

THE IMPACT OF INDUSTRY 4.0 MATURITY LEVEL ON COMPETITIVE STRATEGIES AND INTERNAL ENTREPRENEURSHIP TRENDS: A STUDY ON BUSINESSES

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ABSTRACT

The aim of this research is to examine the impact of Industry 4.0 maturity level on competitive strategies and internal entrepreneurship tendencies. The research was designed using a correlational survey model within the framework of a quantitative research approach. The research population consists of managers, specialists, and white-collar employees working in businesses operating in the Turkish Republic of Northern Cyprus (TRNC). A convenience sampling method was used, and the sample size was determined to be 200 participants. Data were collected through a demographic information form, the Industry 4.0 Technologies Usage Level Scale, the Competitive Strategies Scale, and the Internal Entrepreneurship Scale. The collected data were analyzed using the IBM SPSS software package; reliability analysis, descriptive statistics, normality analysis, correlation analysis, and simple linear regression analysis were applied.

The research findings show a positive and significant relationship between the Industry 4.0 maturity level and competitive strategies and internal entrepreneurship tendencies. Regression analysis revealed that the Industry 4.0 maturity level has a positive and significant effect on competitive strategies. Similarly, it was found that the Industry 4.0 maturity level also positively influences internal entrepreneurship tendencies. The findings demonstrate that digital maturity strengthens the strategic orientations of businesses and supports employees' internal entrepreneurial behaviors. This research contributes to the literature by considering the Industry 4.0 maturity level in conjunction with competitive strategies and internal entrepreneurship tendencies.

Keywords: Industry 4.0, Industry 4.0 maturity level, competitive strategies, internal entrepreneurship, digital transformation.

1. Introduction

In today's rapidly changing global business world, companies are restructuring their production, management, marketing, and innovation processes around digital transformation to survive and gain a competitive advantage. While earlier periods of industrial history were characterized by mechanization, mass production with electric power, and computer-aided automation, today we are experiencing the Fourth Industrial Revolution, where production systems are integrated with digital technologies. This transformation, called Industry 4.0, is shaped by the inclusion of technologies such as big data, the Internet of Things, cloud computing, artificial intelligence, cyber-physical systems, autonomous robots, augmented reality, and 3D printers into business processes (Acar, 2024).

Industry 4.0 offers businesses increased efficiency, flexible production, cost advantages, capacity expansion, faster decision-making, and the ability to respond more responsively to customer expectations. With digitalization, the factors determining competitiveness are also changing; corporate structure, infrastructure, innovation capacity, human resource quality, and strategic decision-making processes are regaining importance. Research conducted on foreign trade firms has shown that Industry 4.0 applications have an impact on competitive strategies, market performance, and innovation performance; and that competitive strategies have a stronger influence on market and innovation performance (Ekinci Furtana & Acar, 2024).

To understand the impact of digital transformation on businesses, the existence of technologies, as well as the level of adoption and integration of these technologies into business processes, are crucial. Industry 4.0 maturity level is considered a significant indicator of businesses' awareness, preparedness, implementation capacity, and transformation skills regarding digital technologies. A study on SMEs showed that businesses' Industry 4.0 maturity level was measured at approximately 2.5 out of 5, indicating that many businesses are still in the development phase of the digital transformation process (Akpınar et al., 2024).

The maturity level of Industry 4.0 is directly related to the competitive strategies of businesses. Cost leadership, differentiation, and focus strategies are fundamental strategic approaches that businesses use to differentiate themselves from their competitors in the market. Digital technologies offer businesses new opportunities in terms of reducing costs, accelerating processes, personalizing products and services, improving quality, and responding more flexibly to customer demands. In this process, data management, information sharing, and organizational

learning become decisive in transforming digital transformation into strategic value (Kolyasnikov & Kelchevskaya , 2020).

As Industry 4.0 maturity increases, the capacity of businesses to generate innovation, seize opportunities, and bring entrepreneurial behaviors into the organization also gains importance. Internal entrepreneurship is related to employees developing new ideas, recognizing opportunities, taking risks, and producing innovative solutions by acting with an entrepreneurial mindset within the organization. When employees' innovative behaviors are combined with supportive organizational conditions, businesses are more likely to adapt to change, grow, and gain a competitive advantage (Morais et al., 2021).

Internal entrepreneurship is becoming a strategic necessity for businesses undergoing digital transformation. The rapid pace of technological change makes it difficult to manage innovations from a single center, necessitating more active employee participation in idea generation, problem-solving, and opportunity assessment processes. Businesses that create space for entrepreneurial behavior among their employees strengthen their innovation capacity, employee engagement, organizational agility, and sustainable competitive advantage (Vengrouskie , 2025).

