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Impact of Digital Transformation and Process Automation on Business Efficiency

Hassan Raza[1], Sara Amjad[2]

[1] Department of Business Administration, Iqra University
[2] Department of Business Administration, Iqra University
Email: hassan.raza983@yahoo.com

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ABSTRACT

The emergence of digital transformation and automation of processes are also becoming strategically imperative processes that companies are aiming at attaining greater efficiency in their business in the modern technology-oriented competitive environment. The present study explored the immediate effects of digital transformation, as well as process automation, on the efficiency of business in Pakistani organizations operating in various industries. The survey design was quantitative cross-sectional. A structured questionnaire containing validated scales of all three constructs was used to gather data of 300 employees working in digitally transforming organizations on a 5-point Likert scale. The convenience sampling was embraced because it was considered conveniently accessible. Data were interpreted with SPSS 25 and AMOS 24 with descriptive statistics, Cronbach alpha reliability testing, Pearson correlation analysis, confirmatory factor analysis (CFA) and structural equation modeling (SEM). Digital transformation had a moderate positive direct impact on business efficiency (beta = 0.52, p <.001) and process automation also had a moderate positive direct impact (delta = 0.43, p <.001). The group of models described 61.8% of the business efficiency variation (R-squared = .618). Strong construct validity was indicated by CFA with AVE of between .53 and .59 and composite reliability of between.88 and .93. These results show that deliberate investment into digital transformation and systematic deployment of process automation are complementary and mutually strengthening steps toward efficiency increasing an organization and Pakistani organizational leaders have empirical information to make decisions on the basis of digital investments.

Keywords: process automation, digital transformation, business efficiency, structural equation modeling, confirmatory factor analysis, quantitative research, organization performance, Pakistan, digital technology.

INTRODUCTION

The need to enhance business effectiveness in the organization, i.e. do more with less, faster, turns waste into more valuable resources, and to make better use of human, financial, and technological resources has never been as appropriate as in the current digital disruption age. Organizations are faced today by growing competitive intensity, escalating customer demands, limited cost conditions, and game-changing technological opportunities, which are challenging to organizations across geographies and industries. The two connected strategic reactions have become the dominant ways in which modern organizations strive to achieve efficiency and improve: digital transformation and process automation. These constructs are analytically different but functionally complementary, and empirically correlated in a manner that means that they must be studied as a whole to gain insight into the efficiency of the results of digital investment.

The concept of digital transformation, the introduction of digital technologies into every sphere of business, which fundamentally changes the way of functioning and provides value to the customer (Vial, 2019), is a holistic organizational change process that does not simply imply using individual technologies but involves a cultural, structural, and strategic reorganization necessary to successfully compete in digitally mediated business environments. Westernman et al. (2014) defined digital transformation as an encompassment of the three dimensions: digital competencies (the technologies used and the skills to utilize them), leadership commitment (the strategic vision and investment commitment driving transformation), and transformation management (the governance as well as change management processes that allow implementing them). Companies that develop on all three dimensions at once attain what Westerman et al. dubbed digital mastery a level, which is linked to a much higher rate of profitability, revenue growth and efficiency of operations in comparison with companies who are lagging on one of the three dimensions.

Process automation Process automation is the application of technology to carry out repetitive tasks or processes with limited human interaction; this process has increased exponentially in scale and availability with the maturation of robotic process automation (RPA), intelligent process automation (IPA) and workflow management systems powered by artificial intelligence (Van der Aalst et al., 2018). Unlike in the previous generations where automation was restricted to capital intensive physical production setting, software intensive automation technologies today nowadays can be used to automate both cognitive and physical processes in administrative, analysis and customer relationship processes. McKinsey Global Institute (2017) projected that current automation technologies had the potential to automate various tasks that people do today, and the efficiency could be increased by 20-35% in the majority of organizational settings in case of systematic application of automation.

