FINANCIAL RISK MANAGEMENT IN INFORMATION TECHNOLOGY PROJECTS OF SOFTWARE COMPANIES IN KERALA

Thesis
Submitted to the University of Calicut
For the award of the degree of

Doctor of Philosophy in Commerce

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Under the Supervision of

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March 2025

DECLARATION

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Acknowledgement

My heart is filled with gratitude and appreciation for everyone who supported and sacrificed for me from the beginning until the completion of my work.

First and foremost I have great pleasure in expressing my deep sense of gratitude to my research supervisor Prof. (Dr.) Sujesh. C. P, Principal, RSM SNDP Yogam College, Koyilandy for his direction and encouragement throughout this research. His continuous support, experience, and loyalty have been significant in shaping this endeavour. At every stage of research, his meticulous attention, scholarly criticism and perceptive suggestions made the research more effective. His guidance has been truly inspirational, making an enduring impact on my academic journey.

I would like to express my deepest gratitude to you, my dear teacher, Dr. O. K Udayakumar, for being such a guiding light in my life. Your unwavering belief in my potential, your encouragement, and your dedication to teaching have shaped me in ways I could never fully express. Your passion for your subject, your patience, and your ability to inspire have made a lasting impact on me. You've always encouraged me to reach higher, think critically, and pursue my dreams with confidence. Thank you for being more than just a teacher. You've been a mentor, a role model, and a source of inspiration, and for that, I will always be grateful. I hope to carry forward the values you've instilled in me and honour your influence in all that I do.

Sincere appreciation should also be extended to the kind and enthusiastic Dr. P. Babu, Head of the Department of Commerce at Government College Madappally, for his encouragement and for ensuring me a pleasant environment for research. I wish to express my profound gratitude to my dear teachers, Vineethan T, Dr. Praveen M. V, Muhammad Salim. K.C and Mahesh P. B. They have been a consistent source of support with their instructions and caring presence. I express my heartfelt thanks to the distinguished faculties of my department Jiji. N, Aghilesh. M, Shyju Koodayil, and Remya. K.M, for their support and guidance.

I wish to express my sincere gratitude to the esteemed former teachers in my UG and PG, A. Vinod, Dr. K.Venugopalan, Dr. Abdul Assis Koroth, Prasad P J, Savitha MA *and Dr. Rathish K Nair for their significant contributions to academic and personal growth. I sincerely thank the dedicated office staff at Government College Madappally for their support and cooperation in completing the research. I also thank my dear teachers Sudhish Babu C P and Ancy Jacob your passion for teaching and commitment to nurturing our potential have inspired me to strive for excellence.*

I would like to express my sincere gratitude to the librarians at the CHMK Central Library, particularly Dr. Vinod V.M and Dr. Abdul Azeez, for their invaluable support. I am also deeply thankful to the University of Calicut, Indian Institute of Management Kozhikode, and Cochin University of Science and Technology, for their generous assistance in providing the essential secondary sources for this study.

I want to take a moment to express my deepest gratitude to Athira A.M, Anusree Ashokan, Swathi Mohanan P. K, Aswathi Ashok and NidhinKumar. K, who have not only been academic partners but also true friends throughout this journey. I enjoy calling you my sisters and brother, and I never want to refer to you all as my fellow scholars. We've shared countless moments and made a lot of memories on this journey. Your friendship has made this journey so much more meaningful. Each of you has contributed something unique and invaluable, not only to my academic development but to my personal growth as well. I feel incredibly fortunate to have you all by my side, and I know these friendships will last well beyond our academic pursuits. I also express my thanks to senior research scholars Arun K, Rosini K, Dhanya K.S, Shamshana V. C and Farisa Aboobacker.

Though you are no longer with us, I want to take a moment to honour and acknowledge the incredible father you were. Your love, wisdom, and strength shaped me into who I am today, and I am forever grateful for everything you did for me. You taught me the value of hard work, integrity, and kindness, and your presence in my life was a constant source of comfort and guidance. Even now, your lessons continue to resonate in my heart, and I find strength in the memories we shared. I miss you more than words can express, but I take solace in knowing that your love will always surround me. I carry you with me in everything I do, and I will continue to live in a way that honours your legacy. Thank you, Dad, for being my hero, I love you always.

I am incredibly moved and would like to thank my dear mother for being a foundation of support and comfort at a tough and stress-filled time in my career and life. Her constant compassion, forgiveness, and morale have shone through the worst moments of my journey like a calming salve. Her presence has been a ray of *hope in the face of hardship, and I will always be grateful for her never-ending encouragement and caring.*

I would like to take a moment to thank my awesome husband from the bottom of my heart for everything. Your consistent love, understanding and support have given me confidence throughout my life. You have supported me through every hardship with tolerance and encouragement. I'm grateful that you are my best friend, confidante, and true mentor. You have repeatedly made a great deal of sacrifices to make sure I am happy and secure. Your constant support has inspired and motivated me to complete my thesis. I dedicate this thesis to you wholeheartedly. You fill my life with so much happiness and tranquillity, and I am very thankful for everything you do. Having you at my side, both now and forever, is such a blessing.

I would like to acknowledge the unique place that you hold in my heart, dear sister. Your continuous support, affection, and understanding have been a persistent source of strength throughout my life. You've been my cheerleader, and companion in times of joy and sadness. I value and enjoy our special relationship because it provides me comfort, love, and perseverance. Thank you for being such a beloved part of my life. My heartfelt gratitude for my cherished brother-in-law. Our deep connections and the bonds we have formed have been nothing but a dazzling source of everlasting joy. Furthermore, to make my life more enjoyable, having you in my life has contributed to the special bond of friendship that I respect.

I am deeply grateful to my loving brother, Arun. Our friendships and bonds have brought us endless joy. I adore the memories we've created together and consider myself fortunate to have such a wonderful brother who has become my close friend, bringing warmth and love into my life. I'm forever grateful for the bond we share, for the laughter we've had, and for all the beautiful memories we've created together. Thank you for being more than just a brother, you've been a true blessing, making my life more wonderful than I could have ever imagined.

I wish to express heartfelt gratitude to my dear friends, Jismi and Nishi, you have been the driving force behind our amazing journey together. Our shared experiences, exciting excursions, vibrant campus life, and friendship have brought me immense joy and affection. Your encouragement has been a regular source of motivation. Your amazing research aid has been crucial to my academic progress. I appreciate our friendship more than words may convey.

I would like to take a moment to express my heartfelt gratitude to my dear father-in-law and mother-in-law. You have welcomed me into your family with open arms and made me feel at home. I am truly grateful for the positive impact you have had on my life. I feel extremely blessed to be a part of such a loving and great family.

I want to express my sincere thanks to the amazing people who have contributed significantly to the fabric of my life, Anitha, Sandhya, Athul, Biji, Sandeep, Haritha, Dhanya, Lincy and Amrutha. I am grateful for all of the wonderful ways you have enriched my life.

I am grateful to all respondents for their honest and sincere responses, which helped me to collect data promptly and complete my research.

Above all, I am grateful to Almighty for his blessings and kindness in making this dream a reality.

BHAVANA. B. V

I dedicate this thesis to my beloved teacher, Dr. O.K Udayakumar, for his constant support and encouragement during my academic life. Your support has been paramount to achieving this success, and I value your presence in my career.

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ABBREVIATIONS

ACC	-	Accenture
AGFI	-	Adjusted Goodness of Fit Index
AI	-	Artificial Intelligence
AVE	-	Average Variance Extracted
CAGR	-	Compounded Annual Growth Rate
CBA	-	Cost Benefit Analysis
CC	-	Co-ordination Challenges
C-DIT	-	Centre for Development of Imaging Technology
CFA	-	Confirmatory Factor Analysis
CFI	-	Comparative Fit Index
CICS	-	Customer Information Control System
CME	-	Communication, Media and Entertainment
CMIN/DF	-	Minimum Discrepancy Function by Degrees of Freedom
CSF	-	Critical Success Factors
CTS	-	Cognizant
DOI	-	Diffusion of Innovation
EMC	-	Electromagnetic Compatibility
ERP	-	Enterprise Resource Planning
ERU	-	Energy, Utilities and Resources
FAHP	-	Fuzzy Analytic Hierarchy Process
FE	-	Financial Effectiveness
FIS	-	Fuzzy Inference System
FMEA	-	Failure Mode and Effect Analysis
FRAT	-	Financial Risk Analysis Techniques
FRIT	-	Financial Risk Identification Techniques
FRMT	-	Financial Risk Monitoring and Controlling Techniques
FRPT	-	Financial Risk Planning Techniques

FSI	-	Financial Securities Insurance
FTA	-	Fault Tree Analysis
GDP	-	Gross Domestic Product
GFI	-	Goodness of Fit Index
HP	-	Hewlett Packard
HSD	-	Honestly Significant Difference
IBM	-	International Business Machines Corporation
ICFOSS	-	International Centre for Free and Open Source System
ICT	-	Information and Communication Technology
IITM-K	-	Indian Institute for Information Technology Management –Kerala
INFY	-	Infosys
IT	-	Information Technology
ITES	-	Information Technology Enables Services
KPI	-	Key Performance Indicators
KSITIL	-	Kerala State Information Technology Infrastructure Ltd
KSITM	-	Kerala State Information Technology Mission
KSUM	-	Kerala Start up Mission
LSH	-	Life Services and Healthcare
MC	-	Market Challenges
ME	-	Management Effectiveness
MFG	-	Manufacturing
NASSCOM	-	National Association of Software and Services Companies
NCR	-	National Capital Region
OD	-	Organisational Development
OS	-	Operating System
PC	-	Personal Computer
PRI	-	Project Risk Index
PRISMA	-	Preferred Reporting Items for Systematic Review
RBF	-	Revenue Based Financing

RCL	-	Retail Consumers packaged goods and Logistics
RD	-	Research and Development
RIMAM	-	Resilience Index Measurement and Analysis
RISKIT	-	Risk Identification, Screening, Knowledge, Implementation and Tracking
RMSEA	-	Root Mean Square Error of Approximation
ROI	-	Return on Investment
SC	-	System Challenges
SD	-	Standard Deviation
SDLC	-	Software Development Life Cycle
SEE	-	Socio-Economic Effectiveness
SEI	-	Software Engineering Institute
SEM	-	Structural Equation Modelling
SERUM	-	Software Engineering Repository for Unified Model
SPI	-	Software Process Improvement
SRE	-	Software Risk Evaluation
STPI	-	Software Technology Park of India
TCS	-	Tata Consultancy Services
USD	-	United States Dollar

ABSTRACT

Financial risk management in Kerala's IT sector plays a crucial role in ensuring the long-term growth and stability of the industry, which in turn benefits the local communities and the broader society. By minimising financial risks, software companies can maintain sustainable operations, which leads to job creation, skill development, and economic growth. When IT companies manage their finances effectively, they are more likely to offer stable employment opportunities, contribute to the local economy, and improve the standard of living in the region. One of the most significant problems confronting the information technology sector is financial risk, which is very hard to control. The current study aims to evaluate financial risk management in information technology projects of software companies in Kerala. The research is descriptive and empirical in nature. The study includes both primary and secondary data. Primary data was collected from project managers of different software companies in Kerala with the help of a structured questionnaire. Secondary data was gathered during two years (2022 and 2023) regarding 680 project reports from 256 software companies. The primary data analysis was conducted using statistical packages such as IBM SPSS 26.0, AMOS 23.0, and the Stats Tools Package. The statistical tools like Percentage, Mean, Standard Deviation, Independent sample t test, One Way Anova, CFA and CB SEM were used for analysis. The study found that large software companies and software companies situated in urban areas are highly affected by financial risk factors. Thus, the usage of financial risk management techniques is potentially high in these companies. Among the factors, scope-related factors affect the software companies to complete the project within the budgeted amount and time. Financial risk planning, financial risk monitoring and controlling techniques and risk acceptance strategies assist software companies in completing projects on time. So, these techniques and strategy are very essential for software companies to manage their financial risk. Moreover, the adoption of financial risk mitigation strategies brings effectiveness to the software companies and the effectiveness is very high in medium-sized software companies. Additionally, software companies have a high level of financial effectiveness. Medium-sized software companies and software companies located in urban areas face many challenges. Further, the market-related challenges highly affect the software companies for the successful completion of projects. Based on an evaluation of financial risk mitigation strategies, small-sized software companies and those in urban areas employ a greater number of these strategies. Furthermore, software companies can adopt the risk-sharing strategy for completing the projects within the budgeted amount. Thus, the project's success depends extensively on the usage of financial risk management techniques and financial risk mitigation strategies. The usage of financial risk management techniques and financial risk mitigation strategies depends upon the nature of the software company and the size of the projects. The study provides valuable insights to project managers regarding the successful completion of the projects within the budgeted amount and time. It also assists them in monitoring and controlling financial risk factors by adopting effective financial risk management techniques and financial risk mitigation strategies.

Keywords: Financial Risk Factors, Financial Risk Management, Information Technology Projects, Financial Risk Management Techniques, Financial Risk Mitigation Strategies.

സംഗ്രഹം

കേരളത്തിലെ വിവരസാങ്കേതിക (ഐ.ടി.) മേഖലയിലെ സാമ്പത്തിക നഷ്ടസാധ്യത മാനേജ്മെന്റ് പ്രസ്തുത വ്യവസായത്തിന്റെ ദീർഘകാല വളർച്ചയും സ്ഥിരതയും ഉറപ്പാക്കുന്നതിൽ നിർണായകമായ പങ്കുവഹിക്കുന്നു. ഇത് പ്രാദേശിക സമൂഹത്തിനും ഒപ്പം പൊതുസമൂഹത്തിനും ഏറെ പ്രയോജനം ചെയ്യുന്നു. സാമ്പത്തിക നഷ്ടസാധ്യതകൾ കുറയ്ക്കുന്നതിലൂടെ സോഫ്റ്റ്‌വെയർ കമ്പനികൾക്ക് സുസ്ഥിരമായ പ്രവർത്തനങ്ങൾ നിലനിർത്തുവാൻ കഴിയും, ഇത് തൊഴിലവസരങ്ങൾ സൃഷ്ടിക്കുന്നതിനും നൈപുണ്യവികസനത്തിനും സാമ്പത്തികവളർച്ചയ്ക്കും കാരണമാവുകയും ചെയ്യും. ഐ.ടി. കമ്പനികൾ അവരുടെ സാമ്പത്തികകാര്യങ്ങൾ ഫലപ്രദമായി കൈകാര്യം ചെയ്യുമ്പോൾ അവർക്ക് സ്ഥിരമായ തൊഴിലവസരങ്ങൾ വാഗ്ദാനം ചെയ്യുവാനും പ്രാദേശിക സമ്പദ്‌വ്യവസ്ഥയ്ക്ക് സംഭാവന നൽകാനും മേഖലയിലെ ജീവിതനിലവാരം മെച്ചപ്പെടുത്തുവാനും സാധിക്കുന്നു. വിവരസാങ്കേതികമേഖല നേരിടുന്ന ഏറ്റവും പ്രധാനപ്പെട്ട പ്രശ്നങ്ങളിൽ ഒന്ന് സാമ്പത്തിക നഷ്ടസാധ്യതയാണ്. ഇത് നിയന്ത്രിക്കാൻ വളരെ പ്രയാസകരമാണ്. കേരളത്തിലെ സോഫ്റ്റ്‌വെയർ കമ്പനികളുടെ വിവരസാങ്കേതികപദ്ധതികളിലെ സാമ്പത്തിക നഷ്ടസാധ്യത മാനേജ്മെന്റിനെ വിലയിരുത്തുക എന്നതാണ് നിലവിലെ പഠനം ലക്ഷ്യമിടുന്നത്. ഗവേഷണം വിവരാത്മകവും അനുഭവപരവും ആണ്. പഠനത്തിൽ പ്രാഥമികവും ദ്വിതീയവുമായ ഡാറ്റ ഉൾപ്പെടുന്നു. ഒരു ഘടനാപരമായ ചോദ്യാവലിയുടെ സഹായത്തോടെ കേരളത്തിലെ വിവിധ സോഫ്റ്റ്‌വെയർ കമ്പനികളുടെ പ്രോജക്ട് മാനേജർമാരിൽനിന്നും പ്രാഥമിക ഡാറ്റ ശേഖരിച്ചു. IBM SPSS 26.0, AMOS 23.0, STATS TOOLS പാക്കേജ് തുടങ്ങിയ സ്റ്റാറ്റിസ്റ്റിക്കൽ പാക്കേജുകൾ ഉപയോഗിച്ചാണ് പ്രാഥമിക ഡാറ്റ വിശകലനം ചെയ്തത്. പ്രോജക്ടുകൾ വിശകലനം ചെയ്യുന്നതിനായി 256 സോഫ്റ്റ്‌വെയർ കമ്പനികളിൽ നിന്നുള്ള 680 പ്രോജക്ട് റിപ്പോർട്ടുകളെക്കുറിച്ചുള്ള രണ്ട് വർഷക്കാലയളവിലെ ദ്വിതീയ ഡാറ്റ ശേഖരിച്ചു. ഡാറ്റ വിശകലനം ചെയ്യുന്നതിനായി ശതമാനം, ശരാശരി, സ്റ്റാൻഡേർഡ് ഡീവിയേഷൻ, Independent Sample t-test, One-Way ANOVA, CFA, CB-SEM എന്നിവ ഉപയോഗിച്ചു. നഗരപ്രദേശങ്ങളിൽ സ്ഥിതിചെയ്യുന്നതും വലിയ സോഫ്റ്റ്‌വെയർ കമ്പനികളിലുമാണ് സാമ്പത്തിക നഷ്ടസാധ്യതാഘടകങ്ങൾ വളരെയധികം ബാധിക്കുന്നതെന്ന് ഈ പഠനം കണ്ടെത്തി. കൂടാതെ ഈ കമ്പനികളിൽ സാമ്പത്തികനഷ്ടസാധ്യത മാനേജ്മെന്റ് ടെക്നിക്കുകളുടെ ഉപയോഗം ഉയർന്നതാണ്. സാമ്പത്തികനഷ്ടഘടകങ്ങളിൽ സ്കോപ്പ് സംബന്ധമായ ഘടകങ്ങളാണ് ബഡ്ജറ്റ് ചെയ്ത തുകയ്ക്കും സമയത്തിനും പ്രോജക്ട് പൂർത്തിയാക്കുന്നതിന് തടസ്സമായി നിൽക്കുന്നത്. സാമ്പത്തികനഷ്ടസാധ്യത ആസൂത്രണം,

സാമ്പത്തികനഷ്ടസാധ്യത നിരീക്ഷണം, നിയന്ത്രണ സാങ്കേതികവിദ്യകൾ, നഷ്ടസാധ്യതാ-സ്വീകാര്യതാ തന്ത്രങ്ങൾ എന്നിവ സോഫ്റ്റ്‌വെയർ കമ്പനികളെ സമയബന്ധിതമായി പ്രോജക്ടുകൾ പൂർത്തിയാക്കാൻ സഹായിക്കുന്നു. അതിനാൽ, സോഫ്റ്റ്‌വെയർ കമ്പനികൾക്ക് അവരുടെ സാമ്പത്തിക നഷ്ടസാധ്യത കൈകാര്യം ചെയ്യുന്നതിന് സാങ്കേതികവിദ്യകളും തന്ത്രങ്ങളും വളരെ അത്യാവശ്യമാണ്. മാത്രമല്ല സാമ്പത്തികനഷ്ടസാധ്യത ലഘൂകരണ തന്ത്രങ്ങൾ സ്വീകരിക്കുന്നത് സോഫ്റ്റ്‌വെയർ കമ്പനികളുടെ കാര്യക്ഷമത കൂട്ടുന്നു. ഇടത്തരം സോഫ്റ്റ്‌വെയർ കമ്പനികളിൽ ഫലപ്രാപ്തി വളരെ ഉയർന്നതാണ്. കൂടാതെ സോഫ്റ്റ്‌വെയർ കമ്പനികൾക്ക് ഉയർന്ന സാമ്പത്തിക ഫലപ്രാപ്തിയും ഉണ്ടാകുന്നുണ്ട്. നഗരപ്രദേശങ്ങൾ സ്ഥിതി ചെയ്യുന്നതും വലിയ സോഫ്റ്റ്‌വെയർ കമ്പനികളും നിരവധി വെല്ലുവിളികൾ നേരിടുന്നുണ്ട്. കൂടാതെ വിപണിയുമായി ബന്ധപ്പെട്ട വെല്ലുവിളികൾ പ്രോജക്ടുകൾ വിജയകരമായി പൂർത്തിയാക്കുന്നതിന് സോഫ്റ്റ്‌വെയർ കമ്പനികളെ വളരെയധികം ബാധിക്കുന്നു. ചെറുകിട സോഫ്റ്റ്‌വെയർ കമ്പനികളും നഗരപ്രദേശങ്ങളിൽ സ്ഥിതി ചെയ്യുന്ന കമ്പനികളിലുമാണ് സാമ്പത്തികനഷ്ടസാധ്യത ലഘൂകരണ തന്ത്രങ്ങൾ ഭൂരിഭാഗവും ഉപയോഗിക്കുന്നത്. കൂടാതെ ബജറ്റ് ചെയ്ത തുകയ്ക്കുള്ളിൽ പൂർത്തിയാക്കുന്നതിന് സോഫ്റ്റ്‌വെയർ കമ്പനികൾക്ക് റിസ്ക് ഷെയറിങ് തന്ത്രം സ്വീകരിക്കാൻ കഴിയും. അതിനാൽ പദ്ധതിയുടെ വിജയം പ്രധാനമായും സാമ്പത്തികനഷ്ടസാധ്യതാ മാനേജ്മെന്റ് ടെക്നിക്കുകളുടെയും സാമ്പത്തിക നഷ്ടസാധ്യതാ ലഘൂകരണതന്ത്രങ്ങളുടെയും ഉപയോഗത്തെ ആശ്രയിച്ചിരിക്കുന്നു. ബജറ്റ് ചെയ്ത തുകയ്ക്കും, സമയത്തിനുമുള്ളിൽ പ്രോജക്ടുകൾ വിജയകരമായി പൂർത്തിയാക്കുന്നതിനെക്കുറിച്ചും പ്രോജക്റ്റ് മാനേജർമാർക്ക് വിലപ്പെട്ട ഉൾക്കാഴ്ചകൾ ഈ പഠനം നൽകുന്നു. കൂടാതെ ഫലപ്രദമായ സാമ്പത്തിക നഷ്ടസാധ്യതാ മാനേജ്മെന്റ് ടെക്നിക്കുകളും സാമ്പത്തിക നഷ്ടസാധ്യതാ ലഘൂകരണ തന്ത്രങ്ങളും സ്വീകരിച്ചുകൊണ്ട് സാമ്പത്തികനഷ്ടസാധ്യത ഘടകങ്ങൾ നിരീക്ഷിക്കുന്നതിനും നിയന്ത്രിക്കുന്നതിനും ഇത് അവരെ സഹായിക്കുന്നു.

കീവേഡുകൾ: സാമ്പത്തിക നഷ്ടസാധ്യതാ ഘടകങ്ങൾ, സാമ്പത്തിക നഷ്ടസാധ്യതാ മാനേജ്മെന്റ്, വിവരസാങ്കേതികവിദ്യാ പ്രൊജക്ടുകൾ, സാമ്പത്തിക നഷ്ടസാധ്യതാ മാനേജ്മെന്റ് ടെക്നിക്കുകൾ, സാമ്പത്തിക നഷ്ടസാധ്യതാ ലഘൂകരണ തന്ത്രങ്ങൾ.

Chapter One

INTRODUCTION

"Anything worth doing has risks. The challenge for a leader is not to avoid them but effectively manage them through de- risking strategies" – N.R. Narayana Murthy, Former CEO of INFOSYS

1.1 BACKGROUND OF THE STUDY

In today's rapidly evolving competitive business environment, every major company endeavours to expand its reach, enhance its operations, and establish a formidable market presence. As businesses strive for growth and innovation, they inevitably encounter a spectrum of challenges. The IT sector stands as a driving force behind innovation and technological progress, continuously reshaping the digital world. IT projects act as a key driver for shaping the future of technology. As stated by Schwalbe, K. (2015), IT projects rely on a seamless integration of hardware, software, and networks to deliver valuable informational products, services, or results. Over time, project management has transformed from a set of recommended organizational practices into a well-defined, indispensable methodology that plays a crucial role in a company's long-term success. Despite its undeniable importance, many projects still struggle to meet their intended goals, with IT projects being particularly susceptible to failure regardless of how well they are managed. Challenges such as scope creep, budget constraints, and unforeseen technical issues often derail project timelines and financial plans. In 2017, 34% of IT projects were completed on schedule, while only 42% managed to stay within their allocated budget. However, 2018 brought a modest improvement, with 40% of projects finishing on time and 46% successfully adhering to their financial plans (The State of Project Management, Annual Report, 2017 and 2018). These statistics highlight the persistent risk in IT project management, emphasizing the need for effective techniques and strategies to improve project outcomes and ensure long-term success.

However, the IT sector expands rapidly but still it faces many uncertainties. Information technology projects typically include some level of risk because of their size, location, and complexity. Financial risk is one of the major problems that hinders the growth of the IT sector. Low financial risk occurrences typically do not affect the budget, schedule, or performance. There is some cost increase and performance degradation as a result of the moderate financial risks. High project financial risks lead to schedule interruption, performance problems, and budget increases for IT projects. Managing financial risks in software projects is essential because these projects are inherently complex, involving multiple stakeholders, evolving requirements, and significant investments. Unlike traditional projects, software projects are affected by many factors such as budget overruns, unforeseen technical challenges, changing market demands, and resource constraints. Without proper financial risk management, these factors can lead to cost delays, compromised quality, or even project failure. The objective of financial risk management is not to eliminate risks since risks are an inherent part of any project but rather to handle them strategically to minimize their impact.

Successful IT project managers recognize that achieving project objectives requires meticulous planning, thorough preparation, focused execution, and continuous assessment. A well-structured financial risk management plan acts as a safeguard, identifying potential risks, evaluating their likelihood, and anticipating their consequences. It also provides a proactive strategy to navigate uncertainties effectively. By integrating financial risk management into their approach, businesses enhance project stability, optimize resource allocation, and increase the likelihood of long-term success. Software companies benefit from project risk management, which offers several approaches and techniques to reduce, manage, transfer, or eliminate these known or unknown risks. Project success rates are increased when financial risk is well managed. Consequently, it aids in increasing income and goodwill, which in turn aids in generating new business from the customers. The goal of financial risk management in IT projects is to offer practical and efficient techniques and to handle any sources of uncertainty, that could affect the project's performance.

The success of IT projects is significantly influenced by the range of risks encountered during their development and execution (Jiang and Klien, et al., 2001). Failure to identify and manage these risks can lead to major challenges, including budget overruns, delays, unmet user expectations, and the creation of systems that fail to deliver business value. As organizations continue to invest heavily in strategic software projects, effective risk management has become a critical priority (Kumar, 2002; Osmundson et al., 2003). Academic research has extensively examined the concept of project success. Some studies define success as simply completing a project within budget, on schedule, and within its defined scope (Bryde, 2008; Fortune et al., 2011; Muller and Turner, 2007; Turner, 2009). However, as Mir and Pinnington (2014) point out, project success criteria vary depending on factors such as complexity, uniqueness, and scale. This variation makes it impossible to establish a single, universal measure of success for all projects.

In the opinion of Talet, Mat-Zin, and Houari (2014), risk management plays a crucial role in addressing project risks. It is widely regarded as a strategy to reduce uncertainty and its potential impact, ultimately increasing the chances of project success. The primary objective of risk management is to mitigate the effects of risks. However, research indicates that 35% of projects are not thoroughly assessed until the implementation stage. This suggests that project managers often fail to identify high-risk projects or discontinue those that are likely to fail due to risks encountered throughout the project lifecycle. In IT projects, risk management strategies may vary depending on the nature and objectives of the projects. Risks can stem from multiple factors, including technological advancements, resource limitations, and shifting project requirements. A particularly common challenge is the introduction of new technology during the execution phase, which can create unforeseen complications and increase project risks. Effective risk management requires proactive identification, continuous monitoring, and adaptive strategies to ensure successful project outcomes.

Information technology in Kerala began to take shape in 1990 in Techno Park, Trivandrum which marked the state's first significant step into the IT industry. As the first technology park in India, Techno Park is credited with establishing Kerala's dominance in the IT industry. There was a significant early expansion that appeared to have the potential to support the development of numerous domestic and foreign businesses. Understanding Techno parks' potential, the state government put in place a thorough IT plan in 2001. It offers advantages for the expansion of the IT industry, including infrastructure support and tax reductions. In addition to promoting economic expansion, Techno Park’s formation opened opportunities for Kerala's IT industry regarding employment generation, skill development, and technological innovation. Kerala's highly educated and skilled labour force is one of the things that makes the state a centre for IT. Every year, hundreds of students majoring in engineering and technology graduate. These graduates are the heart and soul of Kerala's IT industry. Kerala offers excellent social amenities and healthcare services, resulting in a high level of living. Professionals looking for a good work-life balance will find the state to be an interesting option because of its rich culture and work environment.

In recent times, Kerala has witnessed a surge in innovation and entrepreneurship. The state supports projects, accelerators, and start-up incubators that foster innovation-driven firms. Kerala has excellent national and international connectivity. It has a vast road and rail network, as well as well-connected seaports and airports. This connectivity enables smooth business operations and fast access to international markets. The government of Kerala has consistently promoted the growth of the IT sector by offering financial incentives, subsidies, and a welcoming environment for businesses. The development of IT infrastructure and investment stimulation measures, including technology parks and special economic zones, has been undertaken. Kerala has a highly developed infrastructure, including excellent office space, IT parks, and connectivity which helps for the proper functioning of the software companies.

Modern infrastructure and a friendly environment are offered by IT parks in cities like Kannur Cyber Park, Techno Park in Thiruvananthapuram, Info Park Kochi, Info Park Koratty, Smart City, and Cyber Park in Kozhikode. Kozhikode's Cyber Park is the first state-sponsored IT Park in the Malabar region, serving the IT needs of northern Kerala. It focuses on giving IT companies an affordable and safe environment by offering strong infrastructure, digital connectivity, and SEZ benefits. With the support of programs like the Kerala Digital University and several Centers of Excellence in emerging technologies, Kerala is attempting to establish a favourable climate for technology firms and individuals.

Kerala IT Sector Growth in 2023

In 2023, Kerala's IT industry experienced growth, having fully recovered from the dullness of the Covid pandemic phase. The IT companies in Kerala have experienced a notable surge in their export earnings. The sources of the export revenue are Thiruvananthapuram Techno Park, Kochi Info Park, and Kozhikode Cyber Park. Kerala also has a number of private IT parks in addition to these. These include Geo Info Park, Smart City, Muthoot Techno Polis in Kochi, and Kozhikode UL Cyber Park. Additionally, the government intends to build twenty tiny 5G-based IT parks across the national route that runs from Kannur to Thiruvananthapuram. As reported by Chief Minister Pinarayi Vijayan, Kerala's IT exports from 2016 to 23 were an amazing 85,540 crore, a significant rise over the 34,123 crore registered from 2011 to 2016. A remarkable 62,000 employment were produced between 2016 and 23 compared to the 26,000 jobs created between 2011 and 2016. According to him, there was a notable increase in IT built-up space between 2016 and 2023, totalling 7,344,527 square feet, compared to the 4,575,000 square feet recorded between 2011 and 2016.

The following are some of the main elements that set Kerala apart as a top destination for IT companies:

- **Skilled Workforce:** Kerala has an exceptionally knowledgeable and talented workforce in the IT industry. The state places a high priority on education and annually generates a sizable number of graduates in the fields of engineering and technology. This talent pool offers a workforce with the skills necessary to meet the expectations of IT companies.

- **High-quality Education:** Kerala is home to engineering colleges and other prominent educational establishments that are renowned for their excellent education. These institutions foster a talent pool of individuals capable of taking on challenging IT projects by emphasizing technical expertise, creativity, and problem-solving abilities.

- **Government Support:** By providing incentives, subsidies, and a welcoming business climate, the Kerala government has aggressively encouraged the expansion of the IT sector. It established laws in force to promote investment and build IT infrastructure, including special economic zones and technology parks.
- **Infrastructure:** Kerala boasts a sophisticated infrastructure that includes outstanding office buildings, IT parks, and connections. Modern facilities and a friendly atmosphere are offered by IT parks in towns like Thiruvananthapuram, Kochi, and Kozhikode to IT companies.
- **Quality of Life:** Kerala provides a superior quality of life in light of its incredible natural beauty, superior medical facilities, and ample social amenities. The state is a popular travel destination for professionals looking for a healthy work-life balance because of its pleasant temperature, vibrant culture, and varied food.
- **Innovation and Entrepreneurship:** In recent years, Kerala has seen a significant increase in both of these areas. To support businesses that are driven by innovation, the state supports programs, accelerators, and incubators for new businesses. This ecosystem fosters cooperation and aids in the expansion of IT companies.
- **Connectivity:** Excellent domestic and international connectivity is available in Kerala. It boasts a strong network of highways and railroads, as well as well-connected seaports and airports. This connectivity makes it simple to reach international marketplaces and promotes smooth commercial operations.
- **Sustainable Development Practices:** Kerala is a responsible option for IT companies concerned about their environmental impact because of its dedication to sustainable development practices. Many tech businesses support the state's efforts in waste management, renewable energy, and environmentally friendly infrastructure.

Major IT companies consider Kerala to be an attractive option due to the state's infrastructure, government assistance, competent labour, pleasant business climate, and favourable standard of living.

The management of financial risk is one of the crucial areas that is becoming more and more important. This is because poorly managed financial risks have a significant negative effect on an organization's revenue. It has been noted that there are various types of financial risk. Financial risks can arise in a project for a variety of reasons, including those related to technology, wrong estimation of resources, scope ambiguity, poor planning, unfavourable conditions, inefficient design, and unrealistic schedules. By making strategic decisions, financial risk management can be ensured to be effective. The organization can function more effectively when financial risk is minimized. Financial risk management yields significant benefits, such as projects that are completed on time and within budget, successfully close within the constraints they impose, and ultimately satisfy customers. The complexity of the information technology department and the projects they oversee has increased as a result of the field's explosive growth. Higher levels of financial risk are associated with this rise in complexity. Therefore, understanding financial risk management in IT projects is crucial.

1.2 SIGNIFICANCE OF THE STUDY

All software companies have financial risk management as their key objective. Financial risk management is a tool used by software companies to identify, evaluate, and reduce risks that could negatively affect their financial health. IT projects may minimize financial risks, ensure successful project outcomes, and maximize return on investment by giving financial risk management the highest priority. By identifying and reducing cost overruns, financial risk management ensures that the project is completed within the allocated budget. Through the identification and mitigation of schedule-related risks, financial risk management guarantees the timely completion of projects. Efficient financial risk management guards against revenue loss from project delays and scope modifications and aids in revenue recognition. It also offers knowledge for well-informed decision-making, which lowers the possibility of costly mistakes. By assisting in the identification and mitigation of possible risks, financial risk management lowers uncertainty and boosts confidence in project outcomes. Effective financial risk management can be a competitive differentiator, setting companies apart from their peers.

Kerala is often regarded as a very appealing and highly prospective Information Technology (IT) spot for the worldwide economy. Kerala's Information Technology industry has attained this status due to the availability of highly creative and inventive human resources. Kerala's excellent standard of living, carefully considered and executed government regulations, and relatively cheap operating costs have made it a top choice for investors seeking to invest in information technology. Kerala has become a thriving IT hub due to the presence of software companies, which has fostered social, economic, and innovative development. Like anywhere else, Kerala's IT industry is subject to a variety of financial risks that could affect its operations, profitability, and long-term viability. Kerala's IT sector has been growing rapidly, but it still faces numerous challenges and uncertainties. For these businesses to reduce possible risks and improve company continuity, effective financial risk management is essential.

From a social perspective, financial risk management in Kerala's IT sector plays a crucial role in ensuring the long-term growth and stability of the industry, which in turn benefits the local communities and the broader society. By minimizing financial risks, software companies can maintain sustainable operations, which leads to job creation, skill development, and economic growth. When IT companies manage their finances effectively, they are more likely to offer stable employment opportunities, contribute to the local economy, and improve the standard of living in the region. For instance, mitigating risks such as cost overruns and delays helps ensure that IT projects are completed on time and within budget, creating an environment where employees can work with a sense of security and pride.

Moreover, financial risk management supports the development of a competitive business environment. As companies in Kerala's IT sector successfully navigate financial risks, they can attract more investments, expand their operations, and increase their global presence. This, in turn, leads to the growth of the local IT ecosystem, fostering innovation, collaboration, and the emergence of new technologies that can address societal challenges. These efforts can lead to increased community development, environmental sustainability, and social welfare, directly benefiting the people of Kerala. Ultimately, when Kerala's IT companies prioritize financial risk management, they not only ensure their own growth but also contribute to the well-being and prosperity of the community, providing more opportunities for individuals to thrive in a dynamic and innovative environment.

1.3 RESEARCH PROBLEM

One of the most significant problems confronting the information technology sector is financial risk, which is very hard to control. Financial risks that are not appropriately managed will adversely impact firms both now and in the future. In IT projects, the goal of financial risk management is to establish a safe environment for the work being performed. Proper planning is essential to reduce financial risks. To ensure project success and generate income for the business, effective financial risk management is necessary. A lot of software is developed to run activities efficiently. Software companies deal with a lot of challenges and financial risk influences the project. There are numerous factors involved that affect how well information technology projects are carried out. Project risk management is becoming an increasingly important and well-liked component of software companies. Software companies face many challenges and have a great impact of financial risk on project success. Researchers have put forth several strategies for efficient financial risk management. Although the many researchers discussed financial risk management, they did not focus on how to manage financial risk in IT projects. Future scholars and software developers will benefit from this research by understanding the importance of financial risk management in IT projects. The objective of the study is to identify and address the gaps established by previous research. Additionally, an effort is made to raise the success rates of IT projects and provide a comprehensive explanation of financial risk management in IT projects.

1.4 RESEARCH QUESTIONS

The current study attempts to investigate the following key issues.

1. What are the financial risk factors that affect IT projects?
2. How financial risk management techniques are utilized in IT projects?
3. What is the impact of financial risk management techniques on the successful completion of IT projects?
4. How effective are software companies in using financial risk management techniques and financial risk mitigation strategies?
5. What are the challenges faced by software companies for the successful completion of IT projects?
6. What financial risk mitigation strategies can be employed to ensure the successful completion of IT projects?

1.5 SCOPE OF THE STUDY

The research is primarily empirical and provides a macro view of the financial risk management of small, medium and large software companies on the successful completion of IT projects. The study is limited to software companies in Kerala. The study comprises financial risk factors, usage of financial risk management techniques, the impact of financial risk management techniques, the effectiveness of software companies, challenges of software companies and financial risk mitigation strategies. The impact of financial risk management techniques before and after the completion of the project on time and budget were considered for the research. For analysing the impact of financial risk management techniques both primary and secondary data were considered.

1.6 OBJECTIVES OF THE STUDY

The following are the objectives of the study,

1. To analyse the factors affecting financial risk management in information technology projects of software companies in Kerala
2. To examine the extent of usage of financial risk management techniques in information technology projects
3. To study the impact of financial risk management techniques on the successful completion of information technology projects
4. To measure the effectiveness of software companies based on financial risk management techniques and financial risk mitigation strategies of information technology projects.
5. To investigate the challenges faced by software companies in the successful completion of information technology projects
6. To analyse the financial risk mitigation strategies for the successful completion of information technology projects

1.7 HYPOTHESES OF THE STUDY

Based on the objectives mentioned, the following hypotheses were developed and tested using the relevant statistical methods.

Objective 1

1. **Ho:** There is no significant difference between financial risk factors and the nature of software companies
2. **Ho:** There is no significant difference between financial risk factors and the area of software companies

3. **Ho:** Financial risk factors do not influence the average number of projects undertaken by software companies

4. **Ho:** Financial risk factors do not affect the annual revenue invested for managing the financial risk of software companies

5. **Ho:** Financial risk factors do not affect the completion of the projects on time

6. **Ho:** Financial risk factors do not affect the completion of the projects on the budgeted amount

7. **Ho:** Financial risk factors do not influence the average time spent on software projects

Objective 2

8. **Ho:** There is no significant difference between the usage of financial risk management techniques and the nature of software companies

9. **Ho:** There is no significant difference between the usage of financial risk management techniques and the area of software company

10. **Ho:** Usage of financial risk management techniques does not affect the average number of projects undertaken by software companies

11. **Ho:** Usage of financial risk management techniques does not affect the annual revenue invested for managing financial risk of software companies

12. **Ho:** Usage of financial risk management techniques does not influence the completion of the project on time

13. **Ho:** Usage of financial risk management techniques does not influence the completion of the project on the budgeted amount

14. **Ho:** Usage of financial risk management techniques does not influence the average time spent on software projects

Objective 3

15. **Ho:** The impact of financial risk management techniques does not affect the completion of the project on time

16. **Ho:** The impact of financial risk management techniques does not affect the completion of the project on the budgeted amount

Objective 4

17. **Ho:** There is no significant difference between the effectiveness of software companies and the nature of software companies

18. **Ho:** There is no significant difference between the effectiveness of software companies and the area of software companies

19. **Ho:** The effectiveness of software companies does not influence the average number of projects undertaken by software companies

20. **Ho:** The effectiveness of software companies does not affect the annual revenue invested for managing the financial risk of software companies

21. **Ho:** The effectiveness of software companies does not affect the completion of software projects on time

22. **Ho:** The effectiveness of software companies does not affect the completion of projects on the budgeted amount

23. **Ho:** The effectiveness of software companies does not influence the average time spent on software projects

Objective 5

24. **Ho:** There is no significant difference between the challenges of software companies and the nature of software companies

25. **Ho:** There is no significant difference between the challenges of software companies and the area of software companies

26. **Ho:** Challenges of software companies do not influence the average number of projects undertaken by software companies

27. **Ho:** Challenges of software companies do not affect the annual revenue invested for managing financial risk of software companies.

28. **Ho:** Challenges of software companies do not affect the completion of software projects on time

29. **Ho:** Challenges of software companies do not affect the completion of projects on the budgeted amount

30. **Ho:** Challenges of software companies do not influence the average time spent on software projects

Objective 6

31. **Ho:** There is no significant difference between the financial risk mitigation strategies of software companies and the nature of software companies

32. **Ho:** There is no significant difference between the financial risk mitigation strategies of software companies and the area of software companies

33. **Ho:** Financial risk mitigation strategies of software companies do not influence the average number of projects undertaken by software companies

34. **Ho:** Financial risk mitigation strategies of software companies do not affect annual revenue invested for managing financial risk

35. **Ho:** Financial risk mitigation strategies of software companies do not affect the completion of software projects on time

36. **Ho:** Financial risk mitigation strategies of software companies do not affect the completion of the project on the budgeted amount

37. **Ho:** Financial risk mitigation strategies of software companies do not influence the average time spent on software projects

1.8 METHODOLOGY AND DATABASE

The methodologies of the study are narrated under the following heads:

Research Design

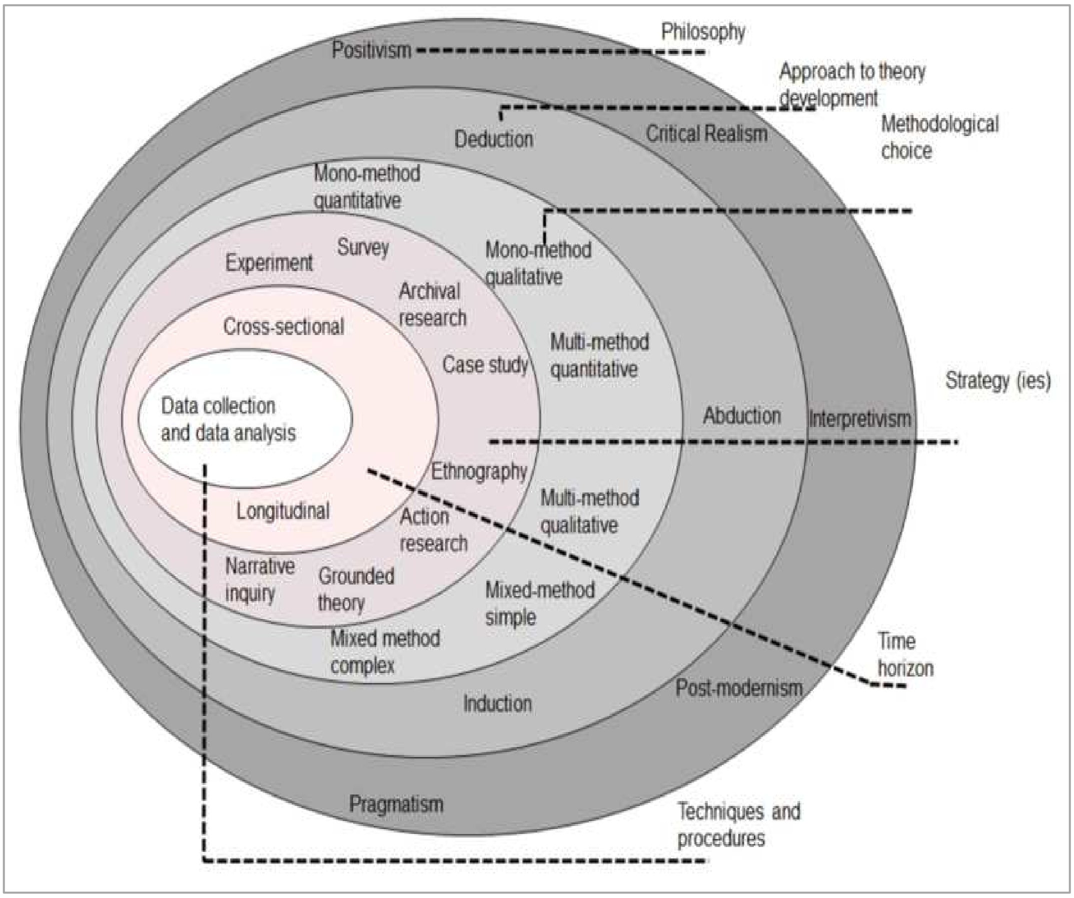
The research design of the study is descriptive and empirical. It determines the financial risk management in IT projects by examining the financial risk factors, usage of financial risk management techniques, impact of financial risk management techniques, effectiveness of software companies, challenges of software companies and financial risk mitigation strategies through observation and inferences drawn from the analysis of primary data collected from the project managers of software companies in Kerala. This research also tries to find the answer to the research problem from the experience of the project managers.

Research Onion

Saunders et al. (2009) introduced the theoretical concept of "research onion" as one strategy for developing research methodology. The research onion gives a very exhausting description of the essential layers or steps that must be completed in order to develop an efficient approach (Melnikovas, 2018). Figure 1.1 demonstrates the research onion model developed by Saunders et al 2009.

Figure 1.1

Research Onion Developed by Saunders, Lewis and Thornhill, 2009



Source: Saunders, Lewis and Thornhill, 2009

The research onion starts by defining the overarching philosophy, followed by the selection of approaches, methods, and strategies, as well as the establishment of time horizons. These elements culminate in the research design, which includes the primary techniques and procedures for data collection and analysis. The research onion comprises six layers, each representing a different aspect of the research process and the description of the layers is as follows,

1. Research Philosophy

Research philosophy is a fundamental belief system that impacts how a researcher perceives and interacts with the environment. It is essentially the lens through which you evaluate reality, create knowledge, and use theory to support your methods. The research philosophy is classified as epistemology, ontology and axiology. In business research, epistemology is a branch of philosophy that focuses on the sources of knowledge. It is primarily concerned with the possibilities, nature, origins, and limitations of knowledge within a specific field of study. It consists of positivism, realism and interpretivism. The fundamental principle of positivism is a scientific perspective on knowledge and the world. Data collection is based on statistics and a large number of individuals. Realism is the belief that a "reality" of tangible objects, and possibly abstract notions, exists in the outside world independent of our thoughts and perceptions. Interpretivism suggests that reality and knowledge are subjective, culturally and historically contextual and shaped by individual experiences. Researchers' views and beliefs shape their data collection, interpretation, and analysis. The study of definitions of reality and presumptions about existence is known as ontology in philosophy. Subjective or subjectivism and objective or objectivism are the two categories of ontology. Subjectivism claims that knowledge and truth are based on individual experience. Objectivism is the belief in an external reality that exists regardless of our knowledge. Because reality is objective, it is equally available to all observers and can be independently verified with our five senses and logical thinking. Axiology is the philosophy that deals with the nature, scope, and significance of values. The present study is based on a research philosophy that follows a positive approach in developing the hypotheses and data collection. The research also uses a large sample for data analysis to arrive at an adequate conclusion. Further, it follows values and logical thinking to support the research objectives.

2. Research Approach

The second layer of research onion reveals the researcher's approach to the investigation. It may be classified as deductive or inductive. The deductive method shifts from broad to specific. The researcher develops theories based on these theories develops hypotheses, collects data and uses tools for data analysis. However, in the inductive approach, the researcher collects data and develops theories. So, this approach moves from specific to general. The current study follows a deductive approach, it develops hypotheses based on the relevant theories, collects data and uses appropriate tools for data analysis.

3. Research Strategy

A research strategy is a detailed plan designed to guide the execution of a research study. It helps researchers in organizing, carrying out, and overseeing their projects effectively. The strategy for research should be appropriate for its aim, assisting researchers in answering the question. The research strategies include experiments, surveys, case studies, ethnography, grounded theory and action research. In this study, the researcher uses a survey by considering a large volume of data for carrying out the research.

4. Research Choice

The next layer of the research onion is labelled "choices"; they could have been more precise. This layer determines how many kinds of data (qualitative or quantitative) you will employ in your investigation. The choices include mono, mixed, and multi-method. A mono approach means you will only use one form of data, either qualitative or quantitative. The use of both qualitative and quantitative data analysis methods is known as mixed methods. The multi-method uses more than one qualitative and quantitative data analysis technique. The current study used a mono-quantitative approach, whereby data is collected using a questionnaire. Quantitative data are analysed using mathematical and statistical techniques.

5. Time Horizon

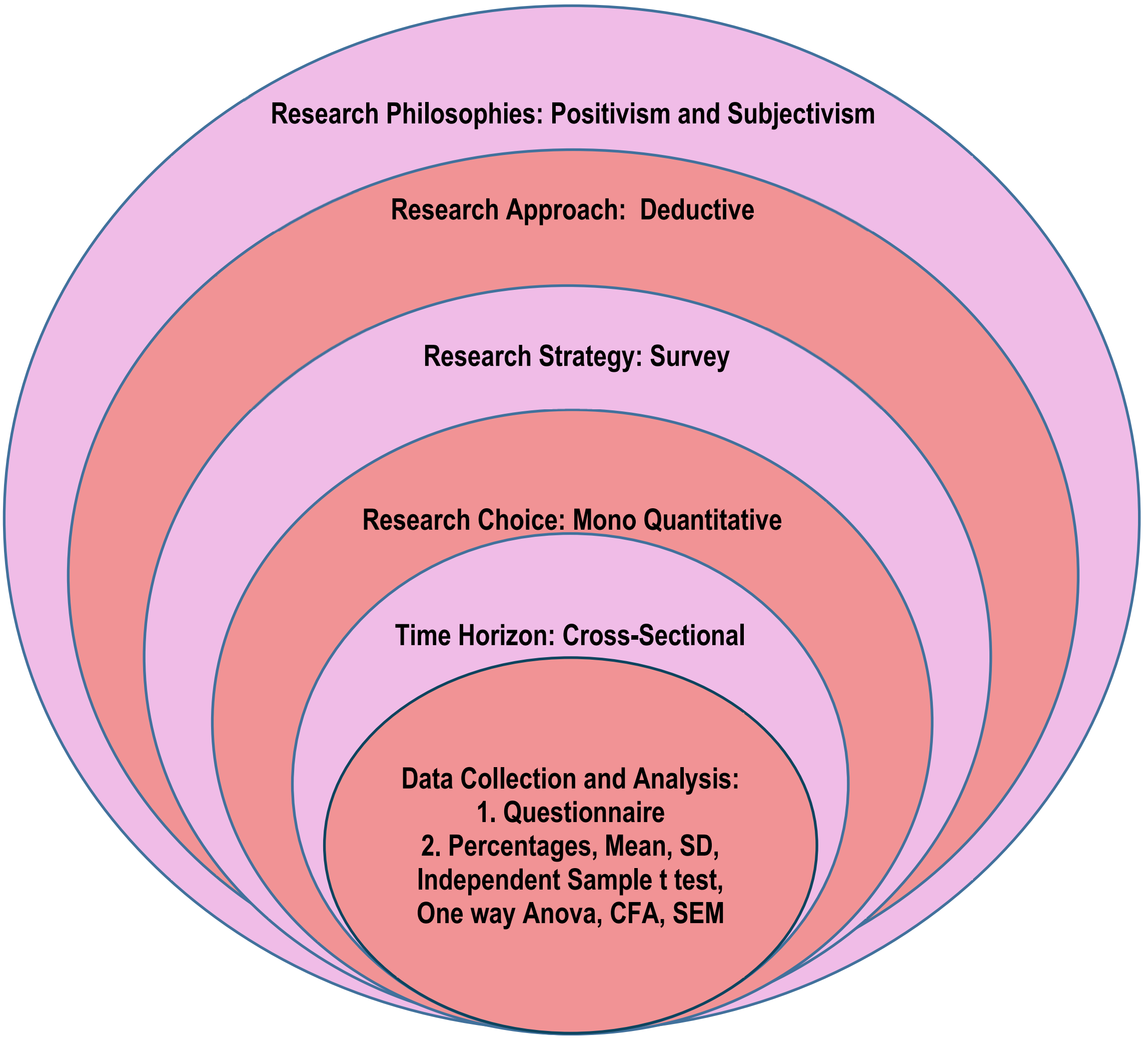
The term time horizon refers to the number of points at which the researcher collects data. It may be cross-sectional or longitudinal. Cross-sectional time horizon data is taken at a single point in time. The attention here is given to the period of data gathering rather than the type of data. Longitudinal time horizon occurs when a researcher collects data at numerous time points. In this research, a cross-sectional time horizon is used for data collection.

6. Data Collection and Analysis Methods

The process of gathering and analysing information or data from various sources to address research problems, provide answers to questions, assess results, and predict trends and probability is known as data collection. To enable accurate calculations and analysis, it is essential to gather reliable data from the appropriate sources. Data collection methods can be classified into two main types, depending on the nature of the data: primary data collection methods and secondary data collection methods. Data analysis involves examining, cleaning, transforming, and modelling data to extract insights that inform decision-making. Various data analysis techniques can be used to interpret the data meaningfully. This research utilizes both primary and secondary data. Primary data are collected through a structured questionnaire, while secondary data are sourced from various references. The study also uses techniques such as Percentage, Mean, Standard Deviation, Independent sample t test, One Way Anova, CFA and CB SEM. The figure 1.2 depicts research onion developed for the study

Figure 1.2

Research Onion Developed for the Study



Source: Saunders, Lewis and Thornhill, 2009

Population

The population under research consists of project managers employed by software companies in the state of Kerala. The Kerala State IT Mission reports that between 2022 and 2023, the state of Kerala had a notable increase in the number of project managers. Therefore, precise information about Kerala's project manager population is unavailable. Hence the population is infinite.

Sample Districts

The sample districts selected are Thiruvananthapuram, Kollam, Ernakulam, Thrissur, Malappuram, Kozhikode and Kannur. The selection of sample districts is based on the large number of software companies that function within the districts of Kerala. It is found that Ernakulam district has the highest number of software companies followed by other districts.

The compositions of project managers is given in table 1.1

Table 1.1

Compositions of Project Managers

Districts	Number of Project Managers		
	Small	Medium	Large
Thiruvananthapuram	27	44	39
Kollam	8	11	26
Ernakulam	32	40	57
Thrissur	23	14	43
Malappuram	7	27	34
Kozhikode	21	33	25
Kannur	9	22	18
Total	127	191	242

Source: Primary Data

Sampling Technique

A purposive sampling technique is used for data collection. Purposive sampling is a sampling technique in which the researcher selects the study region with a particular goal in mind. Here, data are collected from project managers who are in the planning, monitoring and controlling stages of IT projects. Seven districts such as Thiruvananthapuram, Kollam, Ernakulam, Malappuram, Kozhikode and Kannur are selected based on the large number of software companies operating in the districts.

Sample Size Determination

The sample size is determined according to Krejcie and Morgan. Krejcie and Morgan's table indicates that a sample size of 384 is sufficient for a population of up to one million people. Out of the 3.59 crore people living in Kerala, less than 1% are employed as project managers by software companies. Since the precise number of project managers in Kerala is ambiguous, the study uses the following Krejcie and Morgan (1970) formula to compute it:

$$S = Z^2 \times \frac{P(1-P)}{(M)^2}$$

S = Required sample size for unknown population
Z = Z score
P = Population proportion
M = Margin of error

The confidence level is used to calculate the Z score. As a result, the researcher uses a 95% confidence level, and 1.96 is the Z score.

In this study, the population proportion is taken to be 50%, or 0.5.

In the case of computation errors, a 5% margin of error, or 0.05, is allowed.

$S = (1.96)^2 * 0.5(1-0.5) / (.05)^2$
$= 3.8416*0.25/ 0.0025$
$= 384.16$

The minimum sample size of project managers in software companies arrives at 384. To increase accuracy, the researcher collected data from 560 project managers, which was more than the number of samples required for the study.

Sources of Data

The study uses both primary and secondary data. They are as follows,

Primary data

The study collected primary data from 560 project managers of selected software companies in Kerala through a structured questionnaire.

Secondary Data

The researcher used secondary data gathered over two years (2022 and 2023) regarding 680 project reports from 256 software companies to analyse the completed projects on budgeted amount and time. The researcher collected secondary data from the following sources.

- Books
- Newspapers like Economic Times, Business Line, The Hindu and Online Dialies
- Reports published by NASSCOM, Economic Review, Kerala State IT Mission and Department of Industries and Commerce
- IT policies published by the Government of Kerala
- Journals
- Research Dissertations and Theses
- Periodicals and Magazines
- Websites such as CNET, TechCrunch, ITworld, Infoworld and TechRadar

Questionnaire Design

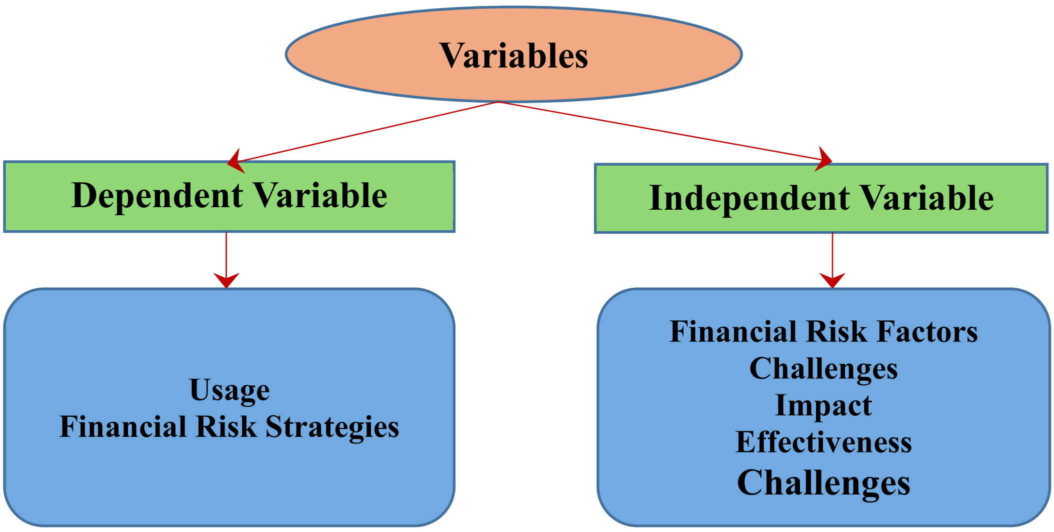
To accomplish the objectives of the study, primary data is gathered using a structured questionnaire. It is created following appropriate consultation and discussion with experts in the field of IT. The first portion of the questionnaire consists of 13 questions related to gender, age, educational qualification, work experience, nature of the company, area of the company, district, average number of projects undertaken by software companies, annual revenue invested for managing financial risk, average time spent on software project, project completed on time and budgeted amount. The second portion of the questionnaire is designed with constructs such as financial risk factors, usage of financial risk management techniques, impact of financial risk management techniques, effectiveness of software companies, challenges faced by software companies and financial risk mitigation strategies. The questionnaire includes 118 statements. Each statements are evaluated using a five-point Likert scale; "Strongly Agree", "Agree", "Neutral", "Disagree", and "Strongly Disagree".

1.9 Variables of the Study

The study aims to know financial risk management in information technology projects of software companies in Kerala which comprises dependent variables and independent variables, which are given in figure 1.3.

Figure 1.3

Variables of the Study



The table 1.2 shows the details of financial risk management variables chosen as constructs.

Table 1.2

Details of Financial Risk Management Variables Chosen as Constructs

Sl. No	Constructs	Items	Related References
1	Technology risks	Too narrow focus on technical issues Inappropriate technology chosen Use of immature technology Failure to adopt the latest technology Technology getting obsolete Lack of technical support teams	Thomas and Bhasi, 2011; Ahlan and Arshad, 2012; Hamid et al., 2019; Talet et al., 2014; Jones, 2004; Liu et al., 2010
2	Requirement risks	Requirements are not documented properly. Incomplete requirements Misunderstanding in requirement gathering Requirements are not deliverable Incorrect system requirements Changes in requirements at the beginning and end Difficulty in identifying requirements	Menezes et al., 2019; Ahlan and Arshad, 2012; Hamid et al., 2019; Talet et al., 2014; Jones, 2004; Liu et al., 2010
3	Organisation risks	Lack of top management support Unstable organizational environment Corporate politics with negative effects on the project Restructuring during the project	Irwin et al., 2022; Thomas and Bhasi, 2011; Ahlan and Arshad, 2012; Hamid et al., 2019; Talet et al., 2014; Jones, 2004; Liu et al., 2010

Sl. No	Constructs	Items	Related References
		Lack of planning Lack of proper coordination Ineffective communication	
4	Scope	Scope changes during the life of the project Partial understanding of project scope Schedule and budget overruns Too narrow scope Ambiguity in scope	Pino et al., 2008; Thomas and Bhasi, 2011; Ahlan and Arshad, 2012; Hamid et al., 2019; Talet et al., 2014; Jones, 2004; Liu et al., 2010
5	Design	Developing the wrong software functions Lack of integrity in design Improper alignment of software project Fail to design user requirements A lot of design errors	Dolan, 2005; Wallace et al., 2004; Clarke, 1999; Menezes et al., 2019; Ahlan and Arshad, 2012;
6	Resource	Lack of adequate resources Wrong estimation of resources Inefficient use of resources Change in procurement of resources frequently	Pino et al., 2008; Thomas and Bhasi, 2011; Ahlan and Arshad, 2012; Hamid et al., 2019; Talet et al., 2014; Jones, 2004
7	Usage of FRPT	Analytical Techniques Regular Meetings Expert Judgments Information-gathering techniques	Pasha et al., 2018; Irfandhi, 2016; Elzamly and Hussin, 2015; Sankhwar and Pandey, 2014; Didraga, 2013; Chowdhury, 2011; Banyahmad, 2011; Mattsson and Nyfjord, 2008; Nasir and Sahibuddin, 2011; Raz and Michael, 2001
8	Usage of FRIT	Risk Checklist	Sankhwar and Pandey, 2014; Didraga, 2013;

Sl. No	Constructs	Items	Related References
		Influence Diagram Cause and Effect Diagrams Failure Mode and Effect Analysis	Chowdhury, 2011; Banyahmad, 2011; Mattsson and Nyfjord, 2008; Nasir and Sahibuddin, 2011; Raz and Michael, 2001
9	Usage of FRAT	Probability and Impact Grid Brain Storming Fault Tree Analysis Risk Urgency Assessment Consequences Analysis Decision Tree Analysis Monte Carlo Analysis Sensitivity Analysis	Satvik and Sanam, 2016; Shahzad, 2014; Pardo, 2011; Elzamly and Hussin, 2015; Sankhwar and Pandey, 2014; Didraga, 2013; Chowdhury, 2011; Banyahmad, 2011; Fairely, 1990
10	Usage of FRM&CT	Risk Audit Risk register Cost and Benefit Analysis Variance and Trend Analysis	Banyahmad, 2011; Mattsson and Nyfjord, 2008; Nasir and Sahibuddin, 2011; Raz and Michael, 2001
11	Impact of FRPT	Develops software project plans Development of contingency plans Efficient assignment of responsibilities Time delays can be managed	Reed and Angolia, 2018; Charetee, 2005; Pinchangthong and Boonjung, 2017; Cagliano et al., 2015; Bandyopadhyay et al., 1999
12	Impact of FRIT	Redesigning software projects Identifies wrong software functions Early detection of various risk factors Reduces mismatches in project requirements Determines accuracy in software project plans	Pinchangthong & Boonjing, 2017; Patil and Ade, 2015; Noor and Abdulla, 2014; Lehtinen, 2014

Sl. No	Constructs	Items	Related References
13	Impact of FRAT	Evaluate the complexity of the project Software project into controllable actions Ensures quality factor deliverables Analyse the software development	Chawan et al., 2013; Peslak, 2012; Bannerman, 2008; Khanfar et al, 2008; Tao, 2008
14	Impact of FRM&CT	Efficient use of financial resources. It helps to prioritize the risk. Eliminates poor risk-reviewing methods Identifies skills to complete the project Identify incomplete user documentation	Verner et al., 2008; Hang and Huang, 2007; Chartee, 2005; Keil et al., 2004; Pinchangthong & Boonjing, 2017;
15	FE	Helps software companies generate huge profit Attainment of better financial position Increased market share Software companies become cost-effective Reduced financial risks	Jiang and Klein, 2000; Kwak and Stoddard, 2004; Jurison, 1999; Bakker et al., 2010; Huang and Wen Han, 2008
16	ME	Timely delivery of project Attainment of project objectives Ensures promised quality Delighted customer More opportunities for new projects Maintains good relations with employees	Kutsch and Hall, 2009; Bakker et al., 2010; Huang and Wen Han, 2008; Sharma et al., 2008; Barki et al., 2001
17	SEE	Provides more employment opportunities High standard of living	Bakker et al., 2010; Thomas and Fernandez, 2008; Samini, 2020; Iriarte and Bayona, 2020; Kutsch and Hall, 2009; Kwak and

Sl. No	Constructs	Items	Related References
		Time and effort can be reduced Software solutions to numerous problem Economic growth and development	Stoddard, 2004; Jurison, 1999
18	MC	Changes in market conditions Changes in IT policies Delays from vendor Stiff competition	Ahmad et al., 2022; Hussain et al., 2016; Islam, 2011; Baccarini et al., 2004
19	SC	Security threats Failed changes No proper control mechanism Lack of disaster preparedness and recovery	Choi et al., 2022; Parent and Reich, 2009; Sundararajan et al., 2013; Hussain et al., 2016
20	CC	Inexperienced team members Conflict in the team Skills gap Lack of communication	Clarke and Connor, 2012; Jiang and Klein, 2001; Annapoorna and Bagalkoli, 2011; Nidumolu, 1995
21	Risk transfer	Transfer by teaming up or by hiring a vendor Avoids adverse effects Transfer of risks is highly essential Efficient management of risk	Berg, 2012; Nidhi et al., 2014; Avdoshni and Pesotskaya, 2016; Azadi, 2015
22	Risk Acceptance	Contingency plans are prepared The cost of transfer risk was very high Accepted when no alternatives are available High recognition of risk	Abdul Rahman et al., 2012; Kuruppuarachichi et al., 2002; Boban et al., 2003; Hijazi et al., 2014
23	Risk Avoidance	Adopts alternative approach to avoid the risk	Taylor et al., 2012; Avdoshni and Pesotskaya,

Sl. No	Constructs	Items	Related References
		Defects of new projects are avoided High-risky projects are avoided Change in material and design to avoid risk	2016; Uzaffer, 2013; Azadi, 2015; Tesch, 2009
24	Risk Sharing	Sharing the risk with other software companies High control of financial risk Evaluation of team expertise Reduce software project failures	Kuruppuarachichi et al., 2002; Boban et al., 2003; Taylor et al., 2012; Hijazi et al., 2014

Pre-testing

A pre-test of a questionnaire was done among 13 project managers in Kozhikode Cyber Park before the pilot study. Their recommendations and viewpoints were taken into consideration when drafting the questionnaire.

