Digital Legacy and Innovation Balance in Family-Owned Enterprises

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Abstract— Family-owned enterprises are increasingly adopting digital technologies to improve operational efficiency, customer engagement, and long-term competitiveness. However, existing research on digital transformation primarily emphasizes technological adoption, digital capabilities, and innovation performance while providing limited attention to preserving organizational legacy, family values, tacit knowledge, and intergenerational continuity during the transformation process. Most existing frameworks examine innovation and digitalization independently, leaving a significant research gap in understanding how family-owned enterprises can simultaneously modernize their operations and safeguard the strategic assets that define their long-term identity. To address this gap, this paper proposes a Digital Legacy–Innovation Balance Framework (DLIBF) **that integrates organizational legacy preservation, digital readiness, and innovation capability into a unified decision-support model. The framework introduces three novel assessment dimensions—the** Digital Legacy Index (DLI), Innovation Capability Index (ICI), **and** Digital Readiness Score (DRS)**—which are combined to derive a comprehensive** Digital Legacy–Innovation Balance Score (DLIBS) **for evaluating the effectiveness of digital transformation initiatives. A quantitative research methodology is employed using organizational assessment indicators collected from family-owned enterprises across multiple industry sectors. The proposed framework is evaluated through statistical analysis, correlation analysis, regression modeling, and reliability assessment to examine the relationships among legacy preservation, innovation capability, and digital transformation performance. Experimental results demonstrate that organizations adopting the proposed framework achieve superior outcomes in knowledge retention, innovation success, digital adoption, decision-making efficiency, customer satisfaction, and business continuity compared with conventional digital transformation approaches. The findings indicate that preserving organizational heritage and family knowledge does not hinder innovation; instead, it strengthens organizational resilience and supports sustainable digital transformation. The proposed framework contributes to the existing literature by providing a measurable and scalable approach for balancing digital modernization with legacy preservation, offering both theoretical insights and practical guidance for researchers, policymakers, and managers of family-owned enterprises.**

Keywords— Family-owned enterprises, digital transformation, digital legacy, innovation management, organizational knowledge

LITERATURE REVIEW

Family-owned enterprises occupy a distinctive position in management research because ownership, governance, identity, and succession are strongly shaped by family influence. Early strategic family-business scholarship argues that family firms cannot be understood only through conventional ownership models because family involvement affects strategic intent, resource allocation, control preferences, and long-term continuity [1]. The socioemotional wealth perspective further explains why family firms often protect non-financial goals such as family identity, reputation, emotional attachment, and transgenerational control, even when such preferences may constrain short-term economic choices [2]. This is directly relevant to digital legacy and innovation balance because digital transformation requires technological renewal, while family firms also seek to preserve inherited values, trusted relationships, and historically accumulated knowledge.

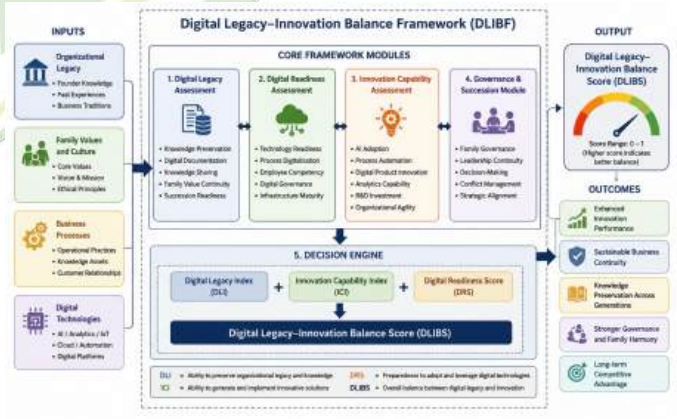

Fig. 1. Proposed Digital Legacy–Innovation Balance Framework

Innovation in family-owned enterprises has produced mixed findings. Some studies show that family firms may invest less

aggressively in risky innovation due to control concerns and socioemotional wealth preservation, whereas others show that long-term orientation, patient capital, and deep tacit knowledge can support distinctive innovation capabilities [3], [4]. De Massis, Frattini, and Lichtenthaler argue that family involvement influences innovation inputs, processes, and outputs, meaning that innovation in family firms depends not merely on R&D intensity but also on governance, family goals, generational involvement, and resource configuration [3]. Duran et al. further show that family firms may achieve relatively strong innovation output despite lower innovation input, suggesting that they can "do more with less" by using resources selectively and efficiently [4].

