

**ADOPTION OF EMERGING TECHNOLOGIES AND ITS IMPACT ON  
FIRM COMPETITIVENESS: A COMPARATIVE STUDY OF SERVICE  
AND MANUFACTURING INDUSTRY**

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AND MANUFACTURING INDUSTRY**

by

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# CERTIFICATE

This is to certify that the thesis entitled “**Adoption of Emerging Technologies and Its Impact on Firm Competitiveness: A Comparative Study of Service and Manufacturing Industry**” being submitted by **Ms. Kumari Surabhi Singh**, to the Indian Institute of Technology Delhi for the award of the degree of **Doctor of Philosophy**, is a record of bona fide original research work carried out by her. She has worked under my guidance and supervision and has fulfilled the requirements for the submission of the thesis, which has attained standard requirements for a Ph.D. degree at the Institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma.

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(Kumari Surabhi Singh)

## **ABSTRACT**

The adoption of emerging technologies is important for firms to enhance performance and attain firm competitiveness. In the competitive dynamic landscape, attaining firm competitiveness can be difficult. Firm strategies sometimes fail to enhance firm competitiveness due to their limited capabilities. The rapid pace of emerging technologies adoption (ETA) and the changing needs of the market add additional complexity to the competitive landscape.

This thesis aims to assess the impact of the critical factors (CFs) of ETA on attaining and enhancing firm competitiveness in the context of the service and manufacturing industry. First, a comprehensive literature review of the emerging technologies literature was conducted to understand the viewpoints of ETA. The study identifies six CFs of ETA and tests their significance in the context of the service and manufacturing industries. In the service industry, anthropomorphism, customer orientation, innovativeness, organizational readiness, relative advantage, and technological capability have a significant positive relationship with ETA and firm competitiveness. In the manufacturing industry, only organizational readiness, relative advantage, and technological capability have a significant positive relationship with ETA and firm competitiveness. In the combined overall industry sample, customer orientation, innovativeness, organizational readiness, relative advantage, and technological capability have a significant positive relationship with ETA and firm competitiveness.

This study analyzes the multi-mediation effect of ETA, reliability, and scalability on the relationship between identified CFs and firm competitiveness. In the service industry, studies confirm the partial multi-mediation effect of ETA, reliability, and scalability on the relationship between firm competitiveness and the CFs of customer orientation, innovativeness, and organizational readiness. In contrast, ETA, reliability, and scalability have no mediation effect on the relationship between firm competitiveness and the identified CFs in the manufacturing

industry. In the combined service and manufacturing industry study, this study finds a partial multi-mediation effect of ETA, reliability, and scalability on the relationship between firm competitiveness and the CFs of customer orientation, innovativeness, organizational readiness, relative advantage, and technological capability. In any industry, reliability and scalability mediate the relationship between ETA and firm competitiveness. In studying the role of strategic flexibility as a moderator between ETA and reliability and ETA and scalability, the study finds a significant effect for ETA and scalability in both the service and manufacturing industries.

Finally, a hierarchical model was developed using evidence-based total interpretive structural modeling (TISM-E) with data collected from the social media site X (formally Twitter). Triangulation using case studies confirms the impact of the significant CFs on the model.

The present thesis conceptualizes and examines the impact of the identified CFs of ETA on firm competitiveness. It extends the extant literature on emerging technologies, ETA, reliability, scalability, and strategic flexibility, confirming the importance of the identified CFs for the effective adoption of emerging technologies and firm competitiveness. The presented plot of four phases for attaining firm competitiveness after ETA helps academicians and practitioners to understand the challenges and opportunities associated with diverse combinations of these two dimensions of reliability and scalability, helping firms advance their technological skills, resource allocation, and competitiveness after ETA. The study strengthens the evidence for the dynamic capability approaches in the ETA literature. Further, it has practical and theoretical implications for practitioners, policymakers, and academicians in the successful adoption of emerging technologies.

## सार

उभरती तकनीकों को अपना फर्मों के लिए प्रदर्शन बढ़ाने और प्रतिस्पर्धात्मकता हासिल करने के लिए महत्वपूर्ण है। प्रतिस्पर्धी गतिशील परिदृश्य में, फर्म की प्रतिस्पर्धात्मकता को बनाए रखना चुनौतीपूर्ण हो सकता है। सीमित क्षमताओं के कारण कई बार फर्म की रणनीतियाँ प्रतिस्पर्धात्मकता को बढ़ाने में विफल रहती हैं। उभरती तकनीकों के तेजी से अपनाने और बदलते बाजार की आवश्यकताओं के कारण प्रतिस्पर्धात्मक परिदृश्य और अधिक जटिल हो गया है।