Pilot Study

To obtain sufficient information on the nature of the study, a pilot study was carried out before the main study. Consequently, it is completed in August and September of 2022, before the primary study. A hundred project managers from different software companies in Kerala participated in the study. Appropriate changes were made to the questionnaire to ensure that the necessary data was collected.

Reliability Test

The scaled statements in the questionnaire were subjected to an internal consistency test using Cronbach's alpha as a reliability measure. A scale is considered reliable if it produces consistent results when measurements are made repeatedly. As the 118 statements' Cronbach's alpha is higher than the average Cronbach's alpha of 0.7, the questionnaire's internal consistency is strong and it can be regarded as extremely reliable.

Table 1.3

Reliability Statistics

Constructs	Variable	Cronbach's Alpha	Number of items
Financial Risk Factors	Technology	0.916	6
	Requirement	0.882	7
	Organisation	0.809	7
	Scope	0.790	5
	Design	0.847	5
	Resources	0.874	4
Usage	Financial Risk Planning Techniques	0.806	4
	Financial Risk Identification Techniques	0.840	4
	Financial Risk Analysis Techniques	0.902	8
	Financial Risk Monitoring and Controlling Techniques	0.802	4
Impact	Financial Risk Planning Techniques	0.770	4
	Financial Risk Identification Techniques	0.739	5
	Financial Risk Analysis Techniques	0.825	4
	Financial Risk Monitoring and Controlling Techniques	0.828	5
Effectiveness	Finance Related Effectiveness	0.815	5
	Market-Related Effectiveness	0.869	6
	System Related Effectiveness	0.882	5
Challenges	Management Related Challenges	0.833	4
	System Related Challenges	0.805	5
	Co- ordination Related Challenges	0.908	4

Constructs	Variable	Cronbach's Alpha	Number of items
Strategies	Risk Transfer Strategies	0.795	4
	Risk Acceptance Strategies	0.769	4
	Risk Avoidance Strategies	0.889	4
	Risk Sharing Strategies	0.864	4

Validity

According to Trochim (2006), "Validity is the extent to which a measurement instrument measures the concept it is supposed to measure, without systematic error". IT sector experts were consulted to improve the survey instrument and assure its authenticity. Several validity methods are available for measuring the variables, including Face, Content, and Construct validity (which is further divided into Convergent and Discriminant validity). A brief description of the different forms of validity that are ensured for the research project is explained below:

1. Face and Content Validity

Content validity is the degree to which a measure covers the range of meanings included within the concept (Kerlinger, 1973). The researcher conducted a thorough analysis of the available literature to ensure the content validity of the scale in financial risk factors, usage of financial risk management techniques, the impact of financial risk management techniques, the effectiveness of software companies, challenges faced by software companies and financial risk mitigation strategies.

2. Construct Validity

Construct validity is the accuracy with which a measuring instrument measures the concept it is supposed to measure (Cronbach and Meehl, 1955). It clarifies how measuring tools and theoretical ideas relate to one another empirically. Therefore, theoretical frameworks and scientific justifications are required to test the proposed relationship. Convergent and discriminant validity are the two categories of construct validity. They are as follows,

a. Convergent Validity

Convergent validity is the degree to which a measure correlates with other measures of the same construct, providing evidence that the measures tap into the same underlying concept (Straub, 1989). The factor loadings connected to the latent variables on scales in this study were discovered to be higher than 0.5. Therefore, it is considered that the constructs' measurement model has a satisfactory convergent validity.

b. Discriminant Validity

Discriminant validity is the degree to which two or more measures of different concepts do not correlate each other (Campbell and Fiske, 1959). The square root of the AVE in this study is greater than the latent variable correlation. Therefore, discriminant validity is ensured.

Test of Normality

Many statistical tests make the assumption of normality, which states that the data are symmetrically distributed around the central tendency and have a normal distribution with equal means, medians, and modes (Hair et al., 2010). To determine whether the data is normal, a KS test is conducted. Applying the One-Sample Kolmogorov-Smirnov test verifies if the data are normal. Nevertheless, as the 'p' values are less than 0.05, the data is considered to be abnormal. To determine whether or not the deviation is harmful, it is therefore essential to analyze the skewness and kurtosis. Consequently, the skewness and kurtosis values fall within the range of ± 3 and ± 10, as stated by Brown (2010). Thus, normality is assumed and applies to parametric test analysis.

Test of Randomness

To determine if a set of observations is representative of a random sample of the population, the run test is utilized. A run test's result makes it evident that most results are higher than 0.05. Consequently, it is proved that the data randomness is true.

Test of Independence

Data independence can be assured when the Durbin-Watson coefficient is between 1.5 and 2.5. The Durbin-Watson value in the current investigation falls within the recommended ranges. It follows that data independence is presumable.

Period of Data Collection

Primary data for the study were collected between November 2022 and July 2023. In August and September of 2022, a pilot study was conducted to evaluate the scales' reliability. The secondary data on the specifics of finished project reports was collected during two years (2022 and 2023).

Tools used for Data Analysis

The statistical and mathematical methods utilized to examine primary data are explained in this section. The primary data is analyzed using parametric tests under the assumptions of homogeneity and normality to meet the study's objectives. Therefore, the certain statistical tests are employed to analyze the data namely: Tukey HSD post-hoc test for Multiple Comparisons, One-way ANOVA, Independent Sample t Test, and Levene's Test of Homogeneity of Variance. Confirmatory Factor Analysis and Structural Equation Modelling are also used as statistical methods to determine the variables' respective measurement models and affecting factors. Here is a brief explanation of each of the following.

1. Descriptive Statistics

Descriptive statistics are employed to investigate, condense, and characterise the data gathered from the primary sources. Its purpose is to give data about the distribution of the chosen variables. Here, the data are described using Measures of Variability (Standard Deviation) and Measures of Central Tendency (Mean). The mean, which can be found by dividing the total number of values by the number of values, is the distribution's average value. The standard deviation, often known as the positive square root of the variance, is the degree of variation or deviation of a set of data.

2. Independent Sample t-test

The purpose of the Independent Sample t-test is to determine whether or not the population means are equal by examining the significant mean difference between two independent groups. Similar to this, two variables are needed to perform the test statistics: a continuous variable and a categorical variable (nominal variable) with two possibilities. A few presumptions must be met for the test to be satisfactory:

- Assumption of Independence: The assumption of independence states that the sample data are unrelated to the score of the variables and independent of one another.
- Assumption of Normality: In this case, the dependent variable in the two populations should have a normal distribution.
- Assumption of Variance: To validate this assumption, the test variables' variances must be identical.
- Outlier of free distribution: The sample data for this test is assumed to have an outlier-free distribution.

3. Levene's test of Homogeneity of Variance

The equal variances across the chosen samples have been tested using this test. To confirm the homogeneity of variance assumption in the statistical test used to examine mean differences, Levene's test was employed. It examines hypotheses H0, which holds that population variances are homoscedastic, and H1, which holds that population variances are heteroscedastic. The "p" value yields the outcome; if it is less than 0.05, equal variances can be presumed, and the "t" and ANOVA tests can be conducted.

4. One-way Analysis of Variance

One-way ANOVA, the parametric statistical test is used to determine whether there is a significant difference between two or more groups and whether two independent factors interact with the dependent variable. Here, the "f" ratio makes it possible to calculate the ratio of variations inside the group to variances between the groups. One-way ANOVA and the Independent Sample "t" test vary primarily in that the latter allows for the comparison of two or more treatment conditions and multiple dependent variables, while the former is confined to two treatment conditions. Comparing the significant difference between the sample means and the population means of similar population distributions is also a statistical technique. The 'f' value is computed at the 1% or 5% significance level to arrive at a similar conclusion.

5. Tukey HSD Post hoc test for Multiple Comparison

Post-hoc analysis is necessary if there is a substantial difference between sample groups. To verify the multiple comparisons of the categorical variables, the post-hoc test is employed. A more pertinent post-hoc technique to show the precise pair-wise comparison of sample groups is Tukey's Honestly Significant Difference (HSD) test. Post-hoc refers to anything done after the event, while multiple comparisons refer to comparing every conceivable pair of elements that was chosen.

6. Confirmatory Factor Analysis (CFA)

Measured variables and their constructs can be compared using the multivariate statistical approach of correlation analysis, or CFA. Determining the pattern of factor loadings based on theoretical and empirical data and information is a unique use of factor analysis. As a result, it is used to assess how well fitting certain characteristics are to an observed set of data. It illustrates the number of components needed in the sample data for the measured variables to have an impact on the latent variables. The substantial connection between the observable variables and their underlying latent components is the central postulate of CFA. Structural Equation Modelling is used to build a suggested model and measurement model to define the factor structure of observed variables.

7. Structural Equation Modelling (SEM)

A multivariate statistical method called structural equation modelling uses structural models to examine the causal relationship between dependent and independent variables. It is the result of combining multiple regression analysis with confirmatory factor analysis using the study's variables. It also illustrates the directional linking path that is supposed to exist between a set of observable variables. In light of this, SEM is intended to demonstrate the explanatory power of the independent variables for the dependent variables by calculating the value of the regression coefficient, which defines the linearity of the latent constructs.

Software used for Data Analysis

Microsoft Excel, SPSS (Statistical Package for Social Science) version 26, and AMOS (Analysis of Moment Structure) version 23, are the statistical programs utilized to analyze the primary data. The study employed AMOS for modelling, SPSS for comparative analysis, and Excel for drawing graphs and diagrams.

1.10 OPERATIONAL DEFINITIONS

The operational definition for each of the variables that were used in this study is briefly explained below.

Financial Risk

Financial risk refers to the likelihood of losing money or facing financial losses as a result of engaging in any financial activity or decision. To minimize potential losses and optimize revenues, it is crucial to identify, assess, and manage financial risks effectively.

Software Companies

Software companies are businesses that invent, test, develop, and deliver software services or products to customers. They create software to meet specific requirements. These companies are crucial for the advancement of technological innovation, increased productivity, and industry growth.

Information Technology Projects

Plans that employ technology to achieve specific business goals or improve organizational performance are known as information technology projects. IT projects may vary depending on the organization's size and nature.

Project Manager

A project manager is an expert who is in the role of planning, coordinating, and supervising the execution of certain projects within an organization. They ensure that projects are completed on time, within budget, and meet the desired quality standards.

Financial Risk Management

Financial risk management is the process of identifying, evaluating, and reducing potential financial risks or losses that could impact a company's financial stability and performance. Software companies can reduce the impact of financial losses and achieve their financial goals with greater confidence by controlling financial risks through the application of financial risk management techniques and financial risk mitigation strategies.

Financial Risk Factors

Financial risk factors are variables that increase the potential impact of financial risks. There are many financial risk factors, but the study focuses primarily on technology, requirements, organization, scope, design, and resources.

Financial Risk Management Techniques

Financial risk management techniques are used in information technology projects to identify, assess, and mitigate any possible financial risks. Using these techniques, it is possible to ensure that the project is completed within budget, time and quality.

Financial Risk Mitigation Strategies

Financial risk management strategies are action plans or guidelines designed to address financial risks. The most frequent financial risk mitigation strategies include risk avoidance, reduction, transfer and acceptance.

Impact of Financial Risk Management Techniques

The performance, stability, and overall achievement of an organization are all impacted by the application of financial risk management techniques. This is known as the impact of financial risk management techniques. The organization might have a positive or negative impact.

Effectiveness of Software Companies

The degree to which anything fulfils its intended purpose, goal, or objective is referred to as its effectiveness. Software companies are considered effective if they can meet their targets and provide value to stakeholders, customers and the market.

Challenges Faced by Software Companies

The growth and success of software development organizations are hindered by several hurdles and difficulties that software companies face, it is known as challenges. Their complexity and impact can differ, and they can be either internal or external, expected or unexpected.

Technology risks

Technology risks are potential risks or deficiencies that may threaten the accessibility, security, or reliability of a company's data, systems, or technology assets. Organizations can safeguard their resources, assure business continuity, and maintain stakeholder trust by identifying and mitigating technological risks.

Requirement risks

Requirement risk refers to the likelihood that a project's requirements contain errors, omissions, or ambiguities. This can lead to miscommunication and misinterpretations among stakeholders, resulting in delays, cost overruns, low quality, and inability to meet the client's expectations.

Organisational risks

Organizational risk is the probability of unfavourable happenings, events, or conditions that will make it more difficult for an organization to carry out its mission, goals, or objectives. Being aware of organizational risks allows project managers to reduce risk, make intelligent decisions, and ensure the organization's long-term success.

Scope risks

The term scope risk refers to possible threats or unforeseen circumstances that could affect the project's scope and lead it to diverge from its initial goals.

Design risks

The possibility of mistakes, omissions, or deficiencies in the project's design is referred to as a design risk. Successful design outcomes are aided by effective financial risk management.

Resource risks

Resource risks are potential perils or uncertainties about the availability, distribution, or use of resources. Reducing potential negative effects on the project is made easier by addressing appropriate resource management.

Financial Risk Planning Techniques

Planning for financial risk is a crucial part of project management. By addressing unforeseen circumstances and unfavourable events that could negatively affect project objectives, the risk management plan helps projects move forward.

Financial Risk Identification Techniques

Financial risk identification is the process of identifying and analysing the sources, types and impacts of potential losses or adverse outcomes on the organisation's objectives, performance and reputation.

Financial Risk Analysis Techniques

The identified risks are assessed using qualitative or quantitative techniques to generate a risk matrix that assesses the likelihood of occurrence and impact of risk is termed as financial risk analysis techniques.

Financial Risk Monitoring and Controlling Techniques

Financial risk monitoring and control techniques are the methods and practices used by companies to discover, evaluate, manage, and minimize financial risks. These techniques aid in detecting potential problems before they become major ones.

Risk Transfer Strategies

Risk transfer strategies involve transferring the financial risk from one party to another. Risk transfer strategies contribute to the reduction or elimination of risk exposure.

Risk Acceptance Strategies

The term risk acceptance strategies refers to approaches for knowingly accepting and dealing with a known risk rather than attempting to reduce or transfer it.

Risk Avoidance Strategies

Risk avoidance strategies are those that avoid or entirely eliminate a potential risk; they differ from risk reduction or management strategies.

Risk Sharing Strategies

Risk-sharing strategies reduce each party's exposure to potential losses or negative effects by distributing the risk among different parties.

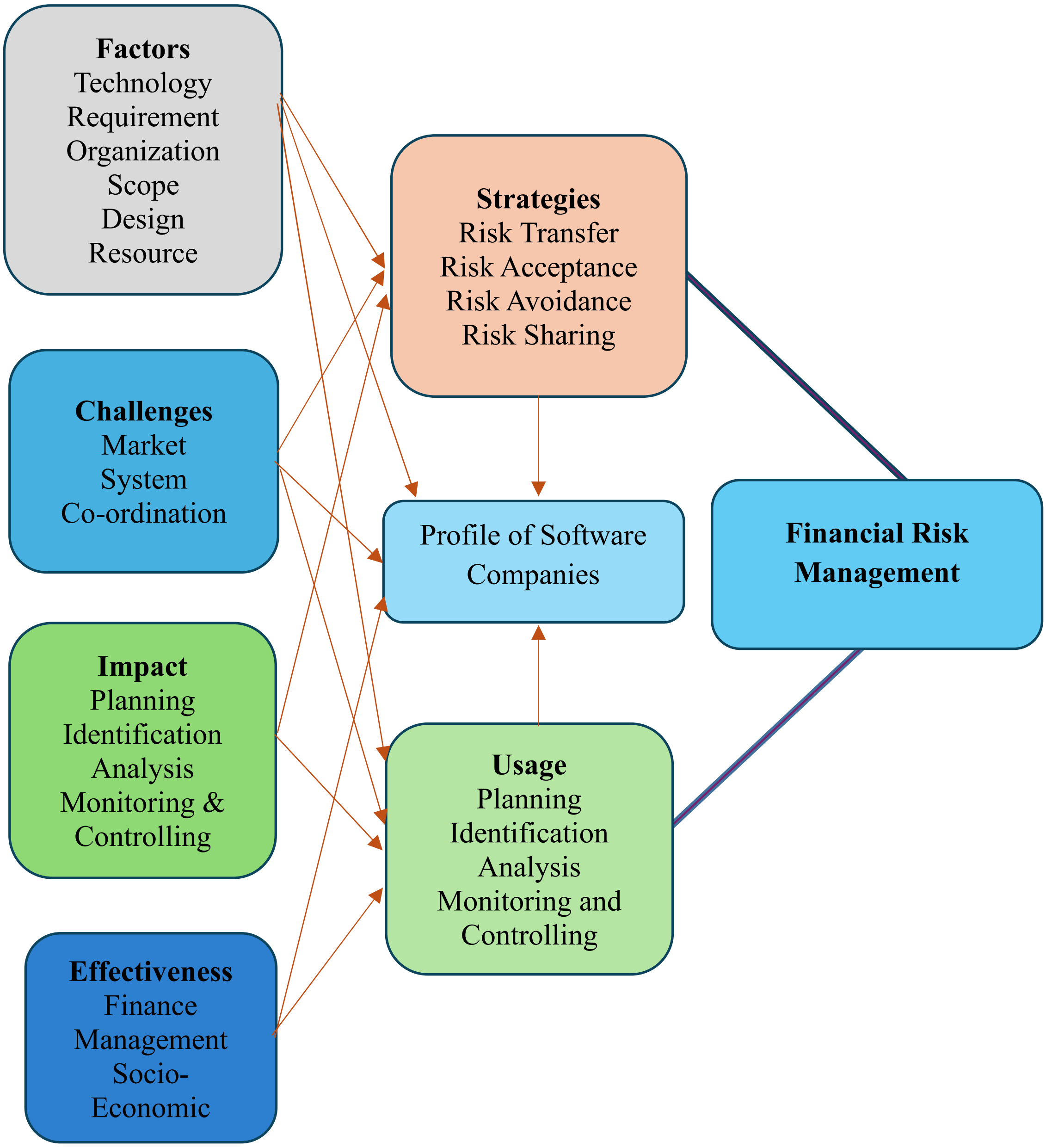
1.11 Conceptual Model Developed for the Study

Information technology projects require sophisticated financial risk management due to the complex relationships between various variables and their characteristics. Financial risk management consists of two important elements. They are financial risk management techniques and financial risk mitigation strategies. To have efficient financial risk management, a model based on the conceptual relationships of profile of software companies, financial risk factors, usage, impact, effectiveness, challenges and financial risk mitigation strategies has been established by the study. Furthermore, the conceptual model can understand the scope and complexity of the research. Figure

1.4 depicts the conceptual model of financial risk management in information technology projects of software companies in Kerala.

Figure 1.4

Conceptual Model of the Study



1.12 Limitations of the Study

There are several limitations to the study. They are given below:

1. The scope of the study is limited to project managers of software companies in Kerala leaving software architects and software engineers.

2. The study primarily focuses on established software companies, neglecting startups.

3. The study focuses on financial risk factors only hence non-financial risk factors are not considered.

1.13 SCHEME OF REPORTING

This section describes the structure of the thesis. The research report consists of eleven chapters, beginning with an introduction and ending with recommendations. A brief overview of the chapters is provided.

1. Background of the Study

The first chapter of the research explains the background of the study and it consists of the significance of the study, statement of the problem, research questions, scope of the study, objectives of the study, research hypotheses, research methodology, variables used for the study, operational definitions, conceptual model, and limitations of the study.

2. Review of Literature

It includes reviews relating to financial risk factors, usage of financial risk management techniques, the impact of financial risk management techniques, the effectiveness of software companies, challenges faced by software companies and financial risk mitigation strategies. In this chapter, the researcher also identified a research gap based on extensive analysis of available literature and presented.

3. Financial Risk Management and Software Industry: An Overview

It covers various theoretical concepts such as the origin of the IT sector, classification of IT projects, risk management theories, risk management process, financial risk factors, different financial risk management techniques, different types of challenges and financial risk mitigation strategies used by software companies.

4. Financial Risk Factors Affecting IT Projects

This section of the study exhibits the analysis of financial risk factors based on financial risk management techniques and financial risk mitigation strategies. This chapter is classified into three sections. Section A discussed the profile of the sample respondents and sample software companies. Section B of this chapter presents the results of financial risk factors based on nature, area, the average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on the budgeted amount and average time spent for software project. Section C, discusses the confirmatory factor analysis of financial risk factors based on the usage of financial risk management techniques and financial risk mitigation strategies.

5. Usage of Financial Risk Management Techniques

This segment describes the extent of usage of financial risk management techniques. This chapter consists of two sections. Section A, presents the results of the analysis regarding the usage of financial risk management techniques based on nature, area, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount and average time spent for software project. Section B of this chapter, deals with confirmatory factor analysis of the usage of financial risk management based on the impact and effectiveness of software companies.

6. Impact of Financial Risk Management Techniques

The sixth chapter outlined the results of the impact of financial risk management techniques. Both primary and secondary data were used. Primary data relating to the completion of the project on time and the completion of the project on budgeted amounts were analysed. Secondary data regarding completed projects and project success were analysed based on financial risk management techniques.

7. Effectiveness of Software Companies

The study analysed the effectiveness of software companies based on financial risk management techniques and financial risk mitigation strategies. This chapter includes two sections. Section A, demonstrates the results of the effectiveness of software companies based on nature, area, the average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on the budgeted amount and average time spent for software project. Section B, deals with confirmatory factor analysis of the effectiveness of software companies based on financial risk mitigation strategies.

8. Challenges Faced by Software Companies

This section of the chapter deals with challenges faced by software companies. To analyse the challenges of software companies, the present chapter is divided into sections. Section A describes the results of challenges of software companies based on nature, area, average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on the budgeted amount and average time spent for software project. Section B, discusses the confirmatory factor analysis of challenges of software companies based on the usage of financial risk management techniques and financial risk mitigation strategies.

9. Financial Risk Mitigation Strategies of Software Companies

The ninth chapter attempts to study the financial risk mitigation strategies of software companies. The current chapter is organised into two sections. Section A deals with the results of financial risk mitigation strategies of software companies based on nature, area, average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on the budgeted amount and average time spent for software project. Section B, presents SEM showing the interrelationship between factors, impact, effectiveness and challenges on usage and strategies.

10. Summary, Findings and Conclusion

In this chapter the summary, significance of the study, statement of the problem, scope of the study, research questions, objectives of the study, research hypotheses, research methodology, summary of chapters, major findings and conclusions are presented.

11. Recommendations

It consists of recommendations, implications of the study and the scope for further research.

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Chapter Two

REVIEW OF LITERATURE

2.1 Introduction

Financial risks exist at all times in any information technology project, affecting the success of software companies. Financial risk management in information technology projects has grown in importance among software companies. The relevance derives from the expanding role that software companies play in meeting the needs of customers. Financial risk management is not a stand-alone or unique process; rather, it is integrated into various projects and organizational management. Various financial risk factors affect the successful implementation of information technology projects. Financial risks are managed with the help of various financial risk management techniques. Software companies also follow different risk mitigation strategies to reduce the risk. In the meanwhile, they face many challenges to carry out their operation efficiently and survive in the business environment. The study categorizes the literature review under six heads based on the objectives. They are:

i) Financial Risk Factors Affecting Information Technology Projects.

ii) Financial Risk Management Techniques in Information Technology Projects

iii) Impact of Financial Risk Management Techniques in IT Projects

iv) Effectiveness of Software Companies

v) Challenges Faced by Software Companies

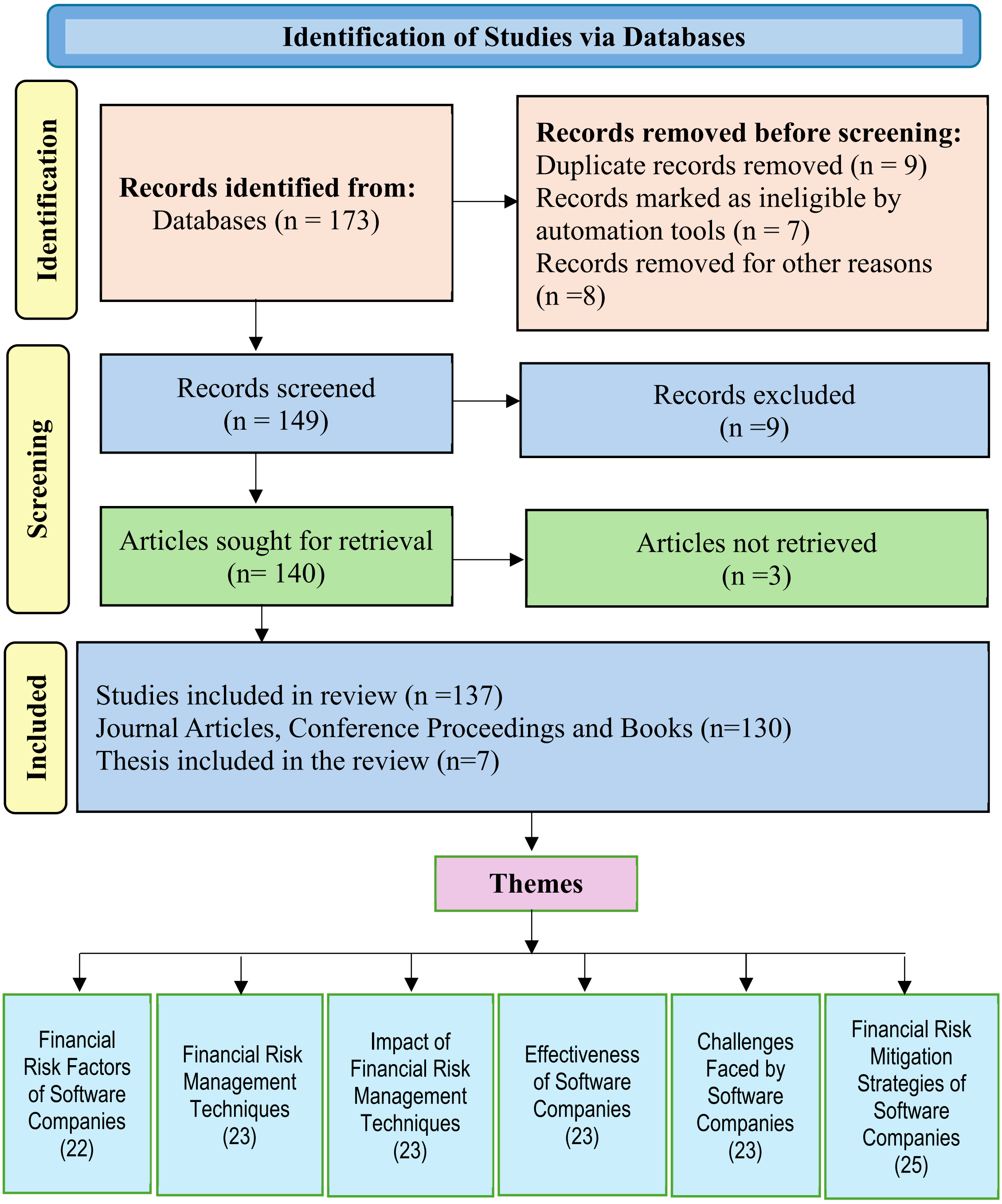
vi) Financial Risk Mitigation Strategies of Software Companies

2.2 Phases of Literature Search

The literature discovered by using databases at different phases of the literature search employing the PRISMA flow chart is presented in Figure 2.1.

Figure 2.1

Prisma Model



2.3 Financial Risk Factors Affecting Information Technology Projects

The researcher prepared a list of studies related to the financial risk factors affecting information technology projects, which is shown in Table 2.1

Table 2.1

Literature on Financial Risk Factors Affecting Information Technology Projects

Sl. No.	Title	Journal /Conference/Thesis	Year
1	Structural Equation Modelling of Risk Factors Influencing the Success of Building Projects	Journal of Facilities Management	2024
2	How Knowledge and Uncertainty Affect Strategic International Business Investment Decisions: Implications for Cross-Border Mergers and Acquisition	Journal of Business Research	2022
3	Information Technology Project Management Processes and Practices: A Comparative Study for Successful Implementation of Information Technology Projects	International Journal of Business and Social Science	2019
4	Factors Contributing to Failures of Software Projects	International Journal of Computer Science and Network Security	2019
5	Risk Factors in Software Development Projects: A Systematic Review	Software Quality Journal	2019
6	Critical Success Factors in Information Technology Projects	Management Science Letters	2017
7	Top Fifty Software Risk Factors and the Best Thirty Risk Management Techniques in Software Development Life Cycle for Successful Software Projects	International Journal of Hybrid Information Technology	2016
8	A Method for the Evaluation of Risk in IT Projects.	Expert System with Applications	2016
9	Risk Management and Information Technology Projects	International Journal of Digital Information and Wireless Communication	2014
10	A Model of Critical Success Factors for Software Projects	Journal of Enterprise Information Management	2012

Sl. No.	Title	Journal /Conference/Thesis	Year
11	Information Technology Risk Management: A case study	Journal of Research Innovation in Information Systems,	2012
12	How Does Software Project Risk Vary across Project: An Exploratory Study from India	International Journal of Intercultural Information Management	2011
13	Comparing Senior Executive and Project Manager Perception of Information Technology Project Risk: A Chinese Delphi Study	Information System Journal	2010
14	Analysis of Critical Success Factors in Information Technology Project Management	International Conference on Industrial and Information Systems	2010
15	Software Process Improvement in Small and Medium Software Enterprise: A Systematic Review	Software Quality Journal	2008
16	An Empirical Investigation of the Key Factors for Success	Software Engineering	2005
17	Critical Success Factors in Information Technology Project	Thesis	2005
18	Software Project Management Practices: Failures Versus Success	The Journal of Defence Software Engineering	2004
19	Understanding Project Risk: Cluster Analysis	Journal of Information and Management	2004
20	A Quantitative and Qualitative Analysis of Factors Affecting Software Processes	Journal of Systems and Software	2003
21	Case Study: Factors for Early Prediction of Software Development Success	Information and Software Technology	2002
22	A Practical Use of Key Success Factors to Improve the Effectiveness of Project Management	International Journal of Project Management	1999

A brief explanation of the reviews is written below,

Adedokun and Egbelakin (2024) used the structural equation modelling technique, which discovered that risk factors had a substantial impact on three of the six criteria for determining the success of higher education construction projects. Environmental risk factors have a considerable impact on completion time when using this non-linear evaluation method. Further, logistic, environmental, and legal risk factors strongly influenced safety performances. Additionally, logistics, design, and environmental risks had a major impact on profit. However, risk factors had no substantial effect on higher education building project completion costs and quality.

Irwin et al. (2022) found that financial risk can stem from various factors, such as market fluctuations, regulatory changes, and economic instability. Effectively addressing these risks requires a comprehensive and flexible strategy. Technologies like artificial intelligence, data analytics, and block chain have introduced innovative approaches to financial risk management. These technologies enable the rapid and accurate analysis of data, helping to identify trends and providing valuable insights that support informed business decision-making.

Almgren (2019) suggests that software companies can enhance their operation through the successful implementation of IT projects. There are two types of factors such as factors that are essential for the development of IT projects and factors that lead to failure of projects. Through the analysis, it was found that benchmarking, planning, and continuous evaluation are the important factors essential for the successful development of IT projects. Insufficient user involvement, lack of strategic planning, and inadequately experienced project managers are the factors that lead to the failure of IT projects. Extensive planning and regular risk assessment are the best practices that reduce the failure of IT projects.

Hamid et al. (2019) identified factors affecting project success which include: inaccurate time and cost estimates, scope creep, insufficient human resources, and risk management. An automated tool will improve decision-making for the management of scope, resource selection, distribution, risk management, and time and cost estimation. A comprehensive automation solution addressing all four primary failure reasons will be established. The study found that focusing on key factors can improve software project management and success rates. Completing software projects effectively increases a country's software exports, leading to economic growth and employment creation.

Menezes et al. (2019) state that risk in information technology projects leads to project failures. Proper monitoring of risk factors can ensure quality software projects. Many projects are avoided due to a lack of knowledge about risk factors. Mapping risk factors and assessment enables software development projects without any delays. The lack of technical skills of project managers increases the failure level. Categorization of risk factors related to project requirements determines the probable loss in information technology projects.

Fayaz et al (2017) examined the management of information technology projects largely impacted by various factors. The project manager concentrated on communication plans for the success of software companies. They identified fifteen critical success factors of information technology projects by surveying eighty IT professionals. The factors are determined with the help of multiple regression analysis. Leadership quality and experienced project team members are considered as most important factors for IT project management. Top management support does not play a key role in software project success.

Abdelrafe et al (2016) determined that software development projects are highly complex and strategically important when it comes to risk management. Through an analysis of data from seventy-six software project managers, they identified fifty risk factors. They also presented thirty risk management techniques to effectively control risks and ensure the success of software projects. Software risk management aims to reduce potential risks, and the authors formulated a series of phases for managing these risks, including risk planning, identification, prioritization, analysis, evaluation, treatment, control, and communication and documentation. Both risk and control factors were assessed to enhance the development of effective risk management.

Rodriguez et al. (2016) presents a new risk assessment method using a combination of the Fuzzy Inference System (FIS) and Fuzzy Analytic Hierarchy Process (FAHP). FIS is used to integrate groups of risk factors. A modified FAHP evaluates risk factors to reduce inefficiencies and create a more user-friendly model for multicriteria decision analysis with lesser processing requirements. The new model considers the unique risk factors associated with information technology projects, including inaccuracy and uncertainty, which make them more probable to be unsuccessful. It uses fuzzy logic and pair comparison to address inaccuracy and uncertainty, implements a hierarchy to handle a large number of risk factors, and incorporates expert knowledge to consider interrelationships among groups of risk factors.

Talet et al. (2014) state that information technology projects are not free from risk. Most of the IT practitioners analyzed various risks that adversely affect the development of information technology projects. Technology, security, information, people, business process, management, and the risk of success are very high for developing software projects. Software companies need to keep information technology projects on schedule and cost estimates. The finishing stage of information technology projects is continuously monitored with the planned resources.

Ahlan and Arshad (2012) suggested that risk management in the field of information technology is very crucial. They identified three categories of risk such as technical risk, security risk, and organization risk. Modern organizations in information technology face risk due to interpersonal problems between team members. The negligence of top management in identifying the risk factors causes serious dissatisfaction in project outcomes and sometimes it turns out to be failure.

Sudhakar (2012) was undertaken a study to develop a model of critical success factors for software projects. The top five factors in each category of factors were identified. Communication, technical, organizational, environmental, product, team, and project management factors were the five categories of critical success factors. Among these categories product, team, project management, and communication factors were highlighted as important categories of critical success factors. They developed a conceptual model by using these factors for better management of software projects. The study suggested that project managers should concentrate on these factors while planning and executing software projects.

Thomas and Bhasi (2011) reveal that software companies in India are concerned with software development risk. The study undertakes five hundred and twenty seven software development projects in India to know the level of risk and different types of projects. They identified major risk dimensions comprising cost, time, and performance of projects among all software companies. The risk variations are highly due to improper planning and control of software projects. The most influential factors of risk level are organizational attributes and project characteristics of software companies.

Daojin Fan's (2010) study analyzed critical success factors in software projects. Information technology projects are affected by many factors at the development and implementation stage. The majority of the software companies failed due to inefficient management of factors. The study determined project communication, collaboration, and information sharing are the critical factors for the project's success. Proper management of these factors reduces the failure of software projects and ensures greater success for software companies.

Liu et al (2010) evaluated the increasing number of information technology projects in China to reduce the success rate. The perception of information technology risk among senior executives and project managers is identified with the help of the Delphi technique. The most important risk of software projects are lack of support from top management. The majority of project managers do not realize their role in delivering successful projects. Senior executives focus on higher levels of risk such as culture, politics, process, and organization structure. Project managers mainly focus on lower-level risk consisting of requirements and user involvement. They focused on overall risk factors for reducing software project failures.

Pino et al. (2008) examined software process improvement in small and medium enterprises. A strategic review of financial resources can improve software processes in small and medium software enterprises. The development of software projects by improving their existing process can be done with the help of software review techniques. Completion of projects with huge investment involves high risk and requires financial support. Project documentation, process planning, process estimation, and requirements elicitation are the improvement processes to be implemented in small and medium software enterprises. Analyzing critical success factors given success helps the development of software projects. Improvement of software process involves a complete change in the procedure of development and implementation of software projects.

Dolan (2005) finds that the information technology project involves factors that lead to success or failure. The failure rate of the project increased in the execution stage of the project. Technical skill was identified as the critical factor that had a significant impact on IT project success. Higher levels of risk and project complexity are to be addressed properly. Factorial analysis was made by the researcher to identify the critical success factor. The identified factors may differ according to the projects initiated by software companies. Technically expert teams are essential for the success of information technology projects.

Dyba (2005) conducted a quantitative survey of one hundred and twenty software companies. Software process improvement indicates the most challenging issue. Six organizational factors are considered key factors for the successful implementation of SPI. Technological changes are required to be studied with the help of prior research. Software companies attempted to check the issues in the organisation to improve the performance of software projects. The outcomes of software projects can be improved through quantitative analysis and properly maintained for succeeding in the critical factors for smooth implementation of software process improvement programs.

Jones (2004) conducted a study by taking two hundred and fifty large software projects. Many projects were terminated without completion. Six common factors were identified that largely influence the success of software companies. The majority of the software projects failed due to inadequate planning and faulty estimation. Large software projects are complex and require sophisticated processes. Failure of large software projects was due to poor software quality. The failure can be converted into success by analyzing the requirements of users, efficient planning, and adopting changes to improve the software project performance. Time, cost, and quality are essential for a project and pave software project to success.

Wallace et al. (2004) suggest that project managers should identify risk factors and control them to reduce the failure of software projects. The study highlighted six dimensions of software project risk. Technical risk affects requirement satisfaction and enhances uncertainty. The study provided more emphasis on internal risk in software development projects. Monitoring the risk level in different dimensions helps to understand the changes in the risk profile of software projects. Mitigation strategies reduce the severity of impact by increasing the probability of success of project performance and reducing the potential loss in information technology projects.

Rainer (2003) showed that the success of a software project involves a software improvement process. He identified seven factors that are highly relevant to the software improvement process with the help of qualitative and quantitative analysis. The variability in software projects is influenced by these factors. There are certain factors such as reward schemes and estimating tools were found relevant to software process improvement. Factors that create a high impact on software projects should be studied and monitored by project managers to overcome the challenges of software process improvement.

Procaccino et al. (2002) state that project managers should identify those factors which create greater impact. Lack of management support, poor requirements, and customers are the factors that create an impact on software development. They analyzed forty-two software projects to find high-risk factors. Early identification of factors helps to mitigate the risk. A well-defined scope and realistic approach to the requirements of the user leads to the successful development of software projects. The project manager should create a level of confidence in the user's mind by providing due consideration to their perception. A successful project satisfies the user with the support of management.

Clarke (1999) reveals that project management addresses several key factors to improve the effectiveness of software projects. Communication throughout the project increases understanding and motivates the team members. The gain achieved by meeting project objectives provides standardization in software projects. Considerable time and resources are required to attain the desired project outcome for customer satisfaction. Effective communication ensures solutions to many problems arising in project management.

2.4 Financial Risk Management Techniques in Information Technology Projects

Table 2.2 summarizes studies regarding financial risk management techniques in information technology projects.

Table 2.2

Literature on Financial Risk Management Techniques in Information Technology Projects

Sl. No.	Title	Journal /Conference/Thesis	Year
1	A Systematic Review of Risk Management Tools and Techniques in Software Projects	The Indonesian Journal of Computer Science	2023
2	The AGP model for risk management in agile IT projects	Journal of Risk and Financial Management	2023
3	A Critical Analysis of Software Risk Management Techniques in Large Scale System	Software Standards and Reducing Software Failure	2018
4	Risk Management in Information Technology Project: An Empirical Study	Computer Mathematics and Engineering Applications	2017
5	Advance Tools and Techniques of Software Risk Management	International Journal of Advanced Research in Computer and Communication Engineering	2016
6	Modelling and Evaluating Software Project Risks with Quantitative Analysis Techniques in Planning Software Development	Journal of Computing and Information Technology	2015
7	Software Project Risk Analysis and Assessment: A Survey	Journal of Multidisciplinary Studies	2014
8	Identification of Risk Factors in Large Scale Software Projects: A Quantitative Study	International Journal of Knowledge Society Research,	2014
9	The Role and the Effects of Risk Management in IT Project Success	Information Economics	2013
10	Risk Analysis in Information Technology and Communication Outsourcing	Journal of Information System and Technology Management	2011
11	Software Risk Management: Importance and Practice.	Journal of Management of Software Projects	2011

Sl. No.	Title	Journal /Conference/Thesis	Year
12	Key Challenges of Information Technology Project Risk Management.	Thesis	2011
13	Review of Risk Management Methods	Business Intelligence Journal	2011
14	Critical Success Factors for Software Projects: A comparative study	Scientific Research and Essays	2011
15	Risk Identification, Mitigation and Avoidance Model for Handling Software Risk	IEEE Software	2010
16	State of software Risk Management Practice	International Journal of Computer Science	2007
17	A Review of Techniques for Risk Management in Projects	Benchmarking An International Journal	2007
18	Supporting Risks in Software Project Management	Journal of System and Software	2004
19	Use and Benefits for Project Risk Management	International Journal of Project Management	2001
20	Risk Analysis Techniques and their Application to Software Development	European Journal of Operational Research	1996
21	Financial Risk and Financial Risk Management Technology	Journal of Information and Management	1993
22	Risk Analysis for Information Technology	Journal of Management Information System	1991
23	Risk Management: The key to Successful Software Projects	Journal of Management of Software Projects	1990

A brief explanation of the reviews is given below,

Luthfiansyah et al. (2024) state that risk management is essential for the success and effectiveness of software development projects, as it helps identify potential risks and provides valuable insights into the project's most critical aspects. This study explores and evaluates various methods and techniques for managing risks in software development projects. Using a systematic literature review (SLR) methodology, relevant research articles were collected and analyzed. The findings highlight a range of risk management methods and techniques, such as brainstorming, root cause analysis, risk probability assessment, artificial intelligence, and risk response planning. These tools and techniques are crucial for detecting, analyzing, planning, and controlling risks in software projects.

Sanjeet Singh et al. (2023) determined that agile projects frequently necessitate a high level of collaboration and trust among team members, and company culture plays an important role in facilitating these characteristics. With a greater awareness of the timeframe and budget, any difficulties can be identified and addressed before they become serious problems. This reduces the chance of project failure and ensures successful completion. The project's organizational framework ensures clarity of roles and provides the necessary information for informed decision-making by offering visibility into project selection objectives and performance. The research's key benefit lies in its ability to predict, detect, assess, and proactively respond to risks in agile information technology projects with greater accuracy. This capability helps project teams allocate resources more effectively, manage budget constraints, and develop successful strategies. Additionally, the AGP model offers a systematic framework and a common language for quickly assessing and managing risks.

Pasha et al. (2018) analysed that competition in the software industry is forced to risk assessment and control of risk factors. The study evaluated the project quality and risk factors with the help of qualitative and quantitative risk analysis techniques. Risk mitigation is quite difficult because the project involves a vast number of risks for large-scale software development. Risk assessment and risk control can reduce the severity of the risks.

Irfandhi (2016) revealed the presence of effective risk management and the influence of a skilled risk manager are key factors contributing to the success of software projects. Additionally, risk analysis, monitoring, and control are closely related to the subjective performance of information technology projects. When risk management techniques are properly applied, the likelihood of project success can be significantly increased.

Satvik and Sanam (2016) observed that the complexity of risk management depends on the complexity of software projects developed. An active risk manager identifies risk at each stage, watches critically with different tools and clears the risk with automated services which update regularly. There is no finite number of risk management techniques. It corresponds to the software companies and management experts. Different software companies use various tools according to their convenience, cost and time. Tools and techniques for information technology projects widen according to the project requirements.

Elzamly and Hussin (2015) revealed that planning software developments are crucial for software project survival. A pro-active maintenance by the project manager helps to mitigate risk in software development. They identified planning software development risk factors with the help of multiple regression analysis. Appropriate risk management techniques are determined for each software risk factor. Management of risk factors can effectively be done by using quantitative risk analysis techniques. The successes of the project are ensured through proper evaluation of risk factors and control factors and showed a significant relationship. All risk factors are controlled with the proper management of control factors.

Sankhwar and Pandey (2014) state that risk assessment determines the risk and aims to accomplish the software project objectives and minimises the threat. Risk analysis identifies the reason for the failure of software projects. The study classified software risk as internal and external risks. The techniques like cost models, performance models and checklists are used to assess the risk in different phases of software development projects. Staff turnover was one of the important factors for software project success. Risk mitigation, monitoring and management plans reduce the risk and increase the quality of the software project. The study identified that risk analysis are performed in major areas such as policy risk, technique risk, scope change risk and management risk. The identified risks were analysed for their impact on cost, schedule and other software risk components.

Shahzad (2014) mentioned that software risk takes place in every software development process. The identification of risk factors becomes a comprehensive task for project managers. Large software project takes longer completion period and involves huge cost. The risk prioritisation technique used by the researcher to identify the risk factors that cause severely to the software project. The study identified the top ten risk factors. Among them, requirements were ranked first and weak project management methodology was ranked as tenth. The proper management of risk factors empowers the success of the project and reduces the losses incurred. The software development process can be controlled and managed by focusing on risk factors.

Didraga (2013) highlights that risk management in software projects helps to avoid project failure and increase team effort. A contingency plan foresees the risk and positively influences project performance. The study measured the subjective and objective performance of information technology projects. Risk analysis and risk monitoring and controlling influenced subjective performance in terms of cost, schedule and effort. Risk identification and planning did not influence the project in terms of reliability, flexibility and quality. Timely delivery of projects enables attaining project objectives and increases the probability of success.

Arias and Stern (2011) reveal that software companies implement risk management procedures and techniques to control and manage projects. The study analyzed commonly used risk management methods to analyze risk factors in IT projects. Bohem's method focused on risk exposure to determine the valence of risk. The RISKIT method helps to provide flexibility in software development projects. SEI-SRE made a detailed risk identification approach. SERUM method emphasized implicit risk management with software projects. Each risk management method depends on specific criteria for software projects.

Chowdhury (2011) suggests that the development of information technology projects involves a high level of risk. Project managers should adopt review-based risk identification and analysis. Checklists, active reviews, and predefined risk factor techniques should be used before developing information technology projects. Critical success factors involved in the projects are recognised to increase the success rate of projects. Ranking the project based on risk factors and reviewing the progress of software projects helps to track the major risk factors. Risk assessment and risk mitigation techniques can be used in to risk management of software projects.

Banyahmad (2011) study analyzed risk management practices and project performance of software companies. Risk management was analyzed from six perspectives: risk identification, evaluation, treatment, monitoring, motivation, and responsibility assignment. The analysis revealed that effective risk management practices directly contribute to improved project performance, helping projects meet their budget, schedule, and deliverables. The usage of standard risk management practices improves the success rates of projects. Project risk management performs continuous monitoring and control of the projects. It is observed that only a few software companies follow proper risk management practices. So, the study suggests that all software companies should practice effective project risk management for better management of projects.

Pardo (2011) attempted to identify a risk management process for risk description and risk estimation. Risk analysis should be done based on the characteristics of software companies which depend upon the information technology. If a software company decides to outsource the risk, there will be a high burden of cost. A better plan should be adopted while managing the risk and it must be analysed properly according to the existing circumstances prevailing in the software companies.

Nasir and Sahibuddin (2011) the study undertakes an extensive survey to identify critical success factors through a comparative approach. Software companies are reported a wide range of factors that increase the chance of success. Critical analysis was made to describe the failure factor through quantitative analysis. A realistic schedule, clear objectives, adequate resources and requirements are the factors that contributes to efficient project management.

Shahzad and A-Mudimigh (2010) suggested software risk identification and mitigation are the most important aspects of every software company. The impact and probability of risk factors are done through surveys, interviews, and learning from personal experience. They identified divergent estimations of time and cost are the major issues related to the failure of software projects. They developed the RIMAM model focused on continuous consultation of customer requirements. The model suggests that an experienced team of project managers should be retained with high perks. Error detection is done for the effective use of time. Continuous risk management can handle the risk and explore new opportunities. Seven risk factors are determined in the software development process and they are assessed in numerous ways to minimize their impact. The model was initiated with minimum cost and can be changed according to the changes in the environment.

Mattsson and Nyfjord (2008) conducted a study in thirty-seven software companies on the industrial practice of risk management and integration in the software development process. The extended risk categorization revised the current risk categorization beyond internal and external categories. Software companies had problems regarding organizational issues, people, skills, processes, tools, resources, and knowledge management. They developed a risk management model for integrating risk management aspects in the majority of software companies to manage risk effectively. Almost thirty-three out of thirty-seven had a risk management process model to document their risk.

Ahmed et al. (2007) state that information technology projects may result in positive or negative opportunities. Software companies manage the project risk through a structured approach to avoid risk, transfer risk, or reduce risk. The project manager should identify the context of the implementation of the project and their particular purpose. Techniques of risk management can be used based on the competitive advantage of software companies. Risk monitoring and control techniques are to be used by the software companies for managing their financial resources.

De Oliveria Barros et al. (2004) revealed that risk management uses a scenario-based framework to evaluate specific project risks. The applications of software are documented by predicting future risks in information technology projects. Contingency strategies resolve the impact of risk factors. Risk identification assesses project status and determines the reasons for project failure. Scenario analysis is used to know the feasibility of software projects. Understanding key elements in more complex projects handles software development risks.

Raz and Michael (2001) examined the uses and benefits of tools for project risk management by classifying project managers into two categories to analyze the most highly influenced tools in project risk management. The study reveals that software companies should adopt the most commonly used risk management techniques and consider competitive advantage in light of cost and budget. Brainstorming, checklists, risk documentation, and periodic reporting were frequently used by software companies.

Bennett et al. (1996) found that several risk analysis techniques are used for software safety. High-risk situations can be assessed with the help of fault tree analysis. The software reliability growth model predicts the failures in software programs. Several faults can be restrained through the application of various quantitative and qualitative analyses. The main advantage of risk analysis is, that it can be carried out at all stages of software development and software companies can reduce the probability of consequences of risk factors in software projects.

Arun and Robert (1993) revealed that risk management activities are broadly classified into risk identification and classification of risky events, measurement of risk, and formulation of relevant actions with the help of the managers. They also analyzed risk management in two dimensions, cost and benefit. The cost incurred and benefit derived should be balanced while developing information technology projects. Information technology projects are to be developed by using cost-benefit analysis.

Rainer and Snyder (1991) state that information technology risks are increased due to improper planning of project managers. The growth of the information technology sector was hindered by financial risks. So, managers should give more attention to minimizing losses and project failures by employing various qualitative and quantitative techniques for managing financial risks. Risk to be analysed to know the gap between success and failure of the information technology projects.

Fairley (1990) found that risk management of software projects had a definite structure which consisted of risk identification, impact analysis, contingency planning, risk monitoring, recovery, and crisis management. The success of information technology projects requires weekly and monthly review meetings, continuous monitoring, and analysis of the impact of risk by adopting techniques that can be suited to the projects. He also classified risk factors under five categories such as personnel, technology, resources, requirements, and external. These factors are identified by evaluating the software projects critically with different dimensions.

2.5 Impact of Financial Risk Management Techniques on IT Projects

Table 2.3 presents a list of studies relating to the impact of financial risk management techniques in information technology projects.

Table 2.3

Literature on the Impact of Financial Risk Management Techniques in IT Projects

Sl. No.	Title	Journal /Conference/Thesis	Year
1	Exploring the Implications of Technology Adoption in Digital Manufacturing on a Sustainable Workforce	Sustainability	2022
2	Risk Management Usage and Impact on Information System Project Success	Journal of Information Technology Project Management	2018
3	Effects of risk Management Practices on IT Project Success	Management and Production Engineering Review	2017
4	Choosing Project Risk Management Techniques: A Theoretical Framework	Journal of Risk Research	2015
5	A Study on Project Financial Risk Management in Information Technology Projects With Reference to Selected Software Companies in Bangalore	Asia Pacific Journal of Project Management and Control	2015
6	A Software Project Risk Analysis Tool using Software Development Goal Modelling Approach	Information System Design and Intelligent Applications	2015
7	Perceived Causes of Software Project Failure – An analysis of their relationship	Information and Software Technology	2014
8	The Impact of Financial Risks on Firm's Performance	European Journal of Business and Management	2014

Sl. No.	Title	Journal /Conference/Thesis	Year
9	Software Risk Management	Journal of Computer and Mobile Computing	2013
10	Information Technology Project Management and Project Success	International Journal of IT Project Management	2012
11	The Impact of Information Technology on Risk Management	Journal of Information Technology	2010
12	Risk and Risk Management in Software Projects: A Reassessment	Journal of Systems and Software	2008
13	Managing Software Project Risks with the Chi-Square Technique	International Management Review	2008
14	A Study of Software Development Project Risk Management	Information Technology and Management Engineering	2008
15	What Factors lead to Software Project Failure	International Conference on Research Challenges in Information Science	2008
16	An Empirical Analysis of Risk Components and Performance on Software Projects	Journal of System and Software	2007
17	Factors Influencing IT Project Performance	Americas Conference on Information System	2006
18	Why Software Fails	IEEE Spectrum	2005
19	A Framework for Integrated Risk Management in Information Technology	Management Decision	1999
20	Software Developer Perceptions about Software Project Failure a Case Study	Journal of System and Software	1999
21	A Framework for Identifying Software Project Risks	Communications of the ACM	1998
22	Can Software Risk Management Improve System Development: An Exploratory Study	European Journal of Information System	1997
23	.Managing Risks in Information Technology Projects: A Case Study of Trade Net	Journal of Information Technology Management	1994

A brief explanation of the reviews are written below,

Leesakul et al (2022) state that incorporating technology into financial risk management can help eliminate potential human errors. Since humans are susceptible to fatigue, inaccuracies, and bias, these factors can negatively affect risk management. By leveraging technology, risk management processes can be automated, reducing errors and improving efficiency. Technological advancements have also facilitated the development of more integrated platforms and systems, enabling real-time access to and processing of financial risk data and information.

Reed and Angolia (2018) determined that the emergence of software companies with various projects changed risk management usage and impact. The study surveyed five hundred and fifty-seven project managers to know the risk management practices regarding to successful outcomes of the project. Risk management plans prepared by well-trained project managers perform risk assessment and control. Correlation analysis indicates a strong relationship between risk management and successful project outcomes. The highest level of risk can be mitigated with assessed usage of risk management practices. The impact of complex software projects can be identified by using prior research techniques.

Pinchangthong and Boonjing (2017) state that risk management becomes one of the important factors for the project's success. Poor risk management causes project failures. Risk identification and risk planning lead to the quality and flexibility of the project. Cost, schedule and effort are essential to be determined in the software project. Risk identification had the highest positive influence on product performance. Risk analysis practices largely help to avoid negative impacts on the scheduled time and budget of information technology projects. The difference in organisational types affects information technology projects in all aspects of success and results in the high performance of software companies.

Cagliano et al. (2015) highlighted that risk management becomes crucial for the success of IT projects. The majority of the failures that occur in software projects are due to budget exceeding, falling below the schedule and missing performance targets. They determined that no risk management techniques fit at every phase of the project.

Risk analysis techniques vary according to the project life cycle and corporate maturity towards risk. Risk response helps to increase opportunities and reduce threats. Understanding the risk management process requires different risk management techniques for the successful implementation of IT projects.

Deepa Ramachandran (2015) has made a detailed study on financial risk management in information technology projects in Bangalore. The study reveals that software companies in Bangalore are highly concerned with financial risk in software projects. Budget constraints of project hinder the completion of the project within schedule. The major cause for the failure of Information technology projects is due to budget overruns. The increased cost of the project delays the projects. Understanding project complexities and proper planning are necessary to avoid financial risk in software projects.

Patil and Ade (2015) found that there are large numbers of risk factors in software development and their impacts on projects are very high. The project manager and team members should equally participate in the identification of risk factors while keeping the given goal modelling. The risk tool was used to identify the risk factors. Risk events are to be identified in each phase of software development to avoid their huge impact on software projects. Team members should be trained to identify the risk factors and analyse their influence on project failure. Sketching the risk before implementing the project largely helps with goal achievement.

Noor and Abdalla (2014) reveal that risks are inevitable but need to be controlled. Financial risk largely affects a firm's performance by restraining it from achieving its objectives. The study focused on credit risk, liquidity risk, market risk and foreign exchange risk and their impact on a firm's performance. These risks had a greater impact on the firm's profitability and financial position. They suggested that proper planning and consistency in financial policies tend to reduce these risks. Effective financial risk management is required to generate better revenue and survive future competition.

Lehtinen et al. (2014) found that software development requires complicated processes and project failures are common in software companies. The project failures of four software companies are studied with the help of root cause analysis. They interpreted that there is no single root cause for project failure. There are many causes and these causes are interconnected. Improvement in the process supported by project managers can reduce software project failure. Identification of causes at the beginning stage of software project development reduces the financial risk of software projects.

Chawan et al. (2013), in their article, 'Software Risk Management' highlighted that software project risks are uncertain and may have a positive or negative effect on the project. Project management involves the realisation of a project plan at a low cost. The project manager should concentrate on minimising negative risk and maximising positive risk. Software companies should identify critical risks involved in the project. Software risk management frameworks are developed to accomplish project objectives within the time. Software risk identification can be done for efficient implementation of projects. Risk identification techniques are used to enhance positive opportunities and to avoid threats to software companies. Special checklists are prepared to identify the probability and magnitude of risks.

Peslak (2012) states that information technology projects are analysed with several variables that have a high impact. Skilled project measurement was found to be overall project development in software companies. The study finds a positive relationship between project success and the overall returns of the software companies. Information technology project differs according to user's requirements hence, the project manager should pay proper attention to each project. Plans regarding software project development are to be disclosed to the team members before initiating the project. Project risk monitoring and controlling are necessary at each phase of the project.

Taymouri and Ashoori (2010) in their study, 'The impact of information technology on risk management' revealed that information technology may have a direct or indirect effect on the efficiency and effectiveness of risk management. Information technology tools have a positive impact on time when compared with the cost and performance of projects. The performance of information technology projects depends upon the risk factors and their effective management. Evaluating time and cost from all perspectives of software projects helps to reduce the risk to a great extent.

Bannerman (2008) points out that software projects use risk management practices for handling risk factors to increase the chance of success in project outcomes. Threats from the external environment create a negative impact on projects. Risk factors are analysed by using the checklist, analytical framework, process model and risk response strategies. Project manager should adopt proactive approach to identify opportunities. Adoption of new ideas improves project performance. Risk planning and review of software projects help to reduce failures. Risk management reassesses the software risk and effectively manages the failure of information technology projects. Risk mitigation strategies are sufficient for project success.

Khanfar et al. (2008) analysed that the failure of a software project can be controlled by evaluating the impact of different control factors and risk factors. Chi-square tests are applied to control risks in information technology projects. An impact matrix was developed to assess the impact of each risk factor and adopt appropriate control factors to improve the project success rate. Controlling the software risk enables integrity and quality solutions for project managers. Reducing the cost avoids project slippage. Identification of potential risks and their involvement can be analysed through monitoring the risk factor. The majority of the risk factors are mitigated with the help of control factors which improve project effectiveness.

Tao (2008) described that software development project faces greater risk throughout the project. A clear understanding of the risk helps to effective management. Prevention of risk and finding possible solutions assess the important risks involved in software projects. Risk identification, risk mitigation and risk conclusion are the three steps developed to assess the level of exposure to the risk. Software projects are developed to meet customers' requirements with minimum impact of risk factors. Risk management mainly focuses on the mitigation of risk with appropriate strategies. Project manager hardly strives to accomplish their deadlines of projects with efficient technology.

Verner et al. (2008) made an in-depth investigation to know the factors behind software project failures. They analysed 70 failed projects to discover the reasons. 93% of projects are failed due to improper delivery. The risks were not reassessed to control the failure. Poor delivery due to inadequate staff impacted the projects. The majority of software projects were underestimated, leading to increased failure rates as customer requirements grew. By keeping projects manageable and offering recognition and support to team members, estimation errors can be reduced, and staff requirements can be better met.

Hang and Huang (2007) conducted an empirical analysis of risk components and performance of hundred and fifteen software projects. They analysed the probability of occurrence of risk and their impact on software project performance by taking six dimensions of risk components in information technology projects. Requirements risk should be continuously monitored to improve project performance. Improper planning and control are the factors that contribute to the low performance of software projects and affect the successful development of software projects.

Gemino et al. (2006) found that larger risk had a greater impact and risk management helps to positive results. Quality and benefit derived had a direct effect on project process performance. Management identifies priori risks to adopt techniques to mitigate these risks. They analysed that the risk management process and level of project performance are positively related but the risk management process and volatility lead to a negative relationship. The risk management process in software projects helps to reduce various risk factors to a large extent. The contingency approach of management identifies priori risk and risk management bridges the gap between priori risk and project performance.

Charetee (2005) reveals that software project failures are common in information technology projects. Proper allocation of resources by project managers can reduce 64% of software failures. Information technology projects are costly but the costs of failure of projects are unpredictable. Most of the software companies work with expert opinion in the development of information technology projects. The impact of risk arising out of software failure can be reduced through continuous monitoring of projects with risk dimensions. The formation of a risk management committee becomes helpful for software companies to assess the impact of risk and software failure.

Keil et al. (2004) find that project risk and project performance show an inverse relationship. They identified risk dimensions based on the level of risk and classified them into high, medium and low. Strategic applications are required to implement the project successfully. Frequently changing the requirements creates a major impact on project outcomes. The attitude of user and their unfavourable involvement increase project failure. Poor planning and control tremendously increase the project risk.

Bandyopadhyay et al. (1999) identified that the framework for integrated risk management includes risk identification, risk analysis, risk-reducing measures and risk monitoring. Risk identification determines the internal and external threats in the IT environment. Risk analysis comprehends the losses from threats. Implementation of measures mitigates the software risks. Software companies use the measures according to the type of risk occurrence in IT projects. The framework provides awareness about the impact of risk on information technology projects and manages them more effectively.

Linberg (1999), in the article 'Software Developer Perception about Software Project Failure', discloses that many of the software projects failed due to customer discontent. The study analysed projects completed and cancelled about various factors. Information technology projects that meet quality, cost, and schedule are considered exceptionally successful. Some projects are cancelled, if nothing is learned and applied in future projects. The success of projects viewed by software developers and the software industry were entirely different. The success of information technology projects depends on fulfilling customer-specific requirements.

Ropponen and Lyytinen (1997) explored that risk management had a positive impact on process-related risk. The use of risk management methods improves project performance on a long-term basis. Project managers continuously face problems related to timing, resources and project complexity risk. Proactive management requires specific risk management techniques. Extensive training for project managers helps to improve software development. Schedule change largely affects larger projects. Smaller projects help in achieving better results even if the schedules are changed in comparison with medium-sized projects.

Neo and Leong (1994) described that software projects fail due to unrealistic time and cost estimates that affect deliverables. Technical issues were found to be difficult to implement the information technology projects based on planning. Organisational changes largely affect the completion of projects within the time and budget schedule. Risk anticipation helps to reduce the impact of risky projects. Strengthening the software project risk management can minimises the risk faced by software companies

2.6 Effectiveness of Software Companies

Table 2.4 shows the compiled list of studies focusing on the effectiveness of software companies.

Table 2.4

Literature on the Effectiveness of Software Companies

Sl. No.	Title	Journal /Conference/Thesis	Year
1	Team Effectiveness: A Key to Success in 'IT Organizations'	Australasian Accounting, Business and Finance Journal	2023
2	An Empirical Study on the Influence of ICT-based Tools on Team Effectiveness in Virtual Software Teams Operating Remotely during the COVID-19 Lockdown.	Thesis	2023
3	Virtual Teams Effectiveness in the Selected IT Companies in South India	Journal of Namibian Studies: History Politics Culture	2023
4	An Effective Framework to Improve the Managerial Activities in Global Software Development	Nonlinear Engineering	2023
5	The Assessment of e-HRM Tools and its Impact on HRM System Effectiveness and Organizational Effectiveness: An Empirical Study of Selected Multinational Companies in Ghana	The Electronic Journal of Information Systems in Developing Countries	2023
6	The Impact of Technology on Effectiveness of Project Management Methodologies: An Empirical Study	Journal of Cardiovascular Disease Research	2022

Sl. No.	Title	Journal /Conference/Thesis	Year
7	Effectiveness of Top-Tier Information Technology Software Service Companies: A Multi-Component Perspective	Journal of Global Information Technology Management	2021
8	IT Project Success Factors: A Literature Review	International Journal of Information Systems and Project Management	2020
9	A Core Factors for Software Project Success	International Journal on Informatics Visualisation	2019
10	A Study on Financial Risk Management Practices of Selected IT Companies in India	Journal of Management and Research	2017
11	An Integrative Contingency Model of Software Project Risk Management	Journal of Management Information Systems	2015
12	Software Release Planning Challenges in Software Development: An Empirical Study	Journal of Business Management	2012
13	Does Risk Management Contribute to Information Technology Project Success: A Meta-Analysis of Empirical Evidence	International Journal of Project Management	2010
14	The Rational Choice of Not Applying Project Risk Management in IT Projects	Project Management Journal	2009
15	Risk Management in Information Technology Projects	International Journal Risk Assessment and Management	2008
16	Exploring the Gap between Priori Risk and Project Performance Duration and Risk Exposure: A Cluster Analysis	Information and Management	2008
17	Identification and Ranking of Software Project Risks.	Identification and Ranking of Software Project Risks	2008
18	Success in IT projects: A Matter of Definition	International Journal of Project Management	2008
19	Managing Risk in Software Development Project: A Case Study	Industrial Management and Data Systems	2007
20	Defining Success for Software Projects: An Exploratory Revelation	International Journal of Project Management	2006
21	Project Risk Management: Lessons Learned from Software Development Environment	Technovation	2004

Sl. No.	Title	Journal /Conference/Thesis	Year
22	Software Development Risks to Project Effectiveness	Journal of System and Software	2000
23	Software Project Management: The Manager's view	Communications of the Association for Information System	1999

A brief explanation of the reviews is given below,

Arora et al. (2023) found that teamwork becomes a complicated phenomenon with positive relationships between team purpose and goals, team responsibilities, and team processes. These components are interrelated. Thus, the relevance of the team effectiveness aspects has been determined to be consistent with past research while also establishing their applicability in today's rapidly changing business environment. Enhancing team spirit through activities that foster trust, understanding, and appreciation among members becomes crucial for improving team effectiveness. Management and teams should develop and implement initiatives to enhance team performance.

Arunadevi and Subhashini (2023) revealed that virtual teams are becoming more common in the IT business, enabling geographically dispersed professionals to cooperate and communicate via technology-mediated channels. The effectiveness of virtual teams is assessed using several critical criteria. Effective communication becomes critical for virtual teams, and IT organizations in South India use a variety of communication solutions to ensure smooth and regular contact among team members. Collaboration is another critical factor, and IT businesses use collaborative tools and platforms to facilitate efficient teamwork and the fulfilment of common goals. Building trust and good interactions among team members is essential and may be achieved through consistent communication and a healthy team environment. Productivity and performance are also measured using important indicators of performance and project milestones. Efficient leadership and support are crucial for virtual teams, and IT companies provide virtual team leaders with the necessary resources, equipment, and assistance.

Kanike's (2023) study evaluates the performance of virtual teams in software development. Team effectiveness elements such as adaptability and mutual trust have a strong correlation with ICT tools like e-resources and project management systems. Team effectiveness is linked to backup behaviour as are shared mental models, closed-loop communication, team orientation, leadership abilities, and reciprocal performance monitoring. ICT tools, blogs, vlogs, podcasts, and editing tools significantly improved employee decision-making and communication inside teams. The team effectiveness evaluation research concludes that trust, communication, knowledge of ICT tools, and shared mental models are crucial for a successful virtual team.

