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Digital Transformation as a Catalyst for Enhancing Business Agility in the Service Sector: The Mediating Roles of Business Performance and Competitive Advantage

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ABSTRACT

Grounded in Dynamic Capabilities and Resource-Based View (RBV) theory, this study explores how digital transformation influences business agility in the service sector through the mediating effects of business performance and competitive advantage. To test the hypothesized model, cross-sectional data were purposively collected from 394 respondents across five diverse service sectors (i.e., education, Healthcare, Bank and Financial Institutions, Hospitality, and IT) operating in the Kathmandu Valley. The data were analyzed using SmartPLS 4.0. The findings indicate that digital transformation, business performance, and competitive advantage are significant predictors of business agility. Further, business performance and competitive advantage mediated the interplay between digital

transformation and business agility. This study advances the digital transformation literature by integrating strategic management principles to explain drivers of business agility, emphasizing technology, talent, customer focus, and policy support to strengthen competitiveness in the service sector.

Keywords: Business agility, business performance, competitive advantage, digital transformation, service sector

INTRODUCTION

The rapid acceleration of digital technologies has redefined the foundations of competition, forcing organizations to rethink how they create value, deliver services, and sustain performance (Warner & Wager, 2019). This transformation is also profoundly influencing STEM-oriented organizations such as IT companies and knowledge-based educational institutions, where digital initiatives and capabilities are increasingly essential for innovation, operational efficiency, adaptive learning systems, and sustainable organizational development (Appelbaum et al., 2019). Similarly, the non-STEM organizations are continuously facing diverse challenges in leveraging digital transformation, as their agility explicitly depends on human interaction, customer support, and process flexibility. In today's VUCA environment, characterized by volatility, uncertainty, complexity, and ambiguity, digital transformation has become a strategic imperative rather than a mere technological upgrade. It equips businesses with agility, enabling them to rapidly respond to disruptive market forces and continuously enhance operational efficiency and performance (Warner & Wager, 2019; Appelbaum et al., 2019).

Industry 4.0 market, by the integration of digital technologies, data-driven decision making, automation, and extending to the wider concept of Society 4.0, is significantly advancing organizational capabilities and transforming business operations (Parashar et al., 2023). The global digital transformation market was valued at $588 billion in 2022, and projections indicate it will reach $3.4 trillion by 2026. The COVID-19 pandemic has significantly expedited digital transformation initiatives, with 97% of businesses acknowledging this impact. The business landscape is swiftly evolving due to digitalization (Pereira & Romero, 2017), where disruptive technologies and changing consumer behaviors are rapidly reshaping industries, which have challenged businesses to evaluate their readiness in the digital realm to stay competitive (Yaqub & Alsabban, 2023; Evanschitzky

et al., 2020). Therefore, Digital transformation is crucial for companies across all sectors and sizes, enabling them to adopt new management styles, tools, workflows, and organizational structures, eventually enhancing performance, efficiency, and competitiveness.

Successful companies such as Amazon, GE, Starbucks, Tesla, Ford, McDonald's, Volkswagen, and Alibaba have adopted customer-centric strategies and leveraged cutting-edge technologies such as e-commerce, IoT, and AI (Institute of Digital Transformation, 2023). In contrast, the failure of Toys "R" Us, Kodak, Blockbuster, and Nokia highlights the risk of not adjusting to the digital age (Osman, 2023). These case studies demonstrate the need for creativity, adaptability, and proactive digital transformation.

The service sector, which comprises a significant portion of global GDP, is under constant pressure to adapt to shifting consumer needs, rapid technological advancements, and fierce competition (Jiang & Jia, 2020). However, due to its reliance on outdated models and sluggish response to digital shifts, the service industry often struggles to keep pace with technological advancements, leading to declining customer satisfaction, operational inefficiencies, and potential loss of market share (World Bank, 2022). In 2021, just 28% of service firms had fully incorporated digital initiatives into their business, compared to 54% of manufacturing organizations (Deloitte, 2021).

Nepal Rastra Bank (2022) noted that the service sector accounted for roughly 57% of the country's GDP, underscoring its vital role in the economy. Similarly, Nepal's 14th and 15th plans aim to increase internet penetration, while the Digital Nepal Framework focuses on infrastructure, connectivity, and governance. However, compared to many of its neighboring countries, only about 30% of Nepal's service firms used digital technologies (World Bank, 2023). Thus, many service firms in Nepal struggle to integrate these strategies, resulting in missed opportunities to improve performance and gain competitive advantage.

Digital transformation and business agility have been topics of interest among scholars and practitioners, but most of the studies have been focused on technology-driven industries and the Western context, leaving very limited comprehension of these phenomena in the developing-economy service sector. In particular, it remains unclear how digital transformation translates into business agility through mediating mechanisms such as business performance and competitive advantage, a gap this study aims to address. By focusing on the service sector, this study extends prior research that has predominantly emphasized technology-driven industries and developed economy contexts

Most existing studies (Thrassou et al., 2020; AlNuaimi et al., 2023) examine digital transformation, competitive advantage, agility, and business performance in isolation. Likewise, studies on digital transformation have predominantly focused on its impact on customer efficiency (Mourtzis & Panopoulos, 2022), organizational efficiency (Chen et al., 2024), and innovation in retail, manufacturing sector, and tech-driven industries (Kraus et al., 2021; Jones et al., 2021), neglecting the service sectors, which rely on human interaction,

customer support, and real-time flexibility. Additionally, past studies (Xu et al., 2024; Yu et al., 2022) have suggested that digital transformation, on its own, may not directly lead to agility; rather, the influence is mediated by factors like competitive advantage and business performance. Many scholars (Troise et al., 2022; Sousa-Zomer et al., 2020) have highlighted the importance of these variables, stating performance as a precondition and competitive advantage as a driver of digital transformation and agility. However, as less than 30% of firms have been able to obtain quantifiable benefits from their digital transformation (Wen et al., 2022), this indicates a dearth of knowledge regarding how to unleash digital agility efficiently.

The pursuit towards digital transformation is not just an option; it is a crucial strategic necessity for success. However, this journey is far from straightforward. In order to fulfill this neglect gap, this study develops and empirically tests a framework linking digital transformation to business agility through the sequential mediating roles of business performance and competitive advantage, grounded in dynamic capabilities and RBV theory.

The STEM-oriented institutions, like educational and knowledge-based, face unique challenges in integrating digital technologies to support agile operation in innovation, knowledge creation, and technology-driven processes. The study primarily contributes to theory by clarifying the mechanism through which digital transformation drives agility and offering practical insights for managers to leverage digital initiatives for improved organizational responsiveness and competitiveness.

