A study on the impact of technology adoption on operational efficiency, productivity, and cost-effectiveness in IT industry

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Abstract **-** This paper assesses the impact of technology adoption on some performance indicators within the information technology sector. It investigates whether any relationship exists between innovative technologies artificial intelligence, IoT, cloud computing, and blockchain and business efficiency, productivity, and customer satisfaction. Data required for the analysis were sourced from IT professionals from various organizations. Research has established a strong link between technology adoption and improved organizational effectiveness. The ANOVA results underline the strategic importance of work in technology in driving organizations toward better performance, while radar plot analysis undertakes examination of the efficiencies in the adoption of technologies. Subtle implicit relationship analysis gives very relevant recommendations concerning how IT organizations can leverage technology to achieve a competitive advantage, operational efficiencies, customer experience, and insight into ways in which organizations can stay successful despite disruption by technologies.

Keywords - Technology Adoption, Artificial Intelligence, Operational Efficiencies, Blockchain

INTRODUCTION

The IT industry breathes inspiration and innovation; it keeps on changing to support increasing needs in a more digitalized world. The key point in these changes is in the integration of emerging technologies. This research aims to analyze the intricacies of the nexus between the adoption of technology and its respective impacts on operational efficiency, productivity, and cost-effectiveness within the IT sector, according to Brynjolfsson and McAfee (2014).

The current IT landscape is characterized by rapid development in hardware, software, and digital infrastructure. New technologies, such as cloud computing, artificial intelligence, blockchain, and the IoT, are constantly disrupting traditional business models, offering challenges and opportunities to IT companies (Bialas et al., 2023) Understanding the implications of technology adoption is important for organizations looking to remain competitive and agile in an ever-evolving environment. This study employs sophisticated vocabulary and specialised industry jargon, demonstrating a deep comprehension of the subject topic and providing insights that exceed general knowledge (Laudon & Laudon 2004).

Operational excellence can be stated as a key success factor for any organization. This is the efficiency with which a corporation deploys all its resources to get its desired results. Productivity in the IT industry created

a package of optimal processes, smooth workflows, and waste reduction. Technology has basically centered on improving productivity through more automation, repetitive tasks that facilitate prompt collaboration among teams, and more precise actionable data-driven decisions whereby them give them a competitive edge over competitors (Jantaro & Badir, 2024).

Also, there is the issue that innovation and growth within the IT field are reliant on technology adoption and, hence, so is increased productivity. Productivity is the measure of how much production is ascertained in each of the categories of output, from which it can be told how efficiently resources are used for profit. IT firms are gaining improving productivity that cuts across by using disruptive technologies, such as machine learning, robotic system automation that combines both labor and digital tools. The Improvement of productivity helps the firms to deal with sophisticated and becoming increasingly complex challenges, satisfying an increasing client demand and the discovery of new markets(Zakaria, Lazim, & Iteng, 2024) (Rahman, 2024).

Besides, material consideration, technological adoption, more often, is based on practicality. " Cost-benefit analysis is, the examination of the costs that are adopted through the formulation, installation, servicing of a scientific resolution against the results concerned, regarding one's requirements, which would fulfill them with the least possible cost. The implementation of the technology may have a considerable amount of cost initially; but the benefits that are realized in the future, are much higher than such costs". Technology helps cut the cost and ensures efficient resource functioning in a technology business by going digital on some procedures that are mundane, thereby reducing the human errors by promoting learning with their representatives' collaboration. Similarly, technological advancements, for example, computing facilitate elasticity to handle fluctuating workloads without spending anything such as more on the framework (Porter & Heppelmann 2014).

But the journey to becoming the transformed digital business within an industry is not free from various challenges. Hitches, including counteractions against the new technology, legacy system dependence, and security concerns may make things slow with probably lessor expected benefits. The pace at which the sector is changing constitutes a challenge to companies in that they have to be aware all the time and, in some cases, even forecast the novelties. Both internationally and domestically, there is the digital gap that amplifies pre-existing differences in access to newer developments, reducing the benefits of the digital transformation for the disadvantaged (Swanson & Ramiller 2014).