Siddique et al. (2023) state that Global Software Development (GSD) is a modern approach to software development that has several benefits, such as increased cost-effectiveness and timely delivery. It provides access to a large pool of talented developers and promotes the exchange of best practices and new ideas in the software industry. However, successful product creation requires good project management. Organizations that achieve project success routinely use well-defined project management processes, resulting in desired objectives within predetermined time and resources. Software project success rates grow dramatically with rigorous software management projects.

William and Singh (2023) explored the impact of e-HRM on the effectiveness of HRM systems and organizations. Their findings revealed that e-HRM tools are statistically significant in enhancing policy-level effectiveness, technical effectiveness, strategic effectiveness, and overall HRM effectiveness. They identified a positive correlation between policy-level and organizational effectiveness, as well as between strategic-level and organizational effectiveness. However, they also found a negative association between technical effectiveness and organizational effectiveness, as well as between HRM effectiveness and organizational effectiveness. Based on these results, it was recommended that management adopt e-HRM technologies, as they demonstrate a positive correlation with both HRM effectiveness and organizational effectiveness.

Chauhan (2022) determined that technology plays a crucial role in improving communication and the effectiveness of projects. Team members can now access real-time data by employing technological advancements. Technology enhances project management methodologies by facilitating the integration of various tools and processes. Technology enables the same individuals to navigate massive amounts of incoming data. Technology enables project managers to select the most effective project management methods. Technology assists in determining the cost, benefits, and timeline for project execution and completion. Technology can also serve in connecting project processes. Using technology, project managers can estimate the overall time required to complete the project. The research found that technology improves the effectiveness of various project management techniques.

Goyal et al. (2021) found through empirical data that INFY emerged as the most efficient company across all components, followed by CTS and ACCN during the specified period. However, TCS and WIPRO were identified as inefficient in certain components. The study revealed that the selected IT companies performed exceptionally well in the FSI, RCL, and CME components, while the ERU, LSH, and MFG components showed a need for further development. This research expands on existing literature by examining the efficiency of selected IT companies across three regions: North America (NA), Europe (EUR), and the Rest of the World (ROW), enabling international comparisons from 2014 to 2017. The findings also indicated that IT companies performed best in the ROW region, followed by EUR, and underperformed in the NA region. Furthermore, the efficiency of the selected IT firms, except TCS, declined in the fourth quarter of 2017 compared to the same period in 2014.

Iriarte and Bayona (2020) suggest that investment in information technology projects rapidly increased but the failure of IT projects also increased in higher ratios. Project success criteria are determined based on scope, time and quality. Information technology projects involve many factors among them human resources is regarded as a critical factor for achieving success in software projects. Better project team members maintain the quality of the system and information. Project management becomes an easier task and increases the success rate of the information technology projects.

Samimi (2020) examined that most of the managers are aware of using technology which leads to increased efficiency, effectiveness and greater customer satisfaction. The failures of information technology projects are not limited to the financial and economic disadvantages and it also influenced by information security risks, organisation risk and management process inefficiencies. Risk management in information technology projects is a highly complicated process that requires greater attention from the project managers and management of the software companies.

Ibraigheeth and Fadzli (2019) identified that the success of software projects depends on achieving schedule and budget. Efficient project management tracks project progress and takes corrective actions in each phase. They determined that the cancelled project was ever released again. The majority of the projects are failed due to non-fulfilment of desired quality and budget. Many factors affect success of a software project. Early recognition of software failure helps to reduce the impact of project failure. Core factors depend upon the type of software projects undertaken by the software companies.

Dalvadi and Warrier (2017) described that the IT companies in India face numerous risks and financial risk causes drastic change in the revenue of software companies. The future performances are assessed through risk management practices. A risk management committee becomes essential for software companies to establish financial risk management effectively. Every software company are required to follow a financial risk management plan for allocating risk management responsibilities. In this study, risk avoidance was preferred more while dealing with risk. Sensitivity analyses are widely used in these companies for measuring market risk. Financial risk management practice showed an increase in the overall value of software companies.

Bakker et al. (2010) analyzed the success of software projects, measuring them based on time, budget, and requirements. Project risk management had known risk factors and new risk factors. Risk management removes uncertainties in information technology projects and increases project deliverables. The risk management plan should be prepared to identify risk factors. Project plan and project delivery are compared to study the project's success. Analysing specific risks for future projects finds the causes of software failure. Well defined risk management profile between the project and the environment increases project performance. Analysing the new risk factors highly contributes to project success.

Kutsch and Hall (2009) determined that risks in IT projects endanger software companies in meeting their project objectives. Cost and time constraints affect the successful implementation of projects. It was found that the IT project manager fails to apply best practices to manage risk. The study highlighted the systematic application of project risk management to mitigate the risk and project outcome. The reactive risk management approach helps to manage information technology project risk. Effective risk management techniques help to improve the project performance.

Dey et al. (2008) state that risk can be managed by identifying the nature of risk. Software development projects becomes successful when proper planning and analysis of risk are done effectively. Managing risk helps to minimise cost and maximise the quality of the project. Each risk events and types of strategies are identified with a quantitative framework. Effective risk management considers project management cycle. Work plan for developing the software with integrating the resources leads to successful software project developments. Software companies should conduct regular meetings to identify the reasons for ineffectiveness in the developed project and take necessary action to rectify the deviations regarding all aspects collectively by the project managers and project team members.

Huang and Han (2008) found that software risk increases the failure rate of the software project. Software risk management involves identifying and assessing risks before they impact the project and implementing controls to mitigate them. Several projects are cancelled due to high-risk exposure. The longer the duration of the software project greater the risk. The project manager identifies risk factors with the help of quantitative risk analysis techniques to mitigate the effect on project performance. User, requirement, team and planning and control are the major four risk factors that involve a greater impact on the outcomes of software projects. A proper risk management plan at an early stage can improve the success rate of information technology projects.

Sharma et al. (2008) reveal that software companies require well-established processes. The study examined the top five risks such as functionality, process, user involvement, personnel and schedule risk in software projects. Misunderstanding of user requirements fails the project. Increased complexity in software projects resulted in slippage of schedules. From the analysis functionality and process are the two topmost risks that affect software project success. Proper management of these risks helps to reduce the failure of information technology projects.

Thomas and Fernandez (2008) state that the success of information technology projects was studied by analyzing thirty-six software companies. IT project outcomes are increased through better utilisation of resources. Checking accuracy, consistency, timeliness and usability measured the effectiveness of the software project. They categorised criteria for success into project management success, technical success and business success. They identified that there is no one best method for defining and measuring success. Project management was highly attained with user satisfaction. System quality showed formal success construct in the technical category and continuity showed a positive impact on business.

Dey et al. (2007) found that effective risk management in software development ensures better financial performance and successful accomplishment of projects. A risk management plan helps ensure the achievement of a project's cost, time, and quality objectives. Risk management planning involves creating a comprehensive strategy for addressing risks, with specific responses tailored to the nature and impact of each identified risk. Brain storming method largely helps to determine risk event and residual risk before the implementation of software projects. Risk analysis finds the impact on schedule and budget with the strategies of avoidance, transfer, reduction and absorption. The study also uses risk mapping method to identify the severity of risk events. Various quantitative and qualitative tools and techniques are employed to analyse risk. Effective communication between customers helps in achieving success.

Agarwal and Rathod (2006) conducted a study on defining success for software projects. The study explored success indicators of software projects based on the internal and external parties of software companies. The research focused on cost, time and scope to access the success of software projects. Software professionals considered scope as most important criteria for information technology project success. The achievement of internal objective of software companies in turn satisfies the customer and leads to project success which creates greater satisfaction to stakeholders who invested in software projects.

Kwak and Stoddard (2004) revealed that software project had high degree of uncertainties. Effective risk management increase the likelihood of project success. Proactive strategies and systematic approach brings unique insight into the identification and management of risk. Properly trained team members can adapt risk management practice to the particular project environment. Continuous improvement in the software project helps in achieving long term success in the management of risk. Each team member must use the risk management process while executing a project. All projects are to be scheduled with adequate resources. Timely management of risk helps software companies to survive in a dynamic environment.

Barki et al. (2001) state that a contingency model was adopted and tested. The model was based on longitudinal data collected from project managers and users across seventy-five software projects. The results obtained that the use of the contingency model increases project performance and reduces risk exposure of high risky projects. The software projects that deviate from the desired outcome are identified and deviation profiles should be maintained to control the risk. A high level of user participation, internal integration and formal planning are to be done to mitigate the deviations.

Jiang and Klein (2000) state that project managers face more difficulty in controlling the risk involved in the development of software projects. The study surveyed eighty-six project managers to know the project's effectiveness. Lack of expertise team leads to project ineffectiveness. The overall success of the projects can be enhanced through effective project management by selecting experienced team members and defining the roles and goals of projects to the project team members. Management of software companies should give due attention to avoid conflict among project managers and team members.

Jurison (1999) found that project management emerged with powerful tools and techniques for software development projects. Management-related problems are poorly defined goals, unrealistic deadlines and budgets. The failures of most of the projects are caused by project managers. Time, cost, and performance are key dimensions of project management. An experienced project manager can handle all the challenges to successfully develop software projects. A project manager should create effective communication within the team to avoid project failures.

2.7 Challenges Faced by Software Companies

Table 2.5 shows a list of studies prepared by the researcher on the challenges faced by software companies.

Table 2.5

Literature on Challenges Faced by Software Companies

Sl. No.	Title	Journal /Conference/ Thesis	Year
1	Objectives and Key Results in Software Teams: Challenges, Opportunities and Impact on Development	International Conference on Software Engineering: Software Engineering in Practice	2024
2	Best Practices in Strategic Project Management across Multinational Corporations: A Global Perspective on Success Factors and Challenges	International Journal of Management & Entrepreneurship Research	2024
3	Challenges in Large-Scale Agile Software Development Projects	Symposium on Applied Computing	2023
4	Quality Requirement Change Management's Challenges: An Exploratory Study Using SLR	IEEE Access	2022
5	Disruptive Technologies and Operations Management in the Industry 4.0 Era and Beyond	Production and Operations Management	2022

Sl. No.	Title	Journal /Conference/ Thesis	Year
6	Risk Management in Information Technology	Journal of Progress in Chemical and Biochemical Research	2020
7	The Role of Requirements in the Success or Failure of Software Projects	International Review of Management and Marketing	2016
8	An Empirical Study of Industry Practices in Software Development Risk Management	International Journal of Scientific Research Publications	2013
9	The Situational Factors that Affect the Software Development Process: Towards a Comprehensive Framework	Information and Software Technology	2012
10	Critical Risk Factors in Outsources Support Project of Information Technology.	Journal of Management Research	2012
11	Development of IT sector in India: Analysis of reasons and challenges	Journal of Economics and Sustainable Development,	2011
12	Software Development Risk Management Model: A Goal-Driven Approach.	Thesis	2011
13	A Framework for Identifying and Understanding Risks in Information Technology Project	Journal of International Technology and Information Management	2010
14	Governing Information Technology Risk	Sage Journal California Management Review	2009
15	Management of Risks in Information Technology	Industrial Management & Data Systems	2004
16	Software Industry: Challenges Ahead	Economic and Political Weekly	2002
17	Global Software Teams: Opportunities and Challenges of Technology-Enabled Work	Perspectives on Work	2002
18	Software Project Risk and Development Focus	Project Management Journal	2001
19	Meeting the Software Challenge: Strategy for Competitive Success	Research Technology Management	1998
20	The Effect of Co-ordination and Uncertainty on Software Project Performance: Residual Performance Risk as an Intervening Variable	Information System Research	1995
21	The Risks of Software	Scientific American	1992

A brief explanation of the reviews are given below,

Butler et al. (2024) evaluated that building software, like any other project, involves collaboration to achieve a shared purpose. In major software companies, middle management is responsible for breaking down the director's ideas into feasible projects. Challenges such as lack of clarity and alignment, difficulties sharing goals, collaboration obstacles, and shifting priorities are inevitable. To implement objective and key results effectively in software companies, managers must receive sufficient training, share consistent learnings, have access to data, and express transparent goals at all levels. Consistently implementing objectives and key results can benefit software developers across companies

Ekemezie and Digitemie (2024) revealed that Multinational Companies (MNCs) face specific challenges in managing significant projects across many geographic locations in the highly competitive and dynamic economic world. The most effective techniques in strategic project management, from a global perspective focus on the key success factors and challenges encountered by multinational corporations. Achieving successful strategic project management in these organizations requires a thorough understanding of various factors, including cultural differences, regulatory constraints, and market dynamics across different regions. MNCs faced coordination and integration challenges in strategic project management due to various organizational frameworks, competing priorities, and resource restrictions. Additionally, managing geopolitical risks, legal challenges, and regulatory complexities presents further obstacles for multinational corporations operating across various countries.

Saeeda et al. (2023) determined that agile software projects face challenges in large-scale development and large software companies, particularly increased workload and team dependencies. The majority of the challenges are related to testing complicated systems in large-scale projects with multiple teams. Many software companies lack specifying the role of team members and the chances of conflict among the team increase project risks. Software companies face significant challenges in testing methodologies, including cooperation, regression modelling, acceptance by users, improper communication and coordination, team interdependence, system integration, testing, and quality assurance. Deadlines, consistent specifications, and scope challenges led to reduced communication, collaboration, and cooperation between teams.

Ahmad et al. (2022) analyzed that failing to address requirement change management challenges leads to dissatisfied customers. The primary challenge of software companies is a lack of preparation for managing requirements and changes. Effective requirement change management requires overcoming challenges to meet the needs of company customers. Lack of quality becomes another challenge that has a negative impact on the quality requirement change management process. Lack of quality components may have an impact on the development stage of software as it prepares for customer satisfaction. To prevent quality challenges, software companies should develop a framework for managing quality.

Choi et al. (2022) found that despite the numerous benefits of technology in reducing financial risks, there are still specific challenges to overcome. One of them is data protection and privacy. When implementing new technology, firms must ensure that their data is appropriately protected and not utilized by unanticipated parties.

Hussain et al. (2016) state that software failures become a challenge in the competitive environment. Software projects fail mainly due to dissatisfaction with requirements. A software project should consider requirement engineering in the software development process. Poor requirements result in challenges for software projects and can ultimately lead to failure. A successful software project considers all changing requirements and satisfies incomplete requirements. The major cause of software failure was poor quality which overruns time and cost. Software companies should adequately define the requirements of users to survive competition and become successful.

Sundararajan et al. (2013) conducted a study on industry practices in software development risk management by taking one hundred and forty five software projects. Many projects run into extra costs and delays due to appropriateness. They found that project scope, technology solution, and estimates are considered to be the major components of the project plan. They developed a risk management profile by considering major risk factors. Majority of the software companies face resource allocation in time to a project as the greatest challenge. Software risk management practices in light of competition and resources steadily improve the success of the software projects. A project manager requires high competency to understand the overall requirements. Documentation in all stages is treated as best practice in all software companies.

Danesh and Ahmed (2012) observed that software release planning requires complex processes and great challenge to software companies. The project manager identifies and produces high-quality software with the help of a qualitative approach. Challenges of software release are classified into human-originated and system-originated. Real software defect identification is highly helpful for new software development. Innovation should be introduced to meet the requirements of the user. Software project monitoring can be done to foresee future uncertainties. Unclear objectives should be avoided for better software planning and development of software projects.

Clarke and Connor (2012) analyzed that software developments are quite large and distinct processes. There are situational factors that affect software development. Technological, business, operation, personal, requirement, and organizational factors create new challenges for software companies. Expert judgments are mainly used by the project manager to estimate the cost of software development. Presently there are no comprehensive frameworks affecting software development. Management of situational factors properly solves the problem of ineffectiveness in software standards.

Gholami (2012) highlighted that information technology projects are exposed to various risks. Project managers and team members may be unaware of new technology which requires continuous updation. Inexperienced teams are unable to complete the projects within the specified time. The environment of software companies had a significant role in the success of the software projects. The culture of software companies influences the decisions related to project development and their effective implementation. The project managers should continuously update the information to the team members for the success of information technology projects.

Annapoorna and Bagalkoti (2011) state that the information technology sector has developed but it faces competition from dominant software companies. Technological changes adversely affect the software companies for the development of information technology projects. Majority of the software companies spend more than 60% of their funds on developing technical skills. Wage inequality creates problems among team members, while a lack of technical knowledge and the inability to adapt contribute to the failure of information technology projects. Adequate training for employees can improve project performance and survive competition.

Islam (2011) highlights risk management activities in the requirements engineering phase, links project goals to risk factors, and examines the impact of risk management methods on software projects. This method provides a structured approach to analyzing challenges within a project. It advocates for a goal-driven approach to software development risk management, helping to justify the identification and handling of risks in software development projects. Concerning experienced project managers, the top three challenges related to software risk management are tangible development costs, a lack of resources, and organizational changes to mitigate risks. The study highlights multiple challenges that hinder risk management in development, including excessive risk, a focus on problem-solving rather than risk mitigation, and overreliance on individual measurements. Risk management constitutes the most challenging aspect of software risk management.

Marchewka (2010) states that managing IT project risk is the greatest challenge for software companies. The study developed a risk identification framework to understand project risk before implementation. Many of the software projects do not follow a formal risk management approach. Known risks and unknown risks should be assessed to analyze the software project. Internal and external risks are monitored to categorize the risks. Project success can be enhanced by minimizing the impact of negative events. Proactive risk management contributes to the success of the project.

The nature of the software project should be focused on by the project team and estimations should be made to adapt to changes.

Parent and Reich (2009) conducted a study on risk governing information technology projects. The study reveals that risk in information technology was due to internal and external factors. Risk can be managed by the software companies if they analyze these two factors and maintain stability in the environment. The majority of the challenges in software projects can be reduced. Good governance on the part of the project manager and management team necessitates the upcoming results generated from the development of projects. Software companies should take it as a challenge to remove all internal and external uncertainties. So, the information technology risk can be made under the control of the management.

Baccarini et al. (2004) evaluated that the major challenge for managers is identifying the risk involved in the implementation of information technology projects. The IT risk varies according to the project. The nature, severity, and consequences affect in numerous ways. Project success not only depends upon cost, time, and quality but also meets customer requirements. They identified twenty-seven risks in IT projects among them personnel shortfall and unrealistic schedules and budgets are the second highest-ranked risks. The project manager should be highly sensitive to these risks. Risks are shown with the help of the checklist method and they provide a wide range of strategies for effective project management.

Carmel (2002) examined that technology-enabled work increases the rise of software companies and at the same time it has certain opportunities and challenges. Global market attainment with sophisticated tools and techniques provides many opportunities but global operations lead to voluminous challenges and the study focused on the managerial challenges of software companies. Loss of control, coordination failures, communication poverty, lack of group cohesion, and cultural diversity are the major challenges identified.

Vaze (2002) reveals that software companies mainly concentrate on exports and they face challenges in generating adequate revenues. Software developments are done to capture international markets which involve high cost and competing success rates.

Long-term projects indicate high resource utilisation and this may decrease profit. Another challenge they had was stiff competition from rivals and a shortage of experienced personnel.

Jiang and Klein (2001) determined that the challenge of project managers was to identify different types of risk and focus on them. The extent of focus required for each risk varied in the project. The majority of software projects were unmet user requirements and schedules. They identified three risks that are most common in IT projects are project size, application complexity, and technology acquisition. Risk response planning should be made by the project manager to mitigate these risks. To achieve higher project performance project manager should focus on risk that leads to project failure and expertise the team to meet user's requirements.

Major et al. (1998) observed that selecting the right tools and techniques becomes a key challenge to run out strategic decisions for future profit. Application of software competency largely creates an impact on project and market success. Satisfying customers and enhancement of software capabilities are also required to break through the challenge and ensure success in the market.

Nidumolu (1995) identified that the coordination challenges are classified into vertical and horizontal to analyze the effect on project performance. The high level of vertical and horizontal coordination increases the uncertainty of the project. There are projects with limited time and resources. These projects had many challenges in the aspects of management to carry out the project successfully. Project team members are largely involved in the creation of major issues in the coordination of projects from different views.

Littlewood and Strigini (1992) found that software safety limits risk assessments before the implementation of the project. Lack of software reliability critically affects the operations. Software companies fear to explicit their information due to competition and complexities in the software development process. Software protection becomes essential to reduce failures in the project. The study suggests that every software company should be careful while dealing with their strategic information. It may damage the critical software systems and harm the competition survival of the software companies.

2.8 Financial Risk Mitigation Strategies of Software Companies

Table 2.13 summarizes studies regarding the financial risk mitigation strategies of software companies.

Table 2.13

Literature on Financial Risk Mitigation Strategies of Software Companies

Sl. No.	Title	Journal /Conference/ Thesis	Year
1	Artificial Intelligence and Ten Societal Megatrends: An Exploratory Study Using GPT-3	Systems	2023
2	Financial Management Strategies to Improve Business Performance.	Journal of Contemporary Administration and Management	2023
3	Effective Risk Management Strategies for Information Technology Project Managers	Thesis	2020
4	Measuring Risks in Software Development Projects	Thesis	2019
5	Strategic Risks in the Implementation of Information Technology Projects	Academy of Strategic Management Journal	2019
6	Recent Trends of Risk Management in Software Development: An analysis	International Scientific Journal of Contemporary Research in Engineering Science and Management	2017
7	The Influence of Software Risk Management on Software Project Success	Thesis	2017
8	Effect of Risk Management Strategies on Project Performance of Small and Medium Information Communication Technology Enterprises in Nairobi, Kenya	International Journal of Economics, Commerce and Management	2017

Sl. No.	Title	Journal /Conference/ Thesis	Year
9	Software Risk Management: Using the Automated Tools	Emerging Trends in Information System,	2016
10	An Investigation of Risk Management Strategies in Projects	Marketing and Branding Research	2015
11	Identifying Causality Relation between Software Projects Risk Factors	Journal of Software Engineering and Applications	2014
12	Risk Management in Software Projects.	International Journal of Computer Science and Mobile Computing	2014
13	A Simulation Model for Strategic Management Process of Software Projects	Journal of Systems and Software	2013
14	Reducing Failures in Software Development Projects: Effectiveness of risk Mitigation Strategies	Journal of Risk Research	2012
15	Information Technology Project Risk Management: Bridging the Gap between Research and Practice	Journal of Information Technology	2012
16	Risk Response Strategies for Supporting Practitioner's Decision making in Software Projects	Procedia Technology	2012
17	Software Risk Management and Avoidance Strategy	International Conference on Machine Learning and Computing	2011
18	Risk Management Procedures, Methods and Experiences	International Journal for Research Technology	2010
19	IT Project Risk Factors: The Project Management Professional Perspective	Journal of Computer Information System	2007
20	Risk Management and Problem Resolution Strategies for IT Projects: Prescription and Practice	Project Management Journal	2006
21	How Software Project Risk Affects Project Performance: An Investigation of the Dimensions of Risk and an Exploratory Model	Decision Science	2004

Sl. No.	Title	Journal /Conference/ Thesis	Year
22	Strategies for Successful Software Development Risk Management.	Journal of Contemporary Management Issues	2003
23	IT Project Implementation Strategies for Effective Changes: A critical Review	Logistics Information Management	2002
24	Strategies for Heading off is Project Failure	Information System Management	2000
25	Improving Risk Management: Moving from Risk Elimination to Risk Avoidance	Information and Software Technology	1999

A brief explanation of the reviews are written below,

Haluza and Jungwith (2023) state that software companies should have a better knowledge of their risk exposure and take timely action. Using technology to control financial risk enables firms to adopt a proactive risk management strategy. With more precise and real-time data, companies may detect possible hazards earlier, establish suitable mitigation plans, and take preventive measures before these risks occur.

Salamah (2023) found that financial management strategy may help companies evaluate and allocate resources effectively, manage risks, and make the appropriate decisions in generating financial opportunities. The company has to improve operational risk management, diversify its investments, and pay attention to data and information security. Companies can enhance their performance by implementing suitable financial risk management strategies into operation. Appropriate and sustainable decision-making can help companies maintain their credibility while also promoting future development. In the face of increasing challenges and possibilities, companies have to evolve and implement new financial risk management strategies.

Sarr (2020) revealed that ineffective risk management strategies lead to the failure of many IT projects in the telecommunications business. IT project managers prioritize effective risk management strategies to increase project success rates. The qualitative case study, based on actor-network theory, examines strategies for risk management employed by IT project managers in the telecommunications industry to improve project success rates. The actor-network theory can help IT project managers develop social relationships and increase trust among team members and customers. IT project managers can use actor-network theory to effectively resolve conflicts and acquire control. Enhancing the success rates of IT projects in the telecom sector may contribute to improving the quality of life.

Menezes Junior (2019) finds that projects are inherently risky. Effective risk management is crucial for successful project execution and performance. Unsuccessful or underperforming projects are detrimental to project-based companies, resulting in losses and negative impacts at all stages implement risk management processes and strategies in software development projects. Proper risk identification assisted in determining essential resources for risk mitigation. Factor analysis helps project leaders identify and minimise risks, particularly for high-risk projects. The application of different strategies reduces the negative impact of the project on performance. When a project has a high PRI value compared to others, it indicates the need for action measures to mitigate risk factors.

Yulia and Svitlana (2019) studied strategic modelling in the risk management of information technology projects, considering periodic risk control and rapid response using constant communication between project stakeholders, analysing information, and accumulating knowledge about risk. The risk management process requires obtaining and using up-to-date information about events and actively using knowledge. The high degree of complexity in software projects hinders the time and budget schedule for the completion of information technology projects.

El-Ahmad and Arafeh (2017) reveal that software risk management had a positive influence on meeting project success. They also opined that the risk increases the budget and time largely affects the quality of the project or sometimes leads to failure. Risk management was considered as a tool to increase the probability of success and if it was misused it may lead to failure of the project. They suggest software companies undertake risk management processes in every project rather than its size.

Bhujang and Suma (2017) in their article 'Recent Trends of Risk Management in Software Development' highlighted that the management of risk becomes a complex process but necessary to analyze risk mitigation strategies and techniques to classify risk parameters. According to them, there are no standard methods to be applied in all projects. Different strategies are used for various information technology projects according to their size. Risk assessment should be made at every stage to detect risk at their early stage and to manage these risks for proper development of software according to the customer requirements.

Kiarie et al. (2017) in their study established that risk management strategies are positively related and affect the performance of projects and their success. They employed a multiple regression model to examine the impact of risk management strategies on the performance of projects in Nairobi and Kenya. Risk assessment paved the way for adopting risk avoidance strategies for the successful completion of the project. The adoption of the checklist, risk controls, and risk screening reduced losses in the projects and improved the quality. Successful project management involves realistic risk control, risk assessment, risk mitigation, and information sharing, resulting in timely software development. Assessing project risks improves communication, reduces risks, and generates informed reports for successful software projects. Companies prioritize risk management to reduce project losses, register risks to improve the success of projects and improve project quality. Improving awareness of risks, beneficial risk management planning, and effective risk detection can minimize project delays and costs.

Avdoshni and Pesotskaya (2016) observed that software risk management faced many challenges in creating high-quality software. Risks are assessed in two dimensions: probability and impact. Risk scores provide priority in risk. Project team members should document risk to analyze root causes for mitigating the risk. Web-based risk management tools provide a wide range of software solutions. Automated tools do not always guarantee success but help project manager for effective project management. The use of automated tools boosts the confidence of project managers and team members, helping them achieve their targets through the practical implementation of software projects. This reduces issues such as going over budget, falling behind schedule, and unreliability. Effectively managing risks within a reasonable time frame ensures the success of the project.

Azadi (2015) analysed that the project manager accepts the responsibility for general project risks and the chief officer accepts the responsibility of responding to strategic risks. Risk acceptance is an approach used to manage project risks that cannot be eliminated. Reduction can be accomplished in a variety of ways, such as by replacing high-risk methods or tools with more secure alternatives, providing workers with specialized training, enforcing strict insurance requirements for personnel and equipment, and organizing preventative measures. Risk avoidance involves adjusting the project management plan to eliminate the potential for conflicting risks, isolating critical project activities from the impact of risks, or reducing high-risk activities by extending timelines or minimizing project scope. Risk transfer often involves paying insurance premiums to third parties. Dynamic and ongoing transfer methods include insurance premiums, guarantees, and commitments.

Hijazi et al. (2014) highlight that software development involves several risk factors and creates uncertainty for the success of software companies. Risk factors negatively affect and serious threats to produce expected results. Software risk factors impact time, budget, and quality. The study found that these risk factors have cause-and-effect relationships and developed a cause-and-effect diagram to illustrate them. Project managers should prioritize the risk according to the dangerous level. More number of strategies should be used to mitigate complex risk factors. Risk factors may change according to the requirements of the customer but there is a common risk factor that affects the entire process of software companies. Efficient use of mitigation strategies can manage the cost, time, effort, and quality of software projects.

Nidhi et al. (2014), in their article, 'Risk Management in Software Projects' revealed that risk management is highly essential to deal with project failures. The majority of the projects failed to deliver on schedule and budget. Risk can be minimized by adopting different risk management approaches. Prioritizing each risk based on its impact will help for developing strategies to overcome the failure of information technology projects.

Uzaffer (2013) mentioned that software development projects are presented with a simulation model for the strategic management process. The model provides a framework for risk management with the help of cost estimation and project management planning. The model determines the schedule and budget required for the information technology projects. The simulation model gives solutions for project managers and software companies at different phases. The study suggests that different strategic management decisions estimate different sets of risks with various cost requirements. The developed framework helps identify the strategic decisions for the development and management of software projects.

Abdul Rahman et al. (2012) found that majority of the project fails due to size and impact of threat estimation. Contingency approach can be followed by the software companies to manage project risks. The project managers should identify the risk and adopt strategies for effective implementation of information technology projects. The projects should be designed by analysing each constraint in the perspective of contingency. Risk management results project success by overcoming the time and budget inefficiencies. They categorised risk factors into project management risk, relationship risk, solution ambiguity risk and environment risk. They evaluated key dimensions of risk management and developed risk spider chart to improve project outcomes.

Lopez and Salmeron (2012) determined that risk management in information technology project creates unexpected results to software companies. Inefficient project managers are unable to manage risk. Difficulty in software projects can be minimised with the help of risk response strategies. Expert judgements regarding the probability of occurrence of risk are considered as best strategies to mitigate and manage risk. Checklist of risk factors determines risk score and helps the project manager to adopt a root cause strategy. Risk assessment and control are suitable strategies for software companies to evaluate the risk.

Taylor et al. (2012) revealed that the success of software project depends on software plan. Risk management technique helps to careful allocation of resources and avoids time and cost overruns. A good project management works out plan and control the constraints. Project manager should identify the critical success factor and specifies the activity that need more control to mitigate the risk. Successful software companies result in project effectiveness through monitoring the project performance. New software development project mainly depends on expert opinion. Failures of software projects can be reduced by applying adequate risk mitigation strategies. A good software risk management strategies always predict the risk and reduce the occurrence of the risk.

Mathkour et al. (2011) highlight that software projects require effective resource management. Risk factors can negatively impact software quality, lead to cost overruns, and cause delays in project completion. Project managers must identify potential risks and assess their consequences and impact. Software companies implement risk mitigation strategies based on their awareness of risks and their level of risk maturity. Changing project objectives and avoiding the occurrence of risks are also key strategies. Poor planning, however, makes it difficult to address risk factors effectively. A well-structured risk management plan helps reduce the impact of risks on information technology projects.

Berg (2010) conducted a study to analyse risk management, procedures, methods, and experiences. Risk management involves identifying, assessing, and developing strategies to control and mitigate risks using available management resources. Typically, financial risk management focuses on financial-related concerns. Risk management aims to address risks within a pre-selected domain. It is important to understand that the concept of risk is dynamic and requires regular formal reviews. The study recommended that risk management practices be implemented in all types of small and medium enterprises.

Tesch et al. (2009) state that project management identifies and analyses the project risk. Information technology project risk factors affect the successful implementation of projects. Time was considered a critical factor for identifying and monitoring the risk. The project management professionals identified ninety-two risk factors. They suggested avoidance strategies to reduce the impact of risks. A successful risk assessment relies on the accuracy of the information provided to the risk management process, as it plays a crucial role in guiding and supporting informed decision-making.

Taylor (2006) suggests that the project strategy should be implemented for each identified risk individually. In this study, respondents classified their risk management and problem-solving strategies into four categories: control, negotiation, research, and monitoring. These strategies were applied universally across all projects, irrespective of the specific risks identified. This approach to risk management for IT projects organizes potential risks into four main categories and suggests the most suitable strategy for each. The control strategy addresses the majority of risks associated with project management. Negotiation strategies effectively address the majority of risks in the relationship with customers and team members. Risks associated with technology and solutions can be addressed by research strategy, but residual risks require a monitoring strategy.

Wallace et al. (2004) suggest that project managers should identify risk factors and control them to reduce the failure of software projects. The study highlighted six dimensions of software project risk. Technical risk affects requirement satisfaction and enhances uncertainty. The study provided more emphasis on internal risk in software development projects. Monitoring the risk level in different dimensions helps to understand the changes in risk profile of software projects. Mitigation strategies reduce the severity of impact and increase the probability of success of project performance and reduce the potential loss in information technology projects.

Boban et al. (2003) determined that software development projects produce successful software systems with advanced technology and a high level of knowledge. Completion of project within the time cannot be achieved without any risk. Risk should be managed by adopting risk management strategies organisational experience and quality of project. The success of a software project depends on addressing the risk at the initial stage. Flexible risk management strategy can be adopted in matured organisation where there are low levels of risk influence. Risk management are mostly practiced on the team together with the support of project manager. Constant planning and project supervisor helps to reduce cost. Contingency strategies should be developed to meet uncertainty. Careful risk management are presented using Unified Modelling Language and Activity Diagram for successful software development risk management strategies.

Kuruppuarachchi et al. (2002) explored that effective management of information technology projects reduces the project risk. Project success depends on customer satisfaction and it becomes major challenge for software companies. Change adoption in IT project brings innovation in project management. A pragmatic approach in IT project helps to carry out the business properly. IT project fail because of poor communication between technical experts and project manager. Adoption of new technology makes changes in IT projects in pre-implementation and post implementation strategies.

Cule et al. (2001), in their study, revealed that investment in information technology projects of software companies are considered to be high risky and require well understanding of intellectual concepts. The investor should identify the classes of risk and mitigation strategies before making investment. Vast number of projects in software companies fails due to inefficient strategies. Development of software projects involves number of stages with huge investment and high level of risk. The risk factors should be compared with earlier developed projects to know the common risk in all projects. The failure of software projects can be minimised by adapting appropriate strategies according to the nature and size of software projects.

Adler et al. (1999) state that software development projects use the popular risk management models on risk avoidance techniques. Corrective risk management plan prevents repetitive risk in software development model. They prepared top ten risk identification checklist to identify the risk that affect cost, schedule and quality. All models recommend risk assessment at early stage as avoidance strategy. Clean room inspection eliminates software defects. The IT risk differs across different types of projects in software companies. They recommended risk management strategies need to be framed on specific project to avoid the risk.

2.9 Research Gap

The literature review of the present study consists of six heads, the first head discussed financial risk factors, the second category provided financial risk management techniques, the third head dealt with the impact of financial risk management techniques in information technology projects, a fourth category of the study detailed about effectiveness of software companies based on financial risk management techniques and financial risk mitigation strategies, fifth head mentioned about challenges faced by software companies and final head conferred with the financial risk mitigation strategies of software companies. The researcher conducted comprehensive database searches at various stages of the literature review process, specifically concentrating on the area of financial risk management in IT projects. By systematically analyzing the existing body of literature, the researcher identified certain research gaps that the current study aimed to explore. The identified research gaps are:

1. Existing research has primarily focused on evaluating financial risk management in IT projects. The current study focuses on financial risk management in information technology projects of software companies in Kerala. More precisely, this study looks at the experiences and perspectives of project managers, who play a critical role in the success of IT projects. These managers are directly involved in key aspects of project execution, including the identification, planning, monitoring, and controlling phases, and their insights are invaluable in understanding how financial risks are identified, assessed, and mitigated throughout the project lifecycle.

2. Despite a great number of research on financial risk management in IT projects around the world. There is no convincing research that explores financial risk management in IT projects from the distinct perspective of Kerala's software industry. To address this gap, the present study places a particular emphasis on examining the financial risk management in IT projects of software companies in Kerala.

3. Most of the research focuses on critical success factors for software companies. Unlike previous studies, which have primarily concentrated on general success factors, this research specifically investigates how various financial risk factors play a crucial role in determining project success. In particular, the study examines six major financial risk factors that are central to the successful management of IT projects: technology, requirements, organization, resources, scope, and design**.**

4. Previous research on financial risk management techniques has largely focused on the identification and analysis of financial risks, with considerable attention given to methods for recognizing potential risks. However, the researcher identified a significant gap in the literature, while financial risk identification and analysis are well-documented, there is limited research on the practical application of financial risk planning, monitoring, and controlling techniques. These are crucial stages in the risk management process, as they involve not only recognizing and understanding risks but also actively managing and mitigating them throughout the project's execution. To gain a deeper understanding of financial risk management, the researcher employed four techniques.

5. Most of the existing studies have primarily investigated the impact of financial risk on software companies, typically exploring how financial risk affects project outcomes, cost overruns, and overall business performance. However, this study takes a distinct approach by focusing on the role of financial risk management techniques in driving the success of IT projects. Rather than merely examining the consequences of financial risks, this research aims to assess how specific techniques used for managing financial risks can contribute to achieving project objectives, ensuring timely delivery, staying within budget, and ultimately improving the likelihood of project success.

6. Numerous studies have previously evaluated the effectiveness of software companies by exclusively focusing on financial risk management techniques. In response to this gap in the literature, the researcher chose to examine the effectiveness of software companies by specifically exploring both the usage of financial risk management techniques and financial risk mitigation strategies to

mitigate financial risks. This dual focus enabled the researcher to gain a better understanding of how software companies manage financial risk, reduce potential losses, and maintain their financial well-being, simultaneously contributing to a deeper knowledge of the variables that influence their overall effectiveness.

7. Previous research has primarily focused on challenges faced by software companies. Despite recognizing the existence of these challenges, there has been a notable gap in the literature when it comes to research that provides actionable recommendations or frameworks that software companies can use to address and mitigate these difficulties effectively. In light of this gap, the current research takes a more solution-oriented approach. Rather than just documenting the challenges, this study aims to provide concrete guidance and strategies to help software companies overcome these challenges.

8. Several studies have explored various aspects of financial risk management strategies employed by software companies. Many of these studies primarily concentrate on the application of risk mitigation strategies that are specifically designed to reduce the negative impact of financial risks on project outcomes. Consequently, the researcher identified a gap in the literature concerning financial risk mitigation strategies. This gap encouraged the researcher to concentrate on studying how software companies can employ financial risk mitigation strategies to reduce risks while also improving the overall success rate of IT projects.

9. Previous research has primarily focused on financial risk management in IT projects, investigating various strategies and techniques related to identifying, analyzing, and reducing financial risks in the context of large IT projects. The software companies in Kerala handle financial risk management, necessitating the development of a model. The previous studies lack an adequate model for financial risk management which could assist software companies in Kerala to enhance their financial risk management techniques and financial risk mitigation strategies for increasing the success of the IT projects.

10. Software companies in Kerala face numerous financial risks and managing these financial risks becomes the major task of the project manager. By investigating

the effect of financial risk on information technology project outcomes and software companies as a whole, it is recognized that the study on financial risk management in information technology projects of software companies in Kerala becomes necessary in the view of the researcher.

2.10 Conclusion

In this chapter, a detailed literature review regarding financial risk management in information technology projects conducted by various researchers is discussed. In the beginning, 173 studies were identified, which were sorted into 137 studies directly relevant to the topic. A total of 130 articles and seven theses were cited from various databases. Through these reviews, it is clear that financial risks are the major problem of software companies. Development and implementation of information technology projects are largely affected by these risks. Many factors influenced the successful implementation of information technology projects and some of the factors are selected for research. Software companies are widely used financial risk management techniques to control the risk. Among them, financial risk planning, financial risk identification, financial risk analysis, and financial risk monitoring and controlling techniques are extensively used. Financial risk also had negative and positive impacts on software projects and their effectiveness in performance. It is known that there are many challenges for software companies and the most influential challenges are considered in the research. Software companies followed strategies to mitigate financial risks. So, the proposed study tries to give an idea to control financial risk for the successful implementation of information technology projects.

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Chapter Three

FINANCIAL RISK MANAGEMENT AND SOFTWARE INDUSTRY: AN OVERVIEW

3.1 Introduction

In the knowledge-based economy, software becomes the foundation of competition. The risks posed to software companies in creating information technology projects have become more challenging. Risks with a high impact and likelihood are regarded as high priorities and need immediate action. Among other risks, financial risk plays an important role in the success or failure of software companies. Financial risk management applies specific knowledge systematically to make decisions in unique situations that help prevent the project from failure. Software companies must implement a proactive action plan, regularly execute the risk management process, and establish contingencies for both known and unforeseen risks.

Every information technology project has some element of originality in the needs, technology, project environment, and resources to be exploited. Financial risk factors heavily influence the success of information technology projects. Many financial risk management techniques assist software firms in managing risk. Financial risks that are not adequately managed can have an impact on software companies' profitability and growth. Effective financial risk management improves the success rate of information technology projects and creates chances for new opportunities. Financial risk management doesn't always entail avoiding projects with high financial risks. In today's software market, taking on high-risk projects is often essential for achieving greater rewards. Many of the most significant software project failures stem from risks that were either unrecognised or overlooked until they led to serious consequences.

Effective software risk management is fundamental to ensure that software projects are delivered effectively, within budget, and on time. Software teams can avoid possible challenges by proactively detecting them, assessing their impact, and adopting appropriate mitigation strategies. Continuous monitoring and enhancement of risk management techniques help to keep the focus on producing high-quality, reliable software, improving the chances of project success. Kerala has emerged as a major IT cluster in India, with an increasing number of both huge global IT companies and creative new start-ups. Kerala has established itself as a prominent player in India's IT sector mainly consisting of robust infrastructure, competent human capital, beneficial government initiatives, and an emphasis on innovation. The state's IT industry is predicted to continue growing and contributing to the overall economy, creating jobs, driving the evolution of technology, and encouraging entrepreneurs.

3.2 Introduction to Software Industry

The software industry is vibrant and constantly developing. Changes in the sector are fuelled by new technologies that disrupt conventional wisdom. The concept of software dates back more than 150 years, yet the first modern computers and computer programs were developed in the 1950s. The software industry has seen numerous ups and downs, including not only innovations and achievements but also some dead ends. To understand where the software industry is today and how it got there, it is useful to look at its history. The history of the software industry is entwined with that of the computer hardware sector. Given the interdependence of computer hardware and software, this should come as no surprise. However, it may surprise you that the first software program existed before the first computer was constructed, and the first programmer was a woman in the 1950s.

3.2.1 The Origin of the Software Industry

In 1964, IBM released the IBM System 360 series of computers, which was a watershed moment in the early history of the software business. The models of this family shared a similar architecture. Families of computers are relatively common today, although the concept was revolutionary in the 1960s. The IBM System 360 was the largest R&D project ever undertaken by a non-governmental organization. The IBM S/360 was notable because its architecture allowed for both upward and downward compatibility within the 360 computer family of computers. This means that the program could run on multiple models in the family because they all had the same architecture.

A book called The Mythical Man Month, published by Frederick P. Brooks, who oversaw the effort to develop the operating system software for the IBM 360 computer (the OS 360), established an early software development standard. The OS 360 project involved over 1000 programmers; the system was delivered years late, millions of dollars over budget, and was never defect-free. In the late 1960s, the danger of antitrust charges from the United States government prompted IBM to unbundle its systems software from its hardware, and the first piece of software marketed by IBM was its transaction processing system, Customer Information Control System (CICS), in 1968.

The unbundling of computer hardware and software is critical to the software industry because it created a market for other software businesses to compete with IBM and led to the creation of software contractors and service providers. This market spawned the early software industry. By 1965, there were over 50 big companies offering software and programming services, as well as several minor businesses.

3.2.2 Evolution of the Software Industry in the Era of the Internet (1995 to Today)

Several trends affected the software industry in the mid-1990s and thereafter. During this time, the software industry witnessed a major increase in enterprise resource planning (ERP) systems. ERP systems connected mainly independent applications (e.g., order management, inventory management, accounting, and human resource management) via a single interface. ERP systems, regardless of size, were sold off-the-shelf, but they frequently required extensive customization, training, and other services to function properly.

Other movements in the software industry were driven by the Internet, a ground-breaking new technology. In the early 1990s, businesses were busy connecting PCs to large networks. Most of these networks were internal. However, a huge disruptor to the software business is about to emerge: the Internet. The Internet originated in the late 1960s when the United States Department of Defence indicated a wish to connect computers at various universities and research organizations to its systems.

The Internet had a significant impact on the software business, and the ripple effects may still be felt today. First, the Internet has spawned the creation of new types of software applications. The first commercial Web browser software, Netscape Navigator, was introduced in 1994 as a free download, and within a year, Netscape had 80% of the browser market. Other firms, many of which were start-ups, entered the software sector during the dot.com boom of the mid-to-late 1990s, developing and marketing software for Internet chores such as e-mail management, exploring new sites, and producing web pages.

Microsoft, of course, responded, and in 1995, the company released its browser Internet Explorer, which was distributed online and free with other Microsoft products. Although the Internet has created new opportunities, it has also created new challenges by allowing outsiders to gain access to businesses. Finally, the Internet has dramatically influenced how software is delivered to customers. During this time, the software services industry expanded fast as businesses required computer applications and systems to improve internal efficiencies and conduct business over the Internet.

Information technology remains a high-growth industry in India. The industry accounts for over 10% of GDP and has a CAGR of 8%. It employs approximately 4.4 million people.

India's IT-BPM sector accounts for around 55% of the worldwide market, with over 1000 global delivery centres built in 80+ countries. The IT sector is predicted to flourish further as the world adapts to the pandemic's restrictions on movement. According to research, the Indian IT sector is projected to reach USD 350 billion by 2025, up from USD 191 billion in 2019-20. This makes it one of the fastest-growing sectors in the country.

3.2.3 Major Companies in the Software Industry

The top 30 software suppliers in the world, based on global software revenues and market share. Some companies, including IBM, Hewlett-Packard (HP), and EMC, supply both hardware and software. The top 30 software companies generate about 60% of worldwide software sales income. These companies create software that represents the various market segments, including applications such as enterprise resource planning, accounting, desktop publishing, games, and healthcare applications, as well as systems software such as network software, security software, operating systems, and data management and storage systems. The software business was mostly dominated by US companies. Microsoft alone accounts for 17% of worldwide software revenues. Twenty-three of the top 30 companies are situated in the United States, accounting for more than half of global software revenues. Microsoft, Oracle, Symantec, CA Technologies, and Adobe are the top five U.S.-based software suppliers.

3.2.4 Information Technology in Kerala

Information technology is crucial not only for the progress of modern enterprises but also for the overall development of the state. Since the Ninth Five-Year Plan, the information and communication technology (ICT) industry has been pivotal in the state's growth. Acknowledging its potential and significance, the State Government has made dedicated efforts to establish robust, world-class infrastructure for the industry, while expanding the state’s digital technology capabilities and resources. As a result, the state has emerged as a leader in implementing ICT projects, e-governance initiatives, e-literacy programs, and developing essential IT infrastructure.

Currently, the state boasts the highest mobile penetration in the country, with around 32 million connections, and leads in internet penetration, reaching approximately 20% of households through broadband and another 15% via mobile. It is making notable strides toward transforming into a knowledge-driven economy. Kerala is a key IT hub in India, ranking eighth in exports among Software Technology Parks of India (STPI)-

registered IT and ITES (Information Technology Enabled Services) companies. Additionally, Kerala is swiftly emerging as a major player in India's digital economy.

The information technology sector has experienced steady growth over the past decade, with new opportunities emerging in the application of IT in everyday life. From the rise of artificial intelligence and self-driving cars to the widespread disruption caused by internet-based business models, the IT sector has transformed every aspect of the economy. To maintain its competitiveness as an IT hub, Kerala’s IT sector must significantly enhance its contribution to the state’s economy. This requires fostering investment in emerging areas of the IT sector, rather than relying primarily on established IT/ITES activities. Kerala must adapt to the evolving trends and increasing challenges in the global IT landscape, just as the Indian IT sector as a whole does. At the same time, the significant progress in digital empowerment and the growing IT awareness among the population should be further developed, with continued investment in suitable infrastructure that will meet the state’s needs over the long term, ensuring it does not face early obsolescence.

The Kerala government recognizes the pivotal role of ICT in driving the state's equitable development. To reinforce its commitment to the sector, the government revised the state’s information technology policy in 2017. The policy’s vision is to position Kerala as a knowledge-powered digital society by 2020, leveraging digital technologies across areas such as digital citizenship, digital lifestyle, and digital commerce. This vision is guided by the principles of freedom, ubiquity, inclusion, transparency, and safety, with a focus on aligning with emerging technology trends, addressing citizen and industry needs, and empowering citizens socially and economically. Kerala boasts a strong infrastructure and skilled human resources to support digital services. To advance further, the state must attract significant investment in the IT sector and foster innovation by supporting new entrepreneurs and start-ups.

The major agencies involved in the implementation and promotion of information technology are the Kerala State Information Technology Mission (KSITM), Indian Institute for Information Technology and Management - Kerala (IIITM-K), Technopark, Info Park, Cyberpark, Kerala State Information Technology Infrastructure Ltd. (KSITIL), International Centre for Free and Open Source Software (ICFOSS), Kerala Start-up Mission (KSUM), and Centre for Development of Imaging Technology (C-DIT).The State Government intends to expand the IT industry in the State in a way that benefits all of its districts. The hub and spoke model has been planned. Thiruvananthapuram (Techno Park), Kochi (Info Park), and Kozhikode (Cyber Park) would function as hubs, with the rest districts serving as spokes. (Economic Review 2017, State Planning Board).

Despite having the potential for growth in the IT industry, Kerala's performance falls behind neighbouring states such as Karnataka, Tamil Nadu, and Telangana. Kerala has an IT service export worth approximately Rs 25,000 crore and employs almost 150,000 people. Although accounting for only 3% of the entire workforce, IT specialists from Kerala make up nearly 15% of the IT industry's human resources, with many working in major IT hubs such as Bangalore, Hyderabad, and NCR.

3.2.5 Growth of the IT Sector in Kerala

Information technology (IT) is the world's fastest-expanding economic sector. The IT industry is an excellent choice for Kerala due to its ability to create jobs while minimizing impact on land, environment, and resources. This industry prioritizes both people and the environment. The Kerala government recognizes the importance of the IT sector in the state's economic development and aims to establish a strong production base through policy initiatives. Kerala views information technology not only as a tool for better government and job creation but also as a way to improve people's living standards. Implementing IT in government services improves responsiveness and transparency, empowering citizens and fulfilling their right to information. The IT Department's targeted actions have resulted in significant success in the IT sector, including investments, infrastructure development, and job creation. Over the past year, the IT sector has made considerable progress by prioritizing quality infrastructure and workforce. Increased demand for software specialists and the domestic IT sector will lead to additional job opportunities. Kerala has a competitive advantage in the IT industry due to its strong proficiency in English workforce and infrastructure. Kerala IT has successfully implemented a hub-and-spoke architecture to provide IT benefits to all citizens. With nearly 3 million plug-and-play workspaces across a variety of formats, including government-owned IT parks, co-developers, and private parks. With over 600 IT companies, Kerala employs over 125000 people directly and exports IT worth 1.5 billion dollars annually.

3.2.6 Government Initiatives and Policies

The Kerala government has taken proactive steps to promote IT sector development in the state:

Kerala IT Policy: Kerala's IT Policy (announced in 2017) aims to promote innovation, digitization, and the growth of IT start-ups. The policy aims to attract global investment, create job opportunities, and promote digital transformation throughout industries.

Kerala Startup Mission (KSUM): The initiative launched by the government encourages entrepreneurship and innovation by offering financing, advising, and infrastructural assistance to IT companies.

Digital Kerala Initiative: The project seeks to implement digital transformation to government services, promote innovation, and increase the popularity of IT solutions in sectors such as healthcare, education, and governance.

The figure 3.1 depicts the details of completed projects and ongoing projects in Kerala.

Figure 3.1

Details of Completed and Ongoing Projects in Kerala

Source: Department of IT, Government of Kerala

3.3 Risk

The term "software risk management" can mean different things to different people; while defining risk, we must consider the qualitative, quantitative, and philosophical components of what makes risk. There are several definitions for risk. The definitions used in the research are as follows.

Risk is a combination of an abnormal event or failure and the consequence of that event or failure to a system's operators, users, or environment. A risk can range from catastrophic (loss of an entire system, loss of permanent disability) to negligible (no system damage or injury). (Glutch 1994)

Risk is a problem that could cause some loss or threaten the success of our project, but it hasn't happened yet. These potential problems might hurt the cost, schedule, or technical success of the project, the quality of our software products, or project team morale. Risk management is the process of identifying, addressing, and eliminating these potential problems before they can damage our project. (Wiegers 1998)

3.3.1 Financial Risk

Financial risks are those that occur as a result of failure to complete financial transactions. Companies are unable to satisfy their debt obligations due to excessive financial risk. Financial risk will rise as the amount of debt increases. Financial risks are present in every company's transactions, although their impact on attaining objectives varies. Understanding and implementing good financial risk management procedures reduces the burden of financial risk in software companies. Software companies have suffered significant losses as a result of the financial risks associated with information technology projects.

3.3.2 Financial Risk Management

Financial risk management provides transparency into the risk situation and the ability to control such losses by balancing the expected earnings of a company action against the risks associated with it. Overall, proactive financial risk management may provide a business with a competitive advantage. Thus, the design and implementation of an appropriate risk management system, as well as its continuous adjustment as external conditions or internal requirements change, is a critical strategic instrument for effectively identifying, measuring, and managing the firm's risk exposure. To achieve the goal of a company-wide consistent risk culture when handling financial risks, a risk management policy must be created and a financial risk management strategy implemented.

3.3.4 Risk Management Theories

The study has a strong base from many theories and some of the theories are largely influenced to make detailed understanding in many aspects. They are as follows;

(a) Financial Economics Theory

This theory applies economic theory to consider time, risk, cost, and information when making a decision. It aids in the development of model-based testing methods. It is regarded as a standard instrument for measuring and evaluating risk. Financial analysis investigates risk and devises strategies to mitigate it. Financial economics explains how software companies can make money from discoveries like software, patents, and other intellectual property. IT advances may involve considerable initial investments for research and development, and financial economics assists companies in evaluating the potential future cash flows from these innovations and managing the associated risks. Financial modelling is the process of developing precise, quantitative estimates of an IT project's finances. This typically involves projecting revenue, costs, cash flows, and returns over time. These models aid in determining the financial viability of an IT project and guiding decision-making processes such as obtaining funds, assigning resources, and evaluating the project's long-term profitability.

(b) Contingency Theory

According to contingency theory, there is no single ideal strategy to handle every situation. Because uncertainty is inherent in all processes, it is impossible to rely on particular assumptions at all times. Management should identify situational aspects before making judgments. The management may make different decisions based on the changes in the environment. The application of contingency theory plays an essential role in the IT sector since the technology market is continually changing and firms confront varied challenges based on their objectives, finances, and the surrounding conditions. It emphasizes that the most productive organizational strategies, leadership styles, and management practices will differ depending on internal and external factors such as technology, team structure, project requirements, and the nature of competition. By being adaptive and reactive to these factors, IT companies can improve their performance and remain competitive in a constantly changing sector.

(c) Diffusion of Innovation Theory

The theory outlines how advances in technology will be presented and implemented to compete with rivals. Innovations lead to improved decisions that contribute to the organization's success. Adopting the latest technologies significantly reduces the chance of risk. The IT sector describes how new technology, ideas, or innovations explode and become accepted by various groups of people, companies, and markets. The DOI theory, developed by Everett Rogers in 1962, describes how innovations are communicated over time through numerous routes to members of a social group. A variety of factors drive innovation adoption, and understanding this process is crucial for successfully introducing new technologies in the IT sector. The DOI theory assists IT companies in understanding the adoption process of emerging technologies such as cloud computing, artificial intelligence (AI), machine learning, and blockchain. IT companies may modify their marketing and support strategies for different groups of adopters by understanding their unique features.

3.4 Software Companies and Information Technology Projects

Information technology projects are defined as projects that involve the purchase or creation of software (including purchases, licenses, and subscriptions. It also means information technology hardware, or both, including upgrades from one major version to another, as well as a variety of associated activities and services.

3.4.1 Classification of Software Companies

The software companies are categorised as small, medium and large based on paid-up capital is presented in Table 3.1.

Table 3.1

Classification of Software Companies

Paid up Capital	Type of Software Company
Below 20 lakh	Small
Between 20 lakh and 50 lakh	Medium
Above 50 lakh	Large

Source: Kerala State IT Mission

3.4.2 Classification of IT Projects

IT projects can be classified into various categories. This study uses the following classification of projects.

(a) Based on size

The projects are classified into small, medium, and large based on the size of the project. This may vary according to the type of project dealt with by software companies. The study considers the following projects.

(i) Small-sized Projects

A project is considered small-sized if the estimated duration in weeks is below 12 weeks and the estimated total project hours are below 500 – 1000 hours.

(ii) Medium-sized Projects

A project is classified as medium-sized if its estimated duration falls between 12 and 26 weeks, and the total estimated project hours range from 500 to 1,000 hours.

(iii) Large-sized Projects

A project is considered large-sized if its estimated duration exceeds 26 weeks and the total estimated project hours exceed 1,000 hours.

(b) Based on complexity

The projects are classified as simple, moderate, and high complexity based on various factors affecting the development and implementation of projects. The study considers the following projects,

(i) Simple Projects

Projects with minimal complexity frequently necessitate fewer resources and shorter schedules. Placing a new printer in an office, configuring a local network, or upgrading an outdated software package.

(ii) Moderately Complex Projects

Projects that are more complicated yet achievable, with well-defined objectives and the latest technologies. Migrating a small firm to the cloud, integrating third-party software into current systems, or redesigning a basic website.

(iii) Highly Complex Projects

A large-scale high-risk project with many stakeholders, sophisticated technology, and complicated interconnections. Creating a new company software system, large-scale data migration projects, complete digital restructuring, or constructing a new IT infrastructure from the beginning.

3.4.3 Types of Projects Executed in Software Companies

The research covers the following projects executed in software companies in Kerala.

(i) Infrastructure Projects –

These included IT projects focused on setting up new infrastructure, such as data centre setup, data centre relocation, server construction, operating system upgrades, service creation, server decommissioning, backup facility setup, monitoring application setup, decommissioning of entire data centres, cloud computing projects, tool installations, and service and process improvement initiatives. Infrastructure projects require the involvement of multiple technical teams, such as operating system teams, database teams, network teams, storage teams, software teams, monitoring teams, operational teams, service management teams and so on.

(ii) Transition Projects

These covered projects arising from the transfer of an account from one company to another, typically occurring when an IT contract is awarded to a different software company. In such cases, the entire IT infrastructure, knowledge, practices, and processes must be transferred to the new organization. These were process-driven projects, characterized by strict deadlines and budgets for transitioning project delivery to the new team. The projects involved both technical and process-oriented knowledge transfer to the newly established team

(iii) Application Development Projects

These included application development projects, where new applications were developed and tested according to customer specifications. The applications were created using the development environment and thoroughly tested in a dedicated test environment. Once the applications successfully passed testing, the environment was made operational, and the application was integrated into the company's production system.

(iv) System Deployment Projects

This comprises installing, configuring, and deploying the software provided by the seller. So, the project manager should review the project's scope, deliverables, and budget. A successful system deployment can increase user and business effectiveness productivity, and satisfaction while reducing the risks, costs, and disruptions associated with change. However, system deployment can be complex and difficult, necessitating meticulous preparation and successful implementation.

(v) Application Maintenance Projects

These projects involved supporting programs running on servers and included tasks such as application upgrades, application-level patching, migrations, scaling, backups, and application-related recovery. Purchasing new software or developing it from scratch every time it fails or contains faults is not a cost-effective strategy. Instead, it is more efficient to maintain existing applications regularly to extend their lifespan and reduce future costs, particularly through mobile and web application development and ongoing maintenance.

(vi) Security and Compliance Projects

These projects involved implementing security and compliance measures on the customer's servers, including server patching, hardening, server health checks, anti-virus installation, intrusion detection systems, and enforcing security features across the customer infrastructure. Project managers play a crucial role in integrating security and compliance into organizational processes and systems. They communicate with stakeholders, understand regulatory requirements, align them with project goals, and implement measures to mitigate security risks. Additionally, they act as stewards of organizational data, ensuring that information is handled appropriately and protected from potential risks. In today's landscape, project managers operate at the intersection of project execution and security compliance, making them vital to the company's success in these areas.

(vii) Organisational Development Projects

An Organizational Development project is structured around a systematic process of engagement, which typically involves several stages such as contracting, diagnosing, developing, intervening, assessing, and optimizing. These projects are designed to bring about changes in the environment to better respond to competition. Software companies often take the lead in adopting new and innovative technologies to drive such transformations.

3.4.4 The Three Pillars of Project Success

The Standish Group identifies three key metrics to assess a project’s potential for success: project size, project duration, and team size, along with company size.

(a) Project Size

CHAOS research confirms that smaller projects are more likely to succeed than larger ones. As project costs increase, often due to the addition of features and functions that are infrequently or never used, the likelihood of success decreases. Smaller projects are generally more manageable, making it easier to ensure they align with the CHAOS ten factors for success.

(b) Project Duration and Team Size

The smaller the team and shorter the duration of a project, the higher the likelihood of success. However, this does not imply that shortening the schedule or reducing the resources of a large project will guarantee success. Nor should it be interpreted to mean that large projects with large teams cannot succeed.

(c) Company Size

Company size does not always correlate with success. The Standish Group has found no direct link between a company's size and its project success rate. Similar to project size, bigger is not always better. Large companies tend to experience more failures and fewer successes compared to medium-sized companies.

3.4.5 Improving the Likelihood of Success

The chances of improving information technology project success and avoiding repeated mistakes in past consist of four approaches. They are,

(a) Value-Driven Approach

IT projects must deliver value to the organization. While many people and organizations define success based on completing the project on time and within budget, these factors alone are not enough to define project success. Success should also be measured in terms of the value the project brings. This value can manifest in improved customer service, more efficient business processes, reduced costs, and increased market share. With an emphasis on outcomes, risks that could threaten the delivery of value are recognized and controlled early on. This lowers the chance of project failure and expense overruns. A value-driven approach focuses on improving the value delivered per unit of expense or effort, resulting in higher ROI. Teams can save resources by emphasizing high-value deliverables above low-priority tasks that do not contribute significantly to company goals.

(b) Social Technical Approach

In the past, organizations have sought to improve the chances of IT project success by concentrating on the tools, techniques, and methodologies of IT development. A purely technical approach tends to focus on technology alone. However, project managers must not only understand the technology but also be actively creative in applying it in ways that create value for the organization. This requires considering the relationships, communication, decision-making processes, and human interactions that arise when users engage with technology. The key is that optimizing one system without accounting for the others can lead to inefficiencies and potential failures. Therefore, the successful application of technology and the achievement of the project's goals should be a shared responsibility between developers and users.

(c) Project Management Approach

Many organizations have applied project management principles and tools in IT projects to improve success. The success or failure of an IT project depends largely on the processes and infrastructure in place, rather than solely on the composition of the project team. While the team is important, it is the set of processes, tools, and controls that truly drive success. A standardized set of tools and controls helps create a common language across projects and allows for comparisons throughout the organization. Timely status updates, clear communication, and sound project management practices are essential. For project management to be effective, it must be embraced and supported at all levels within the organization, with ongoing commitment to training, compensation, career development, and infrastructure.

(d) Knowledge Management Approach

Knowledge management is a structured approach to acquiring, creating, synthesizing, sharing, and utilizing information, insights, and experiences to convert ideas into business value. IT projects, managing knowledge in the form of lessons learned and creating best practices helps to do things most efficiently and effectively. Regular knowledge-sharing sessions, such as project review meetings, evaluations, or seminars, allow team members to discuss their ideas, challenges, and recommendations. Project managers may employ the knowledge gained throughout the project to make better decisions about resource allocation, risk management, and process improvements. Gaining access to a large corpus of knowledge allows teams to innovate effortlessly. IT projects that build on current technologies and combine knowledge from several fields might result in innovative, demanding solutions. It helps companies make better decisions, increase collaboration, innovate, and eliminate redundant work by contributing to the success of IT projects.

3.5 Financial Risk Management Process

Financial risk management is essential to all business, corporate, and personal operations, irrespective of size. All project stakeholders (owner, investor, professionals, architects, project manager, and others) encounter risky scenarios. Despite the many risk-prevention methods used, risks remain inevitable. Risks vary from project to project and are influenced by the involvement of stakeholders. While project stakeholders cannot prevent the rapidly changing, unstable, and risk-prone environments, they must prepare to manage the impact of risks on their roles within the project. To effectively handle risks, all project managers should create contingency plans. In most projects, risks are identified and assessed, and a risk response strategy is formulated to assign responsibilities and establish control measures. If project risks can be detected early on, defined logically, distributed among stakeholders, and managed successfully, the possibility of schedule and expense overruns is greatly decreased. Financial risk management enhances the likelihood of achieving a project's objectives by making the project plan more feasible, reducing costs, minimizing losses and delays, and enabling the exploitation of beneficial opportunities. While there is no one-size-fits-all approach for designing risk management strategies to mitigate these risks, the inherent instability of risk-prone situations requires a structured approach to managing risks in order to meet the project's defined performance goals.

A well-planned risk management strategy can mitigate the impact of potential negative events while maximizing the benefits of favourable opportunities. The following are the financial risk management processes employed in software projects.

3.5.1 Financial Risk Planning

Financial risk planning should begin throughout the project selection process. Project selection involves deciding whether a company or organization should undertake a specific project. Financial risk planning converts risk knowledge into actionable information. Planning entails devising strategies to address particular risks, scheduling risk decisions, and producing an overall risk management plan. The risk management plan guides managing project-specific risks. Every project requires a detailed plan that outlines how risks will be recognized, addressed, recorded, and managed. A plan for addressing a given risk may take various forms:

(a) Create a contingency plan: Identify potential unforeseen situations and develop strategies to minimize the impact of the risk.

(b) Minimize risk: Modify the product design or development process to reduce the likelihood or severity of the risk.

(c) Accept the risk: Acknowledge the potential adverse consequences and take immediate action, accepting the risk as it is.

(d) Conduct additional research: Gather more information to better understand the risk, enabling informed decision-making and improved risk management.

3.5.2 Financial Risk Identification

The risk identification process involves thoroughly researching the project to identify the sources of risk and the related potential risk factors that could lead to risk events. This approach helps minimize the likelihood of overlooking any possible risk event. It is often stated that the true risks in project management are those that we fail to recognize. The identification process must explore every possible scenario to uncover risk sources and events, reducing the chances of missing any potential risks. Any information that indicates a possible issue should be evaluated during the risk identification phase. This includes:

a) Sources of Risk

Modern projects face a wide range of risks from inception through to completion. Common sources of risk include commercial risks, design risks, risks from natural disasters, cost overruns, and time overruns. These risk sources are typically independent of one another and often arise due to changes in both the external and internal environments.

1. Changes in the external environment: These can be triggered by unstable political, legal, economic, and financial conditions, as well as natural disasters like fires and floods. External risks can be further categorized into:

   - External unpredictable risks: These are unknown uncertainties that cannot be anticipated.

   - External predictable risks: These are known risks that can be foreseen and planned for.

2. Changes in the internal environment: Internal risks arise at the project site and are related to factors such as technological changes, quality issues, legal problems, commercial dealings, internal safety and security of resources, accidents, estimation errors, design alterations, labour strikes, material wastage, equipment breakdowns, internal conflicts within project management, client-contractor disputes, corruption, and man-made disasters such as burglary or fraud. These internal risks can be broadly divided into two categories:

   - Risks related to project management objectives: Risks that affect the achievement of project goals.