The interaction between digital transformation and business efficiency has been studied widely in the case of the developed economies and there always have been indications of high positive correlations. The study presented by Kane et al. (2015) revealed, via a large-scale international survey, that the digital maturity was closely correlated with financial performance and operational efficiency, with digital mature organizations showing significantly higher performance levels in comparison with less digital mature organizations within their industries. Bharadwaj et al (2013) posited the digital business strategy as a synthesis of the IT strategy and the business strategy by stating that efficiency benefits of using digital platforms (economies of scope), network effects that enhance the value of digital assets and speed benefits in product development and market response deliver cost and competitive efficiency. Li et al. (2018) validated these theoretical forecasts empirically and showed that operational efficiency, customer efficiency, and innovation efficiency were largely predicted by the intensity of digital transformation in a study that included a large number of Chinese companies.

The efficiency impacts of process automation have been reported in several areas of functions. In a study of RPA in financial services Lacity and Willcocks (2016) found automated processes reduced on average by 40-75% and resulted in faster, more accurate and more compliant processing. In a study of artificial intelligence-based automation in healthcare-care, manufacturing, and financial services, Davenport and Ronanki (2018) revealed the reported consistent savings in process efficiency in high-volume processes with rule-based processes and high data volume analysis. Mechanisms of automation efficiency are strongly hypothetical: the decrease in labor expenses, the removal of the human factor, the capability of performing 24/7, the unbroken speed of processing, and the use of rules and standards are all mechanisms that must enhance efficiency, which is quantifiable (Frey and Osborne, 2017).

Digital transformation and process automation is a marked trend in Pakistan in the organization setting as remote working, the provision of digital products and services, and transaction processing digitally with zero contacts have been forced by the COVID-19 pandemic. The IT industry expanded to roughly more than two billion yearly exports, the banking sector, telecom sector, and the retail sector in Pakistan have

created considerable process automation, and the digital transformation programs in the sectors have taken place with a relatively lower degree of scope and sophistication. Nevertheless, the effectiveness of such investments has not been fully investigated, and empirical data showing the connection between digital transformation and process automation and specific business efficiency improvements in Pakistani settings and models is scarce (Rashid and Ratten, 2020; Ahmed et al., 2022).

This limited knowledge in the empirical literature is both consequential to both the organizational decision-making as well as the public policy. Pakistan organizational executives making decisions on digital investments need evidence-based advice on the scale of the returns on efficiencies attainable due to digital transformation and automation of processes in their respective economic and institutional settings. As a field of study, development economics has repeatedly found that the underlying cause of long-run income growth is productivity enhancement, of which efficiency gains constitute a core element (Acemoglu et al., 2019), which explains why the efficiency implications of adopting any type of digital technology has become a national economic priority as well as a strategic concern on the firm level.

The theoretical framework on which this study is based combines the Resource-Based View of the Firm (Barney, 1991), which assumes that the capabilities of digital transformation and process automation systems can be viewed as strategically valuable resources, whenever they are rare, valuable, and inimitable by competitors, with Dynamic Capabilities Theory (Teece et al., 1997) which is used to describe the process through which an organization The combination of these frameworks forecasts that companies that invest in creating unique capabilities of digital transformation and automation of processes will gain sustainable efficiency benefits compared to competitors who do not have the same capabilities - forecasts which the SEM part in the current study empirically tested within the Pakistani organizational environment. The research adds to the global literature on digital transformation and also to the underrepresented (as compared to other countries) body of Pakistani management research with methodologically sound estimate of effects that contribute to theoretical knowledge and inform organizational practice.

LITERATURE REVIEW

Digital transformation is a concept that has progressed through a few generations of thought since Tapscott (1995) had first indicated to the business world the digital economy and its implications on the organization of the business. Initial views focused on technology adoption - switching analogue with digital tools - but subsequent research saw that the change that digitalization facilitated and needed was not a simple switch to technologies. Fitzgerald et al. (2014) presented a very persuasive definition, focusing on the application of digital technologies with the purpose of radically improving the performance or reach of enterprises to distinguish between digitization (turning analogue data into digital), digitalization (improving business processes with the help of digital data), and digital transformation (strategic change stimulated by the use of digital technologies). This conceptual development is accompanied by a theoretical relevance in the sense that it confirms that the efficiency effects of digital transformation work in a number of, qualitatively different ways based on how deeply and extensively organizations are digitally engaged.