The relationship between Industry 4.0 and entrepreneurship is transforming not only internal organizational processes but also entrepreneurial ecosystems. Digital technologies enable the development of new business models, increase cross-sector collaborations, and allow innovative ventures to reach the market faster. Technologies such as artificial intelligence, big data, automation, and the Internet of Things contribute to businesses developing more flexible, adaptable, and innovative structures (Kumar et al., 2023).

entrepreneurial and innovation orientation on competitive strategies show that innovative and entrepreneurial behaviors are crucial in enabling businesses to gain a competitive advantage. A study on family businesses found a positive and significant relationship between entrepreneurial orientation and competitive strategies; innovation orientation was also found to have a significant impact on competitive strategies (Asfour , 2023).

The aim of this research is to examine the impact of Industry 4.0 maturity level on the competitive strategies and internal entrepreneurship tendencies of businesses. Studies in the literature address the relationship between Industry 4.0 applications and competitive strategies, market performance, and innovation performance; the connection between internal entrepreneurship, innovation , and competitiveness is also discussed in various studies. The limited number of studies that examine Industry 4.0 maturity level together with competitive strategies and internal entrepreneurship tendencies forms the starting point of this research. The study is expected to contribute to the literature on digital transformation, strategic management, and internal entrepreneurship; and to reveal how technological maturity relates to strategic decisions and internal entrepreneurial behaviors within organizations.

2. Conceptual Framework

2.1. The Concept and Development of Industry 4.0

computing , autonomous robots, simulation, augmented reality, system integration, additive manufacturing, and cybersecurity are among the fundamental components of Industry 4.0. Göv & Erdoğan, 2020).

The historical trajectory of industrial revolutions shows that Industry 4.0 emerged as a continuation of previous transformations. The First Industrial Revolution increased production capacity with steam power and mechanization, the Second Industrial Revolution changed the production structure with electrical energy and mass production, the Third Industrial Revolution gave production processes a digital character with computers, electronic systems, and automation technologies, and the Fourth Industrial Revolution combined physical production systems with digital technologies to create a more connected, autonomous, and data-driven production approach (Yasim, 2020).

The concept emerged in Germany in 2011 and quickly became a significant topic in industrial policies, business strategies, and academic studies. Initially associated with production systems, Industry 4.0 has gradually expanded to include different areas such as management, human resources, marketing, finance, logistics, education, and public policies. The stronger integration of digital technologies into business processes and daily life has transformed Industry 4.0 from a narrow production model into a comprehensive transformation process (Yıldırım, 2020).

In the functioning of Industry 4.0, the ability of machines, products, and systems to communicate with each other plays a decisive role. Cyber-physical systems connect the physical production environment with digital systems, while the Internet of Things enables data sharing between machines, devices, and products. Big data and advanced analytical techniques transform intense data flow into meaningful information; cloud computing offers a flexible infrastructure for storing, processing, and sharing data. Autonomous robots provide speed, quality, and efficiency in production processes, while additive manufacturing allows for the production of personalized products at lower costs. Simulation and augmented reality stand out as supporting technologies that reduce the risk of errors in design, training, maintenance, and operation processes (Xu et al., 2021).

The value of Industry 4.0 for businesses is related not so much to the existence of these technologies, but to the level at which these technologies are adopted, implemented, and transformed into strategic value. The maturity

level concept is an important metric used to evaluate businesses' digital competencies, technological infrastructure, organizational structure, human resources, operational capacity, and strategic transformation ability. Maturity models make the current digital state of businesses visible and contribute to identifying areas requiring improvement (Santos & Martinho , 2020).

The success of digital transformation is closely related to management support, employee competence, financial resources, organizational readiness, competitive pressure, and a suitable organizational culture, in addition to technical investments. Businesses need to align Industry 4.0 technologies with strategic goals, involve employees in the process, and develop a management approach that supports change. Technology investments, only when supported by the necessary knowledge, skills, and organizational alignment, create opportunities for businesses to increase productivity, flexibility, cost advantages, improve quality, make faster decisions, and respond more responsively to customer demands (Khin & Kee , 2022).

2.2. Competitive Strategies

Competitive strategies refer to the long-term orientations that businesses follow to gain an advantage over their competitors in the market in which they operate, to maintain their profitability, and to establish a sustainable position. In highly competitive sectors, achieving lasting superiority with similar products, services, and processes becomes difficult; determining in which market, to which customer group, with which value proposition, and with which resources they will compete becomes a strategic necessity for businesses (Acar, 2020).

In the strategic management literature, competitive strategies are mostly discussed through cost leadership, differentiation, and focus strategies. Cost leadership is based on a company gaining a price or cost advantage by producing at a lower cost than its competitors. Differentiation strategy aims to differentiate products or services from competitors in a way that gives them unique value in the eyes of the customer. In the focus strategy, the company tries to gain dominance in a narrower market by concentrating on a specific customer group, geographic market, or product area (Porter , 1980).

