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Disrupting Commercial Real Estate Management and Financing with AI-supported Digital Twin Modeling

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Abstract: The traditional 60/40 stock–bond allocation model has struggled to deliver diversification and stability in today's volatile, inflation-prone markets. This paper explores the strategic inclusion of commercial real estate (CRE) as a core third pillar in modern portfolio construction, alongside equities and bonds. CRE provides unique benefits—inflation resilience, durable income streams, and vital diversification through a low correlation with public markets. Empirical analysis confirms that adding real estate and infrastructure improves risk-adjusted returns and reduces portfolio volatility, especially during inflationary cycles. This allows investors to optimize asset performance, align long-term liabilities with predictable returns, and enhance portfolio resilience. Without such technological integration, CRE's full potential as a core asset class would remain unrealized.

By utilizing a modified Job Demands-Resources framework, this study also quantifies the psychological and operational workload shifts for CRE experts over a three-year horizon. Model simulations reveal that while AI automates routine and repetitive tasks, it simultaneously eliminates critical 'neurological cooling' periods embedded in daily workflows. Consequently, remaining CRE executives and property managers face a concentrated stream of exception-management responsibilities, causing the Final Strain Ratio to escalate dramatically to 6.3 for executives and triggering a more than fourfold acceleration in systemic strain. These findings demonstrate that without fully autonomous, highly dependable AI agents capable of absorbing complex operational tasks, EOTL models risk driving severe cognitive fatigue, decision paralysis, and burnout among senior leadership.

Keywords: Real estate investment; Institutional portfolios; Portfolio diversification; Commercial real estate; Inflation protection; Digital twins; Agentic AI

1. Introduction

The long-standing 60/40 stock–bond allocation model has been a cornerstone of portfolio strateg

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(Penman and Zhu, 2025; Brixton et al., 2023; Henriksen et al., 2019). However, it struggles to deliver desirable diversification and stability. Its limitations have become increasingly apparent in today's complex, inflation-prone environment. Our paper demonstrates that its weaknesses are structural and cannot be resolved without introducing new asset classes and new analytical tools.

This paper argues that by employing AI and digital twins, commercial real estate (CRE) can now serve as a core, third pillar of modern portfolio strategy, alongside equities and bonds. CRE offers inflation resilience, durable income streams, and diversification through low correlation with public markets. Empirical evidence shows that real estate and infrastructure enhance portfolio resilience, improve risk-adjusted returns, and reduce volatility, particularly during inflationary cycles.

The paper further explains that CRE's historical drawbacks, such as illiquidity, valuation lag, subjective management and operational opacity, have prevented it from functioning as a fully optimized portfolio component. To address these issues, we examine the integration of digital twins and Agentic AI as enablers of real-time, data-driven asset and portfolio management.

Digital twins and AI drastically improve the decision-making process for CRE. Although AI-enabled digital twins do not inherently alter conventional algorithmic analytics, they disrupt portfolio management by making comprehensive analysis proactive, agile, near-real-time, more consistent, cheaper and less labor-intensive. Both approaches should be fine, provided they are used (or, in the case of digital twins, supervised) by highly qualified financial analysts.

These new tools replace subjective management approaches, which rely on infrequent appraisals and slow, fragmented data unevenly supported by conventional static or legacy algorithmic methods, with continuous analytical loops that process high-volume operational, regulatory, marketing and financial data flows. They shift CRE management from reactive decisions based on infrequent reporting to proactive, predictive optimization of high-volume, dynamic data flows. This transition provides better-quality, more objective and cost-effective modelling compared with legacy analytic or spreadsheet-based techniques, especially those performed by less qualified financial analysts.

However, the integration of digital twins and AI into CRE decision-making will likely face challenges, particularly from those rooted in traditional methodologies. These conventional approaches, while valuable in their time, have proven conceptually limited in analyzing the complex problems posed by CRE management and financing in the last few decades (Strielkowski et al., 2023; Toprakli, 2025; Amar, 2026). They are slow to adapt to the dynamic and real-time nature of today's data-driven world. The shift to continuous recalibration and predictive modeling offered by digital twins and Agentic AI requires a fundamental rethinking of established practices.

Historical resistance to novel analytical approaches, such as the initial skepticism toward computer modeling in economics or the early doubts surrounding machine learning applications in finance, highlights the difficulties in embracing disruptive innovations (Townsend et al., 2025; Mackenzie, 2006; Barbierato and Gatti, 2024; Agrawal et al., 2022; Brynjolfsson and McAfee, 2014). For example, general equilibrium models were initially criticized for their reliance on highly abstract assumptions, but later

economic historians recognized this period as pivotal in the development of computational methods (Mirowski, 2002). The gradual adoption of machine learning in finance, despite its clear successes in other fields, demonstrates similar hurdles, particularly in the critique of algorithmic trading during its early stages (MacKenzie, 2006). Similarly, industries like manufacturing were initially reluctant to adopt automation technologies, even as robotics and AI revolutionized other sectors (Mahbub, 2008; Khin and Kee, 2022). Acknowledging these historical challenges and fostering open dialogue within the CRE industry will be crucial to ensuring a smooth, sustainable transition to these advanced frameworks.

As a result, the paper demonstrates how these emerging technologies transform CRE into a liquid, transparent, highly scalable and high-performance asset class. Without this technological integration described in our previous article, such a transformation would remain unattainable. It enables institutional and high-net-worth (HNW) investors to strengthen portfolio resilience and align long-term liabilities with performance objectives. This paper, therefore, shows that a dynamic allocation strategy, continuously adapting to real-time macroeconomic and granular operational conditions, positions CRE as a structurally necessary third pillar of modern portfolio construction.

2. Rethinking the Traditional 60/40 Portfolio

For decades, the 60/40 equity–bond framework served as a cornerstone of asset allocation portfolio models. Yet in recent years, its limitations have become apparent. The correlation between stocks and bonds has weakened, reducing diversification benefits and increasing systemic risk. Persistent inflation has further diminished bonds' reliability as a defensive hedge despite historically low interest rates (Rosenberg *et al*., 2025; Gates, 2025; Redmond, 2025; Cuevas, 2025; Croak, 2025; Oyat Advisors, 2024; State Street Global Advisors, 2025; Sodhi *et al*., 2025; Newell *et al*., 2024; Wurstbauer and Schäfers, 2015; Newell *et al*., 2013; Liow *et al*., 2005). A diversified 60/40 strategy failed to protect investors during the broad market decline of 2022 (Arnott and Hampton, 2025; Kephart and Dziubinski, 2023; Hoesli *et al*., 2024).

Valuation pressures compound these dynamics. Elevated equity prices and historically low bond yields constrain forward returns. Fiscal deficits and geopolitical tensions heighten risk. In today's interconnected global markets, traditional asset mixes struggle to absorb shocks or capture new sources of growth.

Against this backdrop, institutional investors increasingly advocate a broader, more sophisticated three-pillar portfolio structure. It balances equities and bonds with CRE and infrastructure investments. This evolution reflects the growing recognition that tangible assets can deliver both income stability and diversification uncorrelated with public markets. However, this approach is far more computationally and labor-intensive and, if performed without the use of AI, substantially slower and more expensive.

The seminal work of Harry Markowitz on Modern Portfolio Theory (MPT) established the basic principles of diversification benefits for risk-averse investors. Based on quantified investors' goals, his theory optimizes portfolios by achieving the maximum expected return for a given level of risk. To

safeguard long-term returns, it allocates more capital to stocks for their higher return potential but higher risks, while using bonds as a conservative hedge to preserve capital in the short term (Markowitz, 1952). The precise asset allocation depends on the investor's risk tolerance; i.e., younger investors might favor more equities, while pensioners prefer fixed-income securities.

The Markowitz model enables investors to construct an optimal portfolio of various assets offering the highest possible expected return for a given level of risk based on four key variables:

- Maximized **Expected Returns:** A weighted average of the expected returns of the individual assets in the portfolio.
- Minimized **Portfolio Variance** or **Standard Deviation:** Measures the volatility of portfolio returns.
- **Covariance:** Assesses the level of diversification. Combining assets with low or negative covariance reduces overall portfolio risk without sacrificing expected return.
- **Asset Weights:** Determine the ideal proportions of different assets to achieve the desired risk-reward balance.