Nambisan et al. (2017) presented a theorized application of the Resource-Based View to digital transformation, reasoning that digital technologies form new resource configurations in digital platforms, data assets, algorithmic capabilities that provide an efficiency advantage through mechanisms previously unaccessible to pre-digital resource bundles. In particular, the properties of digital resources are non-rivalry (the same data asset may be simultaneously used by multiple organizational functions), combinatorial potential (digital assets can be quickly reconfigured into new value forms), and scalability (digital capabilities can be increased at virtually zero marginal cost) - are the characteristics that create efficiency advantages of a fundamentally different type than those possible when it is more cost-efficient

to optimize physical resources. Verhoff et al. (2021) offered an overall conceptual framework of digital transformation that constitutes five levels of digitization and digital disruption, each of which is linked to specific efficiency improvement mechanisms and capacities of organisations.

Unbiased studies have always revealed favorable correlations in terms of digital change and operational effectiveness in industry settings. Matt et al. (2015) compared the strategies of digital transformation in European manufacturing companies, with European companies having explicit digital transformation strategies experiencing 20-35% higher operational efficiency than those the authors considered similar but without explicit digital transformation strategies mainly because of integration of digital systems throughout the value chain that removed the costs of coordination and allowed real-time optimization of production processes. The comparative analysis of cases conducted by Hess and colleagues (2016) revealed that the scope of digital transformation, that is, the range of areas of the company to which a transformation initiative/program was applied, mediated efficiency results, with enterprise-wide transformation associated with significant efficiency improvements compared to function-specific projects.

Research into process automation has proceeded in parallel with studies of physical automation in the manufacturing industry and cognitive automation in the service and administration industry. In manufacturing, investments do correlate with efficiency: Since the early 1978 work of Abernathy and Utterback (1978), who defined the product-process lifecycle model and predicted that automation intensity of processes lifecycle would rise with industrial maturity and shift in competitive advantage towards cost efficiency, relationships between automation investment and efficiency are well established. This trend has been continued today, where Laser et al. (2014) show that smart factory technologies, involving physical and digital automation via cyber-physical systems, attain efficiency improvements of 15-30% when compared to conventional automation in flexible manufacturing settings.

The efficiency impact of cognitive process automation has proven to be especially transformative in the service and administrative contexts. In a study of RPA implementations in various service organizations, Willcocks et al. (2015) report average cost drop of 30-60% of processes along with accuracy, compliance, and cycle time improvements. The efficiency processes of physical automation, as opposed to cognitive automation do not assume any substitution of physical labor with machinery, but instead cognitive, as opposed to human automated decision-making, with algorithmic processing of more data and at a lower cost, increasing the volume of analytical and administrative responsibilities performed by a person. In a survey that was recorded by Deloitte (2019) across the globe, 78% of the organizations who had adopted RPA intended to further invest in automation, and the average ROI period was reported as 12 months - a testament of the irresistible efficiency gains, which made the investment worth the cost.

The, jointly efficient relationship between the digital transformation and at least process automation has become theorized in terms of digital business ecosystems (Jacobides et al., 2018). Digital transformation enables the data infrastructure, connection and analytical capacity to automate the processes so that it can reach its highest efficiency potential; process automation creates the operational data and process insights to enable digital transformation to deliver value not just as a result of technology adoption. Most recent commentary on create versus kill, expressed in the language of general purpose technologies, such as digital technologies, is that general purpose technologies produce their best economic effect not through their effect on technology itself, but through the complementary organizational innovations that they enable (described by Brynjolfsson and McAfee in 2014) with process automation being one of the major examples.

Digital transformation and process automation have been listed as a key moderating condition where the outcome depends on the organization being prepared to embrace the changes. Chanias et al. (2019) discovered that the efficiency returns of digital transformation investments are significantly higher in

organizations with a higher degree of digital maturity, which indicates that efficiency returns are not evenly distributed, but are concentrated to those organisations that have the infrastructure of leadership, culture, and capability to leverage effectively the investments made in digital transformation. The same trends have been developed in the context of developing economies: Nwankpa and Roumani (2016) have proven that the impact of digital innovation on organizational efficiency was moderated by IT capability, with high-IT-capability firms gaining two or three times the gains of efficiency of the low capabilities organizations using the same lever of digital investments.