यह शोध सर्विस सेक्टर एवं निर्माण सेक्टर के संदर्भ में प्रतिस्पर्धात्मकता हासिल करने और उसे बढ़ाने में उभरती तकनीकों के अपनाने के महत्वपूर्ण कारकों के प्रभाव का मूल्यांकन करने का उद्देश्य रखता है। पहले, उभरती तकनीकों पर साहित्य समीक्षा की गई ताकि उभरती तकनीकों को अपनाने के दृष्टिकोण को समझा जा सके। अध्ययन में उभरती तकनीकों को अपनाने के छह महत्वपूर्ण कारकों (CFs) की पहचान की गई है और सर्विस सेक्टर एवं निर्माण सेक्टर के संदर्भ में उनकी प्रासंगिकता का परीक्षण किया गया है। सर्विस सेक्टर में, ऐन्ग्रामॉर्फिज़म, ग्राहक अभिमुखीकरण, नवाचारीपूर्वक, संगठनात्मक तत्परता, रिलेटिव एडवांटेज, और तकनीकी क्षमता का उभरती तकनीकों को अपनाने और फर्म प्रतिस्पर्धात्मकता पर सकारात्मक प्रभाव है। निर्माण सेक्टर में, केवल संगठनात्मक तत्परता, रिलेटिव एडवांटेज, और तकनीकी क्षमता का उभरती तकनीकों को अपनाने और फर्म प्रतिस्पर्धात्मकता पर सकारात्मक प्रभाव है। संयुक्त समग्र सर्विस एवं निर्माण सेक्टरों में, ग्राहक अभिमुखीकरण, नवाचारीपूर्वक, संगठनात्मक तत्परता, रिलेटिव एडवांटेज, और तकनीकी क्षमता का उभरती तकनीकों को अपनाने और फर्म प्रतिस्पर्धात्मकता पर सकारात्मक प्रभाव है।

यह अध्ययन उभरती तकनीकों को अपनाने, विश्वसनीयता, और मापक्रमणीयता के बहु-मध्यस्थता प्रभाव का विश्लेषण करता है, जो कि पहचाने गए CFs और फर्म प्रतिस्पर्धात्मकता के बीच के संबंध को समझने पर आधारित है। सर्विस सेक्टर में, अध्ययन के परिमाण से यह ज्ञात होता है की ग्राहक अभिमुखीकरण, नवाचारीपूर्वक, और संगठनात्मक तत्परता जैसे CFs और फर्म प्रतिस्पर्धात्मकता के संबंध पर उभरती तकनीकों को अपनाने, विश्वसनीयता, और मापक्रमणीयता का आंशिक बहु-मध्यस्थता प्रभाव है। इसके विपरीत, निर्माण सेक्टर में, उभरती तकनीकों को अपनाने, विश्वसनीयता, और मापक्रमणीयता का CFs और फर्म प्रतिस्पर्धात्मकता के बीच कोई मध्यस्थता प्रभाव नहीं है। संयुक्त समग्र सर्विस एवं निर्माण सेक्टरों के अध्ययन में, यह पाया गया है कि उभरती

तकनीकों को अपनाने, विश्वसनीयता, और मापक्रमणीयता का ग्राहक अभिमुखीकरण, नवाचारीपूर्वक, संगठनात्मक तत्परता, रिलेटिव एडवांटेज, और तकनीकी क्षमता जैसे CFs और फर्म प्रतिस्पर्धात्मकता के बीच आंशिक बहु-मध्यस्थता प्रभाव है। किसी भी उद्योग में, विश्वसनीयता और मापक्रमणीयता, उभरती तकनीकों को अपनाने और फर्म प्रतिस्पर्धात्मकता के संबंध में मध्यस्थता करते हैं। उभरती तकनीकों को अपनाने और विश्वसनीयता, तथा उभरती तकनीकों को अपनाने और मापक्रमणीयता के बीच रणनीतिक लचीलापन एक मध्यस्थ की भूमिका रखता है, इस संबंध का अध्ययन करते हुए, यह पाया गया कि सर्विस सेक्टर एवं निर्माण सेक्टर दोनों में उभरती तकनीकों को अपनाने और मापक्रमणीयता के संबंध को रणनीतिक लचीलापन सकारात्मक रूप से प्रभावी करता है।

अंततः, व्याख्यात्मक संरचनात्मक मॉडल साक्ष्य-आधारित टोटल इंटरप्रिटिव स्ट्रक्चरल मॉडलिंग का उपयोग करके एक श्रेणीबद्ध मॉडल विकसित किया गया। इस मॉडल को बनाने में X (पूर्व में ट्विटर) सोशल मीडिया साइट से डेटा एकत्र किया गया। चार केस अध्ययन के माध्यम से त्रिकोणीय सर्वेक्षण ने मॉडल पर महत्वपूर्ण CFs के प्रभाव की परीक्षण किया गया और संबंधों की पुष्टि की गई।

