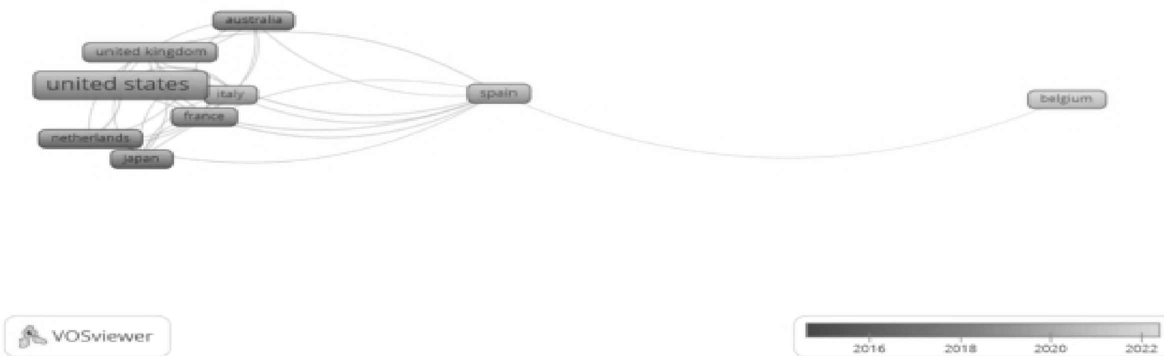
Co-authorship and countries
On the basis of co authorship between countries, out of 31 countries with minimum no. of documents being two, USA being an outlier had the highest no. of documents i.e. 50 with the highest no. of citations i.e. 1247 and UK being second with 66 citations and 4 documents. In the bottom was Sweden with two documents and zero citations and India with two documents and one citation. USA had clusters with five other nations i.e. Australia, France, Germany, Italy, UK whereas Sweden had a cluster with Belgium and Spain and India had no clusters. The first cluster had research work focussed on retention of women faculty in STEM by improving the quality of work and life through various support programs and it also focussed on inclusion of women of colour, leadership development and team building (Dell et al., 2017). The second paper of the two

documents talked about the career barriers of women faculty in STEM and how beyond grants an institution can contribute to the retention and advancement of its human resources (Bailey et al., 2015). The second cluster focussed on the changes in the institutional formal and informal systems to enhance the participation of women faculty in STEM (Dell et al., 2017) and organisational issues that act as a barrier for success of women in their scientific career (Bailey et al., 2015). The third cluster in which there is only one country i.e. India which has 2 documents where the first one focusses on women entrepreneurs who have a STEM background and had taken a career break because of work family conflict and inspite of the hardships are establishing themselves and trying hard to make a place for themselves in a place dominated by men (Sharma, 2022). The other document talks about the role of the scientific institutions in enabling the work life balance of women scientists and engineers as more joint families convert to nuclear ones and the responsibility towards family increases (Kurup and Raj, 2022).

Table 5: Co authorship and countries, Scopus

Country	Documents	Citations
Australia	2	11
Belgium	2	10
France	2	11
Germany	2	11
India	2	1
Italy	3	11
Japan	2	8
Netherlands	2	17
Spain	4	31
Sweden	2	0
United Kingdom	4	66

Figure 3: The clusters of nations working on this topic, Scopus (3 clusters identified).



Source: Vos viewer

Co-occurrence and keywords

On the basis of co-occurrence with the unit of analysis being all keywords, out of a total of 637 keywords with the minimum no. of occurrences of a keyword being 7, the highest no. of occurrences i.e. 24 was of "work life balance" followed by "human" with 16 occurrences" and "female" with 14 occurrences and work carried out on the intersection of the above majorly till mid-2017. Research on professional aspects of work life balance in STEM was being carried out in 2016-17. From 2017 onwards it has shifted to the intersection of 'work life balance' with 'female', 'STEM' and' human'. On the basis of co-occurrence and author keywords, out of 199 keywords with the minimum no. of occurrences being six, 'work life balance' and 'STEM' occurred 14 times followed by 'Women in STEM' and 'gender' which occurred 6 times each. On the basis of co-occurrence and index keywords, out of 495 keywords with the minimum no. of occurrence being 14, 'human' occurred 16 times followed by 'female' and 'work life balance' with 14 occurrences each.

2.2.3 Cambridge Core

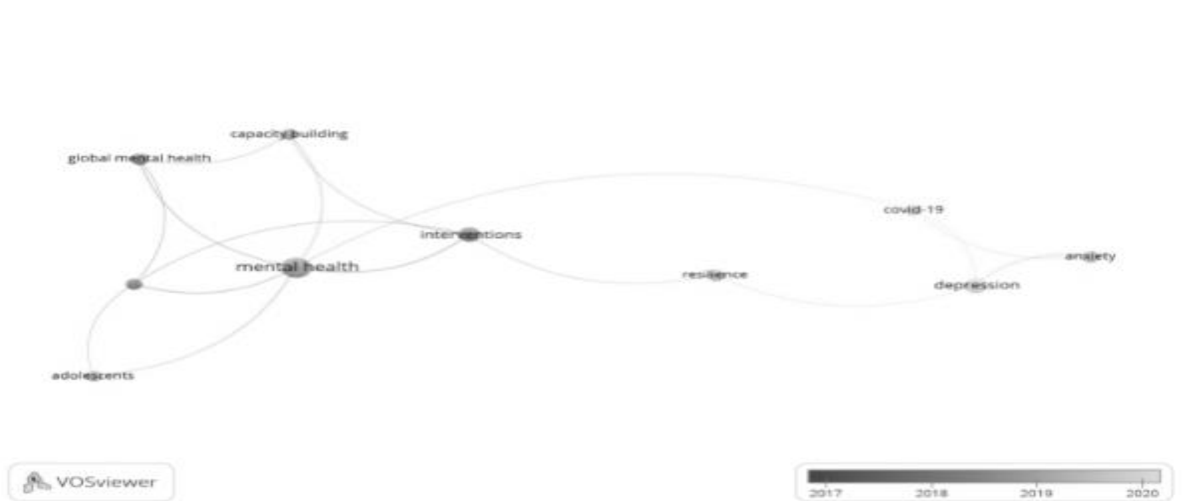
Co-occurrence and keywords
On the basis of co-occurrence and the unit of analysis being keywords, out of 274 keywords with the minimum no. of occurrence being 4, the highest was of 'mental health' with 14 occurrences and the highest link strength of 10 followed by 'depression' with 8 occurrences and the second highest link strength of 6 and furthur with 'interventions' which had 7 occurrences and a link strength of 5. 'Mental health' was highlighted during 2018 whereas 'depression' and 'interventions' during 2022 and 2017 respectively. Furthur analysis could not be done of the above

records, as there was no option of co-occurrences and other units of analysis available for these specific records after exporting it.

Table 6: Keyword analysis, Cambridge Core

Keyword	Occurrences
Adolescents	4
Anxiety	5
capacity building	4
covid-19	4
Depression	8
global mental health	5
Interventions	7
low- and middle-income countries	4
mental health	14
Resilience	5

Figure 4: Keyword Analysis of Cambridge Core



Source: Vos Viewer

2.2.4 Sage

On the basis of co authorship and authors with a minimum no. of documents being two, out of 451 authors only 3 authors had two documents with zero link strength each. Bib excel was used for furthur analysis as co-occurrences and other records were not available in vosviewer for this data. In Bib excel, selecting the type of unit as main and department under frequency distribution, there were three journals articles each by “Albert MN” and “Burt BA”. Under frequency distribution , selecting the type of unit as main organisation and choosing descending order, there appeared only 1 record i.e. “Journal of Transformative Education” in which a journal article named “Educating the Wandering Mind: Pedagogical Mechanisms of Mindfulness for a Curricular Blind Spot” had been published and the author was “Ergas O”. Under frequency distribution, selecting the type of unit as country and sorting via descending order, USA was the only record. Frequency distribution with the unit of analysis being author taken in descending order there were 2 sets of authors namely

"Pyöriä P,Ojala S,Saari T,Järvinen KM" and "Albert MN,Dodeler NL,Guy E" with 2 documents each on which they had collaborated. The same results appeared when we chose cited author. The keyword with the highest frequency in all records was "students" followed by "study".

The segregation of work and family had started in the mid 1800's during industrialisation but still men dominated the workplace. Women mainly mothers started joining the workforce from 1980's when the concept of WLB policies came into existence but even then men occupied the workplace as the usage of technology was identified with them (Naithani, 2010). Earlier research had stated that there weren't any theories which were universally accepted for WLB and all the existing ones are different in terms of the study's framework, variables and perspectives but it also asserted that the boundary and border theory were the two theories with major foundation which had been used by many researchers to explain the different perspectives of WLB (Muthulakshmi, 2018a). The past literature shows that five basic theories had been used to explain the work-life relationship which had been identified by Zedeck and Mosier (1990) and O'Driscoll (1996) namely segmentation, spillover, instrumental, conflict and compensation theories whereas the border and boundary theory had been proposed by Clark (2000) which were related to balancing work and family together (Bello and Tanko, 2020). It had focused only on a small number of theories like the Spillover, Conflict, Segmentation-Integration, Enrichment Facilitation and Border theory leaving the rest A survey of 234 employees working in four organizations in Australia which included a university, private sector firm and two public sector organizations, the results revealed how work to family enrichment and vice versa have a positive relation to self-efficacy which had a positive impact on the WLB (Chan et al., 2016). When WLB positively impacts the job and family satisfaction, it is known as the Enhancement theory (Chan et al., 2016). The enrichment theory propagates that if one has experience in the work role, it facilitates in improving the quality of other roles in life or vice versa (Chan et al., 2016). Theories focussing on mental health have not been highlighted in the light of mental harassment faced by women in STEM and this study has added this particular dimension as earlier the ideas were mainly focussed on social sciences including sociology, psychology etc. whereas the latter focusses on work-life balance. Additionally, in contrast to prior decades, the focus of the current research has switched from the work's unpleasant and contradictory features to its beneficial and facilitative characteristics.(Fatima R. Khateeb, 2021). Extensive literature exists on WLB theories but there is a need to focus on issues apart from work like cross border issues etc. (Thilagavathy S. and Geetha S.N, 2021). The consequences of the work to life conflict are more than life to work and life is more important as revealed in a survey of 215 STEM post-doctoral trainees (Pitt et al., 2021). More theories are needed in the context of developing nations as there is a dearth of reliable work-family and work-life constructs especially in developing nations like India where family, as an institution is very strong and female participation in on the rise.

In today's competitive and globalized environment, higher academic institutions must efficiently manage their faculty, fostering policies that promote work-life balance. This study examines impact of job, family and life satisfaction on work-life balance specifically for STEM academia HoDs, addressing the limited research on the human resources in educational institutions. STEM leaders in academia face higher levels of job stress. For reduction of job stress, the work environment has to be accommodating for an individual to enhance their productivity. The results of a survey involving 190 respondents shed light on the significant role of the work environment in shaping work-life balance perceptions. A substantial 83% of participants acknowledged the pivotal influence of the work environment in maintaining equilibrium between work and personal life. Furthermore, the data revealed that 51% of the respondents expressed strong agreement about the importance of flexible working hours in achieving work-life balance. Notably, technology was also deemed crucial, with a significant 51% of respondents recognizing its role in their work-life balance. Additionally, 46% of participants agreed that fostering positive relationships with superiors played a key role in enhancing their work-life balance (InduGautam, 2018). The greenhaus and allen model predicts how work and family have an indirect impact on the WFB through work family conflict and work family enrichment (Landolfi et al., 2020).Job and family satisfaction, which depend on work family conflict and facilitation, are predictors of work family balance. Organisations need to survive in a competitive world where globalisation demands upgradation of skills and knowledge, innovation and research. In this context, the higher academic institutions need to manage their human resources in an efficient way with policies and strategies favourable for their staff in managing their work and life (Huda Al-Kubaisi, 2022). This study tries to capture the effect of overall satisfaction levels for the faculty (only HOD's) in STEM academia on work life balance as very less studies have been conducted on the human resources in educational institutions providing degrees in STEM courses. There is a need to focus on the work life balance as the aspect of mental health being the most important has been highlighted in the recent theories on WLB (Anuradha & Pandey, 2015).Job stress due to less restructuring of the organisation and downsizing lead to a poor work life balance and greater work conflict in academia (Bello and Tanko, 2020).

2.2.5 Organisations and the WLB policies

Organizations must recognize the paramount importance of work-life balance, not only for the immediate well-being of their employees but also for the long-term survival and success of the organization itself (Naithani, 2010).A delicate equilibrium between work and personal life contributes to sustained employee engagement and heightened productivity, which are critical for an organization's sustained prosperity. To achieve and maintain work-life balance, organizations are encouraged to implement employee-driven policies. These policies encompass reducing overtime, mitigating stress, and managing workloads effectively. Additionally, providing options for working from home enhances flexibility, affording employees more leisure time with their families (InduGautam, 2018).This proactive approach acknowledges the vital role of employees in shaping their work-life equilibrium. Addressing the impact of stress on individual productivity is of paramount importance, and it is a joint responsibility of both the organization and the employee. Policies aimed at managing work-life effectively play a significant role in bolstering organizational productivity while aiding employees in achieving a balanced work-life. A survey conducted in Hong Kong in the year 2008 following the reduction of working hours in public sectors from a five-and-a-half-day week to five, demonstrated its effectiveness in terms of a better WLB. This policy shift led to a noteworthy reduction in the average working week by approximately half a day. Interestingly, the study revealed that male employees tended to work longer hours or overtime (72.9%) compared to their female counterparts (46%), as reported by Richard Welford in 2008. This case study underscores the impact of policy changes on work-life balance. Initiatives aimed at enhancing employee retention and satisfaction, such as offering free health screenings, health insurance, and exercise facilities, have proven highly effective. These measures, as highlighted by Muthulakshmi, (2018) demonstrate the importance of holistic employee well-being in sustaining a motivated and committed workforce. While globally recognized methods for fostering work-life balance are gaining traction, their specific effects within Indian organizations remain less documented. Future research is imperative to explore the unique organizational factors influencing work-life balance in the Indian context. Ali, (2016) underscores the symbiotic relationship between work-life balance programs and employee retention, emphasizing the need for employees to strike a harmonious balance between their personal and professional lives. In summary, work-life balance is a critical aspect of modern organizational dynamics, and the adoption of employee-driven policies and holistic well-being measures is integral to achieving sustained productivity, employee satisfaction, and organizational longevity.

2.2.6 Literature from all four databases

Earlier research was focussed on consequences and the implications of having a balance between work and the rest of life and more emphasis has been given to organisational psychology in the eastern European nations. (Guest, 2002). The research in 2005 was focussed on the race, merit and people of colour that sustained inequity in education and stood against cultural inequities that were a barrier in high quality education (Rogers & Oakes, n.d.; Brooms & Wint, n.d.) and in 2006 it shifted to school environment having an effect on the post high school life path (Lindholm, n.d.), contemplative education in universities in order to bridge the gap between distinctness across ethnic groups, individual differences etc. (Holland, n.d.). In 2008, the focus was on vocational education and training for school students to educate them about their responsibility towards sustainable development and for their empowerment (Arenas, n.d.) and in 2011 there was research on pedagogies in higher education (David, n.d.). It was in the year 2013 according to the Sage database that the research on mental health of Latinos was carried out for the first time as they faced language barriers (Peters et al., n.d.) but the direction of research was again back to the role of vocational training in learning for career and labour market transitions (Barabasch and Merrill, n.d.), maths faculty and classroom practices (Mesa et al., n.d.) in 2014, whereas in Cambridge core it was from 2014 onwards that mental health, maternal and child heath had been focussed upon as resiliencies lead to disordered mood and anxiety (Belkin, 2014; Ahuja et al., 2016). In 2015, documents were published on promoting mental health in low and middle income countries in (Tol, 2015;Sikkema et al., 2015) whereas in 2016, stigma of mental illness (Stuart, 2016; Lora & Sharan, 2015) and treatment of common mental disorders were the topics touched upon (Thomas et al., 2016). More research on mental health was carried out in 2018 (Cherry et al., n.d.; M. Sharma & Razzaque, 2017; Yang et al., 2017) and added to it, the effect of gendered norms and violence on the self-esteem among adolescents was also studied (Stark et al., 2018; M. T. H. Le et al., 2018; Kane et al., 2017). In the year 2020, people of colour mainly the black men in STEM and their sense of belongingness with their peers had been studied (Burt et al., n.d.). In 2021, several topics were being researched upon like teachers resilience to a professional development program as it was mostly the novice teachers who ready to challenge the existing norms (Tamah and Wirjawan, n.d.), developing technical/hard and soft skills (Ochieng and Ngware, n.d.), students engagement in learning (Teravainen-Goff, n.d.), the push and pull factors and the socio cultural context for doctoral student to pursue PhD from abroad or the geopolitical equity in global mobility (Oleksiyenko et al., n.d.), the academic professionals in a research university having the burden of research and teaching and which is the only thing they focus thereby, failing to perform administrative work (Lee et al., n.d.), professional development of teachers or pedagogical approaches to correct the gender equity in science (Forte-Celaya et al., 2021), inquiry based pedagogical approach in teaching (Post and Molen, n.d.), maths teaching practices for teachers by providing a framework of teaching pedagogy (Gargroetzi et al., n.d.; Hu et al., n.d;Post & Molen, n.d.) etc. In 2022, studies were carried on socio cultural adaptation issues (Yılmaz and Temizkan, n.d.), black male graduate students facing public shaming and how caring relationships can assist them better in completing their degrees as opposed to their expectation Burt et al., n.d.), Latina students , early career scientists and junior faculty experiencing diverse environments and mentoring programmes needed to take care of the retention and recruitment of this diverse population for them to achieve academic success (Pagan et al., n.d; Rincón & Rodriguez, n.d; Curry & Athanases, n.d.), more community based partnerships in order to retain the Latin students in STEM (Herrera and Sánchez, n.d.), teachers consciously or unconsciously getting affected by the gender bias while teaching in classrooms (Vu and Pham, n.d.), intersectional factors like race and ethnicity making it difficult for the women in the engineering workforce to progress as they didn't feel a sense of belongingness (Wilson and VanAntwerp, n.d.), university based sports and academic clubs contributing to the development of certain attributes in learners like leadership, communication, resilience etc. (Foley et al., n.d.), science students after pursuing their bachelor and master's degree choosing a discipline in science according to the narratives ,the expectation of having a particular image attached it and on the basis of cultural and institutional capital (Madsen and Holmegaard, n.d.), using Latina college students consider cultural wealth to decide career in healthcare as an honour to the women in their family which is critical to achieving equitable systems (Smith, n.d.), leadership roles of women (Alizadeh et al., n.d.), empowerment of women educators (Calderón, n.d; Edwards & Magill, n.d; Cipollone et al., n.d.) etc. Clearly, there is a dearth of studies in the context of WLB in STEM especially in the developing nations. Future research is needed for the WLB policies in developing nations focussing on the intersection of STEM and women.

