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Business Continuity Model for Knowledge-Based Enterprises

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ABSTRACT

The aim of this study was to develop a comprehensive paradigmatic model for the continuity of knowledge-based enterprises and to identify the key influencing factors, including financial sustainability, organizational capacity, continuous innovation, human capital, networking, environmental and institutional conditions, and organizational strategies. By focusing on the analysis of causal relationships among these factors, the study sought to explain the principal pathways leading to desirable outcomes and organizational resilience. This research was applied-descriptive in nature and was based on Structural Equation Modeling (SEM). Data were collected through questionnaires and interviews with managers and experts of knowledge-based enterprises. The analyses included the evaluation of the measurement model (factor loadings, validity, and reliability), path analysis, coefficient of determination (R^2), predictive relevance index (Q^2), and hypothesis testing. In addition, qualitative analyses were conducted using open and axial coding techniques to extract the key patterns underlying business continuity. The findings indicated that the continuity of knowledge-based enterprises is directly influenced by causal conditions, contextual conditions, and intervening conditions through their effects on organizational strategies and outcomes. The path Causal Conditions → Continuity of Knowledge-Based Enterprises demonstrated the strongest effect ($\beta = 0.668$). Organizational strategies also played a significant mediating role in achieving desirable outcomes and enhancing organizational resilience ($\beta = 0.547$). Furthermore, human capital, networking, continuous innovation, financial sustainability, and organizational capacity were identified as the primary drivers of business continuity. Based on the findings, the doctrine of the knowledge-based enterprise continuity model encompasses maintaining a balance among financial sustainability, organizational capacity, and continuous innovation; leveraging human capital and networking capabilities; paying attention to environmental and institutional conditions; and formulating appropriate and targeted strategies. This framework can serve as a scientific reference and a practical guide for managers of knowledge-based organizations, policymakers, and researchers in designing and implementing long-term strategies.

Keywords: Knowledge-Based Enterprise Continuity, Organizational Resilience, Continuous Innovation, Human Capital, Networking, Paradigmatic Model, Organizational Strategies.

Introduction

The contemporary business environment, characterized by rapid technological advances, global competition, and economic uncertainty, has amplified the importance of sustaining knowledge-based enterprises (KBEs) over time (1, 2). Knowledge-based enterprises, as entities whose primary assets are intangible resources such as

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expertise, intellectual property, and innovative capabilities, rely heavily on continuous innovation, human capital, and adaptive strategies to maintain competitive advantage and organizational resilience (3, 4). In this context, business continuity emerges not merely as a reactive response to crises, but as a proactive framework that integrates risk management, strategic planning, and innovation management to ensure long-term sustainability (5, 6).

Business continuity, historically rooted in disaster recovery and operational resilience, has evolved into a comprehensive management discipline encompassing organizational, technological, and strategic dimensions (7, 8). In knowledge-intensive enterprises, the continuity framework must accommodate not only traditional operational disruptions but also knowledge-specific risks such as loss of tacit expertise, intellectual property breaches, and discontinuities in innovation pipelines (2, 9). Empirical studies indicate that KBEs that integrate knowledge management systems, digital platforms, and innovation-oriented cultures are better positioned to absorb shocks, recover rapidly, and exploit emergent opportunities in competitive markets (1, 10).

The dynamic capabilities perspective emphasizes that KBEs achieve continuity by orchestrating internal resources and external relationships to respond to environmental volatility (4, 11). Components such as organizational agility, absorptive capacity, and networked collaboration enable these enterprises to sense opportunities and threats, seize value-creating initiatives, and transform operations to preserve knowledge assets and market position (3, 12). In addition, governance structures tailored to knowledge management, including decision-making hierarchies and digital knowledge sharing protocols, reinforce the stability and adaptability of KBEs (6, 13).

Innovation plays a pivotal role in sustaining KBEs, as continuous product, process, and service innovation constitutes both a source of competitive advantage and a mechanism for organizational resilience (1, 14). Transformational leadership, fostering an innovation climate, enhances the capacity of employees to engage in creative problem-solving and knowledge exchange, thereby reducing vulnerability to external disruptions (1, 15). Similarly, effective governance of mergers, acquisitions, and strategic partnerships contributes to continuity by consolidating resources, diversifying knowledge assets, and mitigating operational risks (16, 17).

Risk management, encompassing both operational and strategic dimensions, constitutes another critical pillar for business continuity in KBEs (10, 18). Proactive identification of potential threats—ranging from supply chain vulnerabilities and financial uncertainties to technological disruptions—enables organizations to implement contingency strategies, redundant knowledge systems, and adaptive operational processes (7, 19). Studies demonstrate that organizations integrating risk management with knowledge governance and innovation orientation achieve higher resilience scores and are better equipped to maintain operational and strategic performance under crisis conditions (5, 8).

The spatial and contextual factors affecting KBEs further influence their continuity strategies. Research highlights that the location of knowledge-based enterprises, access to specialized labor markets, institutional support, and environmental conditions shape both innovation outcomes and resilience capacities (14, 20). Organizations that leverage favorable spatial positioning, institutional networks, and resource-rich ecosystems exhibit superior continuity performance, as they can mobilize resources rapidly, integrate new knowledge, and exploit strategic collaborations (3, 11).

Integration of supply chain and operational management into the continuity framework is also essential, as production, procurement, and distribution disruptions can critically impair knowledge-based operations (21, 22).

Advanced planning methods, dynamic scheduling, and digital supply chain monitoring enhance predictability, reduce exposure to external shocks, and enable rapid response to operational contingencies (10, 19). Furthermore, lean automation and Industry 4.0 technologies, by embedding intelligence and flexibility into processes, support both innovation and continuity in knowledge-intensive production environments (8, 19).

Sustainability and social responsibility are increasingly integrated into the continuity discourse. KBEs that embed environmental, social, and governance (ESG) principles into strategy and operations not only meet regulatory and societal expectations but also strengthen long-term viability and stakeholder trust (8, 23). Aligning innovation initiatives with sustainable development goals ensures that the enterprise remains competitive while minimizing exposure to reputational and regulatory risks (3, 9).