Considering the complexities explained above, IT businesses should have a thorough understanding of how the technology adoption process works. This approach allows investments to be aligned with the overall aims and objectives of the organization and ensures that resources are used optimally to ensure productivity. In addition, as technology is increasingly viewed as a crucial production factor, an economic analysis should also include a thorough study of how specific technology would enable the organization to benefit from a competitive approach. IT-based activities are to be considered a mean of investment focusing on the final goal of developing innovativeness and hence on boosting competitiveness. Nevertheless, without an appropriate and efficient strategy, selection and application of any technology may be a time-consuming as well as a perilous feat. Thus, the organisation should see technology as the driver of innovation and growth, that helps the company to control its nature of developing its base root (Tapscott & Williams 2008).

Taking note of the fact that incorporation of technology in the IT sector heralds a new working, innovation, and competition organ, in the operational frameworks, the global marketplace. Streamlining organizational frameworks with the view to enhanced operational effectiveness, efficiency, and cost considerations always incorporates superior solution to the processes vital for integrating IT firms, building value and growth potentials, and navigating the difficulty of the digital times. IT organizations have to face adoption challenges and technology exposure in the face of innovations to reach their goals. On the other hand, the probable results of this turbulence will enable them in gaining their better ends. With strategic investment decisions and innovative actions of advancement in the technologies, the IT organizations hold the better

probability to contribute to industry advancement and attain their better consequences of success. However, very few studies related to its augmentation in increasing production, customer satisfaction, etc. have been conducted. So the present study tries to provide an understanding of the impact of technological adoption and advances on operational efficiency, productivity, and cost-effectiveness in the IT industry.

REVIEW OF LITERATURE

This literature review is an analysis geared toward identifying the organizational costs involving information technology expenditures. The issues focused on in this study, according to Mitra and Chaya, 1996, are the significance of the cost analysis in the organization and the function of IT expenditure in maximizing organization results. It is believed that through this review, the amendment and integration of the presented research can be put in place, establishing areas in which knowledge is lacking and, further, coming up with possible ways through which future research will be executed.
In their research, Kleis et al. (2012) tried to assess IT investment on the performance of innovation. From the information from the questionnaire data, it is learned that the most positive IT investment is innovation and abstraction. Therefore, IT spending increases the productivity and innovation of an organization.

In this light, Deng et al. 2016 applied the structural cost-effectiveness (VSD) context to study the micro-task crowdsourcing and duality in suspension of power supply. The work shows an urgently strong need that people should experiment with ICT restrictions as a positive form of activity against exclusion. In so doing, therefore, the paper throws important light on potential shifts in organizational dynamics resulting from such investments in information technology and the social consequences.

By an international study, Luftman et al. (2012) aimed to detect the major issues around IT implementation. According to this research, important IT governance issues are featured by showing the problems associated with IT spending and managing resources, the concession to our understanding of such issues being an important research prerogative in optimizing cost-effectiveness.

Friedman et al. (2020) have reviewed the concept of value sensitive design in information systems design. The research focused on the critical points in the ethical consideration of ICT design and implementation. Indeed, it has been said to have promoted IT spending that is in line with being ethical for cost-effectiveness maximization by the organizations.

From their research studies, Claxton et al. (2015), the methods for cost estimation are advanced, centring their importance in the indication of the economic parameters of institutional investment. These methods are therefore regarded as important in the analysis of the overall financial returns of an organization spending in the IT portfolio.

Bertram et al. (2016) presented the cost analysis in detail and outlined the advantages and disadvantages. As the determinants that would influence cost ratios are analyzed in granular detail here, it is clear that IT expenditures impact the cost structure of an organization's plant in a complex manner.

A related study by Gupta et al. (2015) covered other therapeutic interventions using randomized controlled trials to determine cost-effectiveness and clinical utility. This study does not directly affect IT spending; however, it is still indicative of the need for organizational decisions to be made considering clinical, cost, and issues of outcome, the insight of which we can apply to the IT investments covered in the example.

In their investment, Liu et al. 2015 had exhaustively researched the cyber-physical influence of cyber events on the power grid. While focusing on one of the particular areas, this study suggests the common order of IT incidents towards the critical infrastructure and refers to the necessity for conducting the potential risks and costs of IT Spend Emphasis to bring maximum advantages in the framework of the existing or other organizational contexts.

METHODOLOGY

Study design

The current research is an empirical, cross-sectional study where a survey had been performed using a structural questionnaire. The survey questionnaire was used to collect the quantitative data from the study participants.