The papers in 2023 studied how grit relates to burnout among academic rheumatologists. It found that higher grit is linked to greater professional efficacy but not exhaustion or cynicism(Miyawaki et al., 2023), less self-determined individuals in science showing a stronger inclination to leave later due to perceived lower salary and a lack of work-life balance (Chong et al., 2024), internal factors like sexism navigation, work attitudes/behaviour, stress management, self-concept, work-life-family balance, interpersonal strategies and external factors like social supports, workplace characteristics (Smith, 2024), STEM careers can be highly stressful due to pressures like tight program deadlines, meeting the needs of multiple stakeholders and resolving disputes (Rivera et al., n.d.), students' gender and race/ethnicity significantly influence their career outcome expectations in diverse ways (Doyle et al., 2023), major challenges in the workplace include career progression, workflow organization, family life policies, sexism, and gender imbalance, health workers operating in highly stressful environments during the covid pandemic risking their well-being to deliver life-saving services faced difficulties in managing work life balance and in order to mitigate burnout and prevent premature exits from the workforce, it was crucial to prioritize their protection, provide supportive work environments, offer stress management resources, and ensure access to mental health services when necessary (Hoover et al., 2023), during the pandemic, over one-fifth of pharmacists in psychiatric hospitals reported experiencing symptoms of depression or anxiety, underscoring the necessity for policy reforms to enhance workplace conditions and promote psychological well-being among this professional cohort(Zhang et al., 2023). In the Philippines, individuals reported moderate-to-severe clinical outcomes such as fear, depression, anxiety, or stress during the pandemic. Coping behaviours, including resilience and various adaptation methods such as religious, spiritual, and community-oriented approaches, were highlighted in response to stringent infection prevention and control measures aimed at containing

COVID-19(Ocampo et al., 2024). The research papers published in 2024 were based on pandemic times when offering family-friendly support, including emotional assistance, could ease work-life conflicts for women faculty in computer science, thereby contributing to retention efforts(Lawson et al., 2024), burnout among academician attributed to heavy workload, long hours, and inadequate work-life balance (Shakir et al., 2024), during the pandemic, poor sleep quality was prevalent at 59.4% and the factors significantly associated with and predictive of poor sleep quality included the use of electronic devices before sleep, increased workload, and distractions while working (Aye and Lee, 2024), healthcare workers (HCWs) mainly women commonly addressed the stigma they faced while carrying out their COVID-related duties and a significant proportion, 77.42%, reported experiencing some form of stigma(Grover et al., 2023), Several factors including financial strain, caregiver burden, relationship quality, belief in mental illness, perceived COVID-19 stress, satisfaction with health services, depressive symptoms, anxiety symptoms, and life satisfaction were examined. Results indicated significant correlations between relationship quality among spouses, COVID-19 stress, and caregiver burden with anxiety symptoms, depressive symptoms, and life satisfaction (Cham et al., 2024). Careers can be highly stressful due to pressures like tight program deadlines, meeting the needs of multiple stakeholders, resolving disputes, and ensuring the safety of all individuals on site (Beresford and Rose, 2023)

2.3 Research Productivity

Women scientists are expected to play both the roles of being a good homemaker as well as an earner, which proves to be very taxing for their productivity at the workplace. (Gurnani & Sheth, 1984). Women are expected to have more no. of publications than men do in order to get promotion and tenure, making them work hard to prove their calibre (Kumar, 2001). A study which considered the performance of men and women researchers in the much later stages after completion of their PhDs revealed that male productivity was higher and gender played a major role in it after controlling the performance indicators. (van den Besselaar & Sandström, 2016). Women scientists have fewer patents than men in academia. (Kjerston Bunker Whittingon and Laurel Smith-Doer, 2008).Findings from a study of gender inequality in academic medicine conducted in Canada showed that despite an increases in the number of women physicians there were significant differences between men and women psychiatrists only for junior faculty and not for associate and full professors and women had fewer peer-reviewed publications in comparison to men. (Sarah Chauvin, 2019). Findings from a study in Germany indicated how gender determines the publication in top journals of professors in psychology, and it was observed that after controlling for collaboration, the effect of gender decreased in terms of publications in top journals, which is important for the career advancement of women. (Mayer; Rathmann, 2018). Many researchers have also validated the fact that there exists either a positive or a negative relationship between teaching & research productivity. According to (Welch, 2014), the relationship would depend on the no. of hours dedicated to research and teaching because the faculty in academic institutions have a limited time to invest in different activities of the department. A study on research productivity and the teaching effectiveness reveals that there exists a weak relationship between the two which can be in someway attributed to the characteristics of an individual and the institution in which he is working (Thomas C. Noser, 1996). The recent research points out to the fact that the productivity of men and women differs because of reasons like structural barriers that exist for women at their workplace, more burden of teaching & administration, and other institutional activities that lead to a lower research output as compared to men. (Welch, 2014).According to a research by (J.LerchenmuellerOlavSorenson, 2018) , women produce less output than men in science research ,have fewer papers published, of which mostly are in less prominent journals and have fewer citations. These can be attributed to factors like discrimination, childcare, not good mentoring which in turn account for women having lower-level position in an institution. A study on the academic workplace climate in STEM revealed that although the output of men and women faculty was the same but still the department perceived that women were less productive than men (Rebecca Riffle, 2013). Another study on the productivity gap between men and women in STEM shows that women need to have more scientific knowledge, social capital, and resources to be able to reach the same level of increase in productivity /research output as of men. (Aquinas, 2018). Also, research says that promotion and hiring committees prefer men over women.

According to (J.LerchenmuellerOlavSorenson, 2018), the STEM workforce after the post-doctoral training usually opts for a junior faculty position and in order to secure a long term tenured academic position, finding a means of funding is a must and for being scientifically productive, the no. of publications matter. The results of a study revealed that in spite of no significant differences in research productivity, there are significant differences in the academic ranks of men and women which could be because of sex discrimination. Academic rank and gender are correlated whereas research productivity and gender have no correlation. Ideally, rank/production should have been related to research output but the study reveals that it is not the same. Another revelation was that there was no correlation between research performance and the time spent on doing research which points out that household/dual responsibilities do not stop women from doing quality research. (Kumar, 2001).

2.3.1 A view from Studies conducted in Global north

In a study of the U.S institutions out of an interview of twenty faculty, seven participants characterized themselves as intentionally blending their personal and professional lives, aligning their research agenda pursuits with their family, community, and core personal values 8., the tenured faculty were primarily motivated by intrinsic rewards, such as peer recognition and personal fulfilment through contributions to their field whereas the untenured were motivated by extrinsic rewards, including the attainment of tenure, promotions, and salary increases (Fox and Canagarajah, 2004). Academics in the global north are predominantly driven by intrinsic factors like personal passion and interest in their research (Tariq Mahmood et al., 2018). The study of 1370 academicians in UK suggests that individuals often turn to their immediate peers as a source of inspiration, considering them a vital reference group and benchmark for their own aspirations and actions 24. In UK universities, faculty members contend with intense pressure to "publish or perish," creating a challenging environment where competition, heightened teaching responsibilities, and administrative duties collectively contribute to decreased research productivity. The results of a study conducted in Australia revealed that more time spent on research doesn't necessarily correlate with better teaching and a limited or negative relationship exists between research time and teaching quality (Teodorescu, 2000). In the study of the US, eight out of twenty participants explicitly mentioned that their teaching responsibilities played a supportive role in advancing their research agenda (Kyvik and Reymert, 2017). In a study of Norwegian academics, participation in research groups and international research networks was associated with increased research productivity 11 and similar results were obtained for South Korean academics (Kelly Ward and Tami L Moore, 2010). In a US study, participants expressed that, despite the increasing focus on community engagement by research institutions, promotion and tenure criteria predominantly favor traditional research. This is because participants believe community engagement, while personally valued, is not adequately rewarded by the university and falls outside the normal reward structure. Additionally, concerns were raised about insufficient university sponsorship for the necessary resources. While research institutions are increasingly committed to engagement with the community, the structure of promotion and tenure is still skewed in favour of traditional research at many institutions. In the developed nations, faculty members need to actively engage with the community to benefit from it, while also fulfilling the requirements of publishing and securing funding to maintain a balanced and productive academic career. (Kelly Ward and Tami L Moore, 2010). Researchers from a public university in Italy who had applied frequently for grants turned out to be more actively engaged in teaching and administration and showed persistent funding application behaviour but funding did not lead to higher research productivity (Mitchell and Rebne, 1995). In a study in the US, faculty members face the challenge of meeting university expectations to secure external grants and contracts when internal funding is scarce. Nonetheless, for those who successfully obtain external research support, substantial funding serves as a remedy for their academic marginalization. Participants experienced pressure to meet conventional expectations of publishing and obtaining external funding, and they tailored their work accordingly to align with these expectations. Fifty percent of the participants (10 in total of 20 interviewees) utilized externally funded research grants as a means to incorporate engagement activities into their ongoing scholarly endeavours (Kyvik and Reymert, 2017). The availability of grants and funding support in academic institutions in the global north significantly boosted research engagement and productivity by providing essential resources for projects (Tariq Mahmood et al., 2018). The indirect influence of funding bodies emphasized the necessity for academics in Australia to tailor their research to meet the criteria set by these organizations to successfully secure research grants. They had to align their research with contemporary trends and topics that were considered "in fashion" to increase their chances of securing competitive grants(P.H. et al., 2018). The results of a study conducted in U.S.A in a private university indicate that consultancy done to four hours per week and up to eight hour per week of teaching can facilitate research productivity (Kimkong Heng et al., 2020).

2.3.2 A view from Studies conducted in Global south

The academics' engagement in research and their research productivity are influenced by personal as well as environmental factors (Lawson et al., 2021). A conducive environment provides access to necessary tools, equipment, and resources, facilitating productivity (Snowball and Shackleton, 2018). Motivation, especially the intrinsic one, is identified as a significant factor that empowers academics to thrive in their research endeavours (P.H. et al., 2018). In a study of 20 public universities in Malaysia, the results revealed that a higher level of trust and commitment in self-lead to higher research engagement (Chen et al., 2006). In a study of a public university in Saudi Arabia both intrinsic motivation such as professional development and external motivation like promotions were significant in improving research productivity (Finnegan, 2005). Working alongside supportive colleagues fosters collaboration and idea-sharing, boosting productivity (Snowball and Shackleton, 2018). To facilitate increased international research collaboration in public institutions like IIT Delhi in India, there is a pressing demand to create a conducive research environment and upgrade existing infrastructure (Zahid Ashraf Wani et al., 2013). In a survey of Vietnam university academics, the lack of access to research resources lead to less engagement in research (Fauzi, 2023). Monetary rewards served as a strong motivator for Chinese academics, encouraging them to publish in international journals. Financial incentives were a key factor in their publication decisions (Reynolds and Sariola, 2018). Results of a study on faculties of six public sector universities in Pakistan showed how highly productive researchers were often motivated by various factors, including financial benefits, research grants, rewards, promotions, job security (tenure), and other incentives. These incentives served as powerful drivers for their research efforts and productivity (Kimkong Heng et al., 2020). Establishing suitable research facilities and an encouraging atmosphere can foster greater global connectivity and collaborative efforts within the institution. Public sector institutions like IIT Delhi have collaborations within India but very less abroad (Zahid Ashraf Wani et al., 2013). Although it is possible that people work collaboratively on research with individuals in other departments or even in other universities, much research collaboration occurs within departments because of proximity (Snowball and Shackleton, 2018). In research conducted in twenty Malaysian public universities, the results revealed that knowledge sharing via international research collaborations has led to an increase in research productivity but the same has been criticized by many researchers as the focus on international collaborations is being done because of the pursuit of higher rankings and this ranking-driven approach has some negative consequence (Chen et al., 2006). The high ranking of one private university (second) in Malaysia among all Malaysian universities in the Times Higher Education Ranking for 2021 is intriguing. It presents an opportunity to evaluate how academicians in private universities relate to Knowledge Sharing (KS) behaviour and, subsequently, their research engagement. 39% of the total faculty in a Saudi Arabian public university agreed that they were engaged in research collaborations within the institute although collaboration with colleagues over there wasn't a strong motivating factor in doing research and so mostly the faculty engaged in individual research. The reason could be their cultural identity of preservative Islamic values which discourages the academic staff from engaging in collaborative research (Finnegan, 2005). In a survey of fifty-six Vietnam university academics, the results revealed difficulty in obtaining research funds and the cumbersome process of preparing paperwork for research funding applications were notable barriers, highlighting the importance of streamlined funding procedures and support for researchers (Fauzi, 2023). Funding bodies and academic institutions should acknowledge unintentional biases in their reward systems that favour sole authorship and neglect collaborative contributions. They should advocate for the recognition of knowledge sharing as a valuable academic achievement, fostering a more inclusive and equitable research environment and encourage a re-evaluation of assessment criteria to give due importance to participatory and collaborative research methods (Borg and Alshumaimeri, 2012). Interviews of Cambodian university academics revealed that many were engaged in consultancy because of a lack of promotion-based system and lower salaries. Holding multiple administrative positions in universities demonstrates a strong commitment to the institution in which the faculty is tenured, which may translate into higher overall commitment to the university thereby increasing productivity. Teaching at multiple institutions provides a broader perspective and understanding of the academic landscape, potentially enhancing one's commitment by recognizing the university's role in a larger context. Administrative roles and experience at various institutions can contribute to professional growth, increasing job satisfaction and attachment to the university (Snowball and Shackleton, 2018). Researchers in Cambodian private universities who are untenured engage in part time teaching which reduces their research productivity (Lawson et al., 2021).

2.4 Leadership in academic institution and employability of students

In STEM, career choices and placements are guided by institutional prestige and advisor support. Individuals seek institutions that align with their aspirations, focusing on prestige and mentorship. These dynamic pairing shapes career paths, ensuring alignment with desired institutional attributes in the STEM domain (Pinheiro et al., 2017). A study on examining the placement of the top thousand students in science and mathematics fields within universities. The study utilized data from the Student Selection and Placement Centre (OSYM) to investigate placement trends in STEM fields and it was found that between 2000 and 2014, top students in Turkey predominantly chose engineering departments within STEM fields. However, during this period, there was a decline in overall interest in STEM fields, accompanied by a significant gender gap that favoured males (Akgunduz, 2016).

2.5 Leadership in academic institution and USR activities

Higher education institutions globally face a significant challenge in fulfilling their third mission of contributing to the economic and social development of their communities. The traditional focus on teaching and research is deemed insufficient. The United Nation's "Decade of Education for Sustainable Development" (2005-2014) and "Principles for Responsible Management Education" initiative (launched in 2007) underscore the need for institutions to play a role in fostering responsible and sustainable practices to prepare future leaders (Godemann et al., 2014)

In this context, Community Engagement (CE) is the higher education institution's counterpart to Corporate Social Responsibility (CSR). While teaching and research were traditionally considered as core functions, CE is now widely accepted as the third core function. It enables universities to leverage their expertise to meaningfully address the development challenges of their communities and country (Tembo et al., 2021). It is vital in higher education, equipping students for the workforce and instilling a sense of civic responsibility. It involves students engaging in conversations with communities and institutions to comprehend the lived experiences of their partners. This involvement enables Higher Education Institutions (HEIs) to have a tangible and positive impact on society at large (Cremonini and Adamu, 2021).

There is a dearth of literature specifically addressing social responsibility in higher education from Africa, excluding South Africa, as well as in Asia and the Middle East. Generally, the social responsibility literature complements the extensive body of work on community engagement. In a study of engineers in a university that tried to analyse the engineer's contribution to society, it was analysed that the inclusion of a course on sustainable development in the engineering curricula could motivate the students to contribute to the society through their research. (Pritchard & Baillie, 2006). The engineering students must know the interaction between the society, technology and the environment so that the benefits of the technology are positive for all. (Installs, 1996). In a study of Australian engineers, the results revealed that engineers should try to solve global issues for which they need to communicate effectively with the other professionals to get hold of the problems faced internationally. In order to achieve sustainability and have a good quality of life, they need to create or modify existing technologies to enhance efficiency. For eg: they can develop technologies for the poor and the desolate to upgrade them in the society and help them come out from the shackles of poverty. (Johnston, 2001). An engineer needs to be trained in both a social science and engineering courses together in order to make them realise the importance of social factors in their research. The technologies should serve the purpose of development in the society. A product or process needs to be developed by an engineer taking into consideration the technical point of view as well as its benefit to society. Courses like business studies help the engineers accommodate social factors into their research. It is not just the skills needed to make a product but also its benefit to the society, which matters. (Stroke & de Varies, 1995). According to the world data, 12% of the population did not have electricity in their homes in 2016, in 2015; 2.1 billion people did not have access to safe drinking water. To address these challenges, the economic, social, human and environmental impacts of engineering need to be considered. Courses that help the engineers to incorporate such value-based perspectives need to be added in the engineering curricula of the educational institutions. (UNESCO, 2021). To make the engineers sensitive to the demands of the global world, they need to be educated on courses like ethics and environment (Johnston, 2001). Courses like STS (Science, Technology and Society) have been developed to educate engineers and make them understand how their contributions can turn out to be beneficial to the welfare of society. The students of design weren't stimulated enough by their mentors to look into the social factors of a particular design product. (Stroke & de Vries, 1995). In a study of how female faculty impacted the students in choice of courses, the results revealed that female professors positively influenced the female students to take up an additional course and the students had 5.2 more credits than the other female students under the male faculty. (Bettinger & Long 2005). They serve as role models and help the students develop a keen interest in their subject. The results were highly positive for the subjects of mathematics and geology. The results suggest that the same gender faculty makes the students of the same gender develop a keen interest in their subject as they serve to be role models for them. (Bettinger & Long, 2005). As science competes with other areas in society for public money, it is also faced with the challenge of demonstrating its value to society (Cohen et al. 2015). If a research outcome has a societal impact, which is positive, it will attract more public funding. Since according to past literature, more men take public funding than women, so the former will have projects which impact the society in a positive way (Bornmann, 2012). The results of the research lead to recommendations to funding agencies and educators on the need to develop interdisciplinary technical case studies so that the innovations happening in the engineering world can be communicated to the students in the classrooms. (Raju & Sankar, 1999). A study of 50 studies on health intervention research which used the payback and the Canadian model of research impact, grouped different types of impacts into four levels that might arise from intervention research i.e. scholarly outputs, translational outputs, policy or practice impacts, and long-term population outcomes. Each impact level was populated with sub- categories or indicators to further facilitate assessment of the type of impacts that occur at each level. Thirty-one studies (62%) were classified as having no real-world impacts and 19 (38%) were assessed as having at least one impact. (Cohen et al., 2015). Further, the results revealed numerous commercial product launches, three policy changes, four changes to service delivery, one organizational change, and one change to clinical practice as measured by the two models. Other research has found that individual studies from a range of research types, including basic, applied, and clinical research, can have wider impacts (Cohen et al., 2015).