Finally, digital transformation and platform-based knowledge sharing play a strategic role in business continuity. Digital platforms facilitate real-time collaboration, knowledge retention, and process standardization, which collectively reduce organizational vulnerability to personnel turnover, knowledge loss, and market turbulence (1, 2). The integration of knowledge governance, digital infrastructure, and adaptive leadership enables KBEs to not only survive disruptions but also exploit them as opportunities for renewal and growth (15, 16).

In summary, sustaining knowledge-based enterprises requires a multidimensional approach that integrates risk management, innovation, knowledge governance, spatial and institutional alignment, operational resilience, and digital transformation (3, 6, 13). Previous studies highlight the interplay between organizational resources, strategic agility, and environmental factors as decisive for long-term continuity and competitive advantage (12, 14, 24). The literature consistently emphasizes that a proactive, integrated continuity framework, grounded in both internal capabilities and external relationships, is essential for KBEs to withstand disruptions, preserve critical knowledge, and sustain growth (1, 4, 5).

Based on these considerations, the aim of this study is to develop a comprehensive paradigm model for the continuity of knowledge-based enterprises, integrating strategic, operational, and knowledge-oriented dimensions.

Methods and Materials

This study was conducted with the aim of presenting a comprehensive model for the continuity of knowledge-based enterprises. In terms of orientation, it falls within the category of fundamental-applied research; in terms of research philosophy, it is interpretivist; and in terms of approach and purpose, it is inductive and exploratory. The research method was designed as a mixed-methods approach, including both qualitative and quantitative phases. Accordingly, the qualitative phase was first conducted using grounded theory, and the data were collected through semi-structured and exploratory interviews with academic experts and knowledgeable managers. Sampling in the qualitative phase was carried out purposefully, using snowball and convenience sampling methods, and the data collection process continued until theoretical saturation was achieved. Qualitative data analysis was performed using MAXQDA software through three stages of open, axial, and selective coding. Finally, the core category, causal conditions, contextual conditions, intervening conditions, strategies, and outcomes were identified, and the conceptual model of the study was extracted. The validity of the qualitative findings was ensured through expert review, theoretical sensitivity, theoretical saturation, examination of negative cases, and rich description of the data.

Subsequently, in order to empirically test and generalize the extracted model, the quantitative phase of the study was conducted. Accordingly, a researcher-made multi-item questionnaire based on the results of the qualitative phase was designed and, after preliminary validation through the Delphi method and the Content Validity Ratio

(CVR), was distributed among the statistical population consisting of managers of knowledge-based companies in Tehran Province. The sample size was determined to be 352 participants using Cochran's formula, and the data were collected using a Likert scale. The validity of the instrument was examined and confirmed through content validity and confirmatory factor analysis, while its reliability was assessed using Cronbach's alpha coefficient. Quantitative data analysis was conducted using descriptive and inferential statistics through SPSS and SmartPLS software, including exploratory and confirmatory factor analysis and evaluation of model fit. At all stages of the research, ethical considerations, researcher neutrality, transparency in data analysis, and consensus in categorization were taken into account in order to enhance the validity and reliability of the results.

Findings and Results

In this study, qualitative data were collected through in-depth semi-structured interviews with a group of academic experts, managers of knowledge-based companies, and specialists in the field of innovation policymaking. The criterion for selecting participants was their scientific and practical expertise in the subject of continuity and sustainability of knowledge-based enterprises. The sampling process began with purposive sampling and continued until theoretical saturation was reached.

After data collection, the interviews were transcribed verbatim and analyzed in three main stages: open coding, axial coding, and selective coding. In the first stage, namely open coding, meaning units were extracted from the text and initial concepts were formed. In the second stage, namely axial coding, similar concepts were organized into main and subcategories, and the causal, contextual, intervening, strategic, and outcome-related relationships among them were specified. Finally, in the third stage, namely selective coding, the central category was identified and the paradigmatic model of knowledge-based enterprise continuity was designed.

To ensure researcher neutrality, all stages of data analysis, interpretive decisions, and final codes were reviewed by several experts in the field of knowledge-based enterprises. In addition, a record of analytical memos and the coding process was maintained for external auditing.

Table 1: Validity and Reliability of Qualitative Data in the Knowledge-Based Enterprise Continuity Model

Row	Interviewee Code	Number of Extracted Codes	Inter-Coder Agreement (%)	Confidence Level (High/Moderate/Low)	Participant Review
1	P01	68	90	High	✓
2	P02	62	85	High	✓
3	P03	75	88	High	✓
4	P04	50	82	Moderate	✓
5	P05	73	91	High	✓
6	P06	60	86	High	✓
7	P07	78	89	High	✓
8	P08	55	81	Moderate	✗
9	P09	66	84	High	✓
10	P10	80	92	High	✓
11	P11	58	83	Moderate	✓
12	P12	64	87	High	✓
13	P13	71	90	High	✓
14	P14	52	79	Moderate	✗
15	P15	63	85	High	✓
16	P16	76	89	High	✓
17	P17	47	80	Moderate	✗
18	P18	70	88	High	✓

19	P19	54	82	Moderate	✓
20	P20	72	91	High	✓

The results of the above table indicate a high level of validity and reliability of the qualitative data in the interview analysis process. According to the data, the average inter-coder agreement was approximately 86.5%, indicating high convergence and stability in the coding process. Of the 20 interviews, participant review was conducted in 17 cases, and participants' comments were considered for the revision or final confirmation of the codes; this contributed to enhancing the internal validity of the results. Moreover, in most interviews, the confidence level was evaluated as "high," and only in a limited number of cases, such as P08, P14, and P17, was the confidence level reported as "moderate" due to lack of participation in the review process or lower data volume. Overall, the appropriate volume of extracted codes, with an average of approximately 65 codes per interview, and the high percentage of inter-coder agreement indicate that the analysis and coding of the qualitative phase of the study had desirable reliability, conceptual coherence, and analytical accuracy.