Investors can quantify their ideal asset mix by selecting a subjective **Risk Aversion Parameter**, which typically evolves over time. A higher value indicates greater investors' aversion to risk, favoring lower-volatility portfolios; and vice versa. The most popular remains the 60/40 stock–bond allocation model, designed to balance capital appreciation with stable growth. Its variations reflect investors' income and risk tolerance.

3. The Strategic Value Add of Commercial Real Estate

CRE's appeal lies in its combination of inflation protection and dependable cash flow. It also exhibits low empirical correlations with equities (roughly 0.3) and bonds (0.6) (Garcia, 2024; Primior, 2025; Nguyen and Nguyen, 2025; Devaney and Scofield, 2021). CRE's independence from traditional portfolio assets largely stems from supply–demand dynamics driven by local economic and demographic factors rather than public market sentiment.

At the portfolio level, AI-enabled CRE models materially stabilize covariance estimates and smooth cash-flow distributions. This shifts the efficient frontier upward through enhanced predictability and earlier detection of liquidity events.

Persistent inflation regimes and global reinvestment cycles further underscore the necessity of integrating CRE as a core strategic asset. Extensive research confirms that incorporating real estate and infrastructure enhances portfolio resilience and improves risk-adjusted returns (Rupprechter, 2026; Harrison, 2026; Lirkki and Taipale, 2025; Kumar, 2025, Abate, 2024; Blanc-Brude *et al*., 2024; Pitsiladi *et al*., 2025; Habbab and Kampouridis, 2024; Amenc *et al*., 2022; Günther *et al*., 2022; Panayiotou and Medda, 2016; Case *et al*., 2012; Inderst, 2010; Viezer, 2010; Callender *et al*., 2007; Chun *et al*., 2004; Pyhrr *et al*., 1999; Wiegelmann and Schwab, 2025; Wiegelmann and Weltzien, 2025; Fadeyi *et al*., 2021).

The efficient frontier—a core concept in MPT—defines the set of portfolios that maximize expected return for a given level of risk, or minimize risk for an expected return. In our modelling of a typical stock–bond portfolio, adding direct real estate shifts the efficient frontier upward and to the left (see Figure 1). This reflects both higher returns and lower volatility across many optimal combinations of its components, ranging from 0 to 100%. This diversification benefit explains why endowments, pension funds, and other institutional and HNW investors treat real estate as a core allocation.

During prolonged inflationary periods, CRE acts as a stabilizer for investment returns. The asset class's long-term leases and limited liquidity help mitigate the short-term volatility and behavioral risks that often undermine confidence in public markets. Historical data from North American pension portfolios demonstrate that CRE consistently boosts total returns and reduces volatility, especially during inflationary cycles (Garcia, 2024; Primior, 2025).

In the United States, high-net-worth (HNW) investors typically allocate 20–27 percent of their portfolios to CRE, mostly through direct property ownership. In contrast, institutional allocations currently average 10.7 percent, suggesting substantial potential for growth (Syme, 2023; Altamirano, 2025; Athanasopoulos and Cavalli, 2024; Cornell University and Hodes Weill, 2025; Wiegelmann and Schwab, 2025; Higgins, 2015).

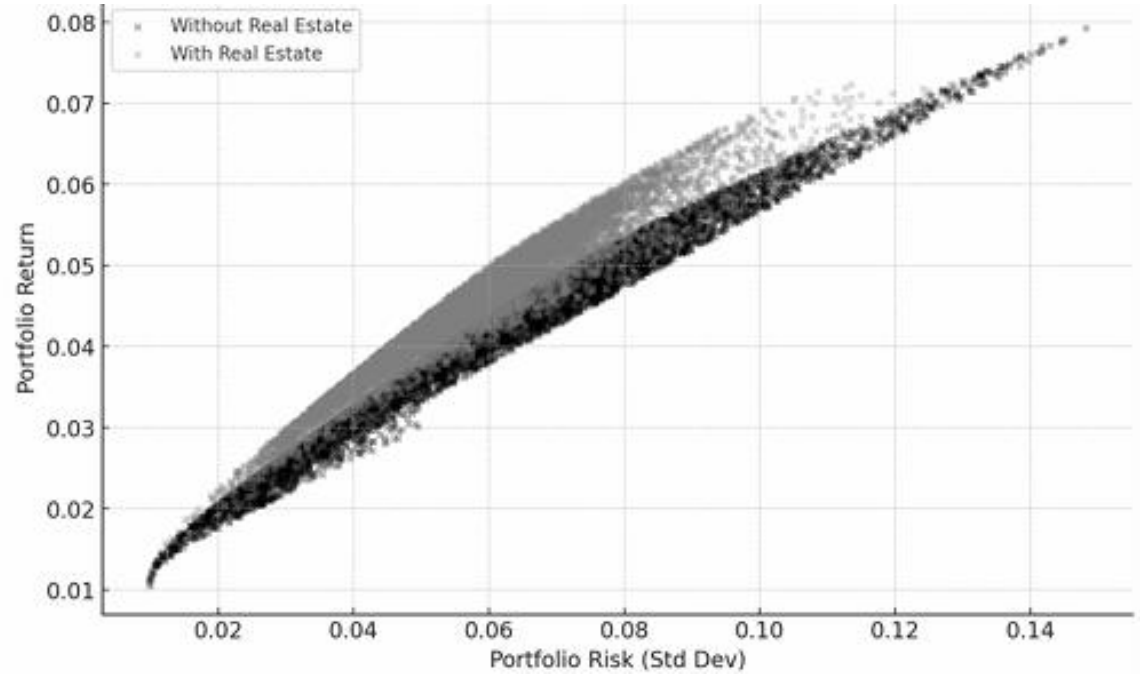


Figure 1: Efficient frontier with and without direct real estate. See text for explanation. Source: Authors' own work.

The picture differs across the Atlantic. For UK HNW investors with assets exceeding £5M, property represents less than 20 percent of total wealth, which is at the lower end compared to their US peers. Moreover, as UK HNW investors become wealthier, their property allocation decreases further

(DIY Investor, 2025). European HNW investors show even lower property ownership at 14.5 percent, though this figure varies widely among countries within the region (Statista, 2026).

Real estate allocations in UK investment fund portfolios have historically lagged behind the US, ranging from 2 percent to 10 percent (UK Investment Association, 2024; Investment Property Forum, 2025; CBRE Research, 2025). EMEA institutional portfolios allocate a higher average of 18 percent to real estate (PGIM, 2024).

These property ownership figures might appear counterintuitive to some North American and European real estate investment professionals. We therefore conducted a careful review of government and industrial statistical sources and academic literature supporting the cited data. Although cross-border comparisons of investment allocations are inherently challenging due to differences in definitions and methodologies, all sources consulted consistently corroborate the credibility of the above evaluations.

Privately traded direct investments in CRE and infrastructure provide great control, stability, physical assets, and tax advantages. However, they are beset by illiquidity and require substantial capital, time and expertise to manage effectively, which are often in short supply. Real Estate Investment Trusts (REITs) provide liquidity and diversification at the expense of control. REITs typically outpace inflation due to lease escalation clauses and supply constraints linked to rising construction costs (Muckenhaupt *et al*., 2025; Muckenhaupt *et al*., 2025a; Lausberg and Brandt, 2024; Zhang *et al*., 2025; Funari, 2022; Greenberg *et al*., 2025; Liu *et al*., 2012).

In the short term, REITs and stock market returns strongly correlate. Direct holdings maintain lower short-term correlations with public markets, offering more genuine diversification compared to publicly traded REITs (Davis, 2025; Babalos *et al*., 2025; Skyline Wealth Management, 2025; D3 Capital, 2025). They also differ from REITs in portfolio allocation, capital requirements, transaction costs, and fees.

Over longer horizons (beyond two to three years), REIT and direct real estate returns and return volatilities tend to converge across well-diversified international portfolios. Both asset types respond similarly to economic shocks, while correlations with equities weaken over time (Hoesli and Oikarinen, 2021; Rizi, 2022; De Francesco and Hartigan, 2009).

Cyclically, the current market entry point appears favorable. Prime properties in key logistics and metropolitan clusters trade at discounts. Significant volumes of CRE debt approach renewal, allowing investors to enter early in the recovery cycle. A calibrated CRE allocation enhances inflation protection, income stability, and long-term funding resilience—all critical attributes for institutional portfolios.