2.6 Leadership in academic institutions and engagement with the corporate and government sector

Recent shifts in knowledge dynamics have led to increased diversity in university-industry interactions, encompassing activities like collaborative research, problem-solving, consultancy, and networking, among others, across regional, national, and global innovation systems (Perkmann and Walsh, 2007). Much of the literature on UII (University Industry interaction) rationales tends to favour the academia in these interactions (Ankrah et al., 2013). Hanel and St-Pierre (2006) argue that firms collaborating with universities credit these partnerships with sustaining their competitive position, profit margins, and international market share growth. Such collaboration is seen as reducing costs, especially in knowledge creation, making it a more cost-effective option compared to in-house research (Hanel and St-Pierre, 2006). The researcher mobility between academia and industry is very important particularly in science fields as it is the human capital which matters and it is difficult for the industry to decodify the knowledge itself.(Beguilers, 2016). Past research has shown how hiring women as consultants in corporates boosts diversity, which enhances decision-making, innovation, and productivity. In a study of UK which studies the physical and engineering scientists who were similar in academic rank, research productivity, and discipline, the results revealed that women engage less with the industry as compared to their males' counterparts (Tartare & Salter, 2015). Academic faculty researchers engage with the industry by providing consultancy on research projects as experts, engaging the students working under them as personnel in the firms, contractual research etc. In a work environment where gender diversity is being promoted, leads more women scientists to collaborate with industry at the same rates as men. Women scientists in their academic careers face triple burden of managing domestic responsibilities, lack of social capital, and chilly or unfavourable workplace. Some scientists doubt that collaboration with the industry might change their way ahead from doing basic research in universities focussing on public agendas to market-driven research and are apprehensive about delays in the publication of their research results due to negotiations about it with the firms that they have collaborated. Because of the environment being unreceptive in the industry as perceived by women, it becomes even more difficult for them to negotiate productive exchanges as compared to their male counterparts. In the field of science and technology, the women scholars felt that the culture of industry was hostile for their research Another factor is the time devoted to domestic responsibilities like childcare which leaves them with less time to engage with industrial partners for research (Tartari et al., 2014). But leaving the domestic responsibilities aside, McKinsey's study reveals a 21% higher chance of above-average profitability with gender-diverse leadership teams. Women's diverse life experiences and backgrounds offer fresh perspectives, fostering innovative ideas. Hiring women as consultants enables businesses to tap into these unique viewpoints for novel problem-solving approaches as they exhibit certain qualities like excelling in communication, relationship building, and teamwork, essential skills for consultants to convey complex ideas and collaborate effectively with various stakeholders (Iain Hay, 2006).

Universities play an important role in the dissemination of knowledge to the industries. They have multiple tasks and face a trade-off between them. Apart from imparting education, inspiring the students to do research that is market driven, developing new products are another challenge in which they face tremendous pressure to excel as it influences their international/national rankings. (Veugelers, 2016). The UI (University-industry) interaction outcome for the PhD students could be measured by the scholarly productivity, commercial productivity which will involve patents and trade secrets and the academic freedom which could be measured by the permission for the student to freely publish the research results by the firm (Thune, 2009). In a study on scientists in academia and industry, the results revealed that women produce less commercial work than their male counterparts but if we compare the quality of it between both the gender and over time it is equal or better in the case of women scientists. (Whittington & Smith-Doerr, 2005). University patents are being acquired by the corporates, and if the researcher/

inventor had been given a royalty or equity, he/she will be encouraged to do an invention and so, schemes should take this in their consideration that the credit should be given to the inventor. (Veugelers, 2016). Not all patent applications are approved, so the university patents that aren't accepted are used in the corporate sector, and if a university patent is licensed, it will tell us how effectively it is being used because the licensing income is an addition to the university's resources. Women academics in the discipline of life sciences have 40% less patents and inventions than their male colleagues (Ding et al., 2006). The university patents help in the technology development of the corporates and the citing of the academic patents by the corporate patents tell us how the former helped in the technology development of the latter. (Veugelers, 2016). The student spin-off is higher as compared to the faculty in the universities but are difficult to trace. It would be interesting to note whether in the case of universities, having a technological park nearby enhance the productivity of the researchers. The researcher mobility between academia and industry is very important particularly in science field as it is the human capital, which matters, and it is difficult for the industry to decodify the knowledge itself (Veugelers, 2016). In a study done in the USA, the results revealed that in a collaboration between the government and the undergraduate students of a university, the projects done with them benefitted the government agency. The students gained hands on experience and also achieved recognition by presentation of papers in conferences (Elaine Venson; Rejane Figueiredo; Wander Silva; Luiz C. M. Ribeiro, 2016) The recruitment of students in the firms as an intern serves as a route for the interaction between firms and universities (Thune, 2009). Informal contacts, conferences and publications, consultancy, recruitment from college were the factors that lead university-firm tech transfer. Research based education by a university to its students is an important factor determining the economic development of a country. (Veugelers, 2016). In order to maintain university- industry relations, students play an important role as they help in the production, transfer of knowledge and the formation of networks between the two. The doctoral students form contacts with the firms with the help of their supervisor's networks of interpersonal relations, which helps to foster exchange relationships. These ties continue even after the student's graduate. Another thing could be the perception about how easier it would be for them to find a job i.e. future career prospects (Thune, 2009). In a study of UK which studies the physical and engineering scientists who were similar in academic rank, research productivity, and discipline, the results revealed that women engage less with the industry as compared to their males' counterparts (Tartari & Salter, 2015). There exists a relationship between the types of collaboration that the students have while they are pursuing a degree and the employment position/status, sector that they choose, after they graduate. (Thune, 2009). This could be attributed to the work environment in which they operate. Support policies for women could help reduce the gap between the gender. The outcome of the PhD student in the industry-university collaboration is influenced by the prior experience of his/her faculty supervisor, department and the firm with whom he/she collaborates. (Thune, 2009). Academic faculty researchers engage with the industry by providing consultancy on research projects as experts, engaging the students working under them as personnel in the firms, contractual research etc. Tenure and quality of the department of affiliation with the industry impact the transfer of technology differently by both the gender. In a work environment where gender diversity is being promoted, leads more women scientists to collaborate with industry at the same rates as men. Women in the scientists in their careers face triple burden of managing domestic responsibilities, lack of social capital, and chilly or unfavourable workplace. The industries should collaborate with the universities in providing the training for the post- graduation students for them to have hand-on experience. (P-GALVIN, 1985). Some scientists doubt that collaboration with the industry might change their way ahead from doing basic research in universities focussing on public agendas to market-driven research and are apprehensive about delays in the publication of their research results due to negotiations about it with the firms that they have collaborated (Tartari & Salter, 2015). Access to industries can be helpful to scientists as they get access to their data and equipment's and engage in new research projects. Because of the environment being unreceptive in the industry as perceived by women scholars, it becomes even more difficult for them to negotiate productive exchanges as compared to their male counterparts. (Tartari & Salter, 2015). In the field of science and technology, the women scholars felt that the culture of industry was hostile for their research (DiTomaso et al., 2007b). Another factor could be time devoted to domestic responsibilities like childcare which leaves them with less time to engage with industrial partners for research. More women in a discipline lead to their more participation in the industrial research as they might have access to more resources in the department in which they are employed, and this reduces the chances of tokenism. (Tartari & Salter, 2015)

2.7 Research gap of the study

Extensive literature review has been done on literature relevant to the topic of the study and it has been found that there is a dearth of studies related to the topic in the following aspects:

1. Gender differences in leadership in STEM academia
2. Differences in research productivity has been done but there is a dearth of studies on gender, designation and discipline wise difference in research productivity of the faculty.
3. Impact of gender of the HoDs on placement of the students.
4. University Social Responsibility has not been studied much in the context of engineering institutions and HoDs
5. Though there are some papers on the issue of leadership in corporate sector but gender differences of the HoDs in establishing association with the corporate and the government sector have not been studied much.

CHAPTER 3
OBJECTIVES AND RESEARCH METHODOLOGY

3.1 Introduction

In this chapter of the study, objectives, hypothesis, methodology, and tools have been discussed. A mixed methods approach has been followed.

3.2 Objective of the Study

There are a total of five objectives. The hypothesis, variables, tools, model specification, data collection methods etc., have been discussed sequentially below.

1. To map gender of the HoDs and assess the gender-wise difference in the work-life balance of HoDs.
2. To measure the productivity of faculty members and compare it across gender, designation and branch.
3. To investigate gender effect of the leaders on placement.
4. To assess gender-wise differences in HoDs for involvement in USR activities.
5. To investigate the gender-wise difference of HoD's in attracting funds from the corporate and government sector.

3.2.1 Objective 1: To map gender of the HoD's and assess the gender-wise difference in the work-life balance of HoD's.

3.2.1.1 Hypothesis

H_{10}: WLB is not significantly different for male and female HoDs.
H_{11}: WLB is significantly different for male and female HoDs.

3.2.1.2 Variables

Table 7: Description of variables and tools

Description	Research Tools
Work-life balance Index = Job satisfaction (JS) + Family satisfaction (FS) + Life Satisfaction (LS).	Independent Sample t test

Source: Made by the Researcher

3.2.2 Objective 2: To measure the productivity of faculty members and compare it across gender, level and branch.

3.2.2.1 Hypothesis

H_{20}: There are no significant differences in the research productivity of male and female Assistant Professors
H_{21}: There are significant differences in the research productivity of male and female Assistant Professors

H_{30}: There are no significant differences in the research productivity of male and female Associate Professors
H_{31}: There are significant differences in the productivity of male and female Associate Professors
H_{40}: There are no significant differences in the research productivity of male and female Professors
H_{41}: There are gender-wise significant differences in the research productivity of male and female Professors
H_{50}: There are no significant differences in research productivity of male and female in applied science branches.
H_{51}: There are significant differences in research productivity male and female in applied science branches
H_{60}: There are no significant differences in research productivity of male and female in engineering branches.
H_{61}: There are significant differences in research productivity of male and female in engineering branches

3.2.2.2 Variable

Table 8: Dependent and Independent variables

Description	Dependent Variable	Independent Variable	Research Tools
1. An index has been made to measure the research productivity for all faculty members (1293) = Citation + h index + i 10index. Productivity will be coded as '1' if it is above the average and '0', otherwise 2. Branch of engineering has been divided as Engineering and Applied sciences.	Gender of the faculty, Designation, Branch.	Prod_Faculty, Gen, Design, Branch	Gender of the faculty, Designation, Branch

Table 9: Variable Measurement

Variable	Definition	Freq.
Prod_faculty	The average productivity will be calculated for all the engg. colleges in Delhi and for a faculty it will be coded as 1 if their productivity is above average & 0, otherwise.	0 = 585 1 = 708
Gender	A dummy variable with 1 as Male and 2 as Female	2 = 391 1 = 900
Designation	A dummy variable with three categories i.e. 1 as Assistant Professor, 2 as Associate Professor and 3 as Professor	1 = 795 2 = 159 3 = 339

Branch	A dummy variable with 1 as Engineering branch and 2 as Applied science	1= 1112 2 = 181

Note: A total of 1293 tenured faculty.
Source: Made by the researcher

3.2.3 Objective 3: To investigate gender effect of the leaders on placement.

3.2.3.1 Hypothesis

H_{70}: There is no effect of gender of the leader on the no. of placements in the department.
H_{71}: Gender of the leader affects the no. of placements in the department.

3.2.3.2 Variables

Table 10: Description of variable and tools

Description	Research Tools
Number of placements under a leader = Number of students placed/ Number of students appeared.	Independent sample t test has been used to test the differences between male and female HoDs

Source: Made by the researcher

3.2.4 Objective 4: To assess gender-wise difference in HoD's for involvement in USR activities.

Students were involved into three kinds of activities i.e. Economic, Social and Environmental. It was difficult to measure the degree of involvement, level of motivation, degree of challenges and to compare the work done under the three types, a qualitative study has been done.

3.2.4.1 Hypothesis

H_{70}: There is no effect of gender of the leader on the number of placements.
H_{71}: Gender of the leader affects the number of placements

3.2.4.2Variables

Table 11: Description of variable and tools

Description	Variables	Research Tools
Students may be involved into different types of USR initiatives.	1. Type of USR activities 2. Degree of Challenges faced 3. Collaborations 4. Motivation & measurement.	Content analysis

Source: Made by the researcher

3.2.5 Objective 5: To investigate the gender-wise difference of HoD's and their WLB in attracting funds from the corporate and government sector.

3.2.5.1 Hypothesis

H_{80}: There are no significant differences in the amount of contribution from corporate and government sector on the basis of gender

H_{81}: There are significant differences in the amount of contribution from corporate and government sector on the basis of gender.

H_{90}: There is no significant difference in the amount of contribution from corporate and government sector on the basis work-Life balance of HoDs

H_{91}: There are significant differences in the amount of contribution from the corporate government sector and work-Life balance of HoDs

3.2.5.2 Variables

Table 12: Dependent and Independent Variables

Description	Dependent Variable	Independent Variable Variable Name	Research Tools
Collaboration of academia with Corporate and the Government sector	Amount of funds received from Corporate & Government sector	Gender, Work-life balance	Logit Model

Source: Made by the researcher

3.3 Population Description

A census had been conducted for colleges providing full time Btech degree in STEM disciplines in twenty engineering colleges of Delhi, India which includes ten private and ten public HEI's. A total of 103 leaders responded to the questionnaires and shared their experiences via semi-structured interviews. Although 127 had been approached but due to some reasons 18 had refused to give an interview and five were unreachable via email. All Professors, Associate Professors and Assistant Professors of the science and engineering departments of these engineering colleges in Delhi will be studied. Each department head of a college will be considered as a single unit for my study.

Table 13: Information of the respondents

Population	Public		Private		Total	
	Male	Female	Male	Female	Male	Female
Heads of Science	10	7	5	1	15	4
Heads of Engineering	40	18	10	16	50	34

Source: Made by the researcher

Table 14: Profile of the respondents

Variable	Freq.	Percent
Gender		
1 – Male	65	63.11

2 – Female	38	36.89
Designation		
1 – Assistant Professor	4	3.88
2 – Associate Professor	19	18.45
3 – Professor	80	77.67
Branch		
1 – Applied Science (Maths)	6	5.83
2- Applied Science (Chemistry)	5	4.85
3 - Applied Science (Physics)	5	4.85
4 – Automation &Robotics	2	1.94
5 – Textile and fibre	1	0.97
6 – Computer Science Engineering	14	13.59
7 – Civil	7	6.80
8 – Electronics and Communication	9	8.74
9 – Electrical	9	8.74
10 – Mechanics and Automation	8	7.77
11 – Information Technology	2	1.94
12 – Biotech	6	5.83
13 – Material Sciences	2	1.94
14 – Environment Engg.	5	4.85
15 – Mechanical	9	8.74
16 – Software	4	3.88
17 – Design	7	6.80
18 – Architecture & Planning	2	1.94
Marital Status		
1 – Married	93	90.29
2 – Unmarried	8	7.77
3 - Widow/Separated/Divorced	2	1.94
Type of College		
1 – Private	35	33.98
2 – Public	68	66.02
Total	103	100.00

Source: Made by the researchers

3.4 Population and sample

3.4.1 Data collection

A mixed methods approach has been used for this research. Both primary and secondary data has been collected. Primary data has been collected from both engineering and science departments. Out of 20 colleges, it is by chance that there is equal no. of public and private HEI's i.e. 10 each and department head is taken as the unit of study for the research. Initially, the data regarding HoDs was collected through the websites of the institutions. A well-structured questionnaire was developed consisting of questions regarding WLB, placement, amount of funds. First, it was sent through email to all the heads and followed by personal visits. The questionnaire was supplemented by interviews and long discussions on the related topics. In the first visit, 47 HoDs gave face-to-face interviews and 56 in the second round. The interviews were conducted for a period of eight months in the respective departments of HEI's, starting from 01-10-2022 to 31-05-2023. Information has been collected in all branches of Engineering and Applied science (Physics, Chemistry and Maths). Faculty of all the three designations i.e. Assistant professor, Associate professor and Professor had been included in my study. Out of 127 HOD's, 103 had responded. Many heads denied to share the placement data for which special permissions were taken from the placement cell to allow for the same. The questionnaire consisted of four parts where part A was introduction, part B was work life balance which consisted of 15 statements on Likert scale of 1 to 5, part C was information related to amount of funds drawn from the corporate sector and part D was about placement related information. An index for work life balance has been created and it has been measured by satisfaction in three domains namely; Job satisfaction, family satisfaction and Life satisfaction. The statements on all these three domains had been measured on likert scale with lowest being '1' and highest being '5'. The maximum score a respondent could achieve was 75 points. The scores were calculated for both the male and female participants and summed up for to know who had a better WLB amongst the gender using independent t test in SPSS.

3.4.1.1 Primary data collection

Primary data has been collected for the second objective. A total of 1293 faculty members are from engineering and science departments from 20 engineering colleges in STEM disciplines providing full time Btech degrees. Research input of all the tenured faculty members has been gathered from their google scholar profiles to note their h index, i10 and citations. A productivity index was made as a summation of the three.

For the first objective, primary data had been collected through the websites of all the 20 engineering colleges to know the status/position of its faculty. Data had been collected from the google scholar profiles of 1293 faculty. In cases where ambiguity is encountered regarding faculty status, Internet searches will be conducted to identify current affiliations and practices and gather information from LinkedIn and other sources. (Lopez et al., 2015). A survey had been conducted to gather information on a five-point Likert scale to measure the latent factors affecting work life balance by conducting a census of 127 STEM HoD's in 20 engineering colleges in Delhi which provide Btech in various disciplines. Out of the total, 103 responded to the questionnaire. Principal Component Analysis had been conducted to know the factors affecting work life balance and further the relationships formed had been tested by multiple regression using SPSS.

For the second objective, their productivity had been calculated through the summation of h index, i10 and citations and accordingly been categorised as "low" = 1 and "high" = 2. Productivity has been taken as the dependent variable whereas gender, designation, branch and are independent variables. Gender is coded as 1 for males and 2 for females. Designation has three categories where 3 = "Assistant Professor", 2 = "Associate Professor" and 1 = "Professor". Branch is taken to be Engineering Branch = 1 and Applied Sciences = 2. The data has been collected for all faculty in 20 engineering colleges of Delhi providing full time Btech degrees. Binary Probit model had been used in STATA to know the effect of productivity on gender, designation, and branch. Futhur, the interaction effect of gender with the rest of the three independent variables has been studies to get a clear picture of the research productivity in various colleges.

