Digital Transformation Enablement Pathways with Effectiveness Verification in Commercial Buildings: An Integrated Practice Study Based on an Intelligent Software Matrix

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Abstract: With the deep empowerment of information technology, digital transformation is reshaping project management and operations in the commercial building sector. Faced with increasingly complex market demands and full life-cycle management challenges, traditional models show clear limitations. As industry practitioners, we have adopted in multiple commercial building projects an integrated intelligent system matrix independently developed and continuously refined by Ms. Xueshi (Blair) Bao. This matrix comprises a project full life-cycle collaborative management platform, a big-data commercial operations decision-support system, a smart retail digital transformation and operations-and-maintenance system, an immersive-experience optimization system, and a commercial-operations proposal generation and presentation platform.

From the user perspective, this paper systematically presents the matrix's innovative architecture and application process and, through typical case studies, empirically evaluates its comprehensive effectiveness along four dimensions: project-management efficiency, optimization of operational decision-making, cost control, and enhancement of customer experience. The empirical results show that the matrix not only significantly shortens project schedules, improves the speed of risk response, and increases the accuracy of operational decisions, but also sets new efficiency benchmarks for core business processes. It thus provides the commercial building industry with a complete digital-management solution that has been thoroughly tested in practice.

Keywords: Digital Transformation; Commercial Buildings; Integrated Intelligent System Matrix; Project Management; Digital Systems

1. Core Technical System Framework and Its Innovative Features

In full life-cycle management of commercial buildings, planning and design, construction, operations, and user experience are often fragmented. This fragmentation leads to information silos, lack of data interoperability, and low decision-making efficiency. To address these pain points, and based on many years of project practice, Ms. Xueshi (Blair) Bao independently developed and integrated five digital systems, forming an intelligent system matrix tailored to the full life cycle of commercial buildings. As users of this matrix, we have experienced first-hand its innovative technical architecture and application model during implementation.

1.1 Project Master Planning, Design, and Operations Platform (PMPOP)

Commercial building projects involve multiple stages and participants. Under traditional management approaches, information is easily distorted and processes are often disconnected. The PMPOP platform that we adopted creates a unified data and business middle platform based on a microservices architecture. It achieves, for the first time in our projects, seamless integration and data closed loops across planning, design, construction, and operations.

The platform's visual interface allows unified management of project objectives, resources, schedules, and documentation, fundamentally transforming linear and fragmented management into an integrated and transparent process. Of particular importance, the built-in big-data analytics and real-time early-warning modules enable our management team to shift from reactive responses to proactive interventions. As shown in Table 1, use of the platform has led to a step change in project-

management effectiveness.

Table 1. Efficiency Improvements from PMPOP in Project Management

Project-management task	Traditional management model	Digital management model (PMPOP)	Efficiency improvement (%)
Overall project duration	12 months	8 months	33.33
Risk-response time	7 days	2 days	71.43
Communication frequency	60 times / month	20 times / month	66.67
Accuracy of resource allocation	75%	90%	20

1.2 Big-Data Commercial Operations Decision-Support System (BCODSS)

The Big Data Commercial Operations Decision Support System (BCODSS) is designed for the operations stage of commercial projects. The platform integrates data from multiple sources—such as sales records, footfall, social-media feedback, and sensor readings—and applies machine-learning algorithms to uncover patterns and trends that underlie the data. It provides operations managers with visual business insights.

Using natural-language processing, BCODSS converts complex analytical results into concise and actionable recommendations, enabling managers to adjust business strategies, optimize tenant mix and layout, and refine marketing plans in a timely manner. In our projects, BCODSS has greatly improved the accuracy and responsiveness of business decisions, turning traditional experience-based decision-making into a data-driven scientific process and significantly enhancing mall operating performance.

1.3 Smart Retail Digital Transformation and O&M System (SRDTOMS)

The Smart Retail Digital Transformation and Operations-and-Maintenance System (SRDTOMS) serves primarily retail scenarios and is an integrated digital management platform. The system monitors in real time the operating status of store equipment, inventory levels, and visitor flows, and uses predictive analytics to optimize inventory allocation. This prevents both excessive stockpiling and stockouts.

Its automatic early-warning function issues alerts based on predefined rules whenever abnormalities arise, helping store managers respond quickly. Through in-depth analysis of customer behavior, SRDTOMS also generates individualized marketing strategies that enhance customer satisfaction and the overall shopping experience. Our use of SRDTOMS in retail projects shows that it significantly improves operational efficiency, optimizes inventory management, and increases customer loyalty.

1.4 Immersive-Experience Optimization Comprehensive Service System (ICSES)

The Immersive-Experience Optimization Comprehensive Service System (ICSES) targets commercial spaces and exhibition venues, combining virtual reality (VR) and augmented reality (AR) technologies. Using high-precision three-dimensional modeling and environment rendering, the system creates highly realistic or creatively designed immersive environments for users. It supports natural interaction via gesture recognition and voice recognition, delivering smooth and intuitive interactive experiences.

In our practical applications, ICSES markedly increases customers' engagement with commercial spaces and strengthens their emotional connection to the environment. It opens new dimensions of experience for retail and commercial-space design and has become an important tool for optimizing user journeys.

