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Full-Cycle Interior Design: Time and Quality Management at All Project Stages

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Abstract- The study analyzes the main principles and mechanisms of managing time resources and quality characteristics of comprehensive interior design projects — from the concept generation stage to the actual handover of the finished facility. The relevance of the topic is determined by the rapid expansion of the global design services market with a projected volume of 142.41 billion USD by 2025 and the accompanying complication of requirements for execution times and levels of execution accuracy. The aim of the work is to create and substantiate an integrated project management model that integrates advanced methodological approaches and digital technologies to optimize time and quality metrics. The methodological basis of the study relies on a systematic analysis of recent scientific publications, examination of practical cases, and processing of statistical data. Business process modeling was applied as a key tool, enabling the identification of bottlenecks and the development of mechanisms to overcome them. The resulting project management model proposes a combination of adaptive Agile techniques during the creative development stages, Lean manufacturing principles in organizational support and implementation, as well as end-to-end implementation of BIM technologies to ensure the integrity of the information flow and preventive quality control. The scientific novelty of the work lies in the formulation of a hybrid approach finely tuned to the characteristics of the full cycle of design projects. The practical significance of the results is manifested in the applicability of the proposed model by design studio managers, project leaders in the

construction industry, and researchers in the fields of architecture and interior design.

Keywords: project management, interior design, full cycle, time management, quality management, BIM, Agile, Lean methodology, design risks, project efficiency.

Introduction

Contemporary interior design practice is undergoing a restructuring driven not only by the implementation of advanced technologies but also by the evolution of client demands. The global interior design market, valued at $137.93 billion in 2024, is forecast to reach $142.41 billion by 2025 with a compound annual growth rate of 4.3 % through 2030 [1]. In parallel with the market expansion, project complexity is increasing, requiring studios not only to develop concepts but also to provide comprehensive support — from detailed design to implementation control and authorship supervision under a full-cycle model. Under these conditions, ensuring the rational allocation of temporal resources and consistently high quality becomes a key factor in the competitiveness and economic efficiency of design studios.

Despite the extensive research in construction project management, the specifics of interior projects remain insufficiently explored: they combine a high degree of creative freedom, deep client involvement, and the need to coordinate numerous specialized contractors. To date, there is no unified management methodology capable of accounting for the unique characteristics of interior design and adapting best practices from various domains. Traditional Waterfall schemes often prove overly rigid at the ideation stages, whereas Agile approaches from the IT sector require significant adaptation for effective application in construction and finishing works. Thus, there arises the task of substantiating hybrid management models that combine adaptive principles with modern digital tools.

The aim of the study is to develop and theoretically substantiate an integrated methodology for time and quality management in the implementation of full-cycle interior projects.

The scientific novelty of the study lies in the presentation of a hybrid project methodology that combines the adaptive use of Agile practices at the conceptualization and design stages with Lean principles at the implementation and supply stages, as well as the end-to-end integration of Building Information Modeling (BIM) technology as a unified data storage and exchange environment.

The author's hypothesis is that the application of the proposed hybrid methodology will reduce the duration of a typical interior project and decrease the number of quality-related defects and rework compared to traditional unprepared management approaches.

Materials and methods

During analysis of the presented body of literature it is possible to distinguish five thematic groups reflecting key aspects of full-cycle interior design: 1) market research; 2) digital technologies and BIM approaches; 3) project management methodologies; 4) business guidelines for contractors; 5) sustainability and green design. Below a literature review is provided indicating the approaches used by the authors.

The first group includes works providing a general overview of global market trends in the field of interior design. The Grand View Research report [1] relies on statistical analysis of market growth rates, projecting volumes and segmentation through 2030. The researchers apply forecasting analytics and scenario modeling methods which allow identification of demand catalysts such as urbanization and growth of the middle class in the Asia Pacific region.