4. Digital Twins: Recasting the Investment Model for Asset Management

Elevating CRE to an equal counterpart of equities and bonds requires analytical precision comparable to financial market standards. Historically, optimization for a particular asset was imprecise, labor-intensive, slow, costly, and thus impractical. Digital twins, integrated with Agentic AI, make it achievable, transforming CRE into a liquid, transparent, highly scalable, high-performance asset class

(Goldmann *et al*., 2025). This technological leap represents the essential enabler for the CRE-as-third-pillar thesis.

A digital twin is a real-time virtual model of a physical asset that integrates operational, environmental and financial data. In CRE, it enables monitoring and adjustment of every physical and virtual element of a property. This includes structural systems, energy use, HVAC, finances, legal documents, and occupancy. Proactive implementation of predictive analytics and maintenance reduces downtime, optimizes resources, and extends asset life. These improvements enhance operating income, asset values, and monetization potential.

AI further improves decision-making by integrating disparate legal, operational, and financial datasets into a unified decision engine. This reduces human-generated errors and inconsistencies common in manual or spreadsheet-based underwriting.

Digital twins paired with Agentic AI support continuous monitoring and adaptive management of assets and portfolios. They model cash-flow stability, detect early signs of tenant stress, and recommend reallocations across asset classes as conditions evolve. Dynamic management and financing convert real estate from a static holding into an actively optimized investment. These capabilities enable investor-use pathways, such as dynamic CRE–bond substitution rules, liability-duration matching based on real-time lease-term projections, and leverage optimization calibrated to property-specific operational data.

This approach contrasts sharply with Excel-based underwriting, which is inherently manual, error-prone, and slow to update. Even sophisticated spreadsheet templates remain static snapshots rather than integrated, real-time analytical engines. Excel is structurally incapable of capturing nonlinear interactions among operating variables while making this process economically efficient to be widely deployed and maintained for industrial applications. Scenario updates require continuous human intervention, introducing compounding model risk across investment committees. Large Excel models become increasingly fragile, especially when incorporating scripts for managing large datasets. Attempts to overlay user-friendly interfaces for non-expert users rarely succeed.

The AI-driven approach successfully resolves three critical flaws in conventional CRE investment modelling based on algorithmic valuation methods:

4.1 Static, infrequent valuations

Traditional methods rely on infrequent, backward-looking annual appraisals, leading to significant valuation lag. Legacy algorithmic models attempt to predict this lag but are constrained by limited, often fragmented input data. Highly granular virtual models realized by digital twins integrate continuous flows of operational, legal-admin, environmental, marketing and financial data, enabling real-time valuation and risk assessment for every asset. This improvement is superior to traditional econometric and factor-model approaches, which cannot ingest or interpret operational datasets at the necessary resolution or frequency.

4.2 Operational opacity and fragmentation

Legacy ERP systems and manual processes struggle to integrate four core segments of CRE data (legal/admin, technical/maintenance, commercial and financial). Each of their 40 subsegments is governed by diverse regulatory and technical requirements, and presented in multiple languages and formats (Goldmann et al., 2025). Fragmentation leads to costly manual exception management and delayed decision-making. In contrast, digital twins enable cross-domain analysis of structured data, detecting patterns invisible to legacy systems (e.g., early signs of tenant stress, maintenance inefficiencies). Continuous optimization of digital twins by Agentic AI allows CRE portfolios to operate with the same precision and liquidity as financial assets. It enables proactive asset and property management.

4.3 Inability to support dynamic allocation

Traditional models yield largely static asset allocations that adjust slowly. Integration of digital twins and Agentic AI enables dynamic portfolio optimization. AI continuously recalculates key Markowitz variables (expected returns, volatility, covariance) based on real-time property performance, macroeconomic shifts, and evolving market conditions. This provides objective criteria for automated, data-driven asset rebalancing, treating CRE with the same precision and responsiveness as public market assets. Persistent inflation further emphasizes the importance of real-time valuation and adaptive allocation, ensuring that portfolios maintain resilience in changing economic environments.

As in other industries, CRE management and financing leaders call for reengineering and automating labor-intensive business processes via AI to improve operational efficiency and productivity. The stated goals include reducing complexity, streamlining management layers, and right-sizing the workforce (Wang *et al*., 2025; Thompson, 2025; Blanco *et al*., 2025; Altankhuyag and Kurzrock, 2025; Starr *et al*., 2021). However, the sector faces a critical talent shortage, as low- to mid-level professionals often lack skills required for automation and AI adoption (Dsouza, 2025; Morgan Stanley, 2025; Aon, 2025; LeFurgy, 2023; Mottaghi *et al*., 2024; Cajias, 2021).

By converting bespoke manual tasks into agile automated processes, Agentic AI dramatically improves the reliability of global technical controls, risk, security management, and compliance. Accelerated disruptive innovation will inevitably render entire industries obsolete (Williams, 2025; Mann, 2025; Cook, 2015).

Digital twins link operational data to financial performance, improving valuation accuracy, compliance, stress testing and capital allocation. They enhance transparency across CRE construction, management and financing that are historic barriers to institutional participation in rapidly expanding private credit markets. Opaque relationships between private investments and the broader financial system, as well as illiquidity and infrequent valuations in private loans, often mask problems brought by inexperienced firms entering the booming market or an unexpected surge of systemic risks, particularly in serious economic downturns. Demographic shifts, including urbanization and changing tenant

demand patterns, underscore the value of dynamic, data-driven CRE management for capturing emerging growth opportunities. These enhancements enable effective portfolio-level applications, such as automated duration matching, dynamic leverage calibration, and systematic CRE–bond substitution based on continuously updated risk–return profiles.

5. The Inadequacy of Legacy ERP Systems

Legacy ERP (Enterprise Resource Planning) systems, such as SAP, Oracle Financials, and Microsoft Dynamics, are fundamentally ill-suited for the complexity of individual CRE asset management. These platforms function effectively only when corporate business processes conform rigidly to their proprietary architectures. Their implementation demands massive upfront capital investments, multi-year deployment timelines, extensive workforce training, continuous technical support, and costly ongoing licenses. While effective for stable, predictable workflows (e.g., mass manufacturing), they fail in the highly variable environment of CRE.

The track record of ERP integration projects reveals troubling patterns. Initiatives are often cancelled before completion, delivered significantly behind schedule, or ultimately cost double their original estimates. Only a fraction of the promised features is typically implemented. Low- to mid-margin businesses rarely survive the financial and operational strain of failed or problematic system integrations and the related burden of business process reengineering.

Larger and more stable businesses perform more efficiently under traditional ERP systems. This explains their historical success in managing predictable, recurring functions in conventional enterprises, such as finance, procurement, supply chain logistics, mass manufacturing, sales, distribution, customer relationship management and human resources. However, these same systems are far less effective in managing individual construction projects or CRE properties, where numerous rapidly changing variables represent the operational norm rather than the exception.

A typical construction project involves dozens of subcontractors who rarely coordinate effectively or maintain consistent communication among trades. Plans change constantly, rendering rigidly programmed ERP platforms impractical and making change-tracking extraordinarily difficult. Persistent breakdowns in communication, documentation errors, and misaligned design assumptions routinely trigger costly rework cycles. These inefficiencies cascade into project delays, budget overruns, duplicated efforts, and eroded stakeholder trust. According to Trimble (2025), construction professionals spend more than one-third of their time managing such friction points rather than focusing on core competencies.

Proposed enhancements to traditional ERP systems often increase complexity rather than address the root causes of expensive, labor-intensive exception management. Obsolete or proprietary data formats from sensors cannot frequently integrate without costly upgrades or cumbersome workarounds. Training initiatives yield minimal returns given the construction industry's high employee turnover rates. Calls for stronger executive oversight or further platform enhancements remain largely impractical. CRE

management and financing face even greater complexity than construction operations and suffer from comparably severe inefficiencies.

In contrast, digital twins powered by Agentic AI offer virtually unlimited flexibility. These systems enhance coordination across critical functions and trades. They enable seamless data integration and benefit from rapidly declining deployment costs. Digital twins can quickly self-adapt by individually defining (or redefining) and operating each CRE and infrastructure asset. By digitizing previously unstructured workflows, creating highly customized solutions, and building property-specific knowledge in real time, they deliver output accuracy and competitive advantages that hard-coded ERP systems fundamentally cannot match.