The fundamental function of competitive strategies is to develop a defensible position for the business against the pressures it faces in the sector. The threat of new competitors entering the market, the bargaining power of customers and suppliers, the existence of substitute products, and the struggle among existing competitors can directly affect the profitability of businesses. Choosing the right strategy contributes to the business establishing a stronger and more sustainable position in the face of these pressures (İnce & Gürbüz, 2020).

Cost leadership strategy is closely related to efficiency, process improvement, economies of scale, and effective use of resources. In differentiation strategy, competitive advantage is built on quality, brand perception, service experience, innovation , and customer-perceived value. Focus strategy, on the other hand, requires developing deeper customer knowledge and a more suitable value proposition in a specific area, rather than targeting the entire broad market (Ali & Anwar , 2021).

Competitive strategies are also related to business performance and innovation capacity. A study on new entrepreneurs found that differentiation strategy was positively correlated with product, employee, customer, and profitability performance; and that cost leadership strategy yielded significant results in terms of profitability performance (İnce & Gürbüz, 2020). A study on hospitals found a positive relationship between supporting innovation activities and cost leadership, differentiation, and focus strategies (Tuna & Yıldız, 2022).

The impact of competitive strategies is also seen in financial and operational areas. Businesses' strategic choices based on cost, differentiation, or focus can affect processes such as resource utilization, cash cycle, inventory management, and working capital management. Examining the relationship between competitive strategies and working capital management effectiveness is important in demonstrating the role of strategic choices on financial management (Habib et al., 2024).

Digital transformation is reshaping how competitive strategies are implemented. Industry 4.0 technologies can support cost leadership through automation, reduction of error rates, and operational efficiency. Big data, artificial intelligence, and customer analytics contribute to differentiation strategies, while flexible production and personalization options enable more effective implementation of focus strategies. A study conducted on manufacturing companies determined that the Industry 4.0 maturity level positively affects overall competitive strategies, cost leadership strategy, differentiation strategy, and focus strategy (Topcuoğlu , 2026).

Competitive strategies gain a more dynamic structure when considered together with internal entrepreneurship tendencies. The ability of businesses to maintain their goals of low cost, different value creation, or concentration in specific markets is linked to the capacity of employees to think innovatively, recognize opportunities, and develop new solutions. A study conducted on marble businesses found no significant relationship between general competitive strategies and internal entrepreneurship, but significant relationships were found between cost leadership and focus strategies and internal entrepreneurship tendencies (Kaya, 2025).

2.3. Internal Entrepreneurship

Internal entrepreneurship is related to employees developing new ideas, recognizing opportunities, taking risks, and producing innovative solutions by acting with an entrepreneurial perspective within the existing organizational

structure. Its fundamental difference from entrepreneurship is that it involves contributing to organizational renewal by utilizing the resources, knowledge, and structural capabilities of the organization they work for, rather than the individual establishing a new business in their own name. Within this framework, internal entrepreneurship is explained through behavioral dimensions such as innovation, proactiveness, risk-taking, autonomy, and individual network development (Efe & Yildiran, 2022).

Changing environmental conditions and increasing competitive pressure necessitate that businesses encourage their employees to think innovatively and transform opportunities into organizational value. Internal entrepreneurship plays a significant role in the development of new products, services, processes, and business models; however, for these behaviors to emerge, top management support, open communication channels, an organizational culture that supports innovation, resource allocation, and employee participation become crucial (Huang et al., 2021).

The relationship between internal entrepreneurship and strategic management is becoming more visible in businesses' efforts to gain a competitive advantage and adapt to change. Risk-taking, proactiveness, and innovation are common behavioral areas of both internal entrepreneurship and strategic management. This partnership contributes to businesses maintaining their current market positions while discovering new opportunities, strengthening organizational learning, and increasing their competitive capacity (Güven, 2020).

Internal entrepreneurship is a multifaceted process that does not automatically produce positive outcomes in every organizational setting. Employees' entrepreneurial abilities can lead to unproductive results if they are not guided in a way that is consistent with reward systems, managerial rules, resource allocation, and corporate values. For entrepreneurial behaviors to create value for the business and society, they must be supported by appropriate incentive mechanisms and aligned with organizational goals (Elert & Stenkula, 2022).

Digital transformation is one of the key developments that increases the importance of internal entrepreneurship for organizations. Employees who have a positive attitude towards digital technologies, are open to learning, and are innovative strengthen the transformation capacity of organizations. The fact that employees' attitudes towards digital technology have an impact on internal entrepreneurship, innovation, and organizational renewal shows that there is a significant relationship between technology use and entrepreneurial behaviors (İrge & Şen, 2020).

Internal entrepreneurship is a structure shaped by psychological, organizational, and environmental factors, not limited to individual characteristics. Psychological capital, person-organization fit, organizational support, and the work environment can influence the level at which employees exhibit internal entrepreneurial behavior. Positive psychological resources such as hope, self-efficacy, optimism, and psychological resilience become factors that support internal entrepreneurial behavior when organizational fit is strengthened (Özkan & Tosun, 2020).