For the third objective, independent t test had been conducted to know the effect gender of the leader on placements. Placement in charge of all the engineering institutions had been approached for data regarding placement statistics of 2022-2023. Most of the lists had been updated on the college websites but eight colleges out of twenty had refused to share the full list of candidates placed. STATA 14.0 and SPSS have been used for statistical work. QDA Miner Lite has been used for qualitative analysis.

For the fourth objective, a mixed methods approach has been used in this study. A qualitative study was conducted among STEM leaders in engineering colleges in Delhi, India to explore their views on USR activities. The thematic analysis approach (Braun and Clarke, 2023) was followed, and it ensured that research findings were rooted in the understandings and experiences of respondents, reflecting their subjective meaning. Interviews were recorded, and data was coded and transcribed verbatim. The transcribed data were collected using The Framework Method (Hackett and Strickland, 2019) and then analysed thematically using a coding process (Braun and Clarke, 2023). After extracting the ideas, the coding was carried out in three phases: (1) Simple/Open Coding: We assign codes to ideas from the data without interpretation, staying close to the empirical evidence; (2) Axial Coding: we group and relate codes into categories and sub-categories, organizing the data for analysis, (3) Selective Coding: we focus on the central category emerging from the previous coding stages, modeling the data by retaining relevant codes (for more information, Mohajan and Mohajan, 2022). Data were initially organized into an Excel spreadsheet using a framework matrix. Each investigator coded the data: the thematic analysis involved constant data checking and meetings to review and combine themes. The process focused on inductively identifying emerging themes rather than a hypothesis-deductive approach. After coding, ideas were organized into a coding chart, categorizing them into main categories and sub-categories of codes for analysis and interpretation. Thematic charts/diagrams were created to offer a visual representation of the coding process. Many quality procedures were implemented to ensure the validity of the qualitative method (Yvonna S. Lincoln et al., 1985). Content saturation, indicating the point where additional interviews cease to yield substantial information, was ensured through persistent, in-depth exploration (averaging one-hour interviews) and thorough discussion to ensure adequate internal validity. To ensure the reliability of coding, various procedures were implemented to confirm the results of the qualitative study, acknowledging its inductive/reflexive nature. Instead of seeking consensus, the focus was on triangulating perspectives, i.e., investigator triangulation (Denzin and Lincoln, 2000), to capture the complexity of the issue. Both the researchers coded and transcribed the data independently. Debriefing meetings were conducted with experts (Dean – student's welfare of different colleges). These meetings addressed problematic codes, such as discrepancies or labelling issues, and involved case-by-case decisions, including merging, renaming, enhancing, or discarding elements from the final thematic tree as necessary. Triangulation and reflective dialogue were consistently employed to support and justify decision-making.

Under semi structures interviews, the heads of various departments were asked about the total no. of partnerships/projects with the industry and the nature of collaboration done in the past one year wherein after the data collection, it was found that the involvement could be classified mainly into three categories/themes based on the responses received i.e. involvement with corporate, govt. sector partnerships and others. There were only a few responses received on the self-initiatives for USR by colleges or any other type of personal collaborations and this third category had been omitted by STATA because of the low responses received. The deductive content analysis approach is used to analyse data via verbal communication to form categories/themes and this method helps in validating the collected data giving new insights with a proper representation of facts. The interview questions asked are as below:

Interview Questions:

Q1 What are the types of USR activities that your department is involved in?

Q2 Do you face any challenges from the university about its operations?

Q3 Are there any linkages to develop the required skills among the students?

Q4 How do you inculcate the value of USR amongst students, and how do you measure it? Can you provide any suggestions?

The fifth objective focuses on the variables i.e. work life balance and amount of funds attracted from the corporate and govt. sector. Amount per head meant the total amount divided by no. of students in a department. Amount was taken to be a dichotomous dependent variable which was judged on the ability to draw funds from the corporate sector and the govt. into academia. The respondents were asked whether they had drawn any funds from the corporate sector in the past one year. Logit model was used in STATA to know the effect of gender and WLB on amount of funds drawn from the corporate and govt. sector. Further, the interaction effect of gender with work-life balance was analysed.

3.5 Model specification

3.5.1 Objective 1 & 3: Model Specification

For the first objective, it has been studied how the WLB differs between male and female HoD's. There is no correlation between job, family and life satisfaction as tested by principal component analysis. The three components had been formed by principal component analysis. Independent sample t test had been conducted to know the difference the scores of both the gender measured by the three components. An independent samples t-test is used to compare the means of two independent groups to determine if there is a statistically significant difference between them.

Hypotheses:

Null Hypothesis (H_0): $\mu_1 = \mu_2$ (The population means of the two groups are equal).
Alternative Hypothesis (H_1): $\mu_1 \neq \mu_2$ (The population means of the two groups are not equal).

Data Requirements:

Two independent samples from the populations.
The data in each group is normally distributed.
The two groups have equal variances (for the traditional t-test; if not, use Welch's t-test).

Test Statistic:

The t statistic was developed by William Sealy Gosset. The independent t-test can be specified in eqn 1:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \qquad 1$$

Where: X_1 and X_2 are the sample means of group 1 and group 2, respectively. S_1 and S_2 are the sample variances of group 1 and group 2, respectively. n_1 and n_2 are the sample sizes of group 1 and group 2, respectively (Kim, 2015)

Degrees of Freedom: For the traditional t-test (assuming equal variances), the degrees of freedom (df) i

If variances are unequal (Welch's t-test) using eqn 2:

$$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}} \qquad 2$$

Assumptions:
Independence: The two groups are independent of each other.
Normality: The data in each group is approximately normally distributed.
Homogeneity of Variance: The variances of the two groups are equal (for the traditional t-test).

Decision Rule:
Compare the calculated t-value to the critical t-value from the t-distribution table based on the chosen significance level (α, typically 0.05) and the degrees of freedom. Alternatively, use the p-value: reject the null hypothesis if the p-value is less than the chosen significance level (Kim, 2015)
Interpretation:
If the null hypothesis is rejected, it suggests that there is a statistically significant difference between the means of the two groups. If the null hypothesis is not rejected, it suggests that there is no statistically significant difference between the means of the two groups.

3.5.2 Objective 2: Model Specification

Probit Model

The binary probit model can be written as:
$P(Y=1) = \Phi\,(X\beta)$
where Φ is the cumulative distribution function (CDF) of the standard normal distribution. The linear combination Xβ represents the underlying latent variable Y*, which is modeled as:
$Y^* = \beta_0 + \beta_1 \text{ Gender} + \beta_2 \text{ Branch} + \beta_3 \text{ Designation} + \epsilon$

where:
$Y*$ is the latent variable that determines the probability of Y=1
β_0 is the intercept term and β1, β2, β3 are the coefficients for the independent variables.
The observed binary outcome Y is related to the latent variable Y^* as described in eqn 3:

$$Y = \begin{Bmatrix} 1, & Y^* > 0 \\ 0, & Y^* \leq 0 \end{Bmatrix} \quad 3$$

We have employed the Probit model for the dependent variables' binary nature (Li and Zhang, 2010; Drydakis, 2016). A binary response model, posits that errors adhere to a standard normal distribution, differing from logistic regression by not assuming constant error variance. Probit regression offers reduced sensitivity to outliers compared to logistic regression, making it a valuable alternative in certain analytical contexts (Ghareib, 1996).
The dependent variable is whether the productivity of the Head of Department (HoD) is greater than the average or less than the average.

Y=1 if productivity is greater than the average and Y=0 otherwise
The independent variables include gender, branch, and designation which are categorical.
Further, the interaction effects will reveal how the effect of gender on the probability of the HoD's productivity being greater than the average changes depending on the branch and designation.

3.5.3 Objective 5: Model Specification
Logit Model
The logit model could be represented in eqn 4;

$$Y = E(Y = 1\ X_i\ ) = \frac{1}{1 + e^{-(\alpha + \sum \beta_i X_i)}} \quad 4$$

Where X i = vector of independent variables which affects the corporate engagement of the Heads and
Pi = is the probability of engagement with the corporate sector.

The Odds ratio can be described as in eqn 5;

$$\left(\frac{P_i}{1 - P_i}\right) = e^{(\alpha + \sum \beta_i X_i)} \quad 5$$

Now the above engagement equation is said to be the odds ratio. It is the ratio of the probability of ability to draw funds to not being able to draw funds.
Logs of odds ratio for K explanatory variables can be computed by taking the natural logarithm of the eqn 6;

$$L_i = \ln\left(\frac{P_i}{1 - P_i}\right) = \alpha + \sum_{i=1}^{k} \beta_i X_i + \mu_i \quad 6$$

Based on the above method, the following equation have been estimated.

Corpgov_Eng: $\alpha + \beta_1 \text{Gender} + \beta_2 \text{WLB} + \varepsilon$

Corpgov_Eng represents corporate and govt. engagement which took 1 if the head engages with the corporate/govt. sector and 0, otherwise (non-engagement), Gender was binary and WLB was measured with as Low = 1 and High = 2 based on the total score measured on the index.

3.6 Reliability of the data

Cronbach's Alpha	N of Items
.755	18

Source: Prepared by the Researcher

Checking the reliability of data is an essential issue during data analysis. One of the most commonly used reliability estimators, which is Cronbach's Alpha, has also been computed (Mohamad et al. 2015). The computed value was 0.83. Various diagnostic tests have been conducted to check the unbiasedness of the estimated coefficients (Hosmer-Lemeshow goodness of fit test). To check the model fit, pseudo R2 has been computed and the value ranges between 0-1 (Windmeijer, 1995). We use literature in order to support the statements in the form of reliability and validity of the primary data collected by conducting semi-structured interviews and to avoid errors and bias.

3.7 Validity Procedures

Many quality procedures were implemented to ensure the validity of the qualitative method (Yvonna S. Lincoln et al., 1985). Content saturation, indicating the point where additional interviews cease to yield substantial information, was ensured through persistent, in-depth exploration (averaging one-hour interviews) and thorough discussion to ensure adequate internal validity. To ensure the reliability of coding, various procedures were implemented to confirm the results of the qualitative study, acknowledging its inductive/reflexive nature. Instead of seeking consensus, the focus was on triangulating perspectives, i.e., investigator triangulation (Denzin and Lincoln, 2000), to capture the complexity of the issue. Both the researchers coded and transcribed the data independently. Debriefing meetings were conducted with experts (Dean – student's welfare of different colleges). These meetings addressed problematic codes, such as discrepancies or labelling issues, and involved case-by-case decisions, including merging, renaming, enhancing, or discarding elements from the final thematic tree as necessary. Triangulation and reflective dialogue were consistently employed to support and justify decision-making.

To sum up, the above chapter includes the objectives and the research models used to test the corresponding hypothesis. It includes the assumption associated with the research models and the conditions for decision rules. It also discussed the reliability and validity procedures.

CHAPTER 4

Assessing Work-Life Balance of HoDs and Research Productivity of Faculty

This chapter discusses the research analysis of the first two objectives. It includes the descriptive and inferential statistics.

Objective 1: To map gender of the HoD's and assess the gender-wise difference in the work-life balance of HoD's.

4.1 Findings

4.1.1 Descriptive Statistics

Table 15: Total no. of Participants

Male Heads	Female Heads	Total
81	46	127

Source: Made by the authors

4.1.2 Inferential Statistics

The job family and life satisfaction were uncorrelated to each other (see appendix). There are male HoD's in the STEM departments of engineering colleges in Delhi. Therefore, we reject the null hypothesis stating that there are no significant differences in leadership positions on the basis of gender in STEM HEI's. We carried out independent t test to know whether there are differences between the two groups. The mean score of one group is significantly lower than the mean score of the other group by 12.415 units. Given the p-values are both 0.000, we reject the null hypothesis and conclude that there is a statistically significant difference in the mean scores between the two groups. So, there are significant differences between the WLB of male and female heads and we reject the null hypothesis and accept the alternative hypothesis, which states that there are significant differences between WLB of men and women

Table 16: Group Statistics

Gender	N
Female	38
Male	65

Source: Made by the researchers

Table 17: Independent samples test

Independent sample test				
	Levene's Test for Equality of variances		t-test for equality of means	
	F	Sig.	t	df

Scores	Equal variances assumed	.014	.907	-5.505	101
	Equal variances not assumed			-5.475	78.289

Independent sample test

		t-test for equality of means		
		Sig (2 tailed)	**Mean Difference**	**Std. Error difference**
Scores	Equal variances assumed	.000	-12.415	2.255
	Equal variances not assumed	.000	-12.415	2.268

Source: Made by the researchers

Objective 2: To measure the productivity of faculty members and compare it across gender, level and branch.

4.2 Findings

4.2.1 Descriptive Statistics

Table 18: Information of participants

Variable	Description	Freq.
Productivity	1 if productivity is above average & 0, otherwise	0 = 585 1 = 708
Gender	A dummy variable with 1 as Male and 2 as Female	2 = 391 1 = 900
Designation	A dummy variable with three categories i.e. 1 as, Professor and 2 as Associate Professor and 3 as Assistant Professor	1 = 339 2 = 159 3 = 795
Branch	A dummy variable with 1 as Engineering branch and 2 as Applied science branch.	1 = 1112 2 = 181

Note: A total of 1293 tenured faculty.

Source: Made by the researchers

4.2.2 Inferential Statistics

The probit model is a binary response model assuming errors follow a standard normal distribution, without assuming constant error variance. It is less sensitive to outliers compared to logistic regression. Results include coefficients, standard errors, z-values, and p-values. The results of probit model with dependent variable taken as productivity are as below:

Table 19: Interaction effects of Gender and Designation

Gender & Designation	Margin	St Std. Err.	z	P>|z|
1 1	.5811	.0190	30.57	0.000
1 2	.5196	.0326	15.93	0.000
2 1	.5471	.0160	34.17	0.000
2 2	.4851	.0338	14.34	0.000
3 1	.5127	.0259	19.79	0.000
3 2	.4508	.0415	10.85	0.000

Dependent variable: Productivity, Above the average = 1 and 0, otherwise.
Independent variable: Gender: Male = 1 and Female = 2; Designation: Professor = 1, Associate Professor = 2 and Assistant Professor = 3
Source: Made by the researcher

Table 20: Interaction effects of Gender and Branch

Gender & Branch	Margin	St Std. Err.	z	P>|z|
1 1	.55450	.0155	35.61	0.000
1 2	.6757	.06181	10.93	0.000
2 1	.3787	.06929	5.47	0.000
2 2	.5039	.03273	15.40	0.000

Dependent variable: Productivity, Above the average = 1 and 0, otherwise.
Independent variable; Gender: Male = 1 and Female = 2 Branch: Engineering Branch = 1 and Applied Sciences = 2
Source: Made by the researcher

The productivity in applied sciences branch is higher than in the engineering branch. The predicted probability of productivity being above average is approximately 56% for male heads in engineering branches. This margin is statistically significant with a p-value of 0.000. The predicted probability of productivity being above average is approximately 68% for male faculty members who are from applied science branches. This margin is statistically significant with a p-value of 0.000. The predicted probability of productivity being above average is approximately 38% for female faculty members who are from engineering branches. This margin is statistically significant with a p-value of 0.000. The predicted probability of productivity being average is approximately 51% for female faculty members from applied science branches. This margin is statistically significant with a p-value of 0.000. We reject the null hypothesis, as there are significant difference between male and female faculty members in Branch. The productivity of male faculty members is higher across all the three designations as compared to female counterparts. The predicted probability of productivity being above average is 58.40% for male faculty members who are professors. This margin is statistically significant with a p-value of 0.000. The predicted probability of productivity being above average is 51.96% for male faculty members who are associate professors. This margin is statistically significant with a p-value of 0.000. The predicted probability of productivity being above average is 54.71% for female faculty members who are professors. This margin is statistically significant with a p-value of 0.000. The predicted probability of productivity being above average is approximately 48.51% for female faculty members who are associate professors. This margin is statistically significant with a p-value of 0.000. The predicted probability of productivity being above average is 51.27% for male heads who are assistant professors. This margin is statistically significant with a p-value of 0.000. The predicted probability of productivity being above average is 45.08% for female faculty members who are assistant professors. This margin is statistically significant with a p-value of 0.000. The z statistics tells the most significant impact. The male faculty members from the digital branches who are professors have the highest probability of productivity being above average. The female faculty members from the engineering branches had the lowest probability of research productivity being above average. The female faculty members who are assistant professors had the lowest probability of research productivity being above average.

Table 21: Average Marginal Effects

Gender & Branch	Margin	St Std. Err.	z	P>|z|
Designation	.0340	.0160	2.13	0.033
Branch	.0771	.0395	1.95	0.051
Gender	.0613	.0356	1.72	0.085

Dependent variable: Productivity, Above the average = 1 and 0, otherwise. Independent variable: Gender: Male = 1 and Female = 2; Branch: Digital Branch = 1 and Non- Digital Branch = 2
Source: Made by the author

It is observed that the coefficients of all the three independent variables are positive.
If the designation of the head increases by one rank, the probability of productivity being above average increases by 3.14%, ceteris paribus. The branch and gender have a significant effect on the probability of the productivity being above average. Designation is the most important factor affecting productivity with a z statistic of 2.13.

CHAPTER 5

Impact of Leadership on Placement, Outreach as well as Government and Corporate Collaboration

This chapter discusses the research analysis of the 3rd, 4th and 5th objectives. It includes descriptive and inferential statistics sequentially for each of them.

Objective 3: To investigate gender effect of the leaders on placement.

5.1 Findings

5.1.1 Descriptive Statistics

Table 22: Descriptive Statistics

Gender	N
Female	23
Male	54

Source: Made by the Researcher

5.1.2 Inferential Statistics

Table 23: Effect of gender of the HoD on placement

Independent sample test

		Levene's Test for Equality of variances		t-test for equality of means	
		F	Sig.	t	df
Scores	Equal variances assumed	.184	.669	2.446	75
	Equal variances not assumed			2.424	40.780

Independent sample test

		t-test for equality of means				
		Sig.(2 tailed)	Mean difference	Std. Error difference	95% confidence interval of the difference	
					Lower	Upper
Scores	Equal variances assumed	.017	10.319	4.219	1.915	18.723
	Equal variances not assumed	.020	10.319	4.257	1.721	18.917

Source: Made by the Researcher

There are significant differences in placements under male and female leaders. So, null hypothesis is rejected.
Both tests (assuming equal variances and not assuming equal variances) indicate a statistically significant difference between the means of the two groups, with p-values of 0.017 and 0.020, respectively. The mean difference between the groups is 10.319 units, with the confidence intervals from both tests confirming this significant difference.