यह शोध उभरती तकनीकों को अपनाने के लिए पहचाने गए छह CFs का फर्म प्रतिस्पर्धात्मकता पर प्रभाव का अवधारणात्मक रूप से अध्ययन करता है और इसे विस्तृत करता है। यह उभरती तकनीकों, उभरती तकनीकों को अपनाना, विश्वसनीयता, मापक्रमणीयता, और रणनीतिक लचीलापन पर साहित्य में विस्तार प्रदान करता है, जो उभरती तकनीकों के प्रभावी अपनाने और फर्म प्रतिस्पर्धात्मकता के लिए पहचाने गए CFs के महत्व की पुष्टि करता है। उभरती तकनीकों को अपनाने के बाद फर्म प्रतिस्पर्धात्मकता प्राप्त करने के चार चरणों का प्रस्तुत चित्रण अकादमिकों और पेशेवरों को इन दो आयामों - विश्वसनीयता और मापक्रमणीयता - के विविध संयोजनों से जुड़ी चुनौतियों और अवसरों को समझने में मदद करता है, जिससे फर्मों को उनके तकनीकी कौशल, संसाधन आवंटन, और उभरती तकनीकों को अपनाने के बाद प्रतिस्पर्धात्मकता में अधिकता लाता है। यह अध्ययन उभरती तकनीकों को अपनाने के साहित्य में गतिशील क्षमता दृष्टिकोणों के लिए साक्ष्य को मजबूत करता है। इसके साथ ही, यह शोध उभरती तकनीकों को सफलता पूर्वक अपनाने में पेशेवरों (उद्योग विशेषज्ञों), नीति निर्माताओं, और शिक्षाविदों के लिए व्यावहारिक और सैद्धांतिक दृष्टिकोण प्रस्तुत करता है।

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## LIST OF ABBREVIATIONS

<b>Abbreviations</b>	<b>Definitions</b>
<b>ACPA</b>	Average Citation per Article
<b>AI</b>	Artificial Intelligence
<b>ANT</b>	Anthropomorphism
<b>AOL</b>	Average Outer Loading
<b>AVE</b>	Average Variance Extracted
<b>BT</b>	Blockchain Technology
<b>CC</b>	Cloud Computing
<b>CFA</b>	Confirmatory Factor Analysis
<b>CFs</b>	Critical Factors
<b>CMV</b>	Common Method Variance
<b>CR</b>	Composite Reliability
<b>CR</b>	Composite Reliability
<b>CUO</b>	Customer Orientation
<b>CV</b>	Convergent Validity
<b>DC</b>	Dynamic Capabilities
<b>DV</b>	Discriminant Validity
<b>EFA</b>	Emerging Technology Adoption
<b>EFA</b>	Robotics
<b>EFA</b>	Metaverse
<b>EFA</b>	Exploratory Factor Analysis
<b>ETiB</b>	Emerging Technologies In Business
<b>FCM</b>	Firm Competitiveness
<b>GenAI</b>	Generative-AI
<b>h</b>	H-Index
<b>HTMT</b>	Heterotrait-Monotrait
<b>INO</b>	Innovativeness
<b>IoT</b>	Internet Of Things
<b>IR</b>	Indicator Reliability
<b>ISM</b>	Interpretive Structural Modeling
<b>IT &amp; ITES</b>	Information Technology & Information Technology Enabled Services
<b>MICMAC</b>	Cross-Impact Matrix Multiplication Applied to Classification

<b>m-TISM</b>	Modified Total Interpretive Structural Modeling
<b>MV</b>	Metaverse
<b>OL</b>	Outer Loading
<b>ORR</b>	Organizational Readiness
<b>PLS-SEM</b>	Partial Least Square Structural Equation Modeling
<b>R&amp;D</b>	Research & Development
<b>REL</b>	Reliability
<b>RLA</b>	Relative Advantage
<b>RT</b>	Robotics
<b>SCA</b>	Scalability
<b>SD</b>	Standard Deviation
<b>SE</b>	Standard Error
<b>STF</b>	Strategic Flexibility
<b>TC</b>	Total Publication
<b>TCY</b>	Total Citation Per Year
<b>TEC</b>	Technological Capability
<b>TISM-A</b>	Argumentation-Based Total Interpretive Structural Modeling
<b>TISM-E</b>	Evidence-Based Total Interpretive Structural Modeling
<b>TISM-P</b>	Polarity Based Total Interpretive Structural Modeling
<b>TP</b>	Total Citation
<b>VIF</b>	Variance Inflation Factor