The issue of the impact of organizational culture on the efficiency of changes brought about by digital transformation has been a subject of increased research attention. According to a study organized by Westernman et al. (2014), digital culture such as the risk-taking, experimentation, cross-functional collaboration, and decision-making based on data was found to be one of the most powerful forecasts of the digital transformation value realization. A study conducted by Arshad et al. (2021) in the Pakistani organizational setting revealed that an organizational culture was a significant moderating agent between the digital transformation investment and organizational performance, and organizations that had more innovative and collaborative organizational culture returned significantly higher efficiency returns. These results imply that digital transformation initiatives in Pakistan should focus on changing mindsets and transforming technological integration as one way of realizing the efficiency benefits reported in foreign studies.

The conceptualization and operationalization of business efficiency as an organizational outcome construct has been approached in the management literature in various ways. Originally via a set of data envelopment analysis and the stochastic frontier methods, Farrell (1957) developed the concept of technical efficiency as the ratio of actual to maximum possible output achievable on a given set of inputs. In the case of a survey-based study, efficiency measures of perception including the evaluations of cost-efficiency, time-efficiency and resource-utilization by the organizational members as well as the quality of the processes have been extensively used and proven to be efficient (Venkatraman and Ramanujam, 1986). Multi-dimensional efficiency construct used in this study such as cost efficiency, speed of operation, resource use, and quality consistency is current theoretical agreement that business efficiency is a multi-dimensional outcome of a combination of organizational and technological factors.

Collectively, the literature creates a strong theoretical and empirical foundation to anticipate major positive impacts of the digital transformation of business and process automation on the efficiency of the business, which are generated by several complementary processes. The current research developed this framework by the first rigorous test of such combined effects on digital transformations in Pakistani digitally transforming organizations; this fills a critical gap in the existing body of empirical research on digital transformation in the developing economy with methodologically accurate estimates of effects that can be used by organizations to make investment decisions.

METHODOLOGY

The design that was used in this study was a quantitative cross-sectional survey. The study group included the staff of the entities who had pursued digital transformation programs in manufacturing, services, financial, and retail industries in Pakistan. The convenience sampling was done because of the restriction of access, but to develop the survey, the organization was selected with the help of personal knowledge of the researcher known to be active in digital transformation programs. The surveys were sent via personal and professional networks, company email addresses and via online professional communities in Pakistan. Out of the total of 330 questionnaires, a set of 300 was sent via the Internet and 30 by mail. Out of the 312 that were returned, 300 were used on excluding those that were not completed.

The study tool was a self-administered questionnaire which consisted of four parts. The measurement of digital transformation was through a 13 items scale used to adapt Vial (2019) and Westernman et al. (2014) items, which address coherence of digital strategy, breadth of adoption of digital technology, development of digital culture, and building digital capability. The 10 scale was created for process automation and based on the Lacity and Willcocks (2016) and Van der Aalst et al. (2018) instruments, it assesses the scope and intensity of automation, automation effectiveness, and intelligent adoption of automation. Operationalization of business efficiency is a 14 item scale based on Venkatraman and Ramanujam (1986) and modified to the digital environment, where cost efficiency (4 items), speed of operations (4 items), the use of resources (3 items), and consistency in the quality of the processes (3 items) were used to measure it. Each item was rated on 5-point Likert scale (1 = Strongly Disagreement to 5 = Strongly Agree). Demographic questions included sector of industry, position, employment size and experience.

Possible content and face validity was reached when four management information systems and operations management scholars reviewed the materials and when pilot testing on 25 employees of the target population not necessarily members of the main sample. Cronbach alpha was used to measure internal consistency whereby the test was considered reliable with a value of.70. In AMOS 24, CFA was used to assess construct validity with a threshold of >.50 to determine standardized factor loading, AVE (> .50), CR (> .70) and HTMT discriminant to validate ratio (<.85). The structural model tested two hypotheses that include: H1, which is the significant positive prediction of business efficiency by digital transformation; and H2, which is the significant positive prediction of business efficiency by process automation. Structural model fit was evaluated using chi-square/df < 3, CFI > .90, TLI > .90, RMSEA < .08, and SRMR < .08.