Objective 4: To assess gender-wise differences in HoDs for involvement in USR activities

5.2 Findings

5.2.1 Descriptive Statistics

Table 24: Involvement in USR activities

USR	Freq.	Percent
0	44	42.72
1	59	57.28
Total	103	100.00

Note: 0 = ‘Yes’ and 1 = ‘No
Source: Made by the authors

5.2.2 Inferential Statistics

The data after coding has been categorised into the themes. In the coding process using QDA Miner Lite software, open, axial, and selective codes were identified. Axial codes represented the categories that formed the selective codes or emerging themes of the study. Four emerging themes were identified. The qualitative data after coding has been categorized into the following themes: Involvement in economic, social, and environmental activities, degree of challenges, Collaboration with the stakeholders, motivation and measurement. In the coding process using QDA Miner Lite software, open, axial, and selective codes were identified. Axial codes represented the categories that formed the selective codes or emerging themes of the study. A total of four emerging themes were identified in this study. The qualitative data after coding has been categorized into the following themes: Involvement in economic, social, and environmental activities, Collaboration with the stakeholders, Lack of resources and delays in conducting the USR activities, and Different ways to inculcate social responsibility amongst students. Below are the details of those axial codes and their related selective codes / emerging themes of this qualitative data.

Table 25: Coding frequency

Selective codes/Theme	Axial Codes	Count	% Codes	Cases	% Cases
Inculcating USR	Sustainability webpage	2	0.70%	2	1.90%
Inculcating USR	Classroom learning	7	2.50%	7	6.80%
Inculcating USR	College internal societies/clubs	6	2.10%	6	5.80%
Inculcating USR	Practical leaning/outside visits	1	0.40%	1	1.00%

Inculcating USR	Specific courses designed	4	1.40%	4	3.90%
Inculcating USR	Counselling/tests	5	1.80%	3	2.90%
Inculcating USR	Collaborations	7	2.50%	6	5.80%
Environmental activities	Recycling programs	9	3.20%	9	8.70%
Environmental activities	water conservation programs	7	2.50%	6	5.80%
Environmental activities	Transportation policy	7	2.50%	7	6.80%
Environmental activities	Biodiversity	8	2.80%	8	7.80%
Environmental activities	building orientation	3	1.10%	3	2.90%
Environmental activities	Cleanliness drives	6	2.10%	6	5.80%
Social activities	Community investment and development	4	1.40%	4	3.90%
Social activities	charity work	6	2.10%	6	5.80%
Social activities	Disaster relief	1	0.40%	1	1.00%
Social activities	Human capital development	5	1.80%	4	3.90%
Social activities	healthcare development	11	3.90%	10	9.70%
Social activities	NSS/NCC activities	33	11.60%	33	32.00%
Social activities	Voter's awareness	1	0.40%	1	1.00%
Social activities	Blood Donation	3	1.10%	3	2.90%
Economic activities	Technology for increasing efficiency	3	1.10%	3	2.90%
Economic activities	Funding	4	1.40%	4	3.90%
Economic activities	Marketing Strategies	3	1.10%	3	2.90%
Economic activities	Research and development for the society	8	2.80%	8	7.80%
Energy saving initiatives	Green technology	24	8.40%	21	20.40%
Lack of resources &delays	Shortage of funds/ human resources/infrastructure	10	3.50%	9	8.70%
Lack of resources & delays	Administrative bottlenecks	2	0.70%	2	1.90%
Lack of resources & delays	Cultural differences amongst students	2	0.70%	2	1.90%
Lack of resources & delays	Environmental challenges	1	0.40%	1	1.00%
Lack of resources & delays	Lack of consensus	3	1.10%	3	2.90%
Lack of resources & delays	lack of community participation	1	0.40%	1	1.00%
Collab_stakeholder	Industry linkages	58	20.40%	47	45.60%

Collab_stakeholder	workshops, conferences, mentoring	13	4.60%	13	12.60%
Collab_stakeholder	Government linkages	17	6.00%	14	13.60%

Source: Made by the authors

Table 44 illustrates varying counts and frequencies of all the codes across different cases. This variability provides insight into the emphasis placed by informants on specific terms in each case. It shows that thirty-five axial codes supported four emerging themes and a sub-theme under the first theme. The codes have been depicted through thematic charts, which comprehensively documented all ideas expressed during the qualitative interviews, as shown in Figure 5. Combining interview responses, the thematic chart reveals the highest-occurring code, i.e., industry linkage of the colleges.

Figure 5: Word Chart

Source: Made by the Researcher

Theme 1: Involvement into economic, social and environmental activities

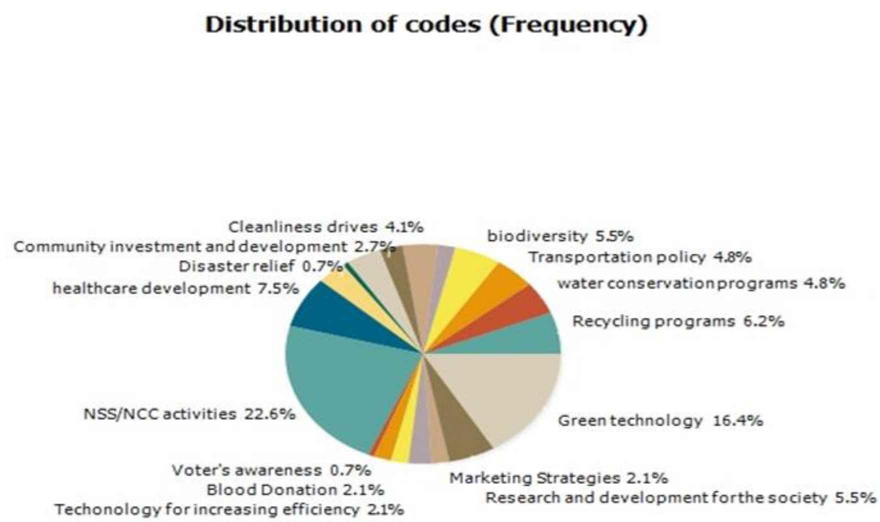
The qualitative data from respondent's interviews showed that in many departments of various universities, the USR activities were absent or the Heads of the departments did not take the initiative to conduct these activities and only a few outreach programmes were done to meet the institutional requirements. The average no. of projects ranged from 2-3 in a year. The universities which were engaged into USR activities had diverse perspectives. When asked about the type of USR activity their department is involved into, they were engaged into three types of activities namely; economic, social and environmental. For eg: Projects like Education for all, gender sensitisation, mental health awareness, design for the marginalised, inclusive design, design for all etc. Many were involved into social activities like woollen clothes distribution, blood donation, health camps, renewable energy, campaigns for saving water and electricity, plantation, anti-drug camps, cleanliness drive ,voter's awareness, programmes like adopt 5 villages nearby college, medicines to needy people, sleep awareness program for patients, education mentoring of govt. school girls in STEM, donation to Kerala relief fund, several projects done by the students targeting benefit of the rural areas.

Table 26: Involvement in USR activities under male and female heads

Women Heads	Male Heads
1. Social activities 2. Eg: Woollen clothes distribution, blood donation, health camps, renewable energy, campaigns for saving water and electricity, plantation, anti-drug camps, cleanliness drive ,voter's awareness, programmes like adopt 5 villages nearby college, medicines to needy people, sleep awareness program for patients, education mentoring of govt. school girls in STEM, donation to Kerala relief fund, projects benefitting rural areas.	1. Economic and Environmental activities 2. Eg: recycling & water conservation programmes, transportation policy, biodiversity, building orientation, cleanliness drives. 3. Also involved in economic activities like developing technologies for increasing efficiency and had more involvement into development of marketing strategies and getting loans from a bank for the projects.

Source: Made by the authors

Figure 6: Distribution of codes for the first theme



Source: Made by the Researcher

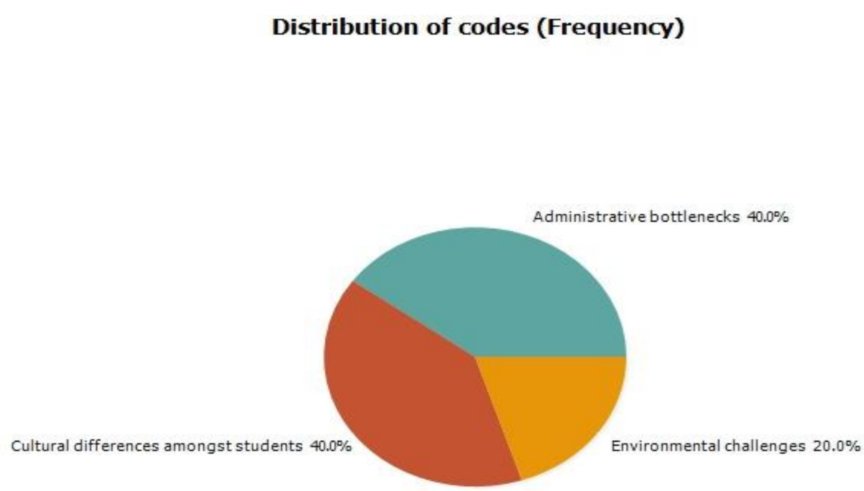
Theme 2: Challenges

The challenges faced by the departments in conducting these activities were shortage of funds and human resources, lack of support from administration (delays in approvals), poor communication, bureaucratic set up, shortage of infrastructure. The participants also expressed concerns about low community engagement in social responsibility activities, the need for building local capacity, transparency issues, a narrower perception of social responsibility, a lack of consensus on implementing social responsibility initiatives and cultural differences among students in a classroom impacted productivity due to varying perspectives on fulfilling social responsibility. Apart from all these many of the leaders raised concerns over environmental challenges like poverty and higher taxes as impediments to fulfilling social responsibility.

Theme 3: Different ways to motivate students for social responsibility

The responsibility towards society was inculcated by the faculty in students through numerous ways like classroom learning, social practices (assigning a social project in co-project mentoring, expert lectures, conferences and workshops in operation with NGO's or mentoring by experts. Involvement of students in business clubs, eco clubs, rotary club, seminars, workshops, discussing real case studies in the classroom, involvement as Drishti and NSS mentors and motivating them by becoming their models. Students were involved into various societies like ENACTUS, discussion of SDGs in the classroom, conducting awareness through workshops etc. Students also engaged in practical learning like arranging a visit to the slums to know the problems of the desolate and come up with low cost effective, innovative solutions for the same and in these way inequalities in the society could be reduced by uprooting the poor and letting them enjoy equal access to technologies. Community engagement had been emphasized by a lot of leaders. Many faculty said that they had certain courses designed to inculcate the values of social responsibility and some colleges had an additional paper of Human Values and Ethics.

Figure 7: Distribution of codes for the third theme

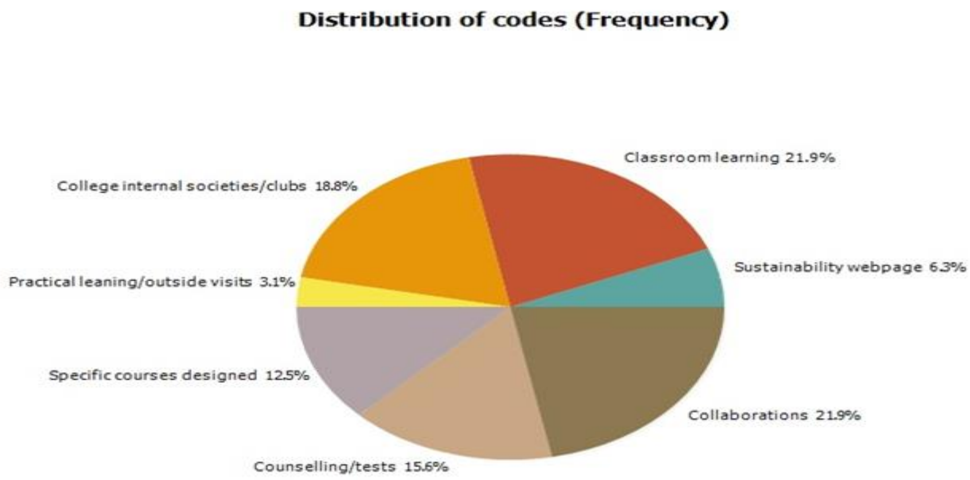


Source: Made by the Researchers

Theme 4: Collaborations with the stakeholders

Most of the participants had a limited view of USR and they focussed only on the social dimension of it whereas a few of the college heads had their students involved into the CSR activities through partnerships/collabs and had linkages with the industry (Microsoft, IBM, pharmaceutical companies, coding blocks) via MoU's and NGOs to conduct joint research projects. The respondents mentioned how training and placement cell helped to sign MOUs to develop linkages with industries and how working with industry gave unique perspectives and an understanding of dynamic sustainability challenges and opportunities to their students.

Figure 8: Distribution of codes for the fourth theme



Source: Made by the Researchers

Table 27: Approach of colleges towards fulfilment of SDG's

SDG	Initiatives taken by HEI's
Goal 1: No poverty	Woollen clothes distribution, programs like adopt five villages nearby colleges, medicines to needy people etc.
Goal 2: Zero Hunger	Nutrition application, Community kitchen initiatives.
Goal 3: Good health and Well being	Blood donation, Health camps, Sleep awareness program for patients.
Goal 4: Quality Education	Teaching in slums
Goal 5: Gender Equality	Gender sensitisation campaigns
Goal 6: Clean Water And Sanitation	Campaigns for saving water, Waste treatment plant, Rainwater harvesting

Goal 7: Affordable And Clean Energy	Biogas plant for lighting, fly ash brick construction, wind energy emulators, fuel cell setups.
Goal 8: Decent Work And Economic Growth	Incubation centres for funding and startup culture.
Goal 9: Industry, Innovation and Infrastructure	Pilot scale reactor for plastic waste, Various energy storage technologies.
Goal 10: Reduced Inequalities	HEI's give quotas and scholarships to students for particular sections of the society.
Goal 11: Sustainable Cities And Communities	Green Technology, Yule e-bikes
Goal 12: Responsible Consumption and Production	Segregating paper and plastic collection, special waste management, composting of garden waste.
Goal 13: Climate Action	Rooftop solar panels, on-site composting and disposal
Goal 15: Life On Land	Tree planting, park cleaning, waste recycling, bio resource recycling
Goal 17: Partnerships for the Goals	Partnership with Tata power for solar rooftops.

Source: Made by the Researcher

All the colleges had some or the other kind of involvement with the industry but less than 50% of the them were involved into USR initiatives. The results revealed that an increase in the interaction between university and the government lead to an increase in the USR activities of the colleges. The interaction included government workshops on sustainability in collaboration with the colleges. Apart from this colleges like BVCE's took certain initiatives like 'International Conference on Renewable Energy Potential for Sustainable Initiatives' and 'National Seminar on Renewable Energy Potential and Status in India etc. DTU organized three day's workshops on Electronic Waste Management. The government provides tax benefits, including accelerated depreciation and income tax exemptions, to promote investments in renewable energy projects. The Indian government's initiatives such as the National Solar Mission and incentives for wind and bioenergy, demonstrate a commitment to a greener future. Many of the colleges have solar rooftops and are following the National Solar Mission (NSM), which was launched in 2010 by the Indian govt., which aims to promote solar energy development for grid-connected and off-grid applications. It sets ambitious capacity addition targets and provides financial incentives, subsidies and policy support to drive solar adoption (Benett University, 2024).

The Ministry of Human Resource Development launched the Smart India Hackathon 2019, offering students a platform to address pressing societal issues through product innovation. Over

5 million students from engineering colleges participated across 35+ locations, with winners awarded Rs 1 lakh, Rs 75,000, and Rs 50,000. Additionally, the Federation of Indian Chamber of Commerce and Industries (FICCI) organized the Smart Cities Summit on February 22, 2019 [37]

Delhi Institute of Tool Engineering (now DSEU Okhla-II campus) was founded with support from the Government of Italy to train manpower for local industry development in Delhi and its surroundings. It also secures sponsored research projects from Govt of India's Ministry of Science and Technology, focusing on sustainable industry solutions and environmental protection [38]. It also conducts consultancy projects for the tooling industry and hosts applied research in collaboration with industries. The Planning Commission recommends integrating 'fostering social responsibility' into higher education strategies for the 12th Plan, emphasizing the need for institutions to provide guidance and support to young, enthusiastic students to reinforce their ethical and social responsibilities. The Ministry of New and Renewable Energy (MNRE) funds research and development initiatives to enhance renewable energy technologies and make them more cost-effective. Many heads had been granted funding for their projects from the govt. which contributed to sustainability. In 2018, UGC formed a Subject Expert Group under the Unnat Bharat Abhiyan to produce a report titled "Fostering Social Responsibility and Community Engagement in Higher Education Institutions (HEIs) in India". Most of the colleges were engaged into USR activities under NSS which is a central sector scheme of Government of India under the Ministry of Youth Affairs & Sports. An excerpt from the interview is as below: "Our students participated in SAGY (Sansad Adarsh Gram Yojana) in a nearby village as a part of the NSS activity. They are also mentoring poor students and giving them free tuitions".

Objective 5: To investigate the gender-wise difference of HoD's in attracting funds from the corporate and government sector.