LITERATURE REVIEW

Historical Roots, Seminal Works, and Contemporary Implications

Over the course of several decades, the phrase "digital economy" evolved, with key milestones in the 1960s, 1990s, and 2010s, which signaled the shift from digitization to digitalization and, eventually, digital transformation (Gaur, 2022). The scholarly works of Michael Hamer and James Champy's on "Reengineering the corporation" in 1993; similarly, Nicholas Carr's seminal work on "IT doesn't matter" in 2003, and another pivotal contribution made by George Waterman, "Leading digital Collectively" in 2014, collectively form a solid comprehension of digital transformation (Djabarouti, 2019).

It was first defined by Patel and McCarthy (2000), who stated that digitalization is a phenomenon associated with new consumer uses and distinctive objects that directly influence established business models and organizations (Chen et al., 2024). Comparably, Stolterman and Fors (2004) provided an extensive description of digital transformation, characterizing it as any alteration or effect that digital technology brings about in any facet of human existence (Laudien et al., 2024). Likewise, other researchers (Kraus et al., 2021; Schneider & Kokshagina, 2021) described digital transformation as the utilization of

technology to generate new business opportunities and radically enhance performance or reach enterprises. Thus, many interpretations of digital transformation can be categorized into three main categories: a) Technologies: these involve utilizing cutting-edge tools like social media, mobile, analytics, or embedded devices; b) Organizational: these involve modifying organizational procedures or developing new business models; and c) Social: these involve societal phenomena that impact every facet of human existence (Ghobakhloo & Iranmanesh, 2021). Likewise, the effects of digital transformation can be observed at multiple tiers in every field or size of organization, including changes to business models, business processes, and customer experiences (Abdallah et al., 2021). Owing to its continuous emergence as a trend that is renewed by new waves of digital technology, digital transformation continuously stands on the agendas of many firms as well as in the domain of research and management.

Business and Digital Agility

In the past, extensive studies have been conducted across the globe on the antecedents of business and digital agility. Their scholarly work has been explicitly focused on change in technology, changes in competitive intensity, market disruptions, changes in customer preferences, and changes in market/industry structure as the prominent drivers for agility (Sergei et al., 2023; Coskun-Setirek & Tanrikulu, 2021; Verhoef et al., 2021). Organizations face a number of difficulties while implementing and embracing digital agility. Scholars have identified issues such as resource allocation, strategic inertia, organizational culture, infrastructure, security and privacy concerns, and competence-capability dissonance as primary factors driving adoption challenges (Ko et al., 2022; Cavalcanti et al., 2022).

To sustain digital transformation efforts, organizations must adopt an integrated approach to digital agility that harmonizes digital strategy with overall strategy and culture. This requires ongoing learning and improvement activities. Several scholars have empirically highlighted platformisation, IT infrastructure, Agile IT management, digital ambidexterity, organizational mindfulness, and active environmental scanning for the development and management of digital transformation (Duviver & Gupta, 2023; Esther & Domingo, 2023). Thus, the adoption of digital agility is essential for an organization to not only survive but thrive in the rapidly evolving digital landscape, ensuring sustained success through adaptability, innovation, and enhanced strategic capabilities.

Furthermore, scholars have discussed and explored improved operational performance, organizational learning, operational flexibility, innovation velocity, organizational resilience, environmental responsiveness and effectiveness, as strategic capabilities and outcomes of business agility (Turi et al., 2023; Miceli et al., 2021).

Digital Transformation in Diverse Economies

Studies in the US by Ciancarini et al. (2024) and Germany by Kolasani (2023) highlighted how cloud-based technologies enable rapid scaling, agile development methodologies, and data-driven decision-making, empowering agility. Similarly, studies in India (Mohapatra et al., 2022) and China (Hsu et al., 2022) emphasize mobile technologies and digital platforms as drivers of agility, streamlining communication, collaboration, and service delivery in resource-constrained contexts. The studies conducted in Japan and Australia by Pemer and Werr (2023) and Melewar et al. (2021) demonstrate how digital innovation drives new service offerings, targeted marketing campaigns, and enhanced customer loyalty, thereby solidifying competitive advantage. Likewise, the studies conducted by two prominent scholars in Brazil demonstrated how digitization empowers local service providers to compete globally by accessing new markets and talent pools (Lugoboni, 2024).

In developed countries such as the UK and Canada, studies by KPMG (2018) and Accenture (2017) reveal increased revenue, cost reductions, and enhanced operational efficiency for service organizations that have undergone digital transformation. Moreover, in developing countries like Indonesia and Kenya, research by Elmassali and Mohieldin (2020) and Nagano et al. (2020) highlights the transformative impact of digital solutions on access to essential services, including financial services, healthcare, and education, playing a pivotal role in fostering both economic growth and social development.

The STEM-focused institutions, such as research laboratories, knowledge-based educational institutions, engineering firms, IT companies, and so on, are closely associated with operational efficiency, sustainability, innovation, competitive advantage, and the ability to quickly adjust to technological change (Thrassou et al., 2020; Kraus et al., 2021). These organizations leverage digital initiatives not only to streamline processes but also to foster knowledge creation, digital literacy, and other key capabilities, making agility a critical outcome.

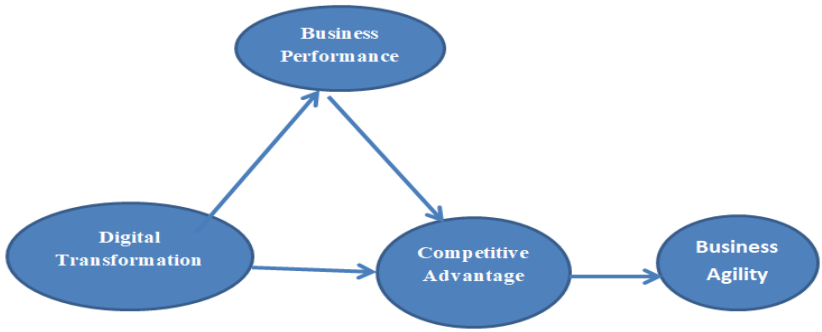
Leading corporations like Google, Facebook, and Twitter proactively embrace digital business models, adjusting their operations to the changing environment. Producers such as Michelin and Faurecia maximize their business value by emphasizing digital transformation, digital culture, and employee engagement (Bharadwaj et al., 2013; Bonnet & Duke, 2021; Kupp & Reppard, 2021). According to Kimberling (2021), a mere 30% of digital transformations are deemed successful, indicating that most businesses are unable to adjust to the current disruptions. Procter and Gamble failed to analyze market and industry trends before launching their digital transformation processes (Morgan, 2019; Kimberling, 2021), while Ford and Nike struggled with integrating new digital segments (Morgan, 2019), and Nike hired an external consultant to address the challenges. Similarly, digital transformation in Nepalese businesses remains in its nascent stages, and challenges like limited infrastructure, low digital literacy, and fragmented regulatory landscapes impede widespread adoption. Despite these

hurdles, recent initiatives like the "Digital Nepal Framework" and growing internet penetration have spurred digital adoption in various sectors (Bhattarai et al., 2023).

