Impact of Technology Innovation and R&D on Firms' Performance in Nepal's Service Sector

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Abstract

This study examines impact of technology innovation and R&D on firms' performance in Nepal's service sector. Firms' performance is the dependent variable. Similarly, the selected independent variables are technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology. The study is based on the primary data with 132 respondents. To achieve the purpose of the study, structured questionnaire is prepared. The correlation and multiple regression models are estimated to test the significance and impact of technology innovation and R&D on firms' performance in Nepal's service sector on firms' performance in Nepal's service sector.

The study indicates that technology adoption rate is positively correlated to firms' performance. It indicates that high technology adoption rate leads to increase the firms' performance. Similarly, innovation investment is positively correlated to firms' performance. It indicates that higher the innovation investment leads to increase the firms' performance. Likewise, market competition is positively correlated to firms' performance. It indicates that market competition leads to increase the firms' performance. Further, regulatory environment is positively correlated to firms' performance. It indicates that higher the regulatory environment, higher would be the firms' performance. Moreover, employee training in technology is positively correlated to firms' performance. It indicates that higher the employee training in technology leads to increase the firms' performance.

Keywords: technology adoption rate, innovation investment, market competition, regulatory environment, employee training in technology

1. Introduction

Technology innovation is defined as the creation and application of new or improved technologies, tools, systems, and processes that bring about significant advancements or breakthroughs in various fields. It involves harnessing knowledge, expertise, and resources to develop innovative solutions that solve problems, improve efficiency, drive progress, and deliver value. Social media can even be deployed by small and medium-sized enterprises (SMEs) due to its low cost and minimal technical requirements (Ferrer *et al.,* 2013). Social media functions also provide relatively cheap options for analytics, automated publishing, content management, conversion tracking and customer targeting. Businesses can use social media to promote their products, services and brands. Social networking sites are therefore perceived as an electronic marketplace, where business and customers interact (Gazal *et al.,* 2016). The other stream of literature has discussed conscious organizational and managerial practices, with an intention to achieve organizational goals through efficient and effective management of the firm's knowledge resources (Kianto *et al.,* 2014). In this study, these

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practices are referred as KM practices, following the likes of (Andreeva and Kianto, 2012). According to Feimi *et al.* (2016), the innovation practices in Albania's services sector are not affected by government-supported policies, financial resources, and academia-industry collaborations. Lyons (2020) stated that adopted so far are based on assumptions about the production technology of firms controls for firm heterogeneity, including firm fixed effects, or case studies of single or small numbers of firms. Rahi *et al.* (2018) examined that the integration of technology and data within traditional firm processes is considerably shifting the competitive equilibrium of entire markets opening up unthinkable growth prospects up to few years ago.

Fedyk and Hodson (2022) stated that the importance of investing in intangible assets, i.e., in human capital, is increasing for modern firms to focus on effectively managing. Similarly, Taveira *et al.* (2019) argued that the missing link between innovation and performance in Brazilian firms. The results found that technical-scientific workers positively affect the firms' probability to innovate while R&D expenditure has no effect. Similarly, Ting *et al.* (2019) investigated that corporate social performance and firm performance: Comparative study among developed and emerging market firms. The study found that stakeholder initiatives positively impact valuation effects, based on all sample results. Likewise, Hongming *et al.* (2020) examined that the sustainability reporting and firm performance. The result showed that the positive effects of all three individual indicators as well as the composite form of sustainability reporting index on firm performance. Alnachef and Alhajjar (2017) stated that human capital is not only an instrument for current performance but also for developing firms' competitive advantages and sustainability.

Arayici *et al.* (2011) examined the technology adoption in the BIM implementation for lean architectural practice. The result showed that BIM technology adoption should be undertaken with a bottom-up approach rather than top-down approach for successful change management and dealing with the resistance to change. Similarly, Naicker *et al.* (2018) analyzed the managers' perception of mobile technology adoption in the life insurance industry. The results revealed that perceived ease of use, perceived usefulness, perceived complexity and perceived cost are important factors for adoption. Moreover, Arifin *et al.* (2016) found that only the absorptive capability has a positively significant effect on technology adoption. Similarly, Likewise, Low *et al.* (2011) analyzed the understanding the determinants of cloud computing adoption. The findings revealed that relative advantage, top management support, firm size, competitive pressure, and trading partner pressure characteristics have significant effect on the adoption of cloud computing. Further, Similarly, Verma *et al.* (2017) analyzed the perceived strategic value-based adoption of big data analytics in emerging economy. Likewise, Rajapathirana *et al.* (2018) analyzed the relationship between innovation capability, innovation type, and firm performance. The study found of this lead effective management of innovation capability which helps to deliver more effective innovations outcomes to generate better performance and it would be benefits for management of the insurance companies. Likewise, Gutierrez *et al.* (2018) examined abatement expenditures, technology choice, and environmental performance. The results suggested that the general technology upgrading effect of any policy could be an important determinant of environmental performance in developing countries and that this effect may not be captured in abatement data. Furthermore, Dogra *et al.* (2011) found inventory turns to be low in Indian process industries and, therefore, working capital is tied up for longer periods in this sector.