Table 2: Descriptive Indices of the Research Variables

Variable	N	Minimum Score	Maximum Score	Mean	Standard Deviation
Financial and economic sustainability	352	1.00	5.00	3.893	0.777
Technological capability and continuous innovation	352	1.75	5.00	3.794	0.718
Organizational and managerial capacity	352	2.00	5.00	3.586	0.663
Networking and strategic collaborations	352	2.67	5.00	3.870	0.475
Marketing and market development	352	2.00	4.75	3.629	0.537
Human capital and organizational learning	352	1.75	5.00	3.555	0.571
Institutional and environmental support	352	1.00	4.67	3.442	0.613
Agility and adaptation to uncertainties	352	1.00	5.00	3.380	0.717
Knowledge-based competitive advantage	352	1.00	5.00	3.534	0.649
Social and environmental responsibility	352	1.50	5.00	3.294	0.691

Based on the results of the table, among the variables examined, financial and economic sustainability had the highest mean value at 3.893, indicating that this dimension was endorsed by respondents more strongly than the other dimensions. It was followed by networking and strategic collaborations (3.870) and technological capability and continuous innovation (3.794), which demonstrates the prominent role of these factors in organizational sustainability and growth. In contrast, social and environmental responsibility, with a mean of 3.294, and agility and adaptation to uncertainties, with a mean of 3.380, showed the lowest mean values; in other words, these dimensions were less developed compared with the other components. In addition, the standard deviation values, which mostly ranged from 0.47 to 0.78, indicate a relatively moderate dispersion of responses and a relative convergence of participants' views regarding the variables under investigation.

Table 3 presents the distribution indices of the research variables, including skewness, kurtosis, and multivariate kurtosis.

Table 3: Distribution Indices of the Research Variables

Variable	Skewness	Kurtosis	Kolmogorov–Smirnov	Significance Level
Financial and economic sustainability	-0.587	0.142	0.093	0.080
Technological capability and continuous innovation	-0.484	-0.215	0.086	0.087
Organizational and managerial capacity	0.259	-0.473	0.079	0.094
Networking and strategic collaborations	-0.056	-0.008	0.057	0.116
Marketing and market development	-0.329	-0.036	0.064	0.109
Human capital and organizational learning	-0.170	0.397	0.068	0.105
Institutional and environmental support	-0.483	0.896	0.073	0.100

Agility and adaptation to uncertainties	-0.251	0.580	0.086	0.088
Knowledge-based competitive advantage	-0.041	0.318	0.078	0.096
Social and environmental responsibility	0.274	0.130	0.083	0.091
Multivariate kurtosis (critical value)	3.059	1.768	—	—

The results of the table show that the skewness and kurtosis values for all variables fall within the acceptable range, and the data have a relatively normal distribution. Most variables have mild negative skewness, such as financial and economic sustainability (-0.587) and technological capability (-0.484), indicating that responses tended more toward higher scores. In contrast, some variables, including organizational and managerial capacity (0.259) and social and environmental responsibility (0.274), have positive skewness, meaning that responses were slightly inclined toward lower values. In terms of kurtosis, all values ranged between -0.47 and 0.89, indicating no significant deviation from the normality of data distribution. Therefore, it can be stated that the distribution of the research variables was statistically appropriate and balanced and can be considered reliable for parametric analyses. In examining multivariate normality, the result of the ratio of the multivariate kurtosis index (3.059) to the critical value (1.768) was obtained as 1.730. Since this ratio is less than 2, multivariate normality was confirmed. Moreover, given that the significance level of the Kolmogorov–Smirnov test was greater than 0.05 for all variables, it can be claimed that the data distribution was normal.

In studies aimed at testing a specific model of relationships among variables, structural equation modeling is used. Structural equation modeling is a very powerful technique from the family of multivariate regression methods and, more precisely, an extension of the general linear model, which enables the researcher to test a set of regression equations simultaneously.

The main advantage of this modeling method over other methods is the validity of research results across different sample sizes. In other words, the partial least squares method does not have sample size limitations, and the selected sample can even be equal to or less than 30 (Gray, 2003). Therefore, considering the reasons stated, the partial least squares method was used in this study with the help of SmartPLS software to fit the conceptual model of the research and test the hypotheses. The research model was examined in three stages. In the first stage, the outer model of the study was examined; in the second stage, the inner model was assessed; and the third stage was devoted to evaluating the overall research model.

At this stage, three indices were used to examine model reliability: the homogeneous reliability criterion (rho) and Cronbach's alpha coefficient.

The homogeneous reliability criterion (rho) was introduced by Werts et al. (1974), and its advantage over Cronbach's alpha is that construct reliability is not calculated absolutely, but rather based on the correlations among the constructs. If the homogeneous reliability value for each construct is above 0.70 (Nunnally, 1978), it indicates appropriate internal reliability for the measurement models, while a value below 0.60 indicates lack of reliability. The rho coefficient is sometimes also referred to as the Dillon–Goldstein coefficient.

Composite reliability is considered a better criterion than Cronbach's alpha in structural modeling. This coefficient ranges from zero to one, and values above 0.70 are accepted. However, Moss et al. (1998) introduced 0.60 as the threshold for Cronbach's alpha coefficient for variables with a small number of questions.

Table 4: Construct Reliability

Variable	Cronbach's Alpha Coefficient	Homogeneous Reliability Statistic (rho/a)	Homogeneous Reliability Statistic (rho/c)
Continuity of knowledge-based enterprises	0.825	0.830	0.884
Strategies	0.847	0.862	0.885

Contextual conditions	0.853	0.863	0.891
Causal conditions	0.836	0.842	0.880
Intervening conditions	0.819	0.826	0.870
Outcomes	0.878	0.891	0.906

The composite reliability values of the research variables were confirmed because they were greater than the standard value of 0.70. This indicates that the model is acceptable in terms of external validity, and the structural dimensions of the model can be relied upon. According to the above table, Cronbach's alpha coefficient for all intended constructs was higher than 0.70, indicating appropriate reliability of the model.

Two criteria were used to examine the validity of the outer model. The first criterion was convergent validity, and the second was discriminant validity.