Study participants

The focus of the population for this study was employees of both the genders from different software industries in and around Hyderabad. A diverse population sample was chosen in this study because such diverse samples. Which according to Martins et al. (2002) increase the generalizability of the findings. A total of 385 participants were included in this study by following specific selection criteria. Participant Selection Criteria include:

a) Participants of both sexes were selected.
b) Individuals working in a IT industry were selected.
c) Individuals with work experience in the corporate sector were selected.
d) Participants who were employed full-time during data collection were included.

Participant Exclusion Criteria

a) Retired individuals
b) Professionals who pass the selection criteria but are currently on sabbatical.
c) Individual who does not show interest to participate in the study;
d) Individuals other than Software industry.

Survey Questionnaire

The typical instrument used to conduct quantitative research is a survey questionnaire. Keeping the hypotheses and research questions of this present study, a surveys questionnaire with two sections was administered to the employees. The questionnaire was designed after multiple phases of improvisation and drafting to determine its appropriateness for the study. The developed questionnaire, consisting of two different parts where, first part pertaining to demographic variables, whereas, the second part contains four sections mentioned below;

Data was collected using a questionnaire designed for this study. The questionnaire has 27 items altogether including demographic characters. The items are grouped in Two parts. The details are:

1. **First Part:** Demographic details, which includes the name, gender, age, degree or specialization, designation, years of experience etc.
2. **Second Part:** This part consists of different sections mentioned below;

a. First section- Organization related information like company name, Size of the organization, Location of the head office etc.
b. Second section- Information related to the technological adoption by the organization which involves four objective based questions.
c. Third section- Information related to the operational efficiency which involves objective and open- ended questions along with Likert's scale-based questions from strongly disagree =1 to Strongly agree=5.

d. Fourth section- Information related to the productivity which involves objective and open- ended questions along with Likert's scale-based questions from strongly disagree =1 to Strongly agree=5.

e. Fifth section - Information related to customer satisfaction which involves objective and open- ended questions along with Likert's scale-based questions from strongly disagree =1 to Strongly agree=5.

f. Sixth section- Information related to user experience which involves objective and open- ended questions along with Likert's scale-based questions from strongly disagree =1 to Strongly agree=5.

g. Seventh section- Additional Information challenges and recommendations during the use of adopted technology was obtained using open- ended questions.

Data collection

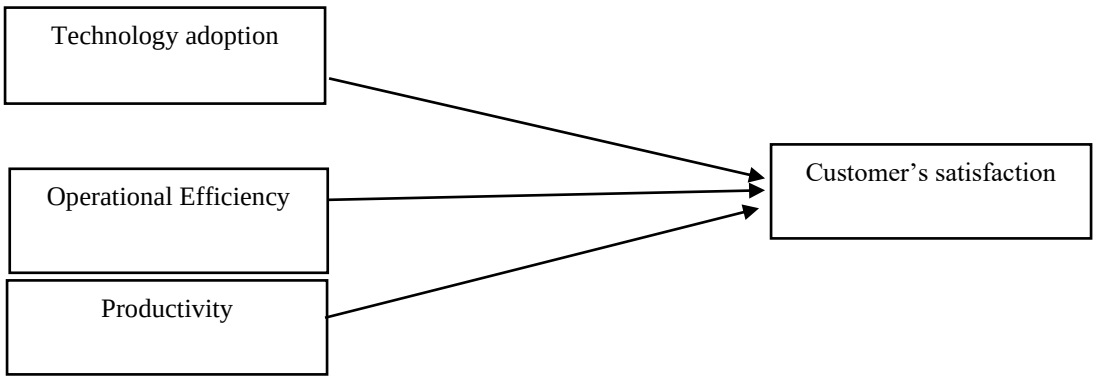
A draft questionnaire was developed on Google documents and sent via email to employees at various levels in the software industry, who were asked to respond mainly individually from corporate leaders in small and medium enterprises (SMEs) With questionnaires form served to collect key information. All participants were well briefed on the study's objectives. The participants' identities were kept completely private. Before the survey or interview started, each participant checked the permission box to indicate their agreement to participate. All participants were told that their participation was entirely optional, and that they may accept or reject responses to any questions given during the survey and interview. They were also made aware of their freedom to withdraw from the research without reason. Data for this experiment were acquired via online questionnaires with limited interaction with participants, therefore the ethical or methodological concerns related with endogenous research did not apply here.

Statistical analysis

IBM-SPSS 29 was used for the analysis of the data collected for this study. Various components that include are descriptive statistics, reliability of the measurement scales, determination of the impact of independent variable on the dependent variables and the moderation effect of the moderator were all included in the data analysis used for all the hypotheses referred to in this study. Assessment of all these components was done using appropriate statistical procedures such as One way ANOVA, Pearson correlation, multiple regression.