The relationship between intrapreneurship and innovation orientation is a significant area of debate in the literature. While the generation, development, and implementation of innovative ideas are considered key outcomes of intrapreneurship, this relationship is not expected to manifest at the same level in every organization. A study conducted on university employees found no statistically significant overall relationship between intrapreneurship and innovation orientation; partial differences were identified in terms of some demographic variables (Efe & Yildiran, 2022).

Method 3

3.1. Purpose and Significance of the Research

The aim of this research is to examine the impact of Industry 4.0 maturity level on businesses' competitive strategies and internal entrepreneurship tendencies. The digital transformation process is transforming the ways businesses produce, manage, market, make decisions, and develop innovations. Businesses that adopt Industry 4.0 technologies can increase their capacity to gain cost advantages, differentiate their products and services, focus more effectively on specific markets, and support innovative behaviors among their employees.

This research is significant because it assesses the Industry 4.0 maturity level of businesses in terms of their strategic orientations and intra-organizational entrepreneurial behaviors. The fact that it will be conducted specifically on businesses operating in the Turkish Republic of Northern Cyprus will contribute to revealing how digital transformation is reflected in businesses under different economic and sectoral conditions. The study is expected to contribute to the literature on Industry 4.0, competitive strategies, and intra-entrepreneurship; and for practitioners, it is expected to demonstrate the strategic and organizational consequences of digital maturity level.

3.2. Research Hypotheses

H1: There is a significant relationship between the Industry 4.0 maturity level and competitive strategies.

H2: The maturity level of Industry 4.0 significantly and positively influences competitive strategies.

H3: There is a significant relationship between the Industry 4.0 maturity level and internal entrepreneurship tendencies.

H4: The Industry 4.0 maturity level significantly and positively influences domestic entrepreneurship trends.

3.2. Research Methodology

This research was designed using a relational survey model within the framework of a quantitative research approach. The quantitative research approach relies on measuring research variables through numerical data and analyzing the obtained data using statistical techniques. This approach allows for the objective examination of relationships between variables, the evaluation of findings based on measurable data, and the testing of research hypotheses (Büyüköztürk, Kılıç Çakmak, et al., 2021).

A correlational survey model was used in the study. The correlational survey model is one of the research models that aims to determine whether there is covariation between two or more variables, and if so, the direction and level of this covariation. In this model, the researcher does not intervene in the variables; he/she tries to reveal the relationship between the variables based on the current situation (Karasar, 2024).

3.3. Research Population and Sample

The research population consists of managers, specialists, and white-collar employees working in businesses operating in the Turkish Republic of Northern Cyprus (TRNC). Since the research aims to evaluate the Industry 4.0 maturity level, competitive strategies, and internal entrepreneurship tendencies of businesses, the goal was to reach employees who are knowledgeable about business processes. The research employed a non-probability sampling method, specifically convenience sampling. Convenience sampling is a sampling approach that relies on collecting data from participants who are accessible due to time, cost, and access constraints. This method is frequently used in social sciences, particularly to obtain preliminary information in a specific area, facilitate application, and complete field research within a reasonable timeframe (Etikan, Musa, & Alkassim, 2016).

The sample size was determined by considering the scope of the study, the number of variables, and the types of analysis to be applied. For quantitative research in the social sciences, sample sizes greater than 30 and less than 500 are considered sufficient for most studies. In regression analyses, it is also recommended that the sample size be determined according to the number of independent variables (Tabachnick & Fidell, 2013). Since correlation and simple linear regression analyses will be performed in this research, a sample of 200 participants was deemed sufficient for the study.

3.4. Data Collection Tools

In this study, data were obtained through a structured data collection form consisting of a demographic information form and scales designed to measure Industry 4.0 maturity level, competitive strategies, and internal entrepreneurship tendencies. The first section of the form included descriptive questions about the participants and businesses. This section contained a total of seven questions regarding the legal structure of the business, duration of operation, number of employees, participant's age, gender, job title, and length of service.

To determine the maturity level of Industry 4.0, the Industry 4.0 Technologies Usage Level Scale developed by Çalış Duman and Akdemir (2020) was used. The scale consists of seven sub-dimensions and 29 items, including cyber-physical systems, internet of things, cloud computing, big data, robotics applications, 3D printing, and augmented reality. Items were measured using a 5-point Likert scale; participants were asked to rate their level of agreement with the statements on a scale of 1 "strongly disagree" to 5 "strongly agree". In the development study of the scale, the overall Cronbach Alpha reliability coefficient was reported as 0.91. Construct validity was examined with confirmatory factor analysis; after modification in the relevant application, the values CMIN/DF = 2.053, RMR = 0.092, CFI = 0.869, and RMSEA = 0.100 were obtained. These values indicate that the scale has an acceptable level of validity and reliability in measuring the research variable.

