

The Impact of Digital Transformation on Enhancing the Competitive Advantage of Startups in Algeria

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Abstract

This study aims to analyze the impact of digital transformation on enhancing the competitive advantage of startups in Algeria, focusing on the technical, human, strategic, cultural, and organizational dimensions, within a business environment characterized by constant change and intensifying competition. To this end, the study adopted a descriptive-analytical approach, using a questionnaire administered to a sample of Algerian startups, through which data related to the dimensions of digital transformation and competitive advantage were collected and analyzed using SPSS software. The results revealed a statistically significant positive effect of digital transformation, across its various dimensions, on competitive advantage, with the human and cultural dimensions emerging as the most influential, confirming that the integration of technology, human resources, culture, strategy, and organization contributes to strengthening startups' capacity for innovation, adaptation, and the achievement of sustainable competitive advantage.

Keywords: Digital transformation, competitive advantage, startups.

Introduction

In recent years, the world has witnessed rapid developments in the digital environment and information and communication technology, prompting organizations — startups in particular — to adopt digital transformation as a strategic choice for strengthening their ability to adapt to technological and economic change. This is reflected in the deployment of a range of digital tools and technologies, most notably electronic marketing, electronic payment, social media platforms, and e-commerce platforms, among other digital solutions. The importance of digital transformation lies in its contribution to improving operational efficiency, expanding access to markets and customers, reducing certain costs, and strengthening organizations' competitiveness, enabling them to achieve a sustainable competitive advantage that supports

their success and continuity in a business environment marked by change and intensifying competition.

Digital transformation constitutes a strategic orientation encompassing technology, skills, culture, processes, and organizational structures, thereby enhancing startups' prospects for improving their performance and competitiveness. In Algeria, digital transformation is gaining growing importance amid support for innovation and the digitization of the economy, which calls for examining the extent to which its technical, human, strategic, cultural, and organizational dimensions contribute to strengthening the competitive capacity of startups.

To what extent does digital transformation affect the achievement of competitive advantage among startups in Algeria?

Research Hypothesis

To answer the research question, the following hypothesis was formulated:

There is a statistically significant effect of digital transformation, in its combined dimensions (technical, human, strategic, cultural, and organizational), on the achievement of competitive advantage among startups in Algeria, at a significance level of $\alpha \leq 0.05$.

The study aims to:

- Identify the current state of digital transformation in Algerian startups.
- Measure the level of competitive capacity of startups.
- Analyze the effect of the dimensions of digital transformation — technical, human, strategic, cultural, and organizational — on the achievement of competitive capacity.
- Determine which dimension of digital transformation has the greatest influence on strengthening the competitive capacity of startups.

This study derives its significance from the fact that digital transformation has become a fundamental factor in strengthening startups' ability to adapt to the requirements of the modern business environment and to withstand competition. It also seeks to highlight the extent to which the dimensions of digital transformation contribute to improving the competitive capacity of startups in Algeria. Its findings provide indicators that can help business owners and decision-makers direct digitization efforts toward the areas with the greatest impact on competitiveness and sustainability.

First: Theoretical Framework

1. Digital Transformation

1.1 The Concept of Digital Transformation

The concept of digital transformation has evolved from the digitization of information (Digitization), to the deployment of digital technologies to improve processes (Digitalization), and ultimately to digital transformation (Digital Transformation), which represents a deeper change in the way an organization operates, its business model, and its value-creation pathways. These levels should not be viewed as mandatory chronological stages that all organizations pass through in the same order, but rather as overlapping levels reflecting the breadth of technology use and the depth of its impact on the organization (Verhoef et al., 2021). Digital transformation is not limited to the adoption of technology; it also encompasses strategic and organizational transformations affecting processes, structures, and culture, with

the aim of reshaping value-creation pathways and responding to technological and organizational change (Vial, 2019).

Digital transformation proceeds through gradual stages, beginning with converting information into digital form, then using technologies to improve processes, and culminating in fundamental changes in working methods and value creation. O'Leary (2023) refers to these levels by distinguishing between digitization (Digitization), operational digitization (Digitalization), and digital transformation (Digital Transformation), as follows:

First stage — Digitization: refers to converting information from its physical or analog form into a digital format that is easier to store, process, and transmit, such as converting paper documents into electronic files, without this necessarily entailing a fundamental change in the way business is conducted.

