Agile Data Management System Reference Model

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1. Introduction

The rapid transformation of digital technologies and the increasing complexity and uncertainty of digital ecosystems have fundamentally changed the requirements of intelligent organizations. Although various reference models for data management have been developed, many of them are based on relatively rigid, standardized, and prediction-oriented approaches and are not sufficiently responsive to dynamic and rapidly changing environments. This limitation is particularly important in contemporary organizations that increasingly seek to employ business intelligence and artificial intelligence technologies without adequately addressing the quality, organization, governance, and lifecycle management of the underlying data.

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2. Literature Review

The literature indicates that agility, data management, and smart business have largely been investigated as separate domains, while their theoretical and practical integration within a unified reference model remains limited. The main objective of the research is to design and develop an agile data management reference model based on agile principles, lean thinking, and smart-system capabilities. The proposed model seeks to support organizations in managing data throughout its lifecycle and supply chain while maintaining alignment between business strategy and data management strategy. The study contributes conceptually by extending agility from development processes to strategic data management, methodologically by combining Design Science Research (DSR), meta-synthesis, and Fuzzy Delphi, and practically by developing a reference model applicable to different data-driven industries.

3. Methodology

The research was conducted within the framework of Design Science Research (DSR), based primarily on the seven-stage methodology proposed by Peffers et al. (2007) and its adaptation in Iranian research. The study was applied-developmental in nature and employed a mixed-method approach with qualitative predominance. Data were collected through documentary analysis, expert panels, field observation, and Fuzzy Delphi. The research process was organized into five main stages: problem identification and motivation, definition of solution objectives, design and development, evaluation and validation, and dissemination.

In the design and development stage, meta-synthesis was used as the main library-based method for extracting concepts and components from the literature. Following systematic review and screening procedures, 77 scientific sources were selected as the initial set of relevant studies. Through open coding, 113 key expressions were identified and labeled. These codes were subsequently integrated into 26 axial codes, which were organized into 10 categories or domains and ultimately synthesized into five major themes. The resulting findings

were compared with existing reference models and refined through iterative feedback from a three-member expert panel.

For evaluation and validation, three complementary perspectives were employed. First, the outputs of the main methodological stages were reviewed by three experts to assess their alignment with the research objective. Second, the reliability of the extraction and conceptualization process was examined using Cohen's kappa based on an 18-item binary checklist. Third, external validation of the major components of the model was conducted using Fuzzy Delphi. A 12-item questionnaire derived from the final model components was distributed to approximately 90 relevant experts, and 57 valid responses were obtained. The expert population included specialists in data management and governance, software and information technology, data analytics and business intelligence, and agile/project management.

4. Results

The main outcome of the research was the development of an agile data management reference model for smart businesses. The model was structured at two conceptual levels. At the zero level, four major themes were identified: fundamental paradigm (P), strategic objectives (X), enablers (Y), and results/values (Z). The fundamental paradigm corresponds to the feedback mechanism and incorporates continuous improvement and the Agile Manifesto. Strategic objectives represent the system inputs and consist of smart business strategy and agile data management strategy. Results/values represent the outputs and include value for smart business as well as data intelligence and agile data excellence.

The model therefore operates through a dynamic relationship among strategic objectives, enabling capabilities, outcomes, and feedback. Strategic objectives determine what the organization seeks to achieve through data. Enablers translate these objectives into operational capabilities and mechanisms for managing data. The outputs include improvements in data quality, accessibility, integration,

and agility, together with improved decision-making, reduced waste, enhanced stakeholder experience, and business value.

The meta-synthesis produced a structured knowledge base that supported the model development. The expert assessment indicated 88% alignment between the defined components and the ultimate research objective. Cohen's kappa coefficient was 0.68, exceeding the stated minimum acceptable threshold of 0.60 and indicating acceptable reliability in the extraction and formulation of the findings. Furthermore, all items evaluated in the first round of Fuzzy Delphi achieved fuzzy means and defuzzified values above 0.70, which was the specified acceptance threshold. Accordingly, the major components of the proposed model were validated and retained in the final model.

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5. Discussion

The findings indicate that agile data management in banking has developed as a multidisciplinary research field situated at the intersection of data management, organizational agility, digital transformation, technology adoption, customer behavior, knowledge management, and sustainability. The five conceptual clusters demonstrate that the field cannot be understood exclusively from a technical perspective. Although emerging technologies such as artificial intelligence, blockchain, machine learning, big data, and cybersecurity constitute an important research stream, the literature simultaneously addresses customer trust, satisfaction, perceived risk, organizational knowledge, innovation, sustainability, and financial inclusion.

The strong position of India and the increasing participation of other Asian countries suggest that developing economies are playing an increasingly important role in producing knowledge concerning digital and agile banking. At the same time, collaboration networks involving European, Asian, Middle Eastern, and other countries demonstrate the international and interdisciplinary nature of the field. The co-authorship, bibliographic coupling, and co-citation analyses also indicate the existence of interconnected research communities and

shared theoretical foundations. In particular, the co-citation analysis revealed the influence of technology acceptance models such as TAM and UTAUT, methodological approaches such as PLS-SEM, and strategic perspectives such as the resource-based view.

6. Conclusion

This study developed and validated an agile data management reference model for smart and data-driven businesses through a Design Science Research approach combined with meta-synthesis and Fuzzy Delphi. The model responds to the limitations of traditional reference models in dealing with dynamic, complex, and uncertain data environments by integrating strategic objectives, enabling capabilities, outcomes, and continuous feedback within a unified conceptual structure.

The findings suggest that effective data management in contemporary smart businesses requires alignment between business and data strategies, continuous improvement, agile governance, appropriate organizational and technological capabilities, and management of data throughout its lifecycle and production-to-consumption chain. The validation results, including 88% expert alignment, a Cohen's kappa coefficient of 0.68, and Fuzzy Delphi values above the 0.70 acceptance threshold, support the validity and reliability of the proposed model.

The study's limitations include difficulties in extracting and documenting experts' tacit knowledge, restricted access to real organizational data because of security considerations, and the lack of indigenous frameworks for measuring data agility in Iran. Future research may therefore focus on piloting the model in specific industries, developing and testing indicators for measuring data-agility maturity, and developing analytical tools for evaluating the model's operational effectiveness. Overall, the proposed model provides a strategic and adaptable foundation for managing data in contemporary smart businesses and emphasizes the importance of establishing sound and agile data management practices before becoming overly dependent on rapidly evolving artificial intelligence and business intelligence tools.

Keywords: Systems Thinking, Smart Business, Agile Manifesto, Lean, and Data Management Body of Knowledge.