Research Model

Anchored on Dynamic capabilities and RBV theories, the researcher has developed the following framework for the study purpose.

Figure 1
Research Model



Digital Transformation and Competitive Advantage: Digital transformation, which alters the logic of service and fosters transformation across a variety of organizational aspects, such as operations, structure, and strategy-making, can considerably contribute to a competitive edge. Organizations can use tools like automation, digital marketing, and data analytics to strengthen the relationship between digital transformation and competitive advantage. This transformation is particularly salient not only in traditional service industries but also in STEM-related organizations, such as IT firms and knowledge-based educational institutions, where digital capabilities are integral to innovation, knowledge creation, and technology-driven value delivery.

Several empirical studies conducted (Masoud & Basahel, 2023; Heredia et al., 2022) have shown that businesses that incorporate technologies like artificial intelligence (AI), cloud computing, and data analytics into their operations are able to gain a competitive advantage. In addition, Warner and Wager (2019) demonstrated how digital transformation improved data-driven decision-making and improved customer experiences, which had a beneficial influence on competitive advantage in the retail sector. Hence, the results of these studies highlight how, in an increasingly digital landscape, digital transformation acts as a catalyst for gaining a competitive edge. As a dynamic capacity, digital transformation enables companies to take advantage of the opportunities presented by the digital age by using technology to boost their competitive edge through

increased productivity, reach, customer experiences, and innovation (Warner & Wager, 2019). Relying on dynamic capabilities, particularly digital sensing, reconfiguring, and acquisition, digital transformation encompasses changes in value creation processes for service firms and operational processes for manufacturing firms to gain a competitive edge (Herold et al., 2023).

Based on the above findings and assumptions, the following hypothesis is postulated:

H1: Digital Transformation positively and significantly influences Competitive advantage

Digital Transformation and Business Performance: Numerous empirical studies (Fremont, 2021; Liu et al., 2022; Chakrouni & Cherkaoui, 2023) highlighted the significant impact of digital transformation on business performance and demonstrated its association with efficiency, productivity, customer engagement, operational effectiveness, and profitability, ultimately leading to enhanced performance. In the manufacturing sector, digitalization has facilitated production processes, minimized operational costs, and enhanced overall productivity (Chakrouni & Cherkaoui, 2023).

This relationship is evident not only in traditional industries but also in STEM-related organizations, such as IT firms, healthcare institutions, and knowledge-based educational organizations, where digital technologies play a critical role in enhancing data-driven decision-making, innovation processes, and service delivery outcomes (Rane et al., 2022). In a similar vein, heterogeneous findings across different geographies (both developed and developing countries) are relatively scarce, as the consensus among researchers and industry experts is that digital transformation leads to improved business performance. Hence, organizations can use digital technologies and techniques, including data analytics, process automation, cloud computing, and customer relationship management systems, to improve their performance. This proposition is supported by dynamic capabilities theory, which states that an organization's ability to sense, seize, and transform resources to achieve strategic goals is in line with digital transformation principles.

Based on the above insights, the following hypothesis is postulated:

H2: Digital Transformation positively and significantly influences business performance

Business Performance and Competitive Advantage: Businesses demonstrating superior performance as well as efficiency and effectiveness in achieving their operational and strategic objectives are more likely to gain and maintain a competitive advantage (Azeem et al., 2021). Comparably, businesses are better positioned to gain a long-term competitive advantage if they can consistently beat their rivals in areas like productivity, operational effectiveness, and satisfaction, among other areas (Cagliyan et al., 2023). In the realm of strategic management, numerous empirical studies have revealed that organizations exhibiting superior

operational efficiency, profitability, and innovation are more likely to maintain a competitive edge over a longer period of time. In the manufacturing sector, Ho et al.'s (2016) study demonstrated strong business performance and operational efficiency for gaining a competitive edge by consistently meeting market demand and guaranteeing product quality, while Rahmadani and Elinur's (2024) study emphasizes the significance of operational efficiency in establishing competitive advantages in the agriculture sector. Likewise, in the hospitality industry, studies conducted by Glaveli et al. (2023) and Kannan (2024) showed that high-performance metrics like customer satisfaction, customer reviews, effective booking procedures, service quality, and operational efficiency helped hotels and travel agencies become more competitive by drawing clients and increasing market share and profitability. Likewise, in STEM-related organizations, such as IT firms, healthcare institutions, and knowledge-based educational organizations, performance excellence is closely linked to innovation capability, technological adoption, and data-driven decision-making.

Indeed, organizations can use a variety of tools and techniques, including strategic planning, performance indicators, innovation projects, and cost management tactics, to improve the relationship between business performance and competitive advantage, aligning with dynamic capabilities theory due to its focus on innovation, adaptability, and resource reconfiguration in a dynamic environment.

Based on the above insights, the following hypothesis is postulated:

H3: There is a significant positive relationship between business performance and competitive advantage

Competitive Advantage and Business Agility*:* Organizations with a competitive advantage are often well-positioned to adapt and respond to market changes more swiftly, as they have the resources and capabilities to do so. Previous empirical research (Chen, 2019; Qosasi et al., 2019) has consistently demonstrated that companies with a competitive advantage tend to exhibit higher levels of business agility. This highlights the critical role that dynamic capabilities play in generating competitive advantage, as research by Teece et al. (1997) has shown. Chen (2019) in manufacturing, Lin et al. (2020) in agriculture, Lyn Chan & Muthuveloo (2021) in education, Anning-Dorson and Nyamekye (2020) in tourism, and in hospitality all show that firms with competitive advantages exhibit agility in responding to changing customer demands, market trends, and fluctuations. All of these results point to a significant association between business agility and competitive advantage, indicating that companies that successfully differentiate themselves are more likely to have the adaptability and responsiveness needed to adjust to dynamic business environments. Thus, this association is supported by dynamic capabilities theory, which postulates that companies can use their internal capabilities as a competitive advantage to create and sustain agility.