Second stage — Digitalization: consists of using digital technologies to improve existing processes and activities by increasing efficiency, speed, and accuracy — such as inventory, sales, and customer-relationship management systems — without producing a radical change in the organization's business model.

Third stage — Digital Transformation: represents the deepest level of technology deployment, going beyond process improvement to bring about fundamental changes in the way the organization operates, its business model, and its relationships, as well as its mechanisms for creating and delivering value. It also requires structural and strategic change and the development of resources and capabilities that enable the organization to adapt to the digital environment and achieve new value.

Accordingly, digital transformation can be defined as the process of deploying digital technologies across an organization's various activities and processes, with the aim of improving efficiency, developing products and services, strengthening decision-making, and meeting customer needs, while bringing about strategic, organizational, and cultural changes that enable the organization to adapt to the digital environment and achieve competitive advantage.

1.2 Dimensions of Digital Transformation

The success of digital transformation requires a set of enabling factors that provide a suitable environment for its effective implementation. In this regard, Moulay (2017) and Meier, Eller, and Peters (2025) concur on a set of core dimensions, namely:

Technological and information infrastructure (technical dimension): the availability of a robust technological infrastructure is among the essential factors for the success of digital transformation, encompassing networks, servers, communication systems, information systems and databases, and the digital equipment needed to support new systems.

Informational society and digital culture (cultural dimension): one of the pillars of digital transformation, as the spread of digital awareness among citizens contributes to enhancing the usability of electronic services and expanding reliance on them.

Legislative and regulatory framework (organizational dimension): provides the legal and regulatory reference that governs the use of digital technologies, regulates the exchange of information, and protects personal data; it helps reduce the legal and regulatory risks associated with digitization, thereby ensuring the sustainability of digital projects.

In addition to these shared dimensions, Moulay (2017, pp. 9–11) adds two further dimensions related to the requirements for the success of digital transformation — the human dimension and the strategic dimension — as follows:

Qualified human resources (human dimension): qualified human resources are a pivotal element in the success of digital transformation, as this is linked to organizations' capacity to build employees' digital skills through training and skills-development programs that respond to the requirements of digitization.

Digital strategy (strategic dimension): a comprehensive digital transformation strategy must be established, encompassing objectives, plans, timelines, and the allocation of the necessary resources; this digital strategy must be integrated with the organization's overall strategy and serve its objectives.

2. Startups

2.1 Definition of Startups

Startups are small, independent companies seeking a profitable, repeatable, and scalable business model, with a focus on innovation — whether in products, services, or technical and administrative processes. The term "start-up" is composed of two words: "start," denoting launch and movement, and "up," denoting strength and energy, reflecting the strong drive and determination to achieve the organization's objectives (Fridenson, 2021).

Blank and Dorf define a startup as a temporary organization in search of a profitable, repeatable, and scalable business model, which at the outset is essentially a canvas filled with ideas and assumptions (Dorf & Blank, 2012, p. 19).

Accordingly, a startup can be defined as a modern economic entity that seeks to develop a sustainable and scalable business model by relying on innovation, knowledge, and technical expertise, through a collaborative team working to deliver new solutions that meet market needs.

2.2 Characteristics of Startups

According to recent research, startups are characterized by the following:

- Innovation: a startup seeks to offer a new product, service, or business model.
- Scalability: the organization's ability to increase the scale of its activity without a proportional increase in costs.
- Reliance on knowledge and technology: particularly among organizations operating in digital and technological fields.
- High risk: because the business model has not yet been fully tested.
- Rapid growth: startups generally seek to achieve rapid growth compared with traditional organizations.
- Flexibility: the ability to quickly adjust the product or business model.
- Limited resources: the scarcity of resources available to the organization relative to its actual needs.

