

Strategies for mitigating cybersecurity challenges to fund management in the digitalized real estate industry

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Abstract

Fund management (FM), a critical managerial aspect of the real estate (RE) industry, is increasingly threatened by cybersecurity challenges. This study examines the challenges and proposes technology-based and conventional (non-technology-based) strategies for mitigating them efficiently and sustainably, emphasizing the application of the former. The study relied on secondary data besides participant observation and introspection on experiential learning. Qualitative method was employed. Systematic review and content and thematic analyses were deployed for synthesis and analysis of data. The analysis shows that artificial intelligence (AI), smart technologies, new media and other 21st century cutting edge technologies have the capacity to significantly mitigate the cybersecurity challenges confronting FM in the RE industry. The study concludes that as the challenges increasingly emerge with the digitalization of RE, viable conventional and technology-based strategies should be devised and deployed significantly to mitigate them. By so doing, digitally secured financial transactions, effective FM, cash flow control, market stability, profit maximization, etc. would be attained at a high extent.

Keywords: Strategies; Mitigating; Cybersecurity challenges; Fund management; Real estate

1. Introduction

From time being, fund management (FM) in real estate (RE) is constrained by a range of challenges. These days, the challenges are increasingly alarming and more pervasive (Vasiu & Vasiu, 2018; Ijiga et al., 2024; Forood 2024; Yasamineh et al., 2024). Managing cybersecurity challenges involves deploying multifarious approaches and measures to identify, analyze and mitigate cyber threats to organizations' digital assets, sensitive data, critical infrastructure, and funds (Jakka et al., 2022; Ijiga et al., 2024; Forood et al., 2024; Jencamet al., 2024). Relying more on technological techniques amidst deploying other measures would yield more results in combating cybersecurity challenges to FM in RE. This thought is given credence by Giuca et al. (2021) and Thach et al. (2021), who consider technological techniques as viable strategies for mitigating cybersecurity challenges.

The digitalization of RE has ushered in 'new' challenges, which confront the RE industry much more than the conventional (non-technology-based) challenges. This study focuses on technology-based challenges to FM in RE. The reason is that these challenges are not only pervasive but also more dreadful and harmful than the conventional ones.

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The study argues that technology-based challenges require technology-based remedies or mechanisms for lasting solutions. The diagram below sheds more light on the foregoing regarding the nature and the kinds of cybersecurity threats or challenges to different spheres:



Source: Bodeau and Graubart (2017)

Figure 1 Spectrum of Cyber Threats: From Conventional to Advanced Persistent Threats (APT)

In view of the above, this study argues that just as AI and ST can address different cybersecurity challenges in different spheres so they can help address the peculiar cybersecurity challenges confronting fund management in RE. Scholars and professionals agree that efficient fund management is essential for growth, optimal performance, investment opportunities, and so on (Alam, 2024; Idoko et al., 2024; Ijiga et al., 2024; Forood et al., 2024). Thus, the need to tackle cybersecurity threats to FM in the RE industry cannot be overemphasized. Ensuring efficient management of funds in any organization or country is of critical national concern and relevance. This means that this research work is of national relevance. To ensure security and appropriate management of funds in RE and other industries, the cybersecurity threats posing a range of challenges ought to be mitigated.

2. Problem

The real estate industry currently faces the dilemma of integrating technologies and dealing with the challenges arising from the integration. In other words, the incorporation of new technologies, artificial intelligence, smart technologies, etc. to RE is both advantageous and disadvantageous. What is quite interesting is that the advantages far outweigh the disadvantages. Leaving the cybersecurity challenges to fund management to thrive or deploying inefficacious measures for dealing with the challenges means undermining the highest challenges in the sector. Consequently, all that has to be done appropriately, if funds were managed well, would be left unsettled or poorly done. Thus, all hands must be on deck to tackle cybersecurity and other challenges of the RE, both individually and in team (group), as typified symbolically in the image below:



Source: Alam (2024)

Figure 2 Collaborative Office Environment in a Real Estate Firm

Therefore, the need to mitigate the challenges to FM in the RE sector is what motivated this study. Cybersecurity challenges are the topmost challenges of the RE industry. As such, for efficient FM, the peculiar commonly obtained cybersecurity challenges thwarting or threatening the realization of efficiency in FM have to be properly mitigated.