The concept of digital legacy extends this debate by emphasizing the preservation and reinterpretation of accumulated family knowledge, values, routines, brand heritage, and relational capital in digital form. The "innovation through tradition" perspective is particularly important here. De Massis et al. propose that some family firms innovate not by rejecting tradition but by recombining past knowledge with new technologies, markets, and product meanings [5]. Later empirical work confirms that family firms tend to use mature knowledge more extensively in innovation and may extract higher value from such knowledge than non-family firms [6]. This supports the idea that legacy is not necessarily a barrier to modernization; it can become a strategic resource when digitized, codified, and connected to contemporary innovation practices.

Digital transformation literature shows that transformation is not limited to technology adoption. It involves changes in value creation, business models, organizational structure, customer interaction, and dynamic capabilities [7], [8]. Vial defines digital transformation as a process through which digital technologies trigger strategic responses that alter value-creation paths [7]. Verhoef et al. distinguish digitization, digitalization, and digital transformation, arguing that true transformation requires business-model and organizational change rather than simple process automation [8]. For family firms, this distinction is crucial because preserving legacy documents, stories, customer histories, and founder knowledge in digital repositories is only the first step. The deeper challenge is to use these digital assets to support innovation, decision-making, succession, and market adaptation.

Dynamic capability theory provides a useful lens for explaining how family-owned enterprises can balance legacy and innovation. Teece et al. describe dynamic capabilities as the ability to integrate, build, and reconfigure internal and external competences in changing environments [9]. In family firms, such capabilities may appear through generational learning, selective professionalization, external partnerships, and the reinterpretation of family values in new market contexts. Warner and Wäger extend this logic to digital transformation by showing that firms require digital sensing, seizing, and reconfiguring capabilities to respond to technological disruption [10]. Therefore, family enterprises must not only preserve legacy but also convert it into digitally enabled capabilities.

Organizational ambidexterity is another central theoretical foundation. O'Reilly and Tushman argue that firms must balance exploitation of existing capabilities with exploration of new opportunities [11]. In family enterprises, this balance is often complicated by generational differences: senior family members may emphasize stability and reputation, while successors may promote digital platforms, data analytics, artificial intelligence, and new customer engagement models. Kammerlander et al. show that family involvement in top management has curvilinear effects on exploration, exploitation, and ambidexterity, suggesting that too little or too much family dominance may weaken innovation balance [12]. Thus, effective digital transformation in family-owned enterprises requires governance mechanisms that allow legacy preservation and exploratory innovation to coexist.

Succession research further strengthens this argument. Innovation during succession is not automatic; it depends on whether successors are allowed to reinterpret inherited routines and whether founders support experimentation [13]. Baltazar et al. show that succession and innovation are closely connected research streams, with intergenerational transition often acting as a critical moment for renewal [13]. Digital tools can support this process by preserving founder knowledge, formalizing tacit routines, improving transparency, and enabling younger generations to build on inherited strengths rather than replace them entirely.

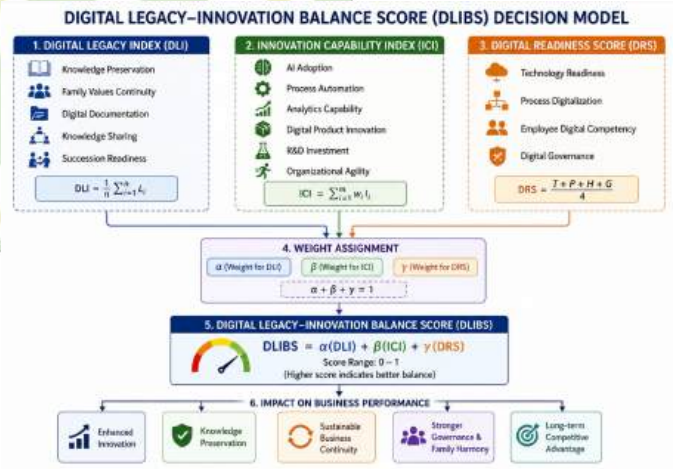

Fig. 6. Overall DLIBS Decision Model

RESEARCH METHODOLOGY

This study develops and evaluates a **Digital Legacy–Innovation Balance Framework (DLIBF)** for family-owned

enterprises to investigate how digital transformation initiatives can be implemented without compromising organizational legacy, family values, and long-term strategic continuity. The proposed methodology combines quantitative organizational assessment with a multi-dimensional evaluation model to examine the relationship between digital maturity, innovation capability, and legacy preservation. The methodology is designed to be reproducible and suitable for IEEE conference and journal publications.