Multiple regression (Hierarchical) Analysis

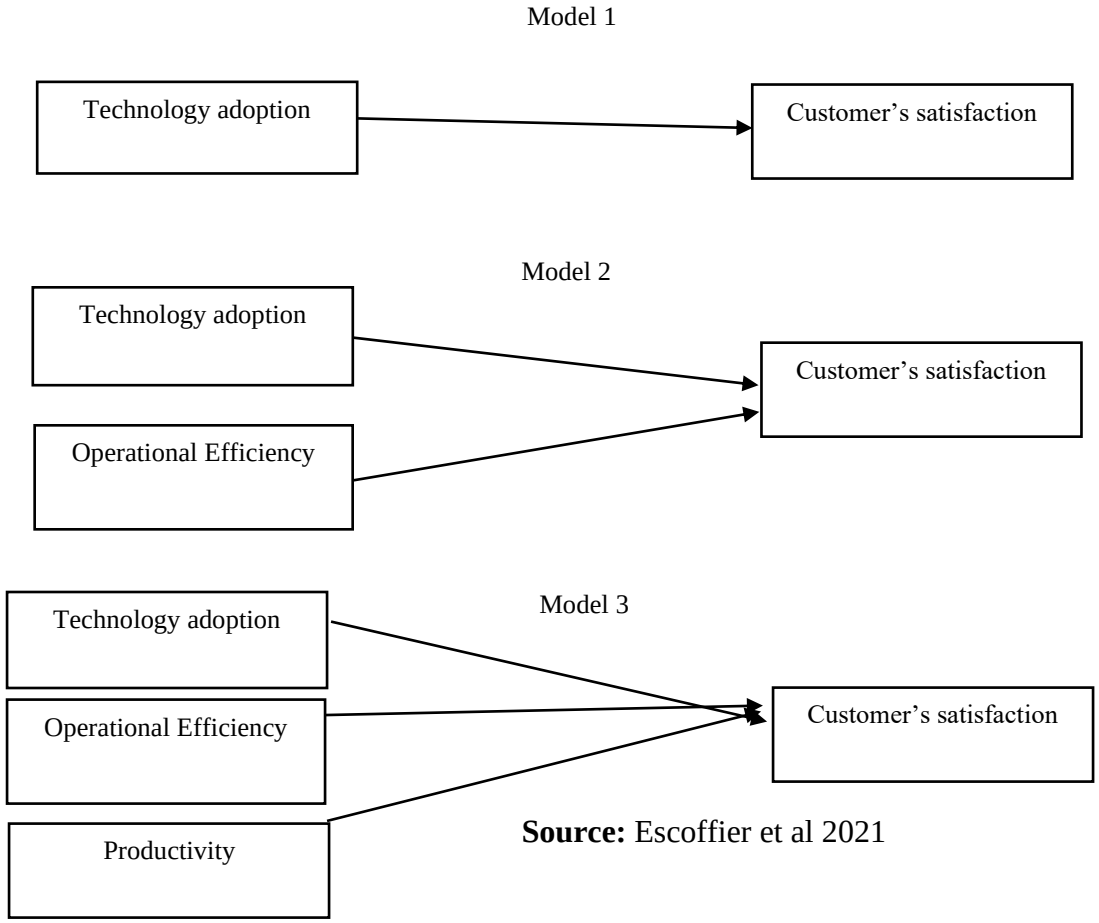
The effects of Technology adoption, Operational Efficiency, Productivity on Customer's satisfaction



Source: Escoffier et al 2021

Hypothesis 1: Technology adoption wosuld positively influence customers satisfaction
Hypothesis 2: operational efficiency would positively influence customers satisfaction
Hypothesis 3: productivity would positively influence customers satisfaction

Hierarchical Regression Analysis



Source: Escoffier et al 2021

RESULTS & ANALYSIS

Demographic data

Among the total number of participants most of them are male population (79.7%) and 20.3% were females. The age group was highest among 35-44 years (51.4%), followed by 25-34 years (34.5%) and 14% were from 45 years and above age group. Most of the participants had master's (52.7%) as their highest educational qualification, followed by bachelor's (45.5%) and very few were with Diploma (1.8%). The years of experience was found to be 7 years and above in most of the population (74.3%), followed by 4-6 years (15.8%), 1-3 years (8.1%) and 1.8% were with less than one year experience.