6. Expert-in-the-loop challenges

Management of physical assets, finances, occupancy, environmental performance, regulatory compliance and legal documentation is often constrained by complex interactions that are familiar to seasoned professionals but rarely fully predictable. Simultaneous monitoring of these domains is labor-intensive and costly.

Legacy ERP software relies on rigid algorithms with limited adaptability to rapidly evolving operational conditions. The operational relevance of such software may decline within months, as programming knowledge depreciates. By contrast, in CRE, AI-supported digital twins can continuously monitor and manage these interdependencies for years through ongoing adaptation, updating and learning. Like human operators and managers, Agentic AI must satisfy accountability, regulatory and risk-management requirements by identifying and correcting errors in real time (Riemer and Peter, 2024).

Human oversight of AI decision-making should be supported by clear and objective criteria and measurable performance outcomes. Governance mechanisms must scale efficiently as data volumes exponentially increase. As digital twins mature, human experts are expected to participate primarily during higher-level governance and exception-review stages.

Agentic AI is expected to shift from continuous human-*in*-the-loop intervention toward distributed *expert-on-the-loop* (*EOTL*) oversight. Human intervention during anomalies helps prevent 'black box' situations in which no executive or manager assumes responsibility for algorithmic failures. This transition reverses the traditional paradigm in which technology primarily supports human decision-making.

Industry projections indicate that, within three to seven years, AI deployment in mainstream organizations will transition toward agent-native platforms that could potentially double productivity. Several forecasts also suggest that AI reasoning may surpass human performance across many cognitive tasks (Dilmegani and Ermut, 2026; Grace *et al*., 2025). These advances may enable as few as five domain experts to manage client volumes that historically required analytical, financial, or management teams of approximately ten members (Levi and Hazuria, 2026; Palakeel, 2026).

In this model, domain professionals and executives provide final supervision, auditing, and discretionary intervention without approving every operational or strategic action individually. Autonomous execution of the majority of complex but routine workflows that monitor risks, develop disaster recovery plans, and arrange granular reinsurance based on catastrophe profiles, may reduce maintenance costs by 15-20%.

EOTL oversight remains essential whenever unexpected outcomes arise, or legal, ethical, or security considerations require fiduciary accountability and transparent decision-making (Zetzsche *et al*., 2020; Kumar *et al*., 2024). Human experts may approve or override only a relatively small proportion of decisions, particularly when projects exceed predefined financial thresholds, affect critical milestones, or involve elevated legal or operational risk, especially in increasingly regulated industrial sectors (Ea, 2024). However, concentrating oversight responsibilities among remaining experts may substantially increase cognitive workload, contributing to stress and burnout.

Digital twins were originally developed to model physical assets and predict maintenance requirements while improving operational performance. Continuously updated using sensor and operational data, they function as dynamic virtual representations of physical objects, processes, and systems. Next-generation digital twins may also establish decentralized digital identities across the ecosystem, covering organizations, equipment, personnel, financial performance, and stakeholder interactions.

Human digital twins integrate information derived from personal characteristics, workplace interactions, and digital activity into actionable analytical models. Supported by AI, these models may predict how evolving business processes influence workforce health and quality of life (Davila-Gonzalez, S., and Martin, S., 2024; Bucci *et al*., 2024; Alfaro-Viquez *et al*., 2025).

Table 1: List of typical property managers' responsibilities for top institutional-grade CRE (above $40M property values)

1	2	3	4	5	6
Row ID	CRE property managers responsibilities	% of total working time	% routine tasks	% exception management	% of automa-table routine tasks
1	Lease Administration, Compliance & Documentation	10%	75%	25%	60%
2	Tenant Relations, Retention & Occupant Experience	15%	45%	55%	20%
3	Property Operations, Maintenance & Inspections	15%	60%	40%	40%
4	Operational Accounting, Rent Collection & Financial Administration	10%	85%	15%	70%
5	Ownership Financial Reporting, Budgeting, Forecasting & Analysis	10%	45%	55%	50%
6	Vendor, Contractor & Service Contract Management	10%	60%	40%	40%
7	Capital Projects, Tenant Improvements & Major Repairs	10%	45%	55%	20%
8	Risk, Compliance, Insurance & Safety Management	5%	50%	50%	35%

1	2	3	4	5	6
9	Emergency Response & Business Continuity	5%	30%	70%	15%
10	ESG, Sustainability, PropTech Oversight & Data Governance	5%	60%	40%	45%
11	Strategic Planning, Asset Coordination, Leasing Support & Stakeholder Relations	5%	55%	45%	20%
	Total averaged (except for column 3)	100%	55%	45%	35%

At the start of our modeling process, we identified the conventional responsibilities of property managers (Table 1) and portfolio executives (Table2) responsible for institutional-grade CRE assets valued above $40 million (see Appendix 1). Estimated time allocations and responsibility ranges were derived from industry-standard job description analyses and job postings from top-tier CRE firms (such as https://careers.cbre.com/en_US/careers/, https://jll.wd1.myworkdayjobs.com/jllcareers, Cushman & Wakefield), alongside empirical studies on property management workflows, such as the Institute of Real Estate Management (IREM) Certified Property Manager (CPM) competency framework.

Table 2: List of typical executive responsibilities for top institutional-grade CRE (above $40M property values)

1	2	3	4	5	6
Row ID	CRE executive responsibilities	% of total working time	% routine tasks	% exception management	% of automatable routine tasks
1	Portfolio Strategy, Business Operations & Capital Planning	20%	20%	80%	15%
2	Ownership-Level Financial Reporting, Asset Strategy, Analysis & Investor Liaison	15%	30%	70%	35%
3	Operational Accounting, Budgeting & Routine Reporting	15%	80%	20%	55%
4	Tenant Retention, Lease Strategy & Stakeholder Relations	15%	35%	65%	20%
5	Team Leadership & Directing Subordinates	10%	30%	70%	10%
6	Property Operations Oversight: Maintenance Scheduling, Vendor & Logistics Management	10%	60%	40%	40%
7	Risk Management, Emergency Response & Business Continuity	5%	20%	80%	20%
8	Institutional Investor Reporting Standards, ESG/Sustainability Reporting & Regulatory Compliance	5%	55%	45%	45%
9	PropTech-Stack Direction, Data Governance & Strategic Technology Oversight	5%	35%	65%	30%
10	Portfolio Performance Monitoring, Continuous Improvement & Cross-Functional Governance	0%	40%	60%	35%
	Total averaged (except for column 3)	100%	40%	60%	30%

The tables represent all CRE property types (office, retail, industrial, multifamily, infrastructure). Time allocations vary significantly by property type and class, age and physical state of assets, geographic location, jurisdiction, capital structure, investment goals and operational phase. For example,

retail managers likely spend more time on marketing/leasing and tenant mix coordination, while industrial managers focus on maintenance and logistics vendor management. We also searched academic literature on property management automation and performance benchmarking, and reviewed internal firm workforce analytics (CBRE, 2026; IREM, 2026; MYBOS, 2026; RIOO, 2026; RIOO, 2026a; Everling, 2026; Burke, 2026; Indeed Employer Content Team, 2026; RFS Onshr, 2026; BOMA Canada, 2025; RCLCO & CEL, 2025; Bouzinac, 2025; Cushman & Wakefield, 2025; JLL, 2025; JLL, 2025a; Burns, 2025; JLL, 2024; Cook *et al*., 2024; CBRE, 2024; Schafer Richardson, 2024; Göppinger *et al*., 2024; REM, 2022; Litser, 2019; Yau and Ho, 2018; De Francesco and Levy, 2017).

Routine-versus-exception allocations reflect the current commercially available property management platforms (e.g., Yardi, MRI, VTS, Building Engines, automation-enabled lease administration, accounting workflow automation, environmental, social and governance reporting tools) and contemporary PropTech adoption patterns reported by major CRE firms and industry organizations. According to the cited literature, tasks like lease administration, operational accounting and compliance tracking exhibit the highest automation potential, while emergency response, investor communications, strategic planning and capital-project decisions remain heavily dependent on human judgment.

Columns 6 in both tables provide range estimates of easily automatable routine tasks for each responsibility, mostly occurring on a daily and weekly cadence (e.g., data entry, standard email generation, scheduled report compilation). Automatable routine tasks were identified using the definition established above and include activities supported by commercially available PropTech solutions, multi-step AI agent orchestration, pilot-stage technologies, or tools expected to become generally available by the mid-2026 baseline.