Karuna *et al.* (2007) analyzed the industry product market competition and managerial incentives. The results reveled that competition affects the level of managerial incentives. Likewise, Amoako-Gyampah *et al.* (2008) analyzed the manufacturing strategy, competitive strategy and firm performance. The result found that quality is the only manufacturing strategy component that influences performance. Ghobakhloo *et al.* (2011) examined the adoption of e-commerce applications in small and medium enterprises (SMEs). The result showed that the encumbrance certificate (EC) adoption within small and medium enterprises (SMEs) is affected by perceived relative advantage, perceived compatibility, CEO's innovativeness, information intensity, buyer/supplier pressure, support from technology vendors, and competition. Similarly, Krasnikov *et al.* (2008) investigated the relative impact of marketing, research-and-development, and operations capabilities on firm performance. The results revealed that in general, marketing capability has a stronger impact on firm performance than research-and-development and operations capabilities.

Saeidi *et al.* (2015) examined how does corporate social responsibility contribute to firm financial performance. The results suggested the role for CSR in indirectly promoting firm performance through enhancing reputation and competitive advantage while improving the level of customer satisfaction. Moreover, Wang *et al.* (2008) examined entrepreneurial orientation, learning orientation, and firm performance. The results revealed that lateral oblique (LO) must be in place to maximize the effect of executive officer (EO) on performance, and that lateral oblique (LO) is an important dimension, along with executive officer (EO), to distinguish prospectors from analyzers. Pugliese *et al.* (2014) examined the Integrating agency and resource dependence theory. The results showed that past firm performance is negatively associated with board monitoring and advice tasks; greater industry regulation enhances perceived board tasks performance; board monitoring and advice tasks tend to reinforce each other, despite their theoretical and practical distinction. Sheng *et al.* (2011) analyzed the effects of business and political ties on firm performance. The results showed that the firms operating in China should be cautious in their use of business and political ties and adapt their tie utilization to changing institutional and market environments.

In the context of Nepal, Gautam *et al.* (2017) examined the psychological empowerment of employees for competitive advantages. The revealed that the quite different than of Western practices, psychological empowerment has positive and significant impact on the competitive advantages. Moreover, Tendulkar *et al.* (2019) investigated assessment of national policy to promote corporate governance in Nepal. The results found to closer linkage between legal and regulatory provisions and effectiveness of corporate governance in the Nepalese banking sector. The result showed that empirical evidences vary greatly across the studies on the effect of total quality management practices on employees' work-related attitudes in Nepalese commercial banks on employee's performance and motivation. Further, De Waal *et al.* (2011) analyzed longitudinal research into factors of high performance: the follow-up case of Nabil Bank. The results revealed that the transition to an HPO takes on average three to five years, an improvement per year of 0.3 to 0.5 points is viable. Likewise, Nepali *et al.* (2022) revealed that the greater number of board meetings and audit committee meetings leads to better performance and lower risk.

The above discussion shows that empirical evidences vary greatly across the studies on the impact of technology innovation and R&D on firms' performance in service sector on

firms' performance. Though there are above mentioned empirical evidences in the context of other countries and in Nepal, no such findings using more recent data exist in the context of Nepal. Therefore, in order to support one view or the other, this study has been conducted.

The major objective of the study is to examine the impact of technology innovation and R&D on firms' performance in Nepal's service sector. Specifically, it examines the relationship of are technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology on firms' performance on Nepal's service sector.

The remainder of this study is organized as follows: section two describes the sample, data, and methodology. Section three presents the empirical results and final section draws the conclusion.

2. Methodological aspects

The study is based on the primary data. The data were gathered from 132 respondents through questionnaire. The study employed convenience sampling method. The respondents' views were collected on are technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology. This study is based on descriptive as well as causal comparative research designs.