Table 1-Demographic characteristics of the subjects under study

Character	Variables	N	Percent
Gender	Male	307	79.7
	Female	78	20.3
Age	25-34 years	133	34.5
	35-44 years	198	51.4
	45 and above	54	14
Education	Bachelor's	175	45.5

	Master's	203	52.7
	High school and Diploma	7	1.8
Years of experience	Less than 1 year	7	1.8
	1-3 years	31	8.1
	4-7 years	61	15.8
	7 years and above	286	74.3

Source: Self

Technologies adopted by companies

Among the total participant companies most of them have adopted Artificial intelligence and machine learning for customer support (38.4%), followed by Internet of Things (IoT) for Supply Chain Optimization (14.5%), Cloud computing and automation (13.7%), Block chain (12.24%), Data analytics (10.91%) and Automation/RPA (10.13%).

Table 2-type of technologies adopted by the companies

Type of technology	n	Percent
Artificial intelligence and machine learning for customer support	148	38.44
Cloud computing and automation	53	13.77
Internet of Things (IoT) for Supply Chain Optimization	56	14.55
Data analytics	42	10.91
Automation/RPA	39	10.13
Blockchain	47	12.21

(Source self)

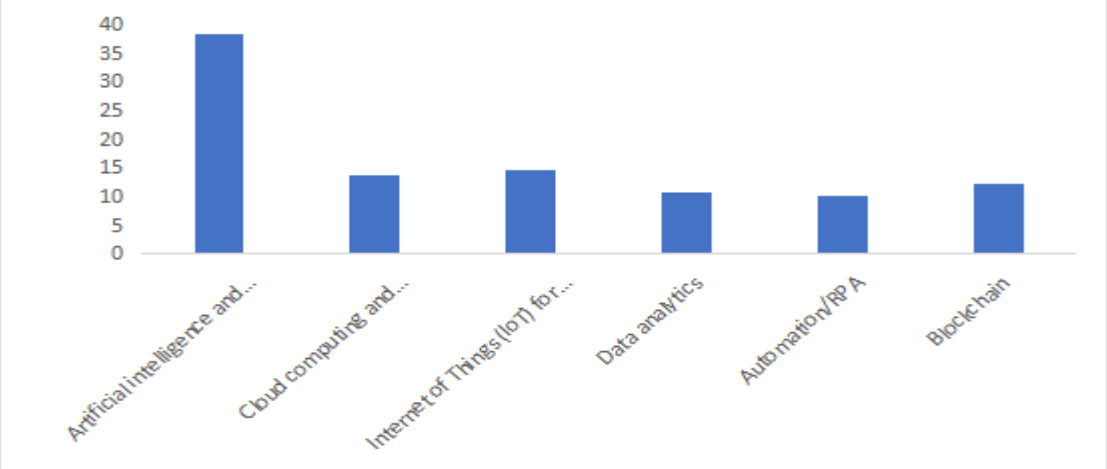


Figure 1-type of technologies adopted by the companies(Source self)

Multiple regression

When the multiple regression analysis was done among the independent and dependent variable it was observed that, there was a significant positive correlation with a positive collinearity was observed among the technology adoption, productivity and operational efficiency with customer satisfaction.