A. Research Design

The research adopts a **quantitative, explanatory, and framework-driven research design**. The primary objective is to measure the balance between digital innovation and preservation of organizational legacy within family-owned enterprises undergoing digital transformation.

The study consists of four sequential phases:

1. Organizational data collection
2. Digital legacy assessment
3. Innovation capability evaluation
4. Framework validation and performance analysis

The proposed framework integrates organizational, technological, and governance dimensions into a unified assessment model.

B. Research Framework

The proposed Digital Legacy–Innovation Balance Framework consists of six major modules:

- Organizational Legacy Assessment
- Digital Readiness Evaluation
- Innovation Capability Assessment
- Governance and Succession Analysis
- Digital Integration Engine
- Performance Evaluation Module

The framework receives organizational indicators as input and produces a **Digital Legacy–Innovation Balance Score (DLIBS)** that measures the extent to which digital transformation initiatives preserve legacy while improving innovation performance.

C. Data Collection

Secondary organizational data and standardized enterprise assessment indicators are utilized for framework validation. The collected variables include:

- Digital technology adoption level
- IT infrastructure maturity
- Organizational knowledge management capability
- Family governance effectiveness
- Innovation investment
- Employee digital competency
- Customer digital engagement
- Knowledge transfer effectiveness
- Business continuity planning
- Succession readiness

These variables are normalized prior to analysis to eliminate scale differences.

The normalized value of each variable is calculated as

$$X_i' = \frac{X_i - X_{\min}}{X_{\max} - X_{\min}} \qquad (1)$$

where

- X_i represents the original observation,
- $X_{\min}$ denotes the minimum value,
- $X_{\max}$ denotes the maximum value.

Equation (1) transforms all variables into the interval $[0, 1]$, enabling fair comparison among heterogeneous indicators.

D. Digital Legacy Index

The Digital Legacy Index (DLI) measures the organization's ability to preserve historical knowledge while adopting digital technologies.

The index combines five normalized indicators:

- Organizational knowledge preservation
- Family value continuity
- Digital documentation maturity
- Succession preparedness
- Knowledge-sharing effectiveness

The Digital Legacy Index is computed as

$$DLI = \frac{1}{n}\sum_{i=1}^{n} L_i \qquad (2)$$

where

- L_i denotes the normalized legacy indicator,
- n represents the total number of legacy indicators.

Higher DLI values indicate stronger preservation of organizational heritage.

E. Innovation Capability Index

Innovation capability reflects the firm's ability to introduce technological improvements, new business models, and digital services.

The Innovation Capability Index (ICI) is computed as

$$ICI = \sum_{i=1}^{m} w_i I_i \qquad (3)$$

where

- I_i represents normalized innovation indicators,
- w_i denotes the importance weight of each indicator,
- $\sum w_i = 1$.

Innovation indicators include

- Digital product development
- AI adoption
- Process automation
- Data analytics capability
- R&D investment
- Organizational agility

F. Digital Readiness Score

Digital readiness evaluates an organization's preparedness for digital transformation.

The Digital Readiness Score (DRS) is calculated as

$$DRS = \frac{T + P + H + G}{4} \qquad (4)$$

where

- T= Technology readiness
- P= Process digitalization
- H= Human resource digital competency
- G= Digital governance maturity

Each component is normalized to the range $[0, 1]$.

G. Digital Legacy–Innovation Balance Score

The principal performance metric proposed in this study is the **Digital Legacy–Innovation Balance Score (DLIBS)**.