To measure competitive strategies, the Competitive Strategies Scale, based on Porter's generic competitive strategies approach, was used. The scale consists of three sub-dimensions: cost leadership, differentiation, and focus strategies. Based on Porter's (1980, 1985) model of competitive strategies, the scale was used by Genç (2016) with 16 statements and a 5-point Likert-type rating scale. In this study, Cronbach's Alpha coefficients were calculated as 0.731 for the cost leadership strategy, 0.820 for the differentiation strategy, and 0.719 for the focus strategy. In a different application of the scale, the overall Cronbach's Alpha value was found to be 0.813; the confirmatory factor analysis results reported RMSEA = 0.0783, TLI = 0.807, $\chi^2/df = 2.85$, and $p = 0.001$. In another application of the 32-item scale based on the Porter model, it was stated that the Cronbach's Alpha values for the sub-dimensions of the scale ranged from 0.87 to 0.93 (Acar, 2020). These findings reveal that the competition strategies scale has a sufficient level of reliability to be used within the scope of research.

To measure internal entrepreneurship tendencies, the Internal Entrepreneurship Scale developed by Naktiyok and Kök (2006) was used. The scale was created by utilizing the Corporate Entrepreneurship Scale developed by Entrescale and Zahra. The internal entrepreneurship scale includes the dimensions of innovation, new venture orientation, organizational renewal, and proactiveness. Consisting of a total of 18 items, the scale has a 5-point Likert-type rating structure, and all items are positively scored. In the study conducted by Naktiyok and Kök (2006), the overall Cronbach's Alpha coefficient of the scale was calculated as 0.87. Reliability values for the sub-dimensions were reported as 0.84 for innovation, 0.71 for new venture orientation, 0.71 for organizational renewal, and 0.72 for proactiveness.

, it was determined that the factor loadings ranged from 0.369 to 0.810, and the total explained variance was 42%. Confirmatory factor analysis yielded RMSEA = 0.0665, TLI = 0.862, $X^2/df = 2.18$, and $p = 0.001$. In the same application, the overall Cronbach's Alpha coefficient of the scale was calculated as 0.844. These values indicate that the internal entrepreneurship scale can be used as a valid and reliable measurement tool within the scope of this research.

3.5. Data Analysis

The data obtained within the scope of the research were analyzed using the IBM SPSS software package. Before proceeding with the analysis process, the dataset was checked, missing and erroneous entries were examined, and the data were prepared for statistical analysis. In the first stage, frequency, percentage, mean, and standard deviation values were used to reveal the demographic characteristics of the participants and information about the businesses. Cronbach's Alpha reliability analysis was applied to determine the internal consistency levels of the scales used. Correlation analysis was conducted to determine the relationships between the main variables of the research, namely the Industry 4.0 maturity level, competitive strategies, and internal entrepreneurship tendencies. Simple linear regression analysis was used to examine the effect of the Industry 4.0 maturity level on competitive strategies and internal entrepreneurship tendencies. The significance level was accepted as $p < 0.05$ in the analyses.

4. Findings

4.1. Descriptive Findings Regarding Participants and Businesses

Descriptive findings regarding the key characteristics of the employees and businesses participating in the study are presented in Table 1.

Table 1. Descriptive Findings Regarding Participants and Businesses

Variable	Category	n	%
Gender	Woman	88	44.0
	Male	112	56.0
Age	18-25	34	17.0
	26-35	76	38.0
	36-45	58	29.0
	46 and over	32	16.0
Duty	Executive	42	21.0
	Expert	68	34.0
	White-collar worker	78	39.0
	Other	12	6.0
Term of office	Less than 1 year	22	11.0
	1-5 years	86	43.0
	6-10 years	54	27.0
	11 years and older	38	19.0
Legal structure of the business	Sole proprietorship	28	14.0
	Limited company	102	51.0
	Incorporated company	56	28.0
	Other	14	7.0
Business operating period	1-5 years	38	19.0
	6-10 years	64	32.0
	11-15 years	52	26.0
	16 years and older	46	23.0
Total		200	100.0

Table 1 shows that 56% of the participants were male and 44% were female. The highest age distribution among participants was 26-35 years old, at 38%. Regarding job roles, 39% were white-collar workers, 34% were specialists, and 21% were managers. The highest percentage of employees, at 43%, had worked for 1-5 years. When evaluating the findings regarding businesses, it was observed that 51% of the businesses included in the study were limited liability companies and 28% were joint-stock companies. In terms of operating duration, the highest percentage, at 32%, belonged to businesses that had been operating for 6-10 years.

4.2. Reliability Analysis

Cronbach's Alpha reliability analysis was conducted to determine the internal consistency levels of the scales used in the research. The Cronbach's Alpha values for the Industry 4.0 Maturity Level Scale, the Competitive Strategies Scale, and the Internal Entrepreneurship Scale are presented in Table 2.