At this stage, the Average Variance Extracted (AVE) index was used. Convergent validity is the second criterion for assessing the fit of measurement models. It examines the degree of correlation between each construct and its own questions or indicators; the stronger this correlation, the greater the model fit. Fornell and Larcker (1981) introduced the Average Variance Extracted (AVE) criterion to assess convergent validity and stated that the critical value is 0.50. The table below presents the value of this coefficient for each construct. It should be noted that if the AVE criterion for a variable is lower than 0.50, the item with the lowest factor loading should be removed and the model should be re-estimated.

Table 5: Average Variance Extracted

Variable	Statistic Value
Continuity of knowledge-based enterprises	0.656
Strategies	0.527
Contextual conditions	0.580
Causal conditions	0.551
Intervening conditions	0.528
Outcomes	0.582

It should be noted that the convergent validity of the research model was confirmed because the extracted variance values for the variables were greater than 0.50.

Discriminant validity is the third criterion for assessing the fit of measurement models and covers two issues: first, comparing the correlation between the indicators of a construct and that construct with the correlation between those indicators and other constructs; and second, comparing the correlation of a construct with its indicators against the correlation of that construct with other constructs (Davari & Rezazadeh, 2013).

Another important criterion determined through discriminant validity is the relationship between a construct and its indicators compared with the relationship between that construct and other constructs. Acceptable discriminant validity in a model indicates that a construct interacts more strongly with its own indicators than with other constructs. Discriminant validity is acceptable when the AVE value for each construct is greater than the shared variance between that construct and other constructs, that is, the squared correlation coefficients between constructs in the model (Fornell & Larcker, 1981). This is examined using a matrix in which the cells contain the correlation coefficients between constructs and the square roots of the AVE values for each construct. Then, the values on the main diagonal of the matrix are replaced with the square roots of the AVE values, and finally, Table 6 is presented.

Table 6: Fornell–Larcker Table after Replacing Values with the Square Root of AVE

Variable	1	2	3	4	5	6
Continuity of knowledge-based enterprises	0.810	—	—	—	—	—
Strategies	0.525	0.726	—	—	—	—

Contextual conditions	0.552	0.534	0.761	—	—	—
Causal conditions	0.668	0.576	0.573	0.742	—	—
Intervening conditions	0.461	0.465	0.591	0.545	0.726	—
Outcomes	0.514	0.547	0.430	0.343	0.613	0.763

As observed in the above table, the values located on the main diagonal of the matrix are greater than all values in their corresponding rows and columns.

In examining the outer model of the study, the factor loadings of the research questions or indicators were first evaluated. Then, reliability and subsequently the validity of the inner model were examined.

At this stage, the factor loadings related to the measured indicators of each latent variable, namely the observed variables, were examined. Factor loadings above 0.50 are desirable, while values below this threshold should be removed.

Table 7: Factor Loadings of the Indicators or Questionnaire Items

Variable	t-Statistic	Standard Deviation	Factor Loading	p-value
Enhancing organizational resilience ← Outcomes	32.554	0.026	0.859	0.001
Increasing sustainable competitive advantage ← Outcomes	9.967	0.068	0.678	0.001
Creating a learning and flexible organizational structure ← Strategies	24.877	0.033	0.812	0.001
Technological branding and digital marketing ← Strategies	21.166	0.036	0.760	0.001
Consolidating position in domestic and global markets ← Outcomes	8.748	0.078	0.684	0.001
Data-driven and agile decision-making ← Strategies	18.596	0.042	0.780	0.001
Rapid technological changes ← Intervening conditions	19.673	0.039	0.775	0.001
Diversification of revenue sources ← Strategies	10.589	0.064	0.679	0.001
Development of a national knowledge-based brand ← Outcomes	18.532	0.042	0.784	0.001
Development of international collaborations ← Strategies	6.204	0.094	0.585	0.001
Recruitment of specialized human resources ← Causal conditions	18.490	0.042	0.775	0.001
Maintaining and enhancing survival ← Continuity of knowledge-based enterprises	20.280	0.038	0.780	0.001
Creating value from knowledge and technology ← Outcomes	37.853	0.022	0.851	0.001
Access to domestic and international markets ← Contextual conditions	7.747	0.078	0.606	0.001
Access to venture capital resources ← Causal conditions	25.316	0.032	0.798	0.001
Growth and competitiveness of the company ← Continuity of knowledge-based enterprises	17.929	0.042	0.759	0.001
Intense market competition ← Intervening conditions	23.419	0.034	0.787	0.001
Digital and technological infrastructure ← Causal conditions	13.704	0.049	0.677	0.001
Institutional and legal infrastructure ← Contextual conditions	32.532	0.026	0.837	0.001
Investment in research and development ← Causal conditions	13.831	0.051	0.711	0.001
Government support policies ← Contextual conditions	17.373	0.043	0.742	0.001
Networking with universities ← Strategies	8.601	0.070	0.602	0.001
Scientific and industrial networks ← Contextual conditions	24.735	0.031	0.776	0.001
Formation of a technological ecosystem ← Causal conditions	19.497	0.040	0.778	0.001
Formation of a dynamic learning cycle ← Continuity of knowledge-based enterprises	26.816	0.032	0.859	0.001
Instability of support policies ← Intervening conditions	14.226	0.053	0.755	0.001
National culture supporting innovation ← Contextual conditions	19.113	0.042	0.799	0.001
Intellectual property laws ← Contextual conditions	25.394	0.031	0.787	0.001
Human and financial resource constraints ← Intervening conditions	12.529	0.056	0.705	0.001
Knowledge management and technology transfer ← Strategies	33.368	0.025	0.823	0.001
Social responsibility ← Outcomes	24.186	0.034	0.815	0.001
Bureaucratic and administrative barriers ← Intervening conditions	11.018	0.058	0.638	0.001
Green innovation ← Outcomes	8.356	0.076	0.633	0.001
Continuous innovation in product and process ← Causal conditions	14.193	0.050	0.705	0.001
Innovation and value creation ← Continuity of knowledge-based enterprises	18.775	0.045	0.837	0.001
Economic and political fluctuations ← Intervening conditions	11.720	0.059	0.686	0.001

As shown in Table 7, the factor loading values related to the items are greater than 0.50, confirming that the items can be used in the model.