5.3 Findings

5.3.1 Descriptive Statistics

Table 28: Information of Respondents

Gender	Freq.	Percent
Female-1	37	35.92
Male-2	66	64.08

Source: Made by the authors

5.3.2 Inferential Statistics

Table 29: Interaction Effect of Male Heads and WLB

	dy/dx	Std. Error	z	P > z
1.	.6397	.1944	3.29	0.001
2.	.8746	.0972	8.99	0.000

Dependent Variable -: Ability to attract funds

Yes = 1 and No = 0

Independent Variable - Gender: Male = 2, WLB: low = 1 and High = 2

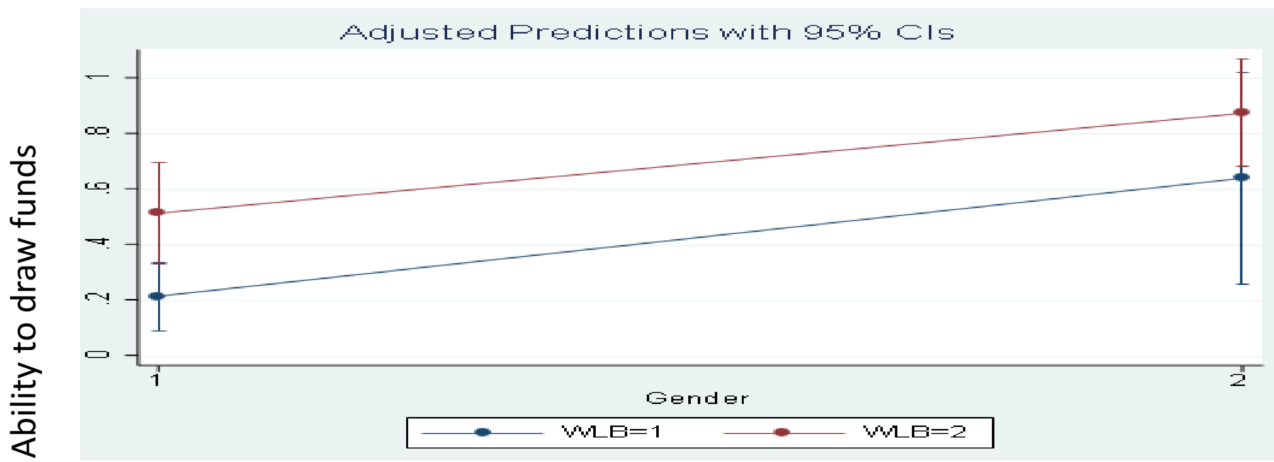
Source: Made by the Researcher

Table 30: Interaction Effect of Female Heads and WLB

	dy/dx	Std. Error	z	P > |z|
1.	.2128	.0637	3.34	0.001
2.	.5151	.0925	5.57	0.000

Dependent Variable -: Ability to attract funds
Yes = 1 and No = 0
Independent Variable - Gender: Female = 1 and Male = 2, WLB: low = 1 and High = 2
Source: Made by the Researcher

Figure 9: Interaction Effect of Gender and WLB



Dependent Variable -: Ability to attract funds
Yes = 1 and No = 0
Independent Variable - Gender: Female = 1 and Male = 2, WLB: low = 1 and High = 2
Source: Made by the Researcher

The Work-life affects the probability of corporate and government engagement of male and female heads significantly. A unit increase in the WLB would lead to an increase in the probability of male and female heads in attracting funds. Male heads are more involved into attracting funds from the corporate and govt. sector as compared to the female heads. A reason for this is poor work-life balance of female heads which leaves less time for collaboration activities with the corporate and govt. sector. Men are less constrained by family responsibilities as compared to women (Lee Cooke & Xiao, 2014).

Table 31 : Average Marginal Effects

	dy/dx	Std. Error	z	P > |z|
1. Gender	.2569	.0693	3.71	0.000
2. WLB	.2268	.0790	2.87	0.004

Dependent Variable -: Ability to attract funds
Yes = 1 and No = 0
Independent Variable - Gender: Female = 1 and Male = 2, WLB: low = 1 and High = 2
Source: Made by the Researcher

Gender is positively affecting the probability of ability of the head to draw funds from corporate and government sector with a p-value of 0.000, which is significant.
A unit increase in the work-life balance is associated with a 23% increase in probability of the head in attracting funds, ceteris paribus. This effect is statistically significant with p-value 0.004. The probability of male heads attracting funds from the corporate and govt. sector is higher as compared to the female heads. A reason for this is poor work-life balance of female heads, which leaves less time for collaboration activities with the corporate and govt. sector. Men are less constrained by family responsibilities as compared to women (Lee Cooke & Xiao, 2014).

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1. Background

It was observed that the WLB of female heads is lower than that of the male heads, policies can be made to improve the WLB of women in STEM academia. The productivity of female faculty members is lower than the male faculty memebers across all the three levels, regulatory bodies should provide incentives and special programs to encourage women in academia for conducting research. The productivity across engineering branches is lower than the Applied science branches, more research facilities may be provided to the former. The placements under the female heads are lower than the male heads, female heads themselves should take initiaitives to collaborate with corporate sector so that ultimately, they will come for placement also. It was observed that the USR activities are present in a few colleges only, so the government should mandate the colleges and it can provide sustainability rankings to all the colleges to encourage them for the same.

6.2 Suggestions & Recommendations

6.2.1 For the Universities

- To improve work-life balance for female heads of STEM departments in Delhi engineering colleges, institutions should implement flexible work arrangements such as remote work options and flexible scheduling, along with equitable parental leave and on-campus childcare facilities. Providing leadership and time management training, along with mentorship programs, can empower female leaders with effective strategies to balance their responsibilities. Additionally, fostering a supportive culture that encourages taking time off, promoting mental health initiatives, and offering administrative support can significantly alleviate the workload. Regular monitoring of work-life balance through surveys and feedback mechanisms will help tailor ongoing improvements to ensure sustained support for female department heads.
- To address the disparity in placement rates under male versus female heads of STEM departments in engineering colleges, the colleges can provide targeted leadership and management training for female heads of departments to enhance their skills in networking, negotiation, and strategic planning, which are crucial for driving successful placement initiatives. They can facilitate regular interactions between female heads and industry leaders through seminars, conferences, and networking events which will help in building strong industry relationships thereby leading to better placement opportunities. By leveraging alumni networks, particularly successful female alumni, they can connect with industry partners. Alumni can play a significant role in advocating for placements from their alma mater. The colleges can ensure that female heads of departments have equal access to resources, such as funding for industry collaboration, research projects, and student development initiatives, which can enhance the placement prospects of their students. They can encourage collaboration between male and female heads of departments, sharing best practices and resources to collectively improve placement outcomes across the institution thereby promoting a culture of inclusivity and equality within the institution, where the contributions of female leaders are recognized and valued equally to their male counterparts. By implementing these recommendations, engineering

colleges in Delhi can work towards creating an environment where female heads of STEM departments are equally successful in securing placements for their students, thereby promoting gender equality in leadership outcomes.

- Engineering colleges can leverage their University Social Responsibility (USR) initiatives, akin to the govt. programmes like Unnat Bharat program by the Ministry of HRD, to foster social innovation development and dissemination. For eg: The students participated in SAGY (Saansad Adarsh Gram Yojana), a govt. initiative in a nearby village as a part of the NSS activity. Engineering colleges should encourage researchers to join innovation and impact hubs, shared spaces for collaboration between academia, corporates, and government on innovative projects and social initiatives. They can also offer workshops and mentorship programs to enhance women leaders' skills in grant writing, fundraising, and networking. Aligning with Sustainable Development Goal (SDG) 17, which emphasizes partnerships with stakeholders, particularly for Goal 11, Sustainable Cities and Communities, is essential for effective implementation. Eg: Partnerships were done for green technology like having Yule e-bikes for travelling inside campus and with Tata power for solar rooftops etc. have been successful in this regard.
- Universities hold a pivotal role in driving SDG implementation. This paper emphasizes the need to fortify partnerships between universities, governments, and communities to effectively advance the 2030 agenda. The government can mandate legislation, and enforce strategies to ensure higher learning institutions prioritize and implement social responsibility to the public. University leaders can drive Social Responsibility (SR) by incorporating it into organizational strategy, creating dedicated units and roles (e.g., vice-rector for sustainability), and aligning rewards (compensation, awards for impactful teaching and research) and performance evaluation measures (volunteering, advisory services) to SR criteria. This establishes essential infrastructure for collaboration with external stakeholders and internal legitimacy for social responsibility. To enhance their social role, universities must align with international benchmarks and leverage partnerships for effective governance and solutions to societal challenges. Examples from the study include HEI’s working on Goal 11: Sustainable Cities and Communities through development of Green Technology, Yule e-bikes etc., Goal 17: Partnerships for the Goals Partnership like Tata power for solar rooftops, Goal 6: Clean Water and Sanitation through Campaigns for saving water, Waste treatment plant, Rainwater harvesting.
- To improve research productivity of female HoDs, they should actively promote collaborations within and across institutions, ensuring that female leaders are included in high-impact research projects. Mentorship programs should be developed to guide female faculty in grant writing and research management. Additionally, fostering a culture that values work-life balance and recognizes research achievements can motivate and empower female faculty to excel in their research endeavours.

6.2.2 For the Policymakers:

- Policymakers should prioritize the implementation of gender-sensitive policies that promote work-life balance for female heads of STEM departments in Delhi's engineering colleges. This includes mandating flexible work arrangements, equitable parental leave, and access to on-campus childcare. Additionally, policies should encourage leadership development programs tailored to the unique challenges faced by women in leadership roles, along with the establishment of mentorship and peer support networks. By enforcing regular assessments of workload distribution and supporting mental health initiatives, policymakers can create an environment where female leaders can thrive both personally and professionally.

- Policymakers should implement initiatives that support female heads of STEM departments in boosting placement rates by fostering stronger industry connections and providing equal access to resources. This includes promoting targeted leadership training, encouraging strategic partnerships between industry and departments led by women, and ensuring equitable distribution of resources for placement activities. Policies should also focus on increasing the visibility of female leaders' achievements and facilitating mentorship programs with successful industry figures. By addressing potential biases and creating a supportive environment, policymakers can help level the playing field and improve placement outcomes under female leadership.
- Policymakers should provide tax incentives or grants for universities engaged in significant USR activities, develop regulatory frameworks to encourage collaborations between universities, corporates, and government, and establish funding programs to support gender-equitable projects. They should create innovation hubs for collaborative R&D, implement systems to monitor USR impact, and strengthen anti-corruption measures. Additionally, policymakers can develop certification programs to recognize USR excellence, offer grants for collaborative projects, and enforce policies ensuring equitable funding access for women-led USR initiatives.

6.2.3 For the Industries

- Effective institution-industry collaboration requires government and educational institutions to develop policies that offer suitable incentives and disincentives. IITs and similar institutions should prioritize a candidate's capability and willingness to foster industry collaboration when selecting faculty members. Technical educational institutions should host "Open House" events for industry and participate in industrial exhibitions and fairs to showcase their capabilities and engage in discussions with industry stakeholders. Knowledge-based industries thrive in global competition. Hence, industries are urged to support university research programs, provide resources, sponsor research, offer financial assistance and promote teaching-training exchange programs. For eg: internships provided to students, training them for projects, conferences, workshops etc. Increased cooperation is essential for mutual benefit in evolving circumstances. Formal organizational structures can facilitate and support collaboration and knowledge transfer between universities and industries. Industrial professionals often face challenges negotiating contracts and intellectual property rights with universities. Conversely, university researchers typically lack the time, resources, and expertise for patent applications or research results transfer. Establishing a dedicated office for patenting and licensing within universities can streamline the process, handling tasks such as patent applications, research result transfer, and commercial potential assessments. This would alleviate administrative burdens on university researchers and USR activities can be in compliance with the CSR initiatives. Partnerships/collaboration between universities and government/civil society/corporates can yield additional funding, research opportunities for USR activities.

6.3 Limitation of the Study

1. The study has been done for permanent faculty only
2. The study includes engineering institutions only
3. Only Delhi has been considered for the study

6.4 Suggestions for future work

1. The study has been limited to only the engineering colleges in Delhi. It can be carried out in other states as well.

2. The study has been done in engineering and applied sciences only, other disciplines can also be studied.

3. It has been done only in the engineering colleges but it can be extended to other non-engineering colleges as well

4. Comparative study can also be done for two or more states or countries.
   Future research should be conducted on colleges to know whether academic engagement is in compliance with USR activities or not.

REFERENCES

Ahmad, A., 1996. Associations of Work-Family Conflict, Job Satisfaction, Family Satisfaction and Life Satisfaction: A Study of Married Female Secretaries. Journal of Social Sciences and Humanities 4, 101–108.

Akgunduz, D., 2016. A Research about the Placement of the Top Thousand Students Placed in STEM Fields in Turkey between the years 2000 and 2014. EURASIA Journal of Mathematics, Science and Technology Education 12. https://doi.org/10.12973/eurasia.2016.1518a

’Ali, A. ’Ali, W., 2016. The Notion of Work Life Balance, Determining Factors, Antecedents And Consequences: A Comprehensive Literature Survey 4.

Ankrah, S.N., Burgess, T.F., Grimshaw, P., Shaw, N.E., 2013. Asking both university and industry actors about their engagement in knowledge transfer: What single-group studies of motives omit. Technovation 33, 50–65. https://doi.org/10.1016/j.technovation.2012.11.001

Anuradha, Pandey, M., 2015. A Review of Work-Life Balance Practices Prevalent in Public Sector Undertakings in India. Prabandhan: Indian Journal of Management 8, 49. https://doi.org/10.17010/pijom/2015/v8i2/61402

Aye, L.M., Lee, W.H., 2024. Poor sleep quality and its associated factors among working adults during COVID-19 pandemic in Malaysia. Cambridge Prisms: Global Mental Health 11, e28. https://doi.org/10.1017/gmh.2024.23

Bello, Z., Tanko, G.I., 2020. Review of Work-Life Balance Theories. GATR Global Journal of Business Social Sciences Review 8, 217–227. https://doi.org/10.35609/gjbssr.2020.8.4(3)

Beresford, P., Rose, D., 2023. Decolonising global mental health: the role of Mad Studies. Cambridge Prisms: Global Mental Health 1–21. https://doi.org/10.1017/gmh.2023.21

Borg, S., Alshumaimeri, Y., 2012. University teacher educators’ research engagement: Perspectives from Saudi Arabia. Teach Teach Educ 28, 347–356. https://doi.org/10.1016/j.tate.2011.10.011

Braun, V., Clarke, V., 2023. Toward good practice in thematic analysis: Avoiding common problems and be(com)ing a *knowing* researcher. Int J Transgend Health 24, 1–6. https://doi.org/10.1080/26895269.2022.2129597

Burton Bollag, 2003. “n Chile, A fast-growing University, Owned by Sylvan, Produces Profits and Scorn. Chron High Educ.

Campion, P., Shrum, W., 2004. Gender and Science in Development: Women Scientists in Ghana, Kenya, and India. Sci Technol Human Values 29, 459–485. https://doi.org/10.1177/0162243904265895

Cham, C.Q., Ibrahim, N., Kalaman, C.R., Ho, M.C., Visvalingam, U., Ahmad Shahabuddin, F., Abd Rahman, F.N., Halim, M.R.T.A., Harbajan Singh, M.K., Azhar, F.L., Yahya, A.N., Roslan, S., Siau, C.S., 2024. Factors associated with depression, anxiety, and satisfaction with life among Malaysian parental caregivers of adolescent psychiatric patients: A cross-sectional study. Cambridge Prisms: Global Mental Health 11, e12. https://doi.org/10.1017/gmh.2024.5

Chan, X.W., Kalliath, T., Brough, P., Siu, O.-L., O’Driscoll, M.P., Timms, C., 2016. Work–family enrichment and satisfaction: the mediating role of self-efficacy and work–life balance. The International Journal of Human Resource Management 27, 1755–1776. https://doi.org/10.1080/09585192.2015.1075574

Chen, Y., Gupta, A., Hoshower, L., 2006. Factors That Motivate Business Faculty to Conduct Research: An Expectancy Theory Analysis. Journal of Education for Business 81, 179–189. https://doi.org/10.3200/JOEB.81.4.179-189

Chong, Y.S., Ahmed, P.K., Amin, H.U., 2024. Career Change Intentions of Science and Engineering Undergraduates: A Behavioral Neuroscience Inquiry. IEEE Access 1–1.

https://doi.org/10.1109/ACCESS.2024.3375358
Christie, M., O'Neill, M., Rutter, K., Young, G., Medland, A., 2017. Understanding why women are under-represented in Science, Technology, Engineering and Mathematics (STEM) within Higher Education: a regional case study. Production 27. https://doi.org/10.1590/0103-6513.220516
Cremonini, L., Adamu, A.Y., 2021. Social Responsibility in Higher Education: The Case of Ethiopia, in: Re-Envisioning Higher Education's Public Mission. Springer International Publishing, Cham, pp. 229–249. https://doi.org/10.1007/978-3-030-55716-4_12
Deloitte Global, 2022. Progress at a Snail's Pace – Women in the Boardroom: A Global Perspective.
Dhindsa, H.S., 2008. Cultural Dimensions of the Learning Environment in Brunei. Int J Sci Math Educ 6, 251–267. https://doi.org/10.1007/s10763-007-9077-8
Doyle, J., Postlewaite, E., Sadler, P.M., Sonnert, G., 2023. Differences in Career Outcome Expectations of College Students by Race/Ethnicity and Gender. Journal of Underrepresented & Minority Progress 7. https://doi.org/10.32674/jump.v7i1.5422
Elaine Lee, 2017. SUTD encouraging more women to join Stem industry. straitstimes.
Elgar, A.G., 2004. Science textbooks for lower secondary schools in Brunei: issues of gender equity. Int J Sci Educ 26, 875–894. https://doi.org/10.1080/0950069032000138888
EU publications, 2015. She figures 2015.
Fan, T.-S., Li, Y.-C., 2005. Gender issues and computers: college computer science education in Taiwan. Comput Educ 44, 285–300. https://doi.org/10.1016/j.compedu.2004.02.003
Fatima R. KHATEEB, 2021. WORK LIFE BALANCE - A REVIEW OF THEORIES, DEFINITIONS AND POLICIES. Cross-Cultural Management Journal 23, 1–29.
Fauzi, M.A., 2023. Research vs. non-research universities: knowledge sharing and research engagement among academicians. Asia Pacific Education Review 24, 25–39. https://doi.org/10.1007/s12564-021-09719-4
Finnegan, D.E., 2005. The Decline of the Guru: The Academic Profession in Developing and Middle-Income Countries (review). Rev High Ed 28, 429–430. https://doi.org/10.1353/rhe.2005.0008
Fox, T., Canagarajah, A.S., 2004. A Geopolitics of Academic Writing. College Composition and Communication 55, 582. https://doi.org/10.2307/4140703
G. A. Lemarchand, 2018. Mapping Research and Innovation in Lao People's Democratic Republic. Paris.
Godemann, J., Haertle, J., Herzig, C., Moon, J., 2014. United Nations supported Principles for Responsible Management Education: purpose, progress and prospects. J Clean Prod 62, 16–23. https://doi.org/10.1016/j.jclepro.2013.07.033
Grover, A., Venkatesh, U., Kishore, J., Chakma, T., Thomas, B., Menon, G., Periyasamy, M., Kulkarni, R., Prusty, R.K., Venkateswaran, C., Mishra, B., Balu, V., Viray, M., Mathew, G., Ketharam, A., Balachandar, R., Singh, P., Jakhar, K., Devi, R., Saha, K., Barde, P., Moral, R., Singh, R., John, D., Yadav, J., Kohli, S., Aggarwal, S., Rao, V., Panda, S., 2023. Factors associated with stigma and manifestations experienced by Indian health care workers involved in COVID-19 management in India: A qualitative study. Cambridge Prisms: Global Mental Health 10, e46. https://doi.org/10.1017/gmh.2023.40
Haar, J.M., Russo, M., Suñe, A., Ollier-Malaterre, A., 2014. Outcomes of work–life balance on job satisfaction, life satisfaction and mental health: A study across seven cultures. J Vocat Behav 85, 361–373. https://doi.org/10.1016/j.jvb.2014.08.010
Hackett, A., Strickland, K., 2019. Using the framework approach to analyse qualitative data: a worked example. Nurse Res 26, 8–13. https://doi.org/10.7748/nr.2018.e1580
Hanel, P., St-Pierre, M., 2006. Industry–University Collaboration by Canadian Manufacturing Firms*.