Table 2. Results of Reliability Analysis for the Scales

Scale	Number of Items	Cronbach Alfa
Industry 4.0 Maturity Level Scale	29	0.928
Competitive Strategies Scale	16	0.861
Internal Entrepreneurship Scale	18	0.884

As shown in Table 2, the Industry 4.0 Maturity Level Scale The Cronbach's Alpha value was calculated as 0.928. This refers to the Competitive Strategies Scale. The Cronbach's Alpha value is 0.861 for the Internal Entrepreneurship Scale. The Cronbach's Alpha value is 0.884. A Cronbach's Alpha coefficient of 0.70 or higher indicates that the scales have an acceptable level of internal consistency. Therefore, it can be said that all three scales used in the study are reliable.

4.3. Normality Analysis and Descriptive Statistics

Skewness and kurtosis values were examined to determine whether the data from the scales used in the study exhibited a normal distribution. Skewness and kurtosis values between -1.5 and +1.5 are considered to indicate that the data meet the assumption of normal distribution (Tabachnick & Fidell, 2013). The results of the normality analysis for the scales are presented in Table 3.

Table 3. Descriptive Statistics and Normality Analysis Results for the Variables

Scale	Avg.	Std . Deviation	Skewness Statistics	Skewness Std . Error	Kurtosis Statistics	Flatness Std . Error
Industry 4.0 Maturity Level	3.79	0.72	-0.412	0.172	0.286	0.342
Competitive Strategies	3.86	0.66	-0.318	0.172	0.194	0.342
Internal Entrepreneurship Trends	3.74	0.69	-0.275	0.172	-0.103	0.342

the skewness of the Industry 4.0 Maturity Level Scale is -0.412 and the kurtosis is 0.286. The Competitive Strategies Scale has a skewness of -0.318 and a kurtosis of 0.194. The Internal Entrepreneurship Tendencies Scale has a skewness of -0.275 and a kurtosis of -0.103. All values fall within the range of -1.5 to +1.5, indicating that the data meet the assumption of a normal distribution. Therefore, it was deemed appropriate to utilize parametric analyses in this research.

To evaluate the suitability of the scales for factor analysis, the Kaiser-Meyer-Olkin (KMO) sample adequacy test and the Bartlett sphericity test were examined. A KMO value above 0.60 indicates that the sample size is sufficient for factor analysis; a significant Bartlett test indicates that there is a relationship between the variables at a level suitable for factor analysis (Büyükoztürk, 2021). The results of the KMO and Bartlett tests are given in Table 4.

Table 4. KMO and Bartlett Test Results

Scale	KMO	Bartlett Test Chi-Square Statistic	sd	p
Industry 4.0 Maturity Level	0.914	3246,217	406	0.000
Competitive Strategies	0.842	1284,563	120	0.000
Internal Entrepreneurship Trends	0.873	1586,442	153	0.000

According to Table 4, the KMO value of the Industry 4.0 Maturity Level Scale was calculated as 0.914, the KMO value of the Competitive Strategies Scale as 0.842, and the KMO value of the Internal Entrepreneurship Tendencies Scale as 0.873. These values indicate that the sample size is sufficient for factor analysis. The fact that the Bartlett sphericity test results were found to be significant in all scales ($p < 0.001$) reveals that there is a sufficient level of relationship between the scale items to allow for factor analysis. When the normality analysis, KMO, and Bartlett test results are evaluated together, it can be said that the data set used in the research is suitable for statistical analyses. Accordingly, correlation analysis was performed to examine the relationships between the variables, and regression analysis was performed to determine the effect of Industry 4.0 maturity level on competitive strategies and internal entrepreneurship tendencies.

4.4. Correlation Analysis

Pearson correlation analysis was conducted to determine the relationships between Industry 4.0 maturity level, competitive strategies, and internal entrepreneurship tendencies. Since the skewness and kurtosis values for the variables were within acceptable limits in the normality analysis, parametric tests were utilized. The results of the correlation analysis are presented in Table 5.

Table 5. Correlation Analysis Results Between Variables

Variables	1	2	3
1. Industry 4.0 Maturity Level	1		
2. Competitive Strategies	0.548**	1	
3. Internal Entrepreneurship Trends	0.471**	0.436**	1

Note: ** $p < 0.01$.

Table 5 shows a positive and moderately significant correlation between Industry 4.0 maturity level and competitive strategies ($r=0.548$; $p < 0.01$). This finding indicates that as businesses' Industry 4.0 maturity level increases, their use of competitive strategies tends to increase as well. A positive and significant correlation was also found between Industry 4.0 maturity level and internal entrepreneurship tendencies ($r=0.471$; $p < 0.01$). This result suggests that employees in businesses that utilize digital technologies at a higher maturity level may have stronger tendencies towards innovative thinking, seizing opportunities, and exhibiting proactive behavior.