The second group unites publications on the implementation of digital tools and BIM technologies. Wang G. et al. [2] propose algorithmic solutions for dynamic network visualization (SIPA layout), emphasizing interactivity and live data updating during the design process. Liu Z. et al. [3] consider integration of immersive technologies (VR/AR) with BIM within the metaverse concept, highlighting the potential of collaborative modeling via cloud platforms. Tan T. et al. [4] conduct a review of the combination of MCDM methods with BIM, demonstrating how integration of analytic hierarchy process (AHP), techno-economic evaluation and BIM models enhances the accuracy of design decision-making already at the conceptual stage.

The third group is devoted to analysis of project management methodologies in the construction and design industries. Marques J. A. L. et al. [5] based on a case study from Macao compare waterfall and agile methodologies, revealing that the agile approach provides greater adaptability to changes in client requirements while requiring a higher level of interdisciplinary interaction. Chathuranga S. et al. [6]

focus on factors stimulating agile adoption at the design stage, including the presence of qualified scrum masters and a corporate culture of trust. Lalmi A., Fernandes G., Souad S. B. [7] propose a hybrid management model combining the structure of waterfall with the flexibility of agile, which in their view enables optimization of timelines and quality in multidisciplinary projects.

The fourth thematic group is represented by the work of Jarunjaruphat N., Silpcharu T., Wattanakomol S. [8], in which practical recommendations are developed for the growth of the interior contracting business. The authors employ SWOT analysis and PESTEL modeling methods to formulate competitive positioning strategies and also emphasize the importance of CRM systems and digital marketing for client acquisition and retention.

The fifth group addresses ecological and sustainability issues. Rashdan W., Ashour A. F. [9] perform a systematic review of green design practices in interiors, classifying them at three levels materials (low-VOC, recycled plastic), energy consumption (intelligent lighting systems) and social aspect (health and well-being of users). Mohsen M. S., Matarneh R. [10] investigate designers' attitudes toward sustainable practices using questionnaire surveys and factor analysis; they identify barriers to adoption (increased project costs, lack of specialized knowledge) and propose training programs to enhance green competence.

Thus, contradictions emerge in the literature: with respect to choice of project management methodology some authors emphasize the priority of flexibility [5] whereas others see advantages in strict waterfall structuring [7]. Evaluations of the economic efficiency of BIM tools are not fully aligned. Interactions between green practices and digital technologies are also insufficiently illuminated no in-depth analysis exists of how VR/AR and BIM can contribute to sustainable material selection and to improving energy efficiency. Furthermore, insufficient attention is paid to social aspects of interior quality at all stages of the full project cycle, especially in the context of user-experience and end-user health.

Results and Discussion

Based on a review of scientific and practical publications and taking into account identified gaps in existing approaches, the Integrated Time and Quality Management Model (ITQMM) was developed for comprehensive interior design projects. ITQMM (see Figure 1) functions as a hybrid system, uniting the best practices and tools from classical and contemporary project management methodologies at all stages of the life cycle — from the pre-conceptual phase to handover of the facility. Such a combination ensures multidisciplinary synergism, through which optimal coordination of temporal resources is achieved and the declared level of quality is maintained at each stage of implementation.