3. Competitive Advantage

3.1 The Concept of Competitive Advantage

Competitive advantage consists of the set of characteristics and capabilities an organization possesses and deploys to achieve superiority and distinction over its competitors

in the market, allowing it to deliver greater value to customers and improve its performance. For a startup, competitive advantage is a fundamental factor contributing to its survival and continuity, by strengthening its ability to distinguish itself, withstand competition, and adapt to market challenges. A startup's competitive advantage is reflected in its strategy, mission, and marketing activity, and a startup can acquire competitive advantage in the following areas:

- Accuracy and speed of delivery time
- Speed of market entry
- Competitive pricing
- The type and modernity of the technology used
- Creativity and artistic touch in design
- Excellence in customer service
- Possession of protected intellectual property / a registered trademark
- The expertise and skills of human capital

Accordingly, it can be said that the competitive advantage of startups rests on speed, price, technology, creativity, customer service, intellectual property, and the efficiency of human capital.

3.2 Dimensions of Competitive Advantage

These are a set of characteristics on which an organization relies when bringing its products to market, with the aim of achieving superiority over competitors by focusing on one or more of the following:

- Cost: producing goods or services at the lowest possible cost, allowing competitive pricing and an increased market share.
- Quality: delivering products and services that meet or exceed customer expectations, thereby strengthening trust and loyalty.
- Flexibility: the organization's ability to adapt quickly to market changes and customer needs, whether in products, processes, or organization.
- Time and delivery: providing products in a timely manner, with speed and accuracy in meeting customer requests.
- Creativity: developing new products and services or improving existing ones by adopting new ideas and methods, helping the organization sustain itself and remain competitive.

Second: The Empirical Study

Digital transformation is of growing importance in strengthening startups' ability to adapt to changes in the competitive environment and to improve their performance, through the deployment of modern technologies and the development of working methods and services. In this context, competitive advantage emerges as one of the key factors helping startups distinguish themselves and survive in the market. Building on this, this section addresses the study's two variables, with digital transformation as the independent variable and competitive advantage as the dependent variable, with the aim of examining the relationship between them and measuring the extent to which digital transformation contributes to strengthening the competitive advantage of startups.

Study Population and Sample

The study population consists of Algerian startups registered or operating in the Algerian market, active in the fields of technology, e-commerce, digital services, or any other modern activity based on innovation and digital technologies. An electronic questionnaire was administered to a study sample estimated at 50 Algerian startups operating in the fields of technology, e-commerce, and digital services.

Study Instrument

The study questionnaire consists of 24 items grouped under six main axes, in addition to personal information, using a five-point Likert scale (strongly agree (5), agree (4), undecided (3), disagree (2), strongly disagree (1)) to measure respondents' answers.

Validity and Reliability of the Questionnaire

1. Construct Validity: Pearson's correlation coefficient was calculated between the score of each axis and the overall score of the questionnaire; the following table illustrates this.

Table 1: Construct Validity of the Study Instrument

Questionnaire Axes	No. of Items	Pearson Correlation Coefficient (r)	Sig.	Result
Competitive advantage	4	0.72**	0.000	Statistically significant correlation
Technical dimension	4	0.70**	0.000	Statistically significant correlation
Human dimension	4	0.73**	0.000	Statistically significant correlation
Strategic dimension	4	0.69**	0.000	Statistically significant correlation
Cultural dimension	4	0.77**	0.000	Statistically significant correlation
Organizational dimension	4	0.79**	0.000	Statistically significant correlation

**** Significant at the 0.01 level (Sig. / error probability, p-value).**

Source: Prepared by the researchers based on SPSS V.23 output.

The table above shows that all correlation coefficients between each axis and the overall mean of the questionnaire items are statistically significant, as the Sig. value (significance level) is below the 0.01 threshold. The axes are therefore considered valid, consistent, and appropriate for measuring what they were designed to measure, and capable of fulfilling the study's objectives.

2. Reliability of the Questionnaire: the reliability of the study questionnaire was verified using Cronbach's Alpha coefficient, which indicates high reliability as it approaches 1. The following table presents the reliability coefficients for the questionnaire's axes.

Table 2: Cronbach's Alpha Values for the Axes of the Study Instrument

Questionnaire Axes	Cronbach's Alpha	No. of Items	Result
Competitive advantage	0.87	4	Reliable
Technical dimension	0.85	4	Reliable
Human dimension	0.88	4	Reliable
Strategic dimension	0.83	4	Reliable
Cultural dimension	0.79	4	Reliable
Organizational dimension	0.81	4	Reliable
All questionnaire items	0.80	24	Reliable

Source: Prepared by the researchers based on SPSS V.23 output.