Drawing on the above arguments, the following hypothesis is formulated:

H4: There is a significant positive relationship between competitive advantage and business agility

Mediating Role of Business Performance: Business performance explains the mechanism through which digital transformation can impact competitive advantage (Kraus et al., 2021). Improved business performance puts a firm in a better position to gain a competitive edge. Strong business performance also enables companies to reinvest resources in areas like innovation, customer service, and operational flexibility, which differentiate them from competitors (Ferreira et al., 2020). Enhancing efficiency, innovation, and customer focus through the use of digital technologies gives businesses a competitive edge and boosts corporate performance (Wen et al, 2022). In addition, studies (Kraus et al., 2021; Ivancic et al., 2019) have consistently demonstrated that digital transformation initiatives yield improved business performance, ultimately resulting in a gained competitive advantage. Likewise, gaining a competitive edge requires leveraging digital transformation to improve business performance, which is consistent with the RBV theory's focus on resource utilization.

Based on the preceding discussion, the following hypothesis is proposed:
H5: Business Performance mediates the relationship between Digital Transformation and Competitive Advantage.

Mediating Role of Competitive Advantage: Studies by Ramadan et al. (2019) and Medeiros and Macada (2019) have shown that competitive advantage can act as a bridge between digital transformation and business agility. Digital transformation entails the adoption of advanced technologies and innovation, which enhance the performance of businesses in different domains (Warner & Wager, 2019). In contrast, in order for digital transformation to result in higher business ability, firms must create and sustain a competitive advantage. Thus, a company becomes more agile after it gains a competitive advantage through digital transformation. Organizations that gain a competitive edge through digital transformation are better positioned to improve their business agility by being able to quickly adjust to changing market conditions and customer demands (Vaz, 2021).

In light of the foregoing insights, the following hypothesis is postulated:
H6: Competitive Advantage mediates the relationship between Digital Transformation and Business Agility.

Serial Mediation of Business Performance and Competitive Advantage: The initial positive impacts of digital transformation on a firm's outcomes are reflected in business performance, and this enhanced performance gives rise to the development of a competitive advantage. Thus, an organization can become more agile through the combination of improved performance and competitive positioning, which successfully connects digital transformation to business agility.

Drawing on the above insights, the following hypothesis is formulated:
H7: Digital transformation positively influences business agility through the serial mediation of business performance and competitive advantage.

RESEARCH METHOD

Sample and Procedures

This study utilized a survey design, following a post-positivist approach. The hypothesis was formulated by integrating dynamic capabilities theory and resource-based theory and was approached deductively using an explanatory research design to establish causality among the study variables. Similarly, a survey-based, cross-sectional approach was used for collecting data. Similarly, the study purposively selected service-sector companies (i.e., IT companies, hospitality, education, health, and BFIs) operating in the Kathmandu Valley. The service firms like BFI and hospitality fall under general service firms, whereas IT and educational institutions fall under STEM-oriented domains. These companies were top–tier performers in their respective sectors over the past three years and demonstrated digital transformation in their business activities. In a similar vein, respondents were also purposively drawn from various strata within the service sectors of Kathmandu Valley. Firstly, senior executives at the C-suite level provided strategic insights into the primary goals of digital transformation initiatives. Similarly, operational managers contributed important insights into the day-to-day effects of digital changes, while IT managers and professionals, who are actively involved in implementing and managing digital initiatives, provided technical perspectives.

In Nepal, there are more than 238,920 registered companies, and among the provinces, Bagmati Province has the highest number, with 171,400 (Kathmandu Post, 2022). Since the researcher was unable to determine the exact number of service sector companies by cluster, there were no official records of that segregation; hence, the population for the study is unknown. The researchers utilized an online sample size calculator due to its user-friendly interface and widespread usage among researchers in social science research (Memon et al., 2020). The online sample size calculator (calculator.net, 2015) determined 384 sample size as adequate at a 95% level of confidence and 5% level of margin of error. For this study, the researchers collected information from more than 384 respondents, which provided evidence of sample adequacy. Regarding response rates, the literature shows some inconsistency: while Rea and Parker (2014) and Roth and BeVier (1998) consider 50% as the minimum acceptable level, Fowler (2013) and Baruch and Holtom (2008) recommend a threshold of 60%. However, most empirical papers have used a 60% expected response rate. Assuming the average response rate of 60%, the number of questionnaires to be distributed = Desired number of responses/Expected response rate (i.e., 384/0.6) = 640. Therefore, the researcher distributed 640 questionnaires to achieve 384 responses with an expected response rate of 60%.

Based on the convenience and preference, questionnaires were made available to respondents in both printed and online forms. In order to reach out to the respondents, the researcher initially contacted HR managers and concerned authorities. Likewise, using KOBO Toolbox, the structured questionnaires were administered. The responses were collected in the months of February and May 2025. Also, the survey guaranteed the confidentiality and anonymity of all the participants. Similarly, out of 640 questionnaires distributed through different channels, 435 were received, out of which 41 responses in printed form were incomplete, filled randomly, and had to be excluded. The remaining 394 responses were found usable and represented a good response rate of 61.56%.

Table 1

Response and Completion Rate

Particulars	**Frequency**	**Percentage (%)**
Distributed	640	100
Retained	435	67.97
Eliminated (Printed Form only)	41	6.40
Total no. of respondents used in this study	394	61.56

Measures and Instruments

The survey instrument contains 7 items that measure digital transformation adopted from (Yusuf et al., 2023; Masoud & Basahel, 2023); 5 items of Business performance adopted from (Yusuf et al., 2023), 7 items of Competitive advantage adopted from (Yusuf et al, 2023; Farida & Setiawan, 2022**),** and 8 items of Business agility adopted from (Yusuf et al, 2023). Furthermore, a five-point Likert scale was used, with 1 indicating strongly disagree and 5 indicating strongly agree.

The study was then pretested by several study experts (i.e., academics who are specialized in information systems and strategic management, as well as service sector executives and business performance management professionals). In a similar vein, following Nunnally's (1978) criteria, a pilot testing of 30 respondents was carried out, which demonstrated a VIF score below the minimum criteria of 3.33, highlighting internal consistency of the observed items.

Data Analysis Tool

The study conducted both descriptive and inferential analyses to comprehend the characteristics and patterns of the dataset, as well as to determine the population. In this study, the descriptive analysis was carried out using SPSS 22.0, and the model was analyzed using Smart PLS 4.0. As this study aims at predicting and explaining the key association (i.e, direct and indirect), the PLS-SEM technique is highly suitable. On the other hand, due to its comparative advantage (i.e., suitability for exploratory research, target prediction, flexibility in managing non-normal distribution, and small to medium sample sizes), the PLS

technique has gained popularity in marketing research (Hair et al., 2019). Thus, the adoption of PLS-SEM for inferential analysis was deemed appropriate.