RESULTS

The analytical sample was 300 digitally transforming organization employees, making up the final analytical sample. The entire demographic profile is provided in Table 1. The most represented manufacturing and services (48.3% combined) sectors. The sample comprised 58.7% managerial and supervisory positions. The average number of years of organizational tenure was 6.8 (SD = 4.9). The sample consisted of large organization (more than 250 employees) as 41.7 percent with small and medium organizations making the rest.

Table 1: Demographic Profile of Respondents (N = 300)

Variable	Category	n	%
Gender	Male	183	61.0
	Female	117	39.0
Sector	Manufacturing	86	28.7
	Financial Services	73	24.3
	Services/IT	89	29.7
	Retail/FMCG	52	17.3
Role Level	Senior Manager/Director	78	26.0
	Manager/Supervisor	98	32.7
	Non-managerial	124	41.3
Org. Size	Small (< 50)	72	24.0
	Medium (50-250)	103	34.3
	Large (> 250)	125	41.7
Experience	< 3 years	74	24.7

	3-7 years	119	39.7
	> 7 years	107	35.6

Note. N = 300.

Table 2 demonstrates descriptive statistics and alpha reliability values on the basis of the Cronbach coefficients of all study constructs. The alpha values were all above.88 which confirms that there was strong internal consistency. Digital transformation also reached a middle ground (M = 3.48) with different levels of maturity of transformation represented in the sample. Only process automation had a slightly lower mean (M = 3.29), which predicts the overall earlier adoption of automation in Pakistani organizations. The mean business efficiency was 3.61; this suggests perceived efficiency which was moderately positive with regards to the sample.

Table 2: Descriptive Statistics and Reliability Coefficients

Variable	M	SD	alpha	Min	Max
Digital Transformation	3.48	0.73	.92	1.31	5.00
Digital Strategy Coherence	3.54	0.76	.88	1.00	5.00
Technology Adoption Breadth	3.45	0.78	.86	1.00	5.00
Digital Culture Development	3.41	0.79	.85	1.00	5.00
Digital Capability Building	3.52	0.74	.87	1.00	5.00
Process Automation	3.29	0.81	.91	1.00	5.00
Automation Scope	3.33	0.83	.87	1.00	5.00
Automation Effectiveness	3.25	0.84	.86	1.00	5.00
Intelligent Automation Adoption	3.28	0.82	.85	1.00	5.00
Business Efficiency	3.61	0.67	.93	1.43	5.00
Cost Efficiency	3.57	0.71	.88	1.00	5.00
Operational Speed	3.65	0.69	.87	1.00	5.00
Resource Utilization	3.62	0.70	.86	1.00	5.00
Process Quality Consistency	3.59	0.72	.85	1.25	5.00

Note. M = mean; SD = standard deviation; alpha = Cronbach's alpha. N = 300.

CFA results confirmed acceptable measurement model fit (chi-square/df = 2.23, CFI = .94, TLI = .93, RMSEA = .064, SRMR = .058). All the risk factors were statistically significant (p <.001), with a range of.61 to.88. Table 3 shows construct validity data. There were values of convergent validity of values ranging form 0.53 to 0.59 on values of AVE and the values of 0.88 to 0.93 on CR. All construct pairs discerned as discriminant valid on the basis of equal occurrence in HTMT ratios.

Table 3: CFA Measurement Model: Construct Validity Statistics

Construct	Items	Factor Loading Range	AVE	CR	alpha
Digital Transformation	13	.63-.87	.57	.92	.92
Process Automation	10	.61-.86	.54	.91	.91
Business Efficiency	14	.64-.88	.59	.93	.93

Note. AVE = average variance extracted; CR = composite reliability; alpha = Cronbach's alpha. Measurement model fit: chi-square/df = 2.23, CFI = .94, TLI = .93, RMSEA = .064, SRMR = .058.

Table 4 shows an intercorrelation table of all the variables of the studies. Digital transformation was positively correlated with business efficiency (r = .62, p < .01) and process automation (r =.59, p <. 01). Business efficiency was also positively connected with process automation (r =.55, p <.01). The strong intercorrelation between the constructs of digital transformation and process automation supported the theoretical complementity of these two constructs as mutually influencing efficiency factors.