   - Risks related to project management practices: Risks stemming from the methods and processes used in managing the project.

b) Risk Events

Sources of risk, also known as risk factors, are typically divided into risk events. To manage these risks effectively, risk sources can be broken down into manageable levels of detail based on project objectives, work packages, management functions, brainstorming, expert judgment, or a combination of these approaches. This breakdown helps risk planners understand the nature of the risk events that are likely to be encountered. There are several methods for identifying risk events, including:

- Project risk sources and project objectives interaction matrix: A tool that helps visualize how different risk sources interact with project objectives, helping to identify potential risk events.
- Project deliverable breakdown analysis: Analyzing the breakdown of deliverables to identify potential risks associated with each deliverable.
- Performance analysis of past projects: Reviewing past project performance to identify recurring risk events and trends that may apply to the current project.
- Brainstorming: A collaborative approach where team members generate ideas and identify possible risks through open discussion.
- Use of checklists: Using predefined checklists based on previous project experiences to identify potential risks systematically.

3.5.3 Financial Risk Analysis

Financial risk analysis involves assessing risks effectively by employing a qualitative risk analysis and quantifying risk exposures to mitigate high-exposure risks and build a risk response strategy. The methodologies for risk analysis differ depending on the objective and project. The technique used for risk analysis depends on the nature of the problem being addressed, the availability and reliability of accessible information, and the type of outcome required. The specific outcome needed is typically determined by the client's particular requirements and the type of decisions that need to be made. Different risk analysis techniques may be applied based on the complexity of the problem, the precision of data available, and the goals of the project.

During the implementation phase, risk assessment methodologies constitute a minor component of the total risk assessment process. There was no single approach to coping with risk and uncertainty. These strategies must be evaluated in the context of an entire mindset, which serves as the structure for risk management. Generally, planners assess and evaluate risks to create a comprehensive project risk plan and monitor future trends. For complex, high-tech projects, expert risk consultants may be brought in to assess risks as needed. Due to scope and space limitations, the project will focus on evaluating methods for determining completion time probabilities and budgeted cost contingencies. These evaluations help manage uncertainty and ensure that the project stays within acceptable parameters for time and cost. It includes,

a. Qualitative Risk Analysis

The qualitative risk analysis technique divides risk events into high, moderate, and low exposure classifications. This can be accomplished by creating a basic probability and impact matrix for each risk event. Using a qualitative analysis.

- The probability-impact matrix: This tool helps identify and rank risk events or sources based on their probability of occurrence and the potential impact they could have on the project. Risks are classified into high, medium, and low-value exposures, allowing project managers to prioritize risks and allocate resources effectively. High-probability, high-impact risks will require immediate attention and mitigation strategies, while low-probability, low-impact risks can be monitored or placed on a watch list.
- Separate low-exposure events (non-critical) into a watch list: Events with low exposure can be monitored and tracked, but they may not require immediate or proactive action. These events are less likely to have a significant impact on the project compared to those in the medium and high exposure categories, which may need more focused attention and mitigation strategies. The watch list helps ensure that low-exposure risks are still monitored, but without diverting resources from higher-priority risks.

- Pareto's rule**:** The probability-impact matrix can be used to sort high-exposure risks for further quantification and mitigation, applying Pareto's rule (the 80/20 rule). This principle suggests that 80% of the project's risks and impacts often come from 20% of the identified risks. By focusing on the most critical 20% of risks, project managers can address the highest threats, allowing for more efficient use of resources and a greater reduction in overall project risk.

b. Quantitative Risk Analysis

Quantitative risk analysis is performed on possibly heavily exposed items that are ranked after the risk qualitative evaluation stages have been completed. The high-exposure risk events are determined using Pareto's 80/20 Rule. It can be used to classify and rate risks. The 20% high probability-high impact risk categories must be thoroughly analyzed to estimate the project's risk exposure and prepare the risk response plan. If several hundred risk events are used for quantitative analysis, the analysis will become bogged down in tiny tactical risk events, failing to focus on key ones. In broad terms, 15 to 30 possibly significant exposure risk events can be prioritized for quantification. The methods employed for risk quantification will vary depending on the type of risk under assessment. Risk is mathematically measured by calculating the product of the probability of an event occurring and the potential impact or consequence of that event. The formula is:

$$\text{Risk Exposure} = \text{Probability of Occurrence of Risk} \times \text{Impact of the Event}$$

This calculation helps to quantify the level of risk, allowing project managers to prioritize risks based on their likelihood and the severity of their impact on the project.

3.5.4 Risk Evaluation

After estimating the likelihood and consequences of each risk, an evaluation is conducted to understand how various risks interact with each other and contribute to the overall exposure to risk in the project. Generally, risk evaluation involves assessing and prioritizing risks, considering the trade-offs necessary to suggest a desirable course of action, and determining which avoidance strategies are most appropriate. Each strategy includes specific implementations aimed at mitigating product, process, and organizational risks. Before recommending any specific risk-avoidance methods, it is essential to confirm that the risks are not directly or indirectly related. Since not all risks can be prevented or eliminated, it is also crucial to develop strategies to address risks that do materialize.

3.5.5 Role of Project Managers in Managing Risks

Project managers establish objectives and validate ideas made by risk management regarding the procedure and state of their project. They must have a global perspective on their project's risks and potential. Their responsibility also includes establishing their view on essential risk response strategies. Major roles are,

- Estimate and allocate cost and time contingency allowances based on identified significant risks and uncertainties.
- Regularly monitor and review risk response strategies with relevant parties to avoid misunderstandings.
- Optimizing project performance by allocating remaining risks among stakeholders.
- Allocating risks to parties should be supported by appropriate incentives, as risks and rewards are intimately associated.
- Maintaining an open mind to novel problem-solving approaches.
- Making timely and suitable decisions.

3.5.6 Benefits of Financial Risk Management in IT Projects

Effective financial risk management provides numerous benefits to a firm, including the following:

1. Increased Risk Awareness

It refers to a culture shift within a firm in which risk management is prioritized at all levels and throughout all functions, rather than simply in specialist risk and compliance departments. This increased awareness ensures that all employees, from top management to operational personnel, are aware of the dangers that may affect the business and understand their role in controlling or minimizing such risks. It is a vital component of a reliable risk management culture, allowing the firm to successfully predict, respond to, and mitigate risks.

2. Compliance with Legal and Organizational Requirements

It refers to the efficient and effective application of the laws, regulations, and internal policies that regulate IT operations. Compliance has become essential in the IT industry, as firms handle confidential information, adhere to stringent regulatory frameworks, and manage sophisticated technical systems. Ensuring compliance not only helps companies avoid legal consequences, but also fosters confidence among consumers, partners, and regulators.

3. Increased Efficiency

It refers to the systematic process of proactively discovering, evaluating, managing, and reducing risks to optimize operations, eliminate inefficiencies, and ensure the smooth running of IT systems and projects. Organizations can function more effectively, respond to challenges faster, and protect their assets by incorporating risk management processes and controls into regular IT practices, all while reducing interruption and enhancing worker efficiency.

4. Increased Worker Safety and Security

Improving worker safety and security in the IT sector is crucial for protecting personnel, safeguarding confidential information, and ensuring seamless corporate operations. This can be accomplished using a combination of tangible, computerized, and managerial measures. Financial risk management makes sure that these risks are identified and that sufficient resources are given to cyber security solutions such as encryption, personnel training, and response plans for incidents.

5. Competitive Advantage

In the rapid growth of IT companies, organizations that can quickly recognize and adjust to financial risks can maintain a competitive advantage. Efficient financial risk management can also help a company create interactions with other companies, such as vendors, customers, or technology providers, by demonstrating financial security and awareness. By managing financial risks, companies may prevent monetary losses and exploit opportunities more quickly than competitors.

6. Improve Quality

Financial risk management plays a vital role in enhancing the quality of IT projects because it ensures that projects are sufficiently funded, resources are distributed efficiently, and possible risks are managed in a way that does not threaten project outcomes. By controlling financial risks, IT projects can achieve better cost management, quicker delivery, and more efficient resource usage, all of which enhance overall quality.

7. Enhanced Stakeholder Value

Investors and stakeholders are more willing to invest in a company that follows efficient financial risk management techniques. Companies that recognize and mitigate risks can boost their confidence and reputation, attracting investors who are seeking trustworthy and safe investment possibilities.

8. Better Resource Allocation

Financial risk management assists in deploying resources more efficiently by determining which projects or areas of company operations carry the most possibility of return while minimizing the chance of excess risk. Financial risk management ensures that resources are distributed properly, avoiding waste, excessive use, or inadequate utilization, and so resulting in the project's success and quality.

9. Enhanced Reputation and Credibility

Companies that have effective financial risk management methods are viewed as lower-risk borrowers by lenders and financial institutions, which can result in more favourable loan terms, such as lower interest rates and more access to funds for development or investment. Software companies can enhance their overall financial health by identifying financial risks and their potential consequences. This reduces the possibility of failure or bankruptcy.

10. Increased Project Success Rate

Financial risk management is essential for improving the success rate of IT projects because it ensures that financial resources are efficiently allocated, risks are detected and addressed early, and the project is completed within budget and on time. Proper financial management decreases the chance of excess costs, delays, and other financial challenges that can disrupt projects, while also keeping the focus on providing satisfactory outcomes.

3.6 Financial Risk Factors Affecting IT Projects

Many financial risk factors affect the successful implementation of information technology projects. The study uses the most influencing financial risk factors they are as follows:

3.6.1 Technology

Technology risk relates to the possibility of financial and operational risks associated with adopting technology in a project. It encompasses the risk of technical failures, cyber-attacks, system breaches, and other unanticipated issues threatening the project's ability to meet its objectives. Technology risk can exist in any project that relies on the use of technology, including software development, infrastructure projects, and technology deployments. Technology risk largely affects the successful completion of the project.

3.6.2 Requirements

Requirements risks are risks that are directly related to certain needs. The incorporation of a risk can have a variety of consequences on a project's risk profile. Requirements risk will also affect a project's ability to meet its objectives. Uncertain requirements lead to ambiguity, which, if not mitigated on time, can lead to project failures. If requirements are not documented properly, it affects customer satisfaction.

3.6.3 Project Scope

Scope risk in a project is a risk for the project's specifications to develop beyond the originally established scope. This can occur due to various circumstances, including changes in stakeholder expectations, changing business needs, or inadequate scheduling of projects. Scope risk can cause delays, higher expenses, lower quality, and project failure. Every project requires a clearly defined scope for understanding the customers' requirements and efficient deliverables. Unclear scope and scope ambiguity are the major reasons for the project's failure.

3.6.4 Design

Design risk refers to the possibility that a design will fail to meet the project's criteria. This comprises designs that are fundamentally faulty, unfeasible, unproductive, unstable, or below client expectations. A poor design might appear as functional faults or bottlenecks to development that hinder project progress. Design becomes the blueprint of the project, any errors or ambiguity may lead to consequences in the implementation of software projects.

3.6.5 Organisational

Organizational risk refers to an organization's possibility of losses as a result of an unforeseen event or activity. Organizations can manage this risk by implementing risk management practices, such as risk identification and prevention, to recognize and tackle possible risks. Organizations should also think about establishing safeguards to defend against potential losses. There are many changes in the internal and external environment of the organisation. Proper planning and support from top management are required. Changes in organisation structure, culture and so on may impact the project outcomes and software companies as a whole.

3.6.6 Resources

Resources are the backbone of every company and a key element for implementing the software project. Inadequate resources are not immediately highlighted to the management and taking action for new resources reduces the resource risks. Resource issues that are not tackled initially can lead to project failures. Resource risk management is crucial because it enables project managers to identify and handle possible challenges before they become serious issues. By recognizing and reducing risks early in the project's lifetime, project managers may ensure that resources are accessible, properly skilled, and correctly deployed over the rest of the project.

3.7 Financial Risk Management Techniques

Financial risk management techniques include techniques as well as resources for identifying, assessing, and mitigating risks that may impact an organization's financial performance. These risks can be attributed to market fluctuations, inefficient operations, liquidity problems, or changes in regulations. Effective risk management enables firms to reduce financial losses, maximize opportunities, and improve decision-making. There are many techniques used to manage the financial risk involved in information technology projects.

3.7.1 Financial Risk Identification Techniques

Risk identification becomes a very difficult task as concerned with project manager. Identifying financial risks is a major milestone for software companies to ensure they are properly equipped to tackle any threats that might impact their financial health. Techniques enable firms to better recognize and manage possible risks, allowing them to foresee and prevent financial losses. The technique chosen is determined by the nature of the company, the industry, and the accessibility of risk management resources. The most commonly used risk identification techniques are;

(a) Risk Checklists

A risk checklist detects and prioritizes a list of risks associated with software projects. It provides project managers with instructions on the consequences of each risk. It enables software companies to proactively identify risks and take appropriate action to reduce or control them. Software Companies can ensure their resilience in the face of market and system challenges by reviewing and updating their checklist on a regular basis.

(b) Influence Diagram

These are diagrams intended to highlight risks that may affect the attainment of project objectives. The influence diagram depicts decision problems with nodes and their influence via directional arrows between nodes. This diagram allows for the rapid identification of potential risks when compared to other techniques. It aids in identifying the most influential risk in internal and external contexts through the use of chance and general variables. It enables project managers, teams, and stakeholders to comprehend the mutual dependency and the results of numerous possibilities and situations. Influence diagrams also serve to minimize uncertainty and enable decisions to be made after a thorough review of all factors influencing the project's success.

(c) Cause and Effect Diagram

It investigates the various causes of the problem and divides it into categories. It documents all factors and identifies the root causes. The cause and effect diagram analyses current problems, assisting in corrective action and revising the diagram with new information. Many software businesses utilize cause-and-effect diagrams to categorize and effectively manage risk events. It enables teams to visualize the correlations between variables, identify the root causes of problems, and formulate remedies. By breaking down large challenges into smaller categories, teams may approach problem-solving in a more organized and productive manner, resulting in improved project outcomes.

(d) Failure Mode and Effect Analysis

FMEA is used to predict, prioritize, and reduce risks associated with project completion, technology implementation, and the introduction of a project. The purpose of FMEA in IT projects is to increase the accuracy, quality, and success rate of the project by addressing challenges before they emerge. These diagrams play an important role in identifying problems in project or process design. It is created to detect, prioritize, and minimize the failure scenarios. It aids in assessing the risk of failure in projects. Effect analysis investigates the consequences of failures. This technique is used by software companies to prevent information technology project failures.

3.7.2 Financial Risk Planning Techniques

Risk planning provides optimal control and effectiveness in managing risk. Financial risk planning is a crucial aspect of managing IT projects as financial resources are frequently scarce and unanticipated risks can have a substantial influence on the project's budget and revenue. Effective financial risk planning enables project managers and stakeholders to identify, assess, and minimize risks associated with project costs, failures, and financial success. Some of the techniques used for the study are,

(a) Analytical Techniques

Analytical techniques were utilized to analyse the problem with limited tasks and time frames for specific challenges. A good solution can only be obtained if it is applied by skilled professionals. Simple analytical techniques are utilized to improve the effectiveness of financial risk management in software companies. These techniques improve the design, implementation, and control of IT projects, resulting in more effective project outcomes. Project managers may strengthen decision-making, reduce risks, and increase the chances of having a successful project completion.

(b) Expert Judgement

They are quite effective for managing financial risk in all companies. Expert opinions might be useful in estimating the cost of software projects. Experts examine prior facts to make reasonable decisions. Experienced individuals require less information to make correct assumptions. Experts contribute to the formulation and refinement of the project scope, ensuring that all requirements are clear, feasible, and in line with business objectives. Expert programmers and technical designers provide feedback on how long individual activities or stages of the project will take, assisting in the creation of realistic deadlines.

(c) Regular Meetings

Regular meetings are a crucial component of IT project management. They help team members, stakeholders, and project managers communicate, coordinate, and collaborate more effectively. Regular meetings ensure that the IT project stays on the right path, meets time constraints, and achieves expected results by providing an opportunity for reviewing progress, addressing challenges, and setting the project's objectives. Project managers gather to make specific plans for optimal financial risk management during the development and implementation of software projects. Team members' diverse perspectives provide significant suggestions for improving the software development process while maintaining within budget and time constraints.

(d) Information Gathering Techniques

Effective information gathering is essential for the successful planning and implementation of IT projects. Project managers can use a variety of techniques to ensure that they acquire precise, extensive, and practical data for integrating the project with the expectations of stakeholders and avoiding risks. Project management involves information collecting to learn more about the project that should be implemented. When planning for financial risk, all available information is required to determine the causes and impacts. Project managers employ several kinds of information-gathering techniques to develop effective plans for assisting the organization.

3.7.3 Financial Risk Analysis Techniques

Successful risk analysis depends upon information and techniques used for risk management in information technology projects. Financial risk analysis in IT projects emphasizes detecting, assessing, and managing any financial risks affecting the project's timeline, budget, and overall revenue. These risks could result from changes in market conditions, unexpected project expenses, failures, scope modifications, or resource mismanagement. Project managers can use various financial risk analysis techniques to proactively decrease these risks and increase the chance of the project's success. Financial risk analysis techniques are broadly classified as qualitative risk analysis techniques and quantitative risk analysis techniques. The study uses both qualitative and quantitative risk analysis techniques. They are,

I. Qualitative Risk Analysis Techniques

Qualitative risk analysis is a significant technique used in IT projects to evaluate possible risks based on their probability of occurrence and impact on project success. This analysis of risk exposure is typically sufficient to filter through a large number of potential risks and identify the most critical ones. By evaluating the likelihood and impact of each risk, project managers can prioritize those that pose the greatest threat to the project, enabling focused resources and attention on mitigating the most significant risks. This technique helps prioritize risks for further investigation, usually without necessitating detailed quantitative data. They enable project managers to make properly informed choices without depending on extensive data or sophisticated models. Some of the techniques are described as,

(a) Probability and Impact Grid

These are the most generally utilized techniques for categorizing common risks and assessing their severe impact on project objectives. The key advantage of this technique is that it prioritises the risk based on its likelihood of occurring in the projects. The computation of risk necessitates the use of probability data to evaluate the impact on projects. Understanding high-priority risks allows project managers to better deploy resources (time, money, and staff) to reduce or avoid the most fundamental risks. The grid communicates the level of risks to stakeholders clearly and understandably, assisting them in determining the risks that demand immediate action.

(b) Brainstorming

It is a simple but well-known and popular problem-solving tool. Everyone in the group had suggestions. Following the brainstorming session, the project manager will make full use of the participants' innovative thinking. Software businesses utilize brainstorming to assess several types of risk. It is especially useful in the beginning phases of a project, during risk management, or when confronted with challenges that require innovative solutions. The objective is to promote transparent, judgment-free thinking by enabling team members to widely contribute ideas. With a diverse set of thoughts and viewpoints, the team is more likely to choose the most effective solution to a given challenge, resulting in greater success.

(c) Risk Urgency Assessment

These are techniques for identifying and analysing risk factors that require quick assessment over other risks. It prioritizes risks to assess their severity. Project managers pay closer attention to these types of risks and take appropriate action at specified times. Urgency assessment assists ensure that the proper decisions are taken fast, reducing project delays and cost overruns by identifying risks that require immediate action. IT projects are more likely to stay on budget when risks that could cause disruptions are identified and addressed in sufficient time. Rather than attempting to address all risks simultaneously, risk urgency assessment helps prioritize and improve operations, resulting in more effective risk management.

(d) Fault Tree Analysis

These are techniques for system design and enhancement. It examines many aspects that contribute to system failure. It is widely utilized with various models to improve system reliability. Fault tree analysis shows the failure route and determines the underlying cause. The causes of failure are retrieved using the identified criteria, and risk mitigation actions are provided. It enables teams to comprehend the interactions between system elements, their failures over time, and their overall effect on the project. FTA enables project teams to foresee problems before they arise, allowing them to take preventive measures. This proactive strategy can greatly reduce unexpected interruptions and delays throughout the project's life cycle. With an in-depth understanding of failure modes and their implications, stakeholders can make intelligent choices about the use of resources, design modifications, and risk mitigation strategies.

II. Quantitative Risk Analysis Techniques

In contrast to qualitative risk analysis, which classifies risks subjectively, quantitative risk analysis aims to assess and calculate the potential effects of risks employing mathematical models, past information, and simulation methods. This technique gives project managers a greater knowledge of how risks may affect the project's cost, plan, or quality, allowing them to make better risk-mitigation strategies. Quantitative risk analysis should be used only for risks that require numerical justification for management and acceptance. Some of the quantitative risk analysis techniques used for the study are as follows,

(a) Consequence analysis

Consequence analysis is primarily designed to determine the magnitude of effects connected to economic losses or environmental impacts. The technique investigates time-sequenced system reactions to initiating challenges, allowing for probability estimates of success or failure outcomes. By assessing possible consequences, teams may better allocate resources to areas with the greatest impact, ensuring that they are spent efficiently. With a comprehensive awareness of the risks involved, IT projects can incorporate more efficient risk mitigation strategies, such as further testing, backup procedures, or enhanced protections for cyber security.

(b) Decision Tree Analysis

These are advanced problem-solving techniques. Decision trees offer a clear structure for evaluating potential courses of action to resolve conflicts. Frequently used in software companies, decision trees help assess different options and identify key decision-making factors, providing a visual representation of the possible outcomes and guiding more informed choices. IT project managers analyze and compare various project alternative solutions or decisions in the face of uncertainty. It is especially beneficial in cases where a project has several option paths and the outcome of each decision is determined by a variety of factors that could impact the project's success. In IT projects, decision tree analysis aids in risk assessment, determining the best course of action, and optimizing resource allocation, especially in complicated circumstances such as technology decisions, cost-benefit analyses, and project planning.

(c) Monte Carlo Analysis

It anticipates the project's behaviour to account for activity time estimations and other uncertain inputs. It aids in the resolution of project scheduling issues and gives distributions and value for items like as time to completion and software project costs. It enables the project manager to take risk mitigation actions and reduce project complexity. Monte Carlo analysis can estimate project cost uncertainties by taking into account variations in expenses for resources, license fees, and unplanned expenses. This assists in determining a more realistic budget and determining the probability. By modelling multiple risk situations project managers can assess the possibility and impact of various risks, allowing them to determine which risks should be minimized. It aids in assessing which risk occurrences are most likely to impact the project's budget, timeline, or scope.

(d) Sensitivity Analysis

Sensitivity analyses are quantitative assessments of uncertainties and risks related to the project. It allows you to determine how long the task will take to complete and gives you a project completion time. It highlights issues with project objectives and assists project managers in making suitable decisions. With a greater understanding of how various factors influence results, project managers may make more knowledgeable long-term decisions. Recognizing how risks affect outcomes allows project managers to develop more effective contingency plans for the most key factors. Sensitivity analysis helps stakeholders understand which factors will have the most effect on project performance, assisting the top management.

3.7.4 Financial Risk Monitoring and Controlling Techniques

Monitoring and controlling risk resulted in a comprehensive understanding of all types of software risk encountered throughout the project, reducing its complexity. Financial risk monitoring and controlling techniques are essential for ensuring that an IT project remains within budget and achieves its financial goals. Using these tools and procedures, project managers can identify possible financial challenges promptly, manage unpredictability, and take remedial actions to ensure the project's financial well-being. Some of the financial risk monitoring and controlling techniques are given as follows,

(a) Risk Audits

Auditors' roles are changing in project and software companies. Increased strategic role in risk assessment, management, and prevention. A risk auditor evaluates risk and risk management and seeks ways to communicate with management to ensure that risk perspectives are consistent. Risk auditing assists software companies in understanding the types of risks involved in all of their projects. Risk audits determine the effectiveness of risk responses and strategies in operation. If a specific risk mitigation is inadequate or unreliable, the audit provides a possibility to modify the mitigation strategy. Audits might advise modifications to the project's risk mitigation strategy, making it more resistant to future uncertainty. Risk audits are essential for regulatory compliance and reporting objectives. The audit ensures that risks are appropriately documented and that all relevant parties are informed.

(b) Risk Register

The project risk register is an integral part of the risk monitoring process, describing a written record of recognized risks. It describes the nature of each risk and maintains relevant details for risk assessment and effective management. It serves as the foundation for the required outputs of risk work, including risk analysis, risk management plans, and risk mitigation plans. As the project expands further, the risk register is utilized to track and manage risks. The project manager analyses it regularly to ensure that mitigation measures are effective, and the status of each risk is updated accordingly. By regularly monitoring the risk register, project managers can make intelligent choices about how to address any possible issues before they get worse, such as changing resources, adjusting the delivery schedule, or implementing new mitigation strategies. The risk register can be utilized in audits or project reviews to show that risks were properly controlled throughout the project.

(c) Cost and Benefit Analysis

The technique allows for a value-added, profit-driven approach to risk management. It regularly analyses the costs required for project development and execution and compares them to the benefits received from them to manage risk in software projects. It becomes necessary for software companies to undertake future projects. CBA enables project managers, chief executives, and other stakeholders to examine the project's financial effects, risks, and long-term value. It's especially beneficial for evaluating investments, getting authorizations, and prioritizing projects. Although challenges include predicting accuracy and measuring intangible benefits, a well-conducted CBA can assist ensure that IT projects add value and contribute to the company's success.

(d) Variance and Trend analysis

The risk is controlled by variance and trend analysis, which compares the project's projected and actual performance. Deviations in time and budget are discovered, and corrective actions are taken to avoid threats and take advantage of project opportunities. Trend analysis promotes continual monitoring of key performance indicators allowing for continual modifications to improve the project as it moves onwards. Trend analysis can aid in forecasting future results based on previous successes. This enables project managers to make decisions based on information, keeping the project on schedule.

3.8 Risk Impact

It refers to the consequences if a particular risk or threat were to occur. The impact of a risk can vary depending on its severity, and it is commonly categorized as follows:

(a) Almost negligible impact: The issue can easily be rectified with minimal effort or cost.

(b) Minor effect on budget or schedule: The issue may cause slight delays or cost overruns, but it can typically be resolved within a few days.

(c) Noticeable and moderate effect on budget and schedule: The risk event causes some disruption, requiring a review of the project plan and possible rescheduling.

(d) Serious problem: This level of risk could significantly affect the credibility of the project, may necessitate additional funding, and could require substantial rescheduling.

(e) Critical project failure: At this level, the risk is likely to cause the project to fail, resulting in significant delays or cost overruns, potentially rendering the project unviable.

3.9 Effectiveness of Software Companies

Peter Drucker, a renowned management expert, defined effectiveness as "doing the right thing." In the context of software companies, project management is often credited with enabling shorter development times, reducing costs, and improving quality. By focusing on both efficiency (executing tasks properly) and effectiveness (ensuring the right tasks are prioritized), project management helps organizations achieve better outcomes and optimize resource use. Software companies can improve their performance by adopting different financial risk management techniques and financial risk mitigation strategies. The major effectiveness of software companies is as follows.

3.9.1 Financial Effectiveness

Financial effectiveness in IT projects is defined as the capacity to manage and deploy financial resources so that the project achieves its objectives, adds value, and meets its financial targets. It entails cost optimization, optimizing return on investment (ROI), and ensuring that the project's financial performance is consistent with the organization's strategic and financial objectives. CBA is essential for deciding whether an IT project is worth the cost. Project managers can assess financial effectiveness by comparing expected benefits and expenditures. Financial effectiveness involves preparing for contingencies and controlling financial risks to avoid budget overruns. Financial effectiveness continues beyond project completion. It is essential to ensure that the information technology approach is long-lasting and continues to provide value. This may include continuing maintenance charges, improvements, and scaling. Financial effectiveness not only ensures that projects are completed under budgetary constraints, but it also maximizes return on investment and generates long-term success for the organization's IT projects.

3.9.2 Management Effectiveness

Management effectiveness in IT projects pertains to project managers' and teams' capacity to effectively plan, execute, and control an IT project to achieve its goals while meeting deadlines, remaining under budget, and delivering high-quality outcomes. It comprises the use of methods and tools to ensure that an IT project is completed effectively. Effective management begins with establishing clear project objectives, outcomes, and constraints. The project manager must ensure that all stakeholders have an extensive knowledge of the project's objectives and limitations. Developing a mindset of continuous improvement among project team members can help to reduce errors, enhance processes, and enhance overall project implementation effectiveness. Addressing challenges or conflicts in a timely and efficient manner, whether they affect team members, stakeholders, or project restrictions, is essential for sustaining the project's progress and success.

3.9.3 Socio-Economic Effectiveness

Socioeconomic effectiveness in IT projects refers to how IT projects affect both the social and economic aspects of a society or community. It includes evaluating how successfully the project contributes to improving social well-being, quality of life, economic growth, and development. Many IT projects, particularly large-scale ones, can create job opportunities both directly through the hiring of engineers, programmers, and project managers) and indirectly through the demand for goods and services generated by the IT project. One of the primary socioeconomic goals of IT projects is to narrow the gap between those who have access to technology and those who don't. Projects that aim to increase internet access, provide economical devices, or develop digital literacy programs can all contribute to reducing inequality and promoting equitable opportunity. To be considered effective, an IT project has to offer value beyond technical requirements and financial measurements, enriching society as a whole.

3.10 Challenges Faced by Software Companies

Software companies are fast growing and have many challenges too. The research considers some of the challenges they are:

3.10.1 Inexperienced Team Members

The proper functioning of information technology projects requires an efficient and experienced team. However, there may be new and inexperienced team members. They cannot solve issues in the development of the project without their experience in handling the problems. Despite their inexperience, new team members may generate lower-quality work, particularly in activities such as coding, debugging, and designing systems. They may not be entirely aware of the long-term consequences of design or technological decisions.

3.10.2 Security Threats

Software companies face many security threats from national and international boundaries. Data breaches occur when unauthorized parties gain permission to access sensitive information. This could be due to insecure authentication protocols, misconfigurations, or threats such as phishing. Failure to address security in the software development lifecycle (SDLC) can lead to risks being neglected during the design, development, and testing stages. Without secure coding techniques and regular security testing, projects are subject to a wide range of risks. Security threat affects the development of innovative software projects and the usage of the latest technologies.

3.10.3 Failed Changes

Changes in the environment are to be adaptive in the information technology projects. If the software companies fail to adopt new changes in the project they cannot provide adequate outcomes to the users. Changes that are not extensively tested or handled properly might have a negative impact on the system or product's quality. This could result in faulty operation, malfunctions or poor performance, all of which have a negative influence on the customer experience.

3.10.4 Skills Gap

Software companies consist of numerous project team members. But they differ from skills. There may be highly-skilled, semi-skilled, and low-skilled employees. These skills gaps become great changes for project managers and to carry out the project smoothly. High employee turnover in technical positions makes it challenging to maintain knowledge and skills within a project or business. Lack of soft skills can result in miscommunication, unproductive teamwork, and inadequate relationships with customers or other departments, all of which have an adverse effect on the project's success.

3.10.5 Conflict in the Team

Grouping people for joint activities requires greater coordination. Sometimes it may lead to conflict among team members due to different ideas. Ineffective communication also creates conflicts. When team members are unfamiliar with their duties and responsibilities, it can result in misunderstandings, dropping projects, or duplication of work. This is especially challenging in IT projects with sophisticated technical tasks.

3.10.6 Stiff Competition

Nowadays, the number of software companies is very high. At the same time, these companies compete with each other to generate huge profits and become market leaders. The use of the latest technology differs from each company and the use of traditional technologies paves to failure. As competition increases, teams may emphasize their aims over the larger company goals. This might result in the segmentation of efforts and a lack of clarity in delivering the project. In a highly competitive market, there is frequently intense pressure to deliver projects faster than competitors. This can lead to accelerating through the project's stages, which reduces quality, increases the likelihood of errors, and causes excessive stress.

3.10.7 Delays from Vendor

Resources are acquired from different vendors for the development of information technology projects. Delay from vendors leads to failure of deliverables in the desired quality and time. The selection of vendor also affects software companies and their success. Vendors dealing with numerous customers may provide inadequate to a project due to competing priorities, resulting in delays.

3.10.8 Lack of Investors

The development of software companies requires heavy investment. Acquisition of funds becomes a difficult task. Investors are ready to invest in profitable ventures. The lack of investors detains the promotion of new software companies. Marketing and sales efforts frequently involve significant investment to improve brand awareness, attract customers, and advance market share. A lack of investment may result in fewer promotional efforts, limiting the company's capacity to acquire new customers or keep existing ones.

3.10.9 Changes in IT Policies

IT policies are to be considered at the time of development of information technology projects. Every software company had to fulfil these conditions. Implementing new IT policies may necessitate significant financial investments in compliance, training, legal advice, and technological changes. This might divert resources out of creative thinking and expansion, particularly for small and medium-sized software enterprises with limited finances. Continuously changing IT policies makes it challenging to follow up with their updates.

3.10.10 Changes in Market Conditions

There may be favourable and unfavourable market conditions. Unfavourable conditions make the market more challenging and influence the decisions of software companies. Changes in market conditions can cause transformations in the preferences of clients, affecting the demand for specific types of software or functionality. A software company should withdraw projects that are no longer desirable or relevant to its target market. Fluctuations in the market increase the cost and functioning of the software companies.

3.11 Financial Risk Mitigation Strategies

Mitigating risk means that the risk event is managed in such a way that either the impact or the likelihood of the event occurring is reduced. Mitigation can be accomplished by reducing the amount of impact, expense, or schedule added to the baseline, decreasing the likelihood of the event occurring, or both. Mitigation is typically accomplished by increasing resources or employing more skilled or experienced staff. Using tried-and-true technology instead of newer, untested technology can help reduce risk. Risk mitigation strategies are designed to reduce the loss, damage, or disruption to a project caused by unplanned events. The study considers the following financial risk mitigation strategies,

3.11.1 Risk Transfers

Project risks can be shifted to someone better suited to dealing with such issues, such as specialist subcontractors, designers, or material suppliers, or to insurance companies. Risk transfer is often accomplished in practice through teaming or employing a vendor. When a project requires expertise that is not available within the business or group, it is usual practice to collaborate with another company or engage a vendor who does have the expertise required.

3.11.2 Risk Acceptance

Accepting risk, also known as risk retention, is a deliberate strategy of understanding the existence of tiny or occasional risks without attempting to hedge, insure, or avoid them. The reason for risk acceptance is that the expenses of mitigating or avoiding risks are too high. Though the risk is accepted, it needs to be continually monitored. This enables the project team to monitor the chance of the risk occurring and evaluate whether its impact changes over time. Monitoring allows for immediate changes to the project if the risk continues to increase.

3.11.3 Risk Avoidance

This requires altering plans to eliminate a risk. This strategy is appropriate for risks that may have a substantial impact on a business or project. In cases where it is more cost-effective or practicable to avoid the risk rather than manage or transfer it. Sometimes alternate strategies can accomplish the desired result without subjecting the software company to the same level of risk. Software companies can decide to avoid the usage of a new, untested software solution that has concerns about data security or stability.

3.11.4 Risk Sharing

Risk sharing is a risk management strategy that allows corporations or individuals to transfer risk to a third party. Individuals and businesses anticipate risks while conducting business and employ risk sharing to cover the possible loss from an unforeseen event. Software companies may employ RBF to share financial risk with investors. In this strategy, investors pay funds in exchange for a share of the company's future earnings until a certain amount is returned to them. This enables the software company to raise funds without incurring fixed debt, while the investor shares in both the risk and the reward based on the company's achievements.

3.12 Conclusion

Financial risks are the major problem that detains the growth of software companies. Hence, financial risk management in information technology projects plays a vital role in the successful running of software companies. Software companies use various financial risk management techniques to attain greater profitability. They also use many financial risk mitigation strategies to reduce the risks. Financial risks are a major problem for software companies, often preventing expansion and long-term profitability. These risks can originate from a variety of sources, including fluctuations in the market, investment ambiguity, inefficiencies in operations, problems with financing, and financial management of new technology projects. In the rapid and highly competitive software sector, successfully managing financial risks is essential to ensuring profitability, long-term viability, and continuous development. This chapter has explored the importance of financial risk management in the software company, with an emphasis on different techniques and strategies for reducing financial risks and increasing profitability. The performance of software companies relies on their ability to quickly identify financial risks, implement effective risk management techniques, and deploy strategies to mitigate those risks, ensuring the protection of their financial stability. Identifying the financial risk factors and challenges peculiar to the information technology sector is vital for researchers, corporate executives, and project managers who want to negotiate the complexity of the digital world. Software companies can improve their chances of long-term success by managing financial risk effectively, ensuring that they are not merely profitable but also flexible in the face of market uncertainty and technological changes. This study also provides valuable insight for research in this area.

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Chapter Four

FINANCIAL RISK FACTORS OF INFORMATION TECHNOLOGY PROJECTS

4.1 Introduction

In this chapter, the study examines the financial risk factors of software companies and how they affect the usage of financial risk management techniques and risk mitigation strategies. It also attempts to study the influence of financial risk factors on the nature of the software company, area of software company, average number of projects undertaken by software companies, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount and average time spent on software project.

The current chapter is divided into three sections for the presentation of analysis. **Section A** describes the profile of the sample respondents and sample software companies. **Section B** discusses the financial risk factors that influence the nature of the software company, area of software company, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount and average time spent on software project. **Section C** of this chapter deals with the relationship of financial risk factors with using financial risk management techniques and risk mitigation strategies.

4.2 Objective of the Chapter

The objective of the chapter is to analyze the factors affecting financial risk management in information technology projects of software companies in Kerala.

4.3 Hypotheses Formulated and Tested

1. There is no significant difference between financial risk factors and the nature of software companies
2. There is no significant difference between financial risk factors and the area of software companies

3. Financial risk factors do not influence the average number of software projects
4. Financial risk factors do not affect the annual revenue invested for managing the financial risk of software companies
5. Financial risk factors do not affect the completion of software projects on time
6. Financial risk factors do not affect the completion of software projects on the budgeted amount
7. Financial risk factors do not influence the average time spent on software projects

4.4 Methodology and Database

To accomplish the objective of this chapter, the primary data regarding financial risk factors, nature of software company, area of software company, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount, average time spent for software project, usage of financial risk management techniques and financial risk mitigation strategies are collected from software companies with the help of a structured questionnaire. For analysis, techniques like Percentage, Arithmetic Mean, Standard Deviation, Levene's test for Homogeneity of Variance, One-way Anova, Tukey HSD Post- Hoc Test for Multiple Comparison, Independent Sample t-test and Confirmatory Factor Analysis were used.

4.5 Variables Used for the Study

To attain the objective of this chapter, the study uses the following variables,

Financial Risk Factors	Technology Requirement Organizational Scope Design Resource

Usage	Financial Risk Planning Techniques Financial Risk Identification Techniques Financial Risk Analysis Techniques Financial Risk Monitoring and Controlling Techniques
Financial Risk Mitigation Strategies	Risk Transfer Strategies Risk Acceptance Strategies Risk Avoidance Strategies Risk Sharing Strategies

Section A

Prior performing any analysis in accordance with the research objectives, it is essential to verify the profiles of the sample respondents to ensure that the sample accurately represents the target population and is consistent with the study's specific goals. In this case, a total of 560 project managers were selected from a variety of districts, including Thiruvananthapuram, Kollam, Ernakulam, Thrissur, Kozhikode, Malappuram, and Kannur. These districts were chosen based on the large concentration of software companies operating within them, making them highly relevant to the study's focus on the software industry. By selecting project managers from these regions, the sample captures a diverse range of perspectives and experiences from professionals working in software companies, ensuring that the data collected is representative of the broader industry context. This careful selection process is important to provide meaningful insights and support the validity of any subsequent analyses related to the research objectives.

4.6 Profile of Sample Respondents and Sample Software Companies

The researcher attempts to study the profile of project managers which comprises the gender, age, educational qualification, and work experience. The research also studies the profile of sample software companies which includes the nature of the software company, area of a software company, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budget and average time spent on software project.

4.6.1 Gender-wise Classification of Respondents

The table 4.1 presents the gender-wise classification of the respondents.

Table 4.1

Gender-wise Classification of the Respondents

Gender	Frequency	Percentage
Male	350	62.5
Female	210	37.5
Total	560	100

Source: Primary Data

It is clear from the table that the majority of the respondents is male which contributes 62.5 percent.

4.6.2 Age-wise Classification of the Respondents

For the purpose of this study, the ages of the respondents were categorized into distinct age groups to better understand any potential age-related patterns or trends within the data. The respondents were grouped into four specific age ranges: 20-30 years, 30-40 years, 40-50 years, and 50-60 years. This classification allows for an analysis, enabling the study to examine how age might influence factors such as experience, job roles, or perspectives related to the subject of the research. The detailed breakdown of the respondents by age group can be found in Table 4.2, which provides a clear overview of the distribution of respondents across these age categories.

Table 4.2

Age-wise Classification of the Respondents

Age	Frequency	Percentage
20-30	140	25.00
30-40	181	32.30
40-50	176	31.40
50-60	63	11.25
Total	560	100

Source: Primary Data

Table 4.2 shows that 25 percent of the respondents are in the age group of 20-30, 32.3 per cent of the respondents are between 30-40 years, 31.4 per cent of the respondents fall under the age group of 40-50 years and 25 per cent of the respondents are in the age group of 50-60 years. Thus, the majority of the respondents are in the 30-40 age group.

4.6.3 Educational Qualification of the Respondents

The educational qualifications of the respondents are taken for the study. Educational qualifications were categorised into SSLC, Plus Two, Graduate, Post Graduate and Others. The educational qualifications of the respondents are presented in table 4.3.

Table 4.3

Educational Qualification of the Respondents

Educational Qualification	Frequency	Percentage
SSLC	4	0.7
Plus Two	79	14.1
Graduate	212	37.9
Post Graduate	255	45.5
Others	10	1.78
Total	560	100

Source: Primary Data

Table 4.3 reveals that about 0.7 percent of the respondents have SSLC qualification, 14.1 percent have Plus Two, 37.9 percent are graduates, 45.52 percent are postgraduates and only 1.78 percent are in other categories. So, it can be concluded that most of the respondents are postgraduate.

4.6.4 Work Experience of the Respondents

The work experience of the respondents is an important variable, as it provides insights into the depth of their professional background and expertise. To facilitate analysis, work experience is categorized based on the number of years the respondents have spent in their respective roles. The experience categories include: 0-5 years, 5-10 years, 10-15 years, 15-20 years, and above 20 years. This classification allows for a better understanding of how individuals at different stages of their careers might view or engage with the study's focus. For instance, those with less than five years of experience might have a different perspective compared to individuals with over 20 years of experience, who are likely to have more in-depth knowledge and expertise. Table 4.4 provides a detailed breakdown of the respondents' work experience, displaying the number of respondents in each category.

Table 4.4

Work Experience of the Respondents

Work Experience (Years)	Frequency	Percentage
0-5	146	26.1
5-10	181	32.3
10-15	171	30.5
15-20	53	9.5
Above 20	9	1.6
Total	560	100

Source: Primary Data

From Table 4.4, it is very clear that 26.1 percent of the respondents have 0-5 years of experience, 32.3 percent of them have 5-10 years, 30.5 percent of them have 10-15 years, 9.5 percent of them have 15-20 and only 1.6 percent have above 20 years of experience. Therefore, it can be concluded that the majority of the respondents are coming under 5-10 years of experience category.

4.6.5 Nature of Software Company

Table 4.5 gives the nature of the software company which are categorised into small, medium, and large.

Table 4.5

Nature of Software Company

Nature of Software Company	Frequency	Percentage
Small	127	22.7
Medium	191	34.1
Large	242	43.2
Total	560	100

Source: Primary Data

It is clear that majority of respondents are from large size company (43.2 percent), followed by medium (34.1 percent) and small (22.7 percent) sized companies.

4.6.6 Area of Software Company

The table 4.6 exhibits the area wise classification of sample software companies. The areas of software companies were measured by categorising them into urban and city.

Table 4.6

Area of Software Company

Area of Software Company	Frequency	Percentage
Urban	404	72.1
City	156	27.9
Total	560	100

Source: Primary Data

Table 4.6 clearly shows that the majority of the software companies are situated in urban areas (72.1 percent), followed by city software companies (27.9 percent).

4.6.7 Average Number of Software Projects Undertaken in a Year

The present study uses the average number of software projects undertaken by software companies during a year. The classification of the same is given in table 4.7.

Table 4.7

Average Number of Software Projects Undertaken in a Year

Average Number of Software Projects	Frequency	Percentage
Below 10	23	4.1
10-25	95	17
25-50	141	25.2
50-75	161	28.7
75-100	140	25
Total	560	100

Source: Primary Data

The table 4.7 states that 4.1 percent of software companies work on less than 10 projects annually on average; 17 percent work on 10–25 projects; 25.2 percent work on 25–50 projects; 28.7 percent work on 50–75 projects; and 25 percent work on 75–100 projects. Thus, it can be said that most software companies work on between 50 and 75 projects on average in a year.

4.6.8 Annual Revenue Invested for Managing Financial Risk

The present study investigates annual revenue invested by software companies for managing financial risk. The annual revenue invested for managing financial risk is presented in table 4.8.

Table 4.8

Annual Revenue Invested for Managing Financial Risk

Annual Revenue Invested (%)	Frequency	Percentage
Below 10	54	9.7
10-25	134	23.9
25-50	94	16.8
50-75	157	28
75-100	121	21.6
Total	560	100

Source: Primary Data

It is observed that 9.7 percent of software companies invest below 10% of their annual revenue in managing financial risk, 23.9 percent invest 10-25%, 16 percent invest 25-50%, 28 percent invest 50-75%, and 21.6 percent invest 75-100% of their annual revenue in managing financial risk. Thus, the majority of software companies invest 50-75% of their annual revenue in managing financial risk.

4.6.9 Completion of Software Project on Time

To better understand the distribution of project completion times, the study classifies the completion of projects into five distinct categories based on the percentage of projects completed on time. These categories are: 'below 10%' for projects that were significantly delayed, '10-25%' for those with some delay, '25-50%' for moderately delayed projects, '50-75%' for projects that were closer to being on schedule but still delayed, and '75-100%' for projects that were mostly or entirely completed on time. This classification allows for a detailed understanding of how often projects meet their deadlines and the degree of delay when they do not. The table 4.9 presents the completion of software projects on time.

Table 4.9

Completion of Software Project on Time

Completion of Software Project on Time (%)	Frequency	Percentage
Below 10	4	0.7
10-25	43	7.7
25-50	99	17.7
50-75	183	32.7
75-100	231	41.3
Total	560	100

Source: Primary Data

It is inferred from table that the majority of the software companies complete 75-100% of the software project on time, followed by 50-75%, 25-50% and 10-25% of the projects.

4.6.10 Completion of Software Project on Budgeted Amount

For the purpose of the study, completion of the software project on the budgeted amount is considered. It includes projects completed within the budgeted amount and projects completed out of the budgeted amount. By examining both categories, the study aims to assess how often projects meet their budget

targets and the potential reasons for any discrepancies, which could offer valuable insights into financial risk management. Table 4.10 provides a comprehensive overview of how the respondents' projects align with or diverge from the budgeted amounts.

Table 4.10

Completion of Software Project on Budgeted Amount

Completion of Software Project on Budgeted Amount	Frequency	Percentage
Project completed within the budgeted amount	193	34.46
Project completed out of the budgeted amount	367	65.54
Total	560	100

Source: Primary Data

It is observed from the table that, 34.46 percent of software companies complete the project within the budgeted amount and 65.54 percent of software companies complete the project out of the budgeted amount. So, it can be concluded that the majority of the software companies complete the project out of the budgeted amount.

4.6.11 Average Time Spent on Software Project

The present research examines the average amount of time spent on software projects, which is determined by grouping the average time spent into four groups: under two months, between two and four months, between four and six months, and six and above months. The average time spent on software projects is given in table 4.11.

Table 4.11

Average Time Spent on Software Project

Average Time Spent on Software Project (Months)	Frequency	Percentage
0-2	116	20.7
2-4	151	27
4-6	127	22.7
6 and above	166	29.6
Total	560	100

Source: Primary Data

From the table, it is evident that 20.7 percent of the software companies spent 0-2 months, 27 percent of them spent 2-4 months, 22.7 percent of them spent 4-6 months and 29.6 percent spent over 6 months. Therefore, it can be concluded that the majority of the software companies take six and more months on software projects.

Section B

Section B of this chapter discusses various financial risk factors that can impact IT projects in software companies. These risk factors are critical because they directly affect the financial performance, stability, and overall profitability of these businesses. In the continually changing IT sector, software businesses face unique financial challenges such as volatile market conditions, cost overruns, and unexpected technology advances, all of which can have a significant impact. Financial risks can emerge in a variety of ways, such as insufficient budgeting, project delays, unexpected technical obligations, or failure to produce expected earnings from software products or services. Addressing these financial risk factors is essential not just for avoiding possible losses, but also for recognizing chances for innovation and economic growth. By successfully identifying and controlling these risks, businesses can make intelligent choices that protect their financial interests, maximize resource allocation, and, ultimately, ensure the success of their IT projects. As a result, an in-depth knowledge of these risk factors is vital for software companies striving for success in an extremely competitive and fluctuating market.

4.7 Financial Risk Factors of Information Technology Projects of Software Companies

In this section, the researcher analysed financial risk factors based on the nature of the software company, area of software company, average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on budgeted amount and average time spent on software project. To achieve the objective, tools like Arithmetic Mean, Standard Deviation, Levene's Test for Homogeneity of Variance, One-way ANOVA, Tukey HSD Post-Hoc Test for Multiple Comparisons and Independent Sample t-test were used.

4.7.1 Financial Risk Factors Based on the Nature of Software Company

In this section, the research mainly concentrates on financial risk factors such as technology, requirement, organisation, scope, design, and resources. The nature of software companies are grouped into small, medium, and large. To analyse significant differences among financial risk factors and the nature of software companies, Levene's Test for Homogeneity of Variance, One-way ANOVA, and Tukey HSD Post-Hoc Test for Multiple Comparisons are applied and the following hypothesis is tested.

Ho: There is no significant difference between financial risk factors and the nature of software company

The table 4.12 presents the homogeneity test of financial risk factors based on the nature of the software company.

Table 4.12

Homogeneity Test of Financial Risk Factors Based on the Nature of Software Company

	Levene statistic	Sig
Technology	1.241	0.288
Requirement	2.643	0.072
Organizational	0.156	0.855
Scope	1.355	0.258
Design	4.121	0.017
Resource	8.356	0.062

Source: Primary Data

Levene's test of homogeneity is employed to determine whether the variances of groups are equal, which is a necessary assumption for various statistical tests, particularly Analysis of Variance. The result of the test indicates that it is insignificant at the 5% level. More specifically, since all the p-values from Levene's test are greater than 0.05, the null hypothesis is accepted, implying that the variances for all the groups being compared are approximately equal. This satisfies the assumption of homogeneity of variances, which is a necessary condition for conducting a valid ANOVA test. One-way ANOVA is used to test for statistically significant differences between the means of three or more independent groups. Since the homogeneity of variance assumption holds, the results of the One-Way ANOVA can be interpreted with confidence, ensuring that the test is valid and the conclusions drawn from it are reliable.

The table 4.13 shows the comparison of financial risk factors based on the nature of the software company

Table 4.13

Comparison of Financial Risk Factors on the Nature of Software Company

Financial Risk Factors	Nature of Software Company			F Value	P Value	Remarks
	Small	Medium	Large			
Technology	3.40 (1.27)	3.52 (1.24)	3.59 (1.24)	0.81	0.445	Insignificant
Requirement	3.48 (1.21)	3.54 (1.20)	3.76 (1.16)	3.05	0.048	Significant
Organisational	3.66 (1.14)	3.67 (1.14)	3.72 (1.18)	0.18	0.835	Insignificant
Scope	3.57 (1.23)	3.64 (1.16)	3.77 (1.17)	1.38	0.251	Insignificant
Design	3.48 (1.24)	3.59 (1.21)	3.80 (1.15)	3.34	0.036	Significant
Resource	3.50 (1.28)	3.67 (1.22)	3.89 (1.12)	4.73	0.009	Significant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 4.13 demonstrates the results of financial risk factors based on the nature of the software company. Technology, requirement, organisational, scope, design and resources are considered as financial risk factors for measuring the nature of software company. As per descriptive statistics, financial risk factors are potentially high in large-sized software companies as compared with medium and small. When compared to other factors, it is also evident that resource-related factors have a significant impact.

It is also clear that the Requirement (p= 0.048), Design (p= 0.036) and Resource (p= 0.009) show statistically significant results towards the nature of the software company. Therefore null hypothesis is rejected at a 5% level of significance and thus the financial risk factors influence the nature of the software company.

But the financial risk factors of Technology (‘p’= 0.445 > 0.05), Organisational (‘p’= 0.835 > 0.05) and Scope (‘p’= 0.251 > 0.05) are not been statistically significant at 5% level of significance. That means the null hypothesis is failed to reject and there is no significant difference among small, medium, and large companies based on these factors.

For precise analysis of the difference, post hoc analyses were conducted using the Tukey HSD test.

The result of the same is given in Table 4.14

Table 4.14

Multiple Comparison of Financial Risk Factors on Nature of Software Company

Financial Risk Factors	Tukey HSD			
	Nature (I)	**Nature (J)**	**Mean Difference**	**Sig**
Requirement	Small	Medium	-0.067	**0.004**
		Large	-0.285	**0.003**
	Medium	Small	0.067	**0.017**
		Large	0.218	**0.012**
	Large	Small	0.285	**0.011**
		Medium	0.218	**0.003**
Design	Small	Medium	0.071	0.282
		Large	0.202	**0.012**
	Medium	Small	0.071	**0.017**
		Large	0.131	**0.013**
	Large	Small	0.202	**0.015**
		Medium	0.131	**0.006**
Resource	Small	Medium	0.154	**0.038**
		Large	-0.384	**0.010**
	Medium	Small	0.154	**0.023**
		Large	0.230	**0.013**
	Large	Small	0.384	**0.010**
		Medium	0.230	**0.042**

Source: Primary Data

The table 4.14 shows the multiple comparisons of financial risk factors such as requirement-related, design-related and resource-related on the nature of software companies such as small, medium and large. The results exhibit that there exists a pairwise difference among requirement-related factors in small, medium and large software companies as the ‘p’ values are lower than 0.05. In the case of design related factors, the comparison of small with large reveals a significant pairwise difference but no difference exists when comparing small with the medium as the ‘p’ value is 0.282 which is higher than the 5% level of significance. Further analysing medium and large software company it depicts that there exists a significant pairwise difference. In the multiple comparisons of resource-related factors with small, medium and large software companies, there exist pairwise differences since the p values are lower than 0.05. Thus, it can be concluded that there exists a comparable difference between requirement-related, design-related and resource-related factors based on the nature of the software company.

4.7.2 Financial Risk Factors Based on Area of Software Company

Risk factors such as technology, requirement, organization, scope, design, and resources are the main focus of the study. Software companies can be classified as urban and city. The Independent Sample t-test is used to examine significant differences between financial risk factors based on the area of the software company and the hypothesis framed for the study is tested.

Ho: There is no significant difference between financial risk factors and the area of software company

Financial risk factors based on the area of the software company are given in table 4.15

Table 4.15

Financial Risk Factors Based on the Area of Software Company

Financial Risk Factors	Area of Software Company				Remarks
	Urban	City	T Value	P Value	
Technology	3.52 (1.25)	3.51 (1.24)	0.219	0.728	Insignificant
Requirement	3.55 (1.26)	3.65 (1.17)	0.845	0.187	Insignificant
Organisational	3.70 (1.19)	3.68 (1.14)	0.135	0.306	Insignificant
Scope	3.72 (1.16)	3.67 (1.19)	0.395	0.310	Insignificant
Design	3.65 (1.23)	3.66 (1.19)	0.054	0.714	Insignificant
Resource	3.75 (1.23)	3.71 (1.19)	0.284	0.471	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Based on the mean score, it can be inferred that software companies in urban areas are highly affected by financial risk factors as compared with software companies in the city. It can also understood that resource-related risk factors affect more in the case of urban (3.75) and city (3.71) followed by other factors. It can also be seen that the technology-related risk factors are least affected in the case of urban (3.52) and city (3.51).

It also states that, since p values are higher than 0.05, the null hypothesis is accepted with regard to financial risk factors based on the area of the software company. Hence, there is no significant difference between the area of software companies based on financial risk factors such as technology, requirement, organization, scope, design, and resource.

4.7.3 Financial Risk Factors Based on Average Number of Software Projects

In this section, the study primarily relies on financial risk factors such as technology, requirement, organisation, scope, design, and resources. The average number of software projects are categorized into below 10, 10-25, 25-50, 50-75, and 75-100. To analyse significant differences among financial risk factors based on the average number of software projects Levene's Test for Homogeneity of Variance, One way ANOVA, Tukey HSD Post-Hoc Test for Multiple Comparison Test are applied and the following hypothesis is developed and tested.

Ho: Financial risk factors do not influence the average number of software projects

The table 4.16 shows the homogeneity test of financial risk factors based on the average number of software projects.

Table 4.16

Homogeneity Test of Financial Risk Factors Based on Average Number of Software Projects

	Levene Statistic	Sig
Technology	2.21	0.06
Requirement	1.33	0.25
Organizational	2.38	0.06
Scope	0.95	0.43
Design	1.24	0.21
Resource	1.60	0.17

Source: Primary Data

At a 5% level of significance, the 'p' values obtained from the statistical tests are considered insignificant, that they are greater than the critical value of 0.05. In the context of the homogeneity of variance test, the null hypothesis assumes that the variances of the groups being compared are equal. Since the 'p' values are greater than 0.05, hence the null hypothesis is accepted, suggesting that there are no significant differences in the variances between the groups. This outcome implies that the assumption of homogeneity of variances has been met. Homogeneity of variance is an important condition in many statistical tests, including One-Way ANOVA. Since the homogeneity test has been satisfied (i.e., the variances are approximately equal across the groups), it confirms that the data meets one of the critical assumptions for conducting One-Way ANOVA. This means that the results of the ANOVA can be trusted to provide accurate insights into whether there are statistically significant differences in the means of the different groups. Consequently, the One-Way ANOVA is appropriate for testing the hypothesis, allowing for comparisons among the group means to assess if there are any significant differences in the financial risk factors based on average number of projects undertaken ny software companies.

The table 4.17 exhibits multiple comparisons of financial risk factors based on the average number of software projects

Table 4.17

Comparison of Financial Risk Factors on Average Number of Software Projects

Financial Risk Factors	Average Number of Software Projects in a Year					F Value	P Value	Remarks
	Below 10	10-25	25-50	50-75	75-100			
Technology	3.41 (1.28)	3.53 (1.25)	3.50 (1.25)	3.62 (1.18)	3.47 (1.30)	0.37	0.826	Insignificant
Requirement	3.44 (1.30)	3.53 (1.19)	3.64 (1.18)	3.57 (1.21)	3.77 (1.14)	0.87	0.041	Significant
Organisational	3.55 (1.33)	3.69 (1.15)	3.68 (1.13)	3.75 (1.10)	3.64 (1.23)	0.26	0.878	Insignificant
Scope	3.57 (1.26)	3.73 (1.14)	3.70 (1.18)	3.65 (1.20)	3.70 (1.20)	0.13	0.969	Insignificant
Design	3.27 (1.43)	3.69 (1.19)	3.71 (1.11)	3.71 (1.11)	3.56 (1.23)	1.13	0.340	Insignificant
Resource	3.59 (1.30)	3.58 (1.28)	3.66 (1.20)	3.76 (1.16)	3.87 (1.16)	1.14	0.334	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 4.17, indicates the financial risk factors such as technology, requirement, organisational, scope, design, and resources for measuring the average number of software projects. As per descriptive statistics, it is very clear that resource-related factors are highly influenced by the average number of software projects and technology-related factors have less influence.

From the table, it is also clear that the Requirement (p= 0.041) shows a statistically significant result towards the average number of software projects. Therefore null hypothesis is rejected at a 5% level of significance and thus the financial risk factors influence the average number of projects undertaken by the software companies.

But the financial risk factors namely Technology (‘p’= 0.826 > 0.05), Organizational (‘p’= 0.898 > .005), Scope (‘p’= 0.969 > 0.05), Resource (‘p’= 0.334 > 0.05) and Design (‘p’= 0.340 > 0.05) are not statistically significant at 5% level. This indicates that, depending on these factors, there is no significant difference in the average number of software projects, and the null hypothesis cannot be rejected.

To thoroughly examine the difference, post-hoc comparisons were performed using the Tukey HSD test. Multiple comparison of financial risk factors based on the average number of software projects is presented in table 4.18.

Table 4.18

Multiple Comparison of Financial Risk Factors Based on Average Number of Software Projects

Financial Risk Factors	Tukey HSD			
	Average Number of Projects (I)	Average Number of Projects (J)	Mean Difference	Sig
Requirement	Below 10	10-25	0.086	**0.004**
		25-50	0.196	**0.043**
		50-75	-0.125	**0.011**
		75-100	0.323	**0.002**
	10-25	Below 10	0.086	**0.014**
		25-50	-0.109	**0.003**
		50-75	-0.038	**0.009**
		75-100	0.236	**0.011**
	25-50	Below 10	0.196	0.114
		10-25	0.109	**0.032**
		50-75	0.071	0.313
		75-100	0.127	0.541

Financial Risk Factors	Tukey HSD			
	Average Number of Projects (I)	**Average Number of Projects (J)**	**Mean Difference**	**Sig**
	50-75	Below 10	0.125	**0.024**
		10-25	0.038	**0.016**
		25-50	0.071	**0.012**
		75-100	0.198	**0.015**
	75-100	Below 10	-0.323	0.529
		10-25	0.236	**0.044**
		25-50	0.127	**0.025**
		50-75	-0.198	**0.013**

Source: Primary Data

The Table 4.18 presents that there exists a significant pairwise difference of requirement-related factors with below 10, 10-25 and 50-75 since the ‘p’ values are lower than 0.05. While comparing 25-50 with 10-25 shows a pairwise difference. But no significant difference exists when comparing 25-50 with below 10, 50-75 and 75-100. Further stating the comparison of 75-100 with below 10, it shows an insignificant difference as the p-value is 0.529. Meanwhile comparing 75-100 with 10-25, 25-50 and 50-75 shows that there exist pairwise differences since the p values are lower than the 5% level of significance. Therefore, the result of the post hoc test explains that there exists a significant difference among requirement-related factors based on the average number of projects undertaken by software companies.

4.7.4 Financial Risk Factors Based on Annual Revenue Invested for Managing Financial Risk

In this section, the study emphasizes financial risk factors such as technology, requirement, organisation, scope, design, and resources. Annual revenue invested for managing financial risk is categorised into below 10, 10-25, 25-50, 50-75, and 75-100. To analyse significant differences among financial risk factors based on annual revenue invested for managing financial risk, Levene’s Test for Homogeneity of

Variance, One Way Anova, Tukey HSD Post-Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Financial risk factors do not affect the annual revenue invested for managing the financial risk of software companies

The result of the homogeneity test of financial risk factors based on annual revenue invested for managing financial risk is presented in Table 4.19

Table 4.19

Homogeneity Test of Financial Risk Factors Based on Annual Revenue Invested for Managing Financial Risk

	Levene statistic	Sig
Technology	1.261	0.281
Requirement	2.663	0.076
Organisational	0.159	0.854
Scope	1.362	0.252
Design	3.128	0.112
Resource	1.357	0.259

Source: Primary Data

From the Table 4.19, it is evident that the results of Levene's Test of Homogeneity of Variance are insignificant at the 5% level of significance. This is determined because all the 'p' values in the table are greater than 0.05, which indicates that there is no statistically significant difference in the variances across the groups being tested. Given that the homogeneity assumption has been met (i.e., the population variances for each group are approximately equal), the next step is to proceed with testing the hypothesis using One-Way ANOVA. The results of this ANOVA test are presented in Table 4.20, where you would typically find the F-statistic, p-value, and other relevant information that would allow you to draw conclusions about whether the means of the groups are statistically different or not.

Table 4.20

Comparison of Financial Risk Factors on Annual Revenue Invested for Managing Financial Risk

Financial Risk Factors	Annual revenue invested for managing financial risk (%)					F Value	P Value	Remarks
	Below 10	10-25	25-50	50-75	75-100			
Technology	3.71 (1.16)	3.66 (1.21)	3.41 (1.29)	3.46 (1.29)	3.50 (1.27)	1.031	0.387	Insignificant
Requirement	3.57 (1.18)	3.74 (1.10)	3.60 (1.20)	3.52 (1.25)	3.67 (1.19)	0.701	0.591	Insignificant
Organisational	4.10 (0.78)	3.74 (1.09)	3.59 (1.21)	3.54 (1.21)	3.71 (1.17)	2.634	0.033	Significant
Scope	3.89 (1.09)	3.88 (1.02)	3.52 (1.26)	3.63 (1.24)	3.57 (1.26)	2.142	0.074	Insignificant
Design	3.89 (1.09)	3.87 (1.09)	3.37 (1.32)	3.50 (1.28)	3.75 (1.16)	3.921	0.004	Significant
Resource	3.80 (1.18)	3.82 (1.15)	3.55 (1.25)	3.62 (1.23)	3.84 (1.16)	1.293	0.272	Insignificant

Source: Primary Data
Note: The values in the bracket indicate S D

The table 4.20 indicates the financial risk factors such as technology, requirement, organisational, scope, design and resources for measuring the annual revenue invested for managing financial risk. As per descriptive statistics, it is very clear that software companies invest the majority of their annual revenue in managing organisational factors as compared to other financial risk factors and it makes less investment in managing technology factors.

From the table, it is also clear that the Organisational (p=0.033) and Design (p=0.004) show statistically significant results towards annual revenue invested for managing financial risk. Therefore null hypothesis is rejected at a 5% level of significance and thus the financial risk factors influence the annual revenue invested for managing financial risk.

But the financial risk factors such as Technology ('p'= 0.387 > 0.05), Requirement ('p'= 0.591 > .005), Scope ('p'= 0.074 > 0.05) and Resources ('p'= 0.270 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis is failed to reject and there is no significant difference in annual revenue invested for managing financial risk based on these factors.

For precise analysis of the difference, post hoc analysis were conducted by using the Tukey HSD test. The result of the same is given in table 4.21.

Table 4.21

Multiple Comparison of Financial Risk Factors Based on Annual Revenue Invested for Managing Financial Risk

Financial Risk Factors	Tukey HSD			
	Annual Revenue (I)	**Annual Revenue (J)**	**Mean Difference**	**Sig**
Organisational	Below 10	10-25	0.351	**0.021**
		25-50	0.504	**0.017**
		50-75	0.559	**0.015**
		75-100	-0.382	**0.032**
	10-25	Below 10	0.354	**0.014**
		25-50	0.153	**0.013**
		50-75	-0.202	**0.024**
		75-100	0.034	**0.015**
	25-50	Below 10	0.502	**0.038**
		10-25	-0.151	**0.024**
		50-75	0.056	**0.011**
		75-100	0.123	**0.032**
	50-75	Below 10	0.551	**0.024**
		10-25	0.202	**0.016**
		25-50	-0.052	**0.006**
		75-100	0.175	**0.012**
	75-100	Below 10	0.386	**0.013**
		10-25	0.032	**0.424**
		25-50	-0.121	**0.005**
		50-75	0.172	**0.041**

Financial Risk Factors	Tukey HSD			
	Annual Revenue (I)	**Annual Revenue (J)**	**Mean Difference**	**Sig**
Design	Below 10	10-25	0.013	**0.005**
		25-50	-0.524	**0.001**
		50-75	-0.394	**0.019**
		75-100	-0.133	**0.006**
	10-25	Below 10	0.016	**0.015**
		25-50	0.507	**0.040**
		50-75	0.375	**0.007**
		75-100	0.124	**0.032**
	25-50	Below 10	-0.522	**0.003**
		10-25	0.503	**0.006**
		50-75	0.124	**0.029**
		75-100	0.387	**0.006**
	50-75	Below 10	0.395	**0.012**
		10-25	0.376	**0.003**
		25-50	0.124	**0.038**
		75-100	0.258	**0.014**
	75-100	Below 10	-0.139	**0.039**
		10-25	0.122	**0.028**
		25-50	0.381	**0.008**
		50-75	0.253	**0.034**

Source: Primary Data

From the table 4.21, it is clear that there exists a significant pairwise difference between organisational factors based on annual revenue categories: below 10, 10-25, 25-50 and 50-75. When comparing 75-100 with 10-25 there is no pairwise difference exist as the p value is 0.424 which is greater than 0.05. But there exist significant pairwise difference when comparing 75-100 with below 10, 25-50 and 50-75, since the p values are lower than 5% level of significance. It also reveals that there exist pairwise difference in the case of design factors with below 10, 10-25, 25-50, 50-75 and 75-100, as the p values are lower than 0.05. So, it can be concluded that the organisational and design factors shows a significant difference based on annual revenue invested for managing financial risk.