RESULTS

Socio-Demographic Profile

Table A1 presents the socio-demographic profile of the respondents, including gender, age group, education level, current position, and types of service sector. Starting with gender distribution, the findings revealed that significant portions of respondents are male (71.1%) as compared to female (28.9%). Moving on to age groups, the findings revealed a fairly balanced distribution (i.e., 30%) within the age brackets of 30 to 50 years, followed by a significant portion (22.6%) of younger age groups (20-30), and a smaller percentage of respondents (15.2%) within the age group of above 50 years. Based on their educational background, most respondents (30.5%) have at least a bachelor's degree, and a significant proportion (47%) hold a master's degree. Similarly, while reviewing the respondents' current positions, the findings showed a wide range of distribution among different job roles in the service sector (i.e., IT professionals (31.7%), Operational Managers (29.9%), Managers (24.4%), and Senior executives (14%). Furthermore, sectoral distribution shows participation from education (26.6%), hospitality (24.9%), financial services (21.8%), and healthcare (16.5%), indicating that the sample adequately reflects diverse service-sector contexts, including STEM-related and non-STEM organizations.

Preliminary Data Screening and Descriptive Analysis

First, the standardized scores for each case were computed in order to screen the data for univariate outliers. Since all of the cases are less than three standard deviations, the analysis failed to identify any univariate outliers (Goodboy & Kline, 2016). Even if none of the individual scores stand out as outliers, the case could still qualify as a multivariate outlier if this pattern is uncommon within the sample. Next, the Mahalanobis distance was computed for screening the data for multivariate outliers. Similarly, the distribution of Mahalanobis distance in large samples is given by Pearson chi-square (x2) statistics, where the number of variables determines the degree of freedom (Tanbachnick & Fidell, 2007). For each case, a conservative level of statistical significance of $P < 0.001$ has been suggested.

Following this, 6 cases were screened as multivariate outliers and were dropped instantly, leaving 394 cases. Therefore, further data analysis was conducted using the final count of 394 samples. In order to examine common method bias, the researcher employed Harman’s single-factor test, following the criteria of Podsakoff et al. (2003), as well as the full collinearity test. Statistically, Harman's single-factor test revealed that no single factor explained most covariance (i.e., 39.260% of variance below the cut-off value of 50%), suggesting that common method bias is not a notable concern within this model. Further

evidence that the model is not impacted by common method bias is provided by the full collinearity test, where the variance inflation factor (VIF) of the individual items is less than 3.3 (Kock, 2015). This indicates that CMB is not a notable concern within this model.

Similarly, the observed items have mean scores ranging from 3.102 to 3.558, suggesting a moderate level of agreement or neutrality throughout the statement. Similarly, the standard deviation values span from 0.88 to 1.07, implying a moderate to high degree of response variability, as well as indicating that respondents' viewpoints differ with respect to each statement. Thus, responses tend to be distributed relatively flat, reflecting a wide range of opinions. Likewise, the range of skewness values lies from -0.622 to -0.197, and kurtosis values fall between -0.595 and 0.007 within the criteria of +/- 2 and +/- 7 as suggested by Curran et al. (1996), indicating that the data is normally distributed and is suitable for further statistical analysis.

Model Specification/PLS - SEM Analysis

Following the procedure recommended in Hair et al. (2019), the proposed research model was evaluated by assessing the measurement and structural model. In the first stage, the measurement model was tested, and the structural model was examined in the second step.

Assessment of the Measurement Model: To specify the four reflective constructs and 27 observed items, the study employed the method suggested by Hair et al. (2019) to assess the measurement model using multiple tests, including standardized factor loading (SFL), internal consistency, content validity, convergent, and discriminant validity, with a focus on the unidirectional predictive relationships between each latent underlying construct and its observed indicators. According to Hair et al. (2014) and Duarte and Raposo (2009), the general rule of thumb is to retain the observed items whose loading falls between 0.40 and 0.70, and only those observed items were retained that satisfied this cut-off criterion. Similarly, the Cronbach Alpha (CA) and composite reliability (CR) values were used to evaluate the internal consistency; these values were greater than the standard of 0.70, indicating the internal consistency of the measures (Cohen, 2013).

Table 2
Validity and Reliability

Constructs	Observed Items	SFL	Cronbach's Alpha	Composite Reliability (CR)	AVE
Digital Transformation	DT_1	0.814	0.928	0.924	0.7
	DT_2	0.862			
	DT_3	0.85			
	DT_4	0.862			
	DT_5	0.84			
	DT_6	0.851			
	DT_7	0.773			
Business Performance	BP_1	0.823	0.928	0.945	0.776
	BP_2	0.897			
	BP_3	0.903			
	BP_4	0.906			
	BP_5	0.873			
Competitive Advantage	CA_2	0.836	0.911	0.931	0.691
	CA_3	0.809			
	CA_4	0.87			
	CA_5	0.835			
	CA_6	0.843			
	CA_7	0.793			
Business Agility	BA_1	0.81	0.91	0.93	0.689
	BA_2	0.811			
	BA_3	0.855			
	BA_4	0.818			
	BA_5	0.842			
	BA_6	0.845			

Note (s). Researcher's Calculation based on Survey Data (2025); One item of Competitive Advantage (CA_1), and two items of Business Agility (BA_7 and BA_8) were dropped due to a low factor loading issue; Calculations based on authors' survey data, 2025

There are two primary measures of construct validity: convergent and discriminant validity. Fornell and Lacker (1981) state that the Average Variance extracted (AVE) values of at least 0.50 indicate sufficient convergent validity, which means that the variable can explain more than half of its indicators on

average. The study's findings indicate that the AVE ranged from 0.689 to 0.776, exceeding its cut-off value of 0.5. As a result, Convergent validity was established (see Table 15).

According to Hair et al. (2019), discriminant validity is used to confirm the distinctness of the constructs utilized in a study. Similarly, to assess the study's discriminant validity, the Fornell-Lacker criterion, HTMT values, and cross-loading are used. According to the Fornell-Larcker criterion, the square root of the AVE should be greater than the correlation values among all target constructs (Fornell & Larcker, 1981). Since the square root of the AVE of each construct exceeds its correlations with other constructs in the study (see Table 3), the condition is met in the study. On the other hand, HTMT is recognized as a contemporary method for evaluating discriminant validity. The results indicated that all values were below the threshold of 0.85 (Henseler et al., 2015). Furthermore, all the items belonging to a particular construct loaded strongly into its own parent construct instead of other constructs (see Table 4). Therefore, the current study does not have any discriminant validity issues.