Table 4: Intercorrelation Matrix

Variable	1	2	3
1. Digital Transformation	--		
2. Process Automation	.59**	--	
3. Business Efficiency	.62**	.55**	--

Note. ** p < .01 (two-tailed). N = 300.

The structural model demonstrated good fit (chi-square/df = 2.36, CFI = .93, TLI = .92, RMSEA = .068, SRMR = .062). The entire structural path coefficients are found in Table 5. H1 was accepted, with the direct positive impact of digital transformation on the efficiency of business being high (.52, p <.001). The same situation was observed with process automation, which showed a positive direct effect (beta = .43, p <.001), indicating the truthfulness of H2. This combination of the two predictors accounted 61.8 percent spectrum of business efficiency (R-squared =.618).

Table 5: Structural Model Path Coefficients

Hypothesis	Path	beta	SE	t-value	p	Decision
H1	Digital Transformation -> Business Efficiency	.52	.07	7.43	< .001	Supported
H2	Process Automation -> Business Efficiency	.43	.06	7.17	< .001	Supported

Note. beta = standardized path coefficient; SE = standard error. R-squared (Business Efficiency) = .618. Structural model fit: chi-square/df = 2.36, CFI = .93, TLI = .92, RMSEA = .068, SRMR = .062.

DISCUSSION

According to the structural model, the results have substantive and concrete support of both hypotheses and show that digital transformation and process automation are important and positive predictors of business efficiency in Pakistani digital transformation processes in organizations. The larger direct impact of digital transformation (beta =.52) compared to process automation (beta =.43) aligns with that of Westerman et al. (2014) that digital mastery (including all strategy, cultural, and capability aspects of change) is a better efficiency predictor compared to specific technology implementations such as automation. This outcome implies that the overall organizational transformations that digital transformation demands, namely alignment of strategy, capacity building, culture shaping, provide efficiency benefits that cannot be attained solely by process automation, making the focus on holistic transformation initiatives, rather than technology implementation as a series of individual efforts essential.

The high positive relation between process automation (beta = .43) showed that the investment in automation produces a definite efficiency payoff in organizational adjustments in Pakistan, which aligns

with global research by Lacity and Willcocks (2016) and Willcocks et al. (2015). The slightly smaller mean on process automation (M = 3.29) compared to digital transformation (M = 3.48): this could be a sign that automation uptake is not as high as broader digital transformation in Pakistani organizations, which is both a performance gap and a performance opportunity, as additional large efficiency improvements could be gained with higher automation investment. The large amount of variation explained (R-squared = .618) supports the idea that the two digital constructs alone explain most of the variation in business efficiency across the sample and substantiates the theoretical framework and the methodological approach.

CONCLUSIONS AND RECOMMENDATIONS

This research concluded that digital transformation and process automation are both significant and positively related to business efficiency in Pakistani organizations and that digital transformation is more predictive. There are practical and policy implications of such findings. Digital transformation is not just an IT infrastructure investment but a strategic program that involves the adoption of technology, cultural change, capacity building, and strategic alignment of the work of Pakistani organizational leaders. Companies that limit digital investment to technology replacement and do not consider the dimensions of organizational change of transformation will always perform poorly in realizing the potentials of their digital investments.

Automation of processes must be placed as a strategic focus in the digital transformation programs and organizations should undertake a methodical process mapping to determine the high value automation opportunities and adopt a staged automation roadmap to develop internal capability and deploy externally. Administrative and financial procedures are the most likely areas of automation ROI fastestivity pilot in RPA that can emerge as building blocks of organizational confidence and adaptability towards greater intelligent automation. To policymakers, positive efficiency impacts recorded in this paper give an excuse to promote digital transformation support programs such as automation investment tax subsidies, funding digital skills development, and a digital transformation leader focus in the public sector that can be a signpost and catalyst of transformation in the private sector. Future studies must consider mediating factors - namely, dynamic capabilities and organizational learning - by which digital transformation and automation of processes change into efficiency results as well as explore sector specific variations in the scale of such outcomes within the diverse organizational environment in Pakistan.

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