4.7.5 Financial Risk Factors Based on Completion of Software Project on Time

In this section, the study focuses on financial risk factors such as technology, requirement, organisational, scope, design and resources. Completion of software projects on time is categorised into below 20, 20-40, 40-60, 60-80 and 80-100. To analyse significant differences among financial risk factors based on completion of software projects on time Levene's Test for Homogeneity of Variance, One way ANOVA, and Tukey HSD Post-Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Financial risk factors do not affect the completion of the project on time

The table 4.22 illustrates the homogeneity test result of financial risk factors based on the completion of the project on time.

Table 4. 22

Homogeneity Test of Financial Risk Factors Based on Completion of Project on Time

	Levene statistic	Sig
Technology	9.84	0.57
Requirement	6.01	0.82
Organisational	5.71	0.62
Scope	6.39	0.25
Design	9.36	0.08
Resource	7.85	0.35

Source: Primary Data

Table 4.22 presents the p-value from the statistical test, and it shows that the p-value is greater than 0.05 at the 5% level of significance in all cases. This indicates that the result is insignificant because the p-value exceeds the commonly accepted threshold for statistical significance (0.05) and this implies that the assumption for conducting One-Way ANOVA is satisfied, as the homogeneity of variance condition has been met. One-way ANOVA is used to test whether there are statistically significant differences in the means of the financial risk factors based on the completion of projects on time. Table 4.23 provides a detailed presentation of the results from the One-Way ANOVA analysis. It outlines the financial risk factors based on whether or not the projects were completed on time.

Table 4.23

Comparison of Financial Risk Factors Based on Completion of Project on Time

Financial Risk Factors	Completion of Project on Time (%)					F Value	P Value	Remarks
	Below 20	20-40	40-60	60-80	80-100			
Technology	3.00 (1.47)	3.35 (1.34)	3.44 (1.28)	3.41 (1.31)	3.71 (1.13)	2.18	0.070	Insignificant
Requirement	3.07 (1.40)	3.26 (1.32)	3.54 (1.21)	3.57 (1.23)	3.78 (1.09)	2.47	0.083	Insignificant
Organisational	3.78 (0.90)	3.39 (1.31)	3.57 (1.26)	3.71 (1.15)	3.78 (1.08)	1.32	0.261	Insignificant
Scope	3.70 (1.27)	3.21 (1.37)	3.77 (1.10)	3.57 (1.23)	3.83 (1.12)	2.74	0.028	Significant
Design	3.95 (1.34)	3.33 (1.30)	3.57 (1.30)	3.55 (1.24)	3.84 (1.06)	3.16	0.062	Insignificant
Resource	4.37 (0.32)	3.38 (1.40)	3.52 (1.28)	3.67 (1.23)	3.90 (1.08)	3.34	0.120	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

It is seen from the table that the technology, requirement, organisational, scope, design and resources are the financial risk factors for measuring the completion of the project on time. As per descriptive statistics, it is very clear that scope-related factors highly affect the software companies to complete the project on time and requirement-related factors of software companies show a low effect on the completion of the project on time.

From the table, it is also clear that, Scope (p=0.028) shows a statistically significant result based on the completion of the project on time. Therefore null hypothesis is rejected at a 5% level of significance and thus the financial risk factor influences the completion of the project on time.

But the financial risk factors namely Technology (‘p’= 0.070 > 0.05), Requirement (‘p’= 0.083 > .005), Organisational (‘p’= 0.261 > 0.05) Design (‘p’= 0.062 > 0.05) and Resources (‘p’= 0.120 > 0.05) are not statistically significant at 5% level of significance. That means the null hypotheses are accepted and there is no significant difference in the completion of the project on time based on these factors.

For precise analysis of the difference, post hoc analysis was conducted by using the Tukey HSD test. The table 4.24 explains Tukey HSD post hoc test results between financial risk factors based on the completion of the project on time.

Table 4.24

Multiple Comparison of Financial Risk Factors Based on Completion of Project on Time

Financial Risk Factors	Tukey HSD			
	Completion of Project (I)	**Completion of Project (J)**	**Mean Difference**	**Sig**
Scope	Below 20	20-40	0.486	**0.009**
		40-60	0.071	**0.007**
		60-80	0.126	**0.032**
		80-100	-0.132	**0.015**
	20-40	Below 20	0.486	**0.031**
		40-60	0.557	**0.012**
		60-80	0.359	**0.004**
		80-100	0.618	**0.040**
	40-60	Below 20	-0.071	**0.008**
		20-40	0.557	**0.024**
		60-80	0.197	**0.011**
		80-100	0.060	**0.019**
	60-80	Below 20	0.126	**0.032**
		20-40	-0.359	**0.029**
		40-60	0.197	**0.016**
		80-100	0.258	**0.022**

Financial Risk Factors	Tukey HSD			
	Completion of Project (I)	**Completion of Project (J)**	**Mean Difference**	**Sig**
	80-100	Below 20	-0.132	**0.041**
		20-40	0.318	**0.026**
		40-60	-0.060	**0.032**
		60-80	0.258	**0.017**

Source: Primary Data

It is evident from the table that there exist significant pairwise differences regarding scope-related factors based on the completion of the project on time as the p values are lower than the 5% level of significance.

4.7.6 Financial Risk Factors Based on Completion of Project on Budgeted Amount

Here, the study has a particular focus on factors that can increase financial risk, including technology, requirement, organisation, scope, design, and resources. Completion of projects on budgeted amount is classified into projects completed within the budgeted amount and projects completed out of budgeted amount. To analyse the significant difference between financial risk factors based on completion of the project on the budgeted amount, Independent Sample t Test is applied and the following hypothesis is tested.

Ho: Financial risk factors of software companies do not affect the completion of projects on budgeted amount

The table 4.25 explains the results of financial risk factors based on the completion of the project on budgeted amount.

Table 4.25

Financial Risk Factors Based on Completion of Project on Budgeted Amount

Financial Risk Factors	Completion of Project on Budgeted Amount		T Value	P Value	Remarks
	Project Completed within Budgeted Amount	Project Completed Out of Budgeted Amount			
Technology	3.87 (1.16)	3.83 (1.14)	0.245	0.143	Insignificant
Requirement	3.44 (1.10)	3.64 (1.11)	0.154	0.325	Insignificant
Organisational	3.65 (1.12)	3.83 (1.15)	0.654	0.412	Insignificant
Scope	3.77 (1.13)	3.94 (1.17)	0.473	0.550	Insignificant
Design	3.34 (1.10)	3.76 (1.14)	0.547	0.320	Insignificant
Resource	3.28 (1.09)	3.45 (1.11)	0.731	0.186	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D values

Based on the mean score, it can be inferred that Technology related factors (3.87) highly influence the software companies to complete the project on the budgeted amount and Scope related factors (3.94) highly affects the software companies to complete the project out of the budgeted amount.

It is also clear that, since p values are higher than 0.05, the null hypothesis is accepted with regard to financial risk factors based on the completion of the project on the budgeted amount. Hence, there is no significant difference between the completion of the project on the budgeted amount based on financial risk factors such as technology, requirement, organisation, scope, design, and resources.

4.7.7 Financial Risk Factors Based on Average Time Spent on Software Projects

In this section, the study considers financial risk factors such as technology, requirement, organisational, scope, design and resources. Average time spent on software project is categorised into below 0-2, 2-4, 4-6 and 6 and above months. To analyse significant differences among financial risk factors based on average time spent on software project, Levene's Test for Homogeneity of Variance, One-way ANOVA, Tukey HSD Post-Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Financial risk factors do not influence the average time spent on software project

The table 4.26 reveals the homogeneity test results of financial risk factors based on average time spent on software project.

Table 4. 26

Homogeneity Test of Financial Risk Factors Based on Average Time Spent on Software Project

	Levene statistic	Sig
Technology	2.87	0.59
Requirement	3.17	0.74
Organisational	6.66	0.62
Scope	1.99	0.46
Design	4.24	0.12
Resource	4.78	0.41

Source: Primary Data

Table 4.26 reveals that the p values of financial risk factors based on average time spent on software projects is greater than 0.05. Thus, it satisfies Levene's test conditions for One Way Anova. So, One way Anova can be applied for checking significant difference in financial risk factors based on average time spent on software project.

Table 4.27 exhibits the results of financial risk factors based on average time spent on software projects.

Table 4.27

Comparison of Financial Risk Factors Based on Average Time Spent on Software Project

Financial Risk Factors	Average Time Spent on Software Project (Months)				F Value	P Value	Remarks
	0-2	2-4	4-6	6 & Above			
Technology	3.49 (1.27)	3.64 (1.20)	3.46 (1.28)	3.52 (1.24)	0.54	0.650	Insignificant
Requirement	3.66 (1.19)	3.68 (1.13)	3.54 (1.21)	3.60 (1.22)	0.39	0.754	Insignificant
Organisational	3.69 (1.17)	3.82 (1.06)	3.70 (1.13)	3.55 (1.23)	1.39	0.244	Insignificant
Scope	3.74 (1.19)	3.74 (1.13)	3.63 (1.22)	3.63 (1.20)	0.38	0.762	Insignificant
Design	3.68 (1.20)	3.76 (1.12)	3.58 (1.21)	3.61 (1.25)	0.62	0.023	Significant
Resource	3.93 (1.11)	3.65 (1.24)	3.72 (1.15)	3.64 (1.25)	1.60	0.014	Significant

Source: Primary Data
Note: The values within the bracket indicate SD

The table 4.27 shows that the technology, requirement, organisational, scope, design and resources are the financial risk factors used for measuring the average time spent on software projects. As per descriptive statistics, it is very clear that resource-related factors have a greater impact on the average time spent on software projects and technology-related factors have a lower impact.

From Table 4.27, it is also clear that Design (p=0.028) and Resource (p=0.014) factors show statistically significant results based on average time spent on software projects. Therefore the null hypothesis is rejected at a 5% level of significance and thus the financial risk factors influences the average time spent on software projects.

But the financial risk factors such as Technology ('p'= 0.548 > 0.05), Requirement ('p'= 0.754 > .005), Organisational ('p'= 0.244 > 0.05) and Scope ('p'= 0.762 > 0.05) are not statistically significant at 5% level. This indicates that, based on these factors, there is no significant difference in the average amount of time spent on the project, and the null hypothesis is accepted.

For precise analysis of the difference in design and resource-related factors based on average time spent on software projects, post hoc analysis was conducted by using the Tukey HSD test. Table 4.28 presents the results of the Tukey HSD post hoc test between financial risk factors based on the average time spent on software projects.

Table 4.28

Multiple Comparison of Financial Risk Factors Based on Average Time Spent on Software Project

Financial Risk Factors	Tukey HSD			
	Average Time (I) (Months)	Average Time (J) (Months)	Mean Difference	Sig
Design	0-2	2-4	-0.731	**0.041**
		4-6	0.100	**0.013**
		6 & Above	0.079	**0.021**
	2-4	0-2	0.073	**0.042**
		4-6	0.174	**0.011**
		6 & Above	0.150	**0.023**
	4-6	0-2	-0.101	**0.009**
		2-4	0.176	**0.016**
		6 & Above	0.023	**0.020**
	6 & Above	0-2	0.077	**0.040**
		2-4	0.150	**0.032**
		4-6	0.023	0.599
Resource	0-2	2-4	0.279	**0.006**
		4-6	0.207	**0.015**
		6 & Above	0.290	**0.025**
	2-4	0-2	0.279	0.426
		4-6	-0.172	0.701
		6 & Above	0.011	**0.016**

Financial Risk Factors	Tukey HSD			
	Average Time (I) (Months)	**Average Time (J) (Months)**	**Mean Difference**	**Sig**
Resource	4-6	0-2	0.207	**0.024**
		2-4	0.072	**0.031**
		6 & Above	-0.083	**0.040**
	6 & Above	0-2	-0.292	**0.029**
		2-4	-0.014	**0.036**
		4-6	0.085	**0.018**

Source: Primary Data

The multiple comparisons of design-related factors on average time such as 0-2, 2-4 and 4-6, show there exists a significant pairwise difference as the p values are lower than 0.05. When comparing 6 and above with 4-6, depicts an insignificant difference since the p-value is 0.599. The pairwise comparison of 6 and above with 0-2 and 2-4 shows a significant difference. In the case of resource-related factors, the pairwise comparison of 2-4 with 0-2 and 4-6, reveals insignificant differences as the p values are 0.426 and 0.701. Further the pairwise comparison of 0-2, 4-6 and 6 and above shows significant differences. Therefore, it can be concluded that there exists a significant difference between design and resource-related factors based on average time spent on software projects.

Section C

This section of the chapter focuses on Confirmatory Factor Analysis (CFA) as a method for examining and validating the financial risk factors associated with financial risk management techniques and financial risk mitigation strategies. Specifically, the researcher is using CFA to assess how well the proposed measurement model fits the observed data. The researcher is particularly interested in determining the validity and reliability of the model. In addition to the technical analysis, tables summarizing the results of the CFA are provided in the chapter, along with detailed interpretations of those results. These tables typically include information such as the factor loadings (which show how strongly each observed variable is associated with its corresponding latent variable), the error terms (which account for the unexplained variance in the observed variables), and the fit indices (which indicate how well the model fits the data). The interpretations of these tables help the researcher conclude whether the model is valid and reliable.

4.8. Confirmatory Factor Analysis of Financial Risk Factors and Usage of Financial Risk Management Techniques

This section of the chapter describes the testing of the measurement model to verify the accuracy and dependability of the scale. Confirmatory factor analysis is used to evaluate how well a predetermined factor model fits a given set of observed data and to explain the findings of model testing carried out to validate the accuracy and reliability of the scale measure. It provides estimates for each measurement model parameter. In this particular study, the measurement model consists of 54 observable variables, which are the direct indicators or items measured in the survey or data collection process. Along with these observable variables, there are 54 error elements (denoted as e1 to e54), representing the measurement errors associated with each observable variable. Measurement errors can arise from various sources, such as biases, random fluctuations, or inaccuracies in the data collection process. These error terms are important for understanding the degree of reliability of each measurement. Furthermore, the model also includes 10 unobserved variables, which are latent factors or constructs that are not directly measured but are inferred from the observed variables. These unobserved variables are the key concepts the study aims to measure. The 10 unobserved variables in this study are:

1. Technology: The role of technology as a latent factor impacting financial risk in IT projects

2. Requirement: The impact of project requirements on financial risks

3. Organisational: Organizational factors contributing to financial risks in software projects

4. Scope: The influence of project scope on financial risk

5. Design: How the design phase of a project contributes to financial risk

6. Resource: The effect of resources on financial risk
7. Usage of Financial Risk Planning Techniques (UP): The extent to which financial risk planning techniques are used in managing risks
8. Usage of Financial Risk Identification Techniques (UI): The role of techniques used to identify financial risks in IT projects
9. Usage of Financial Risk Analysis Techniques (UA): The use of analysis techniques to evaluate and assess financial risks
10. Usage of Financial Risk Monitoring and Controlling Techniques (UM): The application of techniques to monitor and control financial risks during a project

4.9 Evaluation Criteria for CB- CFA Models

While performing CFA, it is essential to establish reliability (Composite reliability) and construct validity (convergent and discriminant validity). Composite reliability (CR) assures that a construct is reliably measured by its indicators, whereas construct validity assures that the constructs are appropriate representations of the theoretical concepts they are supposed to test. Both convergent and discriminant validity tests help to ensure that the constructs are not only well-measured but also different from one another. It enables the researcher to assess the hypothesis demonstrating the relationship between the variables that are observed and the presence of underlying latent constructs (Suhr, 2009). The following tools are applied for the evaluation of the measurement model:

1. Composite Reliability (CR)

Composite reliability (CR) is a key indicator for assessing the overall dependability of a construct in a measurement model. It evaluates how consistently the parameters (observed variables) measure the latent construct they are meant to represent. CR values vary from 0 to 1, with higher values indicating greater reliability. A CR score greater than 0.7 is usually deemed satisfactory, implying that the construct is accurately measured by its parameters. According to Hair et al. (2010), a CR value greater than 0.7 implies good reliability, which allows the researcher to be confident that the observed variables accurately describe the latent construct. However, if the CR value is less than 0.6, it indicates weak internal consistency, implying that the parameters used are not sufficiently reliable to represent the latent construct and that the measurement model may require refinement.

2. Construct Validity

This validity ensures whether the construct is valid to explain the theory. Construct validity refers to how precisely a measurement model represents the theoretical construct it is intended to measure. Construct validity is determined using two main methods: convergent validity and discriminant validity. These methods ensure that the measurement model accurately measures the desired constructs (convergent validity) while simultaneously distinguishing different constructs (discriminant validity).

a) Convergent Validity

Convergent Validity is measured by using the values of Average Variance Extracted (AVE). Convergent validity describes the degree to which various indicators (observed variables) of a construct are associated, indicating that they all measure the same underlying concept. The Average Variance Extracted (AVE) is a widely used measure of convergent validity that quantifies the amount of variance in indicators covered by the latent construct. AVE values range from 0 to 1, with higher values indicating more convergent validity. For a construct to have acceptable convergent validity, the AVE must be larger than 0.50. This suggests that the latent construct accounts for more than 50% of the variance in the observable variables, indicating that those variables are accurately capturing the fundamental aspects of the construct.

b) Discriminant Validity

This signifies the extent to which a construct differs from other constructs. It confirms that the constructs do not measure the same thing and that each latent variable contributes uniquely to the overall model. One popular method for verifying discriminant validity is to compare the AVE of a construct to the Maximum Shared Variance (MSV) of that construct and any other constructs in the model. For discriminant validity to apply, the AVE must be greater than the MSV. This means that the variance shared between a construct and its indicators (AVE) should be greater than the variance shared by any other construct in the model (MSV), indicating that each construct is sufficiently distinctive from the others.

The figure 4.1 presents the confirmatory factor analysis of financial risk factors and usage of financial risk management techniques

Figure 4.1

Confirmatory Factor Analysis of Financial Risk Factors and Usage of Financial Risk Management Techniques

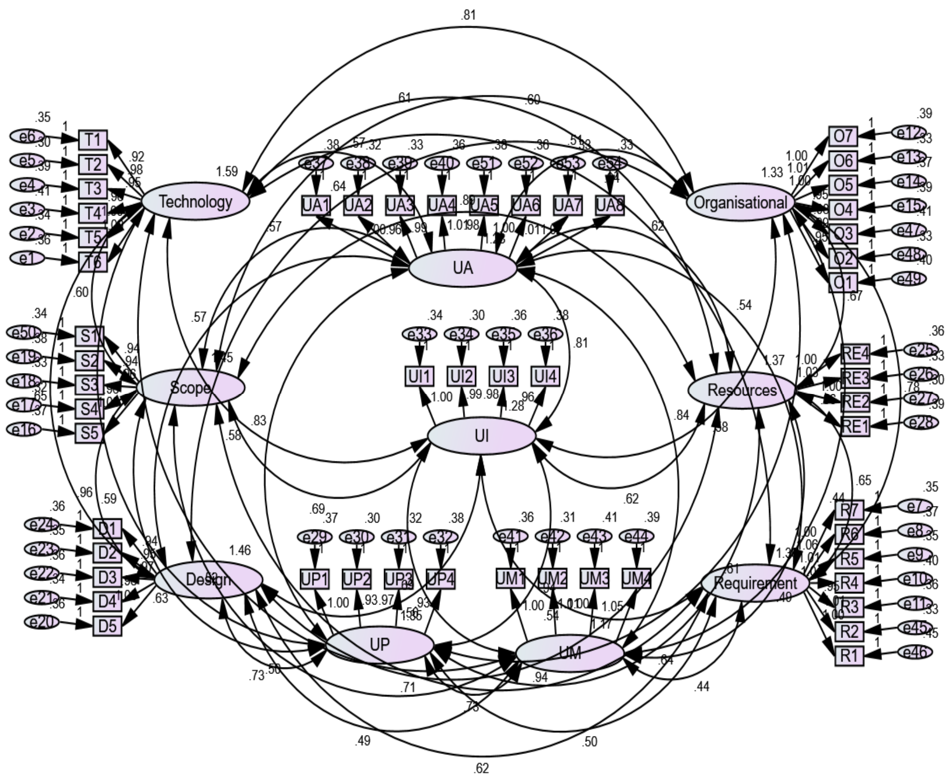


Figure 4.1 provides a detailed representation of the Confirmatory Factor Analysis (CFA) of financial risk factors and the use of financial risk management techniques. It displays the estimates for each measurement parameter, including both observed and error estimates, along with the beta coefficients that quantify the relationships between the factors and the observed variables. The figure shows that the factor loadings for each dimension (construct) are strong, indicating that the observed variables are effectively capturing the latent constructs. Finally, it is concluded that

the model, which consists of ten constructs, offers a good fit, meaning that it adequately represents the relationships among the variables and is suitable for further analysis. The model fit is checked by using the following indices,

a) CMIN/DF (Minimum Discrepancy Function by Degrees of Freedom)
b) CFI (Comparative Fit Index)
c) GFI (Goodness of Fit Index)
d) AGFI (Adjusted Goodness of Fit Index)
e) RMSEA (Root Mean Square Error of Approximation)

The table 4.29 reveals model fit indices for financial risk factors and usage of financial risk management techniques

Table 4.29

Model Fit Indices for Financial Risk Factors and Usage of Financial Risk Management Techniques

Model Fit Indices	Model Values	Threshold	Interpretation
CMIN/DF	1.451	Between 1 and 5	Excellent
CFI	0.982	> 0.95	Excellent
GFI	0.987	> 0.9	Excellent
AGFI	0.978	> 0.9	Excellent
RMSEA	0.028	< 0.08	Excellent

Source: Primary Data

For a model to be considered valid, the Chi-Square to degrees of freedom ratio must be smaller than 5. The value in this instance is 1.451, which is well within the recommended maximum value. The GFI, AGFI, and CFI values are all greater than 0.9. Additionally, the RMSEA value is 0.028, which is far below the acceptable threshold score of 0.08. Given these strong fit indices, the model can be confidently considered for further analysis**,** as it demonstrates both a good overall fit and an accurate approximation of the data. These results suggest that the model is both reliable and valid in its representation of the relationships among the variables being studied.

The table 4.30 shows the reliability and validity of the CFA model for financial risk factors and the usage of financial risk management techniques.

Table 4.30

Reliability and Validity of CFA Model for Financial Risk Factors and Usage of Financial Risk Management Techniques

Constructs	Item Code	Factor Loading	AVE	MSV	CR
Technology	T1	0.891	0.805	0.413	0.961
	T2	0.913			
	T3	0.886			
	T4	0.884			
	T5	0.907			
	T6	0.902			
Requirement	R1	0.866	0.786	0.413	0.963
	R2	0.898			
	R3	0.878			
	R4	0.881			
	R5	0.894			
	R6	0.898			
	R7	0.892			
Organisational	O1	0.868	0.776	0.335	0.960
	O2	0.894			
	O3	0.872			
	O4	0.869			
	O5	0.885			
	O6	0.898			
	O7	0.880			
Scope	S1	0.889	0.794	0.440	0.951
	S2	0.878			
	S3	0.897			
	S4	0.900			
	S5	0.891			

Constructs	Item Code	Factor Loading	AVE	MSV	CR
Design	D1	0.882	0.793	0.444	0.950
	D2	0.889			
	D3	0.891			
	D4	0.897			
	D5	0.895			
Resource	RE1	0.873	0.798	0.444	0.941
	RE2	0.907			
	RE3	0.903			
	RE4	0.890			
UP	UP1	0.887	0.782	0.51	0.935
	UP2	0.891			
	UP3	0.893			
	UP4	0.867			
UI	UI1	0.888	0.781	0.51	0.934
	UI2	0.900			
	UI3	0.878			
	UI4	0.868			
UA	UA1	0.879	0.785	0.471	0.967
	UA2	0.885			
	UA3	0.889			
	UA4	0.886			
	UA5	0.873			
	UA6	0.885			
	UA7	0.894			
	UA8	0.894			
UM	UM1	0.873	0.766	0.47	0.924
	UM2	0.892			
	UM3	0.861			
	UM4	0.876			

Source: Primary Data

Table 4.30 exhibits the use of Standardized Factor Loadings (SFL), Composite Reliability (CR), Average Variance Extracted (AVE), and Maximum Shared Variance (MSV). Standardized factor loading values are greater than 0.5, indicating that all dimensions sufficiently contribute to the constructs. The values of Composite Reliability are greater than 0.7, the values of AVE are greater than 0.5, and the values of CR of the constructs are greater than AVE. These three conditions are met in terms of Convergent Validity. Convergent Validity is so demonstrated. MSV and AVE are also used to demonstrate the scale's discriminant validity. In this case, the values of AVE are higher than the MSV across all dimensions. Consequently, the discriminant validity criteria were further demonstrated.

4.10 Confirmatory Factor Analysis of Financial Risk Factors and Financial Risk Mitigation Strategies

Confirmatory factor analysis is a useful tool for assessing how well a predefined factor model fits a particular collection of observed data and for explaining the results of model testing and undertakes to confirm the validity and reliability. It provides estimates for each measurement model parameter. There are 52 observable variables that can be directly measured and are used as indicators for the latent variables. The model includes 52 error elements (e1 to e52), which represent the measurement errors associated with each observable variable. There are 10 unobserved variables (latent variables), which are theoretical constructs that cannot be directly measured but are inferred from the observed variables. These 10 latent variables are central to the model and represent broad concepts such as technology, requirement, organizational, scope, design, resources, risk transfer, risk acceptance, risk avoidance and risk sharing. The following are the unobserved variables in this measurement model:

1. Technology: A latent construct that might represent technological factors, systems, or innovations that influence the overall model but cannot be directly measured.

2. Requirement: Represents the underlying needs or requirements, which could refer to project or system specifications that shape the observed variables.

3. Organisational: Likely refers to organizational factors such as commitment, structure, or policies that impact the model's observed outcomes.
4. Scope: A latent variable capturing the breadth or extent of a particular domain, such as project scope or business scope, which influences observed outcomes.
5. Design: Represents the design-related factors in the model, which could be related to product design, system design, or other planning aspects.
6. Resource: Refers to underlying resources that affect the observed variables but are not directly measurable.
7. Risk transfer strategies: A latent construct representing strategies employed to shift risks from one party to another, such as through insurance or contractual agreements.
8. Risk acceptance strategies: This factor pertains to the underlying approach where risks are accepted as a part of decision-making, without efforts to reduce or transfer them.
9. Risk avoidance strategies: Refers to the latent strategies aimed at reducing or eliminating risks, such as avoiding risky ventures or activities.
10. Risk sharing strategies: This unobserved variable represents strategies to share risks between different parties, such as joint ventures or partnerships.

The measurement model assesses how the observed variables (direct measures) represent the latent constructs (unobserved variables), allowing the researcher to evaluate the underlying theoretical constructs while taking into consideration measurement error. These estimates assist in determining if the latent constructs are correctly represented and whether they determine the observed variables in the manner that the theoretical model suggests.

The figure 4.2 shows confirmatory analysis of financial risk factors and financial risk mitigation strategies

Figure 4.2

Confirmatory Factor Analysis of Financial Risk Factors and Financial Risk Mitigation Strategies

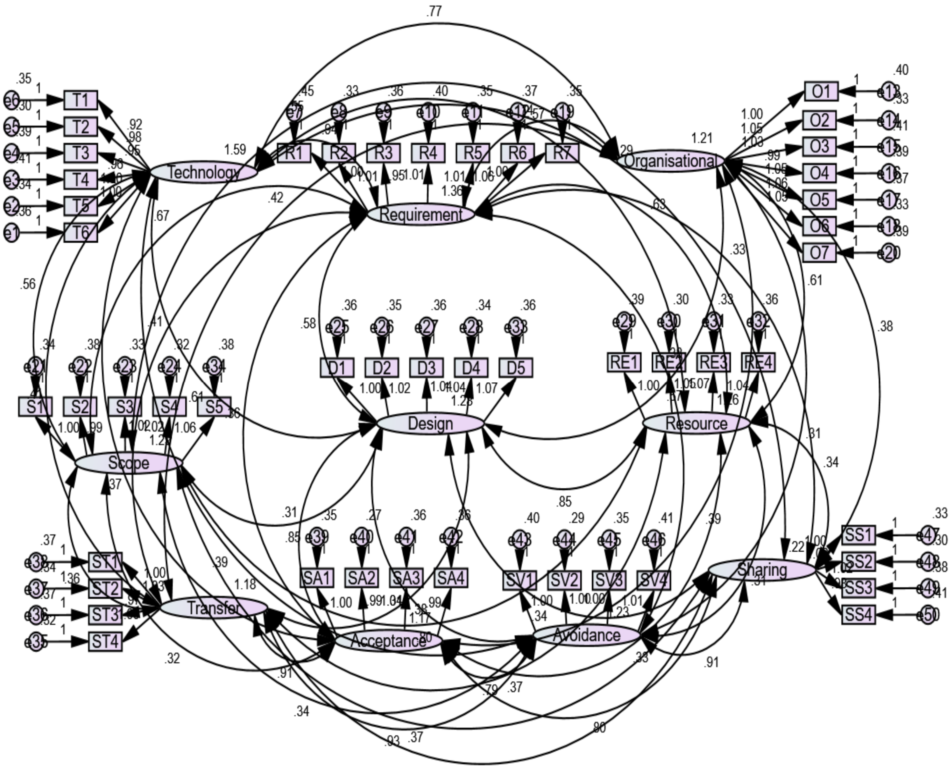


Figure 4.2 explains the confirmatory factor analysis of financial risk factors and financial risk mitigation strategies. It provides estimates for every measurement parameter together with observed and error estimates. It also exhibits the results of the beta co-efficient of all the factors. From the figure, it is clear that there exist strong factor loadings among the items in each factor. The model with ten constructs and its variables were recommended as a good fit.

The table 4.31 presents the model fit indices of financial risk factors and financial risk mitigation strategies.

Table 4.31

Model Fit Indices for Financial Risk Factors and Financial Risk Mitigation Strategies

Model Fit Indices	Model Values	Threshold	Interpretation
CMIN/DF	1.371	Between 1 and 5	Excellent
CFI	0.986	> 0.95	Excellent
GFI	0.900	> 0.9	Excellent
AGFI	0.921	> 0.9	Excellent
RMSEA	0.026	< 0.08	Excellent

Source: Primary Data

For a model to be considered valid, the Chi-Square to degrees of freedom ratio needs to be less than 5. The value in this instance is 1.371, which is well within the recommended maximum value. The RMSEA value is 0.026, which is far below the acceptable threshold score of 0.08. Additionally, the GFI, AGFI, and CFI values are all greater than 0.9. So, the model fit is excellent and can be considered for further analysis.

The reliability and validity of CFA model for financial risk factors on financial risk mitigation strategies are given in table 4.32.

Table 4.32

Reliability and Validity of the CFA Model for Financial Risk Factors and Financial Risk Mitigation Strategies

Constructs	Item Code	Factor Loading	AVE	MSV	C R
Technology	T1	0.891	0.805	0.413	0.805
	T2	0.913			
	T3	0.886			
	T4	0.884			
	T5	0.907			
	T6	0.902			

Constructs	Item Code	Factor Loading	AVE	MSV	C R
Requirement	R1	0.866	0.786	0.713	0.786
	R2	0.898			
	R3	0.878			
	R4	0.881			
	R5	0.894			
	R6	0.898			
	R7	0.892			
Organisational	O1	0.868	0.776	0.335	0.776
	O2	0.895			
	O3	0.872			
	O4	0.868			
	O5	0.885			
	O6	0.898			
	O7	0.881			
Scope	S1	0.889	0.794	0.440	0.794
	S2	0.878			
	S3	0.897			
	S4	0.900			
	S5	0.891			
Design	D1	0.883	0.793	0.445	0.793
	D2	0.889			
	D3	0.891			
	D4	0.896			
	D5	0.895			
Resource	RE1	0.873	0.798	0.445	0.798
	RE2	0.907			
	RE3	0.902			
	RE4	0.891			
Risk Transfer	ST1	0.874	0.773	0.601	0.773
	ST2	0.887			
	ST3	0.867			
	ST4	0.887			

Constructs	Item Code	Factor Loading	AVE	MSV	C R
Risk Acceptance	SA1	0.877	0.778	0.600	0.934
	SA2	0.901			
	SA3	0.878			
	SA4	0.874			
Risk Avoidance	SV1	0.868	0.772	0.601	0.931
	SV2	0.899			
	SV3	0.882			
	SV4	0.866			
Risk Sharing	SS1	0.889	0.776	0.568	0.933
	SS2	0.896			
	SS3	0.878			
	SS4	0.861			

Source: Primary Data

Table 4.32 illustrates the use of the Standardized Factor Loadings (SFL), Composite Reliability (CR), Average Variance Extracted (AVE), and Maximum Shared Variance (MSV) for each dimension in the study. Values for the standardized factor loading are more than 0.5, showing that each dimension contributes sufficiently to the constructs. The values of AVE are higher than 0.5, the values of composite reliability are higher than 0.7, and the values of CR of the constructs are higher than AVE. In terms of convergent validity, these three requirements are satisfied. Additionally, MSV and AVE are employed to show the scale's discriminant validity. In this instance, AVE values are superior to MSV in all dimensions. As a result, the discriminant validity criteria were further proved.

4.11 Conclusion

This chapter covered financial risk factors based on nature of the software company, area of software company, average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on budgeted amount, average time spent on software project, usage of financial risk management techniques and financial risk mitigation strategies. To exhibit the results certain statistical and mathematical techniques were used. In addition, confirmatory factor analysis was used to analyse relationship between financial risk factors with usage of financial risk management techniques and financial risk mitigation strategies. It is found that financial risk factors are potentially high in large software companies and in the case of the area of software companies, urban areas are highly affected by financial risk factors. It is very clear that scope-related factors highly affect the software companies to complete the project on time and out of budgeted amount. The majority of the annual revenue of software companies is invested in managing organisational factors. In addition, resource-related factors have a greater impact on the average number of software projects undertaken by software companies and the average time spent on software projects. Furthermore, there exists a significant relationship between financial risk factors on the usage of financial risk management techniques and financial risk mitigation strategies.

Chapter Five

USAGE OF FINANCIAL RISK MANAGEMENT TECHNIQUES IN INFORMATION TECHNOLOGY PROJECTS

5.1 Introduction

In this chapter, the study tries to analyse the usage of financial risk management techniques and its relationship between the impact of financial risk management techniques and the effectiveness of software companies. It also attempts to study the usage of financial risk management techniques based on the nature of the software company, area of software company, average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on budgeted amount and average time spent on software project.

For proper presentation of the result, the current chapter is divided into two sections. **Section A** discusses the usage of financial risk management techniques on the nature of the software company, area of software company, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on budgeted amount and average time spent on software project. **Section B** of this chapter deals with relationship of usage of financial risk management techniques with the impact of financial risk management techniques and the effectiveness of software companies.

5.2 Objective of the Chapter

The objective of the chapter is to examine the extent of usage of financial risk management techniques in information technology projects.

5.3 Hypotheses Formulated and Tested

1. There is no significant difference between the usage of financial risk management techniques and nature of software company

2. There is no significant difference between the usage of financial risk management techniques and the area of software company
3. Usage of financial risk management techniques does not affect the average number of projects undertaken by software companies
4. Usage of financial risk management techniques does not affect the annual revenue invested for managing financial risk of software companies
5. Usage of financial risk management techniques does not influence the completion of the project on time
6. Usage of financial risk management techniques does not influence the completion of project on budgeted amount
7. Usage of financial risk management techniques does not influence the average time spent on software projects.

5.4 Methodology and Database

To accomplish the objective of this chapter, the primary data regarding usage of financial risk management techniques, nature of software company, area of software company, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount, average time spent on software project and effectiveness of financial risk management techniques are collected from software companies with the help of a structured questionnaire. For the purpose of analysis, techniques like Arithmetic Mean, Standard Deviation, Levene's Test for Homogeneity of Variance, One-way Anova, Tukey HSD Post- Hoc Test for Multiple Comparison, Independent Sample t test and Confirmatory Factor Analysis were used.

5.5 Variables Used for the Study

The following variables are used in the analysis of the usage of financial risk management techniques,

Usage	Financial Risk Planning Techniques Financial Risk Identification Techniques Financial Risk Analysis Techniques Financial Risk Monitoring and Controlling Techniques
Impact	Financial Risk Planning Techniques Financial Risk Identification Techniques Financial Risk Analysis Techniques Financial Risk Monitoring and Controlling Techniques
Effectiveness	Financial related Effectiveness Management related Effectiveness Socio-Economic related Effectiveness

Section A

5.6 Usage of Financial Risk Management Techniques in Information Technology Projects of Software Companies

In this section, the researcher analysed the usage of financial risk management techniques based on nature of the software company, area of the software company, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount and average time spent on software project. To achieve the objective, tools like Arithmetic Mean, Standard Deviation, Levene's Test for Homogeneity of Variance, One-way Anova, Tukey HSD Post- Hoc Test for Multiple Comparisons and Independent Sample t test were used.

5.6.1 Usage of Financial Risk Management Techniques Based on the Nature of Software Company

In this section, the research mainly concentrates on the usage of financial risk management techniques such as financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques. The nature of software companies is small, medium and large. To analyse the significant difference between the usage of financial risk management techniques based on the nature of the software company, Levene's Test for Homogeneity of Variance, One Way Anova, are applied and the following hypothesis is tested.

Ho: There is no significant difference between the usage of financial risk management techniques and the nature of software company

The table 5.1 exhibits the homogeneity test of the usage of financial risk management techniques based on the nature of the software company.

Table 5.1

Homogeneity Test of Usage of Financial Risk Management Techniques Based on the Nature of Software Company

	Levene statistic	**Sig**
Financial Risk Planning techniques	0.61	0.54
Financial Risk Identification Techniques	0.34	0.06
Financial Risk Analysis Techniques	0.75	0.47
Financial Risk Monitoring & Controlling Techniques	0.38	0.25

Source: Primary Data

From the table 5.1, it is very clear that the every value exceeds 0.05, the homogeneity test condition has been satisfied. The population variance for each group is therefore ensured to be approximately equal. Thus, the hypothesis is intended for testing One Way Anova.

The table 5.2 explains the comparison of usage of financial risk management techniques based on nature of software company.

Table 5.2

Comparison of Usage of Financial Risk Management Techniques Based on Nature of Software Company

Usage	Nature of Software Company			F Value	P Value	Remarks
	Small	Medium	Large			
Financial Risk Planning	3.76 (1.17)	3.67 (1.13)	3.86 (1.14)	1.45	0.23	Insignificant
Financial Risk Identification	3.71 (1.15)	3.65 (1.18)	3.85 (1.11)	1.69	0.18	Insignificant
Financial Risk Analysis	3.80 (1.13)	3.73 (1.16)	3.85 (1.13)	0.63	0.52	Insignificant
Financial Risk Monitoring & Controlling	3.77 (1.06)	3.73 (1.15)	3.77 (1.17)	0.09	0.90	Insignificant

Source: Primary Data
Note: The values within the bracket indicates S D

The table 5.2 explains the usage of financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques for measuring the nature of software company. As per descriptive statistics, the usage of financial risk management techniques is potentially high in large company as compared with medium and small. It is also noticeable that software companies heavily rely on financial risk analysis techniques.

The table makes it evident that financial risk planning techniques (‘p’=0.23 > 0.05), financial risk identification techniques (‘p’= 0.18 > 0.05), financial risk analysis techniques (‘p’= 0.52 > 0.05) and financial risk monitoring and controlling techniques (‘p’=0.90 > 0.05) are not statistically significant at the 5% level. As a result, the null hypothesis is accepted. Hence, there is no significant difference between the usages of financial risk management techniques based on nature of software company.

5.6.2 Usage of Financial Risk Management Techniques Based on Area of Software Company

In this section, the study emphasis on the usage of financial risk management techniques such as financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques. The area of software company are classified into urban and city. To analyse significant differences among usage of financial risk management techniques based on area of software company, Independent Sample t test is applied.

Ho: There is no significant difference between the usage of financial risk management techniques and the area of software company

Usage of financial risk management techniques based on of area of software company is given in the table 5.3.

Table 5.3

Usage of Financial Risk Management Techniques Based on Area of Software Company

Usage	Area of Software Company				Remarks
	Urban	City	T Value	P Value	
Financial Risk Planning	3.76 (1.11)	3.78 (1.16)	0.181	0.857	Insignificant
Financial Risk Identification	3.75 (1.17)	3.75 (1.14)	0.004	0.997	Insignificant
Financial Risk Analysis	3.87 (1.12)	3.77 (1.15)	0.943	0.346	Insignificant
Financial Risk Monitoring & Controlling	3.78 (1.09)	3.74 (1.16)	0.313	0.754	Insignificant

Source: Primary Data
Note: The values within the bracket indicate SD

The table 5.3 presents that, the software companies located in the urban area use financial risk management techniques to a greater extent, as shown by the mean score. It is also evident that urban areas make extensive use of financial risk analysis techniques (3.87) and the least use of financial risk identification techniques (3.75). It is additionally noted that, in the case of a city, financial risk planning techniques (3.78) are widely used and financial risk monitoring and controlling techniques (3.74) are used least.

It is also clear that, since p values are higher than 0.05, the usage of financial risk management techniques and the area of software companies support the null hypothesis. Hence, there is no significant difference between the area of software companies with regard to the usage of financial risk management techniques such as financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques.

5.6.3 Usage of Financial Risk Management Techniques Based on Average Number of Software Projects

In this section, the study relies on the usage of financial risk management techniques such as financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques. Average number of software projects are categorised into below 10, 10-25, 25-50, 50-75 and 75-100. To analyse the significant difference among usage of financial risk management techniques based on the average number of projects undertaken by software companies, Levene's Test for Homogeneity of Variance, One Way Anova, Tukey HSD Post-Hoc Test for Multiple Comparison Test are applied and the following hypotheses is tested.

Ho: Usage of financial risk management techniques does not affect the average number of projects undertaken by software companies

The table 5.4 describes the homogeneity test of the usage of financial risk management techniques and the average number of projects undertaken by software companies.

Table 5.4

Homogeneity Test of Usage of Financial Risk Management Techniques on Average Number of Software Projects

	Levene statistic	Sig
Financial Risk Planning Techniques	0.18	0.94
Financial Risk Identification Techniques	0.88	0.47
Financial Risk Analysis Techniques	1.27	0.22
Financial Risk Monitoring & Controlling Techniques	1.22	0.24

Source: Primary Data

The table 5.4 indicates that if every value exceeds 0.05, the homogeneity test criterion has been satisfied. Therefore, it is presumed that the population variance is approximately the same for every group. As such, One Way Anova is intended for hypothesis testing.

Table 5.5 illustrates the results of multiple comparisons of the usage of financial risk management techniques on the basis of the average number of projects undertaken by software companies.

Table 5.5

Comparison of Usage of Financial Risk Management Techniques on Average Number of Software Projects

Usage	Average Number of Software Projects					F Value	P Value	Remarks
	Below 10	10-25	25-50	50-75	75-100			
Financial Risk Planning	3.79 (1.08)	3.77 (1.17)	3.75 (1.13)	3.79 (1.17)	3.77 (1.14)	0.02	0.028	Significant
Financial Risk Identification	3.48 (1.23)	3.74 (1.11)	3.70 (1.14)	3.82 (1.12)	3.78 (1.16)	0.55	0.694	Insignificant
Financial Risk Analysis	3.89 (1.36)	3.87 (1.17)	3.89 (1.04)	3.65 (1.21)	3.82 (1.15)	1.06	0.016	Significant

Usage	**Average Number of Software Projects**					**F Value**	**P Value**	**Remarks**
	Below 10	**10-25**	**25-50**	**50-75**	**75-100**			
Financial Risk Monitoring & Controlling	3.80 (0.99)	3.85 (1.02)	3.76 (1.14)	3.65 (1.24)	3.76 (1.14)	0.48	0.751	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Techniques for financial risk planning, identification, analysis, and monitoring are employed to assess the average number of projects. Descriptive statistics clearly state that, for the average number of projects undertaken by software companies, the use of financial risk analysis techniques is high when compared to other techniques, while the use of financial risk monitoring and controlling techniques is low.

The table 5.5 makes it evident that statistically significant outcomes are shown by Financial Risk Planning Techniques (p=0.028) and Financial Risk Analysis Techniques (p=0.016). With the application of financial risk management techniques influences the average number of projects undertaken by software companies, the null hypothesis is rejected at a 5% level of significance.

In contrast, the Financial Risk Identification Techniques ('p'= 0.694 > 0.05) and Financial Risk Monitoring and Controlling techniques ('p'= 0.751 > 0.05) are not statistically significant at the 5% level of significance. This suggests that the null hypothesis failed to be rejected and there is no significance in financial risk identification techniques and financial risk monitoring and controlling techniques based on the average number of projects undertaken by software companies.

For precise analysis of the difference, post hoc comparisons were conducted by using the Tukey HSD test and the result of the same is exhibited in table 5.6.

Table 5.6

Multiple Comparison of Usage of Financial Risk Management Techniques Based on Average Number of Software Projects

Usage	Tukey HSD			
	Average number of projects (I)	**Average number of projects (J)**	**Mean Difference**	**Sig**
Financial Risk Planning Techniques	Below 10	10-25	0.019	**0.002**
		25-50	0.034	**0.116**
		50-75	-0.003	**0.021**
		75-100	-0.014	**0.126**
	10-25	Below 10	0.019	**0.011**
		25-50	-0.014	**0.004**
		50-75	0.022	**0.032**
		75-100	-0.004	**0.014**
	25-50	Below 10	0.034	**0.033**
		10-25	0.014	**0.028**
		50-75	-0.037	**0.016**
		75-100	0.019	**0.009**
	50-75	Below 10	-0.003	**0.004**
		10-25	-0.022	**0.026**
		25-50	0.037	**0.029**
		75-100	0.018	**0.035**
	75-100	Below 10	0.014	**0.011**
		10-25	-0.004	**0.006**
		25-50	-0.019	**0.031**
		50-75	0.018	**0.048**
Financial Risk Analysis Techniques	Below 10	10-25	0.019	**0.030**
		25-50	0.033	0.512
		50-75	0.244	**0.022**
		75-100	0.074	**0.019**
	10-25	Below 10	0.019	**0.006**
		25-50	0.015	**0.023**
		50-75	0.225	**0.041**
		75-100	0.055	**0.003**

Usage	Tukey HSD			
	Average number of projects (I)	**Average number of projects (J)**	**Mean Difference**	**Sig**
	25-50	Below 10	-0.003	**0.019**
		10-25	0.015	**0.004**
		50-75	0.241	**0.012**
		75-100	0.071	**0.040**
	50-75	Below 10	0.244	**0.032**
		10-25	0.255	**0.015**
		25-50	0.241	**0.020**
		75-100	0.170	**0.036**
	75-100	Below 10	0.074	**0.002**
		10-25	0.055	**0.018**
		25-50	-0.071	**0.025**
		50-75	0.170	**0.034**

Source: Primary Data

The table 5.6 presents the result of multiple comparison of usage of financial risk management techniques based on average number of projects. In the case of financial risk planning techniques on below 10 with 10-25 and 50-75 shows significant pairwise differences as the p values are 0.002 and 0.021. When comparing below 10 with 25-5 and 75-100 there exist insignificant differences. Further analysing 10-25, 25-50, 50-75 and 75-100 shows pairwise differences since the p values are lower than the 5% level of significance. In the case of financial risk analysis techniques, the comparison of below 10 with 25-50 shows insignificant difference as the p value is 0.512. Meanwhile, the pairwise comparison of 10-25, 25-50, 50-75 and 75-100 reveals that there exist significant pairwise differences as the p values are lower than 0.05. Thus, there exist significant difference between financial risk planning techniques and financial risk analysis techniques based on average number of projects undertaken by software companies.

5.6.4 Usage of Financial Risk Management Techniques Based on Annual Revenue Invested for Managing Financial Risk

In this section the research highlights on usage of financial risk management techniques such as financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques. Annual revenue invested for managing financial risk is categorised into below 10, 10-25, 25-50, 50-75 and 75-100. To analyse significant differences among usage of financial risk management techniques based on annual revenue invested for managing financial risk, Levene's Test for Homogeneity of Variance, One Way Anova, Tukey HSD Post-Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Usage of financial risk management techniques does not affect annual revenue invested for managing financial risk

The table 5.7 illustrates homogeneity test results of usage of financial risk management techniques based on annual revenue invested for managing financial risk.

Table 5.7

Homogeneity Test of Usage of Financial Risk Management Techniques Based on Annual Revenue Invested for Managing Financial Risk

	Levene statistic	Sig
Financial Risk Planning Techniques	0.41	0.06
Financial Risk Identification Techniques	0.32	0.09
Financial Risk Analysis Techniques	0.27	0.12
Financial Risk Monitoring & Controlling Techniques	0.14	0.24

Source: Primary Data

From the table 5.7 it is determined that, at the 5% level of significance, the 'p' value obtained from Levene's Test of Homogeneity of Variance is insignificant. The requirement of the homogeneity test criteria is satisfied. Hence, it is ensured that the population variance for each group is approximately equal. Consequently, the testing of the hypothesis is meant for One Way Anova.

Table 5.8 shows the results of the usage of financial risk management techniques on annual revenue invested for managing financial risk.

Table 5.8

Comparison of Usage of Financial Risk Management Techniques Based on Annual Revenue Invested for Managing Financial Risk

Usage	Annual revenue invested for managing financial risk (%)					F Value	P Value	Remarks
	Below 10	10-25	25-50	50-75	75-100			
Financial Risk Planning	4.05 (1.01)	3.95 (0.99)	3.55 (1.24)	3.55 (1.24)	3.75 (1.20)	2.76	0.027	Significant
Financial Risk Identification	3.92 (1.04)	3.87 (1.06)	3.72 (1.12)	3.69 (1.23)	3.64 (1.18)	1.02	0.392	Insignificant
Financial Risk Analysis	4.10 (0.90)	4.05 (0.93)	3.75 (1.20)	3.58 (1.24)	3.70 (1.20)	4.31	0.002	Significant
Financial Risk Monitoring & Controlling	4.02 (0.89)	3.90 (0.99)	3.57 (1.27)	3.57 (1.27)	3.70 (1.14)	2.45	0.045	Significant

Source: Primary Data
Note: The values within the bracket indicate S D

It is noted that financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques are used for measuring the annual revenue invested for managing financial risk. As per descriptive statistics, it is very clear that software companies invest the majority of their annual revenue in the usage of financial risk analysis techniques and it also makes less investment for the usage of financial risk planning techniques.

From the table 5.8, it is also clear that Financial Risk Planning Techniques (p= 0.027), Financial Risk Analysis Techniques (p= 0.002) and Financial Risk Monitoring and Controlling Techniques (p= .0045) show statistically significant results towards annual revenue invested for managing financial risk. Therefore the null hypothesis is rejected at a 5% level of significance and thus the usage of financial risk management techniques influences the annual revenue invested for managing financial risk.

However, the Financial Risk Identification Techniques ('p'= 0.32 > 0.05) is not statistically significant at a 5% level of significance. That means the null hypothesis is failed to reject and there is no significant difference in annual revenue invested for managing financial risk based on financial risk identification techniques.

For precise analysis of the difference, post hoc comparisons were conducted by using the Tukey HSD test. The results are shown in table 5.9.

Table 5.9

Multiple Comparison of Usage of Financial Risk Management Techniques Based on Annual Revenue Invested for Managing Financial Risk

Usage	Tukey HSD			
	Annual revenue (I)	**Annual revenue (J)**	**Mean Difference**	**Sig**
Financial Risk Planning Techniques	Below 10	10-25	0.100	**0.008**
		25-50	0.497	**0.015**
		50-75	0.375	**0.021**
		75-100	0.297	**0.040**
	10-25	Below 10	-0.100	**0.002**
		25-50	0.396	**0.024**
		50-75	0.275	**0.006**
		75-100	-0.196	**0.041**
	25-50	Below 10	0.497	**0.012**
		10-25	-0.396	**0.032**
		50-75	0.121	**0.011**
		75-100	0.199	**0.005**

Usage	**Tukey HSD**			
	Annual revenue (I)	**Annual revenue (J)**	**Mean Difference**	**Sig**
	50-75	Below 10	0.375	**0.012**
		10-25	0.275	**0.043**
		25-50	0.121	**0.006**
		75-100	0.078	**0.014**
	75-100	Below 10	0.297	**0.023**
		10-25	0.196	**0.022**
		25-50	0.199	**0.031**
		50-75	0.078	**0.005**
Financial Risk Analysis Techniques	Below 10	10-25	-0.044	**0.021**
		25-50	-0.342	**0.031**
		50-75	-0.515	**0.014**
		75-100	0.395	**0.025**
	10-25	Below 10	0.182	**0.034**
		25-50	0.152	**0.014**
		50-75	0.133	**0.016**
		75-100	0.142	**0.005**
	25-50	Below 10	0.193	**0.017**
		10-25	0.152	0.321
		50-75	0.147	**0.014**
		75-100	0.156	**0.023**
	50-75	Below 10	0.515	**0.035**
		10-25	0.417	**0.016**
		25-50	0.173	**0.018**
		75-100	0.120	**0.009**
	75-100	Below 10	0.185	**0.026**
		10-25	0.142	**0.027**
		25-50	0.156	**0.015**
		50-75	0.137	**0.036**

Usage	Tukey HSD			
	Annual revenue (I)	**Annual revenue (J)**	**Mean Difference**	**Sig**
Financial Risk Monitoring and Controlling Techniques	Below 10	10-25	0.119	**0.013**
		25-50	0.235	**0.024**
		50-75	0.452	**0.035**
		75-100	0.325	**0.016**
	10-25	Below 10	0.119	**0.037**
		25-50	0.116	**0.046**
		50-75	0.333	**0.015**
		75-100	0.206	**0.008**
	25-50	Below 10	0.235	**0.017**
		10-25	0.116	**0.024**
		50-75	0.333	**0.026**
		75-100	0.206	**0.041**
	50-75	Below 10	0.452	0.015
		10-25	0.333	**0.007**
		25-50	0.217	**0.037**
		75-100	0.127	**0.028**
	75-100	Below 10	0.325	**0.016**
		10-25	0.206	**0.019**
		25-50	0.090	**0.024**
		50-75	0.127	**0.016**

Source: Primary Data

The pairwise comparison of financial risk planning techniques and financial risk monitoring and controlling techniques on annual revenue such as below 10, 10-25, 25-50, 50-75 and 75-100 shows significant differences as the p values are lower than the 5% level of significance. In the case of financial risk analysis techniques, there exists a pairwise difference in the mean score of below 10-25, 50-75 and 75-100, since the 'p' values are less than 0.05. Further analysing 25-50 with 10-25, no pairwise difference exists as the 'p' value is 0.31 which is greater than 0.05. Meanwhile, the comparison of 25-50 with below 10, 50-75 and 75-100 shows significant pairwise differences. Therefore, it can be concluded that there exists a significant difference between financial risk planning techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques based on annual revenue invested for managing financial risk.

5.6.5 Usage of Financial Risk Management Techniques Based on Completion of Software Project on Time

Financial risk management techniques, including financial risk planning, financial risk identification, financial risk analysis, and financial risk monitoring and controlling techniques, are used for analysis. Completion of software project on time are categorised into below 20, 20-40, 40-60, 60-80 and 80-100. In order to analyse significant difference among usage of financial risk management techniques based on completion of software project on time, Levene's Test for Homogeneity of Variance, One way Anova, Tukey HSD Post- Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Usage of financial risk management techniques does not influence completion of software project on time

Homogeneity test results of usage of financial risk management techniques based on completion of project on time is shown in table 5.10

Table 5. 10

Homogeneity Test of Usage of Financial Risk Management Techniques on Completion of Project on Time

	Levene statistic	**Sig**
Financial Risk Planning techniques	3.85	0.06
Financial Risk Identification Techniques	1.24	0.14
Financial Risk Analysis Techniques	2.57	0.28
Financial Risk Monitoring & Controlling Techniques	2.66	0.34

Source: Primary Data

According to Levene's test, the p-value between group variances is higher than 0.05. Thus, One Way Anova can be utilised to verify a significant difference between the usage of financial risk management techniques based on completion of projects on time.

Table 5.11 shows the results usage of financial risk management techniques based on completion of software project on time.

Table 5.11

Comparison of Usage of Financial Risk Management Techniques Based on Completion of Software Projects on Time

Usage	Completion of Software Project on Time (%)					F Value	P Value	Remarks
	Below 20	20-40	40-60	60-80	80-100			
Financial Risk Planning	3.41 (1.42)	3.67 (1.29)	3.66 (1.24)	3.68 (1.17)	3.90 (1.05)	1.55	0.025	Significant
Financial Risk Identification	3.31 (1.42)	3.46 (1.22)	3.71 (1.17)	3.69 (1.17)	3.56 (1.10)	1.77	0.132	Insignificant
Financial Risk Analysis	3.87 (1.11)	3.65 (1.28)	3.75 (1.17)	3.68 (1.22)	3.93 (1.04)	1.79	0.128	Insignificant
Financial Risk Monitoring & Controlling	4.50 (0.20)	3.55 (1.24)	3.85 (1.15)	3.64 (1.20)	3.83 (1.06)	1.69	0.015	Significant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 5.11 shows that financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques, and financial risk monitoring and controlling techniques are used to measure completion of project on time. Descriptive statistics make it very clear that software companies employing financial risk monitoring and controlling techniques helped them to finish the project on time, while using financial risk identification techniques are least preferred method for meeting deadlines.

From the table, it is also evident that Financial Risk Planning Techniques (p= 0.025) and Financial Risk Monitoring and Controlling Techniques (p= 0.015) show statistically significant results towards the completion of projects on time. As a result, the null hypothesis is rejected at the 5% level of significance, and the usage of financial risk management techniques influences the completion of projects on time.

But the Financial Risk Identification Techniques ('p'= 0.132 > 0.05) and Financial Risk Analysis Techniques ('p'= 0.128 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis is failed to reject and the usage of financial risk management techniques does not influence the completion of the project on time.

For precise analysis of the difference, post hoc analysis was conducted by using the Tukey HSD test. The multiple comparison of the usage of financial risk management techniques based on the completion of the project on time is presented in Table 5.12.

Table 5.12

Multiple Comparison of Usage of Financial Risk Management Techniques Based on Completion of Project on Time

Usage	Tukey HSD			
	Completion of Project (I)	**Completion of Project (J)**	**Mean Difference**	**Sig**
Financial Risk Planning Techniques	Below 20	20-40	0.338	**0.024**
		40-60	0.343	**0.008**
		60-80	0.325	**0.012**
		80-100	0.304	**0.040**
	20-40	Below 20	0.123	**0.016**
		40-60	0.005	**0.011**
		60-80	0.012	**0.022**
		80-100	0.233	**0.034**
	40-60	Below 20	0.431	**0.066**
		20-40	0.212	**0.017**
		60-80	0.842	**0.009**
		80-100	0.232	**0.006**

Usage	Tukey HSD			
	Completion of Project (I)	Completion of Project (J)	Mean Difference	Sig
	60-80	Below 20	0.425	**0.009**
		20-40	0.141	**0.011**
		40-60	0.323	**0.026**
		80-100	0.376	**0.014**
	80-100	Below 20	0.304	**0.036**
		20-40	0.233	**0.028**
		40-60	0.238	**0.017**
		60-80	0.204	**0.040**
	Below 20	20-40	0.941	**0.013**
		40-60	0.641	0.842
		60-80	0.855	**0.011**
		80-100	0.660	**0.020**
Financial Risk Monitoring and Controlling	20-40	Below 20	0.941	**0.039**
		40-60	0.300	**0.014**
		60-80	0.086	**0.006**
		80-100	0.281	**0.031**
	40-60	Below 20	0.641	**0.028**
		20-40	0.300	**0.009**
		60-80	0.213	**0.016**
		80-100	0.018	**0.027**
	60-80	Below 20	0.855	**0.017**
		20-40	0.086	**0.032**
		40-60	0.213	**0.025**
		80-100	0.195	**0.014**
	80-100	Below 20	0.660	**0.036**
		20-40	0.281	**0.019**
		40-60	0.018	**0.025**
		60-80	0.195	**0.038**

Source: Primary Data

From the table 5.12, it is clear that there exist significant pairwise difference between the usage of financial risk planning techniques based on completion of projects on time, since the p values are lower than 0.05. In the case of financial risk monitoring and controlling techniques, the comparison of below 20 with 40-60 shows insignificant differences as the p value is 0.842. When analysing 40-60, 60-80 and 80-100, there exist significant pairwise difference, since the p values are lower than 5% level of significance. So, it can be concluded that there exist comparable difference between financial risk planning techniques and financial risk monitoring and controlling techniques based on completion of projects on time.

5.6.6 Usage of Financial Risk Management Techniques Based on Completion of Project on Budgeted Amount

In this section, the study has a particular focus on usage of financial risk management techniques such as financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques. Completion of project on budgeted amount are classified into project completed within the budgeted amount and project completed out of the budgeted amount. In order to analyse significant difference between the usage of financial risk management techniques based on completion of project on budgeted amount, the Independent Sample t Test is applied and the following hypothesis is tested.

Ho: Usage of financial risk management techniques does not influence the completion of the project on budgeted amount.

The table 5.13 depicts the usage of financial risk management techniques based on the completion of the project on budgeted amount.

Table 5.13

Usage of Financial Risk Management Techniques Based on Completion of Project on Budgeted Amount

Usage	Completion of Project on Budgeted Amount				Remarks
	Project Completed within Budgeted Amount	Project Completed Out of Budgeted amount	T Value	P Value	
Financial Risk Planning	3.92 (1.17)	3.33 (1.09)	0.348	0.078	Insignificant
Financial Risk Identification	3.68 (1.14)	3.52 (1.12)	0.541	0.125	Insignificant
Financial Risk Analysis	3.72 (1.15)	3.86 (1.16)	0.702	0.347	Insignificant
Financial Risk Monitoring and Controlling	3.44 (1.10)	3.54 (1.12)	0.623	0.244	Insignificant

Source: Primary Data
Note: The values within the bracket indicates S D

It can be inferred from the mean score stated in Table 5.13 that financial risk planning techniques (3.92) highly influence the software companies to complete the project on budgeted amount and financial risk analysis techniques (3.86) accelerates the software companies to complete the project out of budgeted amount.

It is also evident that the p value is higher than 0.05, the null hypothesis is accepted with regard to usage of financial risk management techniques based on completion of project on budgeted amount. Hence, there is no significant difference between the usage of financial risk planning, financial risk identification, financial risk analysis and financial risk monitoring and controlling techniques with regard to completion of project on budgeted amount.

5.6.7 Usage of Financial Risk Management Techniques Based on Average Time Spent on Software Project

In order to study the usage of financial risk management techniques on average time spent on software project, the study considers financial risk management techniques such as financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques. The average time spent on software project is categorised into below 0-2, 2-4, 4-6 and 6 and above months. To analyse the significant difference between the usage of financial risk management techniques based on average time spent on the project, Levene's Test for Homogeneity of Variance, One Way Anova, Tukey HSD Post-Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Usage of financial risk management techniques does not influence the average time spent on software projects

The table 5.14 reveals the homogeneity test result of the usage of financial risk management techniques on average time spent on software projects.

Table 5. 14

Homogeneity Test of Usage of Financial Risk Management Techniques Based on Average Time Spent on Software Projects

	Levene statistic	Sig
Financial Risk Planning Techniques	2.85	0.092
Financial Risk Identification Techniques	1.42	0.069
Financial Risk Analysis Techniques	3.14	0.253
Financial Risk Monitoring & Controlling Techniques	4.92	0.347

Source: Primary Data

From the table 5.14, it is very clear that the Levene's Test of Homogeneity of Variance is insignificant at a 5% level. Since all the values are greater than 0.05, the requirement of the homogeneity test has been met. Consequently, the testing of the hypothesis is meant for One Way Anova. One way Anova can be applied for checking significant difference between the usage of financial risk management techniques based on average time spent on software projects. The result of the same is given in table 5.15.

Table 5.15

Comparison of Usage of Financial Risk Management Techniques on Average Time Spent on Software Project

Usage	Average Time Spent on Software Project (Months)				F Value	P Value	Remarks
	0-2	2-4	4-6	6 & Above			
Financial Risk Planning	3.89 (1.05)	3.87 (1.08)	3.71 (1.18)	3.65 (1.23)	1.58	0.027	Significant
Financial Risk Identification	3.76 (1.19)	3.87 (1.08)	3.73 (1.12)	3.66 (1.23)	0.92	0.427	Insignificant
Financial Risk Analysis	3.97 (1.05)	3.88 (1.11)	3.73 (1.13)	3.66 (1.23)	2.07	0.102	Insignificant
Financial Risk Monitoring & Controlling	3.85 (1.10)	3.81 (1.14)	3.70 (1.13)	3.68 (1.17)	0.74	0.525	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 5.15 shows the results of the usage of financial risk management techniques based on average time spent on the project. Financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques are the usage of financial risk management techniques used for measuring the average time spent on software project. As per descriptive statistics, it is very clear that the usage of financial risk analysis techniques has a greater impact on the average amount of time spent on the project, while the usage of financial risk identification techniques has a lower impact.

From the table, it is also clear that Financial Risk Planning Techniques (p=0.028) show statistically significant results towards average time spent on software projects. Therefore the null hypothesis is rejected at a 5% level of significance and thus the usage of financial risk management techniques influences the average time spent on software projects.

But the usage of Financial Risk Identification Techniques (‘p’= 0.427 > 0.05), Financial Risk Analysis Techniques (‘p’= 0.102 > 0.05) and Financial Risk Monitoring and Controlling Techniques (‘p’= 0.525 > 0.05) are not statistically significant at 5% level of significance. That means the null hypothesis is failed to reject and there is no significant difference between the usage of financial risk management techniques based on average time spent on software projects.

Post hoc analysis were carried out using the Tukey HSD test to ensure accurate examination of the difference. Multiple comparison of the usage of financial risk management techniques based on average time spent on software projects is illustrated in table 5.16.

Table 5.16

Multiple Comparison of Usage of Financial Risk Management Techniques Based on Average Time Spent on Software Projects

Usage	Tukey HSD			
	Average Time (I) (Months)	**Average Time (J) (Months)**	**Mean Difference**	**Sig**
Financial Risk Planning Techniques	0-2	2-4	0.021	**0.011**
		4-6	0.184	**0.022**
		6 & Above	0.245	**0.031**
	2-4	0-2	0.021	**0.006**
		4-6	0.162	**0.024**
		6 & Above	0.223	**0.028**
	4-6	0-2	0.184	**0.036**
		2-4	0.162	**0.017**
		6 & Above	0.060	**0.029**
	6 & Above	0-2	0.245	**0.024**
		2-4	0.223	**0.033**
		4-6	0.060	**0.018**

Source: Primary Data

It is evident from the data presented in Table 5.16 that there is a statistically significant mean difference in the usage of financial risk planning techniques based on the average time spent on software projects. This significance is confirmed by the p-value being less than the commonly accepted threshold of 0.05, indicating that the observed difference is not due to random chance but reflects a true effect. The Tukey HSD (Honest Significant Difference) post hoc test was conducted to explore these differences further. The results of this test show that there are substantial and meaningful differences between the various groups in terms of how financial risk planning techniques are used, depending on the amount of time spent on software projects. This implies that time is an important factor in determining the adoption or intensity of financial risk planning techniques in these projects.