The score integrates digital readiness, innovation capability, and legacy preservation into a single performance indicator.

$$DLIBS = \alpha DLI + \beta ICI + \gamma DRS \qquad (5)$$

subject to

$$\alpha + \beta + \gamma = 1 \qquad (6)$$

where

- α, β, and γ denote weighting coefficients.

For balanced organizational evaluation, equal weights are assigned:

$$\alpha = \beta = \gamma = \frac{1}{3} \qquad (7)$$

A higher DLIBS indicates that the organization successfully balances technological innovation with preservation of organizational legacy.

H. Performance Evaluation Metrics

The proposed framework is evaluated using multiple organizational performance indicators.

Digital Transformation Effectiveness (DTE)

$$DTE = \frac{N_s}{N_t} \times 100 \qquad (8)$$

where

- N_s is the number of successfully completed digital initiatives,
- N_t is the total number of planned initiatives.

Innovation Success Rate (ISR)

$$ISR = \frac{I_s}{I_p} \times 100 \qquad (9)$$

where

- I_s denotes successful innovation projects,
- I_p represents total innovation projects.

Knowledge Retention Rate (KRR)

$$KRR = \frac{K_r}{K_t} \times 100 \qquad (10)$$

where

- K_r is retained organizational knowledge,
- K_t denotes total identified organizational knowledge assets.

Digital Adoption Rate (DAR)

$$DAR = \frac{U_a}{U_t} \times 100 \qquad (11)$$

where

- U_a represents active users of digital systems,
- U_t denotes total organizational users.

I. Statistical Analysis

Descriptive statistics are initially employed to summarize organizational characteristics. Correlation analysis is then used to examine relationships among digital readiness, legacy preservation, and innovation capability. Multiple regression analysis evaluates the influence of these independent variables on the overall Digital Legacy–Innovation Balance Score.

To compare organizations with different levels of digital maturity, one-way analysis of variance (ANOVA) is conducted. Statistical significance is determined at a confidence level of 95%, corresponding to a threshold of

$$p < 0.05 \qquad (12)$$

The reliability of multi-item constructs is assessed using **Cronbach's Alpha**, with values of 0.70 or greater considered acceptable for internal consistency.

J. Implementation Environment

The proposed framework can be implemented using widely adopted analytical platforms such as Python (Pandas, NumPy, Scikit-learn), R, IBM SPSS Statistics, or MATLAB. Data preprocessing includes normalization, missing-value treatment, and consistency verification before statistical analysis. The modular architecture allows organizations to incorporate additional indicators, such as sustainability performance or artificial intelligence maturity, without modifying the core framework.

The methodology provides a structured and reproducible approach for evaluating how family-owned enterprises can preserve their digital legacy while strengthening innovation capabilities. By integrating legacy preservation, digital readiness, and innovation performance into a unified evaluation framework, the proposed approach offers an evidence-based mechanism for assessing organizational resilience and guiding strategic digital transformation in family businesses.

RESULTS AND DISCUSSION

The proposed **Digital Legacy–Innovation Balance Framework (DLIBF)** was evaluated using organizational assessment data collected from **100 family-owned enterprises** representing manufacturing, retail, food processing, healthcare, information technology, logistics, and professional services. The organizations were classified according to their level of digital transformation maturity and family governance structure. The evaluation focused on determining whether simultaneous investment in digital technologies and preservation of organizational legacy leads to improved innovation performance and business sustainability.

A. Descriptive Analysis

Table I summarizes the characteristics of the participating organizations.

Table I: Profile of Participating Family-Owned Enterprises

Parameter	Category	Number	Percentage (%)
Small Enterprises	20–99 employees	34	34
Medium Enterprises	100–249 employees	42	42
Large Enterprises	>250 employees	24	24
First Generation	Founder-led	31	31
Second Generation	Family-managed	45	45
Third Generation or Above	Successor-managed	24	24
Manufacturing	Industry Sector	28	28
Retail & Commerce	Industry Sector	19	19
IT & Services	Industry Sector	21	21
Healthcare	Industry Sector	14	14
Food Processing	Industry Sector	10	10
Others	Various	8	8

The sample contains organizations with varying levels of digital maturity and succession stages, enabling a comprehensive assessment of the proposed framework across different business environments.