The percentage estimates in this study should be interpreted as informed industry approximations rather than empirically measured workforce averages. While individual differences could be critical when initially designing a digital twin for a particular property, averaging across these factors simplifies our model and clarifies broader trends in AI-driven workforce decomposition.

Some businesses apply an informal '30% rule', originally proposed by McKinsey (Ellingrud *et al*., 2023). This rule suggests that approximately *one-third of business tasks can be automated with AI today*. These tasks are typically structured, repetitive, controllable, and low-risk if corrected later, making them ideal for machine execution. The remaining two-thirds require human expertise, contextual understanding, relationship management, regulatory compliance oversight, and accountability for high-stakes decisions (Ivanov, 2026; Novikova, 2026).

In CRE, breaching these boundaries creates severe operational liabilities. Any process where an error causes significant financial or asset damage must remain human-verified, while life-safety or emergency operations cannot be fully automated. As outlined in real estate legal briefings (Lundie and Peterson, 2026; Radcliffe and Taylor, 2026), AI-driven optimization cannot assume legal liability, which is a soft boundary condition. Siloed or unintegrated legacy property management software serves as a hard systemic boundary.

This human–AI partnership maintains EOTL alertness and operational efficiency (Rojas, 2026). While too little human involvement can lead to disengagement, excessive oversight may be premature and unproductive. In Tables 1 and 2, the totals in column 6 confirm that our baseline model follows the 30% rule on average for both managers and executives. In several years, these proportions are projected to invert, with accelerated AI assuming responsibility for roughly 70% of execution, and EOTL personnel retaining 30% for values-driven decisions.

With the introduction of AI and digital twins, professionals and executives transition from operational execution to EOTL oversight. Decisions on daily and weekly cadences, especially high-volume, repetitive tasks with immediate impact on building performance and tenant satisfaction, are expected to become increasingly automated to prevent operational bottlenecks.

Strategic human oversight across lower-frequency monthly financial and performance governance, and quarterly/annual strategic value creation decisions can be expanded, requiring less time and effort from experienced human personnel. This enables more objective, large-scale portfolio management and asset monetization, without proportionally increasing headcount, achieving operational performance and financial advantages beyond what present-day top CRE companies can offer.

Much has been published recently on AI splitting the job market into two tracks and rendering lower-skilled staff obsolete, with jobs 'professionalized' through AI growing twice as fast as jobs 'democratized' by it (Atkinson and Brown, 2026). For senior CRE executives, it implies that they will increasingly assume EOTL responsibilities previously performed by property managers.

However, little research has explored so far how higher demands for senior leadership skills might affect the health and well-being of top executives, nor has a general methodology been established for AI-driven workforce decomposition. Using digital twins, we examine how the stress caused by consolidated responsibilities may affect remaining EOTL staff.

The process was modeled (see Appendix 1, Table 3, calculated column 4 (*% routine tasks*) by multiplying the routine-task percentages from Appendix 1, Table 1-1, column 4 by the automatable-routine values in column 6 *(% of automatable routine tasks*) and dividing by 100. Resulting values were rounded to the nearest 5% using standard half-up rounding. The same calculation was applied over a three-year horizon relative to the baseline year in Table 4. In column 5 *(% exception management*), values were calculated as 100% minus the rounded Routine Tasks values. In column 3 *(% of total working time*), time allocations across all responsibilities sum to 100% per property manager or executive without double-counting.

Comparative digital twin modeling of evolving property manager responsibilities in Tables 1 and 3 illustrates that, on average, AI-driven automation of one-third of business activities over three years is projected to reduce routine tasks by more than half (from 55% of total working time to as little as 25%). The need to compensate for workforce reductions resulting from AI adoption and new EOTL duties is expected to substantially increase productivity demands. Correspondingly, property managers' more

challenging Exception Management Workload will likely increase by approximately two-thirds (from 45% to 75%), if not doubling!

Table 3: Digital twin modeling of evolving property manager and CRE executive responsibilities within 3 years with the introduction of AI

1	2	3	4	5	6
Row ID	Operational variable	Property managers (current)	Property managers (year 3)	CRE executives (current)	CRE executives (year 3)
1	Exception Management Workload (EMW)	45%	75%	60%	85%
2	Additional Systemic Pressure (ASP)		15%		10%
3	Total Job Demand (TJD)	45%	90%	60%	95%
4	Routine Operational Tasks (ROT)	55%	25%	40%	15%
5	Final Strain Ratio (FSR)	0.8	3.6	1.5	6.3
6	Systemic Strain Acceleration (SSA)		4.5		4.2

Table 4: List of expected CRE executives' responsibilities for top institutional-grade CRE (above $40M property values) within 3 years

1	2	3	4	5	6
Row ID	CRE property managers' responsibilities	% of total working time	% routine tasks	% exception management	% additional systemic pressure (ASP)
1	Portfolio Strategy, Business Operations & Capital Planning	20%	5%	95%	
2	Ownership-Level Financial Reporting, Asset Strategy, Analysis & Investor Liaison	15%	10%	90%	
3	Operational Accounting, Budgeting & Routine Reporting	15%	45%	55%	
4	Tenant Retention, Lease Strategy & Stakeholder Relations	15%	5%	95%	20%
5	Team Leadership & Directing Subordinates	10%	5%	95%	20%
6	Property Operations Oversight: Maintenance Scheduling, Vendor & Logistics Management	10%	25%	75%	15%
7	Risk Management, Emergency Response & Business Continuity	5%	5%	95%	20%
8	Institutional Investor Reporting Standards, ESG/Sustainability Reporting & Regulatory Compliance	5%	25%	75%	
9	PropTech Stack Direction, Data Governance & Strategic Technology Oversight	5%	10%	90%	
10	Portfolio Performance Monitoring, Continuous Improvement & Cross-Functional Governance	0%	15%	85%	
	Total average (except for column 3)	100%	15%	85%	10%

A similar analysis for CRE executives in Tables 2 and 4 shows that, on average, AI-driven automation of routine business tasks over three years is projected to reduce routine tasks to approximately one-third of their current level (from 40% to 15%). However, their Exception Management Workload will increase by at least 40% (from 60% to 85%), if not more. The need to

offset workforce downsizing while managing heavy EOTL duties is expected to significantly increase performance pressure.

Modeling burnout drivers in managerial and leadership positions is far more subjective and challenging than modeling workload. Executive burnout may increase exponentially with workload, showing measurable effects on the nervous system and behavior. As senior leaders take on greater responsibility, stress transforms from healthy pressure into cognitive and decision fatigue, and 'stress contagion', potentially turning heavy workload into an enterprise risk (Sanchez-Segura *et al*., 2023; Gaynor, 2025; Dallisson, 2026; Evenstad, 2018).

According to the *2025 Views From the C-Suite* report by LHH, a division of The Adecco Group, external pressures such as inflation and trade wars, coupled with rapid AI adoption, have created unprecedented stress for senior leaders. The report notes that leadership burnout across sectors increased from 52% in 2023 to 56% in 2024 (SIA, 2025).

Our objective was to quantify the psychological and operational imbalance in property manager and CRE executive workloads following AI integration. Our digital-twin workload simulation framework evaluates occupational strain as a function of measurable workplace factors using a modified *Job Demands-Resources (JD-R) model* (Demerouti *et al*., 2001). Occupational strain was operationalized using the *Resources-Demands Ratio* indexing methodology (Jenny *et al*., 2020).

In Table 5, the digital twin model demonstrates a compounding imbalance on the 'demand' side of the occupational ecosystem.

● *Exception Management Workload (EMW)*: The percentage of total working time devoted to exception-management activities, taken from Tables 1, 2, 3, and 4.

● *Additional Systemic Pressure (ASP)*: The non-routine administrative, organizational, and psychological burden falling on remaining personnel due to downsizing and heavy EOTL duties that managers and executives face with the introduction of AI. These duties include final verification, compliance archiving, data auditing, and decommissioning automated processes, as well as the systemic stress of operating within a reduced department. For every hour a worker spends generating useful output from AI, another hour is spent on its review and validation (Hinds *et al*., 2026; Brassey *et al*., 2026; Tankersley, 2026; Goel, 2026). Based on literature analysis and industry reports, ASP is conservatively estimated as 20% of the values in Tables 3 and 4, column 5 *(% exception management*), for responsibilities involving risk factors and human interaction (see column 6)

● *Total Job Demand (TJD)*:

TJD = EW + ASP

● *Routine Operational Tasks (ROT)*: In the JD-R model, it represents the percentage of total working time managers and executives spend on predictable, lower-stress, repetitive tasks. These tasks act as critical cooling-down periods that support recovery from high-stress decision-making and cognitive workload.