Table 3

Fornell-Lacker Analysis

	BA	BP	CA	DT
BA	**0.83**			
BP	0.315	**0.881**		
CA	0.5	0.508	**0.831**	
DT	0.407	0.387	0.471	**0.837**

Note. Calculations based on researchers' survey data (2025)

Table 4

HTMT Analysis

	BA	BP	CA	DT
BA				
BP	**0.342**			
CA	0.548	**0.553**		
DT	0.443	0.414	**0.507**	

Note. Calculations based on researchers' survey data (2025)

Structural Model

After assessing the measurement model, the subsequent phase involves validating the structural model, which was carried out using a bootstrapping technique with a resample of 10,000.

Predictive Relevance: The structural model's predictive relevance and accuracy were assessed using the predictive accuracy (R^2), effect size (f^2), and predictive relevance (Q^2). The model's in-sample predictive power is measured by the coefficient of determination (R^2) values. According to Hair et al. (2013), R^2 values of 0.75, 0.50, and 0.25 are deemed as substantial, moderate, and weak, respectively. In our study R^2 value of BA was 0.25, and CA was 0.347, signifying a moderate predictive power level of exogenous variables. Likewise, the R^2 value of BP was 0.15, indicating weak predictive power. Following the assessment of the overall effect size (R^2), the researcher evaluated the specific effect size (f^2) to ascertain the contribution of exogenous constructs to the R^2 values of the endogenous latent variable. As a guideline for evaluating f^2, values of 0.02, 0.15, and 0.35 represent small, medium, and large effects, respectively, while f^2 values below 0.02 indicate that there is no effect (Cohen, 2013). The results showed that CA has an influence on BA falls in the moderate range, although it's not quite close large effect (0.333). Similarly, BP has a moderate effect on CA (0.191). Likewise, DT has a moderate effect on BP (0.176) and a comparatively lower effect on CA (0.135). Thus, the study found moderate to lower effects of the exogenous constructs on the endogenous constructs.

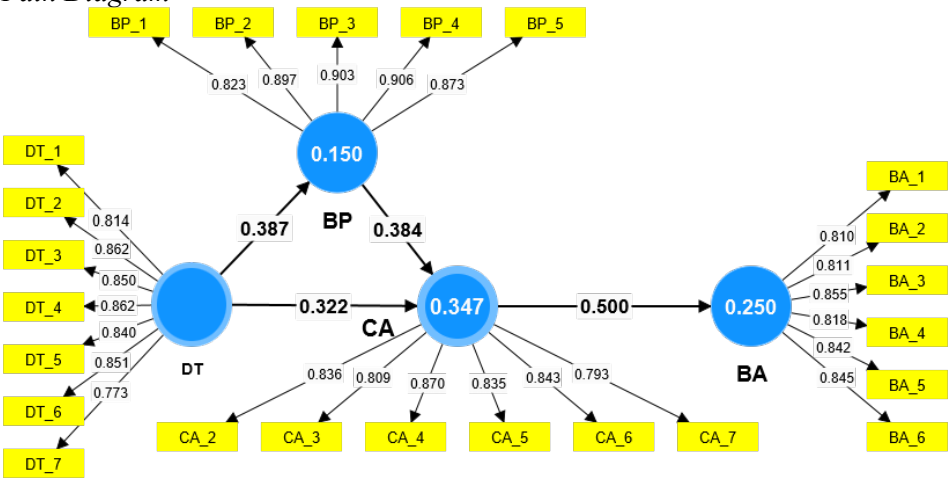
As an indicator of the model's predictive relevance, or ability to make predictions, studies based on the PLS technique must also report the value of Stone-Geisser's Q^2 value in addition to the magnitude of R2 (Henseler et al., 2015). The PLS-predict technique was utilized in the study to examine the target constructs, specifically BA, with 10 repetitions and a 10-fold cross-validation. The Q^2 values of all the exogenous variables, CA (0.213), BP (0.142), and BA (0.133), all of which are considerably above zero, demonstrate that these results support that the model is predictive. The analysis was expanded further by incorporating another predictive relevance analysis, the PLSpredict, which was recommended by Shmueli et al. (2016). According to cited in Nepal et al. (2023), PLSpredict is a sample-based handout method that produces case-level predictions on an item or construct level in order to assess predictive relevance. Initially, the values of the latent variable Q^2 were examined, and all the Q^2 values of the latent variables were greater than zero.

Furthermore, an analysis was conducted on the distribution of the prediction errors. According to Shmueli et al. (2016), residuals derived by PLS-SEM should have a normal distribution; a left-tailed distribution denotes overprediction, while a right-tailed distribution denotes underprediction. Thus, the majority of the latent indicator charts that are generated demonstrate a normal distribution, supporting the normal prediction. Lastly, due to the reflective nature of each construct, model fit was determined based on the SRMR value. The finding revealed that the SRMR value of 0.058, which is below the criterion of 0.080 (Hair et al., 2019), indicates the model has a good explanatory power. Furthermore, an NFI value of 0.793 suggests a relatively poor fit, since the value should range from 0 to 1 and is considered better when closer to 1 (Hizam et al., 2023).

Estimation of Path Coefficient: After satisfying the quality criteria of the PLS-SEM, the path coefficients were estimated to determine whether the hypotheses were supported or rejected. These results were utilized to discuss four direct effects, two indirect effects, and one serial mediation of the structural path. Following standard bootstrap procedures, all the path coefficients are statistically significant (see Table 5).

Figure 2

Path Diagram



The findings revealed that DT has a positive and significant effect on CA (β= 0.322, t = 5.506, p < 0.001), followed by the positive and significant effect of DT on BP (β = 0.387, t = 7.533, p < 0.001). Similarly, BP (β = 0.384, t = 7.833, p < 0.001) positively impacted CA. Additionally, the finding also revealed that CA is an important predictor for BA (β = 0.50, t = 11.481, p < 0.001). Therefore, all four direct structural relationships (H1, H2, H3, and H4) were supported.