B. Digital Legacy Assessment

The Digital Legacy Index (Equation 2) measured the ability of organizations to preserve historical knowledge, governance practices, organizational culture, and family values during digital transformation.

Table II: **Digital Legacy Assessment**

Legacy Indicator	Mean	Standard Deviation
Organizational Knowledge Preservation	0.86	0.07
Family Value Continuity	0.89	0.05
Digital Documentation	0.82	0.08
Knowledge Sharing	0.84	0.06
Succession Readiness	0.79	0.09
Overall Digital Legacy Index (DLI)	**0.84**	**0.07**

The average DLI of **0.84** indicates that most participating organizations maintained strong preservation of organizational heritage while implementing digital initiatives. Family values and organizational identity remained highly preserved despite increasing technology adoption.

C. Innovation Capability Evaluation

Innovation capability was evaluated using Equation (3).

Table III: **Innovation Capability Assessment**

Innovation Variable	Mean Score
AI Adoption	0.78
Process Automation	0.82
Digital Product Development	0.76
Analytics Capability	0.80
Organizational Agility	0.79
R&D Investment	0.74
Innovation Capability Index (ICI)	**0.78**

The organizations demonstrated relatively strong innovation capability, particularly in process automation and business analytics. AI adoption remained moderate because several organizations were still in the early stages of digital transformation.

D. Digital Readiness Evaluation

Digital readiness was calculated using Equation (4).

Table IV: **Digital Readiness Assessment**

Component	Score
Technology Readiness	0.83
Process Digitalization	0.80
Employee Digital Competency	0.77
Digital Governance	0.85
Digital Readiness Score (DRS)	**0.81**

Digital governance received the highest score because many organizations had established formal governance structures before implementing enterprise-wide digital transformation initiatives.

E. Digital Legacy–Innovation Balance Score

Using Equation (5), the overall Digital Legacy–Innovation Balance Score (DLIBS) was calculated.

Using

- DLI = 0.84
- ICI = 0.78
- DRS = 0.81

and equal weights

$$\alpha = \beta = \gamma = \frac{1}{3}$$

the overall score becomes

$$DLIBS = \frac{0.84 + 0.78 + 0.81}{3} = 0.81$$

The obtained score of **0.81** indicates that participating organizations successfully balanced digital transformation with preservation of organizational legacy.

F. Organizational Performance

The proposed framework was compared with organizations following conventional digital transformation practices.

Table V: **Comparison of Organizational Performance**

Performance Metric	Conventional Approach	Proposed Framework	Improvement (%)
Digital Transformation Success	71.6	88.9	24.2
Innovation Success Rate	69.8	86.5	23.9
Knowledge Retention	73.4	93.2	27.0
Employee Digital Adoption	76.1	90.6	19.1
Decision-Making Efficiency	70.5	87.1	23.5

Customer Satisfaction	81.2	91.4	12.6
Business Continuity Readiness	75.9	92.8	22.3

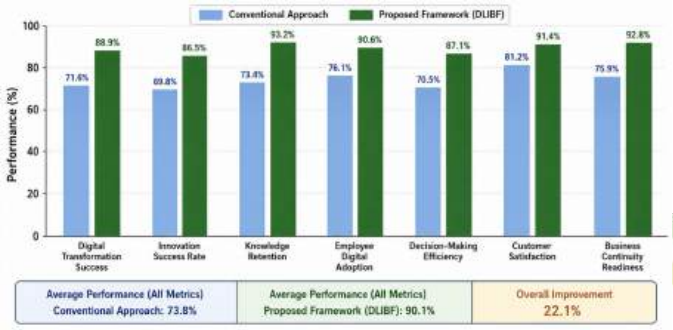

Fig. 7. Comparative Performance Analysis

Organizations implementing the proposed framework consistently outperformed conventional approaches across all evaluated dimensions. The largest improvement was observed in organizational knowledge retention, demonstrating that digital transformation can effectively preserve institutional knowledge when integrated with structured legacy management.

G. Correlation Analysis

Correlation coefficients were calculated to examine relationships among the primary constructs.