ROT = 100% - EW

● *Final Strain Ratio (FSR)*: Quantifies the psychological-operational imbalance within a job role. High job demands drive health impairment, leading to chronic fatigue and burnout if left unmanaged. Job resources (physical, social, or organizational elements) motivate personnel to achieve organizational goals, reduce demands, and support professional development. With AI eliminating low-hanging-fruit tasks, the FSR represents the units of high-stress job demands managers and executives face for every single unit of available job resources. This metric identifies job profiles with unbalanced ratios, allowing executive leadership to inject targeted resources (e.g., enhanced training or structural support), to restore equilibrium and improve organizational resilience.

FSR = TJD / ROT

A healthy job role is generally characterized by an FSR < 1, where available resources exceed demands (Jenny *et al*., 2020; Chang *et al*., 2026; Li *et al*., 2025). An FSR = 6.3 means that a CRE executive faces over six times more cognitive demands than recovery resource time, signaling severe burnout risk.

● *Systemic Strain Acceleration (SSA)*: Measures the rate at which occupational stress increases over time due to significant operational shifts. It quantifies structural organizational changes during its transition to a future state.

$SSA = FSR_{Year\ 3} / FSR_{Current}$

where $FSR_{Year\ 3}$ for property managers and CRE executives are listed in row 5, columns 4 and 6, while the corresponding $FSR_{Current}$ values are in row 5, columns 3 and 5.

For the remaining property managers transitioning to EOTL oversight, removing the routine operational workload buffer triggers a 3.6 spike in their FSR. This structural deterioration is even more pronounced for CRE executives, whose projected job demands far exceed available recovery capacity, escalating their FSR to an unsustainable 6.3 (Figure 2). By demonstrating that removing routine 'neurological cooling' periods locks executives into continuous cognitive overactivation, potentially contributing to enterprise-wide decision paralysis, the model reinforces the conclusions of Gaynor (2025) and Dallisson (2026).

Industrial surveys we cited indicate that real-world ASP components often exceed the conservative 20% minimum baseline applied in Tables 2-1 and 2-2. In practice, ASP values could be an order of magnitude higher. Based on the above-cited literature, the real-world ASP numbers could reach an order of magnitude or even higher values. However, given the exponential trajectory of the FSR curve, exploring ASP values above 20% yields limited additional insight, as an increase from FSR = 6.3 to an even more frightening value of FSR = 63 does not materially alter the study's primary conclusions.

Figure 3 illustrates the digital twin simulation results, modeling the inverse linear relationship between Exception Management Workload (EMW) and Routine Operational Tasks (ROT). The simulation demonstrates that AI not only reduces routine workload, but also strips away the mental rest stops embedded in a manager's workday. Routine operational tasks, such as data entry, basic sorting, or

repetitive reporting, provide periodic cognitive recovery breaks from sustained high-stakes decision-making. As AI automates these activities, these recovery phases are largely eliminated.

With routine tasks gone, a manager's remaining time is packed with high-intensity oversight, including complex crisis management, risk auditing, and error resolution. Consequently, executives and managers become trapped in a high-stress loop that accelerates nervous system fatigue and burnout. In effect, the role transforms from a manageable, balanced mix of routine and complex tasks to a relentless stream of high-stakes problem-solving.

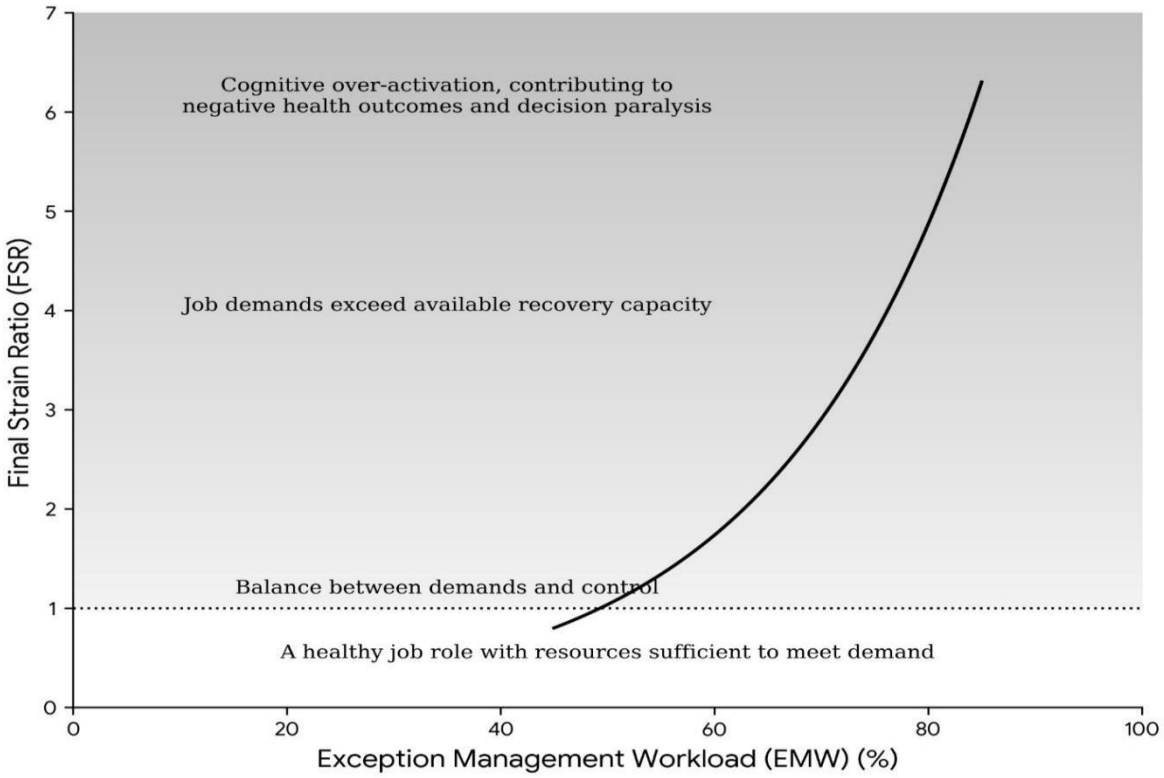


Figure 2: Exponential escalation of Final Strain Ratio (FSR) as a function of Exception Management Workload (EMW). See text for explanation. Source: Authors' own work.

The high SSA values in Table 5 indicate that systemic strain experienced by remaining property managers and CRE executives is not projected to increase linearly with the growth in workload following AI implementation. Instead, the model predicts a strain acceleration exceeding fourfold within just three years, potentially transforming an already heavy workload into enterprise-level risks tied to cognitive fatigue and decision paralysis, consistent with cited literature.

Figure 4 presents representative benchmarks for comparison with the projected exponential growth in systemic strain. The bar chart contrasts the projected three-year strain acceleration multipliers for Property Managers with PM (SSA) = 4.5 and Executives with CRE Exec (SSA) = 4.2 with established technological and macroeconomic growth trajectories, normalized to three years. Benchmark references include global smartphone adoption between 2007 and 2010 (5.0), Moore’s Law computational density growth (2.83), and normalized U.S. e-commerce penetration growth between 2010 and 2020 (1.52).

Our benchmark comparison logic for the acceleration of systemic stress rests on baseline trends across mainstream modern computer science and technology literature over recent years. In advanced AI research, comparing technological acceleration with biological systems and physical mechanisms is routine and foundational. Indeed, the development of AI translates biological neural architectures into physical computing mechanisms. Market-leading 'Magnificent Seven' tech giants (Alphabet/Google, Amazon, Apple, Meta, Microsoft, Nvidia, and Tesla) provide real-world evidence of this convergence by integrating diverse domains to drive exponential growth.