1.5 Commercial-Operations Proposal Generation and Presentation Platform (COPGP)

The Commercial-Operations Proposal Generation and Presentation Platform (COPGP) streamlines the formulation of commercial operations proposals. The platform provides standardized template-management functions, allowing users to create, edit, and categorize different types of operations-proposal templates. Its built-in intelligent algorithms automatically generate proposals that align with designated commercial and operational objectives, helping enterprises rapidly adapt to market changes.

COPGP supports multiple display and comparison modes so that managers can efficiently screen and select the most appropriate proposal. Our practice shows that COPGP shortens the proposal-generation cycle,

improves decision accuracy, and reduces submission errors. The empirical results are summarized in Table 2.

Table 2. Effects of COPGP in Commercial-Operations Management

Item	Traditional operations model	Digital operations model (COPGP)	Efficiency improvement (%)
Proposal generation time	7–10 days	1–2 days	70
Proposal adjustment cycle	5 days	1 day	80
Decision accuracy	75%	90%	20
Proposal submission error rate	10%	3%	70
Customer-feedback cycle	3 days	1 day	66.67

2. Collaborative Application and Performance Evaluation in Typical Projects

2.1 Project Case Studies

2.1.1 UniFun Tianfu Ring Park (Chengdu)

UniFun Tianfu Ring Park is a key commercial real estate project in Chengdu. Throughout the project we deployed the PMPOP platform across all stages. With PMPOP, planning, design, construction, and operations workflows were coordinated within a single system. The project-management team could use the visual interface to track progress, resource status, and quality metrics in real time, adjusting resource allocation as needed to keep tasks on track.

The platform's built-in real-time monitoring and early-warning functions helped the team quickly identify potential risks and take timely action. This not only shortened the project's overall duration but also improved construction quality. The use of PMPOP significantly enhanced the scientific rigor and efficiency of project management, fully demonstrating its value in full life-cycle control.

2.1.2 Shanghai Xinhuan Plaza

In the Shanghai Xinhuan Plaza project, we focused on deploying the BCODSS platform to support mall operations. The platform continuously integrated data on sales, footfall, and tenant performance, and used machine learning to analyze consumption patterns and market trends. This gave mall management a solid basis for formulating finely tuned operational strategies.

The system automatically adjusted marketing campaigns, tenant layout, and product assortments in response to data changes, enabling the mall to maintain competitiveness in a rapidly changing business environment. With BCODSS in place, both operating efficiency and tenant profitability improved significantly.

2.2 Practical Application Process of the Platforms

2.2.1 Real-Time Data Collection and Monitoring

Real-time data collection and monitoring is one of the core functions of the integrated system matrix. In construction projects, PMPOP uses sensors and real-time data analytics to monitor material consumption, working hours, equipment usage, and other key indicators. In the operations phase, BCODSS and SRDTOMS collect data on footfall, sales, inventory, and equipment status to support decision-making.

Our experience in the UniFun and Xinhuan projects shows that real-time data collection and monitoring greatly improve the responsiveness of management teams. They can address potential risks in advance and ensure smooth project delivery and day-to-day operations.

2.2.2 Project management and scheduling

By integrating tasks and resources for each project stage into a single platform, the system matrix provides visualized views of progress and supports real-time adjustments. PMPOP's collaborative-management capabilities enable information sharing across teams, reducing information silos. BCODSS's data-driven decision support helps operations managers quickly adjust strategies in the face of market changes. The combination of these functions significantly improves the efficiency of both project and operations management.

2.3 Before-and-After Performance Comparison

Based on empirical analysis across multiple projects, the integrated system matrix demonstrates clear advantages in management efficiency, operational performance, and profitability. Table 3 summarizes key metrics before and after adopting the matrix.

For example, in the UniFun project, after introducing PMPOP, overall project duration

was reduced by about 30–40%, risk-response time declined by 60%, and management efficiency rose by 35.71%. In the Xinhuan Plaza project, BCODSS helped the mall raise operating efficiency by 41.67%, while tenant profit growth reached 200%. These results provide strong evidence of the matrix's value in digital management of commercial buildings.

Table 3. Comparison of Project Performance Before and After Digitalization

Item	Traditional management model	Digital management model (PMPOP / BCODSS)	Efficiency improvement (%)
Project duration	12 months	8–9 months	30–40
Risk-management response time	5 days	2 days	60
Management efficiency	70%	95%	35.71
Mall operating efficiency	60%	85%	41.67
Tenant profit growth	5%	15%	200

3. Conclusion

As actual users of the integrated intelligent system matrix, we find that it has outstanding value in the full life-cycle management of commercial buildings. By relying on independently developed core technologies, the matrix achieves high-level integration of data and processes across all stages. It leverages big-data analytics and intelligent algorithms to raise the scientific quality and efficiency of decision-making. In real projects, its application has significantly shortened project schedules, improved operating performance, and enhanced customer experience.

The matrix not only provides a replicable and scalable path for digital practice but also offers a referenceable paradigm for digital transformation in the commercial building industry. Looking ahead, as the Internet of Things and artificial intelligence continue to evolve, the matrix has the potential to be applied in an even wider range of industry scenarios, further promoting intelligent, green, and sustainable development in the commercial building sector.

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