The following model shows the path coefficients and coefficient of determination related to the structural relationships among the variables.

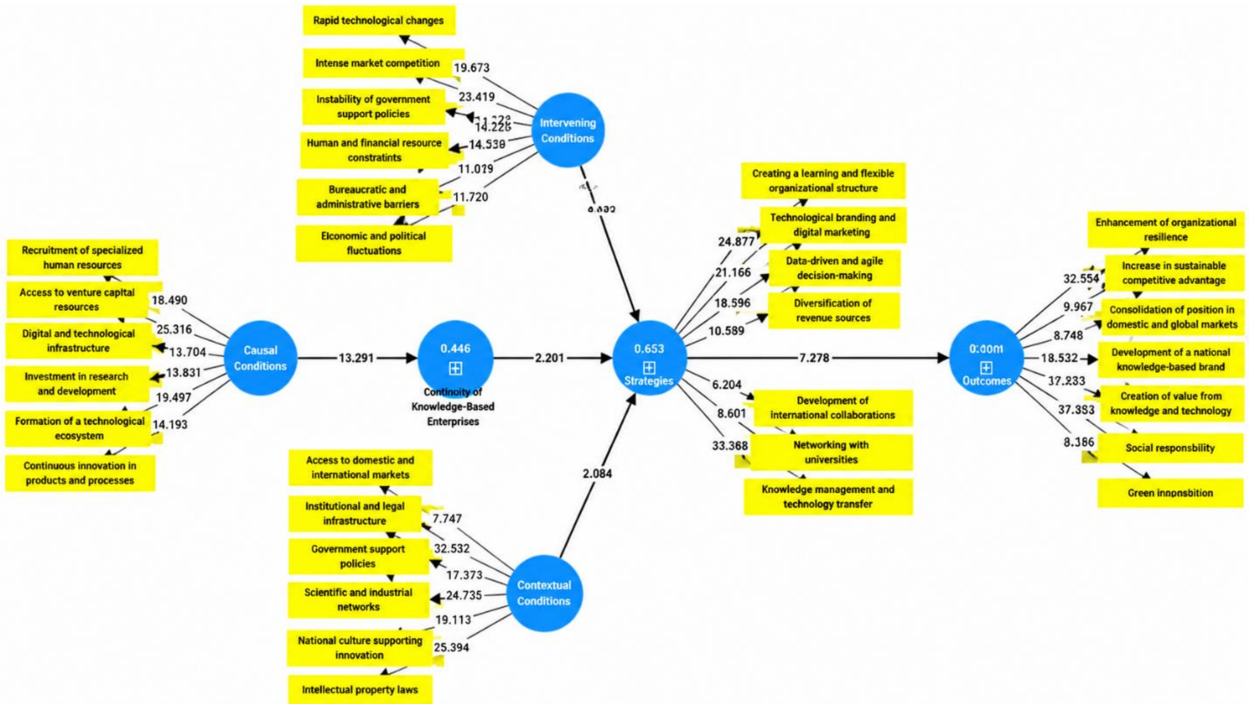

Figure 1: Path Coefficients Related to the Model

As observed, the factor loading values related to the items are greater than 0.50, confirming that the items can be used in the model.

The following figure shows the t-statistic values related to the structural relationships among the research variables.

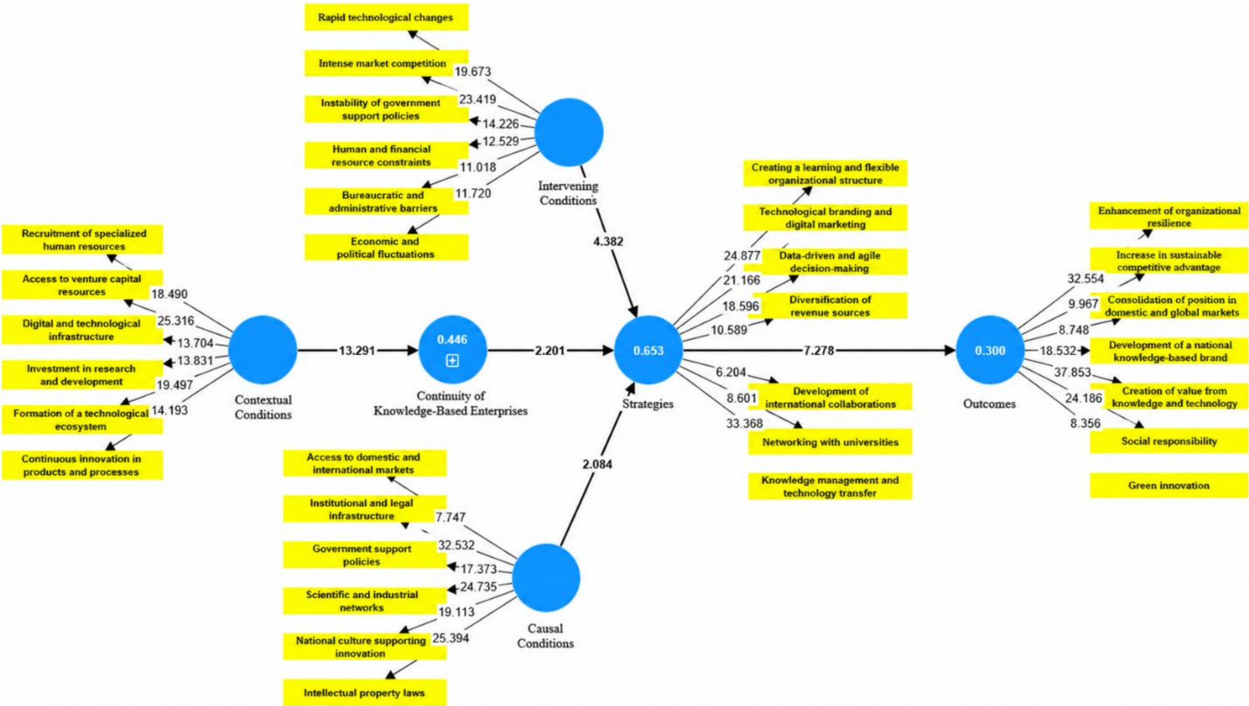

Figure 2: t-Statistic Values Related to the Model

The t-statistic value related to the path is greater than 1.96, confirming that the path coefficient values of the model are statistically significant.