We note that Cronbach's Alpha coefficients for the questionnaire's axes range between 0.79 and 0.88, which are high coefficients; the coefficient for all questionnaire items combined reached 0.80. It can therefore be concluded that the instrument developed to address the research problem is valid and reliable across all its items.

Characteristics of the Study Sample

Presented in the following tables:

By Year of Establishment

Table 3: Distribution of Organizations by Year of Establishment

Year of Establishment	Before 2015	2015–2017	2018–2020	2021–2023	Total
Number of organizations	10	15	18	7	50
Percentage	20%	30%	36%	14%	100%

Source: Produced by the researchers.

Most Algerian startups were established after 2015, particularly between 2018 and 2020, reflecting the increasing orientation toward entrepreneurship in recent years.

Distribution of Organizations by Number of Employees

Table 4: Distribution of Organizations by Number of Employees

Number of Employees	1–5	6–10	11–20	More than 20	Total
Number of organizations	12	20	10	8	50

Percentage	24%	40%	20%	16%	100%
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Source: Produced by the researchers.

We note that the majority of organizations fall within the range of 6–10 employees, reflecting the reality of Algerian startups, which are generally very small to small in terms of workforce size.

Distribution of Organizations by Field of Activity

Table 5: Distribution of Organizations by Field of Activity

Field	Number of Organizations	Percentage
Technology	18	36%
E-commerce	12	24%
Digital services	15	30%
Other	5	10%
Total	50	100%

Source: Produced by the researchers.

The concentration in technology and digital services reflects the nature of the majority of startups in Algeria, as these sectors are the most active and innovative.

Distribution of Organizations by Level of Digitization Adoption

Table 6: Distribution of Organizations by Level of Digitization Adoption

Level	Weak (1–2)	Average (3)	Good (4)	Excellent (5)	Total
Number of organizations	9	20	14	7	50
Percentage	18%	40%	28%	14%	100%

Source: Produced by the researchers.

We note that more than half of the sampled organizations have an average or good level of digitization, reflecting the real challenges present in Algeria, such as the weakness of digital infrastructure and the high cost of digital transformation.

4. Testing the Study Hypothesis

Main Hypothesis: There is a statistically significant effect of digital transformation, in its combined dimensions (technical, human, strategic, cultural, and organizational), on the achievement of competitive advantage among startups in Algeria, at a significance level of $\alpha \leq 0.05$.

To test the effect of the dimensions of digital transformation on competitive advantage, multiple regression analysis was used with the Enter method, entering all independent dimensions (technical, human, strategic, cultural, and organizational) into the model simultaneously. The significance of the model was assessed using the F statistic and its significance level, its explanatory power was assessed using R^2 , and the regression coefficients

(B) were used to identify the dimensions influencing competitive advantage. The test results are presented below.

Table 7: Results of the Multiple Regression Analysis Between the Independent Variable and the Dependent Variable

Model Summary

Correlation Coefficient R	Coefficient of Determination R ²	Adjusted R ²
0.651	0.424	0.360

ANOVA

Model	F value	Significance Level (Sig.)
Regression	6.614	0.000

Coefficients

Model	B	Std. Error	Beta	t	Sig.
(Constant)	0.516	0.179	—	1.621	0.012
Technical dimension	0.235	0.122	0.345	2.272	0.028
Human dimension	0.479	0.140	0.465	3.240	0.001
Strategic dimension	0.431	0.126	0.444	3.423	0.001
Cultural dimension	0.627	0.222	0.450	2.821	0.007
Organizational dimension	0.362	0.184	0.436	1.972	0.025

Source: Prepared by the researchers based on SPSS V.23 output.

The results of the multiple linear regression show that the correlation coefficient $R = 0.651$ indicates a positive relationship between the combined independent dimensions and the dependent variable. This means that as these dimensions improve overall, the dependent variable tends to improve as well. This leads us to accept the hypothesis — namely, that there is a statistically significant effect of digital transformation, in its combined dimensions (technical, human, strategic, cultural, and organizational), on the achievement of competitive advantage among startups in Algeria, at a significance level of $\alpha \leq 0.05$.