J Technol Transf 31, 485–499. https://doi.org/10.1007/s10961-006-0009-5
Hei Hang, Hayes Tang, 2019. World-Class Universities and Female Leadership in the Academic Profession: Case Studies of East Asian Higher Education. Gender and the Changing Face of Higher Education in Asia Pacific 41–56.
Helen Coult, 2020. The Rise of the Female Chief Technology Officer in Asia Pacific: Observations from the Market.
Heng, K., Hamid, M.O., Khan, A., 2023. Research engagement of academics in the Global South: the case of Cambodian academics. Globalisation, Societies and Education 21, 322–337. https://doi.org/10.1080/14767724.2022.2040355
Hoover, J., Bolton, P., Clonchmore, A., Sussman, L., Frymus, D., 2023. Responding to the impact of COVID-19 on the mental health and well-being of health workers in LMICs. Cambridge Prisms: Global Mental Health 10, e41. https://doi.org/10.1017/gmh.2023.30
Huda Al-Kubaisi, 2022. Human Resource Management in Academia of Universities; Essential Characterisitics and upcoming Challenges-Literature Review. Journal of Positive Psychology and Wellbeing 6.
Iain Hay, 2006. Transformational leadership: characteristics and criticisms. E-journal of Organizational Learning and Leadership.
ILO, 2016. ASEAN in Transformation: How Technology is Changing Jobs and Enterprises.
InduGautam, S.J., 2018. A STUDY OF WORK-LIFE BALANCE: CHALLENGES AND SOLUTIONS, in: Emerging Role of Leadership, Values and Ethics in Organisational DevelopmentAt: KIET. Ghaziabad, pp. 1–20.
International Labour Organisation, 2020. Women in STEM workforce readiness and development programme in Thailand. Thailand.
Irene Evangelista, 2017. Sexism in Higher Education Institutions in Countryside Philippines. Journal of Academic Research 2, 7–17.
Jamil, H., Ahmad Shabudin, A.F., Raman, S.R., Ling, O.P., 2019. Changing Landscape of the Malaysian Higher Education: An Overview of Women's Glass Ceiling. pp. 145–165. https://doi.org/10.1007/978-3-030-02795-7_10
Jessica Vechbanyongratana, J Vechbanyongratana, 2015. Private returns to STEM education in Thailand. Science (1979).
Kahn, M.J., 2022. The Status of Science, Technology and Innovation in Africa. Science, Technology and Society 27, 327–350. https://doi.org/10.1177/09717218221078540
Kelly Ward, Tami L Moore, 2010. Institutionalizing Faculty Engagement through Research, Teaching, and Service at Research Universities. Mich J Community Serv Learn 17, 44–58.
Kenneth Jones, L., Hite, R.L., 2020. Who wants to be a scientist in South Korea: assessing role model influences on Korean students' perceptions of science and scientists. Int J Sci Educ 42, 2674–2695. https://doi.org/10.1080/09500693.2020.1829158
Khine, M.S., 2002. Study of Learning Environment for Improving Science Education in Brunei, in: Studies in Educational Learning Environments. WORLD SCIENTIFIC, pp. 131–151. https://doi.org/10.1142/9789812777133_0006
KHIN KHIN MR, 2021. Women fight the dual evils of dictatorship and patriarchal norms in Myanmar. New Mandala.
Kholis, N., 2012. Gendered Career Productivity and Success in Academia in Indonesia's Islamic Higher Education Institutions. Journal of Indonesian Islam 6, 341. https://doi.org/10.15642/JIIS.2012.6.2.341-366
Kimkong Heng, M. Obaidul Hamid, Asaduzzaman Khan, 2020. Factors influencing academics'

research engagement and productivity: A developing countries perspective. Issues in Educational Research 30.
Kim, T.K., 2015. T test as a parametric statistic. Korean J Anesthesiol 68, 540. https://doi.org/10.4097/kjae.2015.68.6.540
Kyvik, S., Reymert, I., 2017. Research collaboration in groups and networks: differences across academic fields. Scientometrics 113, 951–967. https://doi.org/10.1007/s11192-017-2497-5
Landivar L. C, 2013. Disparities in STEM employment by sex, race, and hispanic origin. U.S. Census Bureau: American Community.
Landolfi, A., Barattucci, M., Lo Presti, A., 2020. A Time-Lagged Examination of the Greenhaus and Allen Work-Family Balance Model. Behavioral Sciences 10, 140. https://doi.org/10.3390/bs10090140
Lawson, C., Geuna, A., Finardi, U., 2021. The funding-productivity-gender nexus in science, a multistage analysis. Res Policy 50, 104182. https://doi.org/10.1016/j.respol.2020.104182
Lawson, K.M., Lee, S., Smith, C., Thiem, K.C., 2024. Retaining U.S. stem women faculty during the COVID-19 pandemic: the important role of family-supportive supervisor behaviors to lower work-to-life conflict. Gender in Management: An International Journal 39, 52–70. https://doi.org/10.1108/GM-10-2022-0326
Mitchell, J.E., Rebne, D.S., 1995. Nonlinear effects of teaching and consulting on academic research productivity. Socioecon Plann Sci 29, 47–57. https://doi.org/10.1016/0038-0121(95)98606-V
Miyawaki, Y., Sada, K., Shidahara, K., Nawachi, S., Asano, Y., Katayama, Y., Hayashi, K., Katsuyama, E., Katsuyama, T., Takano-Narazaki, M., Matsumoto, Y., Oguro, N., Yajima, N., Ishikawa, Y., Sakurai, N., Hidekawa, C., Yoshimi, R., Ichikawa, T., Kishida, D., Shimojima, Y., Wada, J., Kurita, N., 2023. The Association of Grit With Burnout Components (Professional Efficacy, Exhaustion, and Cynicism) Among Academic Rheumatologists. JCR: Journal of Clinical Rheumatology 29, 268–274. https://doi.org/10.1097/RHU.0000000000001989
Mohajan, D., Mohajan, H.K., 2022. Development of Grounded Theory in Social Sciences: A Qualitative Approach. Studies in Social Science & Humanities 1, 13–24. https://doi.org/10.56397/SSSH.2022.12.02
Morley, L., 2014. Lost leaders: women in the global academy. Higher Education Research & Development 33, 114–128. https://doi.org/10.1080/07294360.2013.864611
Mukhopadhyay, C.C., Seymour, S., 2021. Women, Education, and Family Structure in India. Routledge, New York. https://doi.org/10.4324/9780429268649
Muthulakshmi, C., 2018a. A Study on Work Life Balance Among the Teaching Professionals of Arts and Colleges in Tuticorin District. ICTACT Journal on Management Studies 4, 657–662. https://doi.org/10.21917/ijms.2018.0089
Muthulakshmi, C., 2018b. A Study on Work Life Balance Among the Teaching Professionals of Arts and Colleges in Tuticorin District. ICTACT Journal on Management Studies 4, 657–662. https://doi.org/10.21917/ijms.2018.0089
Naithani, P., 2010. Overview of Work-Life Balance Discourse and Its Relevance in Current Economic Scenario. Asian Soc Sci 6. https://doi.org/10.5539/ass.v6n6p148
Ocampo, J.M.F., Santos, R.A.N., Sevilleja, J.E.A.D., Gloria, C.T., 2024. The COVID-19 pandemic's effects on mental and psychosocial health in the Philippines: A scoping review. Cambridge Prisms: Global Mental Health 11, e27. https://doi.org/10.1017/gmh.2024.14
Pearson, W., J., C.L. McNeely, Lisa M Frehill, 2015. Advancing Women in Science. Springer International Publishing, Cham. https://doi.org/10.1007/978-3-319-08629-3
Perkmann, M., Walsh, K., 2007. University–industry relationships and open innovation: Towards a

research agenda. International Journal of Management Reviews 9, 259–280. https://doi.org/10.1111/j.1468-2370.2007.00225.x
Pfeffer, J., Langton, N., 1993. The Effect of Wage Dispersion on Satisfaction, Productivity, and Working Collaboratively: Evidence from College and University Faculty. Adm Sci Q 38, 382. https://doi.org/10.2307/2393373
P.H., Y., V.P., Q., L.T.B., P., L.B., N., 2018. English lecturers' perceptions and practices of research engagement: The case of Can Tho University. Can Tho University Journal of Science 54(2), 122. https://doi.org/10.22144/ctu.jen.2018.016
Pinheiro, D.L., Melkers, J., Newton, S., 2017. Take me where I want to go: Institutional prestige, advisor sponsorship, and academic career placement preferences. PLoS One 12, e0176977. https://doi.org/10.1371/journal.pone.0176977
Pitt, R.N., Taskin Alp, Y., Shell, I.A., 2021. The Mental Health Consequences of Work-Life and Life-Work Conflicts for STEM Postdoctoral Trainees. Front Psychol 12. https://doi.org/10.3389/fpsyg.2021.750490
Priyatna, A., 2013. Negotiating and Rethinking Local Culture: The Narratives of Indonesian Women Juggling Higher Education, Work, and Domestic Roles. Asian J Women Stud 19, 95–123. https://doi.org/10.1080/12259276.2013.11666167
Reynolds, L., Sariola, S., 2018. The ethics and politics of community engagement in global health research. Crit Public Health 28, 257–268. https://doi.org/10.1080/09581596.2018.1449598
Rivera, E., Elzomor, , Mohamed, Pradhananga, P., n.d. Transforming Education Pedagogies to Include Life-Work Balance in Engineering, in: 2023 ASEE Annual Conference & Exposition Proceedings. ASEE Conferences. https://doi.org/10.18260/1-2--44519
Rohini M. Godbole, R.R., 2015. Women Scientists in India. new delhi.
Rosser, S., 2020. The national science foundation's advance programme: Issues for senior compared to junior academic women scientists, Gender, Science and Innovation: New Perspectives. https://doi.org/10.4337/9781786438973.00011
Shakir, M., Irshad, H.A., Khowaja, A.H., Altaf, A., Enam, S.A., 2024. Exploring the neurosurgery training landscape in Pakistan: A trainee's perspective in resource-limited settings. World Neurosurg X 22, 100346. https://doi.org/10.1016/j.wnsx.2024.100346
Singapore Tripartite Forum, 2022. The Annual Report outlines TAL's activities and achievements.
Smith, C.R., 2024. Why (And How) Do Women Engineers Stay?: A Positive Psychology Approach to Understanding the Career Sustainability of Women in Engineering. J Women Minor Sci Eng 30, 99–122. https://doi.org/10.1615/JWomenMinorScienEng.2022040353
Snowball, J.D., Shackleton, C.M., 2018. Factors enabling and constraining research in a small, research-intensive South African University. Res Eval 27, 119–131. https://doi.org/10.1093/reseval/rvy002
Statistics Canada, 2019. Persistence and Representation of Women in STEM Programs. Insights on Canadian Society. canada.
Takuya Matsuura, Daiki Nakamura, 2021. Trends in STEM/STEAM Education and Students' Perceptions in Japan. Asia-Pacific Science Education.
Tantiwiramanond, D., 2007. The Growth and Challenges of Women's Studies in Thailand. Interventions 9, 194–208. https://doi.org/10.1080/13698010701409145
Tariq Mahmood, Khan, S., Syed Manzoor Hussain, 2018. An Investigation of Attitudes towards the Research Activities of University Teachers. Bulletin of Education and Research 40, 215–230.
Tartari, V., Perkmann, M., Salter, A., 2014. In good company: The influence of peers on industry engagement by academic scientists. Res Policy 43, 1189–1203. https://doi.org/10.1016/j.respol.2014.02.003

Tartari, V., Salter, A., 2015. The engagement gap:Exploring gender differences in University – Industry collaboration activities. Res Policy 44, 1176–1191. https://doi.org/10.1016/j.respol.2015.01.014

Tembo, D., Hickey, G., Montenegro, C., Chandler, D., Nelson, E., Porter, K., Dikomitis, L., Chambers, M., Chimbari, M., Mumba, N., Beresford, P., Ekiikina, P.O., Musesengwa, R., Staniszewska, S., Coldham, T., Rennard, U., 2021. Effective engagement and involvement with community stakeholders in the co-production of global health research. BMJ n178. https://doi.org/10.1136/bmj.n178

Teodorescu, D., 2000. Correlates of faculty publication productivity: A cross-national analysis. High Educ (Dordr) 39, 201–222. https://doi.org/10.1023/A:1003901018634

Thilagavathy S. and Geetha S.N, 2021. Work-life balance -a systematic review. Vilakshan - XIMB Journal of Management.

UNESCO, 2018. Telling SAGA: improving measurement and policies for gender equality in science, technology and innovation.

UNESCO, 2017. Cracking the code: girls' and women's education in science, technology, engineering and mathematics (STEM). UNESCO. https://doi.org/10.54675/QYHK2407

Vaishali Rastogi, Michael Meyer, Michael Tan, Justine Tasiaux, 2020. Boosting Women in Technology in Southeast Asia [WWW Document]. Boston Consulting Group.

Veugelers, R., 2016. The embodiment of knowledge: universities as engines of growth. Oxf Rev Econ Policy 32, 615–631. https://doi.org/10.1093/oxrep/grw026

Zahid Ashraf Wani, Mohd Tahir Pandit, Nighat Majeed, 2013. Research productivity of Indian Institute of Technology. International Journal of Library and Information Science 5.

Zhang, L., Li, Z., Li, M., Yang, Y., Hsu, M., Xia, L., Liu, T., Liu, Y., Jiang, F., Liu, H., Tang, Y., 2023. Mental health symptoms and their associated factors among pharmacists in psychiatric hospitals during the early stage of the COVID-19 pandemic. Cambridge Prisms: Global Mental Health 10, e77. https://doi.org/10.1017/gmh.2023.71

Žnidaršič, J., Marič, M., 2021. Relationships between Work-Family Balance, Job Satisfaction, Life Satisfaction and Work Engagement among Higher Education Lecturers. Organizacija 54, 227–237. https://doi.org/10.2478/orga-2021-0015

Appendix

Table 1: Branches included in the study

S.N.O	Branches
1	CSE
2	ECE
3	EEE
4	ME
5	ECE
6	CHEMICAL
7	BIOLOGICAL
8	CIVIL
9	CSE
10	ECE
11	IT
12	ICE
13	SE
14	AS
15	AI & DS
16	DOD
17	TFE
18	ICT
19	BIOTECH
20	MSE, material sciences
21	ENE, environmental engg.
22	Mechatronics engg.
23	Industrial engg.
24	ESE
25	EE, energy engg.
26	EP, engg. Physics

Table 2: List of HEI's included in the study:

S.N.O	Name	Sector
1	Delhi technological university	Government
2	HMR Institute of Technology and Management-(HMR-ITM)	Private
3	Northern India Engineering College - NIEC, Dr Akhilesh Das Gupta Institute of Technology and Management, New Delhi, IP university	Private
4	Indraprastha Institute of Information Technology	Government
5	Maharaja Agrasen Institute of Technology-MAIT, IP University	Private
6	Maharaja Surajmal Institute of Technology-MSIT, IP university	Private
7	Bharati Vidyapeeth College of Engineering-BVCE,IP university	Private
8	Bhagwan Parsuram Institute of Technology-BPIT, IP university	Private
9	National Power Training Institute –NPTI , IP university, Faridabad	Government
10	Delhi Institute of Tool Engineering (DITE),IP university	Government
11	FORMERLY Ambedkar Institute of Advance communication Technology & Research - AIACTR, (NSUT east campus, NOW),IP	Government
12	VIPS	Private
13	Indira Gandhi Delhi Technical University for Women	Government
14	IIT Delhi	Government
15	Ch. Brahm Prakash Government Engineering College (NSUT now)	Government

16	Netaji Subhas Institute/university of Technology	Government
17	G .B. Pant Government Engineering College-GBGEWC, Delhi skill and entrepreneurship university, IP university	Government
18	GTBIT	Private
19	National Institute of Technology (NIT)	Government
20	Kasturba Gandhi Institute of Technology	Private

Table 3: Index to measure Work-Life balance, Principal component analysis

Measuring variables	PC1	PC2	PC3	Uniqueness
I feel tired to complete the required hours of being in the university in my place according to the university norms (eg: biometric system/ fixed work hours)	0. 834			0. 264
I can take a leave for doctor's appointment in illness	0. 791			0. 312
I can take a compensatory leave for Child care/family emergency	0. 773			0. 178
I smile and act happy infront of people even after having stress on the inside (not getting irritated)	0. 722			0. 414
I am thinking of switching from this university	0. 716			0. 417
Job sharing (I can send someone else to attend a meeting on my behalf)	0. 716			0. 258
I get respect and appreciation from my co -workers for the work that I do	0. 706			0. 205
I can share positive feelings, appreciation, humour, and fun with my family and find relief from difficulties		0. 693		0. 440
I am able to fullfil extra roles like taking part in my family pooja/festivals/family functions etc		0.666		0. 214

My workplace helps me acquire certain skills (Eg:Conflict resolution skills learned at work enables me to resolve conflicts more effectively within my family) and this helps me become a better family member		0. 895		0. 134
I don't act the usual way at work if I have a problem at home (A change in my behaviour because of mood)		0. 870		0. 202
My workplace helps me learn new behaviors (Eg:Greeting everyone when you meet them and passing a smile etc) and this helps me become a better family member		0. 858		0. 244
Our family faces difficulties together as a team, rather than individually		0. 817		0. 226
If I face a problem because of a chilly environment at my workplace and get frustrated, I try to move on and recover by adapting to different strategies or getting help from social groups/family		0. 546		0. 550
The conditions of my life are excellent			0. 887	0. 154
I am very focussed on achieving my goals in life.			0. 861	0. 210
If I could live my life over, I would change almost nothing			0. 755	0. 363
My life is close to my ideal			0. 558	0. 647
I am satisfied with my life			0. 830	0. 136

Source: Prepared by the authors

List of Publications and their proofs

1. IASSI QUARTERLY, UGC CARE

Gmail

Japji Kaur <japesnnats@gmail.com>

Regarding Manuscript submission

IASSI <stiassi79@gmail.com> 26 April 2024 at 14:24
To: Japji Kaur <japesnnats@gmail.com>

To whom it may concern

The paper titled "Investigating Work-Life Balance of STEM Leaders in Academia: A Study of Engineering Colleges in Delhi, India" by Japji Kaur and Seema Singh, from the Department of Humanities at Delhi Technological University, Delhi has been accepted for publication in the IASSI Quarterly. It is scheduled to appear in the July-September 2024 issue.