Unlike measurement models, the structural model is not concerned with questions or observed variables and only examines latent variables together with the relationships among.

R^2 is a criterion used to connect the measurement and structural parts of structural equation modeling and indicates the effect that an exogenous variable has on an endogenous variable. It is important to note that R^2 is calculated only for the dependent or endogenous constructs of the model, while for exogenous constructs, the value of this criterion is zero. The higher the R^2 value for the endogenous constructs of a model, the better the model fit. This coefficient ranges from zero to one, and higher values are more desirable. Chin (1998) considered values close to 0.67 as substantial, values close to 0.33 as moderate, and values close to 0.19 as weak.

Table 8: Coefficient of Determination R^2

Variable	Coefficient of Determination R^2	Adjusted Coefficient of Determination R^2	Predictive Relevance Quality (Q^2)
Continuity of knowledge-based enterprises	0.446	0.442	0.547
Strategies	0.653	0.646	0.460
Outcomes	0.300	0.295	0.521

According to the above table, the R^2 values related to all variables are at a moderate and acceptable level.

The predictive relevance criterion (Q^2) determines the predictive power of the model. Models that have an acceptable fit in the structural section should be capable of predicting the indicators related to the endogenous constructs of the model (Stone & Geisser, 1975). Henseler et al. (2009) defined the three values of 0.02, 0.15, and 0.35 as indicating weak, moderate, and strong predictive power, respectively, for the construct or constructs related to the corresponding exogenous variables. It should be noted that this value is calculated only for the endogenous constructs of the model whose indicators are reflective.

The following figure shows the model based on the coefficients of determination and significance levels.