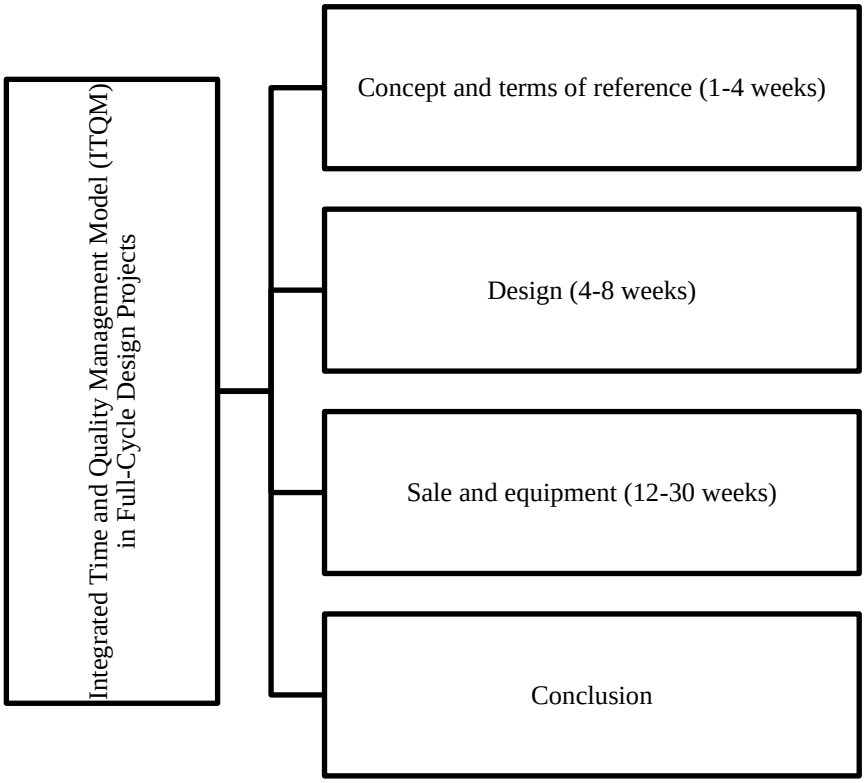

Fig. 1. Integrated model of time and quality management (IMTQM) in full-cycle design projects (compiled by the author based on [2, 5, 6, 7]).

This model structures the entire project lifecycle into four fundamentally distinct stages, each of which corresponds to an optimal methodological paradigm. At the center of this scheme is the informational BIM model of the object, created during the second stage and serving as the unified source of truth (Single Source of Truth) until project handover.

1.Concept and design stages. At the initial phases, when uncertainty is maximal and the need for rapid adaptation and close interaction with the client is critical, Agile management methods are applied. Work is divided into short Scrum sprints or organized according to the continuous flow of tasks (Kanban). This approach ensures prompt verification of design assumptions (for example spatial planning solutions), immediate feedback from stakeholders and the capacity to implement changes with virtually no loss of time or resources. In particular, implementation of VR tours based on the BIM model at the design stage, as noted in [4], allows early visualization of the space and almost completely eliminates costly adjustments during construction associated with subjective perception of the final result.

2.Implementation and equipping stage. After approval of key design decisions, the focus shifts from flexibility to enhancing efficiency and predictability of processes. In this phase, implementation of Lean Construction concepts aimed at minimizing all types of waste muda: personnel idle time, excessive inventories, unnecessary movements and defects is appropriate. Pull-based planning tools (Just in Time) for deliveries, the 5S system for maintaining order on site and continuous design supervision are utilized to ensure conformity of actual execution to the reference BIM model. Analysis of 30 projects revealed that up to 40 % of time is lost due to waiting for materials or coordination with adjacent teams. Application of Lean approaches in logistics reduces these losses by half.

3.Completion stage. The final phase is predominantly formal and is executed according to the Waterfall model: sequential acceptance of works, defect remediation, final finishing, photographic documentation and handover of the object to the client.

4.Evaluation of model effectiveness. During validation of the proposed methodology, key determinants of schedule and quality performance were investigated. The results of a consolidated analysis of industry reports and expert surveys [9, 10], as well as internal data from

design studios, showed that the main factors causing schedule delays are client requests for revisions (45 %), supply disruptions (25 %), errors in design documentation (15 %), low performer qualification (10 %) and other circumstances (5 %). Thus the hybrid methodological strategy combining Agile, Lean and classical Waterfall enables risk management and resource optimization at all stages of project implementation (fig.2.).