Table 1

Hypothesis Testing

Structural Path	Beta Coefficient (B)	Standard Deviation	t-value	2.50%	97.50%	Empirical Decision
H1: BP -> CA	(0.384) ***	0.049	7.833	0.285	0.476	Supported
H2: CA-> BA	(0.5) ***	0.044	11.481	0.408	0.578	Supported
H3: DT-> BP	(0.387) ***	0.051	7.533	0.282	0.483	Supported
H4:DT -> CA	(0.322) ***	0.059	5.506	0.206	0.434	Supported

In order to determine the mediating role of business performance and competitive advantage, as well as serial mediation, the study used variance adjusted for (VAF), which was computed by dividing the indirect effect by the total effect. According to Hair et al. (2014), a value of VAF below 20% indicates no mediation, a value between 20% and 80% indicates moderate mediation, and a value above 80% indicates full mediation. Following the mediator analysis procedure, a clear and direct significant effect was found between constructs (DT→CA) and (DT→BA). Similarly, Table 6 demonstrates that all paths having a mediator variable were significant. For this study, BP partially mediates the relationship between DT and CA (VAF = 31.63%). Again, CA partially mediates the relationship between DT and BA, as the VAF value lies within the range of 20% - 80%. In addition, for serial mediation (BP and CA), it partially mediates the relationship between DT and BA (VAF 25.54%). Hence, H5, H6, and H7 are significantly supported. The detailed calculation of the mediating effect and VAF is presented in Table A2.

Table 6

Mediation Analysis

IV	DV	MV	IE	TE	VAF (%)
DT	CA	BP	0.14899	0.47099	31.63%
DT	BA	CA	0.1869	0.4089	45.71%
For Serial Mediation					
DT	BA	BP, CA	0.07721	0.3022	25.54%

Note: IV: Independent Variable; DV: Dependent Variable; MV: Mediating Variable; IE: Indirect Effect; TE: Total Effect

DISCUSSION AND CONCLUSIONS

Based on dynamic capability and RBV theory, this study sheds light on the dynamic interplay between digital transformation, business performance, competitive advantage, and business agility within the service sectors. As previous eminent studies (Lee & Lee, 2020; Ulaga & Lusch, 2022) have shown, service-based industries are particularly susceptible to rapid changes in customer preferences, market trends, and technological advancements. This study highlighted the pressing need for digital transformation and business ability within the dynamic service sector.

Firstly, the study found a significant association between digital transformation and both business performance and competitive advantage. This finding is consistent with previous studies (Thuy, 2021; Yu & Moon, 2021), affirming the transformative potential of digital initiatives in improving market positioning and organizational effectiveness. In addition, prior studies (Bharadwaj et al., 2013; Wielgos et al., 2021) on digital business transformation align with the study findings, emphasizing the transformative potential of digital technology in driving efficiency, innovation, and customer satisfaction. Given that digital

capabilities are increasingly acknowledged as strategic resources that generate long-term competitive advantage, this is in line with the Resource-Based View (Barney, 1991). Domino's Pizza, Amazon, and Netflix serve as prime examples of companies leveraging digital transformation, disrupting markets, consumption patterns, and achieving substantial growth while maintaining a competitive edge. Therefore, achieving successful digital transformation is expected to lead to enhanced firm performance and competitive advantage, a consistent finding echoed across numerous studies investigating the impacts of digital transformation, digitization, or technology adoption (Bresciani et al., 2021; Tsou & Chen, 2023).

Likewise, the results indicate a significant relationship between competitive advantage and business agility, aligning with previous empirical studies (Bharadwaj et al.,2013; Tsou & Chen, 2023); it demonstrates that firms with strong competitive advantage exhibited faster and more effective responses to market change, customer demand, enabling differentiation, snapping up new opportunities, continuous improvement, and innovation. Likewise, echoing the findings of previous studies (Foley, 2020; Evanschitzky et al., 2020; Yaqub & Alsabban, 2023). In addition, a few of the service sectors demonstrated contrasting results with regulated sectors like pharmaceuticals and finance, where stability often outweighs adaptability (Verhoef et al., 2021). Innovation tends to bolster agility more effectively than cost leadership, while organizational culture and leadership significantly shape how advantages translate into agility (Appelbaum et al., 2019; Salmela et al., 2022). For example, Uber's tech-driven disruption in transportation initially gave it a competitive edge. Adapting strategically, it diversified its services, entered new markets, and invested in autonomous vehicles, ensuring competitiveness amid industry evolution.

Furthermore, the mediating effects of business performance and competitive advantage in linking DT to BA highlight the intricate relationships among these variables, consistent with the tenets of Dynamic Capability theory (Teece, 2007). The findings are consistent with a study (Wahid & Zulkifli, 2021; Yuen & Baskaran, 2023) carried out across various industries (such as manufacturing, retail, healthcare, and hospitality), which supports the notion that organizations possessing superior digital capabilities are better able to innovate, adjust to shifting market conditions, and make efficient use of resources, all of which improve agility. On the contrary, few studies (Bresciani et al., 2021; Konopik et al., 2022) suggest that this relationship is mostly influenced by industry dynamics, organizational capabilities, and external factors when evaluating the impact of digital transformation on business outcomes. Moreover, while digital transformation fuels agility, its impact on firm performance and competitive advantage remains multifaceted, hinging on contextual factors and organizational capabilities.

From the standpoint of STEM education and knowledge management, these findings indicate that digital transformation in STEM-focused and higher education institutions encompasses more than just the adoption of technological

infrastructure. Previous research on digital transformation in higher education (Pokropek, 2024; Pasi & Dhamak, 2026) highlights that digitalization significantly improves institutional effectiveness when integrated into pedagogical innovation, research collaboration, and administrative responsiveness. For example, universities that use learning management systems, AI-driven analytics, and digital research platforms together are better at improving student performance, getting students more involved, and making their schools more competitive in global rankings (Rahate et al., 2025). This is in line with the current results, which show that having digital skills alone is not enough unless they lead to better performance and more competitive strategies.

Based on these insights, the study advances the Digital Capability-Performance-Agility Framework (DCPA) for both STEM and service-oriented institutions as a sequential capability-building process of STEM institutions. The framework posits that digital capability improves institutional performance by enhancing efficiency, innovation, and knowledge utilization, thereby strengthening competitive positioning and ultimately fostering organizational agility. The framework posits that digital capability can improve an institution's performance and positioning, thereby fostering organizational agility. Thus, the DCPA framework provides a structured explanation of how digital transformation translates into sustainable agility in STEM-oriented and knowledge-based institutions, particularly in dynamic and technology-driven ecosystems.

IMPLICATIONS

DT is an emerging and novel concept that is essential to a firm's survival and competitiveness in this era of technological revolution, where economies and enterprises are changing simultaneously. Likewise, digital transformation is crucial for organizations to maintain agility and requires strategic planning and implementation across all aspects of the organization; failure to adopt it may lead to market obsolescence. The findings highlight the significance of aligning digital initiatives with overall business strategy and fostering a culture of innovation and adaptability. Furthermore, the research reinforces the revolutionary capacity of digital technology to improve market positioning and organizational efficacy, mirroring the achievements of industry disruptors. It also stresses the importance of competitive advantage for agility, which allows businesses to innovate, adapt to changing market conditions, and maintain a competitive edge.