Section B

Section B of the chapter describes the confirmatory Factor Analysis of the usage of financial risk management techniques with regard to the impact of financial risk management techniques and the effectiveness of software companies. The researcher also tries to know the validity and reliability of the model. The measurement model under study is being tested. The tables from the CFA analysis and their explanations are also given in this section.

5.7 Confirmatory Factor Analysis of Usage of Financial Risk Management Techniques and Impact of Financial Risk Management Techniques

This section outlines the tests that were conducted on the measurement model to validate its dependability and precision. Confirmatory Factor Analysis is used to understand the findings of model testing that is carried out to establish the accuracy and dependability of the scale measure as well as to evaluate how well a defined factor model fits a certain collection of observed data. It provides estimates for each measurement model parameter.

The measurement model comprises a total of 7 latent (unobserved) variables, 36 error terms (denoted e1 to e36), and 36 observable variables. The unobserved variables represent the key constructs being measured and are crucial in determining the overall structure of the model. These unobserved variables include:

1. Usage of Financial Risk Planning Techniques (UP) – Measures the application of techniques to plan for financial risks.
2. Usage of Financial Risk and Identification Techniques (UI) – Assesses the extent to which financial risks are identified using specific techniques.
3. Usage of Financial Risk Analysis Techniques (UA) – Evaluate how financial risks are analyzed in the context of the project.
4. Usage of Financial Risk Monitoring and Controlling Techniques (UM) – Measures the implementation of techniques for monitoring and controlling financial risks during the project.
5. Impact of Financial Risk Planning Techniques (IP) – Evaluate the effectiveness and outcomes of using financial risk planning techniques.
6. Impact of Financial Risk Identification Techniques (II) – Assesses the effects of identifying financial risks on the overall project outcomes.
7. Impact of Financial Risk Analysis Techniques (IA) – Examines how financial risk analysis techniques influence project performance.
8. Impact of Financial Risk Monitoring and Controlling Techniques (IM) – Measures the impact of monitoring and controlling financial risks on the success of the project.

These variables represent crucial areas in the financial risk management and contribute to understanding the broader dynamics of risk management in projects. The inclusion of both the usage and impact of these techniques in the model allows for a comprehensive analysis of their role in managing financial risks in software projects.

Figure 5.1

Confirmatory Factor Analysis of Usage of Financial Risk Management Techniques and Impact of Financial Risk Management Techniques

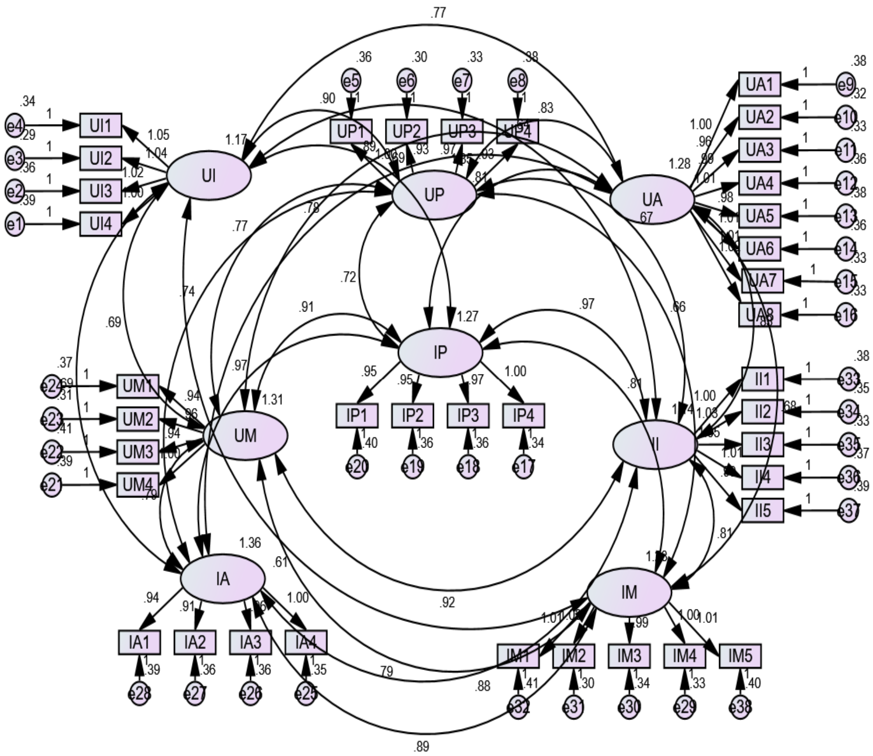


Figure 5.1 presents a Confirmatory Factor Analysis that assesses the relationship between financial risk management techniques and their impact. The analysis includes various important measures such as estimates for measurement parameters, error estimates, and the beta coefficients that indicate the strength of relationships between the factors. The figure also highlights that there are strong factor loadings between the variables in each factor, suggesting that the constructs are well-defined. Additionally, the model, which includes ten constructs, is recommended as a good fit, meaning that the model is statistically sound and provides an accurate representation of how financial risk management techniques contribute to the outcomes in software companies.

The table 5.17 illustrates model fit indices for usage of financial risk management techniques and impact of financial risk management techniques.

Table 5.17

Model Fit Indices for Usage of Financial Risk Management Techniques and Impact of Financial Risk Management Techniques

Model Fit Indices	Model Values	Threshold	Interpretation
CMIN/DF	1.70	Between 1 and 5	Excellent
CFI	0.980	> 0.95	Excellent
GFI	0.907	> 0.9	Excellent
AGFI	0.911	> 0.9	Excellent
RMSEA	0.036	< 0.08	Excellent

Source: Primary Data

For a model to be considered valid and a good fit for the data, it is essential that several fit indices meet specific criteria. One such criterion is the Chi-Square to degrees of freedom ratio, which should ideally be smaller than 5. This ratio provides a measure of how well the model fits the data relative to its complexity. In this case, the ratio is 1.70, which is well below the recommended maximum value of 5, suggesting that the model fits the data quite well.

Another important measure is the Root Mean Square Error of Approximation (RMSEA), which evaluates the discrepancy between the observed and the estimated covariance matrices. An RMSEA value below 0.08 is considered acceptable, with lower values indicating a better fit. In this instance, the RMSEA is 0.036, which is significantly below the threshold of 0.08, indicating a very good fit and minimal approximation error in the model.

Additionally, other goodness-of-fit indices, such as the Goodness-of-Fit Index (GFI), the Adjusted Goodness-of-Fit Index (AGFI), and the Comparative Fit Index (CFI), are all crucial in assessing the model's overall fit. Values greater than 0.90 for these indices generally indicate a well-fitting model. In this case, these values exceed 0.90, further supporting the model's excellent fit.

These fit indices suggest that the model aligns well with the observed data and provides a reliable representation of the underlying relationships. Therefore, based on these statistical indicators, the model can be considered to have an excellent fit and is suitable for further analysis and interpretation.

The table 5.18 explains the reliability and validity of CFA model for usage of financial risk management techniques and impact of financial risk management techniques.

Table 5.18

Reliability and Validity of CFA Model for Usage of Financial Risk Management Techniques and Impact of Financial Risk Management Techniques

Constructs	Item Code	Factor Loading	AVE	MSV	C R
Usage of Financial Risk Planning Techniques	UP1	0.888	0.782	0.516	0.935
	UP2	0.891			
	UP3	0.892			
	UP4	0.867			
Usage of Financial Risk Identification Techniques	UI1	0.889	0.780	0.516	0.934
	UI2	0.901			
	UI3	0.878			
	UI4	0.866			
Usage of Financial Risk Analysis Techniques	UA1	0.878	0.785	0.471	0.967
	UA2	0.885			
	UA3	0.889			
	UA4	0.887			
	UA5	0.874			
	UA6	0.886			
	UA7	0.893			
	UA8	0.894			
Usage of Financial Risk Monitoring and Controlling Techniques	UM1	0.873	0.766	0.562	0.929
	UM2	0.890			
	UM3	0.860			
	UM4	0.879			

Constructs	Item Code	Factor Loading	AVE	MSV	C R
Impact of Financial Risk Planning Techniques	IP1	0.862	0.765	0.648	0.929
	IP2	0.871			
	IP3	0.876			
	IP4	0.888			
Impact of Financial Risk Identification Techniques	II1	0.867	0.764	0.648	0.948
	II2	0.881			
	II3	0.891			
	II4	0.872			
	II5	0.859			
Impact of Financial Risk Analysis Techniques	IA1	0.870	0.771	0.546	0.931
	IA2	0.870			
	IA3	0.881			
	IA4	0.892			
Impact of Financial Risk Monitoring and Controlling Techniques	IM1	0.867	0.777	0.480	0.946
	IM2	0.901			
	IM3	0.882			
	IM4	0.887			
	IM5	0.872			

Source: Primary Data

From the table it clear that standardized factor loading value exceeds 0.5, it means that each dimension significantly affects the constructs. The CR values of the constructs are larger than 0.7, the CR values of the AVE are greater than 0.5, and the CR values are greater than AVE. In terms of convergent validity, these three requirements are satisfied. In this way, convergence validity is shown. Additionally, MSV and AVE are employed to show the scale's discriminant validity. AVE values in this case outperform MSV in every aspect. As a result, the criteria for discriminant validity are also satisfied.

5.8 Confirmatory Factor Analysis of Usage of Financial Risk Management Techniques and Effectiveness of Software Companies

This section describes the testing that was done on the measurement model to ensure the reliability and accuracy of the scale measure. Confirmatory Factor Analysis is used to assess how well a specified factor model fits a specific set of observed data as well as to interpret the results of model testing that is done to confirm the precision and dependability of the scale measure. In CFA, each parameter in the measurement model is estimated to determine how well it represents the underlying factor it is supposed to measure. The model in question consists of 36 observable variables, 36 error terms (denoted as e1 to e36), and 7 unobserved (latent) variables. Observable variables are those that can be directly measured or observed in the data, while error terms account for measurement inaccuracies or unexplained variance. The unobserved variables, which are the central focus of the model, represent abstract constructs that cannot be directly measured but are inferred from the observable variables.

The unobserved variables in the measurement model include:

1. Usage of Financial Risk Planning Techniques (UP) – This variable represents the extent to which various financial risk planning techniques are employed in the project.
2. Usage of Financial Risk Identification Techniques (UI) – This variable captures the application of techniques used to identify potential financial risks in the project.
3. Usage of Financial Risk Analysis Techniques (UA) – This variable reflects how financial risks are analysed in terms of their potential impact and likelihood.
4. Usage of Financial Risk Monitoring and Controlling Techniques (UM) – This variable pertains to the use of methods for monitoring and controlling financial risks throughout the project lifecycle.

5. Financial-Related Effectiveness (EF) – This latent variable measures the effectiveness of financial risk management techniques in achieving financial goals and minimizing risks.

6. Management-Related Effectiveness (EM) – This variable assesses the overall effectiveness of management in mitigating financial risks and ensuring the success of the project.

7. Socio-Economic Related Effectiveness (ES) – This unobserved variable focuses on the social and economic impacts of financial risk management techniques, considering broader factors like community involvement and economic sustainability.

The figure 5.2 shows the confirmatory factor analysis of usage of financial risk management techniques and effectiveness of software companies.

Figure 5.2

Confirmatory Factor Analysis of Usage of Financial Risk Management Techniques and Effectiveness of Software Companies

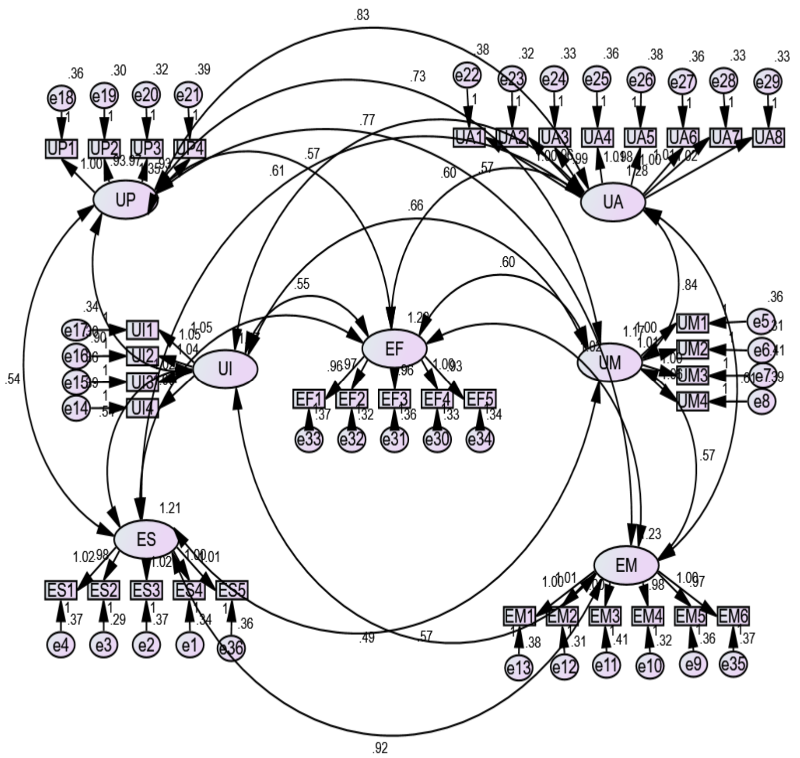


Figure 5.2 presents a Confirmatory Factor Analysis (CFA) focused on the usage of financial risk management techniques and effectiveness of software companies. The figure includes important statistical outputs such as estimates for measurement parameters, observed and error estimates, and beta coefficients for each factor. The strong factor loadings indicate that the items within each construct are highly correlated with the respective constructs, suggesting that the model is both reliable and meaningful. Furthermore, the model with ten constructs and its associated variables is considered a good fit and it accurately represents the relationships between financial risk management techniques and their impact on software companies, with the model explaining the data well.

The table 5.19 illustrates model fit indices for usage of financial risk management techniques and effectiveness of software companies.

Table 5.19

Model Fit Indices for Usage of Financial Risk Management Techniques and Effectiveness of Software Companies

Model Fit Indices	Model Values	Threshold	Interpretation
CMIN/DF	1.599	Between 1 and 5	Excellent
CFI	0.984	> 0.95	Excellent
GFI	0.918	> 0.9	Excellent
AGFI	0.918	> 0.9	Excellent
RMSEA	0.03	< 0.08	Excellent

Source: Primary Data

For a model to be considered valid, the Chi-Square to degrees of freedom ratio must be smaller than 5. The value in this instance is 1.599, which is well within the recommended maximum value. The RMSEA value is 0.03, which is far below the acceptable threshold score of 0.08. Additionally, all the GFI, AGFI, and CFI values are greater than 0.9. So, the model fit is excellent and can be considered for further analysis.

The table 5.20 exhibits reliability and validity of CFA model for usage of financial risk management techniques and effectiveness of software companies.

Table 5.20

Reliability and Validity of CFA Model for Usage of Financial Risk Management Techniques and Effectiveness of Software Companies

Constructs	Item Code	Factor Loading	AVE	MSV	C R
Financial Risk Planning Techniques	UP1	0.888	0.935	0.516	0.935
	UP2	0.892			
	UP3	0.892			
	UP4	0.867			
Financial Risk Identification Techniques	UI1	0.888	0.934	0.516	0.934
	UI2	0.900			
	UI3	0.878			
	UI4	0.868			
Financial Risk Analysis Techniques	UA1	0.879	0.785	0.471	0.967
	UA2	0.885			
	UA3	0.889			
	UA4	0.886			
	UA5	0.874			
	UA6	0.885			
	UA7	0.894			
	UA8	0.894			

Constructs	Item Code	Factor Loading	AVE	MSV	C R
Financial Risk Monitoring and Controlling Techniques	UM1	0.874	0.929	0.471	0.929
	UM2	0.890			
	UM3	0.860			
	UM4	0.877			
Financial Effectiveness	EF1	0.872	0.945	0.707	0.945
	EF2	0.887			
	EF3	0.877			
	EF4	0.891			
	EF5	0.875			
	ES5	0.880			
Management Effectiveness	EM1	0.874	0.953	0.656	0.953
	EM2	0.895			
	EM3	0.865			
	EM4	0.867			
	EM5	0.881			
	EM6	0.870			
Socio-Economic Effectiveness	ES1	0.881	0.947	0.707	0.947
	ES2	0.898			
	ES3	0.879			
	ES4	0.884			
	ES5	0.880			

Source: Primary Data

Table 5.20 shows how to apply the Standardized Factor Loadings (SFL), Composite Reliability (CR), Average Variance Extracted (AVE), and Maximum Shared Variance

(MSV). The standardized factor loading values are greater than 0.5, indicating that each dimension makes a significant contribution to the constructs. The AVE values are greater than 0.5, the CR values are greater than 0.7, and the CR values of the constructs are greater than AVE. These three conditions are met in terms of convergent validity. MSV and AVE are also used to demonstrate the scale's discriminant validity. In this situation, AVE values outperform MSV in every dimension. Therefore, the requirements for discriminant validity are also satisfied.

5.9 Conclusion

This chapter covered the usage of financial risk management techniques based on the nature of the software company, area of the software company, average number of software projects, annual revenue invested for managing financial risk, completion of the project on time completion of the project on budgeted amount, average time spent on software project, usage of financial risk management techniques and financial risk mitigation strategies. To exhibit the results certain statistical and mathematical techniques were used. In addition, confirmatory factor analysis was used to analyse the relationship between the usage of financial risk management techniques and the effectiveness of software companies. It is found that the usage of financial risk management techniques is potentially high in large software companies and in the case of area of software companies, urban areas have a high usage of financial risk management techniques. The usage of financial risk analysis techniques is high in the case of the average number of software projects undertaken by software companies and the average spent time on projects. The majority of the annual revenue of software companies is invested for the usage of financial risk analysis techniques. It is also evident that the usage of financial risk monitoring and controlling techniques is highly helpful for software companies to complete the project on time and financial risk planning techniques highly influence to complete the project on budgeted amount and financial risk analysis techniques highly affect the software companies to close the project out of budgeted amount. Furthermore, there exists a significant relationship between the usage of financial risk management techniques on the impact of financial risk management techniques and the effectiveness of software companies. This reinforces the idea that effective financial risk management is key to the successful completion of software projects.

Chapter Six

IMPACT OF FINANCIAL RISK MANAGEMENT TECHNIQUES ON INFORMATION TECHNOLOGY PROJECTS

6.1 Introduction

In this chapter, the study aims to evaluate how financial risk management techniques affect the successful completion of projects, focusing specifically on whether projects are completed on time and within the budgeted amount. The researcher analyses a sample of projects that met these criteria to investigate the role that financial risk management techniques in achieving these outcomes. By examining the relationship between the usage of these techniques and project success, the study seeks to understand how financial risk management techniques based on the completion of the project on time and completion of the project on budgeted amount can contribute to more effective project execution.

For analysis, the current chapter is divided into two sections. **Section A** discusses the impact of financial risk management techniques on the completion of projects on time and the completion of projects on budgeted amounts**.** **Section B** of this chapter covers the impacts of financial risk management techniques and number of projects completed within the time and budgeted amount.

6.2 Objective of the Chapter

The objective of the chapter is to study the impact of financial risk management techniques on the successful completion of information technology projects.

6.3 Hypotheses Formulated and Tested

1. The impact of financial risk management techniques does not affect the completion of the project on time

2. The impact of financial risk management techniques does not affect the completion of projects on the budgeted amount

6.4 Methodology and Database

To accomplish the objective of this chapter, the primary data regarding the impact of financial risk management techniques, completion of projects on time, and completion of projects on budgeted amounts are collected from software companies with the help of a structured questionnaire. It analyzes how various financial risk management techniques influence two critical outcomes for software companies: completion of projects on time and completion of projects within the budgeted amount. The chapter aims to gather empirical evidence and analyze data to understand whether the use of financial risk management techniques has a measurable impact on these outcomes. In addition to primary data, the study also uses secondary data**.** The secondary data pertains to completed projects on budgeted amount and on time. It includes data, reports, or records from software companies about previous projects and their outcomes. The secondary data serves to supplement the primary data and may offer broader insights into the general trends or patterns in project completion, beyond the specific sample studied. A total of 680 projects from 256 software companies are taken for this purpose. Out of 680 projects, 200 are small-sized, 160 are medium-sized and 320 are large-sized projects. By categorizing the projects by size, the study can assess whether financial risk management techniques are more effective in projects of certain sizes, offering deeper insights into how these techniques influence project outcomes based on project characteristics. For analysis, techniques like Arithmetic Mean, Standard Deviation, Levene's Test for Homogeneity of Variance, One-way ANOVA, and Independent Sample t Test were used.

6.5 Variables Used for the Study

To study the impact of financial risk management techniques based on completion of projects on time the following variables are used.

Usage	Financial Risk Planning Techniques Financial Risk Identification Techniques Financial Risk Analysis Techniques Financial Risk Monitoring and Controlling Techniques

Impact	Financial Risk Planning Techniques Financial Risk Identification Techniques Financial Risk Analysis Techniques Financial Risk Monitoring and Controlling Techniques

Section A

6.6 Impact of Financial Risk Management Techniques on the Successful Completion of Software Projects

In this section, the researcher analysed the impact of financial risk management techniques based on the completion of the project on time and the completion of the project on the budgeted amount. To achieve the objective, tools like Arithmetic Mean, Standard Deviation, Levene's Test for Homogeneity of Variance, One-way ANOVA and Independent Sample t Test were used.

6.6.1 Impact of Financial Risk Management Techniques on Completion of Software Project on Time

In this section, the study focuses on the impact of financial risk management techniques such as financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques. Completion of software projects on time are categorised into below 20, 20-40, 40-60, 60-80 and 80-100. To analyse significant differences among usage of financial risk management techniques based on completion of software projects on time Levene's Test for Homogeneity of Variance and One way ANOVA are applied and the following hypothesis is tested.

Ho: Impact of financial risk management techniques do not affect the completion of software projects on time

The homogeneity test result of the impact of financial risk management techniques based on the completion of projects on time is displayed in table 6.1.

Table 6.1

Homogeneity Test of Impact of Financial Risk Management Techniques Based on Completion of Projects on Time

	Levene statistic	Sig
Financial Risk Planning Techniques	8.09	0.098
Financial Risk Identification Techniques	6.28	0.169
Financial Risk Analysis Techniques	5.50	0.082
Financial Risk Monitoring & Controlling Techniques	8.69	0.346

Source: Primary Data

Levene's test checks if the variability within each group is consistent across the groups being compared. In this case, it's being used to check if the variability in the impacts of financial risk management techniques on the completion of projects on time is similar across different groups. Levene's test confirms that the variances between groups are equal (p-value > 0.05), allowing the use of One-Way ANOVA**.** One-way ANOVA is used to test if there are any significant differences in the impacts of different financial risk management techniques on project completion.

Comparison of impact of financial risk management techniques based on completion of software projects on time is shown in table 6.2.

Table 6.2

Comparison of Impact of Financial Risk Management Techniques on Completion of Software Projects on Time

Impact	Completion of Software Project on Time (%)					F Value	P Value	Remarks
	Below 20	20-40	40-60	60-80	80-100			
Financial Risk Planning	4.50 (0.408)	3.54 (1.27)	3.87 (1.15)	3.68 (1.23)	3.92 (1.00)	2.18	0.069	Insignificant
Financial Risk Identification	4.45 (0.378)	3.61 (1.27)	3.71 (1.13)	3.70 (1.19)	3.90 (1.01)	1.46	0.211	Insignificant

Impact	Completion of Software Project on Time (%)					F Value	P Value	Remarks
	Below 20	20-40	40-60	60-80	80-100			
Financial Risk Analysis	4.43 (0.239)	3.53 (1.31)	3.78 (1.18)	3.70 (1.19)	3.89 (1.06)	1.58	0.178	Insignificant
Financial Risk Monitoring & Controlling	4.40 (0.282)	3.64 (1.27)	3.86 (1.14)	3.61 (1.24)	3.89 (1.02)	2.13	0.078	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Techniques for managing financial risk include financial risk planning, financial risk identification, financial risk analysis and financial risk monitoring, and controlling. These techniques are used to measure the completion of projects on time. Descriptive statistics make it evident that, in comparison to other techniques, financial risk planning techniques have a higher influence on completion of projects on time. Financial risk analysis techniques have a low impact on the completion of the project on time.

From the table 6.2, it is also clear that Financial Risk Planning Techniques (‘p’=0.069 > .005) Financial Risk Identification Techniques (‘p’= 0.211 > 0.05), Financial Risk Analysis Techniques (‘p’= 0.178 > 0.05) and Financial Risk Monitoring and Controlling Techniques (‘p’=0.078 > .005) are not statistically significant at 5% level. That means the null hypothesis is accepted and the impact of financial risk management techniques does not influence the completion of projects on time.

6.6.2 Impact of Financial Risk Management Techniques Based on Completion of Project on Budgeted Amount

In this section, the study primarily focuses on the impact of financial risk management techniques such as financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques. Completion of projects on budgeted amount is classified into projects completed within the budgeted amount and projects completed out of the budgeted amount. To analyse the significant difference between the impact of financial risk management techniques based on the completion of the project on budgeted amount, Independent Sample t Test is applied and the following hypothesis is tested.

Ho: The Impact of financial risk management techniques does not affect the completion of the project on the budgeted amount

The table 6.3 describes the results of the impact of financial risk management techniques on the completion of projects on the budgeted amount.

Table 6.3

Impact of Financial Risk Management Techniques on Completion of Project on Budgeted Amount

Impact	Completion of Project on Budgeted Amount				Remarks
	Project Completed within Budgeted Amount	Project Completed Out of Budgeted Amount	T Value	P Value	
Financial Risk Planning	3.86 (1.13)	3.52 (1.13)	0.181	0.957	Insignificant
Financial Risk Identification	3.78 (1.15)	3.73 (1.12)	0.006	0.597	Insignificant
Financial Risk Analysis	3.72 (1.11)	3.74 (1.14)	0.843	0.386	Insignificant
Financial Risk Monitoring & Controlling	3.79 (1.06)	3.59 (1.17)	0.413	0.764	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

It can be inferred from the table 6.3 that the majority of the project was completed within the budgeted amount with the impact of financial risk planning techniques (3.86). Financial risk analysis techniques (3.74) have a high impact on the project closed out of budgeted amount. Since all the p values are higher than 0.05, the null hypothesis is accepted with regard to the impact of financial risk management techniques on the completion of projects on budgeted amount. Hence, there is no significant difference between the impact of financial risk management techniques such as financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques based on the completion of projects on the budgeted amount.

Section B

6.7 Impact of Financial Risk Management Techniques on Project Success

In this section, the researcher used secondary data collected from 256 software companies by taking 680 projects during 2 years (2022 and 2023). The successful completion of projects was analysed based on two constraints such as budgeted amount and time. The study takes into account small, medium, and large projects that are effectively completed with the aid of financial risk management techniques. The study tries to analyse the impact of financial risk management techniques based on a number of projects completed on the budgeted amount and time.

6.7.1. Impact of Financial Risk Planning Techniques on Project Success

The study focuses on the impact of financial risk planning techniques such as analytical techniques, regular meetings, expert judgement and information gathering techniques and types of projects such as small-sized projects, medium-sized projects and large-sized projects which have been completed during 2 years. Table 6.4 shows the results of the impact of financial risk planning techniques on project success

Table 6.4

Impact of Financial Risk Planning Techniques on Project Success

Financial Risk Planning Techniques	Number of projects Completed within the Budgeted Amount and Time		
	Small Projects	Medium Projects	Large Projects
Analytical Techniques	36	55	76
Expert Judgement	48	40	66
Regular Meeting	81	49	69
Information Gathering Techniques	35	16	109
Total	200	160	320

Source: Secondary Data

It is found that regular meetings (81) are highly helpful for small projects to be completed within the budgeted amount and time. In the case of medium projects, analytical techniques (55) benefit more for project success. Information-gathering techniques have a very low impact in the case of both small and medium-sized projects. In large projects, the impact of information gathering techniques (109) is potentially high, and expert judgement (66) has a low impact on the successful completion of projects. Among all the techniques, regular meeting mainly lead to project success, and information gathering show low influence.

6.7.2. Impact of Financial Risk Identification Techniques on Project Success

The study also focuses on the impact of financial risk identification techniques such as risk checklists, influence diagram, cause and effect diagram and failure mode and effect analysis and types of projects such as small-sized projects, medium-sized projects and large-sized projects which are completed during 2 years. Table 6.5 presents the results of the impact of financial risk identification techniques on project success

Table 6.5

Impact of Financial Risk Identification Techniques on Project Success

Financial Risk Identification Techniques	Number of projects Completed within Budgeted Amount and Time		
	Small Projects	Medium Projects	Large Projects
Risk Checklist	49	54	74
Influence Diagram	61	36	46
Cause and Effect Diagram	20	29	77
Failure Mode and Effect Analysis	70	41	123
Total	200	160	320

Source: Secondary Data

It is very clear that failure mode and effect analysis favoured project success in small and large projects. Medium projects are highly impacted by the risk checklist (54) for successful completion. Cause and effect diagrams have a low impact in the case of both small and medium projects. In the case of large projects, the influence diagram (46) favoured less to complete the project within the budgeted amount and time. Among all the techniques, failure mode and effect analysis mainly lead to project success, and cause and effect diagrams show low influence.

6.7.3. Impact of Financial Risk Analysis Techniques on Project Success

The study also analyses the impact of financial risk analysis techniques such as probability and impact grid, brainstorming, fault tree analysis, risk urgency assessment, consequences analysis, decision tree analysis, Monte Carlo analysis and sensitivity analysis and types of projects such as small-sized project, medium-sized project and large sized project which are completed during 2 years. Table 6.6 reveals the impact of financial risk analysis techniques on success of small, medium and large projects.

Table 6.6

Impact of Financial Risk Analysis Techniques on Project Success

Financial Risk Analysis Techniques	Number of projects Completed within the Budgeted Amount and Time		
	Small Projects	Medium Projects	Large Projects
Probability and Impact Grid	44	30	94
Brain Storming	12	14	60
Fault Tree Analysis	50	12	50
Risk Urgency Assessment	24	40	36
Consequences Analysis	36	6	13
Decision Tree Analysis	15	43	34
Monte Carlo Analysis	11	7	23
Sensitivity Analysis	8	8	10
Total	200	160	320

Source: Secondary Data

It is evident that fault tree analysis (50) highly influences project success in small projects. Sensitivity analysis shows low impact in the case of both small and large projects. In the case of medium projects, decision tree analysis (43) has a greater impact on project success and consequences analysis (6) has a low impact. Probability and impact grid (94) in large projects helped for successful completion of projects within budgeted amount and time. Sensitivity analysis has not much effect on project performance, whereas probability and impact techniques are extremely useful.

6.7.4 Impact of Financial Risk Monitoring and Controlling Techniques on Project Success

The study also examines the impact of financial risk monitoring and controlling techniques such as risk audit, risk register, cost and benefit analysis and variance & trend analysis and types of projects such as small-sized projects, medium-sized projects and large sized projects which have been successfully completed during 2 years. The impact of financial risk monitoring and controlling techniques on project success is shown in table 6.7.

Table 6.7

Impact of Financial Risk Monitoring and Controlling Techniques on Project Success

Financial Risk Monitoring & Controlling Techniques	Number of projects Completed within the Budgeted Amount and Time		
	Small Projects	Medium Projects	Large Projects
Risk Audit	35	68	66
Risk Register	20	14	73
Cost and Benefit Analysis	43	28	147
Variance and Trend Analysis	102	50	34
Total	200	160	320

Source: Secondary Data

From Table 6.7, it is clear that variance and trend analysis have a greater impact on the successful completion of projects within the constraints of small projects and a lower impact on large projects. Risk register has a low impact in the case of both small and medium projects. In the case of medium projects, the risk audit (68) performed highly for the project completion. Cost and benefit analysis (147) has a high impact on the successful completion of large projects. Moreover, Cost and benefit analysis is highly beneficial for the successful completion of the project.

6.8 Conclusion

This chapter covered the impact of financial risk management techniques based on the completion of the project on time and the completion of the project on the budgeted amount. It is found that the impact of financial risk management techniques does not influence the completion of the project on time and budgeted amount. The study also analysed the number of projects completed within the budgeted amount and time on the influence of financial risk management techniques with the help of secondary data related to 680 projects from 256 software companies and discovered that the impact of financial risk planning techniques, financial risk identification techniques, financial risk analysis techniques and financial risk monitoring and controlling techniques influenced small, medium and large projects to complete the projects within the budgeted amount and time.

Chapter Seven

EFFECTIVENESS OF SOFTWARE COMPANIES BASED ON FINANCIAL RISK MANAGEMENT TECHNIQUES AND FINANCIAL RISK MITIGATION STRATEGIES

7.1 Introduction

In this chapter, the study attempts to measure the effectiveness of software companies based on nature of software companies, the area of software companies, average number of projects undertaken by software companies, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount and average time spent on software project. The study also tries to measure the effectiveness of software companies and their relationship with financial risk mitigation strategies.

For analysis, the current chapter is divided into two sections. **Section A** discusses the effectiveness of software companies based on nature of software companies, area of software companies, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount and average time spent on software project. **Section B** of this chapter deals with the relationship between the effectiveness of software companies concerning financial risk mitigation strategies.

7.2 Objective of the Chapter

To measure the effectiveness of software companies based on financial risk management techniques and financial risk mitigation strategies of information technology projects.

7.3 Hypotheses Formulated and Tested

1. There is no significant difference between the effectiveness of software companies and the nature of software companies

2. There is no significant difference between the effectiveness of software companies and the area of software companies
3. The effectiveness of software companies does not influence the average number of software projects
4. The effectiveness of software companies does not affect the annual revenue invested for managing the financial risk of software companies
5. The effectiveness of software companies does not affect the completion of software projects on time
6. The Effectiveness of software companies does not affect the completion of software projects on the budgeted amount
7. The effectiveness of software companies does not influence the average time spent on software project

7.4 Methodology and Database

To accomplish the objective of this chapter, the primary data regarding the effectiveness of software companies, nature of software companies, area of software companies, the average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of the project on budgeted amount and average time spent on software project and financial risk mitigation strategies are collected from software companies with the help of a structured questionnaire. For the purpose of analysis, techniques like Arithmetic Mean, Standard Deviation, Levene's test for Homogeneity of Variance, One Way ANOVA, Tukey HSD Post-Hoc Test for Multiple Comparisons, Independent Sample t Test and Confirmatory Factor Analysis were used.

7.5 Variables Used for the Study

In order to analyse the effectiveness of software companies based on financial risk management the following variables are used.

Effectiveness	Financial Effectiveness Management Effectiveness Socio-Economic Effectiveness
Financial Risk Mitigation Strategies	Risk Transfer Strategies Risk Acceptance Strategies Risk Sharing Strategies Risk Avoidance Strategies

Section A

7.6 Effectiveness of Software Companies Based on Financial Risk Management Techniques

In this section, the researcher analysed the effectiveness of software companies based on the nature of the software company, the area of the software company, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount and average time spent on software project. To achieve the objective, tools like Arithmetic Mean, Standard Deviation, Levene's Test for Homogeneity of Variance, One Way Anova, Tukey HSD Post-Hoc Test for Multiple Comparison and Independent Sample t Test were used.

7.6.1 Effectiveness of Software Companies Based on the Nature of Software Company

In this section, the research mainly concentrates on financial, management and socio-economic related effectiveness of software companies. The nature of software companies is classified into small, medium and large. To analyse the significant difference between the effectiveness of software companies based on the nature of the software company, Levene's Test for Homogeneity of Variance, One Way Anova, Tukey HSD Post-Hoc Test for Multiple Comparison tests are applied and the following hypothesis is tested.

Ho: There is no significant difference between the effectiveness of software companies and the nature of software company.

The table 7.1 presents the homogeneity test results of the effectiveness of software companies based on the nature of the software company

Table 7.1

Homogeneity Test of Effectiveness of Software Companies Based on Nature of Software Company

	Levene statistic	Sig
Financial Effectiveness	2.24	0.10
Management Effectiveness	2.39	0.09
Socio-Economic Effectiveness	1.43	0.89

Source: Primary Data

Levene's test for homogeneity of variance indicated that the variances across the groups were equal, as the p-value was greater than 0.05. This means the assumption of equal variances required for One-Way ANOVA has been satisfied. As a result, the researcher can confidently proceed with using One-Way ANOVA to test for statistically significant differences between the means of the groups, thereby evaluating the effectiveness of software companies based on the nature of the software company.

Table 7.2 demonstrates the results of the effectiveness of software companies based on the nature of software companies.

Table 7.2

Comparison of Effectiveness of Software Companies on the Nature of Software Company

Effectiveness	Nature of Software Company			F Value	P Value	Remarks
	Small	Medium	Large			
Financial	3.74 (1.13)	3.90 (1.06)	3.82 (1.15)	0.834	0.043	Significant
Management	3.78 (1.14)	3.83 (1.06)	3.80 (1.17)	0.083	0.009	Significant
Socio-Economic	3.70 (1.16)	3.80 (1.14)	3.84 (1.13)	0.633	0.034	Significant

Source: Primary Data
Note: The values within the bracket indicate S D

As per descriptive statistics, effectiveness of software companies is potentially high in medium-sized software companies as compared with large and small and the effectiveness of software companies is very low in small-sized software companies. It is noticeable that software companies have high managerial effectiveness but poor socioeconomic effectiveness based on the nature of software company.

From the table, it is also clear that the Financial related effectiveness (p= 0.043), Management related effectiveness (p= 0.009) and Socio-economic related effectiveness (p= 0.034) shows statistically significant results. Therefore null hypothesis is rejected at a 5% level of significance and there is a significant difference among small, medium and large software companies regarding their effectiveness.

For precise analysis of the difference, post hoc analysis were conducted using the Tukey HSD test.

Table 7.3 explains Tukey HSD post hoc test results between the effectiveness of software companies based on nature of software company

Table 7.3

Multiple Comparison of Effectiveness of Software Companies on Nature of Software Company

Effectiveness	Tukey HSD			
	Nature (I)	**Nature (J)**	**Mean Difference**	**Sig**
Financial	Small	Medium	0.164	**0.003**
		Large	0.081	**0.012**
	Medium	Small	0.164	**0.026**
		Large	0.083	**0.011**
	Large	Small	0.081	**0.004**
		Medium	0.083	**0.023**
Management	Small	Medium	0.052	**0.016**
		Large	0.025	**0.014**
	Medium	Small	0.052	**0.022**
		Large	0.027	**0.031**
	Large	Small	0.025	**0.040**
		Medium	0.027	**0.039**
Socio-Economic	Small	Medium	0.099	**0.014**
		Large	0.140	**0.006**
	Medium	Small	0.099	**0.019**
		Large	0.041	**0.039**
	Large	Small	0.140	**0.029**
		Medium	0.041	**0.017**

Source: Primary Data

It is evident that the mean difference of effectiveness of software companies based on small, medium and large companies shows statistically significant result at 5% level. It further means the p values are less than 0.05 there is a comparable difference between financial, management and socio-economic effectiveness based on nature of software company.

7.6.2 Effectiveness of Software Companies Based on Area of Software Company

Here, the study primarily financial, management and socio-economic related effectiveness of software companies. The area of software company is classified into urban and city. To analyse significant differences among the effectiveness of software companies based on area of software companies, an Independent Sample t Test is applied and the following hypothesis is tested.

Ho: There is no significant difference between the effectiveness of software companies and the area of software company

The table 7.4 explains the effectiveness of software companies based on area of software company

Table 7.4

Effectiveness of Software Companies based on Area of Software Company

Effectiveness	Area of Software Company				Remarks
	Urban	City	T Value	P Value	
Financial	3.84 (1.14)	3.83 (1.11)	0.083	0.934	Insignificant
Management	3.80 (1.14)	3.81 (1.12)	0.109	0.913	Insignificant
Socio-Economic	3.82 (1.13)	3.78 (1.14)	0.406	0.685	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

The results based on the mean score indicate that software companies in urban areas are more effective than software companies in cities. It can also be understood that financial effectiveness is potentially high in urban (3.84) and city (3.83). It can also be seen that management effectiveness is low in urban areas (3.80), and in cities, socioeconomic effectiveness (3.78) is quite low. Since p values are higher than 0.05, the null hypothesis is accepted. Hence, there is no significant difference between effectiveness such as financial, management, and socio-economic based on the area of the software company.

7.6.3 Effectiveness of Software Companies Based on Average Number of Software Projects

The study primarily relies on financial, management and socio-economic related effectiveness of software companies. Average number of software projects are categorised into below 10, 10-25, 25-50, 50-75 and 75-100. To analyse significant difference between effectiveness of software companies based on average number of software projects, Levene's Test for Homogeneity of Variance, One way Anova, Tukey HSD Post-Hoc Test for Multiple Comparison are applied and the following hypothesis is tested.

Ho: Effectiveness of software companies does not influence the average number of software projects

The table 7.5 shows the results of homogeneity test of effectiveness of software companies based on average number of software projects

Table 7.5

Homogeneity Test of Effectiveness of Software Companies Based on Average Number of Software Projects

	Levene statistic	Sig
Financial	0.35	0.55
Management	0.38	0.53
Socio-Economic	0.08	0.77

Source: Primary Data

The 'p' value of Levene's test of Homogeneity of Variance is not significant at a 5% level of significance. Since all the values are greater than 0.05, the requirement of the homogeneity test has been met. Hence, it is ensured that the population variance for each group is approximately equal. Consequently, the testing of the hypothesis is meant for One Way ANOVA.

Table 7.6

Comparison of Effectiveness of Software Companies on Average Number of Software Projects

Effectiveness	Average Number of Software Projects					F Value	P Value	Remarks
	Below 10	10-25	25-50	50-75	75-100			
Financial	3.77 (1.08)	4.03 (.98)	3.79 (1.10)	3.87 (1.10)	3.70 (1.34)	1.30	0.266	Insignificant
Management	3.86 (1.13)	4.02 (.96)	3.77 (1.12)	3.82 (1.09)	3.67 (1.26)	1.41	0.277	Insignificant
Socio-Economic	3.67 (1.13)	3.90 (1.02)	3.73 (1.19)	3.92 (1.05)	3.64 (1.24)	1.46	0.212	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

The table 7.6 depicts that the financial, management, and socioeconomic effectiveness of software companies are used to determine the average number of software projects. In terms of descriptive statistics, management-related effectiveness has a significant influence on the average number of software projects, whereas socioeconomic effectiveness has less effect.

From the table, it is also clear that Financial related effectiveness (‘p’= 0.266 > 0.05), Management related effectiveness (‘p’= 0.277 > .005) and Socio-economic related effectiveness (‘p’= 0.212 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis is failed to reject and the effectiveness of software companies does not influence the average number of projects.

7.6.4 Effectiveness of Software Companies on Annual Revenue Invested for Managing Financial Risk

In this section, the study primarily focus on financial, management and socio-economic related effectiveness of software companies. Annual revenue invested for managing financial risk are categorised into Below 10, 10-25, 25-50, 50-75 and 75-100. To analyse significant difference between effectiveness of software companies based on annual revenue invested for managing financial risk, Levene's Test for Homogeneity of Variance, One way Anova, Tukey HSD Post-Hoc Test for Multiple Comparison are applied and the following hypothesis is tested.

Ho: The effectiveness of software companies do not affect the annual revenue invested for managing the financial risk of software companies

The table 7.7 shows the results of homogeneity test of effectiveness of software companies based on annual revenue invested for managing financial risk

Table 7.7

Homogeneity Test of Effectiveness of Software Companies Based on Annual Revenue Invested for Managing Financial Risk

	Levene statistic	Sig
Financial	0.49	0.61
Management	0.56	0.34
Socio-Economic	0.92	0.21

Source: Primary Data

Levene's test of homogeneity of variance revealed that all significant values are greater than 0.05, indicating the acceptance of the null hypothesis of homogeneity of variance. As a result, the test intended to compare the effectiveness of software companies based on annual revenue invested for managing financial risk is meant to One-Way Anova.

The table 7.7 shows the comparison of effectiveness of software companies based on annual turnover invested for managing financial risk.

Table 7.8

Comparison of Effectiveness of Software Companies Based on Annual Revenue Invested for Managing Financial Risk

Effectiveness	Annual Revenue Invested for Managing Financial Risk					F Value	P Value	Remarks
	Below 10	10-25	25-50	50-75	75-100			
Financial	4.07 (0.92)	4.04 (.93)	3.94 (1.01)	3.67 (1.21)	3.62 (1.28)	3.90	0.004	Significant
Management	4.15 (0.07)	3.93 (1.01)	3.93 (1.03)	3.70 (1.21)	3.56 (1.29)	3.78	0.005	Significant
Socio-Economic	3.90 (1.02)	3.95 (1.03)	3.99 (1.01)	3.63 (1.21)	3.62 (1.25)	3.01	0.18	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

The table 7.8 demonstrates that the financial, management, and socioeconomic effectiveness of software companies are used to determine the annual revenue invested for managing financial risk. Regarding descriptive statistics, financial-related effectiveness significantly influences the annual revenue invested for managing financial risk, whereas socioeconomic effectiveness has less effect.

P value is less than 0.05 for software companies' financial and management-related effectiveness. So, the null hypothesis is rejected at a 5% level of significance. It reveals that there is a significant difference between financial and management-related effectiveness in terms of annual revenue invested for managing financial risk.

In terms of socioeconomic-related effectiveness, the p-value is greater than 0.05. So, it failed to reject the null hypothesis. There is no significant difference between the effectiveness of software companies based on annual turnover invested for managing financial risk.

For precise analysis of the difference, post hoc analysis was conducted using the Tukey HSD test, and the result is given in Table 7.9.

Table 7.9

Multiple Comparison of Effectiveness of Software Companies on Annual Revenue Invested for Managing Financial Risk

Effectiveness	Tukey HSD			
	Annual turnover (I)	**Annual turnover (J)**	**Mean Difference**	**Sig**
Financial	Below 10	10-25	0.031	0.211
		25-50	0.124	0.211
		50-75	0.393	0.314
		75-100	0.441	0.126
	10-25	Below 10	-0.303	0.153
		25-50	0.094	0.431
		50-75	0.362	0.173
		75-100	0.411	0.320
	25-50	Below 10	-0.123	0.397
		10-25	-0.093	0.127
		50-75	0.274	**0.017**
		75-100	0.322	0.645
	50-75	Below 10	-0.397	0.818
		10-25	-0.367	0.531
		25-50	-0.274	0.721
		75-100	0.047	0.611
	75-100	Below 10	-0.445	0.221
		10-25	-0.415	0.144
		25-50	-0.322	0.311
		50-75	-0.47	0.376
Management	Below 10	10-25	0.222	**0.034**
		25-50	0.216	0.515
		50-75	0.452	**0.026**
		75-100	0.589	0.417

Effectiveness	Tukey HSD			
	Annual turnover (I)	**Annual turnover (J)**	**Mean Difference**	**Sig**
	10-25	Below 10	-0.223	0.625
		25-50	-0.007	0.136
		50-75	0.226	0.913
		75-100	0.365	0.514
	25-50	Below 10	-0.216	0.713
		10-25	0.007	0.632
		50-75	0.234	0.341
		75-100	0.373	0.212
	50-75	Below 10	-0.450	0.636
		10-25	-0.226	**0.021**
		25-50	-0.234	0.147
		75-100	0.139	0.317
	75-100	Below 10	-0.539	0.719
		10-25	-0.365	0.516
		25-50	-0.373	0.424
		50-75	-0.139	0.635

Source: Primary Data

From Table 7.9, with respect to financial related effectiveness, it is clear that there exists a significant pairwise difference in the mean scores of below 10, and 25-50 as the p-value is less than 0.05 level of significance. It is also evident that the annual revenue invested below 10 with 10-25 explains that there doesn't exist any significant difference. Moreover, there doesn't exist a significant pairwise difference between the mean score of 10-25 with 25-50, 50-75 and 75-100 as their p values are greater than 0.05 at 5% level of significance.

It can be noted that the pairwise difference between the mean score of the annual revenue 25-50 with 50-75 with a p value of 0.017, which is less than the significant level. The pairwise comparison of the annual revenue 50-75 with below 10 (0.818), 10-25 (0.531), 25-50 (0.721) and 75-100 (0.611) explains that there is no significant difference between the mean scores of these annual revenue invested for managing financial risk in respect of financial related effectiveness. Further stating that the comparison of 75-100 with below 10, 10-25, 25-50 and 50-75 have no significant differences as their p values are more than 0.05 level of significance.

In the case of management related effectiveness there exist significant differences in the mean score of below 10 and 50-75 as the p values are less than 0.05 level of significance. It is also clear that the annual revenue invested below 10 with 25-50 and 75-100 explains that there doesn't exist any significant difference. Moreover, there doesn't exist a significant pairwise difference between the mean score of 10-25 and 25-50 with below 10, 10-25, 25-50, 50-75 and 75-100 as their p values are greater than 0.05 level of significance.

It can be seen that the pairwise difference between the mean score of the annual revenue 50-75 with 10-25 with a p value of 0.021 which is less than the significant level and the pairwise comparison of the annual revenue 50-75 with below 10 (0.636), 25-50 (0.147) and 75-100 (0.317) explains that there is no significant difference between the mean scores of these annual revenue invested for managing financial risk with respect to management related effectiveness. Additionally claiming that the comparison of 75-100 with below 10, 10-25, 25-50 and 50-75 have no significant differences as their p values are more than 0.05 level of significance.

7.6.5 Effectiveness of Software Companies Based on Completion of Software Project on Time

In this section, the study emphasis on financial, management and socio-economic related effectiveness of software companies. Completion of software projects on time are categorised into below 20, 20-40, 40-60, 60-80 and 80-100. To analyse significant differences among effectiveness of software companies and completion of software projects on time Levene's Test for Homogeneity of Variance, One way ANOVA, and Tukey HSD Post-Hoc Test for Multiple Comparison tests are applied and the following hypothesis is tested.

Ho: Effectiveness of software companies do not affect the completion of project on time

The table 7.10 illustrates homogeneity test results of effectiveness of software companies based on completion of project on time.

Table 7.10

Homogeneity Test of Effectiveness of Software Companies Based on Completion of Project on Time

	Levene statistic	**Sig**
Financial	7.84	0.17
Management	4.01	0.52
Socio-Economic	3.71	0.42

Source: Primary Data

Table 7.10 presents the results of a Levene's test showing that the p-value is greater than 0.05 at the 5% level of significance. As a result, One-Way ANOVA has been applied to check for differences between effectiveness of software companies based on the completion of the project on time.

Table 7.11 describes the results of effectiveness of software companies based on the completion of the project on time.

Table 7.11

Comparison of Effectiveness of Software Companies Based on Completion of Project on Time

Effectiveness	Completion of Project on Time (%)					F Value	P Value	Remarks
	Below 20	20-40	40-60	60-80	80-100			
Financial	4.50 (0.52)	3.70 (1.17)	3.81 (1.13)	3.72 (1.21)	3.94 (1.02)	1.53	0.191	Insignificant
Management	4.45 (0.15)	3.74 (1.25)	3.91 (1.05)	3.61 (1.21)	3.92 (1.05)	2.67	0.031	Significant
Socio-Economic	4.45 (0.37)	3.73 (1.30)	3.77 (1.19)	3.69 (1.16)	3.88 (1.09)	1.05	0.379	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

It is seen that the financial, management and socio-economic related effectiveness are used for measuring the completion of the project on time. As per descriptive statistics, it is very clear that financial related effectiveness highly affect the software companies to complete the project on time and socio-economic related effectiveness of software companies shows a low effect on the completion of the project on time.

From the table, it is also clear that, Management (p=0.031) shows a statistically significant result based on completion of project on time. Therefore null hypothesis is rejected at a 5% level of significance and thus the effectiveness of software companies influence the completion of the project on time.

But the effectiveness namely Financial (‘p’= 0.191 > 0.05), and Socio-Economic (‘p’= 0.379 > 0.05) are not statistically significant at 5% level of significance. That means the null hypothesis failed to reject and there is no significant difference in the completion of the project on time based on these effectiveness.

For precise analysis of the difference, post hoc analysis was conducted by using the Tukey HSD test. The table 7.12 explains Tukey HSD post hoc test result between effectiveness of software companies on completion of the project on time.

Table 7.12

Multiple Comparison of Effectiveness of Software Companies Based on Completion of Project on Time

Effectiveness	Tukey HSD			
	Completion of Project (I)	**Completion of Project (J)**	**Mean Difference**	**Sig**
Management	Below 20	20-40	0.721	0.737
		40-60	0.547	0.874
		60-80	0.848	0.566
		80-100	0.529	0.883
	20-40	Below 20	-0.718	**0.014**
		40-60	-0.170	0.921
		60-80	0.130	0.960
		80-100	-0.188	0.851
	40-60	Below 20	-0.547	0.874
		20-40	.0170	0.925
		60-80	0.300	0.202
		80-100	-0.170	1.000
	60-80	Below 20	-0.848	0.566
		20-40	-0.130	0.962
		40-60	-0.300	0.204
		80-100	-0.318	0.357
	80-100	Below 20	-0.529	0.883
		20-40	0.188	0.851
		40-60	0.177	1.000
		60-80	0.319	**0.035**

Source: Primary Data

From Table 7.12, with respect to management related effectiveness, it is clear that there exists a significant pairwise difference in the mean scores of 20-40 and 80-100 as the p-value is less than 0.05 level of significance. It is also evident that the completion of project of below 20 with 20-40, 40-60 60-80 and 80-100 explains that there doesn't exist any significant difference. Moreover, there doesn't exist a significant pairwise difference between the mean score of 20-40 with 40-60, 60-80 and 80-100 as their p values are greater than 0.05 level of significance. But the pairwise comparison between 20-40 with below 20 has a p value of 0.014, which is below the significance level.

It can be noted that the pairwise comparison of completion of projects 40-60 and 60-80 with below 20, 20-40, 40-60, 60-80 and 80-100 shows there is no significant difference, since the p values are greater than 0.05 level of significance. Further stating that the comparison of 80-100 with below 20, 20-40 and 40-60 have no significant differences as their p values are more than 0.05 level of significance. However, the pairwise comparison of 80-100 with 60-80 with a p value of 0.035, which is less than the significant level which implies that there exist a significant difference among completion of project on time on the effectiveness of software companies.

7.6.6 Effectiveness of Software Companies Based on Completion of Project on Budgeted Amount

The study has a particular focus on the effectiveness of software companies such as financial, management and socio-economic. Completion of projects on budgeted amount is classified into projects completed within the budgeted amount and projects completed out of budgeted amount. To analyse the significant difference between the effectiveness of software companies and the completion of the project on budgeted amount, Independent Sample t-test is applied and the following hypothesis is tested.

Ho: Effectiveness of software companies do not affect the completion of projects on budgeted amount

The table 7.13 explains the results of effectiveness of software companies based on completion of project on budgeted amount.

Table 7.13

Effectiveness of Software Companies on Completion of Project Based on Budgeted Amount

Effectiveness	Completion of Project on Budgeted Amount		T Value	P Value	Remarks
	Project Completed within Budgeted Amount	Project Completed Out of Budgeted Amount			
Financial	3.84 (1.09)	3.82 (1.14)	0.149	0.881	Insignificant
Management	3.83 (1.05)	3.72 (1.17)	0.444	0.657	Insignificant
Socio-Economic	3.85 (1.09)	3.86 (1.17)	0.885	0.377	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

It is clear from the table that, since p values are higher than 0.05, the null hypothesis is accepted with regard to the effectiveness of software companies based on the completion of the project on the budgeted amount. Hence, there is no significant difference between the completion of the project on the budgeted amount based on financial, management and socio-economic related effectiveness. Based on the mean score, it can be inferred that Socio-Economic related effectiveness (3.85) highly influence the software companies to complete the project on budgeted amount and Management related effectiveness (3.72) highly affect the software companies to complete the project out of budgeted amount.

7.6.7 Effectiveness of Software Companies on Average Time Spent on Software Project

The study considers the effectiveness of software companies such as financial, management and socio-economic. The average time spent on the project is categorised into below 0-2, 2-4, 4-6 and 6 and above months. To analyse significant differences among the effectiveness of software companies based on average time spent on the project, Levene’s test for Homogeneity of Variance, One-way ANOVA, Tukey HSD Post-Hoc Test for Multiple Comparison Tests are applied and the following hypothesis is tested.

Ho: The effectiveness of software companies does not influence the average time spent on software project

The table 7.14 reveals the homogeneity test of the effectiveness of software companies based on average time spent on software projects.

Table 7.14

Homogeneity Test of Effectiveness of Software Companies Based on Average Time Spent on Software Project

	Levene statistic	Sig
Financial	2.336	0.061
Management	1.378	0.092
Socio-Economic	3.154	0.143

Source: Primary Data

Table 7.14 reveals that the p values of the effectiveness of software companies based on average time spent on software projects is greater than 0.05 at a 5% level of significance. Thus, it satisfies Levene's test conditions for One Way ANOVA.

Table 7.15 exhibits the results of comparison of effectiveness of software companies based on average time spent on software projects.

Table 7.15

Comparison of Effectiveness of Software Companies Based on Average Time Spent on Software Project

Effectiveness	Average Time Spent on Software Project (Months)				F Value	P Value	Remarks
	0-2	2-4	4-6	6 & Above			
Financial	3.97 (0.09)	4.00 (0.08)	3.66 (0.10)	3.71 (0.09)	3.34	0.192	Insignificant
Management	3.94 (1.01)	4.11 (0.09)	3.66 (1.16)	3.65 (1.26)	3.84	0.103	Insignificant
Socio-Economic	3.85 (1.14)	3.99 (0.091)	3.69 (1.18)	3.64 (1.21)	2.94	0.032	Significant

Source: Primary Data
Note: The values within the bracket indicate S D

The table 7.15 shows that the financial, management and socio-economic effectiveness are used for measuring the average time spent on software projects. As per descriptive statistics, it is very clear that financial related effectiveness have a greater impact on the average time spent on software projects and socio-economic related effectiveness have a lower impact.

From the table 7.15, it is also clear that Socio-Economic related effectiveness (p=0.032) show statistically significant result based on average time spent on software project. Therefore the null hypothesis is rejected at a 5% level of significance and thus the effectiveness of software companies influence the average time spent on software projects.

But the effectiveness such as Financial (‘p’= 0.192 > 0.05) and Management (‘p’= 0.103 > 0.05) are not statistically significant at 5% level. This indicates that, based on these effectiveness, there is no significant difference in the average amount of time spent on the project, and the null hypothesis is failed to reject.

For precise analysis of the difference of socio-economic related effectiveness based on average time spent on software projects, post hoc analyses were conducted by using the Tukey HSD test. Table 7.16 presents the results of the Tukey HSD post hoc test between the effectiveness of software companies based on the average time spent on software projects.

Table 7.16

Multiple Comparison of Effectiveness of Software Companies Based on Average Time Spent on Software Project

Effectiveness	Tukey HSD			
	Average Time (I) (Months)	**Average Time (J) (Months)**	**Mean Difference**	**Sig**
Socio-Economic	0-2	2-4	-0.140	**0.017**
		4-6	0.159	**0.025**
		6 & Above	0.208	0.429
	2-4	0-2	0.140	0.749
		4-6	0.299	0.126
		6 & Above	0.349	0.245
	4-6	0-2	-0.159	**0.020**
		2-4	-0.299	0.514
		6 & Above	0.049	0.121
	6 & Above	0-2	-0.208	0.111
		2-4	-0.349	0.312
		4-6	-0.049	0.985

Source: Primary Data

Table 7.16 describes the pairwise comparison of average time spent on software projects based on management-related effectiveness and it is also clear that there exists a significant pairwise difference in the mean scores of 0-2 and 4-6 as the p-value is less than 0.05 level of significance. It is also evident that the pairwise comparison of 0-2 with 2-4 and 4-6, explains that there is a significant difference as their p values are less than 0.05 level of significance. When comparing 0- 2 with 6 and above months, it can be seen that no pairwise difference between the months as the p-value is 0.429, which is higher than the 0.05 level of significance.

In the case of analysis of 2-4 with 0-2, 4-6 and 6 and above months, it is seen from the table that there is no pairwise difference because the p values are higher than 0.05 level of significance. The pairwise comparison of 4-6 with 0-2 shows a significant difference since the p value is 0.020, which is less than 0.05 level of significance. However, there is no significant difference that can be seen in the relationship with 2-4 (0.514) and 6 and above months (0.121). Additionally claiming that the comparison of 6 and above months with 0-2, 2-4 and 4-6 have no significant differences as their p values are more than 0.05 level of significance.

Section B

This section of the chapter focuses on performing Confirmatory Factor Analysis (CFA) to assess the effectiveness of software companies and the financial risk mitigation strategies. The research aims to test the validity and reliability of the model. The measurement model is tested to understand the relationships between latent variables and observed indicators. The results of these analyses are presented in CFA tables, which are explained to assess the model's accuracy and appropriateness.

7.7 Confirmatory Factor Analysis of Effectiveness of Software Companies and Financial Risk Mitigation Strategies

This section outlines the tests that were conducted on the measurement model to validate its dependability and precision. Confirmatory factor analysis is used to understand the findings of model testing that is carried out to establish the accuracy and dependability of the scale measure as well as to evaluate how well a defined factor model fits a certain collection of observed data. The measurement model consists of 36 observable variables, 36 error elements (e1 to e36), and 7 unobserved variables. The model essentially tries to explain how the observable variables (which can be directly measured) relate to the latent constructs (which cannot be directly measured) and how these latent constructs influence the software company's effectiveness and risk mitigation strategies. The measurement model ultimately aims to understand how these constructs are related and how they influence the performance of software companies, particularly in managing financial risks.

The following variables are unobserved.

1. Financial Effectiveness (EF): This latent variable represents the overall financial performance and effectiveness of a software company in managing its finances.

2. Management Effectiveness (EM): This variable reflects the overall effectiveness of the management within the software company. It could measure how well the management is making decisions, allocating resources, and guiding the company toward success.

3. Socio-Economic Effectiveness (ES): This factor refers to how well the company performs in terms of social-economic effectiveness. It might include social responsibility, community engagement, sustainability, and the company's role in the broader economic environment.

4. Risk Transfer Strategies (ST): This latent variable captures the financial risk management strategies employed by the company to transfer risks to other parties.

5. Risk Acceptance Strategies (SA): Risk acceptance refers to the company's approach to accepting certain risks without attempting to mitigate or transfer them.

6. Risk Avoidance Strategies (SV): This factor reflects the company's use of strategies to avoid risks altogether.

7. Risk Sharing Strategies (SS): This latent variable measures the company's efforts to share risks with other parties, often through partnerships, joint ventures, or contracts that spread the financial burden of certain risks.

The figure 7.1 depicts the confirmatory analysis of effectiveness of software companies based on financial risk mitigation strategies.

Figure 7.1

Confirmatory Factor Analysis of Effectiveness of Software Companies and Financial Risk Mitigation Strategies

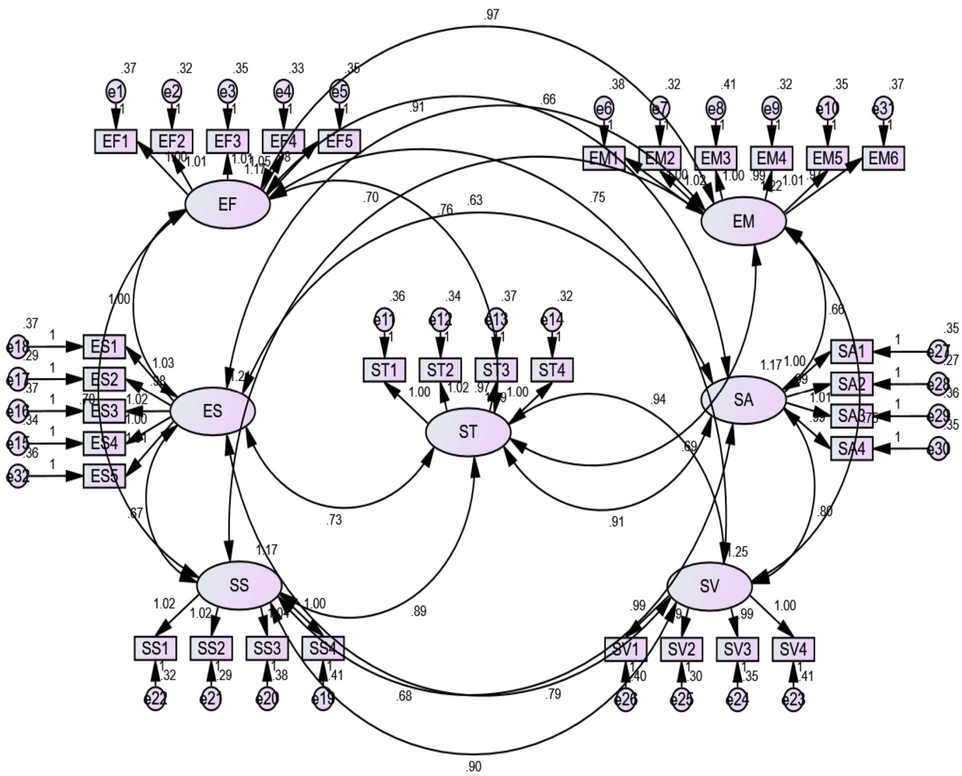


Figure 7.1 explains the confirmatory factor analysis of the effectiveness of software companies and financial risk mitigation strategies. It offers estimates along with observed and error estimates for each measurement parameter. Additionally, it displays the outcomes of the beta coefficients for each factor. Strong factor loadings between the components in each factor are evident from the figure. It was recommended that the model with seven constructs and associated variables was suggested as a good fit.

Model fit indices for effectiveness of software companies and financial risk mitigation strategies is shown in table 7.17.

Table 7.17

Model Fit Indices for Effectiveness of Software Companies and Financial Risk Mitigation Strategies

Model Fit Indices	Model Values	Threshold	Interpretation
CMIN/DF	1.556	Between 1 and 5	Excellent
CFI	0.985	> 0.95	Excellent
GFI	0.928	> 0.9	Excellent
AGFI	0.913	> 0.9	Excellent
RMSEA	0.032	< 0.08	Excellent

Source: Primary Data

For a model to be considered valid, the Chi-Square to degrees of freedom ratio must be smaller than 5. The value in this instance is 1.556 which is well within the recommended maximum value. The RMSEA value is 0.032, which is far below the acceptable threshold score of 0.08. Additionally, the GFI, AGFI, and CFI values are all greater than 0.9. Thus, the model fit is excellent.

The table 7.18 describes reliability and validity of the CFA model for effectiveness of software companies and financial risk mitigation strategies.

Table 7.18

Reliability and Validity of the CFA Model for Effectiveness of Software Companies and Financial Risk Mitigation Strategies

Constructs	Item Code	Factor Loading	AVE	MSV	C R
Financial Effectiveness	EF1	0.872	0.775	0.707	0.945
	EF2	0.887			
	EF3	0.877			
	EF4	0.891			
	EF5	0.874			

Constructs	Item Code	Factor Loading	AVE	MSV	C R
Management Effectiveness	EM1	0.873	0.772	0.656	0.953
	EM2	0.894			
	EM3	0.865			
	EM4	0.888			
	EM5	0.882			
	EM6	0.881			
Socio-Economic Effectiveness	ES1	0.881	0.781	0.707	0.947
	ES2	0.895			
	ES3	0.879			
	ES4	0.883			
	ES5	0.881			
Risk Transfer	ST1	0.875	0.773	0.601	0.931
	ST2	0.887			
	ST3	0.867			
	ST4	0.887			
Risk Acceptance	SA1	0.877	0.778	0.600	0.934
	SA2	0.900			
	SA3	0.877			
	SA4	0.874			
Risk Avoidance	SV1	0.870	0.772	0.601	0.931
	SV2	0.896			
	SV3	0.882			
	SV4	0.868			
Risk Sharing	SS1	0.889	0.776	0.568	0.933
	SS2	0.897			
	SS3	0.877			
	SS4	0.860			

Source: Primary Data

Table 7.18 illustrates the Standardized Factor Loadings (SFL), Composite Reliability (CR), Average Variance Extracted (AVE), and Maximum Shared Variance (MSV). Every factor strongly influences the constructs when its standardized factor loading value surpasses 0.5. The CR values are greater than AVE, the CR values are greater than the constructs, and the CR values are greater than 0.7. These three conditions are met in terms of convergent validity. MSV and AVE are also used to demonstrate the scale's discriminant validity. In this instance, AVE values perform better than MSV in all cases. Therefore, the requirements for discriminant validity were also satisfied.