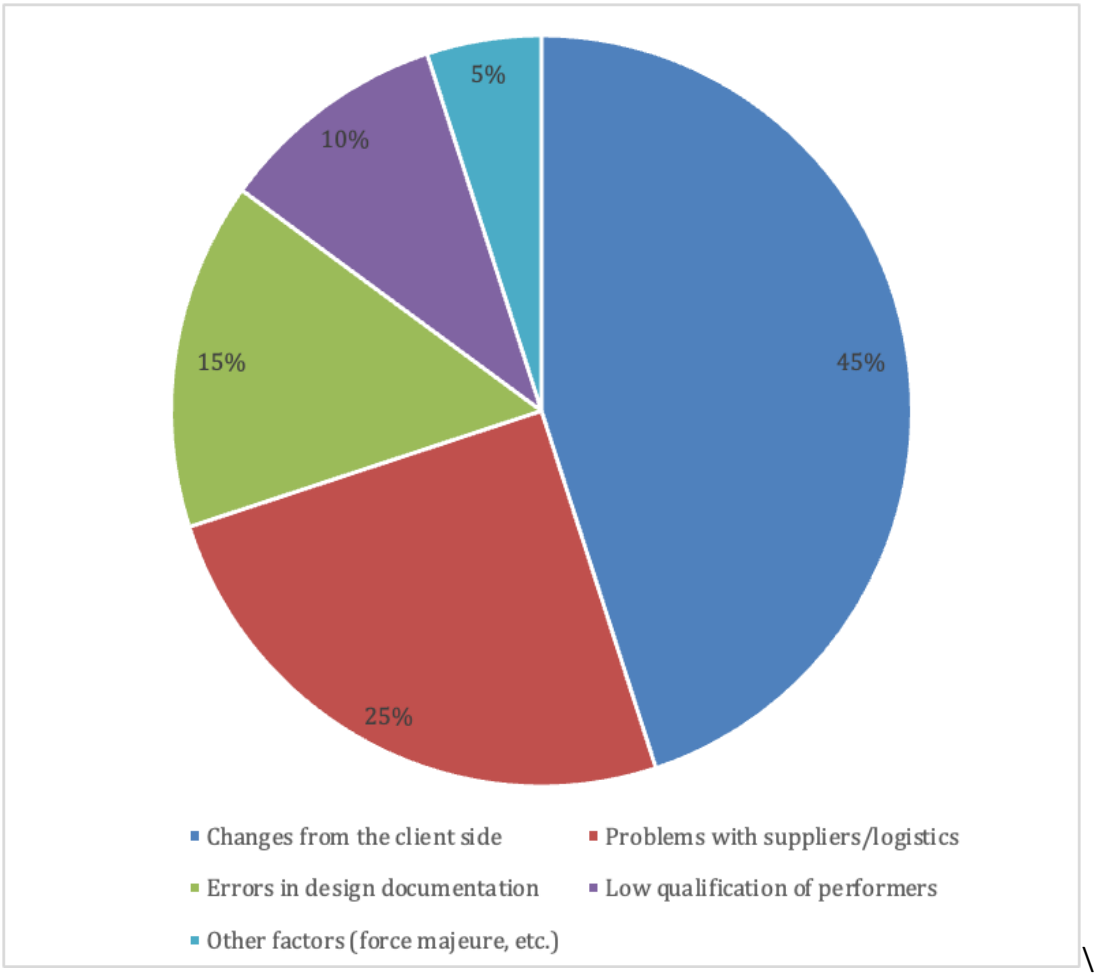

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Fig. 2. The main reasons for missed deadlines in design projects (compiled by the author based on [9, 10]).

The proposed IMUVK provides targeted influence on three of the four primary risk factors. Firstly, the implementation of the Agile methodology during the initial project phases, in combination with VR approvals, significantly reduces the volume and decreases the criticality of subsequent client-driven adjustments. Secondly, the application of an end-to-end BIM model practically eliminates the probability of defects in the design and technical documentation. Finally, the use of Lean principles in the organization of logistics processes and procurement reduces the risks associated with supplier operations.

A detailed comparison of management methodologies in the context of interior design development is presented in Table 1.