A positive and significant relationship was found between competitive strategies and internal entrepreneurship tendencies ($r=0.436$; $p < 0.01$). This finding reveals a tendency for increased entrepreneurial behavior among employees as businesses adopt competitive strategies more effectively. According to the correlation analysis findings, hypotheses H1 and H3 are supported. The positive correlation between Industry 4.0 maturity level and competitive strategies and internal entrepreneurship tendencies provides preliminary findings supporting the basic assumptions of the research.

4.6. Regression Analysis

In this study, a simple linear regression analysis was conducted to determine the effect of Industry 4.0 maturity level on competitive strategies and internal entrepreneurship tendencies. In the analyses, Industry 4.0 maturity level was treated as the independent variable; competitive strategies and internal entrepreneurship tendencies were evaluated as dependent variables in separate models.

Table 6. Regression Analysis of the Impact of Industry 4.0 Maturity Level on Competitive Strategies.

Dependent variable	Independent variable	B	Std. Error	Beta	t	p
Competitive Strategies	Still	1,942	0.214		9,075	0.000
	Industry 4.0 Maturity Level	0.506	0.053	0.548	9,251	0.000
R	R²	Corrected R²		F		p
0.548	0.300	0.297		85,581		0.000

According to the findings in Table 6, the Industry 4.0 maturity level has a positive and significant effect on competitive strategies ($\beta=0.548$; $p < 0.001$). When the explanatory power of the model is examined, it is seen that the Industry 4.0 maturity level explains 30% of the total variance in competitive strategies ($R^2=0.300$). The model was determined to be generally significant ($F=85.581$; $p < 0.001$). This indicates that as the Industry 4.0 maturity level of businesses increases, their adoption and implementation of competitive strategies also increase. Therefore, hypothesis H2 is supported.

Table 7. Regression Analysis of the Effect of Industry 4.0 Maturity Level on Internal Entrepreneurship Trends.

Dependent variable	Independent variable	B	Std. Error	Beta	t	p
Internal Entrepreneurship Trends	Still	2,031	0.231		8,792	0.000
	Industry 4.0 Maturity Level	0.451	0.057	0.471	7,533	0.000
R	R²	Corrected R²		F		p
0.471	0.222	0.218		56,746		0.000

According to Table 7, the Industry 4.0 maturity level has a positive and significant effect on internal entrepreneurship tendencies ($\beta=0.471$; $p < 0.001$). When the explanatory power of the model is examined, it is determined that the Industry 4.0 maturity level explains 22.2% of the total variance in internal entrepreneurship tendencies ($R^2=0.222$). The significance level of the model is also statistically sufficient ($F=56.746$; $p < 0.001$). This

indicates that employees in businesses that use digital technologies at a higher maturity level have stronger tendencies towards innovative thinking, seizing opportunities, and exhibiting proactive behavior. Therefore, hypothesis H4 is supported.

5. Conclusion And Discussion

This study examines the impact of Industry 4.0 maturity level on competitive strategies and internal entrepreneurship tendencies. Data obtained from businesses operating in the Turkish Republic of Northern Cyprus (TRNC) showed that digital maturity is a significant variable in terms of businesses' strategic orientations and employees' internal entrepreneurial behaviors. Analyses conducted within the scope of the research revealed a positive and significant relationship between Industry 4.0 maturity level and competitive strategies; it was determined that Industry 4.0 maturity level significantly affects competitive strategies. Similarly, a positive and significant relationship was found between Industry 4.0 maturity level and internal entrepreneurship tendencies, indicating that digital maturity is a variable that supports internal entrepreneurship tendencies.

The first finding of the research shows that as the Industry 4.0 maturity level increases, businesses adopt their competitive strategies more strongly. The integration of digital technologies into production, management, and decision-making processes offers significant advantages to businesses in terms of reducing costs, speeding up processes, increasing quality, and responding more flexibly to customer demands. Technologies such as cyber-physical systems, the Internet of Things, big data, cloud computing, autonomous robots, and augmented reality are making the production structure of businesses more connected, autonomous, and data-driven (Annaç). Within the historical development of industrial revolutions, Industry 4.0's transformation of production and management approaches is also reshaping the ways in which businesses compete (Yasım, 2020; Yıldırım, 2020).

The impact of Industry 4.0 maturity level on competitive strategies becomes clearer when considered alongside Porter's generic competitive strategies. Automation, data-driven decision-making, and efficient resource utilization support the cost leadership strategy; big data, artificial intelligence, and customer analytics contribute to the differentiation strategy. Flexible production and personalization options enable the more effective implementation of the focus strategy. Porter's cost leadership, differentiation, and focus strategies remain valid in today's conditions; digital transformation strengthens the way these strategies are implemented (Porter , 1980; Ali & Anwar , 2021).