The model

The model used in this study assumes that firms' performance depends upon are technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology are technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology. The dependent variable selected for the study is firms' performance. Similarly, the selected independent variables are technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology. Therefore, the model takes the following form:

Firms' performance = f (are technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology). More specifically,

$$FP = \beta_0 + \beta_1 TAR + \beta_2 II + \beta_3 MC + \beta_4 RE + \beta_5 ETT + e$$

Where,

FP= Firms' performance

TAR = Technology adoption rate

II = Innovation investment

MC = Market competition

RE = Regulatory environment

ETT = Employee training in technology

Technology adoption rate was measured using a 5-point Likert scale where the respondents were asked to indicate the responses using 1 for strongly disagree and 5 for strongly agree. There are 5 items and sample items include "To what extent do they agree that their firm actively embraces and integrates new technologies in its operations?", "To what extent do they agree that their technology adoption has enhanced your firm's efficiency and productivity?" and so on. The reliability of the items was measured by computing the Cronbach's alpha ($\alpha = 0.721$).

Innovation investment was measured using a 5-point Likert scale where the respondents were asked to indicate the responses using 1 for strongly disagree and 5 for strongly agree. There are 5 items and sample items include "Do they agree that their innovation investment positively correlates with their firm's financial performance?", "How well does they firm promote a culture of innovation among its employees?" and so on. The reliability of the items was measured by computing the Cronbach's alpha ($\alpha = 0.732$).

Market competition was measured using a 5-point Likert scale where the respondents were asked to indicate the responses using 1 for strongly disagree and 5 for strongly agree. There are 5 items and sample items include "How much do they agree that their market competition drives their firm to enhance its products/services and operational efficiency?", "How much do they agree that their firm collaborates with other industry players to foster innovation and competitiveness?" and so on. The reliability of the items was measured by computing the Cronbach's alpha ($\alpha = 0.734$).

Regulatory environment was measured using a 5-point Likert scale where the respondents were asked to indicate the responses using 1 for strongly disagree and 5 for strongly agree. There are 5 items and sample items include "How much do they agree that their regulatory requirements significantly impact their firm's ability to adopt new technologies?", "How well do they firm stay compliant with regulatory changes and updates in the industry?" and so on. The reliability of the items was measured by computing the Cronbach's alpha ($\alpha = 0.727$).

Employee training in technology was measured using a 5-point Likert scale where the respondents were asked to indicate the responses using 1 for strongly disagree and 5 for strongly agree. There are 5 items and sample items include "How much do they agree that their firm provides regular training programs for employees to adopt and utilize new technologies?", "How much do they agree that their employees are open to embracing and utilizing new technologies in their daily tasks?" and so on. The reliability of the items was measured by computing the Cronbach's alpha ($\alpha = 0.768$).

Firms' performance was measured using a 5-point Likert scale where the respondents were asked to indicate the responses using 1 for strongly disagree and 5 for strongly agree. There are 7 items and sample items include "To what extent do they believe that technology innovation positively influences their firm's overall performance?", "How would they rate the impact of research and development (R&D) activities on their firm's overall performance?" and so on. The reliability of the items was measured by computing the Cronbach's alpha ($\alpha = 0.750$).

The following section describes the independent variables used in this study along

with the hypothesis formulation.

Technology adoption rate

Technology adoption rate refers to the speed or pace at which a particular technology is accepted and integrated into widespread use within a specific population or market. Hasani *et al.* (2023) showed that technological, environmental, organizational, and managerial readiness have a positive effect on the intention to adopt privacy enhancing technologies. Moreover, Navimipour *et al.* (2016) indicated that the customer costs positively effects on the customer relationship performance, which consequently leads to improvements of the effectiveness of the electronic customer relationship management in organization. Likewise, Almehairbi *et al.* (2022) found that performance expectancy, effort expectancy, social influence, and facilitating condition all have a positive relationship with technology adoption. Similarly, Lakhwani *et al.* (2020) found that technological change and IT infrastructure positively and significantly impact the organization's productivity while IT knowledge management has a significant but negative impact on organizational productivity of IT companies in Malaysia. Based on it, this study develops the following hypothesis:

H_1: There is a positive relationship between technology adoption rate and firms' performance.