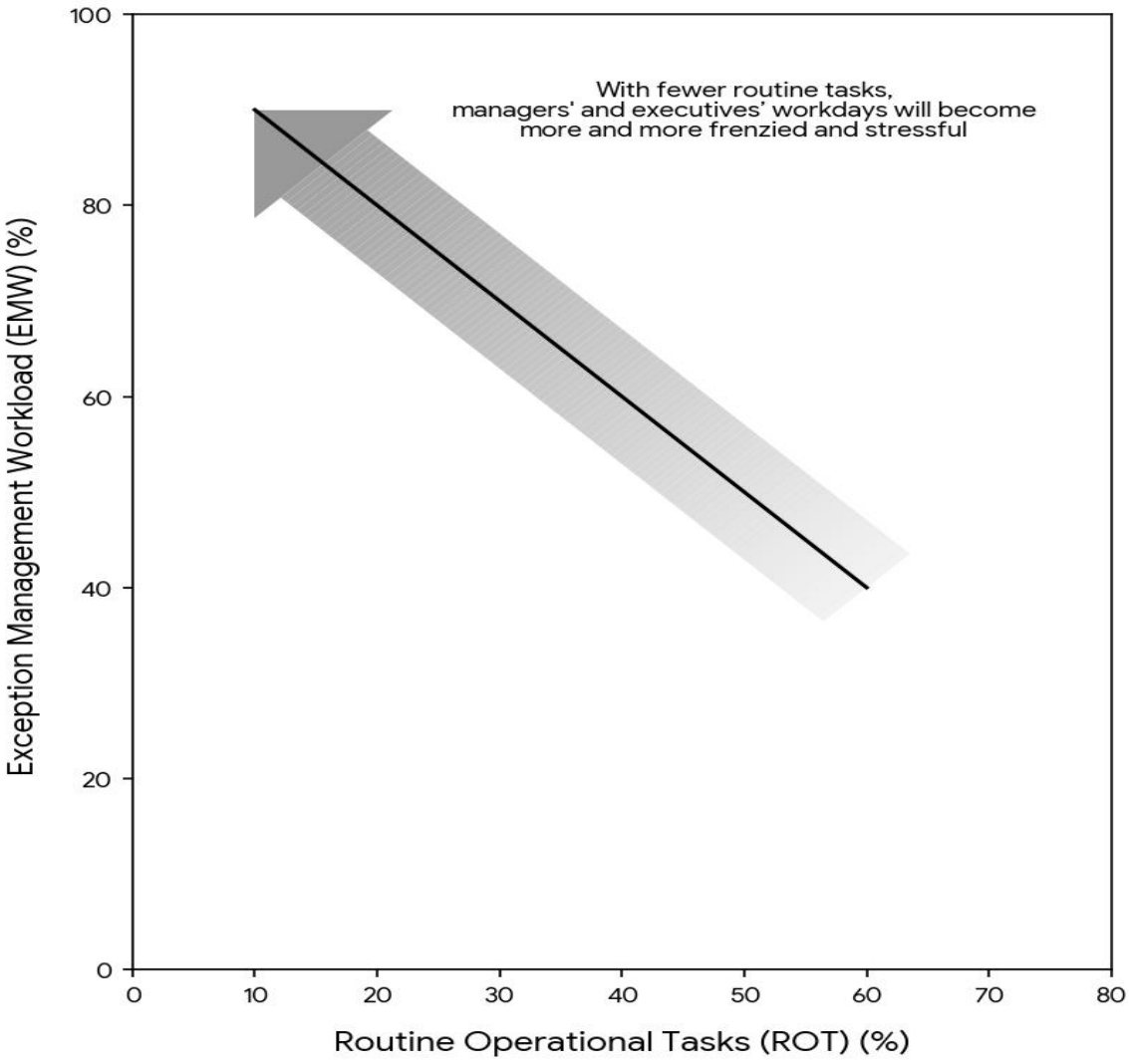


Figure 3: Inverse linear substitution relationship between Routine Operational Tasks (ROT) and Exception Management Workload (EMW). See text for detailed explanation. Source: Authors' own work.

Companies like Alphabet and Meta regularly combine advanced AI models with neuroscience concepts to map human behavior and optimize digital interfaces. Tesla integrates autonomous automotive robotics, artificial intelligence, and cutting-edge manufacturing, while its sister venture Neuralink interfaces physical computing mechanisms directly with biological brains. Amazon seamlessly unifies AI-driven logistics networks, physical robotics, and bio-centric healthcare and cloud

systems. Such new paradigm cross-disciplinary comparisons reflect the reality of modern technological scaling.

Table 5: List of expected property managers' responsibilities for top institutional-grade CRE (above $40M property values) within 3-years

1	2	3	4	5	6
Row ID	CRE property managers responsibilities	% of total working time	% routine tasks	% exception management	% additional systemic pressure (ASP)
1	Lease Administration, Compliance & Documentation	10%	45%	55%	
2	Tenant Relations, Retention & Occupant Experience	15%	10%	90%	20%
3	Property Operations, Maintenance & Inspections	15%	25%	75%	15%
4	Operational Accounting, Rent Collection & Financial Administration	10%	60%	40%	10%
5	Ownership Financial Reporting, Budgeting, Forecasting & Analysis	10%	25%	75%	75%
6	Vendor, Contractor & Service Contract Management	10%	25%	75%	15%
7	Capital Projects, Tenant Improvements & Major Repairs	10%	10%	90%	20%
8	Risk, Compliance, Insurance & Safety Management	5%	20%	80%	15%
9	Emergency Response & Business Continuity	5%	5%	95%	20%
10	ESG, Sustainability, PropTech Oversight & Data Governance	5%	25%	75%	
11	Strategic Planning, Asset Coordination, Leasing Support & Stakeholder Relations	5%	10%	90%	
	Total averaged (except for column 3)	100%	25%	75%	15%

Conventional applications of the JD-R model treat automation as a static job resource, relying on broad survey categories. In contrast, our digital twin model captures the dynamic paradox of digital transformation. By quantifying the proportion of time spent on Exception Management Workload relative to Routine Operational Tasks, the model tracks how AI shrinks the denominator (routine workload providing an expert with cognitive recovery opportunities from decision overload) while inflating the numerator through expanded EOTL responsibilities and workforce downsizing.

Applying this digital twin framework indicates that conventional Human-in-the-Loop approaches are likely to cause severe burnout among remaining human operators. These findings highlight the need for robust and dependable Agentic AI systems capable of assuming greater operational autonomy while minimizing the sustained cognitive overload imposed on human supervisors caused by the exception management workload.