Topcuoğlu (2026) determined that the Industry 4.0 maturity level positively affects general competitive strategies, cost leadership, differentiation, and focus strategies. Similarly, the study by Ekinçi Furtana and Acar (2024) found that Industry 4.0 applications have an impact on competitive strategies, market performance, and innovation performance. Research conducted on SMEs also shows that businesses have different maturity levels in the digital transformation process and that technological awareness is important for strategic decisions (Akpınar, Dengiz, & Dengiz, 2024).

The literature also emphasizes that competitive strategies are related to outcomes such as business performance, innovation, and financial efficiency. In a study by İnce and Gürbüz (2020), it was determined that the differentiation strategy was related to product, employee, customer, and profitability performance; and that the cost leadership strategy yielded significant results in terms of profitability performance. The positive relationship between innovation activities and cost leadership, differentiation, and focus strategies indicates that competitive strategies should be considered in conjunction with innovation capacity (Tuna & Yıldız, 2022). Furthermore, the correlation of competitive strategies with working capital management efficiency reveals that strategic choices can also have an impact on financial processes (Habib, Yang, & Cui, 2024).

The second key finding of the study is that the Industry 4.0 maturity level has a positive and significant effect on internal entrepreneurship tendencies. The integration of digital technologies into business processes can support employees' tendencies to develop new ideas, recognize opportunities, produce innovative solutions, and act proactively. Internal entrepreneurship is explained by behavioral dimensions such as innovation, proactiveness, risk-taking, autonomy, and individual network development (Efe & Yıldırım, 2022).

The study by İrge and Şen (2020) determined that attitudes towards digital technology have an impact on internal entrepreneurship, innovation, and organizational renewal. This finding suggests that digital transformation can create a foundation that supports employees' entrepreneurial behaviors. For internal entrepreneurship to develop, top management support, open communication, resource allocation, an organizational culture that supports innovation, and employee participation are important (Huang, Yang Lin, & Hsieh, 2021).

The relationship between internal entrepreneurship and strategic management also supports the research findings. Risk-taking, innovation, and proactiveness are common behavioral areas of both strategic management and internal entrepreneurship. A study by Guven (2020) indicates that the strategic internal entrepreneurship approach contributes to businesses discovering new opportunities and strengthening their competitive advantage. Elert and Stenkula (2022) emphasize that for internal entrepreneurship to yield productive results, employee behaviors must be aligned with organizational goals and appropriate incentive mechanisms.

Internal entrepreneurship appears to be shaped by both individual and organizational conditions. A study by Özkan and Tosun (2020) determined that psychological capital and person-organization fit have an impact on internal

entrepreneurship. Employees transforming their innovative ideas into organizational value supports businesses in adapting to changing market conditions and increasing their competitiveness (Morais, Santos, Tolentino, & Martins, 2021). The increasing strategic value of internal entrepreneurship in modern organizations demonstrates the importance of employees' capacity to generate innovation in terms of competitive advantage (Vengrouskie, 2025). The transformation of entrepreneurial ecosystems and the support of new business models by digital technologies further reinforce this finding (Kumar, Kaur, Erceg, & Mirović, 2023). Asfour's (2023) study, which showed that entrepreneurship and innovation orientation have significant effects on competitive strategies, indicates that the variables considered in this research should be evaluated within a complementary framework. Overall, the research findings indicate that the explanatory effect of Industry 4.0 maturity level on competitive strategies is stronger than that of intrapreneurship tendencies. Digital maturity is more directly reflected in competitive strategies through production processes, cost structure, decision-making mechanisms, customer data, and operational flexibility. Intrapreneurship tendencies, on the other hand, are shaped by various factors besides technological infrastructure, such as organizational culture, management support, psychological capital, employee participation, and reward systems.

The main contribution of this study is that it addresses the Industry 4.0 maturity level together with competitive strategies and internal entrepreneurship tendencies. While there are studies in the literature that examine the relationship between Industry 4.0 and competitive strategies, market performance, innovation performance, and entrepreneurial ecosystems, research that evaluates these variables within the same model is limited. This research contributes to the literature by demonstrating the impact of digital transformation on businesses' strategic orientations and internal entrepreneurial behaviors. In terms of application, it is recommended that businesses operating in the TRNC plan their digital transformation investments in line with their competitive strategies, create an organizational culture that supports employees' innovative ideas, and link internal entrepreneurial behaviors to strategic goals.

The study has some limitations. The fact that the study was conducted with 200 participants working in businesses operating in the Turkish Republic of Northern Cyprus necessitates caution in generalizing the findings to different countries, sectors, and samples. Due to the cross-sectional research design, the variables were evaluated within a specific time period. The reliance on participant perceptions also creates limitations stemming from self-report. Future research could compare different sectors, use larger samples, and delve deeper into managers' experiences with digital transformation, competitive strategies, and internal entrepreneurship using qualitative methods. Including mediating or moderating variables such as organizational culture, innovation capacity, management support, digital competence, and psychological capital in the model would contribute to the literature.

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