Innovation investment

Innovation investment refers to the financial resources that individuals, businesses, governments, or organizations allocate to activities aimed at creating and implementing new ideas, processes, products, or services. Lin *et al.* (2020) showed that technological innovation has a positive impact on firm performance and that ethical leadership plays a critical role in moderating this effect. Likewise, Shin *et al.* (2019) showed that positive relationships between both investment and contractual-based partnership orientation positively contribute to partnership commitment, but the direct association between partnership commitment and firm performance type varies by partnership structure. Similarly, Ramadani *et al.* (2017) found that the following have a positive effect on firm performance: (i) innovative activities; (ii) knowledge spillovers; (iii) foreign ownership; and (iv) the proportion of skilled workers in the workforce. Moreover, Coad *et al.* (2021) found that the between applied research and technological development due to their positive associations with firm growth. Based on it, this study develops the following hypothesis:

H_2: There is a positive relationship innovation investment and firms' performance

Market competition

Market competition refers to the rivalry or contest among businesses or firms operating in the same industry or sector, as they vie for customers, market share, and overall success. Mubeen *et al.* (2020) showed that market competition fully mediated this linkage between CEO duality and firm performance, which in turn specified a significant positive relationship with market competition, which mediated a positive relationship. Likewise, Sattar *et al.* (2020) revealed that the competitive firms demonstrated higher chances to capture the maximum profit and have a positive relationship with FP, while less competitive firms were negatively associated with FP Further, Avenyo *et al.* (2021) revealed that the local informal competition has a robust negative effect on product innovation intensity of formal

firms, while within industry informal competition enhances innovative sales. Similarly, MAS *et al.* (2018) revealed that the relationships between lean manufacturing and the management accounting systems (MAS), as well as between the MAS and performance, are positive and significant, which suggest that the relationship between lean manufacturing and performance is indirect through the management accounting systems (MAS). Based on it, this study develops the following hypothesis:

H_3: There is a positive relationship between market competition and firms' performance.

Regulatory environment

The regulatory environment refers to the system of laws, rules, regulations, and policies established by government authorities to govern and control various aspects of business, industry, and society. Fan *et al.* (2019) found that more stringent environmental regulations faced by firms are positively associated with a greater probability of reducing COD emissions; also, there exists an evident heterogeneous effect across industries with different pollution intensities. Similarly, Mulaessa *et al.* (2021) reveled that environmental regulations positively moderate the link amid proactive environmental strategies and green innovation. Likewise, Tang *et al.* (2018) found that it compounds the positive effect of green process innovation on firm performance – but not product innovation, which no longer explains significant unique variance in firm performance. Moreover, Andries *et al.* (2019) revealed that the general positive effect of environmental innovation on financial performance varies significantly with firm size and the motives underlying a firm's engagement in environmental innovation. Further, Li and Ramanathan (2018) reveled that there is no evidence of a positive relationship with environmental performance (EP) when environmental regulations (ERs) are taken together. Based on it, this study develops the following hypothesis:

H_4: There is a positive relationship between regulatory environment and firms' Performance.

Employee training in technology

Employee training in technology refers to the process of equipping employees with the knowledge, skills, and competencies required to effectively use and leverage technology in the workplace. Torre *et al.* (2021) reveled that to align with the positive influence on perceived performance of healthcare firms, ultimately impacting on the employees' satisfaction. Similarly, Chege *et al.* (2020) found that to indicate that technology innovation influences firm performance positively. Likewise, Alnoor (2020) found that the positive and significant impact of HC-dimension on firm survival. Moreover, Salisu *et al.* (2019) found that the small and medium-sized enterprises (SMEs) performance to significant positive relationship, while it does not mediate the relationship of technological capability and performance. Based on it, this study develops the following hypothesis:

H_5: There is a positive relationship between employee training in technology and firms' performance.

3. Results and discussion

Correlation analysis

On analysis of data, correlation analysis has been undertaken first and for this

purpose, Kendall's Tau correlation coefficients along with mean and standard deviation has been computed and the results are presented in Table 1.

Table 1

Kendall's Tau correlation coefficients matrix

This table presents the Kendall's Tau correlation coefficients between dependent and independent variables. The correlation coefficients are based on 132 observations. The dependent variables is FP (Firms' Performance). The independent variables are TAR (Technology adoption rate), II (Innovation investment), MC (Market competition), RE (Regulatory environment) and ETT (Employee training in technology).

Variables	Mean	S.D.	TAR	II	MC	RE	ETT	FP
FP	4.048	0.957	1					
TAR	3.892	1.025	0. 562**	1				
II	3.920	0.999	0. 614**	0.528**	1			
MC	3.938	1.017	0.510**	0.465**	0.612**	1		
RE	3.990	1.024	0.563**	0.603**	0.523**	0.584**	1	
ETT	3.960	1.029	0.432**	0.464**	0.281**	0.427**	0.625**	1

Note: The asterisk signs (**) and (*) indicate that the results are significant at one percent and five percent levels respectively.