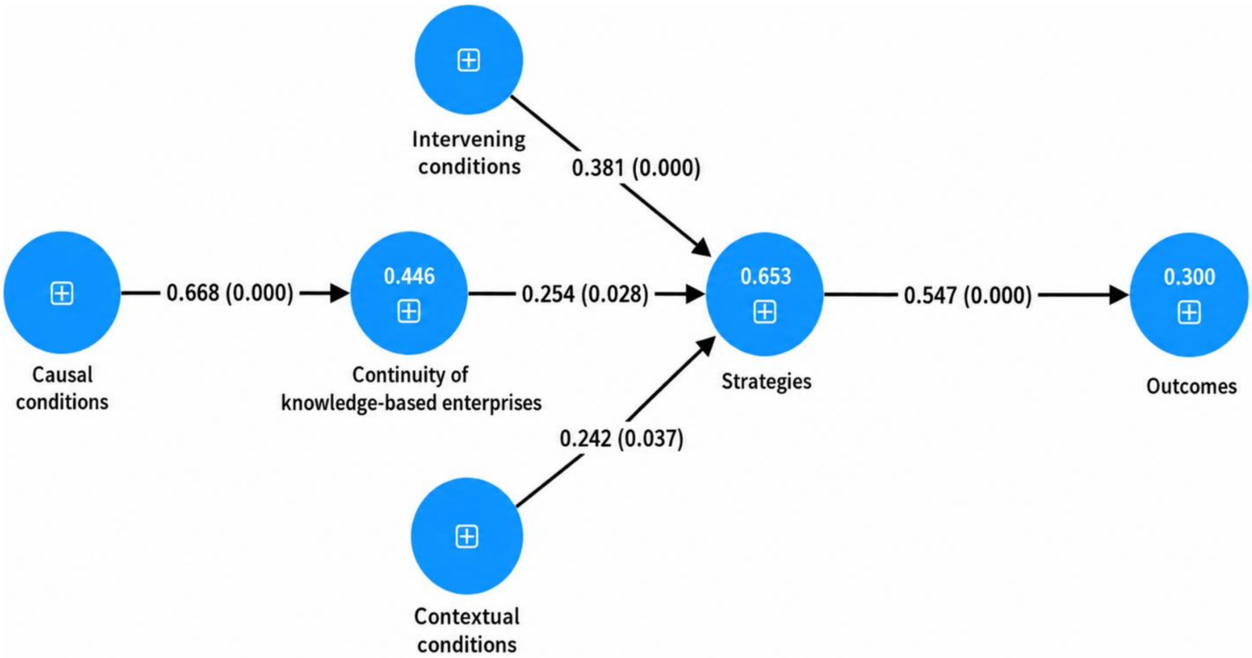

Figure 3: Figure of Coefficients of Determination and Significance Levels

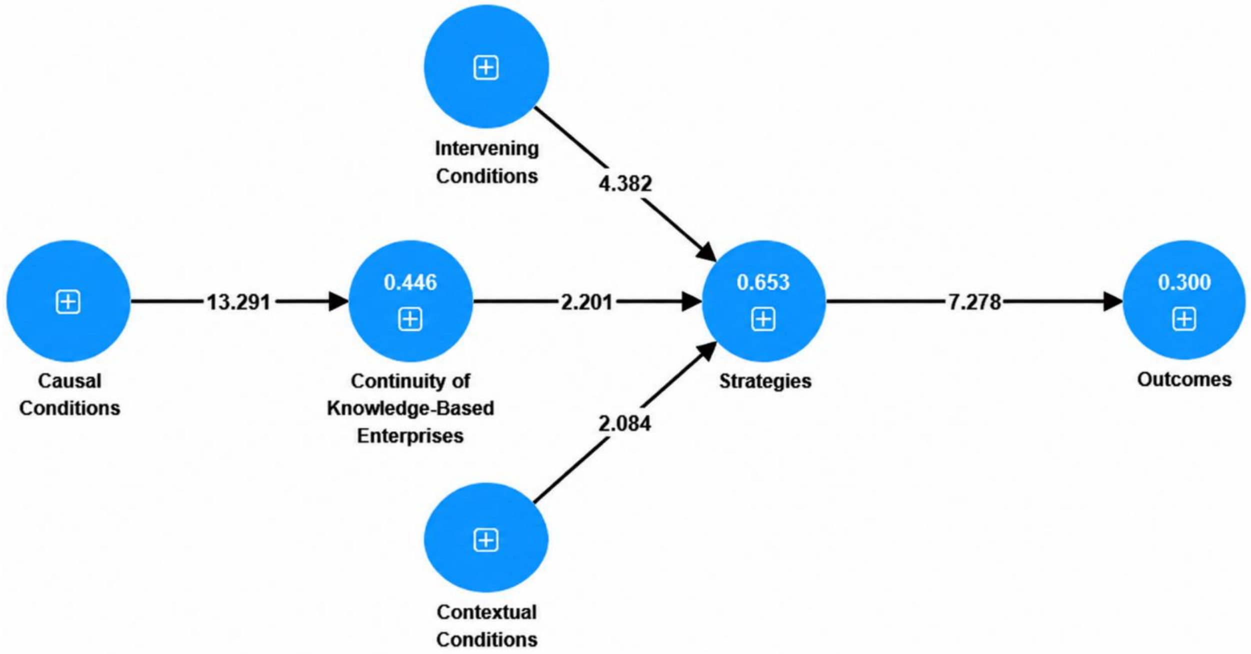

Figure 4: Figure of t-Statistic Values at the 0.95 Confidence Level

As indicated, all paths were significant, the t-statistic value at the 0.95 confidence level was greater than 1.96, and the error value was smaller than 0.05.

The overall research model was examined using the SRMR criterion.

Table 9: Goodness-of-Fit Index of the Overall Research Model

Index Description	Index	Standard Model	Estimated Model
Standardized Root Mean Square Residual	SRMR	0.055	0.064
Root Mean Square	RMS Theta	—	0.052

An SRMR value lower than 0.10, or lower than 0.08 in a more conservative version, indicates a good model fit. RMS Theta values below 0.12 indicate an appropriate model, whereas higher values indicate lack of fit.

Discussion and Conclusion

The findings of the present study showed that the continuity of knowledge-based enterprises is a multidimensional phenomenon shaped by causal conditions, contextual conditions, intervening conditions, organizational strategies, and outcomes. The qualitative findings indicated that continuity in such enterprises cannot be reduced to financial survival or short-term operational persistence; rather, it is formed through the interaction of financial and economic sustainability, technological capability, continuous innovation, organizational and managerial capacity, human capital, organizational learning, networking, institutional support, and agility in confronting uncertainty. This result is consistent with the view that business continuity is no longer limited to crisis response or disaster recovery, but has become an integrated managerial capability involving risk management, strategic preparedness, organizational learning, and resilience (5-7). In knowledge-based enterprises, where value creation depends heavily on intangible resources, knowledge assets, innovation capacity, and specialized human resources, continuity requires a broader model that simultaneously considers internal capabilities and external environmental pressures (3, 4).

The quantitative findings confirmed the structural validity of the proposed model. The reliability coefficients, including Cronbach's alpha and rho values, were higher than the acceptable threshold, and the AVE values confirmed convergent validity. Moreover, the Fornell–Larcker results supported discriminant validity, indicating that the constructs of the model were conceptually distinct. These results demonstrate that the extracted paradigm model has acceptable measurement quality and can be used to explain the continuity of knowledge-based enterprises. This finding aligns with prior studies emphasizing that business continuity models must be empirically grounded and structurally coherent to explain complex organizational relationships (9, 13). The acceptable SRMR and RMS Theta values also confirmed the overall fit of the model, suggesting that the conceptual structure derived from the qualitative phase was statistically supported in the quantitative phase.

Among the identified paths, the effect of causal conditions on the continuity of knowledge-based enterprises was the strongest. This indicates that core internal drivers such as access to financial resources, specialized human resources, technological infrastructure, investment in research and development, and continuous innovation directly determine the ability of these enterprises to survive, grow, and remain competitive. This result is consistent with studies that highlight dynamic capabilities, technological competence, and innovation capacity as fundamental factors in the development and persistence of knowledge-based firms (1, 4). In particular, the strong role of causal conditions confirms that knowledge-based enterprises must continuously renew their resources, improve their technological capabilities, and transform knowledge into marketable value. This interpretation is supported by research showing that digital knowledge-sharing capabilities, digital platforms, and digital business models influence innovation and internationalization in knowledge-based enterprises (2).

The descriptive results also showed that financial and economic sustainability had the highest mean among the examined dimensions, followed by networking and strategic collaborations and technological capability with continuous innovation. This suggests that managers of knowledge-based companies perceive financial stability, strategic relationships, and technological innovation as the most important pillars of continuity. This finding is aligned with studies showing that enterprises operating in knowledge-based and high-technology environments require continuous access to financial resources, market opportunities, and collaborative networks to maintain their competitive position (14, 20). The importance of networking and collaboration is especially meaningful because knowledge-based firms often operate in ecosystems where universities, research centers, government agencies, investors, and industrial partners jointly shape innovation outcomes. Therefore, continuity is not only an internal organizational issue but also an ecosystem-level phenomenon (3, 11).

The findings further indicated that organizational strategies play an important mediating role in achieving desirable outcomes and strengthening resilience. Strategies such as knowledge management, technology transfer, data-driven decision-making, digital marketing, diversification of revenue sources, collaboration with universities, and international cooperation were identified as mechanisms through which causal, contextual, and intervening conditions are translated into continuity outcomes. This result is consistent with the literature emphasizing that business continuity depends on the organization's ability to formulate adaptive strategies before, during, and after disruptions (16, 18). In knowledge-based enterprises, strategic responses must be flexible enough to address technological change, market uncertainty, institutional instability, and resource constraints. Such strategies are also related to competitiveness in the context of industrial transformation, where firms must use knowledge management, technology readiness, and external environmental scanning to maintain continuity (17, 24).