7.8 Conclusion

This chapter covered the effectiveness of software companies based on financial risk management techniques and their relationship with financial risk mitigation strategies. It also attempts to study the effectiveness of software companies based on the nature of the software company, the area of the software company, the average number of software projects undertaken, annual revenue invested for managing the financial risk, completion of project on time and completion of project on the budgeted amount. To exhibit the results certain statistical and mathematical techniques were used. In addition, confirmatory factor analysis was used to analyse the relationship between the effectiveness of software companies and financial risk mitigation strategies. It was found that medium-sized software companies have a high potential for effectiveness, and those located in urban areas demonstrated a high level of effectiveness. Management-related effectiveness is highly influenced in the case of an average number of software projects. In the case of annual revenue invested for managing financial risk, completion of projects on time and average time spent on software project, financial-related effectiveness significantly influences, whereas socioeconomic effectiveness has less effect. It can also be inferred that socio-economic effectiveness highly influences the software companies to complete the project on the budgeted amount and management effectiveness highly affects the software companies to complete the project out of the budgeted amount. Furthermore, there exists a significant relationship between the effectiveness of software companies and financial risk mitigation strategies.

Chapter Eight

CHALLENGES FACED BY SOFTWARE COMPANIES

8.1 Introduction

In this chapter, the study tries to examine the challenges faced by software companies and the influence of the usage of financial risk management techniques and financial risk mitigation strategies to overcome the challenges. It also attempts to study the influence of challenges of software companies on the nature of software company, area of software company, average number of software projects, annual revenue invested for managing financial risk, completion of project on time completion of project on budgeted amount and average time spent on software project.

For analysis, the current chapter is divided into two sections. **Section A** discusses the challenges faced by software companies and their influence on the nature of software company, the area of software company, the average number of software projects, the annual revenue invested for managing financial risk, completion of the project on time, completion of the project on budgeted amount and average time spent on software project. **Section B** of this chapter deals with the relationship of challenges of software companies with usage of financial risk management techniques and financial risk mitigation strategies.

8.2 Objective of the chapter

The objective of the chapter is to study the challenges faced by software companies in the successful completion of information technology projects.

8.3 Hypotheses Formulated and Tested

1. There is no significant difference between the challenges of software companies and the nature of software companies
2. There is no significant difference between the challenges of software companies and the area of software companies

3. Challenges of software companies do not influence the average number of software projects
4. Challenges of software companies do not affect the annual revenue invested for managing the financial risk of software companies
5. Challenges of software companies do not affect the completion of software projects on time
6. Challenges of software companies do not affect the completion of projects on budgeted amounts
7. Challenges of software companies do not influence the average time spent on software projects

8.4 Methodology and Database

To accomplish the objective of this chapter, the primary data regarding the challenges of software companies, nature of software company, area of software company, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount, average time spent on software project, usage of financial risk management techniques and financial risk mitigation strategies are collected from software companies with the help of a structured questionnaire. For analysis, techniques like Arithmetic Mean, Standard Deviation, Levene's Test for Homogeneity of Variance, Way Anova, Tukey HSD Post-Hoc Test for Multiple Comparisons, Independent Sample t-test and Confirmatory Factor Analysis are used.

8.5 Variables Used for the Study

The study uses the following variables to accomplish the objective of the chapter.

Challenges	Market-related Challenges System-related Challenges Co-ordination related Challenges

Usage	Financial Risk Planning Techniques Financial Risk Identification Techniques Financial Risk Analysis Techniques Financial Risk Monitoring and Controlling Techniques
Financial Risk Mitigation Strategies	Risk Transfer Strategies Risk Acceptance Strategies Risk Avoidance Strategies Risk Sharing Strategies

Section A

8.6 Challenges Faced by Software Companies

In this section, the researcher analysed the challenges of software companies based on the nature of the software company, area of the software company, the average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on budgeted amount and average time spent on software project. To achieve the objective, tools like Arithmetic Mean, Standard Deviation, Levene's Test for Homogeneity of Variance, One way Anova, Tukey HSD Post-Hoc Test for Multiple Comparisons and Independent Sample t Test were used.

8.6.1 Challenges of Software Companies Based on the Nature of Software Company

In this section, the research mainly concentrates on the challenges of software companies such as market-related, system-related and coordination-related. The nature of software companies is categorised as large, medium and small. To analyse the significant difference between the challenges of software companies based on the nature of software companies, Levene's test for Homogeneity of Variance, One-way

ANOVA, and Tukey HSD Post-Hoc Test for Multiple Comparison tests are applied and the hypothesis is presented below.

Ho: There is no significant difference between the challenges of software companies and the nature of software companies

The table 8.1 presents the homogeneity test of challenges of software companies based on the nature of software company.

Table 8.1

Homogeneity Test of Challenges of Software Companies Based on the Nature of Software Company

	Levene statistic	Sig
Market	3.22	0.060
System	1.601	0.203
Co-ordination	0.671	0.512

Source: Primary Data

From table 8.1, it is evident that the p-values associated with the market, system, and coordination-related challenges values exceed the 0.05 threshold. This suggests that the differences in variances between the groups being compared are not statistically significant, which is a key assumption for conducting parametric tests like ANOVA. Since the p-values for these challenges are greater than 0.05, it indicates that the assumption of homogeneity of variance is satisfied. As a result, the researcher can confidently proceed with conducting a One-Way Analysis of Variance, as this test is appropriate when the assumption of homogeneity of variances is met.

Table 8.2

Comparison of Challenges of Software Companies Based on the Nature of Software Company

Challenges	Nature of Software Company			F Value	P Value	Remarks
	Small	Medium	Large			
Market	3.60 (1.20)	3.68 (1.20)	3.57 (1.28)	0.401	0.032	Significant
System	3.63 (1.19)	3.57 (1.21)	3.58 (1.27)	0.103	0.020	Significant
Co-ordination	3.41 (1.27)	3.46 (1.25)	3.42 (1.28)	0.092	0.014	Significant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 8.2 observes the results of the challenges of software companies based on the nature of the software companies. Market, system and coordination are considered as challenges of software companies for measuring the nature of software companies. As per descriptive statistics, challenges of software companies are potentially high in medium-sized software companies as compared with small and large. System-related challenges are high in small and large companies and market-related challenges are high in the case of medium companies. It is also clear that market challenges are very high when compared with system and coordination-related challenges.

From the table, it is also clear that the Market (p= 0.032), System (p= 0.020) and Coordination (p= 0.014) show statistically significant results. Therefore the null hypothesis is rejected at a 5% level of significance and there exists a significant difference among small, medium and large companies based on the challenges of software companies. For precise analysis of the difference, post hoc comparisons were conducted using the Tukey HSD test and the result of the same is given in table 8.3

Table 8.3

Multiple Comparison of Challenges of Software Companies Based on the Nature of Software Company

Challenges	Tukey HSD			
	Nature (I)	**Nature (J)**	**Mean Difference**	**Sig**
Market	Small	Medium	0.077	0.314
		Large	0.136	0.119
	Medium	Small	0.142	0.315
		Large	0.120	0.443
	Large	Small	0.136	**0.028**
		Medium	0.125	**0.016**
System	Small	Medium	0.137	**0.024**
		Large	0.120	**0.011**
	Medium	Small	0.141	**0.009**
		Large	0.135	**0.021**
	Large	Small	0.141	0.039
		Medium	0.119	0.019
Co-ordination	Small	Medium	0.052	**0.013**
		Large	0.006	**0.022**
	Medium	Small	0.052	0.316
		Large	0.046	0.253
	Large	Small	0.006	**0.004**
		Medium	0.046	**0.020**

Source: Primary Data

From the table, it is evident that the pairwise comparison of large software companies with small (0.028) and medium (0.016) sized companies reveals that the significant values of both companies are lower than the 5% level. Thus, it means that these companies are significantly different from large software companies with regard to market-related challenges. But there is no significant pairwise comparison between small and medium-sized software companies as the values are higher than the 5% level of significance.

In the pairwise relationship, in the case of system related challenges, the p values of small and medium software companies are lower than the 5% level. However, there is no significant difference in the case of large software companies as the p values are greater than the 5% level.

Further analysis of co-ordination related challenges, it is observed from the table that there exist pairwise differences between small and large software companies since the significant values are lower than 0.05. However, there is no pairwise difference exists between medium-sized software companies with small and large software companies, as the p values are higher than the 5% level of significance.

8.6.2 Challenges of Software Companies Based on Area of Software Company

The study investigates on challenges such as market-related, system-related and coordination-related. The areas of software companies are classified into urban and city. To analyse significant differences among challenges of software companies based on areas of software companies, Independent Sample t Test is applied and the following hypothesis is tested.

Ho: There is no significant difference between the challenges of software companies and the area of software company

The table 8.4 shows the challenges of software companies based on area of software company.

Table 8.4

Challenges of Software Companies Based on the Area of Software Company

Challenges	Area of Software Company				Remarks
	Urban	City	T Value	P Value	
Market	3.61 (1.24)	3.62 (1.24)	0.072	0.942	Insignificant
System	3.62 (1.21)	3.57 (1.24)	0.400	0.670	Insignificant
Co-ordination	3.42 (1.31)	3.44 (1.25)	0.230	0.922	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Based on the mean score, it can be inferred that software companies in urban areas are highly affected by challenges as compared with software companies in the city. It is also understood that system-related challenges affect more in the case of urban (3.62) and market-related challenges affect more in city (3.62). It can also be seen that the coordination-related challenges are least affected in the case of urban (3.42) and city (3.44).

It is also clear that, since p values are higher than 0.05, the null hypothesis is accepted concerning the challenges of software companies based on the area of software companies. Hence, there is no significant difference between areas of software companies concerning challenges such as market, system and coordination.

8.6.3 Challenges of Software Companies Based on Average Number of Software Projects

In this section, the study primarily relies on the challenges of software companies such as market-related, system-related and coordination-related. Average number of software projects are categorised into below 10, 10-25, 25-50, 50-75 and 75-100. To analyse significant differences among challenges of software companies based on the average number of software projects, Levene's Test for Homogeneity of Variance, One-way ANOVA, and Tukey HSD Post-Hoc Test for Multiple Comparison Tests are applied and the hypothesis framed for the research is outlined below.

Ho: Challenges of software companies do not influence the average number of software projects

The table 8.5 demonstrates the result of the homogeneity test of challenges of software companies based on the average number of software projects.

Table 8.5

Homogeneity Test of Challenges of Software Companies Based on Average Number of Software Projects

	Levene Statistic	Sig
Market	5.45	0.333
System	3.97	0.481
Co-ordination	2.43	0.380

Source: Primary Data

Measuring the differences between the groups under comparison is a prerequisite for the ANOVA test. Levene developed the homogeneity of variance test to evaluate this assumption. When examining the dimensions' significance value, it is higher than 0.05. Consequently, the homogeneity assumption is accepted at the 5% significance level, making one-way Anova the best test for comparing the means of the variables. One-way ANOVA is presented in Table 8.6.

Table 8.6

Comparison of Challenges of Software Companies Based on Average Number of Software Projects

Challenges	Average Number of Software Projects					F Value	P Value	Remarks
	Below 10	10-25	25-50	50-75	75-100			
Market	3.63 (1.06)	3.86 (1.16)	3.60 (1.29)	3.56 (1.23)	3.53 (1.29)	1.140	0.034	Significant
System	3.41 (1.31)	3.79 (1.10)	3.55 (1.26)	3.58 (1.23)	3.72 (1.28)	0.871	0.621	Insignificant
Co-ordination	3.65 (1.14)	3.62 (1.22)	3.32 (1.29)	3.38 (1.25)	3.44 (1.31)	1.051	0.580	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 8.6 explains the results of the challenges of software companies on the average number of software projects. Market, system and coordination are the challenges in measuring the average number of software projects. As per descriptive statistics, it is very clear that market-related challenges and coordination-related challenges highly influence the average number of software projects and system-related challenges have a low influence on the average number of software projects.

From the table, it is also clear that the Market (p= 0.034) shows statistically significant results towards the average number of software projects. Therefore the null hypothesis is rejected at a 5% level of significance and thus the challenges of software companies influence the average number of projects undertaken by software companies.

But the challenges such as System ('p'= .621 > 0.05) and Co-ordination ('p'= .580 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis is failed to reject and there is no significant difference in the average number of software projects based on these challenges.

For precise analysis of the difference, post hoc comparisons were conducted by using the Tukey HSD test. The result of the same is presented in table 8.7.

Table 8.7

Multiple Comparison of Challenges of Software Companies Based on Average Number of Software Projects

Challenges	Tukey HSD			
	Average Number of Projects (I)	**Average Number of Projects (J)**	**Mean Difference**	**Sig**
Market	Below 10	10-25	0.230	**0.012**
		25-50	-0.029	**0.003**
		50-75	-0.069	**0.034**
		75-100	0.094	**0.004**
	10-25	Below 10	0.230	0.117
		25-50	0.259	0.266
		50-75	-0.299	0.320
		75-100	0.324	0.511

Challenges	Tukey HSD			
	Average Number of Projects (I)	**Average Number of Projects (J)**	**Mean Difference**	**Sig**
	25-50	Below 10	-0.029	**0.006**
		10-25	0.259	**0.021**
		50-75	0.040	**0.019**
		75-100	0.065	**0.036**
	50-75	Below 10	0.069	0.721
		10-25	0.299	0.317
		25-50	0.040	0.425
		75-100	0.024	0.339
	75-100	Below 10	0.094	**0.002**
		10-25	0.324	**0.014**
		25-50	0.065	**0.030**
		50-75	0.024	**0.043**

Source: Primary Data

By analysing the result of market-related challenges, it is seen that below 10, 25-50 and 75-100 categories have significant differences from 10-25 and 50-75 with p value less than 0.05. Therefore it can be concluded that there is a difference among the average number of software projects undertaken regarding the market-related challenges. But no significant difference can be seen in the 10-25 and 50-75 as the p values are greater than 0.05. So, there is no significant pairwise difference exist with these average number of software projects on market-related challenges.

8.6.4 Challenges of Software Companies Based on Annual Revenue Invested for Managing Financial Risk

In this section, the study emphasises challenges such as market, system and co-ordination. Annual revenue invested for managing financial risk is categorised into below 10, 10-25, 25-50, 50-75 and 75-100. To analyse significant differences among challenges based on annual revenue invested for managing financial risk, Levene's Test for Homogeneity of Variance, One Way Anova, Tukey HSD Post-Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Challenges of software companies do not affect annual revenue invested for managing the financial risk of software companies

The table 8.8 illustrates the result of the homogeneity test results of challenges of software companies based on annual revenue invested for managing financial risk

Table 8.8

Homogeneity Test of Challenges of Software Companies Based on Annual Revenue Invested for Managing Financial Risk

	Levene statistic	Sig
Market	0.482	0.523
System	1.692	0.083
Co-ordination	1.423	3.326

Source: Primary Data

The outcome of Levene's test for the homogeneity assumption of one-way ANOVA is explained in the table. Since all dimensions' "p" values are higher than 0.05, the null hypothesis failed to reject at the 5% level of significance. Therefore, it examined the null hypothesis, which states that all groups' population variances are equal. Consequently, the mean comparison of challenges on annual revenue invested for managing financial is tested with the help of One Way ANOVA.

Table 8.9

Comparison of Challenges of Software Companies Based on Annual Revenue Invested for Managing Financial Risk

Challenges	Annual revenue invested for managing financial risk (%)					F Value	P Value	Remarks
	Below 10	10-25	25-50	50-75	75-100			
Market	3.76 (1.19)	3.81 (1.14)	3.78 (1.15)	3.48 (1.30)	3.38 (1.32)	3.000	0.018	Significant
System	3.75 (1.06)	3.73 (1.20)	3.61 (1.19)	3.51 (1.22)	3.44 (1.36)	1.272	0.278	Insignificant
Co-ordination	3.62 (1.18)	3.58 (1.26)	3.58 (1.26)	3.33 (1.32)	3.25 (1.31)	1.774	0.132	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 8.9 shows the results of challenges of software companies on annual revenue invested for managing financial risk. Market, system and co-ordination are the challenges for measuring the annual revenue invested for managing financial risk. As per descriptive statistics, it is very clear that software companies invest the majority of their annual revenue for managing market-related challenges as compared with other challenges and it makes low investment for managing co-ordination related challenges.

From the table, it is clear that the Market (p=0.018) shows statistically significant results towards annual revenue invested for managing financial risk. Therefore the null hypothesis is accepted at a 5% level of significance and thus the challenges of software companies influence the annual revenue invested for managing financial risk.

But the challenges such as System ('p'= 0.278 > 0.05) and Co-ordination ('p'= 0.132 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis failed to reject and there is no significant difference in annual revenue invested for managing financial risk based on these challenges.

For precise analysis of the difference, post hoc comparisons were conducted by using the Tukey HSD test. The result of the same is given in table 8.10.

Table 8.10

Multiple Comparison of Challenges of Software Companies Based on Annual Revenue Invested for Managing Financial Risk

Challenges	**Tukey HSD**			
	Annual revenue (I)	**Annual revenue (J)**	**Mean Difference**	**Sig**
Market	Below 10	10-25	0.470	**0.012**
		25-50	0.230	0.112
		50-75	0.281	0.504
		75-100	0.379	0.620

Challenges	Tukey HSD			
	Annual revenue (I)	**Annual revenue (J)**	**Mean Difference**	**Sig**
	10-25	Below 10	0.047	0.115
		25-50	0.024	**0.027**
		50-75	0.329	**0.008**
		75-100	0.427	**0.042**
	25-50	Below 10	0.230	**0.006**
		10-25	0.240	**0.014**
		50-75	0.304	**0.028**
		75-100	0.402	**0.036**
	50-75	Below 10	0.281	**0.013**
		10-25	0.329	**0.027**
		25-50	0.304	**0.014**
		75-100	0.980	**0.031**
	75-100	Below 10	0.379	**0.040**
		10-25	0.427	**0.039**
		25-50	0.402	**0.041**
		50-75	0.980	**0.033**

Source: Primary Data

From the table, it is evident that there exists a pairwise difference between below 10 with 10-25 as the p-value is 0.012 which is lower than the 5% level of significance. But in the case of 25-50, 50-75 and 75-100, there is no significant pairwise difference exists, since all the p values are greater than 0.05. When comparing 10-25 with 25-50, 50-75 and 75-100, there exists a significant pair-wise difference, as the p values in these cases are lower than 0.05. Further analysis of 25-50, 50-75 and 75-100 shows significant pairwise differences as their p-values are lower than 0.05. Therefore, the multiple comparison results reveal considerable differences in market related challenges on annual revenue invested for managing financial risk.

8.6.5 Challenges of Software Companies Based on Completion of Software Project on Time

In this study, the focus is also on challenges of software companies such as market related, system related and co-ordination related. Completion of software project on time are categorised into below 20, 20-40, 40-60, 60-80 and 80-100. In order to analyse significant difference among challenges of software companies on completion of software project on time, Levene’s Test for Homogeneity of Variance, One way Anova, Tukey HSD Post- Hoc Test for Multiple Comparison Test are applied and the following hypothesis is developed and tested.

Ho: Challenges of software companies do not affect completion of project on time

Table 8.11

Homogeneity Test of Challenges of Software Companies Based on Completion of Project on Time

	Levene statistic	Sig
Market	1.721	0.094
System	1.994	1.203
Co-ordination	1.436	0.856

Source: Primary Data

The table 8.11 shows the homogeneity test result of challenges of software companies on completion of projects on time. Levene's test indicates that there is no significant difference because the p value is greater than 0.05 at a 5% level of significance for group variances. The homogeneity test criteria are met. So, One Way Anova can be applied to checking significant differences in the challenges of software companies on completion of projects on time.

The comparison of challenges of software companies based on completion of projects on time is given in table 8.12.

Table 8.12

Comparison of Challenges of Software Companies Based on Completion of Projects on Time

Challenges	Completion of Project on Time (%)					F Value	P Value	Remarks
	Below 20	20-40	40-60	60-80	80-100			
Market	4.43 (0.37)	3.58 (1.38)	3.55 (1.24)	3.56 (1.29)	3.67 (1.18)	0.718	0.580	Insignificant
System	4.31 (0.37)	3.48 (1.27)	3.52 (1.26)	3.52 (1.29)	3.68 (1.17)	0.949	0.029	Significant
Co-ordination	4.62 (0.14)	3.45 (1.25)	3.31 (1.26)	3.42 (1.26)	3.47 (1.28)	1.150	0.328	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 8.12 shows the results of the challenges of software companies on completion of projects on time. Market-related, system-related and coordination-related are the challenges for measuring completion of the project on time. As per descriptive statistics, it is very clear that market-related challenges highly affect the software companies to complete the project on time as compared with other challenges and coordination-related challenges have a low effect on the completion of projects on time.

From the table, it is clear that the System (p=0.029) shows statistically significant results towards completion of projects on time. Therefore the null hypothesis is rejected at a 5% level of significance and thus the challenges of software companies influence the completion of projects on time.

But the challenges such as Market ('p'= 0.580 > 0.05) and Co-ordination ('p'= 0.328 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis is accepted and there is no significant difference in completion of the project on time based on these challenges.

For precise analysis of the difference, post hoc comparisons were conducted by using the Tukey HSD test. The result of multiple comparisons of challenges of software companies on the completion of projects on time is shown in table 8.13.

Table 8.13

Multiple Comparison of Challenges of Software Companies Based on Completion of Projects on Time

Challenges	Tukey HSD			
	Completion of Project (I)	**Completion of Project (J)**	**Mean Difference**	**Sig**
System	Below 20	20-40	0.824	**0.241**
		40-60	0.784	**0.036**
		60-80	0.790	0.212
		80-100	0.629	**0.039**
	20-40	Below 20	0.824	**0.014**
		40-60	0.039	**0.006**
		60-80	0.033	**0.009**
		80-100	0.194	**0.015**
	40-60	Below 20	0.784	0.334
		20-40	0.039	**0.017**
		60-80	0.059	**0.026**
		80-100	0.161	**0.030**
	60-80	Below 20	0.720	0.518
		20-40	0.033	**0.029**
		40-60	0.050	**0.003**
		80-100	0.161	**0.041**
	80-100	Below 20	0.629	**0.037**
		20-40	0.194	**0.025**
		40-60	0.155	**0.019**
		60-80	0.161	**0.031**

Source: Primary Data

From the table 8.13, it can be concluded that there exists a significant pairwise difference in the mean score of 20-40 and 80-40 as the p-value is less than 0.05. Further analysing the pairwise comparison of below 20 with 20-40, 40-60 and 80-100, there exist significant pairwise differences. But in the comparison of below 20 with 60-80 p value is 0.212 which is higher than a 5% level of significance. So, there is no significant pairwise difference exists between system-related challenges with 60-80% of completion of projects on time.

The pairwise comparison of 40-60 with 20-40, 60-80 and 80-100 shows significant differences since the p values are lower than 0.05. But in the comparison of 40-60 with below 20, the p-value is 0.334, which is higher than the 5% level of significance. Meanwhile, the pairwise comparison of 60-80 with 20-40, 40-60 and 80-100 depicts p values are less than 0.05. Hence there exist significant differences among system-related challenges with the completion of the project on time. Moreover, there doesn't exist a significant pairwise difference of 40-60 with below 20 as the p-value is greater than 0.05.

8.6.6 Challenges of Software Companies Based on Completion of Projects on Budgeted Amount

The study offers a major focus on challenges affecting software companies like market-related, system-related, and coordination-related. Completion of projects on budgeted amount is classified into projects completed within the budgeted amount and projects completed out of budgeted amount. To analyse significant differences among challenges of software companies based on the completion of projects on budgeted amount, Independent Sample t Test is applied and the hypothesis presented below is tested.

Ho: Challenges of software companies do not affect the completion of projects on the budgeted amount

The table 8.14 explains the challenges of software companies based on completion of project on budgeted amount.

Table 8.14

Challenges of Software Companies Based on Completion of Project on Budgeted Amount

Challenges	Completion of Project on Budgeted Amount: Project Completed within Budgeted Amount	Project Completed Out of Budgeted Amount	T Value	P Value	Remarks
Market	3.28 (1.03)	3.73 (1.13)	0.184	0.587	Insignificant
System	3.38 (1.10)	3.43 (1.09)	0.009	0.641	Insignificant
Co-ordination	3.58 (1.12)	3.41 (1.11)	0.753	0.543	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Based on the mean score, it can be inferred that coordination-related challenges (3.58) highly influenced to complete of the project on budgeted amount and market-related challenges (3.73) impacted the software companies to complete the project out of budgeted amount.

It is also clear that, since p-values are higher than 0.05, the null hypothesis is accepted. Hence, there is no significant difference between the completion of the project on the budgeted amount concerning challenges such as market related, system related and coordination related.

8.6.7 Challenges of Software Companies Based on Average Time Spent on Software Project

The study considers the challenges of software companies such as market related, system related and coordination related. Average time spent on project is categorised into below 0-2, 2-4, 4-6 and 6 and above months. To analyse significant differences among challenges based on average time spent on the project, Levene's Test for Homogeneity of Variance, One way ANOVA, Tukey HSD Post- Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Challenges of software companies do not influence the average time spent on software projects

The table 8.15 describes the homogeneity test of challenges of software companies on average time spent on software projects.

Table 8. 15

Homogeneity Test of Challenges of Software Companies Based on Average Time Spent on Software Projects

	Levene statistic	Sig
Market	1.321	0.283
System	0.744	0.526
Co-ordination	1.023	0.381

Source: Primary Data

Levene's test of homogeneity of variance is used to assess variability within groups. All dimensions have 'p' values greater than 0.05, rejecting the null hypothesis at the 5% level of significance. The sample groups are homogeneous, so One-way Anova is the suitable test to measure significant differences in challenges of software companies based on average time spent on software projects.

The table 8.16 illustrates the comparison of challenges on average time spent on software projects

Table 8.16

Comparison of Challenges on Average Time Spent on Software Projects

Challenges	Average Time Spent on Project (Months)				F Value	P Value	Remarks
	0-2	2-4	4-6	6 and Above			
Market	3.65 (1.20)	3.77 (1.18)	3.36 (1.32)	3.64 (1.24)	0.562	0.640	Insignificant
System	3.61 (1.26)	3.68 (1.21)	3.51 (1.23)	3.54 (1.24)	1.435	0.231	Insignificant
Co-ordination	3.57 (1.23)	3.48 (1.06)	3.25 (1.26)	3.44 (1.28)	1.612	0.040	Significant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 8.16 exhibits the results of the challenges of software companies based on average time spent on the project. Market-related, system-related and coordination-related are the challenges for measuring the average time spent on software projects. As per descriptive statistics, it is very clear that compared to other challenges, market-related challenges have a greater impact on the average time spent on software projects, while coordination-related challenges have a lower impact.

From the table, it is also clear that Coordination (p=0.040) shows statistically significant results towards challenges of software companies on average time spent on software projects. Therefore the null hypothesis is rejected at a 5% level of significance and thus the challenges of software companies influence the average time spent on software projects.

But the challenges such as Market (‘p’= 0.640 > 0.05) and System (‘p’= 0.231 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis is failed to reject and there is no significant difference in average time spent on the project based on these challenges. For precise analysis of the difference, post hoc comparisons were conducted by using the Tukey HSD test. The result of the same is presented in table 8.17.

Table 8.17

Multiple Comparison of Challenges of Software Companies Based on Average Time Spent on Software Projects

Challenges	Tukey HSD			
	Average Time (I) (Months)	**Average Time (J) (Months)**	**Mean Difference**	**Sig**
Co-ordination	0-2	2-4	-0.041	**0.032**
		4-6	0.524	**0.029**
		6 and above	0.629	**0.012**
	2-4	0-2	0.448	**0.035**
		4-6	0.610	**0.040**
		6 and above	-0.521	**0.027**
	4-6	0-2	-0.592	**0.025**
		2-4	0.756	**0.010**
		6 and above	-0.442	**0.034**
	6 and above	0-2	0.437	**0.036**
		2-4	-0.534	**0.023**
		4-6	.0839	**0.015**

Source: Primary Data

Table 8.17 displays the results of the Tukey HSD (Honest Significant Difference) post hoc test, which compares coordination-related challenges based on the average time spent on software projects. The Tukey HSD test aims to identify which specific pairs of groups (defined by different time ranges) show statistically significant differences in the coordination challenges faced by software companies. In this case, the groups being compared are the software projects with average durations of 0-2 months, 2-4 months, 4-6 months, and 6 months and above.

The results indicate that there are pairwise significant differences between these groups, as the p-values for comparisons between the different time categories (0-2 months, 2-4 months, 4-6 months, and 6 months and above) are all less than the 5% significance level ($p < 0.05$). This means that for each of these comparisons, the difference in the coordination-related challenges experienced by the teams working on projects of different durations is statistically meaningful.

Therefore, based on these findings, it can be concluded that the average time spent on software projects plays a significant role in the variation of coordination-related challenges. As the duration of the project increases, the nature and intensity of coordination-related issues likely change, suggesting that project length is an important factor influencing how coordination challenges are experienced in information technology projects.

Section B

This section of the chapter focuses on the Confirmatory Factor Analysis (CFA) conducted to examine the challenges faced by software companies in relation to the usage of financial risk management techniques and financial risk mitigation strategies. The primary aim of this analysis is to assess how effectively the model reflects the underlying factors influencing these challenges. The researcher is also concerned with evaluating the validity and reliability of the model, ensuring that the measurements used are consistent and accurately represent the theoretical concepts they are meant to measure. As part of this process, the measurement model, which outlines the relationships between observed variables and latent factors, is being tested for its reliability. To support the findings, the chapter includes tables derived from the CFA analysis, which detail the statistical results, along with explanations to help interpret the data and its implications for understanding financial risk management in the context of software companies.

8.7 Confirmatory Factor Analysis of Challenges of Software Companies and Usage of Financial Risk Management Techniques

The tests that were run on the measurement model to confirm its reliability and accuracy are described in this section. Confirmatory Factor Analysis is used to comprehend the results of model testing, which is done to determine the reliability and correctness of the scale measure and to assess how well a defined factor model fits a specific set of observed data. It provides estimates for each measurement model parameter. The measurement model consisted of 7 unobserved variables, 32 error elements (e1 to e32), and 32 observable variables. The following variables are unobserved.

1. Market-related challenges (CM): Refers to the difficulties faced in the marketplace, which may influence business performance, such as competition, market saturation, or customer preferences.

2. System-related challenges (CS): Encompasses issues related to the technological or organizational systems that might impede smooth operations or hinder efficiency, such as outdated software, infrastructure issues, or system incompatibilities.

3. Co-ordination related challenges (CC): Involves difficulties in coordinating tasks, teams, or processes within an organization, often leading to inefficiencies, misunderstandings, or delays in achieving organizational goals.

4. Financial Risk Planning Techniques (UP): Represents techniques employed to anticipate and prepare for financial risks, such as budgeting, forecasting, or scenario planning.

5. Financial Risk Identification Techniques (UI): Refers to the approaches used to identify potential financial risks.

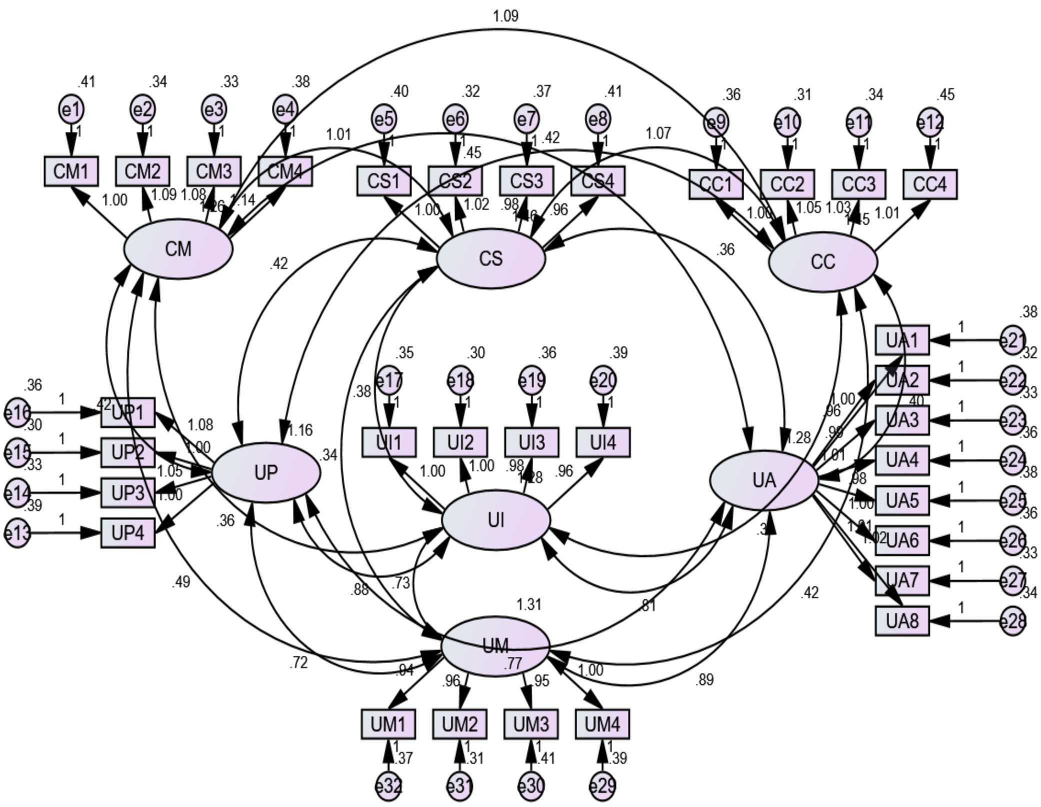
6. Financial Risk Analysis Techniques (UA): Involves methods to analyse and evaluate the severity and probability of identified financial risks, such as quantitative models, simulations, or expert judgment.

7. Financial Risk Monitoring and Controlling Techniques (UM): Describes the processes or techniques used to track and manage financial risks over time, ensuring that risks are kept within acceptable limits through ongoing monitoring and corrective actions.

Figure 8.1 shows the confirmatory factor analysis of the challenges of software companies and usage of financial risk management techniques.

Figure 8.1

Confirmatory Factor Analysis of Challenges of Software Companies and Usage of Financial Risk Management Techniques



The challenges of software companies and the usage of financial risk management techniques are explained in Figure 8.1. It offers estimates along with observed and error estimates for each measurement parameter. Additionally, it displays the outcomes of the beta coefficients for each factor. Strong factor loadings between the components in each factor are evident from the figure. It is recommended that the model with seven constructs and associated variables suited the data well.

Model fit indices for challenges of software companies and usage of financial risk management techniques is given in table 8.18.

Table 8.18

Model Fit Indices for Challenges of Software Companies and Usage of Financial Risk Management Techniques

Model Fit Indices	Model Values	Threshold	Interpretation
CMIN/DF	1.609	Between 1 and 5	Excellent
CFI	0.986	> 0.95	Excellent
GFI	0.927	> 0.9	Excellent
AGFI	0.913	> 0.9	Excellent
RMSEA	0.033	< 0.08	Excellent

Source: Primary Data

The Chi-Square to degrees of freedom ratio needs to be less than 5 for a model to be declared viable. The value in this case is 1.609, which is significantly below the suggested upper limit. The RMSEA score is 0.033, which is significantly less than the 0.08 acceptable threshold level. The GFI, AGFI, and CFI values are all higher than 0.9 as well. Since the model fit is excellent, further analysis can be considered.

The table 8.19 describes reliability and validity of CFA model for challenges of software companies and usage of financial risk management techniques.

Table 8.19

Reliability and Validity of CFA Model for Challenges of Software Companies and Usage of Financial Risk Management Techniques

Constructs	Item Code	Factor Loading	AVE	MSV	CR
Market	CM1	0.868	0.798	0.653	0.941
	CM2	0.902			
	CM3	0.902			
	CM4	0.901			
System	CS1	0.887	0.792	0.557	0.938
	CS2	0.910			
	CS3	0.888			
	CS4	0.875			

Constructs	Item Code	Factor Loading	AVE	MSV	CR
Co-ordination	CC1	0.896	0.806	0.653	0.943
	CC2	0.914			
	CC3	0.905			
	CC4	0.876			
UP	UP1	0.887	0.782	0.516	0.935
	UP2	0.892			
	UP3	0.892			
	UP4	0.866			
UI	UI1	0.887	0.781	0.516	0.934
	UI2	0.900			
	UI3	0.879			
	UI4	0.867			
UA	UA1	0.879	0.785	0.471	0.967
	UA2	0.885			
	UA3	0.889			
	UA4	0.887			
	UA5	0.874			
	UA6	0.885			
	UA7	0.894			
UM	UA8	0.893	0.766	0.471	0.929
	UM1	0.871			
	UM2	0.891			
	UM3	0.861			
	UM4	0.877			

Source: Primary Data

Standardized Factor Loadings (SFL), Composite Reliability (CR), Average Variance Extracted (AVE), and Maximum Shared Variance (MSV) are shown in Table 8.19. Values for the standardized factor loading are more than 0.5, showing that each dimension contributes sufficiently to the constructs. The values of AVE are higher than 0.5, the values of Composite Reliability (CR) are higher than 0.7, and the values of CR of the constructs are higher than AVE. In terms of convergent validity, these three requirements are satisfied. Additionally, MSV and AVE are employed to show the scale's discriminant validity. In this instance, AVE values are superior to MSV in all dimensions. Thus, discriminant validity criteria are also ensured.

8.8 Confirmatory Factor Analysis of Challenges of Software Companies and Financial Risk Mitigation Strategies

Confirmatory factor analysis is used to evaluate how well a predetermined factor model fits a given set of observed data and to explain the findings of model testing carried out to validate the accuracy and reliability of the scale measure. It provides estimates for each measurement model parameter. The measurement model included 28 observable variables, 28 error elements (e1 to e28), and 7 unobserved variables. The following variables are unobserved.

1. Market-related challenges (CM): This latent variable represents the obstacles or difficulties faced in the marketplace, such as changes in consumer behaviour, market saturation, economic fluctuations, or increased competition.

2. System-related challenges (CS): This refers to issues that arise within the organization's technological infrastructure or internal systems.

3. Co-ordination related challenges (CC): This unobserved variable captures the difficulties in coordinating tasks, people, or processes across different departments, teams, or functions.

4. Risk transfer strategies (ST): This latent variable represents strategies used by organizations to mitigate risks by transferring them to other parties.

5. Risk acceptance strategies (SA): This variable pertains to strategies where an organization decides to accept certain risks instead of mitigating or transferring them.

6. Risk avoidance strategies (SV): This unobserved variable refers to strategies that involve eliminating or avoiding risks entirely.

7. Risk sharing strategies (SS): Risk sharing aims to reduce the individual exposure to risks by involving others in managing them.

Figure 8.2 illustrates confirmatory factor analysis of challenges of software companies and financial risk mitigation strategies

Figure 8.2

Confirmatory Factor Analysis of Challenges of Software Companies and Financial Risk Mitigation Strategies

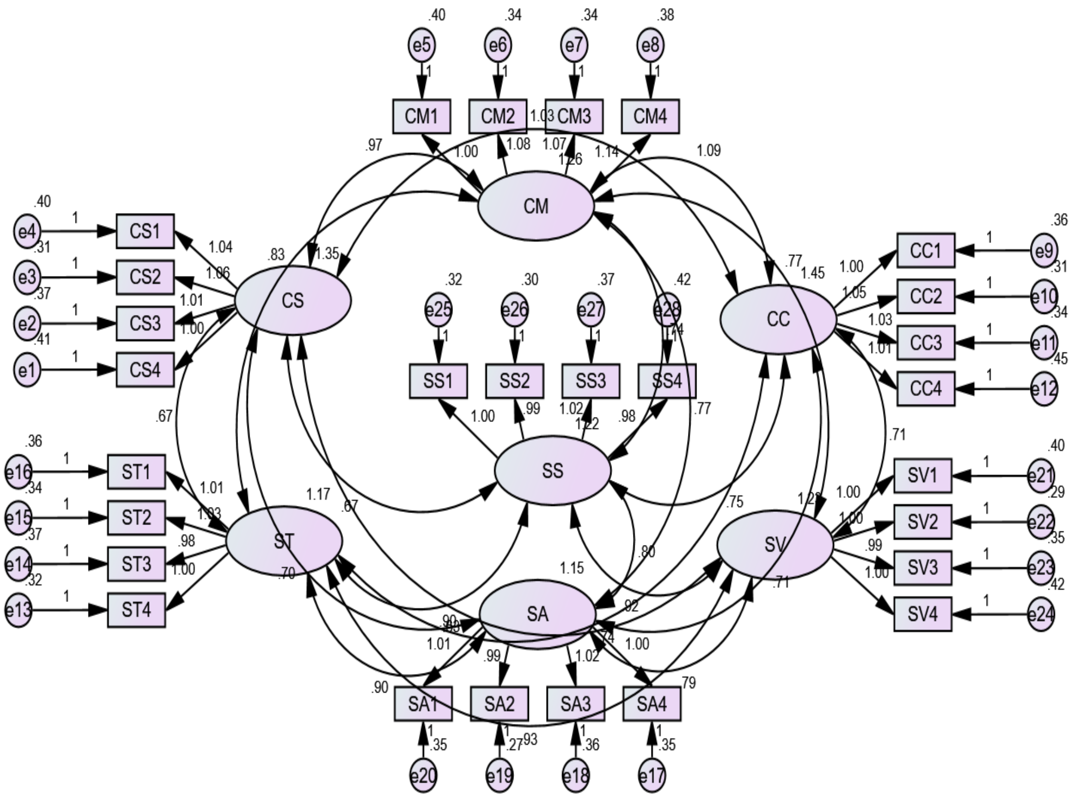


Figure 8.2 explains the challenges of software companies and financial risk mitigation strategies. It provides estimates for each measurement parameter, in addition to observed and error estimates. The results of the beta coefficients for each factor are also shown. The figure makes clear that there are significant factor loadings between the components of each factor. The model with seven components and related variables fits the data effectively.

The table 8.20 describes model fit indices for challenges of software companies and financial risk mitigation strategies.

Table 8.20

Model Fit Indices for Challenges of Software Companies and Financial Risk Mitigation Strategies

Model Fit Indices	Model Values	Threshold	Interpretation
CMIN/DF	1.712	Between 1 and 5	Excellent
CFI	0.986	> 0.95	Excellent
GFI	0.934	> 0.9	Excellent
AGFI	0.918	> 0.9	Excellent
RMSEA	0.036	< 0.08	Excellent

Source: Primary Data

For a model to be considered feasible, the Chi-Square to degrees of freedom ratio must be lower than 5. In this instance, the result is 1.712, which is considerably less than the stated limit. The RMSEA score is 0.036, which is much lower than the recommended threshold value of 0.08. The values of the GFI, AGFI, and CFI are all greater than 0.9 as well. Model fit is excellent so, it is possible to explore additional analysis.

Reliability and validity of CFA model for challenges of software companies and financial risk mitigation strategies is shown in table 8.21.

Table 8.21

Reliability and Validity of CFA Model for Challenges of software companies and Financial Risk Mitigation Strategies

Constructs	Item Code	Factor Loading	AVE	MSV	CR
Market	CM1	0.871	0.799	0.653	0.941
	CM2	0.902			
	CM3	0.901			
	CM4	0.901			
System	CS1	0.886	0.792	0.557	0.938
	CS2	0.911			
	CS3	0.887			
	CS4	0.875			
Co-ordination	CC1	0.895	0.806	0.653	0.943
	CC2	0.914			
	CC3	0.906			
	CC4	0.876			
Risk Transfer	ST1	0.875	0.773	0.601	0.931
	ST2	0.888			
	ST3	0.868			
	ST4	0.885			
Risk Acceptance	SA1	0.877	0.778	0.600	0.934
	SA2	0.899			
	SA3	0.878			
	SA4	0.875			
Risk Avoidance	SV1	0.869	0.772	0.601	0.931
	SV2	0.900			
	SV3	0.881			
	SV4	0.865			
Risk Sharing	SS1	0.889	0.776	0.568	0.933
	SS2	0.895			
	SS3	0.880			
	SS4	0.859			

Source: Primary Data

Table 8.21 employs Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and Standardized Factor Loadings (SFL). The standardized factor loading values are greater than 0.5, indicating that each dimension makes a significant contribution to the constructs. The AVE values are greater than 0.5, the CR values are greater than 0.7, and the CR values of the constructions are greater than AVE. These three conditions are met in terms of convergent validity. MSV and AVE are also used to demonstrate the scale's discriminant validity. In this situation, AVE values outperform MSV in every dimension. The discriminant validity criteria were further demonstrated.

8.9 Conclusion

This chapter covered the challenges of software companies based on nature of the software company, area of the software company, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount, average time spent for software projects, usage of financial risk management techniques and financial risk mitigation strategies. To exhibit the results certain statistical and mathematical techniques were used. In addition, confirmatory factor analysis was used to analyse the relationship between challenges in the usage of financial risk management techniques and financial risk mitigation strategies. It is found that challenges are potentially high in medium-sized software companies and in the case of the area of software companies, urban areas are highly affected by challenges. The majority of the annual revenue of software companies is invested in managing market-related challenges. It is also evident that market-related challenges highly affect the software companies to complete the project on time and average time spent on projects. Meanwhile, coordination-related challenges influence the software companies to complete the projects on the budgeted amount. Furthermore, there exists a significant relationship between the challenges of software companies on the usage of financial risk management techniques and financial risk mitigation strategies.

Chapter Nine

FINANCIAL RISK MITIGATION STRATEGIES OF SOFTWARE COMPANIES

9.1 Introduction

In this chapter, the study tries to analyse the financial risk mitigation strategies of software companies based on nature of the software company, the area of the software company, the average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on budgeted amount and average time spent on software project.

For analysis, the current chapter is divided into two sections. **Section A** discusses the financial risk mitigation strategies of software companies and their influence on the nature of the software company, area of software company, average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on budgeted amount and average time spent on software project. **Section B** of this chapter deals with structural equation modelling showing the effect of factors, impact, effectiveness, and challenges on usage and strategies.

9.2 Objective of the chapter

The objective of the chapter is to analyse the financial risk mitigation strategies for the successful completion of information technology projects.

9.3 Hypotheses Formulated and Tested

1. There is no significant difference between the financial risk mitigation strategies of software companies and the nature of software company
2. There is no significant difference between the financial risk mitigation strategies of software companies and the area of software company

3. Financial risk mitigation strategies of software companies do not influence the average number of software projects
4. Financial risk mitigation strategies of software companies do not affect annual revenue invested for managing financial risk
5. Financial risk mitigation strategies of software companies do not affect the completion of software projects on time
6. Financial risk mitigation strategies of software companies do not affect the completion of the project on budgeted amount
7. Financial risk mitigation strategies of software companies do not influence the average time spent on software projects

9.4 Methodology and Database

To accomplish the objective of this chapter, the primary data regarding financial risk mitigation strategies of software companies, nature of software company, area of software company, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on budgeted amount, average time spent on software project, are collected from software companies with the help of a structured questionnaire. For analysis, techniques like Arithmetic Mean, Standard Deviation, Levene's Test for Homogeneity of Variance, Way Anova, Tukey HSD Post-Hoc Test for Multiple Comparison, Independent Sample t test and Structural Equation Modelling were used.

9.5 Variables Used for the Study

To achieve the objective of the chapter, the following variables are used.

Financial Risk Mitigation Strategies	Risk Transfer Strategies Risk Acceptance Strategies Risk Avoidance Strategies Risk Sharing Strategies

Financial Risk Factors	Technology Requirement Organisational Scope Design Resource
Usage	Financial Risk Planning Techniques Financial Risk Identification Techniques Financial Risk Analysis Techniques Financial Risk Monitoring and Controlling Techniques
Impact	Financial Risk Planning Techniques Financial Risk Identification Techniques Financial Risk Analysis Techniques Financial Risk Monitoring and Controlling Techniques
Effectiveness	Financial related Effectiveness Management related Effectiveness Socio-Economic related Effectiveness
Challenges	Market related Challenges System-related Challenges Co-ordination related Challenges

Section A

9.6 Financial Risk Mitigation Strategies of Software Companies

In this section, the researcher analysed financial risk mitigation strategies of software companies based on the nature of the software company, area of the software company, average number of software projects, annual turnover invested for managing financial risk, completion of project on time, completion of project on budgeted amount and average time spent on software project. To achieve the objective, tools like Arithmetic Mean, Standard Deviation, Levene's Test for Homogeneity of Variance, Way Anova, Tukey HSD Post-Hoc Test for Multiple Comparisons and Independent Sample t test were used.

9.6.1 Financial Risk Mitigation Strategies of Software Companies Based on Nature of Software Company

In this section, the research mainly concentrates on financial risk mitigation strategies of software companies such as risk transfer, risk acceptance, risk avoidance and risk sharing. The nature of software companies is categorised as small, medium and large. To analyse the significant difference between the financial risk mitigation strategies of software companies based on nature of software companies, Levene's Test for Homogeneity of Variance, One-way ANOVA, Tukey HSD Post- Hoc Test for Multiple Comparison test are applied and the following hypothesis is tested.

Ho: There is no significant difference between the financial risk mitigation strategies of software companies and the nature of software companies

The homogeneity test of financial risk mitigation strategies based on the nature of the software company is given in table 9.1.

Table 9.1

Homogeneity Test of Financial Risk Mitigation Strategies Based on Nature of Software Company

	Levene statistic	Sig
Risk Transfer	1.411	0.243
Risk Acceptance	2.463	0.086
Risk Avoidance	3.414	0.126
Risk Sharing	0.628	0.534

Source: Primary Data

The 'p' result of Levene's Test of Homogeneity of Variance is not significant at a 5% level of significance. Every value is more than 0.05, hence the homogeneity test's requirement has been met. This guarantees that the population variance within each category is about equal. As a result, the One Way Anova is designed to test hypotheses.

Comparison of financial risk mitigation strategies of software companies on the nature of software company is explained in table 9.2

Table 9.2

Comparison of Financial Risk Mitigation Strategies of Software Companies on the Nature of Software Company

Financial Risk Mitigation Strategies	Nature of Software Company			F Value	P Value	Remarks
	Small	Medium	Large			
Risk Transfer	3.90 (1.08)	3.74 (1.11)	3.83 (1.16)	0.855	0.034	Significant
Risk Acceptance	3.87 (1.11)	3.90 (1.05)	3.83 (1.17)	0.201	0.818	Insignificant
Risk Avoidance	3.91 (1.01)	3.76 (1.17)	3.78 (1.15)	0.708	0.042	Significant
Risk Sharing	3.79 (1.10)	3.75 (1.12)	3.83 (1.18)	0.301	0.740	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 9.2 demonstrates the results of financial risk mitigation strategies of software companies based on the nature of the software company. Risk transfer, risk acceptance, risk avoidance, and risk sharing are financial risk mitigation strategies used to assess the nature of software companies. As per descriptive statistics, financial risk mitigation strategies of software companies are potentially high in small-sized software companies as compared with medium and large. It is also clear that strategies for accepting risk are extensively used while those for sharing risk are less popular.

From the table, it is also clear that Risk Transfer (p=0.034) and Risk avoidance (p=0.042) show statistically significant results. Therefore, the null hypothesis is rejected at a 5% level of significance and there exists a significant difference among small, medium and large companies based on financial risk mitigation strategies of software companies.

But the financial risk mitigation strategies namely Risk Acceptance (‘p’= 0.818 > 0.05), and Risk Sharing (‘p’= 0.740 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis failed to reject and there is no significant difference in the financial risk mitigation strategies based on the nature of the software company.

For precise analysis of the difference, post hoc comparisons were conducted using the Tukey HSD test. Multiple comparison of financial risk mitigation strategies based on the nature of the software company is shown in table 9.3.

Table 9.3

Multiple Comparison of Financial Risk Mitigation Strategies Based on Nature of Software Company

Financial Risk Mitigation Strategies	Tukey HSD			
	Nature (I)	**Nature (J)**	**Mean Difference**	**Sig**
Risk Transfer	Small	Medium	0.163	**0.022**
		Large	0.066	**0.014**
	Medium	Small	-0.163	**0.006**
		Large	-0.096	**0.011**
	Large	Small	-0.066	**0.032**
		Medium	0.096	**0.024**
Risk Avoidance	Small	Medium	-0.029	**0.015**
		Large	0.039	0.271
	Medium	Small	-0.029	0.119
		Large	-0.068	**0.017**
	Large	Small	-0.039	**0.028**
		Medium	-0.068	**0.016**

Source: Primary Data

Table 9.3 shows that there exist significant pairwise difference between risk transfer strategies with small, medium and large software companies since the p values are less than 0.05. In the case of risk avoidance strategies, the pairwise comparison of small with medium, the p value is 0.015 which is lower than 5% level of significance. But in the case of small, there is no significant pairwise difference exists with large as the p value is 0.271 which is higher than 0.05. When comparing medium with large software company, it is evident that exists significant difference. It is understood from further analysis of medium with small that there is no significant pairwise difference exists as the p value is 0.119. Further stating the pairwise comparison of large with small and medium, there exists pairwise comparison since the p values are 0.028 and 0.016 respectively. So, it can be concluded that risk transfer and risk avoidance strategies shows significant difference on the nature of software companies.

9.6.2 Financial Risk Mitigation Strategies of Software Companies Based on Area of Software Company

In this section, the study primarily focuses on financial risk mitigation strategies of software companies such as risk transfer, risk acceptance, risk avoidance and risk sharing. Area of software company are classified into urban and city. In order to analyse significant difference among financial risk mitigation strategies of software companies based on area of software company, Independent Sample t test is applied and the hypothesis outlined below is tested.

Ho: There is no significant difference between financial risk mitigation strategies of software companies and area of software company

Table 9.4

Financial Risk Mitigation Strategies of Software Companies Based on Area of Software Company

Financial Risk Mitigation Strategies	Area of Software Company				Remarks
	Urban	City	T Value	P Value	
Risk Transfer	3.90 (1.12)	3.78 (1.12)	1.081	0.280	Insignificant
Risk Acceptance	3.94 (1.08)	3.79 (1.15)	0.875	0.382	Insignificant
Risk Avoidance	3.86 (1.13)	3.84 (1.12)	0.687	0.492	Insignificant
Risk Sharing	3.93 (1.11)	3.74 (1.15)	1.832	0.067	Insignificant

Source: Primary Data
Note: The values within the bracket indicates S D

Based on the mean score, it can be inferred that software company in urban area has highly influenced by financial risk mitigation strategies as compared with software companies in city. It is also understood that risk acceptance strategies are adopted high in software company situated in urban area (3.94) and risk avoidance strategies (3.84) are high in software companies in city. It can also be seen that the risk avoidance strategies are low in urban (3.86) and risk sharing strategies are low in software companies in city (3.44). Additionally, it has been noted that software companies heavily rely on risk acceptance strategies.

It is also evident that, since p values is higher than 0.05, the null hypothesis is accepted with regard to financial risk mitigation strategies of software companies based on the area of software company. Hence, there is no significant difference exists between area of software company with regard to financial risk mitigation strategies such as risk transfer, risk acceptance, risk avoidance and risk sharing.

9.6.3 Financial Risk Mitigation Strategies of Software Companies Based on Average Number of Software Projects

In this section, the study primarily relies on financial risk mitigation strategies of software companies such as risk transfer, risk acceptance, risk avoidance and risk sharing. Average number of software projects are categorised into below 10, 10-25, 25-50, 50-75 and 75-100. In order to analyse significant differences among financial risk mitigation strategies of software companies based on average number of software projects, Levene's Test for Homogeneity of Variance, One Way Anova, Tukey HSD Post- Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Financial risk mitigation strategies of software companies do not influence the average number of software projects

Homogeneity test of financial risk mitigation strategies of software companies based on average number of software projects is given in table 9.5.

Table 9.5

Homogeneity Test of Financial Risk Mitigation Strategies of Software Companies Based on Average Number of Software Projects

	Levene statistic	Sig
Risk Transfer	4.202	0.245
Risk Acceptance	5.734	0.321
Risk Avoidance	3.314	0.098
Risk Sharing	2.831	0.143

Source: Primary Data

Levene's Test is a statistical test used to determine whether the variances across multiple groups in a dataset are equal, which is required to perform an ANOVA. The ‘p’ value of Levene’s Test of Homogeneity of Variance is not significant at 5% level of significance. Since all the values are greater than 0.05, the requirement of the homogeneity test has been met. Hence, it is ensured that the population variance for each group is approximately equal. Consequently, the testing of the hypothesis is meant for One Way ANOVA.

The table 9.6 explains comparison of financial risk mitigation strategies of software companies based on average number of software projects.

Table 9.6

Comparison of Financial Risk Mitigation Strategies of Software Companies Based on Average Number of Software Projects

Financial Risk Mitigation Strategies	Average Number of Software Projects					F Value	P Value	Remarks
	Below 10	10-25	25-50	50-75	75-100			
Risk Transfer	3.93 (1.08)	4.06 (.991)	3.82 (1.12)	3.70 (1.11)	3.76 (1.22)	1.701	0.148	Insignificant
Risk Acceptance	3.91 (.928)	4.13 (.906)	3.85 (1.11)	3.86 (1.10)	3.70 (1.25)	2.114	0.037	Significant
Risk Avoidance	3.65 (1.31)	3.99 (1.02)	3.77 (1.16)	3.86 (1.12)	3.68 (1.21)	1.263	0.284	Insignificant
Risk Sharing	3.57 (1.07)	3.91 (1.01)	3.76 (1.14)	3.79 (1.13)	3.78 (1.25)	0.488	0.745	Insignificant

Source: Primary Data
Note: The values within the bracket indicates S D

Table 9.6 shows the results of financial risk mitigation strategies based on average number of software projects. Risk transfer, risk acceptance, risk avoidance and risk sharing are the financial risk mitigation strategies for measuring average number of software projects. As per descriptive statistics, it is very clear that the average number of software projects are highly influenced by risk acceptance strategies and it shows low influence on risk sharing strategies.

From the table, it is also clear that Risk Acceptance (p= 0.037) shows a statistically significant result towards average number of software projects. Therefore, the null hypothesis is rejected at a 5% level of significance and thus the financial risk mitigation strategies of software companies influence the average number of software projects undertaken by software companies.

But the strategies such as Risk Transfer (‘p’= 0.148 > 0.05), Risk Avoidance (‘p’= 0.126 > 0.05) and Risk Sharing (‘p’= 0.745 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis is accepted and there is no significant difference in an average number of software projects based on these strategies.

For precise analysis of the difference, post hoc comparisons were conducted by using the Tukey HSD test. The result of the same is given in table 9.7.

Table 9.7

Multiple Comparison of Financial Risk Mitigation Strategies of Software Companies Based on Average Number of Software Projects

Financial Risk Mitigation Strategies	**Tukey HSD**			
	Average Number of Projects (I)	**Average Number of Projects (J)**	**Mean Difference**	**Sig**
Risk Acceptance	Below 10	10-25	-0.221	**0.002**
		25-50	0.056	**0.023**
		50-75	0.046	**0.015**
		75-100	0.207	**0.033**
	10-25	Below 10	0.221	**0.011**
		25-50	0.277	**0.021**
		50-75	0.267	**0.036**
		75-100	0.428	**0.009**
	25-50	Below 10	-0.056	**0.012**
		10-25	-0.277	**0.004**
		50-75	-0.010	0.126
		75-100	0.151	**0.031**
	50-75	Below 10	-0.046	**0.007**
		10-25	-0.267	**0.019**
		25-50	0.010	**0.027**
		75-100	0.161	**0.040**
	75-100	Below 10	-0.207	**0.016**
		10-25	-0.428	**0.029**
		25-50	-0.151	**0.035**
		50-75	-0.161	**0.024**

Source: Primary Data

From the table 9.7, it can be seen that the risk acceptance strategies shows significant pairwise difference among below 10, 10-25, 50-75 and 75-100 as the p values are lower than 0.05. But in the case of 25-50 with 50-75, there exist no significant difference as the p value is 0.126 which is higher than 5% level of significance. Therefore Tukey HSD post hoc test explains that there exist significant difference between risk acceptance strategies of software companies based on average number of software projects undertaken by software companies.

9.6.4 Financial Risk Mitigation Strategies of Software Companies Based on Annual Revenue Invested for Managing Financial Risk

In this section, the study emphasises on financial risk mitigation strategies such as risk transfer, risk acceptance, risk avoidance and risk sharing. Annual revenue invested for managing financial risk is categorised into below 10, 10-25, 25-50, 50-75 and 75-100. In order to analyse significant differences among financial risk mitigation strategies based on annual reveue invested for managing financial risk, Levene's Test for Homogeneity of Variance, One Way Anova, Tukey HSD Post- Hoc Test for Multiple Comparison Test are applied and the hypothesis presented below is tested.

Ho: Financial risk mitigation strategies of software companies do not affect annual revenue invested for managing financial risk

Table 9.8

Homogeneity Test of Financial Risk Mitigation Strategies Based on Annual Revenue Invested for Managing Financial Risk

	Levene statistic	Sig
Risk Transfer	7.202	0.323
Risk Acceptance	3.046	0.087
Risk Avoidance	2.322	0.129
Risk Sharing	4.101	0.230

Source: Primary Data

From Table 9.8, it is clear that the Levene's Test for homogeneity of variance does not yield significant results at the 5% level of significance as the p-values associated with the test are greater than 0.05. This indicates that the assumption of homogeneity of variance has been met, meaning the variances across the groups being compared are roughly equal. Since this condition is satisfied, it is appropriate to proceed with the analysis using One-Way ANOVA. The results of the One-Way ANOVA are provided in Table 9.9. This test will help to determine if there are statistically significant differences between financial risk mitigation strategies based on annual revenue invested for managing financial risk.

Table 9.9

Comparison of Financial Risk Mitigation Strategies of Software Companies Based on Annual Revenue Invested for Managing Financial Risk

Financial Risk Mitigation Strategies	**Annual revenue invested for managing financial risk (%)**					**F Value**	**P Value**	**Remarks**
	Below 10	**10-25**	**25-50**	**50-75**	**75-100**			
Risk Transfer	4.19 (0.91)	3.92 (0.99)	4.04 (0.92)	3.62 (1.24)	3.61 (1.24)	5.172	0.316	Insignificant
Risk Acceptance	4.21 (0.70)	3.94 (1.03)	4.06 (1.02)	3.70 (1.20)	3.69 (1.24)	3.851	0.051	Insignificant
Risk Avoidance	3.99 (0.94)	3.87 (1.17)	4.05 (0.93)	3.67 (1.20)	3.81 (1.15)	2.673	0.120	Insignificant
Risk Sharing	3.78 (0.81)	3.78 (1.11)	4.03 (0.98)	3.69 (1.17)	3.61 (1.33)	3.181	0.013	Significant

Source: Primary Data
Note: The values within the bracket indicates S D

Table 9.9 shows the results of financial risk mitigation strategies of software companies based on annual revenue invested for managing financial risk. Risk transfer, risk acceptance, risk avoidance and risk sharing are the financial risk mitigation strategies for measuring the annual revenue invested for managing financial risk. As per descriptive statistics, it is very clear that software companies invest majority of their annual revenue for risk acceptance strategies and it also makes low investment for risk sharing strategies.

From the table, it is also clear that Risk Sharing (p=0.013) shows statistically significant result towards annual revenue invested for managing financial risk. Therefore, the null hypothesis is rejected at 5% level of significance and thus the financial risk mitigation strategies of software companies influence the annual revenue invested for managing financial risk.

But the Strategies such as Risk Transfer ('p'= 0.316 > 0.05), Risk Acceptance ('p'=0.051 > 0.05) and Risk Avoidance ('p'= 0.120 > 0.05) are not statistically significant at 5% level of significance. That means the null hypothesis is failed to reject and there is no significant difference in annual revenue invested based on the strategies.

For precise analysis of the difference, post hoc comparisons were conducted by using the Tukey HSD test. The result of the same is presented in table 9.10.

Table 9.10

Multiple Comparison of Financial Risk Mitigation Strategies Based on Annual Revenue Invested for Managing Financial Risk

Financial Risk Mitigation Strategies	**Tukey HSD**			
	Annual Revenue (I)	**Annual Revenue (J)**	**Mean Difference**	**Sig**
Risk Sharing	Below 10	10-25	0.323	**0.005**
		25-50	0.076	0.415
		50-75	0.415	0.431
		75-100	0.499	0.713
	10-25	Below 10	-0.323	**0.024**
		25-50	-0.247	**0.021**
		50-75	0.091	**0.012**
		75-100	-0.175	**0.034**

Financial Risk Mitigation Strategies	Tukey HSD			
	Annual Revenue (I)	**Annual Revenue (J)**	**Mean Difference**	**Sig**
	25-50	Below 10	-0.076	0.511
		10-25	0.247	0.422
		50-75	0.338	0.234
		75-100	0.423	0.114
	50-75	Below 10	-0.415	0.640
		10-25	0.091	0.925
		25-50	-0.338	0.117
		75-100	0.084	0.338
	75-100	Below 10	-0.499	**0.019**
		10-25	-0.175	**0.007**
		25-50	-0.423	**0.036**
		50-75	-0.084	**0.029**

Source: Primary Data

When analysing the result of post hoc test, it is found that the risk sharing strategies based on annual revenue of below 10 with 10-25 shows that there is significant pairwise difference as the p value is 0.005. But in the case of below 10 with 25-50, 50-75 and 75-100, there is no significant pairwise difference exists since the p values are greater than 0.05. When comparing 10-25 with below 10, 25-50, 50-75 and 75-100, there exist no significant pairwise difference. Meanwhile there exist significant pairwise difference between 75-100 with below 10, 10-25, 25-50 and 50-75. So, it can be concluded that there exist significant difference between risk sharing strategies based on annual revenue invested for managing financial risk.

9.6.5 Financial Risk Mitigation Strategies Based on Completion of Software Project on Time

In this section, the study focuses on financial risk mitigation strategies such as risk transfer, risk acceptance, risk avoidance and risk sharing. Completion of software project on time are categorised into below 20, 20-40, 40-60, 60-80 and 80-100. In order to analyse significant difference among financial risk mitigation strategies based on completion of software project on time, Levene's Test for Homogeneity of Variance, One way Anova, Tukey HSD Post- Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Financial risk mitigation strategies of software companies do not affect completion of project on time

Homogeneity test of financial risk mitigation strategies based on completion of project on time is shown in table 9.11.

Table 9.11

Homogeneity Test of Financial Risk Mitigation Strategies Based on Completion of Project on Time

	Levene statistic	Sig
Risk Transfer	6.971	0.089
Risk Acceptance	3.613	0.127
Risk Avoidance	5.994	0.230
Risk Sharing	5.772	0.315

Source: Primary Data

The homogeneity test results are displayed in table 9.11. According to Levene's test, the difference is not significant. Since the p value is higher than 0.05, there are differences between the groups. Therefore, One Way Anova can be used to examine whether there are any notable differences between the financial risk mitigation strategies employed by software companies based on completion of projects on time. The comparison of financial risk mitigation strategies based on completion of project on time is given in table 9.12.

Table 9.12

Comparison of Financial Risk Mitigation Strategies Based on Completion of Project on Time

Financial Risk Mitigation Strategies	Completion of Project on Time (%)					F Value	P Value	Remarks
	Below 20	20-40	40-60	60-80	80-100			
Risk Transfer	4.31 (0.31)	3.84 (1.18)	3.86 (1.15)	3.64 (1.22)	3.92 (1.18)	1.821	0.122	Insignificant
Risk Acceptance	4.68 (0.23)	3.68 (1.31)	3.91 (1.14)	3.81 (1.13)	3.91 (1.05)	1.082	0.363	Insignificant
Risk Avoidance	4.43 (0.31)	3.77 (1.14)	3.85 (1.11)	3.61 (1.24)	3.95 (1.08)	2.603	0.035	Significant
Risk Sharing	4.31 (0.37)	3.72 (1.14)	3.72 (1.14)	3.68 (1.24)	3.91 (1.05)	1.461	0.213	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Table 9.12 shows the results of financial risk mitigation strategies of software companies based on completion of project on time. Risk transfer, risk acceptance, risk avoidance and risk sharing strategies are used for measuring completion of projects on time. As per descriptive statistics, it is very clear that risk avoidance strategies are highly helpful for software companies to complete the project on time, and risk sharing strategies of software companies have a low influence on the completion of the project on time.