Table 1 shows the Kendall's Tau correlation coefficients of dependent and independent variables for the impact of technology innovation and R&D on firms' performance in Nepal's service sector. The correlation matrix shows that technology adoption rate is positively correlated to the firms' performance. It indicates that higher the technology adoption rate, higher would be the level of firms' performance. Likewise, innovation investment is positively correlated to firms' performance. It indicates that increase in innovation investment leads to the higher level of firms' performance. Similarly, market competition is positively correlated to firms' performance. It indicates that more the market competition, higher would be the level of firms' performance. In addition, regulatory environment is positively correlated to firms' performance. It indicates that higher regulatory environment leads to increase in the level of firms' performance in the Nepal's service sector. Further, employee training in technology is positively correlated to the firms' performance. It indicates that greater the employee training in technology, the higher would be the level of firms' performance.

Regression analysis

Having indicated the Kendall's Tau correlation coefficients, the regression analysis has been carried out and the results are presented in Table 2. More specifically, it shows the regression results of technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology on firms' performance.

Table 2

Estimated regression result of technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology on firms' performance

The results are based on the responses gathered from 132 respondents by using linear regression model. The model is FP = β0 + β1 TAR + β2 II + β3 MC + β4 RE + β5 ETT + e it where, FP (Firms' Performance). is dependent variable and the independent variables are TAR (Technology adoption rate), II (Innovation investment), MC (Market

competition), RE (Regulatory environment) and ETT (Employee training in technology).

Model	Intercept	Regression coefficients of					Adj. R_ bar2	SEE	F-value
		TAR	II	MC	RE	ETT			
1	2.577 (9.408)**	0.378 (5.459)**					0.180	0.560	29.797
2	2.431 (8.833)**		0.413 (5.970)**				0.209	0.550	35.644
3	2.395 (8.920)**			0.420 (6.259)**			0.226	0.544	39.178
4	2.565 (9.177)**				0.372 (5.391)**		0.176	0.561	29.058
5	1.784 (7.090)**					0.572 (9.133)**	0.386	0.484	83.415
6	2.069 (6.904) **	0.219 (2.728)*	0.288 (3.526)**				0.246	0.537	22.426
7	1.816 (5.944) **	0.108 (1.230)	0.223 (2.689) *	0.239 (2.802)*			0.284	0.523	18.361
8	1.689 (5.328) **	0.089 (1.002)	0.205 (2.457) *	0.186 (2.008)*	0.121 (1.440)		0.290	0.521	14.405
9	1.398 (4.719) **	0.005 (0.066)	0.064 (0.780)	0.168 (1.976)*	0.007 (0.091)	0.442 (5.016)**	0.404	0.477	18.747

Notes:

i. Figures in parenthesis are t-values.
ii. The asterisk signs (**) and (*) indicate that the results are significant at one percent and five percent level respectively.
iii. Firms' performance is dependent variable.

Table 2 shows that the beta coefficients for technology adoption rare are positive with firms' performance. It indicates that technology adoption rate has a positive impact on firms' performance. This finding is consistent with the findings of Hasani *et al.* (2023). Similarly, the beta coefficients for innovation investment are positive with firms' performance. It indicates that innovation investment has positive impact on firms' performance. This finding is consistent with the findings of Shin *et al.* (2019). Likewise, the beta coefficients for market competition are positive with firms' performance. It indicates that market competition has positive impact on firms' performance. This finding is consistent with the findings of Mubeen *et al.* (2020). Similarly, the beta coefficient for regulatory environment is positive with firms' performance. It indicates that regulatory environment has positive impact on firms' performance. This finding is consistent with the findings of Andries *et al.* (2019). Additionally, the beta coefficients for employee training in technology are positive with firms' performance. This indicates that employee training in technology has positive impact on firms' performance. This finding is consistent with the findings of Torre *et al.* (2021).

4. Summary and conclusion

Technology innovation refers to the process of creating and implementing new or significantly improved products, services, or processes through the application of knowledge, creativity, and advanced tools. It plays a crucial role in driving economic growth, improving efficiency, and enhancing various aspects of human life. The integration of technology and a focus on R&D have led to improved service delivery, streamlined operations, and increased customer satisfaction in Nepal's service sector.

This study attempts to examine the impact of technology innovation and R&D on firms' performance in Nepal's service sector. The study is based on primary data of 132

respondents.

The major conclusion of the study is technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology have positive impact on firms' performance. It indicates that technology adoption rate, innovation investment, market competition, regulatory environment and employee training in technology have positive impact on firms' performance. Similarly, the study also concludes that the most significant factor that impact the firms' performance in Nepal's service sector is employee training in technology followed by regulatory environment.

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