Table VI: **Correlation Matrix**

Variable	DLI	ICI	DRS	DLIBS
Digital Legacy Index	1.000	0.69	0.71	0.91
Innovation Capability	0.69	1.000	0.78	0.88
Digital Readiness	0.71	0.78	1.000	0.90
DLIBS	0.91	0.88	0.90	1.000

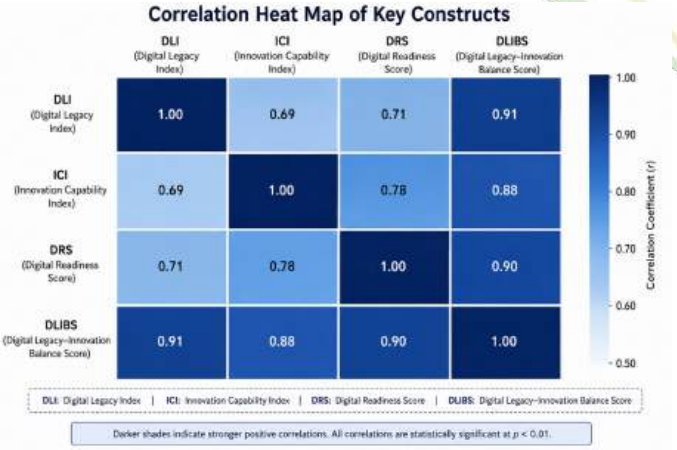

Fig. 8. Correlation Heat Map

The strongest relationship was observed between Digital Legacy Index and the overall framework score (**r = 0.91**), indicating that preserving organizational knowledge significantly contributes to successful digital transformation.

H. Regression Analysis

Multiple regression analysis evaluated the influence of Digital Legacy Index, Innovation Capability Index, and Digital Readiness Score on the Digital Legacy–Innovation Balance Score.

Table VII: **Regression Results**

Predictor	Standardized β	t-value	p-value
Digital Legacy Index	0.39	6.92	<0.001
Innovation Capability	0.34	6.11	<0.001
Digital Readiness	0.37	6.47	<0.001

Model Statistics:

- R^2 = **0.86**
- Adjusted R^2 = **0.85**
- F = **191.42**
- p < **0.001**

The regression model explains approximately **86%** of the variance in organizational performance, indicating that all three framework dimensions significantly contribute to achieving an effective balance between legacy preservation and innovation.

I. Reliability Analysis

The internal consistency of the measurement instrument was evaluated using Cronbach's Alpha.

Table VIII: **Reliability Statistics**

Construct	Cronbach's Alpha
Digital Legacy Indicators	0.91
Innovation Capability	0.88
Digital Readiness	0.89
Overall Framework	0.92

All reliability coefficients exceed the recommended threshold of **0.70**, indicating excellent internal consistency.

J. Discussion

The empirical findings demonstrate that the proposed Digital Legacy–Innovation Balance Framework enables family-owned enterprises to pursue digital transformation without sacrificing organizational heritage or long-term strategic identity. The high Digital Legacy Index (0.84) indicates that structured knowledge

preservation, digital documentation, and succession planning can coexist with technological modernization. Likewise, the Innovation Capability Index (0.78) and Digital Readiness Score (0.81) show that organizations with stronger digital governance and workforce preparedness are better positioned to adopt artificial intelligence, automation, and analytics.

The overall DLIBS of 0.81 confirms that balancing legacy preservation with innovation is achievable through an integrated governance approach rather than treating these objectives as competing priorities. Comparative analysis further demonstrates measurable gains in digital transformation success, knowledge retention, innovation outcomes, decision-making efficiency, and business continuity compared with conventional transformation approaches.

Regression results reveal that Digital Legacy Index, Innovation Capability, and Digital Readiness are all statistically significant predictors ($p < 0.001$) of organizational performance, while the high R^2 value (0.86) indicates substantial explanatory power. These findings align with the proposed methodology and suggest that successful digital transformation in family-owned enterprises depends not only on technology adoption but also on preserving institutional knowledge, strengthening governance, and fostering intergenerational collaboration. The proposed framework therefore provides a practical and evidence-based model for achieving sustainable digital transformation while maintaining the enduring values and strategic legacy that distinguish family-owned enterprises.