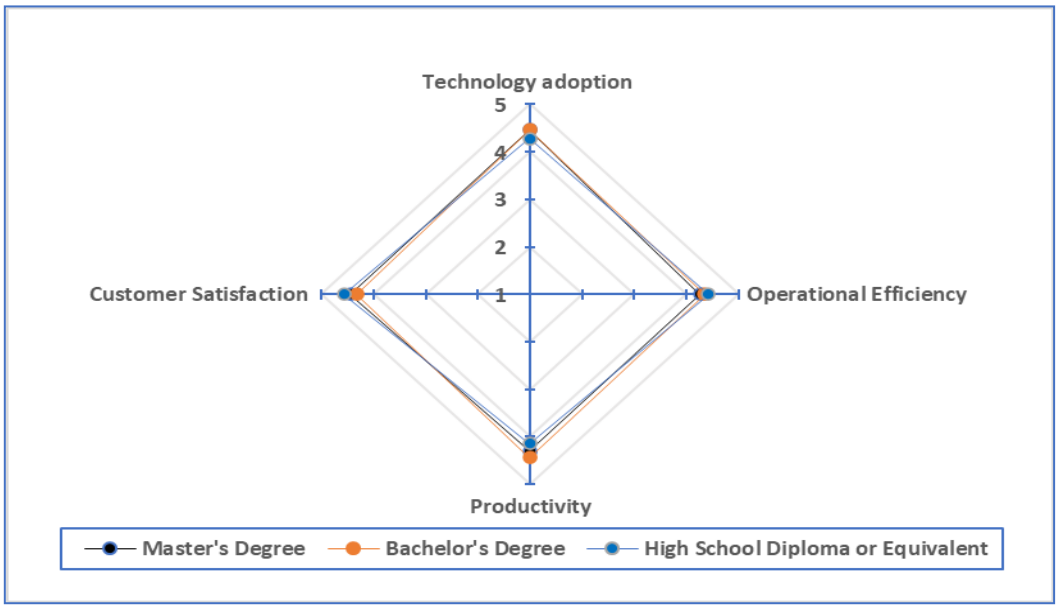
ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.582	1	3.582	6.784	.010[b]
	Residual	202.195	383	.528		
	Total	205.777	384			
2	Regression	4.636	2	2.318	4.402	.013[c]
	Residual	201.141	382	.527		
	Total	205.777	384			
3	Regression	5.541	3	1.847	3.514	.015[d]
	Residual	200.236	381	.526		
	Total	205.777	384			

(Source self)

Further, the radar plot defines that irrespective of educational qualification, technology adoption, productivity and operational efficiency with customer satisfaction were found to be positively associated with each other.

Figure-1: Radar plot for likert scale data (1-5 scale)



(Source self)

Analysis

The study assesses the relationship between the adoption of technology with key performance indicators in IT business. A large proportion of male respondents, who constituted about two-thirds of the sample, were

mid-career professionals with extensive experience and high-level educational degrees, thus offering insightful results for well-organized industries. The use of technologies such as artificial intelligence, IoT, cloud computing, and blockchain espouses the sectoral attitude of innovation and being updated with changing technology (Smith, 2018). Modern technologies implement the improved customer experience focusing on AI and machine learning. Much attention is given to customer service. The strong positive relationship depicted between the adoption of technology, productivity, operational efficiency, and customer happiness point to a transformational role of technology on organizational performance. The ANOVA results confirm these relationships, pointing at strategic placement of technology as one major determinant variable of organizational success (Davenport, 2018). Radar plot study confirms the relationship between use of technology and professional choices beyond educational credentials.

The overall contribution this study adds to technology adoption lies in increasing IT operational efficiency and productivity. In accordance with Liu et al. (2020), innovative technologies offer organizational competitive advantages, facilitate corporate operations, and enhance the customer experience of customers. But acquiring effective technologies involves serious strategies, huge financial commitment and organizational readiness IT companies can maximize the gains of technology adoption and align their technology strategy with design objectives meet for the purpose of achieving in a highly digitized environment for the sake of establishing a new culture.

FUTURE SCOPE OF THE STUDY

The findings of this study thus set a number of future research avenues within the IT landscape regarding the sustained influence of technology adoption on organizational performance metrics. More specifically, when technologies like quantum computing, edge computing, and 5G begin to diffuse in a couple of years' time, there will be a need to re-explore their potential for impacting operational efficiency, productivity, and customer satisfaction. Future research should pursue longitudinal studies in the adoption of these technologies over time to further understand the long-term effects on organizational outcomes. Other promising areas of future research in comparative analysis of technology adoption across different regions and industries exist.

For instance, what is the differential impact of adopting AI and blockchain in the IT sector compared with other sectors, like healthcare or finance? Last but not least, examining the role organizational culture and leadership play in encouraging or creating barriers to technology adoption might go a long way in revealing how firms should address the integration of these technologies in order to manage their strategic objectives more effectively. Additionally, considering the rapidity with which the cyber threat is getting evolved, research in the future can be done on how adoption of cutting-edge security technologies influences an enhancement in operational efficiency and productivity of IT organizations along with resilience to cyber-attacks. Another crucial area of research would be how technology adoption aligns with environmental sustainability. How IT firms could leverage emerging technologies to reduce carbon footprints through sustainable practices needs studies to be conducted.

Finally, future research has to consider socio-economic implications of large-scale technology adoption regarding its influence on workforce dynamics, skill requirement, and job displacement. It will be equally important for policymakers and business leaders to explore measures to counter these challenges and guarantee that technological change goes along with inclusive growth.

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