The coefficient of determination reached $R^2 = 0.424$, meaning that the five dimensions studied explain approximately 42.4% of the variance in the dependent variable, while the remaining proportion is attributable to other factors not included in the model and to random error. The adjusted coefficient of determination reached $R^2 = 0.360$, indicating that the model

retains an explanatory power of approximately 36% after accounting for the number of independent variables.

Regarding the analysis of variance (ANOVA), the F value of 6.614 indicates that the model is statistically significant, which reinforces the credibility of the analysis. The significance level (Sig.) of 0.000, being below 0.05, indicates that the model explains the variance in the dependent variable well.

The results also show a positive and statistically significant effect for all dimensions, with beta coefficients of 0.345 for the technical dimension, 0.465 for the human dimension, 0.444 for the strategic dimension, 0.450 for the cultural dimension, and 0.436 for the organizational dimension, with significance levels at or below 0.05. In terms of strength of effect, the human dimension ranked first, followed by the cultural, strategic, organizational, and finally the technical dimension, confirming the importance of integrating these dimensions in explaining and improving the dependent variable, despite variation in their relative strength. Accordingly, the multiple regression equation can be derived as follows:

$$Y = 0.516 + 0.235X_1 + 0.479X_2 + 0.431X_3 + 0.627X_4 + 0.362X_5$$

Where:

- Y: the dependent variable (competitive advantage)
- X₁: the technical dimension; X₂: the human dimension; X₃: the strategic dimension; X₄: the cultural dimension; X₅: the organizational dimension.

Research Findings

The results of the statistical analysis revealed a positive, statistically significant effect of the technical, human, strategic, cultural, and organizational dimensions of digital transformation on the competitive advantage of startups, confirming the importance of these dimensions in strengthening their competitive capacity and improving their responsiveness to the requirements of the business environment. The results also showed that these dimensions, taken together, explain a considerable proportion of the variation in competitive advantage, reflecting the importance of their integration in achieving and strengthening the competitive advantage of startups.

The results also revealed a statistically significant effect for the human dimension and the cultural dimension, with the human dimension ranking first in terms of strength of effect, followed by the cultural dimension. This confirms that human resources possessing the necessary competencies and skills, together with the establishment of an organizational culture supportive of innovation and change, are two key factors in building competitive advantage and strengthening the organization's capacity for development.

On the other hand, the results showed a statistically significant effect for the strategic, organizational, and technical dimensions, confirming the importance of strategic planning, the development of organizational structures and practices, and the use of modern technologies in supporting the competitive advantage of startups and improving their ability to face challenges and changes in the business environment.

Overall, the results confirm that the technical, human, strategic, cultural, and organizational dimensions of digital transformation represent integrated dimensions that contribute to strengthening the competitive advantage of startups, by supporting their capacity

for adaptation, innovation, and continuity. The results also indicate that achieving a stronger competitive advantage requires adopting an integrated approach that combines the development of human resources, the promotion of a culture supportive of change, improved planning and organization, and the effective use of modern technologies.

Conclusion

Through its theoretical component, the study concluded that digital transformation is no longer limited to the adoption of modern technologies and the digitization of processes, but has become a strategic and organizational orientation encompassing the technical, human, strategic, cultural, and organizational dimensions, thereby contributing to the development of organizations' capabilities and strengthening their capacity for adaptation, innovation, and value creation. The theoretical component also showed that the integrated deployment of these dimensions can constitute an important source for building and strengthening competitive advantage, particularly among startups operating in an environment characterized by change and competition.

From an empirical standpoint, the results of the statistical analysis revealed a positive, statistically significant effect of digital transformation, across its various dimensions, on the competitive advantage of the startups under study. They also showed a significant effect for the human, cultural, strategic, organizational, and technical dimensions, albeit with varying strength of effect. Accordingly, the study's main hypothesis — which posits a statistically significant effect of digital transformation in strengthening the competitive advantage of startups — was confirmed. These findings confirm that achieving sustainable competitive advantage requires adopting an integrated vision of digital transformation that combines technology, human competencies, organizational culture, strategic orientation, and organizational capabilities.

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