Through the seamless integration of concepts from RBV and Dynamic Capabilities theory, this study offers a comprehensive understanding of digitalization and the ability concept from Nepal's service industry. In addition, the study redefines business agility by highlighting its dependence upon both business performance and competitive advantage. This challenges the traditional view of agility as solely focused on responsiveness and flexibility. Likewise, this study broadens understanding of the impact of digital transformation on business agility in developing countries, consolidates key factors and dimensions, enriches

scholarly discourse, and paves the way for future theoretical advancements. Furthermore, the study sheds light on the critical mediators that business performance and competitive advantage play in the relationship between digital transformation and business agility, particularly in the service industry, which advances our comprehension of mechanisms involved in this relationship.

Practically, managers must recognize the critical importance of digital agility, digital technologies and evolving consumer behaviors that have reshaped competition, compelling organizations to adopt agility to stay competitive. Similarly, to cultivate market agility, managers must recognize that digital transformation encompasses not only technological advancements but also entails reshaping organizational culture and leadership paradigms, emphasizing strategic alignment, continuous learning, and tackling barriers like resistance to change, cultivating a digital-centric culture, addressing skill deficiencies, and fostering an environment conducive to innovation. To maintain agility and long-term competitiveness, Nepalese service sector companies should also include digital transformation into their overall strategy and culture, placing a strong emphasis on technology, talent, and customer attention. Similarly, this study also provides valuable practical insights for diverse stakeholders of service sectors, such as emphasis on fostering supportive regulations and bridging the digital literacy gap, educational institutions nurturing digital skills, and investors identifying opportunities for impactful investments in a digitally evolving landscape.

This empirical study exclusively considered only the five-service sector (i.e, education, health care, BFIS, hospitality, IT companies), whereas future research could explore other industry sectors to analyze the effects of digital transformation, technology-specific impacts, and enhance knowledge of similarities, differences, and conformity among these sectors. The R^2 value of 0.15 for BP demonstrates that DT explains only 15% of the variance in the service sector, suggesting that DT's contribution to BP is relatively low, implying that other organizational, strategic, and environmental factors may also play a significant role in shaping BP. This highlights the multifaceted nature of performance outcomes, and DT alone is not a strong predictor of BP in this context. sufficient to fully stimulate BP.

Likewise, the study was guided by purposive sampling, especially the selection of top-tier service firms, introducing possible selection bias, as the findings may particularly demonstrate the practices and outcomes of high-performing organizations. Consequently, the results may overestimate the impact of digital transformation and have limited generalizability to firms with lower performance levels or varying degrees of digital maturity. Hence, in order to mitigate this bias, future researchers should adopt more diverse and representative sampling approaches, incorporating firms from diverse performance levels and degrees of digital maturity, to enhance the generalizability of findings.

Additionally, documenting participant experiences using a qualitative approach, like interviews with a few top-level executives, would further validate the research findings. Furthermore, the model incorporates mediating variables

such as organizational culture, technological capabilities, and customer dynamics. Additionally, this study highlights the need for future research to explore how employees' digital literacy and managers' competencies, as moderating factors, could influence the relationship between digital transformation, firm performance, and digital agility.

Contributions Load

Ujjwal Bhattarai: Conceptualization, Methodology, Data Collection, Data Analysis, Writing-Original Draft, Review and Editing, Visualization, Validation, Software, Resources, and Investigation
Arhan Sthapit: Conceptualization, Methodology, Data Collection, Data Analysis, Writing-Original Draft, Review and Editing, Visualization, Validation, Software, Resources, and Investigation
Baburam Timsina: Conceptualization, Data Collection, Data Analysis, Review and Editing, Visualization, Validation, Software, and Resources.
Oshin Gurung: Conceptualization, Data Collection, Data Analysis, Review and Editing, Visualization, Validation, Software, and Resources.

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ANNEX

Table A1

Socio-demographic Profile

Variables	Category	Frequency	Percentage (%)
Gender	Male	280	0.711
	Female	114	0.289
Age Group	20 to 30	89	0.226
	30 to 40	120	0.305
	40 to 50	125	0.317
	Above 50	60	0.152
Education Level	Diploma Course	24	0.061
	Bachelor's Degree	120	0.305
	Master's Degree	185	0.470
	M.Phil. and PhD	65	0.165
Current Position	Senior Executive	55	0.140
	IT Professional	125	0.317
	Manager	96	0.244
	Operational Manager	118	0.299
Types of Service Sector	Health Care	65	0.165
	Financial Sector	86	0.218
	IT Companies	40	0.102
	Education Sector	105	0.266
	Hospitality	98	0.249

ANNEX II

Table 2

Analysis of Mediation

Structural Path	Direct Path (No Mediation)	Full Model (With Mediation)	Variance Accounted for (VAF)
Mediating Analysis Result (I) DT→ BP→CA			
Direct Effects			
DT→BP (P12)		0.387	**VAF = Indirect Effect/ Total Effect**
BP→CA (P23)		0.385	
DT→CA (P13)		0.322	
Indirect Effect		0.387*0.385	

DT→ BP→CA		=0.14899	=0.14899/0.47099
Total Effect		(0.387*0.385+0.322)	= 0.3163
(P12*P23+P13)		= 0.14899+0.322	= 31.63%
		= 0.47099	
Mediating Analysis Result (II) D→CA→BA			
Direct Effect			
DT→CA (P12)		0.472	
CA→BA (P23)		0.396	
DT→BA (P13) o		0.222	= 0.1869/0.4089
Indirect Effect		0.472 * 0.396	= 0.4571
DT→ CA→BA		= 0.1869	=45.71%
Total Effect		(0.472 * 0.396 +	
(P12*P23+P13)	0.411	0.222)	
		0.4089	
Serial Mediation (III): DT→BP→ CA→BA			
Direct Effects			**VAF = Indirect**
DT→BP(P12)		0.386	**Effect/ Total**
BP→CA (P23)		0.509	**Effect**
CA → BA (P13)		0.394	
DT→BA (P14)		0.225	= 0.07721/0.3022
Indirect Effect		P12*P23*P24	= 0.2554
DT→BP→		= 0.385*0.509*0.394	= 25.54%
CA→BA		= 0.07721	
Total Effect		P12*P23*P24 + P14	
DT→BA		= 0.007721 * 0.225	
		= 0.3022	

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