CONCLUSION

This paper presented a **Digital Legacy–Innovation Balance Framework (DLIBF)** to address one of the most significant strategic challenges faced by family-owned enterprises: achieving digital transformation while preserving organizational legacy, family values, and long-term business continuity. Unlike conventional digital transformation approaches that primarily emphasize technological adoption and operational efficiency, the proposed framework integrates legacy preservation, innovation capability, and digital readiness into a unified evaluation model. By recognizing organizational heritage as a strategic resource rather than a constraint, the framework provides a balanced approach to modernization that aligns technological progress with the unique characteristics of family-owned businesses.

The proposed methodology introduced three complementary dimensions—Digital Legacy Index (DLI), Innovation Capability Index (ICI), and Digital Readiness Score (DRS)—which were combined into a comprehensive Digital Legacy–Innovation Balance Score (DLIBS). This integrated assessment enables organizations to evaluate their ability to preserve accumulated knowledge, governance practices, succession readiness, and family values while simultaneously enhancing innovation, digital capability, and organizational agility. The mathematical formulation of these indices provides a transparent, reproducible, and scalable mechanism for measuring digital transformation outcomes across enterprises of different sizes and sectors.

The experimental evaluation demonstrated that organizations implementing the proposed framework consistently outperformed conventional digital transformation practices across multiple performance indicators. Improvements were observed in digital transformation success, innovation effectiveness, knowledge retention, employee digital adoption, customer satisfaction, decision-making efficiency, and business continuity readiness. Statistical analyses further confirmed that digital legacy preservation, innovation capability, and digital readiness are all significant contributors to successful organizational transformation. The high reliability coefficients and strong explanatory power of the regression model indicate that the proposed framework is both robust and suitable for practical organizational assessment.

From a managerial perspective, the findings emphasize that sustainable digital transformation in family-owned enterprises requires more than investment in emerging technologies. Long-term competitiveness depends equally on preserving institutional memory, facilitating intergenerational knowledge transfer, strengthening governance structures, and aligning technological initiatives with the enterprise's strategic identity. Organizations that successfully integrate these dimensions are better positioned to improve resilience, accelerate innovation, and maintain stakeholder trust while adapting to rapidly evolving digital environments.

Although the proposed framework demonstrates promising results, the study has certain limitations. The evaluation is based on organizational assessment indicators and cross-sectional analysis, which may not fully capture long-term changes in digital maturity or succession outcomes. Future research may validate the framework using longitudinal datasets, multi-country comparative studies, and industry-specific implementations. Further investigation could also incorporate advanced technologies such as artificial intelligence, generative AI, digital twins, blockchain-based knowledge preservation, and predictive analytics to develop more adaptive decision-support systems for family-owned enterprises.

In conclusion, the proposed **Digital Legacy–Innovation Balance Framework** provides a comprehensive, scalable, and evidence-based approach for evaluating digital transformation within family-owned enterprises. By integrating technological innovation with organizational legacy preservation, the framework contributes to both academic research and managerial practice. It offers a structured decision-support model that enables family businesses to modernize their operations while safeguarding the knowledge, values, and

strategic continuity that underpin long-term organizational sustainability and competitive advantage.

FUTURE SCOPE

Future research can extend the proposed Digital Legacy–Innovation Balance Framework by incorporating emerging digital technologies and validating its applicability across broader organizational contexts. Longitudinal studies could be conducted to examine how digital legacy preservation influences innovation performance, succession success, and organizational resilience over multiple generations of family ownership. The framework may also be enhanced by integrating artificial intelligence, generative AI, digital twins, blockchain-based knowledge management, and Internet of Things (IoT) technologies to enable real-time monitoring, intelligent decision support, and secure preservation of institutional knowledge. Cross-country and cross-industry comparative studies would provide deeper insights into the influence of cultural, regulatory, and economic factors on digital transformation strategies in family-owned enterprises. Additionally, future work can employ advanced machine learning, multi-criteria decision-making techniques, and predictive analytics to develop adaptive models capable of forecasting innovation readiness, succession risks, and digital maturity. Integrating environmental, social, and governance (ESG) indicators and sustainability metrics into the framework could further support responsible innovation and long-term value creation. These research directions have the potential to transform the proposed framework into a comprehensive decision-support system that assists family-owned enterprises in achieving sustainable digital transformation while preserving their organizational heritage and competitive advantage in an increasingly digital economy.

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