The significant role of contextual conditions indicates that the continuity of knowledge-based enterprises is influenced by institutional and environmental factors, including legal infrastructure, intellectual property regulations, government support policies, scientific and industrial networks, digital infrastructure, and access to domestic and international markets. This finding supports previous research showing that knowledge-based enterprises are highly dependent on spatial, institutional, and ecosystem conditions (14). In emerging knowledge-based economies, competitive advantage is not produced only through firm-level resources, but also through strategic configuration within supportive policy, market, and institutional environments (3). Therefore, weak institutional support, unstable regulations, limited intellectual property protection, and fragmented innovation ecosystems can weaken the continuity capacity of knowledge-based firms, even when internal capabilities are relatively strong.

The results also demonstrated that intervening conditions such as rapid technological change, intense market competition, instability of support policies, bureaucratic barriers, resource limitations, and economic and political fluctuations affect strategies and outcomes. This finding is consistent with business continuity and risk management studies emphasizing that organizations must identify vulnerabilities and design preventive and adaptive mechanisms to reduce disruption effects (7, 10). Knowledge-based enterprises are particularly vulnerable to environmental turbulence because their survival depends on continuous innovation, skilled human resources, access to investment, and technological relevance. Therefore, uncertainty does not simply threaten current operations; it can disrupt innovation cycles, reduce market responsiveness, and weaken knowledge-based competitive advantage. This interpretation is supported by studies on organizational resilience strategies in the face of technological change, which show that continuity requires both structural preparedness and adaptive learning (16).

Another important result was the identification of outcomes such as organizational resilience, sustainable competitive advantage, value creation from knowledge and technology, national knowledge-based branding, social responsibility, green innovation, and market consolidation. These outcomes indicate that the continuity of knowledge-based enterprises is not merely the avoidance of failure, but the achievement of sustainable growth, competitiveness, and long-term value creation. This finding is aligned with studies suggesting that competitive advantage in the current industrial and knowledge-based economy depends on innovation, technological readiness, and strategic responsiveness (12, 17). In addition, the emergence of social responsibility and green innovation among the outcomes shows that continuity is increasingly connected to sustainability-oriented performance, stakeholder legitimacy, and responsible innovation. This is consistent with research suggesting that enterprises that integrate social, environmental, and ethical considerations into business practices are better positioned to achieve long-term continuity (8, 23).

The relatively lower mean values for social and environmental responsibility and agility in adapting to uncertainty indicate that these areas may be less developed in the studied companies. Although financial sustainability, networking, and technological innovation were highly emphasized, the lower scores for agility and responsibility suggest potential weaknesses in long-term resilience. This finding is important because business continuity requires not only financial and technological strength but also ethical legitimacy, flexibility, and responsiveness to change. Previous studies have shown that Industry 4.0 technologies, lean automation, digital transformation, and flexible operational systems can improve agility and responsiveness (19, 24). Similarly, supply chain and operational planning approaches can reduce vulnerability and improve continuity in uncertain environments (21, 22). Therefore, knowledge-based enterprises should not interpret continuity only as maintaining current operations; rather, they must develop anticipatory capabilities that enable rapid adaptation to technological, market, and institutional disruptions.

Overall, the findings of this study support the argument that continuity in knowledge-based enterprises is a systemic, strategic, and dynamic construct. The proposed model integrates the internal logic of firm capabilities with the external logic of institutional and environmental conditions. It also demonstrates that strategies function as a bridge between conditions and outcomes. This integrated perspective is consistent with previous studies that emphasize the role of knowledge governance, business model innovation, technological readiness, competitive strategy, and resilience in sustaining knowledge-based and high-technology enterprises (1, 2, 11). The findings also extend previous business continuity models by adapting them to the specific characteristics of knowledge-based enterprises, where intellectual capital, continuous innovation, knowledge transfer, digital platforms, and strategic networks are central to survival and growth (6, 13). Therefore, the model presented in this study can provide a more contextualized understanding of continuity for enterprises whose main source of value is knowledge.

The present study had several limitations. First, the quantitative phase was conducted among managers of knowledge-based companies in Tehran Province, which may limit the generalizability of the findings to other regions, industries, or institutional environments. Second, the study relied on self-reported questionnaire data, and participants' perceptions may have been influenced by organizational position, experience, or subjective evaluation of firm performance. Third, although the mixed-methods design strengthened the depth and validity of the findings, the study was cross-sectional and therefore could not capture the dynamic evolution of continuity capabilities over time. Fourth, the model focused on managerial and organizational dimensions and did not directly measure objective performance indicators such as revenue growth, patent output, survival rate, export performance, or crisis recovery time.

Future research is suggested to test the proposed model in different geographical regions, industrial sectors, and types of knowledge-based enterprises in order to examine its external validity and comparative applicability. Longitudinal studies are also recommended to investigate how continuity capabilities evolve across different stages of organizational growth and under different crisis conditions. Future studies may also integrate objective performance indicators with perceptual data to provide a more comprehensive assessment of business continuity. In addition, researchers can examine the moderating role of firm size, maturity level, digital transformation intensity, governance structure, and international market orientation in the relationship between causal conditions, strategies, and continuity outcomes. Comparative studies between successful and failed knowledge-based enterprises may also provide deeper insight into the mechanisms that differentiate resilient firms from vulnerable ones.

From a practical perspective, managers of knowledge-based enterprises should treat continuity as a strategic management priority rather than a temporary crisis-management activity. They should strengthen financial sustainability, diversify revenue sources, invest in specialized human resources, develop knowledge management systems, and institutionalize continuous innovation in products, processes, and services. Managers should also build strategic networks with universities, investors, industrial partners, and international collaborators to increase access to knowledge, resources, and markets. Policymakers should provide stable support policies, transparent regulations, intellectual property protection, venture capital mechanisms, and innovation-oriented infrastructure. At the organizational level, companies should enhance agility, use data-driven decision-making, develop digital platforms, improve technology transfer mechanisms, and integrate social and environmental responsibility into their long-term continuity strategies.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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