IASSI Secretariat

IASSI Quarterly: Contributions to Indian Social Science, Vol. 43, No. 3, 2024

Investigating Work-Life Balance of STEM Leaders in Academia: A Study of Engineering Colleges in Delhi, India

Japji Kaur and Seema Singh*

This study aims to identify how the overall satisfaction of STEM leaders affected their WLB (work-life balance). Research in STEM (Science, technology, engineering, mathematics) disciplines is mandatory for a nation to grow economically. In recent times, the issue of WLB of STEM employees in academia has gained increased attention. WLB in STEM disciplines is difficult for heads of these departments who face the extra burden of nonteaching activities. Earlier research has focused on faculty rather than STEM leaders. Data was collected from 103 heads of STEM departments in the engineering institutions of Delhi by conducting a census, and it was analyzed using principal component analysis and multiple regression to test the associations formed. The results showed that satisfaction in three domains, i.e., job, family, and life, positively impacted the work-life balance of STEM leaders. This study aims to help higher academic institutions develop work-life balance policies that enhance employee well-being. A balanced work-life approach is essential for improving skills and productivity in the workplace and hence research, particularly considering the demand for a skilled STEM workforce in today's era. Academicians in STEM higher education institutions in Delhi, India, can achieve

2. JIM QUEST, UGC CARE

JIM QUEST January-June 2024 Volume 20 Issue Number 1/Proofreading Inbox ×

JIM Ghaziabad JIMQUEST

to me, seemasinghdtu

Tue, 23 Jul, 14:28

Dear Author(s),

We would like to inform you that your paper accepted for the JIM QUEST (Vol. 20, No. 1, Jan - Jun 2024) is currently in the final production stages for the publication to which you are an author. We are very pleased to present you with the proof of your contribution to this publication for your review.

It is the responsibility of the author(s) to have their work copyedited prior to final submission. No major changes to the text can be made at this stage. Please check the following items for accuracy and clarity:

- Names and Affiliations
- Manuscript Titles, Subtitles, and Headings
- Font style/size, General spacing, Grammatical errors, and Referencing
- Figures, Tables, and Equations

It is important that you act on this proof request by **Tomorrow (26 July 2024)**. Kindly make the changes in the attached PDF itself. Please note that revisions submitted after the proofing deadline cannot be accommodated and will not appear in the finalized version of this publication. Afterwards, JIM QUEST Editorial Team will not be responsible for any error.

Thanks and Regards

Editorial Team

Work-Life Balance of Women in STEM Fields: A Bibliometric Analysis

*Japji Kaur
**Seema Singh

Abstract

This study focused on understanding how women in male-dominated fields like STEM, manage their work and personal obligations. This paper conducts a comprehensive review of the literature on work-life balance (WLB) theories and factors influencing it, focusing on women in both developed and developing nations, as well as organizational practices using bibliometric analysis methods on publications from four databases, namely Scopus, Web of Science, Cambridge Core, and Sage, spanning roughly from 2005 to 2023, it identifies major research gaps and trends. The findings highlighted the challenges women face in distinguishing between their work and personal roles, emphasizing the importance of informational and emotional support in their careers. It also identified spouses/significant others, female co-workers, and external mentors as significant sources of support, enabling them to maintain and advance in their STEM careers. The analysis reveals that the USA has been the primary contributor to research on WLB in STEM careers, with developing nations lagging behind, as evidenced by cluster analysis.

Keywords: Work-Life Balance, STEM careers, Bibliometric analysis, VOS viewer.

3. Journal of Educational Planning and administration, NIEPA, UGC CARE

Copy edited version for proofreading and confirmation Inbox ×

Prof.A.K. Singh <aksingh@niepa.ac.in> Thu, 20 Jun, 10:01

to me

Dear Prof. Kaur

Kindly find attached the copy edited version of your paper for confirmation and proofreading at your end. Looking forward to receiving its accepted final version.

Warm regards,

Avinash

--

Prof. Avinash Kumar Singh
Dean, Academic and Research
Head, Department of Educational Policy,
Editor: Journal of Educational Planning and Administration
National Institute of Educational Planning and Administration,
(Deemed to be University)
17- B,Sri Aurobindo Marg,New Delhi- 110016 (INDIA)
91-011-26544856 (office)
Fax : 91-011-26853041, 26865180
Website: www.niepa.ac.in

Journal of Educational Planning and Administration
Volume XXXVIII, No. 2, April 2024, pp. 123-140

A Bibliometric Analysis of Work Life Balance in STEM Careers

Japji Kaur*
Seema Singh#

Abstract

In recent years, the fast-paced globalisation and modernisation have prompted organisations to prioritise family-friendly work-life balance (WLB) policies. Past literature has focussed on the work-life conflicts prevalent across various professions which show a decreased well-being among workers. There exist many theories on WLB; however, there has been a notable gap in research concerning work-life balance amongst the science, technology, engineering, and mathematics (STEM) workforce. Broadening participation in STEM fields is essential as it enriches innovation and problem-solving, improving the nation's living standards and maintaining global competitiveness. Despite the critical role of STEM fields in driving innovation and economic growth, the demanding nature of these professions often poses challenges for maintaining a healthy balance between work responsibilities and personal life. This paper explores the published literature in order to find out the factors responsible for poor WLB in STEM careers. It uses bibliometric and visual analysis methods to analyse the publications in a systematic way from four databases namely Scopus, Web of Science, Cambridge Core and Sage roughly from 2005 to 2024. It investigates the most influential countries, research organisations, top clusters etc. The results reveal that the USA is the only country which has done a major chunk of research on this topic as compared to the developing nations which are far behind as evident in the cluster analysis. Work-life balance in STEM academia is not just

4. Naturalista Campano, Web of Science

Factors Affecting Researcher Productivity of Public and Private Universities in the Global South: the Case of Indian Academia

pdf

Keywords:
STEM Research, Researcher Productivity, STEM Academia.

Miss. Japji Kaur
Research Scholar, Department of Humanities, Delhi Technological University, Delhi, India.

Professor Seema Singh
Professor of Economics, Delhi Technological University, Delhi, India.

Abstract

Research productivity not only plays a vital role in the development of higher education institutes but it is also equally important for academic evolution of faculty. The STEM researchers from global south look for higher educational opportunities in the global north than in their own nations due to several constraints. They prefer to move to nations like USA, UK to pursue their careers because of issues like lack of funding or research infrastructure etc in their nations. This article explores factors influencing research engagement, with a primary focus on academia from underrepresented Global South communities. It compares the

Copyright Form

Paper Template

Important Links

Home

Aims and Scope

Instructions for Authors

Editorial Board

Ethics & Policies

Publication Ethics and Publication Malpractice Statement

Peer Review Policy

Plagiarism Policy

Copyright, Grants and Ownership Declaration

Open Access Overview

Open Access License

Permissions

COPE

DELHI TECHNOLOGICAL UNIVERSITY
(Formerly Delhi College of Engineering)
Shahbad Daulatpur, Main Bawana Road, Delhi-42

PLAGIARISM VERIFICATION

Title of the Thesis - The Leadership of Women in STEM Education: A Study of Engineering Institutions in Delhi, Total Pages – 97, Name of the Scholar – Japji Kaur, Supervisor - Professor Seema Singh, Department – Humanities.

This is to report that the above thesis was scanned for similarity detection. Process and outcome is given below:

Software used: Turnitin, Similarity Index: 8%, Total Word Count: 33716.

Date: 10/10/2024

Candidate's Signature **Signature of Supervisor(s)**

BRIEF PROFILE

Japji Kaur is a passionate advocate for women empowerment and has a keen interest in conducting research on women-centric issues. She is an enthusiastic sports lover, which fuels her dedication to promoting equality and strength in all areas of life. In addition to her focus on women's rights, Japji enjoys staying informed on economic issues, regularly reading articles and exploring trends in this field. Her commitment to research and advocacy makes her a strong voice for gender equality and empowerment. She can be reached at japesnnats@gmail.com.

Professor Seema Singh specializes in the intersection of technology and its influence on the labor market, gender dynamics, education, and training. She is an accomplished academic with a strong publication record in leading refereed journals and has successfully completed numerous research projects supported by both national and international organizations. In her role as an educator, she supervises PhD and post-doctoral students and is a frequent reviewer for SCOPUS, Emerging Sources Citation Index, Web of Science, and Science Citation Index Expanded journals. Her ORCID is 0000-0001-5193-1639, and she can be reached at prof.seemasinghdtu@gmail.com.

Questionnaire on

The Leadership of Women in STEM Education: A Study of Engineering Institutions in Delhi

for the partial fulfilment for the award of Ph.D. degree

Conducted by

Japji kaur

(2k20/Ph.D/HUECO/01)

Under supervision of

Prof Seema Singh

Professor of Economics

Dear Madam/ Sir
The information through the questionnaire is for my Ph. D. thesis work.

Personal information and responses will be used for research purpose only and will remain confidential.

Department of Humanities, Delhi Technological University

Shahabad Daulatpur, Bawana Road

Delhi-110042 (India)

Questionnaire

Part A : Introduction

1. Name -

2. a Mobile 2.b Email -

3. Organization -

4. Designation - Professor/ Associate Professor/Assistant Professor

5 Branch

6 Gender – Male/ Female

7 Age Group

a) Below 30 years

b) 30 – 40 years

c) 40 – 50 years

d) 50 – 60 years

8. Whether done from Indian/ Foreign university

9. Please mention the name of the university-

10 Marital Status

a) Married

b) Unmarried

c) Divorcee

d) Widow

e) Other :

11. Type of family

Nuclear

Joint

12. Total no. of dependents in the family (including children and the elderly)--------

13. No. of children you have :

a) How many children do you have in each of the following age group of 0-4-

14. Sex of the children (Please mention the no. of kids in each category)

a) Girl :

b) Boy :

B. WORK LIFE BALANCE

15. Who in the family/outside family does the following type of work mentioned below:

**** Please indicate ( ) in the box below that corresponds to your answer.***

S.NO.	Type of work	Done by myself	Done by my spouse/partner	Grandparents/elderly at home /extended family members	Maid /servant	Any other person
1.	Cooking					
2.	Getting the ingredients for food from the market					
3.	Cleaning the house					

4.	House maintenance (Repairs) Eg: getting the fault in electricty checked, getting the bath tap fixed etc.					
5.	Picking up/dropping children to school/creche/ extra curricular classes etc.					
6.	Vegetable shopping					
7.	Monthly recharge of wifi					
8.	Payment of electricity bills					
9.	Bank related work					
10.	Supervision of a full /part time maid servant at home.					
11.	Teaching kids					

16 Please indicate the time you personally spend on family/domestic/caring responsibilities in a week :

a) None (Staff/Extended family members eg: grandparents/partner)

b) < 8 hrs

c) 8-20 hrs

d) >20 hr

17 Do you have any research equipments available in your department
a) Research laboratory,

b) Software and library subsciptions
c) Any other :

18 Is your department involved in consultancy with the corporate sector?

a) Yes

b) No

19 How many papers have you presented/presented & got published in national, international conferences in the past one year?

a) 1-3

b) 3-6

c) 6 & above

d) None

20 Have you organised any conference/seminar (National/International) in the past 1 year?

a) Yes

b) No

21 How many meetings do you attend on an average in a week?

a) 1-3

b) 3-6

c) 6 & above

d) None (send someone to attend the meeting)

22 Please indicate your teaching workload in a week?

a) 1-3 classes

b) 3-6

c) 6 & above

23 How many days per month do you work extra hours beyond your usual schedule?

a) 1-3

b) 3-6

c) 6-8

d) None

24 How many hours do you devote to doing research apart from teaching in a week?

a) 1-6

b) 6-8

c) 8 & above

d) None

25 Do you own a patent for any of your research work?

a) Yes

b) No

26 Are you currently collaborating with any other researcher/ corporate/university for any paper/project ?

a) Yes

b) No

27 How many hours in a week are you involved into doing administrative work?

a) 1-6

b) 6-8

c) 8 & above

d) None

28 After an average work day, about how many hours do you have to relax or pursue activities that you enjoy?

a) 1-2 hrs

b) 2-3 hrs

c) 3 & above

29 In the past 12 months, have you had back pain or pain in the hands, wrists, arms,or shoulders every day for a week or more?

a) Yes

b) No

30 How often have you worked during vacations (During summer or festive holidays in your university) ?

a) Sometimes

b) Often

c) Rarely

d) Never

31 Do you take extra help from your students for department work to complete the tasks before deadline ?

e) Sometimes

f) Often

g) Rarely

h) Never

32. Perceptions related to Role conflict (Job stress, Job satisfaction, perceptual bias, Employee intent to stay)

**** Please indicate ( ) in the box below that corresponds to your answer.***

S.N.O	Role conflict	1 = Strongly Disagree	2 = Disagree	3 = Neither Agree nor Disagree	4 = Agree	5 = Strongly Agree
1.	I can take a leave for Child / Elder care leave/ family emergency					
2.	I can take leave for Doctor's appointment in illness					

3.	I don't act the same way at work as I am at home. (A change in my behaviour).					
4.	Job sharing (I can send someone else to attend a meeting on my behalf)					
5.	I am thinking of switching from this university. (Propensity to Leave)					
6.	I get respect and appreciation from my co workers for the work that I do.					
7.	I am happy with my job.					

33. Perceptions related to work-family enrichment (Skills, Knowledge, Behaviour, Abilities)

**** Please indicate ( ) in the box below that corresponds to your answer.***

S.N.O	Work-family enrichment	1 = Strongly Disagree	2 = Disagree	3 = Neither Agree nor Disagree	4 = Agree	5 = Strongly Agree
2.	My workplace helps me to develop my abilities and this helps me be a better family member					
4.	My workplace helps me acquire certain skills (Eg: Conflict resolution skills learned at work enables me to					

	resolve conflicts more effectively within my family) and this helps me become a better family member.					
5.	My workplace helps me learn new behaviors (Eg: Greeting everyone when you meet them and passing a smile) and this helps me become a better family member.					
6.	My workplace helps me expand my knowledge of new things and this helps me become a better family member.					

34. **Perceptions related to Resiliency (I*ndividual's personality, Family, and Environment***

**** Please indicate ( ) in the box below that corresponds to your answer.***

S.N.O	Resiliency	1 = Strongly Disagree	2 = Disagree	3 = Neither Agree nor Disagree	4 = Agree	5 = Strongly Agree
1.	I get affected by a problem at work and face stress , anxiety and depression.					
2.	At work, I feel bursting with energy and motivated to accomplish all goals irrespective of how difficult they are.					

3.	We can share positive feelings, appreciation, humor, and fun and find relief from difficulties					
4.	Our family faces difficulties together as a team, rather than individually.					
5.	If I face a problem because of a chilly environment at my work and get frustrated, I try to move on and recover by adapting to different strategies or getting help from social groups.					
6.	I try to complete all my work responsibilities even if they require extra hours than the usual work load.					

35. Perceptions related to spillover (Permeable work Family Boundary , Surface Emotional Labour, Long working hours, Age)

**** Please indicate ( ) in the box below that corresponds to your answer.***

S.N.O	Spillover	1 = Strongly Disagree	2 = Disagree	3 = Neither Agree nor Disagree	4 = Agree		5 = Strongly Agree
1.	My behaviour with my kids and family is the same as that of my workplace (no change in my behaviour)						

2.	I am able to fullfil extra roles like taking part in my family pooja/ festivals/ family functions etc. as expected by my inlaws .						
3.	I am unable to spend quality time with my family because of prolonged working hours.						
4.	I smile and act happy infront of people even after having stress on the inside (not getting irritated).						
5.	I resist expressing my true feelings be it at workplace or my home.						
6.	I think I am able to take right decisions and maintain calm both at my workplace and home at my current age.						
7.	I am unable to fetch time for the elderly care in my family due to long working hours.						

36 Perceptions relatd to Leadership style (Task-oriented, Interpersonally oriented/Affiliative, Autocratic, Authoritarian/Coercive/ Commanding Coaching, Democratic style/Facilitative/ Participative, Laissez-faire , Delegative styles, Emergent)

**** Please indicate ( ) in the box below that corresponds to your answer.***

S.N.O	Leadership style	1 = Strongly Disagree	2 = Disagre e	3 = Neither Agree nor Disagree	4 = Agree	5 = Strongly Agree

1.	I am very focussed on achieving my goals					
2.	I have an emotional bond with mostly every person in the department .					
3.	I take decisions independently without consulting anyone in the department.					
4.	I encourage my faculty and help them in every way possible to get the best out of them.					
5.	I arrange a meeting to dicuss each and every matter and listen to the opinions of everyone in the department .					
6.	Everyone in the department trusts me and has full faith in me.					
7.	It took me a lot of time to interact and be familiar with each and everyone in the department and make them comfortable working with me.					

37 Perceptions related to Life

**** Please indicate ( ) in the box below that corresponds to your answer.***

S.N.O	Perceptions related to Life	1 = Strongly Disagree	2 = Disagree	3 = Neither Agree nor Disagree	4 = Agree	5 = Strongly Agree
1.	The conditions					

	of my life are excellent					
2.	I am very focussed on achieving my goals in life.					
3.	If I could live my life over, I would change almost nothing					
4.	My life is close to my ideal					
5.	I am satisfied with my life					

C: Funds from Corporate and Govt. Sector

37 How many funds have been drawn under your headship for collaboration with the corporate and govt. sector in the past one year?

---

38 Please indicate the total no. of faculty in your department which includes only (Professor, Associate Professor and assistant Professor) ?

D. Admission and placement

Year	List of students admitted in the department with their gender	List of passed out students	List of students appeared for placement	List of placed students with their gender and salary
2018-19				
2019-20				
2020-21				
2021-22				

E: Interview on University Social Responsibility (Economic, Social, Environmental)

Q1 What is the context of USR within your department and what are the mechanisms that are put up to manage USR? The changes and challenges that your department faces with regard to its operations?

Q2 Tell me number of work projects students of your department are involved into which can be Economic, Social, Environmental?

Q3 How many of them have started this year and how are being continued from the past?

Q 4 How you inculcate the value of economic, social or environmental responsibility amongst the students? Is it done through classroom learning, social practices (assigning a social project in cooperation with an NGO) or mentoring by experts or any other way?

Q5 Are there any linkages with the industry/ N.G.O./ Other university in order to develop required skills among the students?

Q6 How do you measure the level of change a student underwent after taking the module / mentoring/project ? Do you have a scale to evaluate it?

Q7 Do you encourage students to participate in voluntry and charitable activities within their local communities ? If yes, how?

Q8 Has your department contributed in reduction of scarce resources, eg : water and electricity?