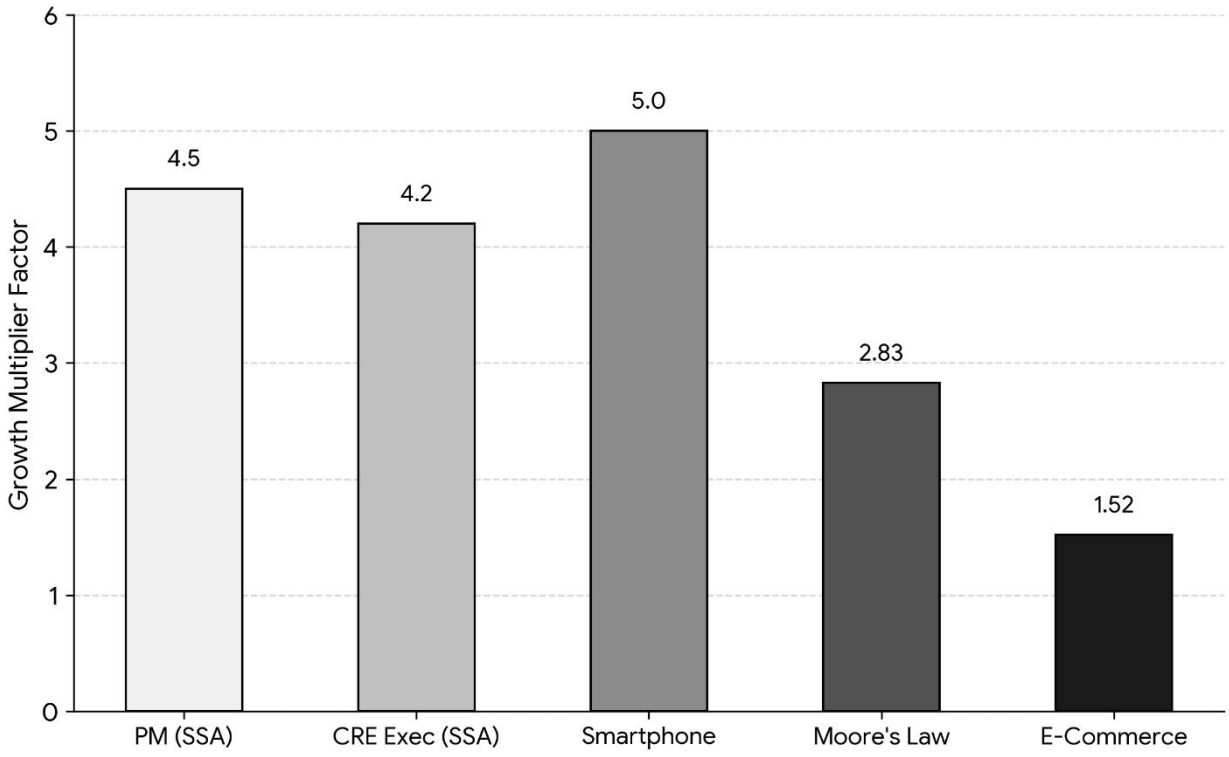


Figure 4: Three-year Systemic Strain Acceleration (SSA) compared with historical technology benchmarks. See text for explanation. Source: Authors' own work.

7. Implications for Investors

Digital twin technology, empowered by AI, fundamentally reshapes how investors perceive and manage CRE holdings. By combining the stability of physical assets with the responsiveness of real-time analytics, investors can achieve greater efficiency and resilience. Their integration elevates real estate's role within capital allocation frameworks.

Based on dynamic analysis, Agentic AI can assemble optimal portfolios across asset classes. For CRE and infrastructure, it identifies ways to calculate Markowitz model variables, select relevant metrics, such as Net Operating Income (evaluating a property's performance independent of financing), and compute real-time total property value based on appraisal, location, and evolving market conditions.

For portfolio managers, this evolution offers strategic advantages:

- **Improved capital efficiency:** Operational transparency and predictive modelling support accurate underwriting, valuation, and financing.
- **Dynamic portfolio optimization:** Automated analysis enables rebalancing among asset classes as economic, environmental, or operational variables shift.
- **Operational transparency:** AI tracks key metrics, such as customer satisfaction and lifetime value, and explains changes through clear visualizations and tutorials.
- **Enhanced risk management:** Real-time monitoring of property systems and market conditions allows proactive intervention and adaptive risk mitigation.
- **Lower transaction costs:** Agile automation reduces administrative and analytical overhead.

● **Disruptive innovation:** Digital twins supported by Agentic AI implement and manage global controls, compliance and security (Goldmann *et al*., 2025).

These benefits strengthen the case for CRE as a modern core portfolio holding capable of delivering long-term value and inflation resilience.

Based on previous research (Goldmann *et al*., 2025), critical factors for the successful implementation of a Dynamic Allocation Strategy include:

● **AI-driven transformation:** Routine research and analytical functions integrate seamlessly into management and financing decision-making. We project that widespread AI adoption will radically reshape CRE within 5–10 years, particularly for assets exceeding $40M.

● **Core enablers:** Digital twins and property passports leverage Agentic AI and smart XML digitization to build highly customizable, data-rich property ecosystems.

● **Operational impact:** Digital twin models can increase property management efficiency more than tenfold, aligning transactional costs across all functional domains with modern, data-driven industries while increasing transparency.

● **Beyond incremental change:** Gradual digital adoption or conventional workflow automation is insufficient; only comprehensive, AI-enabled reinvention unlocks full market potential.

● **Market consolidation:** The CRE management and financing sector is on the verge of rapid consolidation driven by unprecedented efficiency gains and operational transparency. Drastically lower expert costs will accelerate the global expansion of specialized, value-added CRE management and financing services. By synthesizing insights from human and virtual experts, Agentic AI will render decision-making transparent and quantifiable. Within five years, this technological advancement will drive rapid consolidation to a handful of dominant global conglomerates. Their clients will pay relatively modest monthly subscription fees for continuous, highly specialized digital-twin and AI-expert services covering all physical and digital assets, while operating such sophisticated systems in-house will remain uneconomical for most organizations. This disruptive consolidation pattern mirrors transformations previously witnessed in e-commerce (exemplified by Amazon and Alibaba) and high-tech sectors (the Magnificent Seven). Agile startups, rather than financial institutions constrained by legacy systems, will likely lead this transformation and capture a disproportionate share of business.

● **Leadership imperative:** This sweeping transformation demands new visionary leaders, willing to embrace disruptive innovation and rapid investment—akin to Musk, Bezos, Zuckerberg, Gates, Jobs, and Ellison—surpassing conventional CRE executive approaches.

● **Capital requirements and monetization:** Substantial investment in digital twin infrastructure is essential. NFT-based architectures will create new liquidity pathways and enable dynamic, granular monetization of digital asset components.

8. Conclusion: The New Foundation of Portfolio Strategy

This paper demonstrates that the traditional 60/40 stock–bond model is no longer sufficient for today's volatile, inflation-sensitive environment. Its limitations are structural and persist even when supported by updated analytical adjustments. A more resilient and forward-looking portfolio architecture requires the systematic elevation of commercial real estate (CRE) to a core third pillar. CRE's long-term income stability, inflation protection, and low correlations with public markets create diversification benefits that conventional asset mixes cannot replicate.

However, the full value of CRE cannot be realized under legacy frameworks that rely on static appraisals, slow operational feedback loops, and fragmented data sources. Illiquidity and valuation opacity have historically constrained CRE's contribution to portfolio optimization. The integration of digital twins and Agentic AI resolves these weaknesses.

By enabling continuous data capture, real-time valuation, and dynamic recalibration of risk–return parameters, these technologies transform CRE into a transparent, liquid, performance-optimized and responsive asset class. Transitioning from fragmented manual processes and lagging appraisals to an AI-enabled, performance-oriented asset class redefines global CRE economics, ensuring structural diversification and long-term income stability. This advance is of academic and practical significance because it allows CRE to be managed with the same analytical precision as publicly traded securities.

Our findings show that digital twins and Agentic AI establish the analytical foundation required for dynamic allocation strategies. As asset-level operational conditions, macroeconomic signals and portfolio interactions evolve, these strategies continuously adjust exposure. They reduce valuation lag, detect emerging risks earlier, and enhance both operational performance and financial decision-making. With these essential enablers of real-time, data-driven asset management, CRE becomes a liquid and high-performance component, capable of strengthening portfolio resilience during inflationary cycles and broader reinvestment transitions.

The paper also highlights that widespread adoption of these technologies requires organizational readiness, leadership commitment, and investment in advanced analytical capabilities. Although these challenges are significant, the potential benefits make this shift both necessary and strategically compelling. The main benefits include higher precision in risk management, enhanced transparency, and structurally improved returns. More importantly, they ensure a prosperous CRE industry in the new socio-economic paradigm.

As new operational and macroeconomic data streams expand through continuously updated digital-twin systems, the opportunity to refine CRE's role within portfolio construction will continue to grow. The drive for efficiency and transparency, powered by digital twins, will likely lead to rapid consolidation of the CRE industry, managed by a small number of dominant global players. This transformation demands new visionary leaders, eager to embrace disruptive innovation. Large-scale investment in digital twin infrastructure is essential. Investors and executives who lead this

transformation early, aligning CRE practices and costs with other modern data-driven industries, will enhance both returns and portfolio resilience, securing a decisive competitive advantage in the new era of portfolio management. However, CRE executives and property managers who have to act as experts-in-the-loop face substantial challenges in using AI for managing such complex interactions.

In conclusion, CRE's elevation to an equal counterpart of equities and bonds is justified not only by its empirical performance but also by the transformative impact of emerging analytical technologies. Digital twins and Agentic AI create a new foundation for real-time, data-driven portfolio optimization, enabling investors to manage CRE with a level of rigor previously unattainable. Together, these developments support a coherent, durable, and future-ready investment model in which CRE functions as the third pillar of institutional and HNW portfolios. CRE organizations developing and implementing AI-driven digital twins must proactively account for executive and managerial chronic overstress, restructuring oversight roles to safeguard leadership health before deploying automated systems.

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Author contributions

Equal

Article classification

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Category

Research paper

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Data supporting this study are available from the corresponding author upon reasonable request.

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