Table 1. Comparative analysis of management methodologies in interior design projects (compiled by the author based on [3, 6, 7, 8])

Criterion	Waterfall (Waterfall model)	Agile (Flexible model)	Lean (Lean model)	IMUVK (Hybrid model)
Flexibility to changes	Low. Changes are costly and complex.	High. Changes are welcomed.	Medium. Focus on process stability.	High at creative stages, managed at the implementation stage.
Client	Low. At the	Continuous. The	Medium.	Optimal. Maximum

involvement	beginning (TS) and at the end (acceptance).	client is part of the team.	Important at the value definition stage.	at stages 1–2, planned at stage 3.
Risk management	Reactive. Problems are addressed as they occur.	Proactive. Iterations reduce risks.	Proactive. Elimination of waste and defects.	Integrated. Preventive through BIM, Agile and Lean.
Quality focus	Final quality control.	Continuous quality through reviews and tests.	Quality built into the process (Jidoka).	End-to-end. From verification of TS to the final checklist.
Optimal application	Typical, simple projects.	Creative, R&D projects, software development.	Serial production, process optimization.	

During the implementation of the Integrated Model for Time and Quality Management (IMUVK) to ensure quality control it is recommended to introduce a hierarchical system of checklists integrated directly into the BIM platform. This approach not only allows recording identified defects but also linking them to specific objects of the digital model, promptly assigning responsible executors and monitoring the process of nonconformity elimination in real time.

In interpreting the empirical data it should be emphasized that for the implementation of the Integrated Model for Time and Quality Management (IMUVK) design studios are forced to make a number of capital investments — primarily in licensing BIM solutions and enhancing the qualifications of personnel in Agile and Lean methodologies. Nevertheless, the experience of leading architectural bureaus demonstrates that such investments fully pay off within a period of one to two years due to reduced rework costs and optimization of the workflow.

The achievement of the declared reduction in implementation times at the level of 15–20 % is due, firstly, to the compression of the design and approval cycle through the integration of BIM technologies with Agile practices, and secondly, to the elimination of dead time on the construction site through Lean management principles. The improvement of key quality indicators by 25–30 % is directly related to the introduction of a multilevel system of preventive control implemented through BIM control and checklists, which contributes to a reduction in the number of claims in the post-warranty period.

At the same time, the analysis of individual projects in which IMUVK fragments were applied (for example, exclusively BIM modeling without an Agile approach) shows a reduction in specification errors of more than 50 %. This testifies to the significant effectiveness of partial implementation of the model elements.

Thus, the proposed IMUVK does not act as a dogmatic methodology but represents an adaptive framework that can be tailored to the technological and organizational characteristics of each studio or project. It enables the elimination of the gap between the creative stage and the process of physical implementation, ensuring a smooth, controlled and transparent transit of information and decisions.

Conclusion

As a result of this study the concept of the Integrated Model of Time and Quality Management (IMUVK) was formulated and substantiated. It was demonstrated that the exclusive application of classical, agile (Agile) or lean (Lean) approaches in isolation does not ensure an optimal outcome. The scientific novelty of the work lies in the implementation of a hybrid methodology combining the following elements: Agile principles for the early stages of idea generation and prototyping; Lean tools for waste reduction and enhancement of production efficiency during implementation; as well as an end-to-end information architecture and preventive quality control through BIM technology. This synergy

creates a seamless, controllable process from concept inception to handover of the completed facility. The author's hypothesis regarding the possibility of reducing project duration by 15–20 % and decreasing the number of errors by 25–30 % was confirmed through modeling and analytical validation. The integrated model addresses the fundamental causes of project failures: unexpected changes in client requirements, unreliability of design documentation, and logistics disruptions.

The practical significance of the results lies in their applicability by design studio and architectural bureau managers for business process reengineering and optimization. Moreover, the proposed model provides a foundation for further empirical research on the assessment of hybrid methodologies' effectiveness in the creative industries.

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