From the table, it is also clear that Risk Avoidance (p=0.035) shows statistically significant results towards completion of projects on time. Therefore, the null hypothesis is rejected at a 5% level of significance and thus the financial risk mitigation strategies of software companies influence the completion of projects on time.

But the financial risk mitigation strategies such as Risk Transfer (‘p’= 0.580 > 0.05), Risk Acceptance (‘p’= 0.363 > .005) and Risk Sharing (‘p’= 0.213 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis is accepted and there is no significant difference in completion of projects on time based on these strategies.

For precise analysis of the difference, post hoc comparisons was conducted by using Tukey HSD test. The result of the same is given in table 9.13

Table 9.13

Multiple Comparison of Financial Risk Mitigation Strategies Based on Completion of Projects on Time

Financial Risk Mitigation Strategies	**Tukey HSD**			
	Completion of Project (I)	**Completion of Project (J)**	**Mean Difference**	**Sig**
Risk Avoidance	Below 20	20-40	0.664	**0.008**
		40-60	0.586	0.253
		60-80	0.826	**0.009**
		80-100	0.487	0.217
	Below 20	Below 20	-0.664	**0.010**
		40-60	-0.077	**0.026**
		60-80	0.162	**0.018**
		80-100	-0.176	**0.035**
	Below 20	Below 20	-0.586	**0.033**
		20-40	0.077	**0.036**
		60-80	0.240	**0.044**
		80-100	-0.099	**0.025**
	Below 20	Below 20	-0.826	0.116
		20-40	-0.162	**0.018**
		40-60	-0.240	0.245
		80-100	-0.339	0.524
	Below 20	Below 20	-0.487	**0.017**
		20-40	0.176	**0.029**
		40-60	0.099	**0.031**
		60-80	0.339	**0.024**

Source: Primary Data

The table 9.13 shows that the pairwise comparison of risk avoidance strategies based on completion of projects on time of below 20 with 20-40 and 60-80 shows significant pairwise differences as the p values are lower than 0.05. But in the case of comparing below 20 with 40-60 and 80-100, no significant pairwise differences exist. The pairwise comparison of 20-40 and 40-60 with below 20, 20-40, 40-60, 60-80 and 80-100 shows significant differences in the completion of projects on time. Further the comparison of 60-80 with 20-40 shows significant differences. Meanwhile, 60-80 with below 20, 40-60 and 80-100, no significant differences exist as the p values are greater than 0.05. When comparing 80-100 with below 20, 20-40, 40-60, 60-80 and 80-100 shows significant pairwise differences since the p values are lower than 0.05. Therefore, the Tukey HSD post hoc test explains that there exists significant difference between risk avoidance strategies based on the completion of projects on time.

9.6.6 Financial Risk Mitigation Strategies of Software Companies Based on Completion of Project on Budgeted Amount

Here, the study offers a major focus on financial risk mitigation strategies such as risk transfer, risk acceptance, risk avoidance and risk sharing. Completion of project on budgeted amount is classified as projects completed within budgeted amount and projects completed out of budgeted amount. To analyse the significant difference between the financial risk mitigation strategies of software companies based on the completion of projects on the budgeted amount, Independent Sample t Test is applied and the following hypothesis is tested.

Ho: Financial risk mitigation strategies of software companies do not affect the completion of the project on the budgeted amount

The table 9.14 explains financial risk mitigation strategies based on completion of project on budgeted amount.

Table 9.14

Financial Risk Mitigation Strategies Based on Completion of Project on Budgeted Amount

Financial Risk Mitigation Strategies	Completion of Project on Budgeted Amount				Remarks
	Project Completed within Budgeted Amount	Project Completed Out of Budgeted Amount	T Value	P Value	
Risk Transfer	3.35 (1.12)	3.83 (1.18)	0.124	0.412	Insignificant
Risk Acceptance	3.45 (1.15)	3.38 (1.14)	0.024	0.341	Insignificant
Risk Avoidance	3.76 (1.17)	3.24 (1.09)	0.641	0.442	Insignificant
Risk Sharing	3.92 (1.21)	3.79 (1.17)	0.554	0.319	Insignificant

Source: Primary Data
Note: The values within the bracket indicate S D

Based on the mean score, it can be inferred that Risk Sharing (3.92) highly influences to completion of the project on the budgeted amount and Risk Transfer (3.83) highly affects the software companies to complete the project out of the budgeted amount.

It is also clear that, since p values are higher than 0.05, the null hypothesis is accepted about the financial risk mitigation strategies of software companies based on completion of the project on the budgeted amount. Hence, there is no significant difference between the completion of the project on budgeted amount concerning financial risk mitigation strategies such as risk transfer, risk acceptance, risk avoidance and risk sharing.

9.6.7 Financial Risk Mitigation Strategies of Software Companies Based on Average Time Spent on Software Projects

In this section, the study considers financial risk mitigation strategies such as risk transfer, risk acceptance, risk avoidance and risk sharing. Average time spent on software projects is categorised as below 0-2, 2-4, 4-6 and 6 & above months. To analyse significant differences among financial risk mitigation strategies based on average time spent on software projects, Levene's Test for Homogeneity of Variance, One way Anova, and Tukey HSD Post-Hoc Test for Multiple Comparison Test are applied and the following hypothesis is tested.

Ho: Financial risk mitigation strategies of software companies do not influence the average time spent on software projects

Homogeneity test of financial risk mitigation strategies based on average time spent on software projects is shown in table 9.15.

Table 9. 15

Homogeneity Test of Financial Risk Mitigation Strategies Based on Average Time Spent on Software Projects

	Levene statistic	Sig
Risk Transfer	1.371	0.090
Risk Acceptance	6.532	0.120
Risk Avoidance	1.886	0.130
Risk Sharing	4.834	0.436

Source: Primary Data

Table 9.15 reveals the homogeneity test result of financial risk mitigation strategies based on average time spent on software projects. Levene's test suggests that there is an insignificant difference, since the p-value is greater than 0.05. So, One Way Anova can be applied for checking the significant difference in financial risk mitigation strategies of software companies based on average time spent on software projects.

Comparison of financial risk mitigation strategies on average time spent on software projects is described in table 9.16.

Table 9.16

Comparison of Financial Risk Mitigation Strategies on Average Time Spent on Software Projects

Financial Risk Mitigation Strategies	Average Time Spent on Project (Months)				F Value	P Value	Remarks
	0-2	2-4	4-6	Above 6			
Risk Transfer	3.94 (1.03)	4.01 (1.01)	3.59 (1.22)	3.73 (1.17)	3.932	0.009	Significant
Risk Acceptance	4.06 (0.97)	4.01 (1.03)	3.60 (1.18)	3.80 (1.18)	4.724	0.003	Significant
Risk Avoidance	3.91 (1.10)	3.87 (1.13)	3.71 (1.19)	3.75 (1.15)	0.958	0.412	Insignificant
Risk Sharing	3.91 (1.05)	3.90 (1.05)	3.58 (1.23)	3.77 (1.19)	2.321	0.074	Insignificant

Source: Primary Data
Note: The value in the bracket indicate S D

Table 9.16 shows the results of financial risk mitigation strategies of software companies based on average time spent on software projects. Risk transfer, risk acceptance, risk avoidance and risk sharing are strategies for measuring average time spent on software projects. As per descriptive statistics, it is very clear that, risk acceptance strategies have a greater influence on average time spent on software projects, while risk sharing strategies have a lower influence.

From the table, it is also clear that Risk Transfer (p=0.009) and Risk Acceptance (p=0.003) show significant results towards the average time spent on software projects. Therefore the null hypothesis is rejected at a 5% level of significance and thus the financial risk mitigation strategies of software companies influence the average time spent on software projects.

But the financial risk mitigation strategies such as Risk Avoidance (‘p’= 0.412 > 0.05) and risk sharing (‘p’= 0.074 > 0.05) are not statistically significant at a 5% level of significance. That means the null hypothesis is failed to reject and there is no significant difference in average time spent on software projects based on these strategies.

For precise analysis of the difference, post hoc comparisons were conducted by using the Tukey HSD test. The result of the same is depicted in table 9.17.

Table 9.17

Multiple Comparison of Financial Risk Mitigation Strategies Based on Average Time Spent on Software Projects

Financial Risk Mitigation Strategies	**Tukey HSD**			
	Average Time (I) (Months)	**Average Time (J) (Months)**	**Mean Difference**	**Sig**
Risk Transfer	0-2	2-4	-0.061	**0.038**
		4-6	0.343	**0.008**
		6 and above	0.208	**0.014**
	2-4	0-2	0.069	**0.039**
		4-6	0.413	**0.012**
		6 and above	0.278	**0.010**
	4-6	0-2	-0.343	**0.040**
		2-4	-0.413	**0.012**
		6 and above	-0.135	**0.037**
	6 and above	0-2	0.044	**0.014**
		2-4	0.058	**0.021**
		4-6	0.361	**0.033**

Financial Risk Mitigation Strategies	Tukey HSD			
	Average Time (I) (Months)	Average Time (J) (Months)	Mean Difference	Sig
Risk Acceptance	0-2	2-4	-0.044	**0.017**
		4-6	0.413	0.407
		6 and above	0.217	0.126
	2-4	0-2	-0.458	**0.007**
		4-6	-0.413	**0.011**
		6 and above	-0.196	**0.043**
	4-6	0-2	-0.261	**0.002**
		2-4	-0.217	**0.021**
		6 and above	0.196	**0.034**
	6 and above	0-2	0.009	**0.007**
		2-4	0.014	**0.014**
		4-6	0.025	**0.025**

Source: Primary Data

From the table, it is clear that the risk transfer strategies show significant pairwise differences on 0-2, 2-4, 4-6 and 6 and above months, since the p values are lower than 0.05. In the case of risk acceptance strategies, the pairwise comparison of 0-2 with 2-4 shows a significant difference. But 0-2 with 4-6 and 6 and above months, no significant differences exist. Further analysing 2-4, 4-6 and 6 and above months, there exist pairwise differences as the p values are lower than a 5% level of significance. Therefore, it can be concluded that there exists a significant difference between risk transfer and risk acceptance strategies based on average time spent on software projects.

Section B

This section of the chapter explains Co-variance Based Structural Equation Modelling. SEM, a second-generation statistical method, is a widely used analytical tool (Babin, Hair and Boles, 2008). Concept and theory development as well as hypothesis testing are a demanding phase of empirical research. Both exploratory and confirmatory factor analysis are generally needed, as well as structural modelling. The latent constructs are too often ill-defined and the structural relationships, particularly directional effects, often do not have a sound theoretical foundation (Hair et al., 2013). SEM-based techniques are particularly useful in developing and expanding theory particularly when second and third-order factors provide a better understanding of the relationship (Astrachan, Patel and Wanzenreid, 2014).

SEM facilitates the discovery and confirmation of relationships among multiple variables. Perhaps the most important strength of SEM is that the relationship among numerous latent constructs can be examined in a way that reduces the error in the model (Hair et al., 2013). This feature enables assessment and ultimately elimination of variables characterized by weak measurement (Chin, Peterson and Brown, 2008). Bagozzi & Yi (2012) summarize the benefits of SEM techniques by suggesting 'The use of SEM yield benefits not possible with first generation statistical methods'. Concept and theory development requires the ability to operationalize hypothesized latent constructs and associated indicators, which is only possible with SEM. Moreover, statistical models can be complex and interactive effects can be assessed by CB-SEM. The study uses the CB-SEM technique to evaluate the relationship between the variables.

9.7 Hypotheses Development

The creation of the hypotheses and quantitative research tools based on the comprehensive research model. The model was mainly created through a thorough evaluation of the literature, which was then contextualized.

9.7.1 Financial Risk Factors on Financial Risk Management Techniques

Software companies have numerous financial risk factors. The study mainly analyses technology, scope, organization, resource, requirement, and design risk factors. Linda et al (2004) found that technical risk affects requirement satisfaction and enhances uncertainty. Dolan (2005) found that technical skill was a critical factor that significantly impacted IT project success. Tore Dyba (2005) suggests that the outcomes of software projects can be improved through quantitative risk analysis techniques. Sam Thomas and Bhasi (2001) reveal that the most influential factors of risk level are organizational attributes and project characteristics of software companies. Charles and Snyder (1991) state that managers should give more attention to minimizing losses and project failures by employing various qualitative and quantitative techniques. Bennett et al (1996) found that the main advantage of risk analysis was, that it can be carried out at all stages of software development and software companies can reduce the probability of consequences of risk factors in software projects. Raz and Michael (2001) reveal that software companies should adopt the most commonly used risk management techniques in light of cost and budget. Based on these insights, the following hypothesis is proposed,

SM.H1: Financial risk factors have a positive influence on the usage of financial risk management techniques

9.7.2 Financial Risk Factors on Financial Risk Mitigation Strategies

According to Linda et al (2004), financial risk mitigation strategies reduce the severity of impact and increase the probability of success and also reduce the potential loss in information technology projects. The project management professionals identified ninety risk factors. They suggested risk avoidance strategies to mitigate the risk (Debbie Tesch et al 2009). Hassan et al 2011, highlight that software projects require efficient handling of resources. Risk factors affect software quality, cost overrun and time delay in project completion. Software companies should implement risk mitigation strategies depending on their risk awareness and level of risk maturity. Cristina and Jose: 2012 find that difficulty in software projects can be minimized with the help of risk mitigation strategies. Expert judgement regarding the probability of occurrence of risks is considered the best strategy to mitigate and manage risk. A checklist of risk factors determines the risk score and helps the project manager to adopt a risk acceptance strategy. Software risk factors change the time, budget and quality. Project managers should prioritize the risk according to the dangerous level. More number of strategies should be used to mitigate complex risk factors. Efficient use of mitigation strategies can manage the cost, time, effort and quality of software projects. Based on the above analysis, the following hypothesis is developed, SM.H2: Financial risk factors have a positive influence on financial risk mitigation strategies

9.7.3 Impact of Financial Risk Management Techniques on the Usage of Financial Risk Management Techniques

Software projects are failed due to unrealistic time and cost estimates that affect deliverables. Technical issues were found to be difficult to implement IT projects on pre-planning. Organizational changes largely affect the completion of projects within the time and budget. Risk anticipation helps to reduce the impact of risky projects (Neo and Leong, 1994). Robert Charette 2005, reveals that information technology projects are costly but the cost of failure of projects is unpredictable. The impact of risk arising out of software failure can be reduced through continuous monitoring of projects with risk dimensions. The formation of a risk management committee becomes helpful for software companies to assess the impact of risk and software failure. According to Andrew et al 2006, management identifies priori risk to adopt techniques to mitigate the risks. Identification of causes at the beginning stage of software project development reduces the financial risk of software companies. Consequently, the following hypothesis is proposed,

SM.H3: The impact of financial risk management techniques has a positive influence on the usage of financial risk management techniques

9.7.4 Effectiveness of Software Companies on the Usage of Financial Risk Management Techniques

Prasanta and Jason 2008, evaluated risk management in IT projects and stated effective risk management ensures the successful implementation of projects with customer satisfaction, functional achievement and overall better financial performance of software companies. A risk management plan along with a work plan is necessary to achieve the time, cost and quality of the project. Software companies should conduct regular meetings to identify the reason for ineffectiveness. Sun Jeng Huang and Wen Ming Han 2008, found that project manager identifies risk factors with the help of quantitative risk analysis techniques to mitigate the effect on project performance. A proper risk management plan at an early stage can improve the success rate of IT projects. Henei and Suzzane 2015, state the use of the contingency model increases project performance and reduces risk exposure of high-risk projects. Yagnesh and Anu 2017, described that the usage of financial risk management techniques improves the financial-related effectiveness of software companies. Analyzing the specific risks for future projects finds the causes of software failure. (De Bakker et al, 2010). Effective use of financial risk management techniques increases project performance. Therefore, based on the above discussions, it is hypothesized that.

SM.H4: The effectiveness of software companies has a positive influence on the usage of financial risk management techniques

9.7.5 Effectiveness of Software Companies on Financial Risk Mitigation Strategies

Kwak and Stoddard analyzed that software projects are often characterized by a high level of uncertainty. They emphasized that effective risk management plays a crucial role in increasing the likelihood of a project's success. Proactive strategies and systematic approaches bring unique insight into the identification and management of risk. According to Kutsch and Hall 2009, IT projects endanger software companies in meeting their project objectives. The study emphasized the systematic application of project risk management to mitigate risks, demonstrating that a proactive risk management approach is effective in managing IT project risks. Yagnesh and Anu 2017, in their study, mentioned that a risk avoidance strategy is preferred more while dealing with risk. Hamzah et al 2012, revealed that the success of software projects depends on the software plan. Successful software companies result in project effectiveness by monitoring the project performance. Software risk management can be reduced by applying adequate risk mitigation strategies. A good software risk mitigation strategies always prevent the risk and reduce the occurrence of the risk. Nidhi and Neha 2014, established that risk management is highly essential to deal with each project's failures. Risk can be minimized by adopting different risk mitigation strategies. Prioritizing each risk based on its impact will help to develop strategies to overcome the failures of IT projects. Kinyua et al 2015, observed that risk mitigation strategies are positively related and affect project performance. Risk assessment paved the way for adopting a risk avoidance strategy for successful completion of the project. Based on the aforementioned analysis, the following hypothesis is formulated,

SM.H5: The effectiveness of software companies has a positive influence on financial risk mitigation strategies

9.7.6 Challenges of Software Companies on the Usage of Financial Risk Management Techniques

David et al 2006, evaluated that the major challenge for managers is identifying the risk involved in the implementation of IT projects. Risks are shown with the help of a checklist method to identify the highly sensitive risks. Srikrishnan et al 2013, found that many projects run into extra costs and delays due to inappropriateness. They developed a risk management profile by considering major risk factors to avoid these challenges. Documentation in all stages is treated as best practice in all software companies. Raz and Michael 2001, reveal that software companies should adopt the most commonly used risk management techniques to overcome all the challenges faced by software companies. Ammar and Berman 2007, state IT projects may result in positive or negative opportunities. Techniques of risk management can be used based on the competitive advantage of software companies. Risk monitoring and controlling techniques are used by software companies to manage the inadequacy of financial resources. Otniel 2013, highlighted that risk management in software projects helps to avoid project failures and increases team effort. Risk analysis and risk monitoring and controlling techniques influence in terms of cost, delivery and effort. It also helps with the timely delivery of the project and increases the probability of success. Consequently, the following hypothesis is proposed,

SM.H6: Challenges of software companies have a positive influence on the usage of financial risk management techniques

9.7.7 Challenges of Software Companies on Financial Risk Mitigation Strategies

Jiang and Klein 2010, determined that the challenge of project managers is to identify the different financial risks in IT projects and focus on them. The majority of software projects are unmet user requirements and schedules. Risk response planning should be made by project managers to mitigate these risks. Elzamly and Burariah 2015, observed that the planning of software developments is crucial for software project survival. Proactive maintenance by the project manager helps to mitigate risk in software development. David et al 2006, evaluated that the major challenge for the manager is to identify the risk involved in the implementation of IT projects. The IT risk varies according to the nature and size of projects. The project managers should be highly sensitive to risks and they provide a wide range of strategies for effective project management. Sergey and Elena 2016, observed that software risk management faced many challenges to create high-quality software. Project team members should document risk in every phase for adopting mitigation strategies. Software companies can resolve the quality issues of projects by adopting financial risk mitigation strategies. Based on the above analysis, the following hypothesis is formulated,

SM.H7: Challenges of software companies have a positive influence on financial risk mitigation strategies

The table 9.18 displays hypotheses for model building.

Table 9.18

Hypotheses for Model Building

Hypotheses No.	Hypotheses For Model Building
SM.H1	Financial risk factors have a positive influence on the usage of financial risk management techniques
SM.H2	Financial risk factors have a positive influence on financial risk mitigation strategies
SM.H3	The impact of financial risk management techniques has a positive influence on the usage of financial risk management techniques
SM.H4	The effectiveness of software companies has a positive influence on the usage of financial risk management techniques
SM.H5	The effectiveness of software companies has a positive influence on financial risk mitigation strategies
SM.H6	Challenges of software companies have a positive influence on the usage of financial risk management techniques
SM.H7	Challenges of software companies have a positive influence on financial risk mitigation strategies

Note: SM.H1 to SM.H7 indicates Structural Model Hypotheses

9.8 CB-SEM Showing Interrelationship between Factors, Impact, Effectiveness and Challenges on Usage and Strategies

Figure 9.1

CB-SEM Showing Interrelationship between Factors, Impact, Effectiveness and Challenges on Usage and Strategies

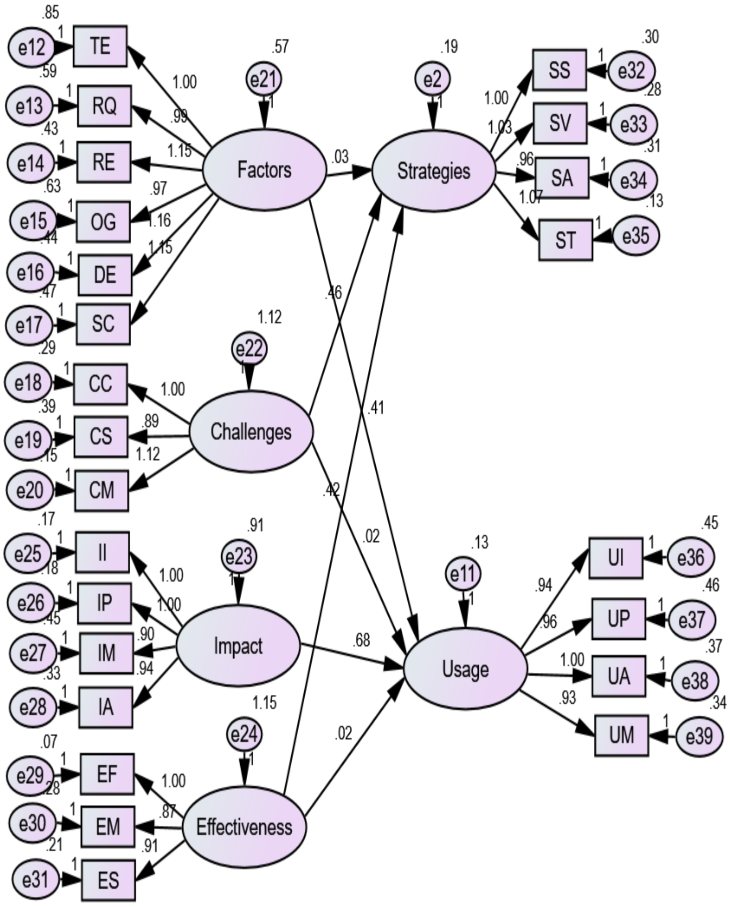


Figure 9.1 shows the hypothesized model developed by examining the regression effect of financial risk factors, the impact of financial risk management techniques, the effectiveness of software companies and the challenges of software companies on the usage of financial risk management techniques and financial risk mitigation strategies. The model was developed and tested with the help of AMOS Graphics based on data collected from project managers of software companies.

9.8.1 Model Fit Indices for Factors, Impact, Effectiveness and Challenges on the Usage and Strategies

As an initial stage of structural equation modelling, the researcher tries to confirm the scale and to determine the goodness of fit between the hypothesized model and the sampled data. Model fit indices for factors, impact, effectiveness and challenges on usage and strategies is given in table 9.19.

Table 9.19

Model Fit Indices for Factors, Impact, Effectiveness and Challenges on Usage and Strategies

Model	CMIN/DF	CFI	GFI	AGFI	RMSEA
Study Model	1.361	0.96	0.938	0.918	0.025
Recommended Value	Excellent fit 1-5	Greater than 0.9	Greater than 0.9	Greater than 0.9	Less than 0.08
Literature Support	Hair et al., (1998)	Barrett (2007)	Hair et al., (2006)	Hu and Bentler (1999)	Hair et al., (2006)

Source: Primary Data

Table 9.19 represents the model fit indices to access the model fit. The value of the chi-square to the degree of freedom ratio for an acceptable model should be less than 5. In this case, the value is 1.361 which is within the suggested maximum value. RMSEA score is 0.025 which is below the accepted threshold score of 0.08. Moreover, the GFI and AFGI values are above 0.9 and CFI is 0.96 above the threshold limit. As a result, the model fits perfectly.

9.8.2 Results of Hypotheses Tested

SEM is applied to examine the structural relationship between each variable. The structural model is measured with the help of path co-efficient at a 1% level of significance. Table 9.20 shows the hypotheses tested and path co-efficient.

Table 9.20

Results of Hypotheses tested

Hypotheses	Path	Path Co-efficient	P Value	Result (Supported/ Not Supported)
Financial risk factors have a positive influence on the usage of financial risk management techniques	Factors → Usage	0.388	< 0.001	**Supported**
Financial risk factors have a positive influence on financial risk mitigation strategies	Factors → Strategies	0.172	< 0.001	**Supported**
The impact of financial risk management techniques has a positive influence on the usage of financial risk management techniques	Impact → Usage	0.676	< 0.001	**Supported**
The effectiveness of software companies has a positive influence on the usage of financial risk management techniques	Effectiveness → Usage	0.024	0.281	Not Supported
The effectiveness of software companies has a positive influence on financial risk mitigation strategies	Effectiveness → Strategies	0.423	<0.001	**Supported**
Challenges of software companies have a positive influence on the usage of financial risk management techniques	Challenges → Usage	0.020	0.357	Not Supported
Challenges of software companies have a positive influence on financial risk mitigation strategies	Challenges → Strategies	0.625	< 0.001	**Supported**

9.8.3. Results of Path Analysis and Hypothesis Testing

The main objective of the present analysis is to investigate the structural relationship between the variables such as financial risk factors, usage of financial risk management techniques, impact of financial risk management techniques, effectiveness of software companies, challenges of software companies and financial risk mitigation strategies.

SM.H1: Financial risk factors have a positive influence on the usage of financial risk management techniques

The standardised beta coefficient of financial risk factors on the usage of financial risk management techniques is 0.388 at a 1% level of significance. It further explains that there exists a positive influence of financial risk factors on the usage of financial risk management techniques. The estimated positive sign implies that the usage of financial risk management techniques would increase by 0.388 for every unit of standard deviation increase in financial risk factors. Thus, the increase in financial risk factors can be managed by increasing the usage of financial risk management techniques for the successful completion of IT projects.

SM.H2: Financial risk factors have a positive influence on financial risk mitigation strategies

The standardised beta coefficient of financial risk factors on the usage of financial risk mitigation strategies is 0.172 at a 1% level of significance. It further explains that there exists a positive influence of financial risk factors on financial risk mitigation strategies. The estimated positive sign implies that the financial risk mitigation strategies would increase by 0.172 for every unit of standard deviation increase in financial risk factors. It suggests that the increase in financial risk factors can be mitigated by the increasing adoption of different financial risk mitigation strategies.

SM.H3: The impact of financial risk management techniques has a positive influence on the usage of financial risk management techniques

The standardised beta coefficient of the impact of financial risk management techniques on the usage of financial risk management techniques is 0.676 at a 1% level of significance. It further explains that there exists a positive influence of the impact of financial risk management techniques on the usage of financial risk management techniques. The estimated positive sign implies that the usage of financial risk management techniques would increase by 0.676 for every unit of standard deviation increase in the usage of financial risk management techniques. It can be concluded that the usage of financial risk management techniques positively impacts the project's success.

SM.H4: The effectiveness of software companies has a positive influence on the usage of financial risk management techniques

The standardised beta coefficient of the effectiveness of software companies on the usage of financial risk management techniques is 0.024 at a 1% level of significance. Hypothesis testing applying SEM analysis indicates that the coefficient value is not statistically significant. Further, it means, the effectiveness of software companies does not have any significant positive influence on the usage of financial risk management techniques.

SM.H5: The effectiveness of software companies has a positive influence on financial risk mitigation strategies

The standardised beta coefficient of the effectiveness of software companies on the usage of financial risk mitigation strategies is 0.423 at a 1% level of significance. It further explains that there exists a positive influence of the effectiveness of software companies on financial risk mitigation strategies. The estimated positive sign implies that the financial risk mitigation strategies would increase by 0.423 for every unit of standard deviation increase in the effectiveness of software companies. It can be concluded that the effectiveness of software companies can be improved by adopting financial risk mitigation strategies.

SM.H6: Challenges of software companies have a positive influence on the usage of financial risk management techniques

The standardised beta coefficient of the challenges of software companies on the usage of financial risk management techniques is 0.020 at a 1% level of significance. Hypothesis testing applying SEM analysis indicates that the coefficient value is not statistically significant. Therefore, the challenges of software companies do not have any significant positive influence on the usage of financial risk management techniques.

SM.H7: Challenges of software companies have a positive influence on financial risk mitigation strategies

The standardised beta coefficient of the challenges of software companies on the usage of financial risk mitigation strategies is 0.625 at a 1% level of significance. It further explains that there exists a positive influence of the challenges of software companies on financial risk mitigation strategies. The estimated positive sign implies that the financial risk mitigation strategies would increase by 0.625 for every unit of standard deviation increase in the challenges of software companies. It can be concluded that the challenges of software companies can be overcome by adopting financial risk mitigation strategies.

9.9 Conclusion

This chapter covered financial risk mitigation strategies based on the nature of the software company, area, average number of software projects, annual revenue invested for managing financial risk, completion of project on time, completion of project on the budgeted amount and average time spent on software projects. It also attempts to study the structural relationship between variables such as financial risk factors, usage, impact, effectiveness, challenges and strategies. It is found that financial risk mitigation strategies of software companies are potentially high in small-sized software companies. Further stating, software company in urban areas is highly influenced by financial risk mitigation strategies. Risk acceptance strategies have a greater influence on the average number of projects, annual revenue invested for managing risk, completion of projects on time, and average time spent on software projects. It is established that risk-sharing strategies help software companies to complete the project on the budgeted amount. The chapter also included the testing of the proposed model showing the interrelationship between financial risk factors, impact, effectiveness and challenges on usage and financial risk mitigation strategies. For SEM analysis, seven hypotheses were examined; five were supported, and two were not supported by the model.

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Chapter Ten

SUMMARY, FINDINGS AND CONCLUSION

10.1 Introduction

This chapter covers a brief overview of the study, followed by major findings derived from the data analysis. The chapter begins with a summary of the work done, after analysing the data, the study presented a detailed conclusion that covered the objectives and hypotheses.

10.2 Summary

Financial risk management has become crucial for software companies to ensure the successful execution of IT projects. Many software companies fail to meet deadlines due to ineffective financial risk management. Financial risks can take numerous forms, including technology, requirements, resources etc. Meanwhile, software companies face numerous challenges in completing their projects successfully. To address financial risks and challenges, software companies should employ both financial risk management techniques and financial risk mitigation strategies. The usage of financial risk management techniques can have either a positive or negative impact. Positive impact in the sense of project success, while negative impact in the form of completion of project out of the budgeted amount and time. The usage of financial risk management techniques and mitigation strategies contributes to financial, management, and socioeconomic effectiveness. Thus, the project's success depends extensively on the usage of financial risk management techniques and financial risk mitigation strategies.

10.2.1 Significance of the Problem

Financial risk management is a tool used by software companies to identify, assess, and mitigate risks to attain financial stability. Effective financial risk management promotes revenue recognition and protects against revenue loss due to scope changes and project delays. The availability of extremely creative human resources has contributed to Kerala's information technology industry's success. Kerala's high level of living, thoroughly researched and enforced government rules, and low operating expenses have made it a popular destination for investors looking to invest in information technology. The existence of software businesses in Kerala has helped to stimulate social, economic, and inventive development. Like anywhere else, Kerala's IT business is vulnerable to several financial risks that may endanger its operations, profitability, and long-term existence. Kerala's IT sector is quickly expanding, yet it faces various hurdles and uncertainties. Effective financial risk management is crucial for software companies to lower potential risks and enhance business continuity.

10.2.2 Statement of the Problem

Software companies face numerous challenges and financial risks, which have a significant impact on the project. Various factors influence how well information technology initiatives are executed. Project risk management is becoming a more essential component of software companies. Software companies encounter numerous hurdles and financial risks in project performance. Researchers have proposed numerous ways for effective financial risk management. Although the researchers discussed financial risk management, they did not specifically address how to manage financial risk in IT projects. This research will help future researchers and software developers comprehend the necessity of financial risk management in IT projects. The objective of this research is to identify and resolve gaps in past studies. Furthermore, an attempt is made to improve IT project success rates and provide extensive knowledge of financial risk management in IT projects.

10.2.3 Research Questions

The current study attempts to investigate the following key issues.

1. What are the financial risk factors that affect IT projects?
2. How financial risk management techniques are utilized in IT projects?
3. What is the impact of financial risk management techniques on the successful completion of IT projects?

4. How effective are software companies in using financial risk management techniques?

5. What are the challenges faced by software companies for the successful completion of IT projects?

6. What financial risk mitigation strategies can be employed to ensure the successful completion of IT projects?

10.2.4 Scope of the Study

The research is primarily empirical and provides a macro view of the financial risk management of small, medium and large software companies on the successful completion of IT projects. The study is limited to software companies in Kerala. The research focuses on financial risk factors, usage of financial risk management techniques, the impact of financial risk management techniques, the effectiveness of software companies, challenges of software companies and financial risk mitigation strategies.

10.2.5 Research Objectives

The following specific objectives are outlined by the scope of the study.

1. To analyse the factors affecting financial risk management in information technology projects of software companies in Kerala

2. To examine the extent of usage of financial risk management techniques in information technology projects

3. To study the impact of financial risk management techniques on the successful completion of information technology projects

4. To measure the effectiveness of software companies based on financial risk management techniques and financial risk mitigation strategies of information technology projects

5. To investigate the challenges faced by software companies in the successful completion of information technology projects

6. To analyse the financial risk mitigation strategies for the successful completion of information technology projects

10.2.6 Research Hypotheses

The following hypotheses are developed and tested,

Objective 1

1. **Ho:** There is no significant difference between financial risk factors and the nature of software companies

2. **Ho:** There is no significant difference between financial risk factors and the area of software companies

3. **Ho:** Financial risk factors do not influence the average number of projects undertaken by software companies

4. **Ho:** Financial risk factors do not affect the annual revenue invested for managing the financial risk of software companies

5. **Ho:** Financial risk factors do not affect the completion of the projects on time

6. **Ho:** Financial risk factors do not affect the completion of the projects on the budgeted amount

7. **Ho:** Financial risk factors do not influence the average time spent on software projects

Objective 2

8. **Ho:** There is no significant difference between the usage of financial risk management techniques and the nature of software companies

9. **Ho:** There is no significant difference between the usage of financial risk management techniques and the area of software company

10. **Ho:** Usage of financial risk management techniques does not affect the average number of projects undertaken by software companies

11. **Ho:** Usage of financial risk management techniques does not affect the annual revenue invested for managing financial risk of software companies

12. **Ho:** Usage of financial risk management techniques does not influence the completion of the project on time

13. **Ho:** Usage of financial risk management techniques does not influence the completion of the project on the budgeted amount

14. **Ho:** Usage of financial risk management techniques does not influence the average time spent on software projects

Objective 3

15. **Ho:** The impact of financial risk management techniques does not affect the completion of the project on time

16. **Ho:** The impact of financial risk management techniques does not affect the completion of the project on the budgeted amount

Objective 4

17. **Ho:** There is no significant difference between the effectiveness of software companies and the nature of software companies

18. **Ho:** There is no significant difference between the effectiveness of software companies and the area of software companies

19. **Ho:** The effectiveness of software companies does not influence the average number of projects undertaken by software companies

20. **Ho:** The effectiveness of software companies does not affect the annual revenue invested for managing the financial risk of software companies

21. **Ho:** The effectiveness of software companies does not affect the completion of software projects on time

22. **Ho:** The effectiveness of software companies does not affect the completion of projects on the budgeted amount

23. **Ho:** The effectiveness of software companies does not influence the average time spent on software projects

Objective 5

24. **Ho:** There is no significant difference between the challenges of software companies and the nature of software companies

25. **Ho:** There is no significant difference between the challenges of software companies and the area of software companies

26. **Ho:** Challenges of software companies do not influence the average number of projects undertaken by software companies

27. **Ho:** Challenges of software companies do not affect the annual revenue invested for managing financial risk of software companies.

28. **Ho:** Challenges of software companies do not affect the completion of software projects on time

29. **Ho:** Challenges of software companies do not affect the completion of projects on the budgeted amount

30. **Ho:** Challenges of software companies do not influence the average time spent on software projects

Objective 6

31. **Ho:** There is no significant difference between the financial risk mitigation strategies of software companies and the nature of software companies

32. **Ho:** There is no significant difference between the financial risk mitigation strategies of software companies and the area of software companies

33. **Ho:** Financial risk mitigation strategies of software companies do not influence the average number of projects undertaken by software companies

34. **Ho:** Financial risk mitigation strategies of software companies do not affect annual revenue invested for managing financial risk

35. **Ho:** Financial risk mitigation strategies of software companies do not affect the completion of software projects on time

36. **Ho:** Financial risk mitigation strategies of software companies do not affect the completion of the project on the budgeted amount

37. **Ho:** Financial risk mitigation strategies of software companies do not influence the average time spent on software projects

10.2.7 Research Methodology

The research design of the study is descriptive and empirical. The population under research consists of project managers employed by software companies in the state of Kerala. The sample districts selected are Thiruvananthapuram, Kollam, Ernakulam, Thrissur, Malappuram, Kozhikode and Kannur. A purposive sampling technique was used for data collection. The sample size of the study consists of 560 project managers. The study uses both primary and secondary data. The study collected primary data through a structured questionnaire. Statistical and mathematical methods were used for the examination of primary data. The data were analysed by using percentages, descriptive statistics, Levene's Test of Homogeneity of Variance, One-way ANOVA, Tukey HSD Post-hoc Test for Multiple Comparisons, Independent Sample t Test, Confirmatory Factor Analysis and Structural Equation Modelling. Software packages such as IBM SPSS 26.0 and AMOS 23.0 were used for analysing primary data.

10.2.8. Summary of the Chapters

The research is outlined in eight chapters. The summary of each chapter is described as follows.

The first chapter explains the background of the study and it consists of the significance of the study, statement of the problem, scope of the study, research questions, objectives of the study, research hypotheses, research methodology, variables used for the study, conceptual model, operational definitions, tools for data analysis and interpretation, limitations of the study and chapter scheme.

The second chapter of the study deals with the review of literature based on the objectives of the study. It includes reviews relating to financial risk factors, usage of financial risk management techniques, the impact of financial risk management techniques, the effectiveness of software companies, challenges faced by software companies and financial risk mitigation strategies. In this chapter, the researcher also identified a research gap based on extensive analysis of available literature and presented.

The third chapter presents the theoretical background of the study. It includes various theoretical concepts such as the origin of the IT sector, classification of IT projects, risk management theories, risk management process, financial risk factors, different financial risk management techniques, different types of challenges and financial risk mitigation strategies used by software companies.

The fourth chapter of the study exhibits the analysis of financial risk factors based on financial risk management techniques and financial risk mitigation strategies. This chapter is classified into three sections. Section A discussed the profile of the sample respondents and sample software companies. Section B of this chapter presents the results of financial risk factors based on nature, area, the average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on the budgeted amount and average time spent for software project. Section C discusses the confirmatory factor analysis of financial risk factors based on the usage of financial risk management techniques and financial risk mitigation strategies.

The fifth chapter describes the extent of usage of financial risk management techniques. This chapter consists of two sections. Section A presents the results of the analysis regarding the usage of financial risk management techniques based on nature, area, the average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on budgeted amount and average time spent for software project. Section B of this chapter deals with confirmatory factor analysis of the usage of financial risk management based on the impact and effectiveness of software companies.

The sixth chapter outlined the results of the impact of financial risk management techniques. Both primary and secondary data were used. Primary data relating to the completion of the project on time and the completion of the project on budgeted amounts were analysed. Secondary data regarding completed projects and project success were analysed based on financial risk management techniques.

The seventh chapter analysed the effectiveness of software companies based on financial risk management techniques and financial risk mitigation strategies. This chapter includes two sections. Section A demonstrates the results of the effectiveness of software companies based on nature, area, the average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on the budgeted amount and average time spent for software project. Section B deals with confirmatory factor analysis of the effectiveness of software companies based on financial risk mitigation strategies.

The eighth chapter deals with challenges faced by software companies. To analyse the challenges of software companies, the present chapter is divided into two sections. Section A describes the results of challenges of software companies based on nature, area, average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on the budgeted amount and average time spent for software project. Section B discusses the confirmatory factor analysis of challenges of software companies based on the usage of financial risk management techniques and financial risk mitigation strategies.

The ninth chapter attempts to study the financial risk mitigation strategies of software companies. The current chapter is organised into two sections. Section A deals with the results of financial risk mitigation strategies of software companies based on nature, area, average number of software projects, annual revenue invested for managing financial risk, completion of the project on time, completion of the project on the budgeted amount and average time spent for software project. Section B, presents SEM showing the interrelationship between factors, impact, effectiveness and challenges on usage and strategies.

In chapter ten, the summary, significance of the study, statement of the problem, scope of the study, research questions, objectives of the study, research hypotheses, research methodology, summary of chapters, major findings and conclusions are presented.

The eleventh chapter consists of recommendations, implications of the study and the scope for further research.

10.3 Major Findings of the Study

Based on the analysis of primary and secondary data from project managers of software companies in Kerala, some valuable insights were made. They are stated in different sections. They are as follows,

1. Profile of sample respondents
2. Financial Risk Factors Affecting IT Projects
3. Usage of Financial Risk Management Techniques
4. Impact of Financial Risk Management Techniques
5. Effectiveness of Software Companies
6. Challenges Faced by Software Companies
7. Financial Risk Mitigation Strategies of Software Companies

10.3.1. Profile of sample respondents

1. The present study found that 62.5% (350) of the respondents are male and 37.5% (210) of the respondents are female. Thus, most of the respondents are male.

2. It is found that 32.3% (181) of project managers are between 30-40 years old, indicating that middle-aged individuals are more likely to be project managers in Kerala than those aged 20-30.

3. More than 45.52% (255) of project managers have post-graduation as their educational qualification, 37.5% of the respondents are graduates, 14.1% are plus two, 1.78% of the respondents are in others category, and only 7% with school education as their educational qualification. Thus, people with high educational qualifications are appointed as project managers in software companies in the state of Kerala.

4. Most of the project managers have experience of 5-10 years in software companies. Thus it can be found that project managers are highly experienced.

5. The majority of the software companies are large-sized in the state of Kerala which constitutes 43.2% (242).

6. About 72.1% (404) of software companies are situated in urban areas. Thus, it can be ascertained that software companies are more in urban areas when compared with cities.

7. 28.7% of software companies undertake an average of 50-75 projects annually. So it can be observed that the average number of software projects undertaken in a year is high.

8. Most software companies invest 50-75 % (157) of their annual revenue to manage financial risk. Thus, the annual revenue invested for managing financial risk is comparatively high in all software companies in Kerala.

9. It is found that the majority of the software companies complete 75 to 100 % (231) of the software projects on time.

10. About 65.54% (367) of software companies complete the project out of the budgeted amount. Thus, this indicates that software companies' budget planning is weak.

11. Most software companies spend 29.6% of the average time on a software project. Thus, the majority of software companies spend more than six months on software projects.

10.3.2 Financial Risk Factors in Information Technology Projects

1. The result found that there is a significant difference between requirement, design, and resource-related factors based on the nature of the software company. Compared to medium and small software companies, large software companies have higher financial risk factors.

2. There is no significant difference between the area of software companies based on financial risk factors. As per the mean score, software companies in urban areas are also highly affected by financial risk factors. Both urban and city, resource-related factors have a greater impact.

3. To compare the difference in financial risk factors based on the average number of projects undertaken by software companies, one-way ANOVA is employed, and the significance of the difference in software companies' requirement factors has been established. According to the mean score, the average number of software projects is found to be strongly driven by resource-related factors, while technological factors have minimal impact.

4. It is found that there is a significant difference in organizational and design factors with annual revenue invested in managing financial risk. It is also observed that software companies invest the majority of their annual revenue in managing organizational factors and make less investment in managing technology factors.

5. There is a significant difference between scope-related factors and completion of projects on time. Besides, there is no significant difference in technology, requirement, organizational, design, and resource factors. Additionally, scope-

related factors highly affect a software company's ability to complete the project on time, and requirement factors have a low effect.

6. It is ascertained that there is no significant difference between financial risk factors and the completion of the project on the budgeted amount. However, the technology factors highly influence the software companies' ability to complete the project on the budgeted amount, and scope-related factors are the main cause of software companies' failure to complete the project on the budgeted amount.

7. The study found that there is a significant difference between design and resource factors based on the average time spent on a software project. In the cases of technology, requirement, organization, and scope, there is no significant difference. In addition, resource factors have a greater impact on the average time spent on software projects, while technology factors have a lower impact.

8. It is seen that there is a significant relationship between financial risk factors based on the usage of financial risk management techniques and financial risk mitigation strategies.

10.3.3 Usage of Financial Risk Management Techniques

1. It can be inferred that there is no significant difference among small, medium, and large companies based on the usage of financial risk management techniques. As per descriptive statistics, the usage of financial risk management techniques is high in large companies. It is also noticeable that software companies heavily rely on financial risk analysis techniques.

2. It is understood that there is no significant difference between the areas of software companies with regard to the usage of financial risk management techniques. Based on the mean score, it can be inferred that software companies in urban areas have high usage of financial risk management techniques as compared with cities. It is also found that financial risk analysis is highly used in software companies situated in urban and financial risk planning techniques are highly adopted by software companies in the city.

3. It is perceived that there is a significant difference between financial risk planning techniques and financial risk analysis techniques with regard to the average number of projects undertaken by software companies. Moreover mean score implies that the usage of financial risk analysis techniques highly influences the average number of software projects undertaken by software companies and financial risk monitoring and controlling techniques have low influence.

4. The one-way ANOVA test result exhibits that there is a significant difference in financial risk planning, financial risk analysis, and financial risk monitoring and controlling techniques with regard to annual revenue invested for managing financial risk. However, financial risk identification techniques show statistically insignificant results. It is also determined that software companies invest the majority of their annual revenue in the usage of financial risk analysis techniques and make less investment in the usage of financial risk planning techniques.

5. The results found that there is a significant difference between financial risk planning techniques and financial risk monitoring and controlling techniques regarding the completion of the project on time. As per the mean score, the usage of financial risk monitoring and controlling techniques is highly helpful for software companies to complete the project on time and the usage of financial risk identification techniques is least preferred.

6. With regard to the usage of financial risk management techniques based on completion of projects on budgeted amount, it is ascertained that there is no significant difference. It is also inferred that financial risk planning techniques highly influence the software companies to complete the project on the budgeted amount and financial risk analysis techniques accelerate the software companies to complete the project out of the budgeted amount.

7. As far as the usage of financial risk management techniques based on average time spent on software projects is concerned, there exists a significant difference in financial risk planning techniques. It is also evident that the usage of financial risk analysis techniques has a greater impact on the average time spent on software projects and financial risk identification techniques have a low influence.

8. It can be inferred that there exists a significant relationship between the usage of financial risk management techniques with the impact of financial risk management techniques and the effectiveness of software companies.

10.3.4 Impact of Financial Risk Management Techniques

The impact of financial risk management techniques is analyzed with the help of primary and secondary data.

10.3.4.1 Findings of the Study Based on Primary Data Analysis

The researcher considers the completion of the project on time and within the budgeted amount to analyse the impact of financial risk management techniques.

1. In the case of the impact of financial risk management techniques based on the completion of projects on time, there is no significant difference. Based on the mean score, it is found that financial risk planning techniques have a greater impact and financial risk analysis techniques have a lower impact on the completion of the project on time.

2. There is no significant difference between the impact of financial risk management techniques and the completion of the project on budgeted amounts. Additionally, it is inferred that the majority of the project is completed within the budgeted amount with the impact of financial risk planning techniques. Financial risk analysis techniques have a high impact on project closing out of budgeted amounts.

10.3.4.2 Findings of the Study Based on Secondary Data Analysis

The researcher used secondary data collected from 256 software companies by taking 680 projects in two years (2022 and 2023). The successful completion of projects is analyzed based on two constraints such as time and budgeted amount. The study considers small, medium, and large projects that are effectively completed with the aid of financial risk management techniques. The study analyses the impact of financial risk management techniques based on the project completed on time and within the budgeted amount and the findings are,

1. In the case of financial risk planning techniques, regular meetings assist small projects in being completed within the budgeted amount and time. Meanwhile, analytical techniques contribute more to the success of medium and information gathering techniques in large projects influences the successful completion of projects.

2. Failure mode and effect analysis is found to be more effective in identifying financial risks in both small and large projects. The risk checklist used in medium-sized projects influences the successful completion of projects.

3. With respect to financial risk analysis techniques, fault tree analysis highly influences small projects for successful completion. In the case of medium projects, decision tree analysis contributes to project success and it is also found that probability and impact grids used in large projects favoured for completion of the project on the budgeted amount and time.

4. The impact of financial risk monitoring and controlling techniques on project success revealed that the variance and trend analysis contribute more in the case of small projects. Risk audit used in medium projects favoured project success. Meanwhile, cost and benefit analysis in large projects influences the successful completion of projects.

10.3.5 Effectiveness of Software Companies

1. There are significant differences in terms of the effectiveness of software companies based on the nature of the software company. According to descriptive statistics, medium-sized software companies have the potential to be highly effective. It is also evident that software companies have extremely excellent management.

2. There is no observable influence noticed in the effectiveness of software companies based on their area. It is also clear that both urban and city areas have

high financial effectiveness. Furthermore, software companies in urban areas are more effective.

3. The result found that there is no change in the effectiveness of software companies based on the average number of software projects undertaken. Based on the mean score, it is also observed that management effectiveness has a greater influence on the average number of projects.

4. It can be noticed that there is a significant difference between financial and management-related effectiveness in terms of annual revenue invested for managing financial risk.

5. There is no observable influence noticed between the financial and socio-economic effectiveness towards the completion of projects on time. Based on the mean score, it is also understood that management-related effectiveness largely affects the software companies to complete the projects on time.

6. It can be understood that there is no significant difference between the effectiveness of software companies based on the completion of projects on the budgeted amount. It is also revealed that management-related effectiveness largely affects the software companies to complete the project out of budgeted amount.

7. It can be seen that socio-economic effectiveness shows differences based on the average time spent on software projects. It is also evident that financial effectiveness has a greater impact on the average time spent on software projects.

8. It is ascertained that there exists a significant relationship between the effectiveness of software companies based on financial risk mitigation strategies.

10.3.6 Challenges faced by Software Companies

1. With regard to the challenges based on the nature of software companies, it is found that there exist significant differences among small, medium and large companies. It is also ascertained that challenges are potentially high in medium-

sized companies. Among the challenges system related challenges are high in small and large companies and market-related challenges are high in the case of medium-sized companies.

2. There is no significant difference in challenges based on the area of software companies. It is also determined that software companies in the urban area are highly affected by challenges. System-related challenges are high in urban and market-related challenges are high in the city.

3. It is observed that market-related challenges are statistically significant with the average number of projects undertaken by software companies and annual revenue invested for managing financial risk. Based on the mean score, it is revealed that the average number of projects is highly influenced by market-related challenges and software companies invest the majority of their revenue in managing market-related challenges.

4. Results show a significant difference between system-related challenges based on the completion of the projects on time. It is also understood that market-related challenges highly affect the software companies to complete the project on time.

5. There is no significant difference between challenges based on the completion of the project on budgeted amount. Based on the mean score, it is inferred that coordination-related challenges highly influence the software companies to complete the project on the budgeted amount and market-related challenges lead the software companies to complete the project out of the budgeted amount.

6. Coordination-related challenges show statistically significant results with average time spent on the project. As per the descriptive statistics, it has arrived that market-related challenges have a greater impact on the average time spent on a project while coordination-related challenges have a lower impact.

7. There exists a significant relationship between the challenges of software companies based on the usage of financial risk management techniques and financial risk mitigation strategies.

10.3.7 Financial Risk Mitigation Strategies of Software Companies

1. It is seen that risk transfer and risk avoidance strategies have significant differences based on the nature of software company. It is also found that small companies highly prefer financial risk mitigation strategies than medium and large companies.

2. In the case of financial risk mitigation strategies based on the area of software company there is no significant difference. Based on the mean score, it is inferred that software companies in urban areas are highly influenced by financial risk mitigation strategies. It is also determined that risk acceptance strategies are highly adopted by software companies in urban and risk avoidance in cities.

3. Results show a significant difference between risk acceptance strategies based on the average number of projects undertaken. As per descriptive statistics, the average number of software projects is highly influenced by risk acceptance strategies.

4. It is ascertained that risk-sharing strategies based on annual revenue invested for managing financial risk show statistically significant results. It is also inferred that software companies invest the majority of their annual revenue in risk acceptance strategies.

5. There exists a significant difference between risk avoidance strategies based on the completion of projects on time. Based on the mean score, it is found that risk acceptance strategies are highly helpful for completing the project on time.

6. It is understood that there is no significant difference between financial risk mitigation strategies based on the completion of projects on budgeted amount. As

per descriptive statistics, it is inferred that risk-sharing strategies highly influence the software companies to complete the project on the budgeted amount and risk-transfer strategies highly affect the software companies to complete the project out of the budgeted amount.

7. It can be observed that risk transfer and risk acceptance show statistically significant results based on the average time spent on software projects. It is also found that risk acceptance strategies have a greater influence on the average time spent on software projects.

8. The results of the hypotheses testing model revealed that,

   - The financial risk factors positively influence the usage of financial risk management techniques. Thus, the increase in financial risk factors can be managed by increasing the usage of financial risk management techniques for the successful completion of IT projects.

   - It can be seen that financial risk factors positively influence financial risk mitigation strategies. It suggests that the increase in financial risk factors can be mitigated by the increasing adoption of different financial risk mitigation strategies.

   - It is visible that the usage of financial risk management techniques positively impacts the project's success.

   - The effectiveness of software companies does not have any significant positive influence on the usage of financial risk management techniques.

   - The effectiveness of software companies can be improved by adopting financial risk mitigation strategies.

   - The challenges of software companies do not have any significant positive influence on the usage of financial risk management techniques.

- The challenges of software companies can be overcome with the adoption of financial risk mitigation strategies.

10.4 Conclusion

The study “Financial Risk Management in Information Technology Projects of Software Companies in Kerala” has a comprehensive analysis of various aspects related to financial risk management, highlighting its crucial role in ensuring the successful completion of IT projects. In the dynamic world of software development, financial risk management is not just a precaution but a necessity, as it helps companies navigate uncertainties and maintain financial stability. The findings reveal that large software companies and those based in urban areas are more significantly impacted by financial risks, leading to a higher adoption of financial risk management techniques in these companies. Among the key risk factors, scope-related factors play a pivotal role in determining whether a project is completed within the budgeted amount and timeframe. Additionally, resource-related factors have a substantial influence on the average number of projects undertaken and the average time spent on each project. Furthermore, financial risk analysis techniques significantly impact software companies, particularly in terms of the average number of projects managed, the annual revenue invested for managing financial risk, and the average time spent on projects. Techniques such as financial risk planning, monitoring, and control, along with risk acceptance strategies, prove to be instrumental in helping software companies complete projects on time. These techniques are not just beneficial but essential for effectively managing financial risks. The study also highlights that the usage of financial risk management techniques has positive impact on project success. The implementation of financial risk mitigation strategies enhances the efficiency of software companies, with medium-sized companies experiencing the highest level of effectiveness. Moreover, software companies, in general, demonstrate a high degree of financial effectiveness. Medium-sized software companies and software companies located in urban areas face many challenges. Among these challenges, market-related challenges stand out as a major hurdle, significantly impacting the successful completion of projects. An interesting observation from the study is that small-sized software companies and those in urban areas adopt a greater number of financial risk mitigation strategies, demonstrating their proactive approach to managing uncertainties. One effective approach that software companies can adopt is the risk-sharing strategy, which helps to ensure that the projects are completed within the budgeted amount. Ultimately, the study concludes that software companies in Kerala face numerous financial risks, but they manage these risks properly by adopting various financial risk management techniques and mitigation strategies to drive the success of the projects. The choice of financial risk management techniques largely depends on the nature of the company and the complexity of the projects undertaken. As financial risks cannot be eliminated, they can certainly be managed and mitigated to a significant extent, allowing software companies to capitalize on uncertain projects and grab future market opportunities.

Chapter Eleven

RECOMMENDATIONS, THEORETICAL IMPLICATIONS AND SCOPE FOR FURTHER RESEARCH

11.1 Introduction

In the preceding chapters, the study discussed the financial risk factors, usage of financial risk management techniques, the impact of financial risk management techniques, the effectiveness of software companies, challenges faced by software companies and financial risk mitigation strategies of software companies in the state of Kerala. In this chapter, the recommendations and implications developed based on the findings are discussed. Furthermore, the researcher also suggests areas for further research. The recommendations of the study can be practically implemented by the software companies to overcome the major drawbacks in managing financial risk and thereby attain project success.

11.2 Recommendations

After analysing the study's findings, the following suggestions are offered to software companies for controlling financial risk. To improve the project's success, it is very essential to adapt financial risk management techniques and financial risk mitigation strategies. The recommendations put forward by the researcher are,

1. It is evident that companies located in urban areas as well as large software companies face significant financial risks. As a result, these organizations should adopt effective financial risk management techniques.

2. Analysis of financial risk factors based on the nature of software companies, resource-related factors have a major effect. Therefore, software companies must prioritize resource control by establishing clear resource allocation plans, monitoring utilization, and maintaining flexibility.

3. Scope-related factors have an impact on the ability of companies to deliver projects on time and within budgeted amounts. Thus, before implementing the

project, software companies' scope-related factors should be appropriately identified and handled.

4. Technology-related factors should be well managed to enhance the average number of projects undertaken by software companies. This allows them to improve their profitability, team communication, and increase their ability to manage a larger number of projects without sacrificing quality or schedules.

5. When financial risk factors are compared based on annual revenue invested, it is recognized that a significant portion of annual revenue is invested in managing organisational factors. However, resource-related factors have a greater impact, thus they must invest annual revenue in managing resource-related factors rather than organisational-related factors.

6. The majority of projects are completed beyond the planned amount. This is a common problem in software companies, where unanticipated challenges, scope modifications, or deficiencies in project management may result in budget overruns. As a result, software companies should conduct better budget planning.

7. Small and medium projects face greater financial risk compared to large project due to limited resources, inefficient budgets, and improper delivery. To mitigate these risks and increase the likelihood of project success, it is essential for software companies to broaden their usage of financial risk management techniques.

8. Socioeconomic related effectiveness is extremely low. As a result, software companies should improve their social and economic performance. By improving their socioeconomic effectiveness, software companies can not only improve their public image, but also promote long-term growth, acquire highly skilled personnel, and offer greater contributions to the economy.

9. Medium-sized software companies face numerous challenges, thus they should use effective financial risk mitigation strategies. Using these strategies, medium-sized software companies can reduce the impact of risks, maintain their financial

well-being, and improve their capacity to successfully complete projects and maintain growth in a competitive and challenging market.

10. Market challenges affect the software companies' ability to complete the projects on time and within budgeted amounts. As a result, software companies have to invest the majority of their annual revenue in handling market challenges.

11. Software companies should implement risk acceptance strategies to improve the average number of projects. By effectively managing and accepting certain risks, software companies can increase project efficiency and portfolio development ultimately leading to improved company performance.

11.3 Implications of the Study

The study properly addressed all of the research questions and met the research objectives. The study's practical implications benefit both project managers and software executives in terms of project planning and execution. The implications are,

11.3.1 Project Managers

The study provides valuable insights to project managers regarding the successful completion of the projects within the budgeted amount and time. It also assists them in monitoring and controlling financial risk factors by adopting effective financial risk management techniques and financial risk mitigation strategies. Furthermore, it helps project managers to develop projects with minimum resources and establish a good work environment for the successful implementation of projects.

11.3.2 Software Executives and Managers

Socioeconomic effectiveness is found to be low in software companies. As a result, software firm executives should engage in socio-economic development in order to gain greater opportunities in the global market. The study assists software companies in identifying the market challenges that are most critical to them. Software companies should conduct market research in order to survive in a competitive market. Software companies can use the research model for their financial well-being.

11.3.3 Researchers

The study can help the researcher expand their knowledge of financial risk and financial risk management concepts in IT projects for software companies in Kerala. This increased awareness would not only improve the researcher's theoretical understanding of financial risk management but will also provide them with practical knowledge of how these techniques and strategies are used in software companies.

11.4 Scope for Further Research

The IT sector plays an important role in day-to-day operations. Nowadays, it is impossible to live without technology. Technological advancement reduces the effort and time of the people. In this context, this area of research has vast scope and the researcher discovered the following areas for further studies in the software industry. They are as follows,

- Exploring AI and Machine Learning Applications in Financial Risk Management for Software Companies
- Analysing the Relationship between Financial Performance and Software Development Outcomes
- A Study on Employee Engagement and Its Impact on the Software Industry
- Emerging Trends in Software Development: A Glimpse into the Future
- A Comparative Analysis of Software Development Methodologies: Effectiveness and Outcomes

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APPENDIX

QUESTIONNAIRE

Dear Respondent,

I am BHAVANA. B.V. undergoing research work as a part of my PhD from the Department of Commerce, Government College Madappally, Vadakara. I would be extremely grateful if you could fill out this questionnaire by sparing a few minutes of your time. Kindly respond to all the statements with your valuable input. The data collected will be used for academic purposes only and will be handled confidentially. Thanks in advance.

1. Name:
2. Gender : Male ☐ Female ☐
3. Age : ______ years
4. Educational Qualification:

   SSLC ☐ Plus Two ☐

   Graduate ☐ Post Graduate ☐

   Others ☐
5. Nature of your Company

   Small ☐ Medium ☐

   Large ☐
6. Work Experience:

   0-5 ☐ 5-10 ☐

   10-15 ☐ 15-20 ☐

   above 20 ☐
7. Area of the Company:

   Urban ☐ City ☐
8. In which district the company situates: _________________
9. The average number of projects undertaken by your company in a year: __________
10. What is the percentage of the annual revenue that your company invests in managing financial risks in projects: _____________

11. Do you complete the project on time?

Less than 20% ☐ 20-40% ☐

40-60% ☐ 60-80% ☐

80-100% ☐

12. Do you complete the project on budget?

Completed within Budget ☐

Completed out of Budget ☐

13. Average time spent on a project?

0-2 months ☐ 2-4 months ☐

4-6 months ☐ above 6 months ☐

14. Give your opinion as to financial risk factors in information technology projects of software companies.

Technology related risks	S A	A	N	D	S D
Too narrow focus on technical issues					
Inappropriate technology chosen					
Use of immature technology					
Failure to adopt the latest technology					
Technology getting obsolete					
Lack of technical support teams					
Requirement related risks					
Requirements are not documented properly					
Incomplete requirements					
Misunderstanding in requirement gathering					
Requirements are not deliverable					
Incorrect system requirements					
Difference in requirements between the beginning and end					
Difficulty in identifying a common set of requirements					

Organisation related risks					
Lack of top management support					
Unstable organisational environment					
Corporate politics with negative effects on the project					
Organisations undergoing restructuring during the project					
Lack of planning					
Lack of proper coordination					
Ineffective communication					
Scope related risks					
Scope changes during the life of the project					
Partial understanding of project scope					
Schedule and budget overruns					
Too narrow scope					
Ambiguity in scope					
Design related risks					
Developing the wrong software functions					
Lack of integrity in design					
Improper alignment of software project					
Fail to design user requirements					
A lot of design errors					
Resource related risks					
Lack of adequate resources					
Wrong estimation of resources					
Inefficient use of resources					
Changes in the procurement of resources frequently					

15. State the extent of usage of the following financial risk management techniques used by your software company.

Financial Risk Planning Techniques	SA	A	N	D	SD
Analytical Techniques are most preferred to plan financial risk					
Software companies conduct Regular Meetings					

Expert Judgement are adopted for assessing financial risk					
Software companies prefer information-gathering techniques					
Financial Risk Identification Techniques					
Software companies mostly prefer Risk Checklist					
The influence Diagram identifies the most influenced risk					
Software companies use Cause and Effect Diagrams to determine root causes					
Failure Mode and Effect Analysis are used to prevent failures					
Financial Risk Analysis Techniques					
Probability and Impact Grid are prepared regularly					
Brain Storming helps to analyse financial risk					
System design can be improved with Fault Tree Analysis					
Risk Urgency Assessment prioritises the risk factors					
Consequences Analysis assesses success or failure outcomes					
Critical decisions are taken with the help of Decision Tree Analysis					
Monte Carlo Analysis forecasts uncertain inputs					
Sensitivity Analysis is used to determine project duration					
Financial Risk Monitoring and Controlling Techniques					
Risk Audit helps to know the types of risk					
Formal records of risk are maintained in the risk register					
Cost and Benefit Analysis are essential to implement future project					
Planned and actual performance are analysed by Variance and Trend Analysis					

16. Give your opinion as to the impact of financial risk management techniques on the successful completion of information technology projects.

Financial Risk Planning Techniques	SA	A	N	D	SD
Develops and adheres to software project plans					
Development of contingency plans to cope with future					
Efficient assignment of responsibilities to team members					

Time delays can be managed					
Financial Risk Identification Techniques					
Helps with redesigning software projects					
Identifies wrong software functions and properties					
Early detection of various risk factors					
Reduces mismatches in project requirements					
Determines accuracy in software project plans					
Financial Risk Analysis Techniques					
Evaluate the complexity of the project					
Divides the software project into controllable actions					
Ensures quality factor deliverables and task analysis					
Create and analyse software development process by modelling					
Financial Risk Monitoring and Controlling Techniques					
Efficient use of financial resources.					
Helps to prioritise the risk.					
Poor risk reviewing methods can be eliminated.					
Identifies skills necessary to complete the project.					
Helps to identify incomplete user documentation					

17. Give your opinion as to the effectiveness of software companies in the successful completion of information technology projects.

Financial Related Effectiveness	S A	A	N	D	S D
Helps software companies generate huge profit					
Attainment of better financial position					
The market share of software companies increased					
Software companies become cost-effective					
Reduced financial risks					
Management Related Effectiveness					
Software companies ensure the timely delivery of project					

Attainment of project objectives					
Ensures promised quality					
Highly satisfied customer					
More opportunities for new projects					
Maintains good relations with employees					
Socio-Economic related Effectiveness					
Provides more employment opportunities					
High standard of living					
Time and effort can be reduced					
Software solutions to numerous problem					
Economic growth and development					

18. Give your opinion as to challenges faced by you in the software successful completion of information technology projects.

Market-related challenges	S A	A	N	D	S D
Changes in market conditions					
Changes in IT policies					
Delays from vendor					
Stiff competition					
System-related challenges					
Security threats					
Failed changes					
No proper control mechanism					
Lack of disaster preparedness and recovery					
Co-ordination related challenges					
Inexperienced team members					
Conflict in the team					
Skills gap					
Lack of communication					

19. Give your opinion regarding the financial risk mitigation strategies in the success of information technology projects.

Risk Transfer Strategies	S A	A	N	D	S D
Transference is done by teaming up or by hiring a vendor					
Avoids adverse effects					
Transfer of risks is highly essential					
Efficient management of risk					
Risk Acceptance Strategies					
Contingency plans are prepared					
Used when the cost of transfer risk was very high					
Risk accepted when no alternatives are available					
High recognition of risk					
Risk Avoidance Strategies					
Adoption of an alternative approach to avoid the risk					
Defects of new projects are avoided					
High-risky projects are avoided					
Change in material and design avoid risk					
Risk Sharing Strategies					
Sharing the risk with other software companies					
High control of financial risk					
Evaluation of team expertise					
Reduce software project failures					

Thank you for your co-operation