Mitigating the challenges of the digital era FM in RE implies combating some of the pressing challenges of the industry. By addressing these peculiar challenges, fund management becomes relatively easy, thereby paving way for adequate and well managed flow of finance in the industry. Managing these challenges significantly would enhance the overall management of RE, inclusive of assets.

Aim and Objectives

The aim of this study is to critically examine the distinct cybersecurity challenges confronting fund management in contemporary real estate. The specific objectives are to:

- Identify the specific cybersecurity challenges constraining fund management in the digital era RE.
- Show scholarly evidence for recent incidents of cybersecurity challenges to fund management in RE.
- Determine the advanced strategies for mitigating cybersecurity challenges to fund management in RE.
- Proffer scholarly solutions to the challenges.

2.1. Research Questions

The following research questions are designed to guide the study:

- What are the specific cybersecurity challenges constraining FM in the digital era RE?
- Are there scholarly studies showing evidence for recent incidents of cybersecurity challenges to fund management in RE?
- Which of the advanced strategies can help in mitigating cybersecurity challenges to fund management in RE?
- What scholarly solutions can be proffered to mitigate the challenges?

2.2. Gap in Literature and Novelty of Study

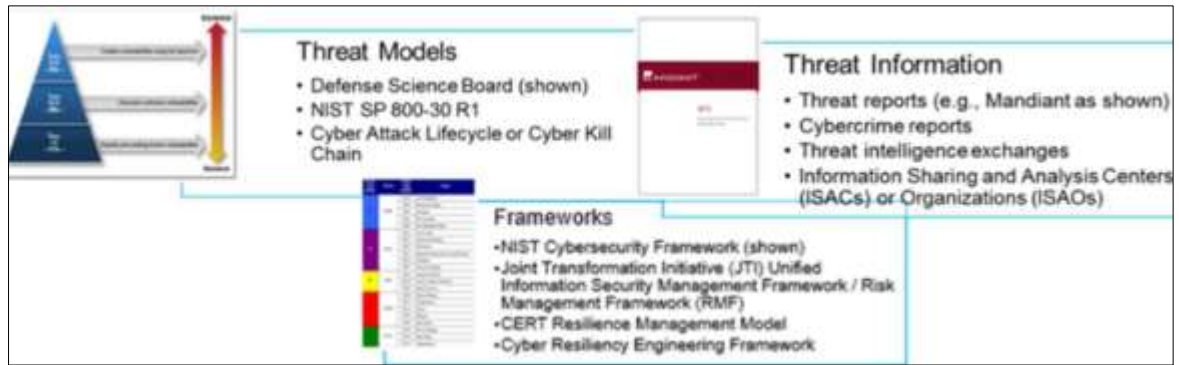
It is evident in extant literatures that regardless of the fact that AI, ST and the other cutting edge technologies (or technological innovations) have huge prospects and have been impacting more positively than negatively on various spheres of life, many individuals, organizations and governments are yet to duly adopt and utilize them at an appreciable extent. This assertion is evident in the studies by Obiuto et al. (2024), Alsakkaet al. (2023), Bidhendi and Azizi (2021) Oberer and Erkollar (2018), and Zhang et al. (2015), among others. The implication of the foregoing is that while various technological solutions to societal problems in various spheres abound, the failure to exploit and utilize them for problem-solving purposes allows for the prevalence of the problems that ought to have been rolled out or reduced drastically by now.

It follows that regardless of the capacities of AI, ST and other technological innovations to appropriately tackle the growing challenges to fund management in RE, many of the firms involved as well as the governments of their host communities are yet to duly key into the opportunities and solutions offered by these innovations. This study argues that technological challenges, such as those posed by the digital operations or digitalization to FM in RE, can best be tackled technologically and strategically.

Unlike other studies that focus on the general management of real estate, particularly asset management (e.g. Lucernex, 2023), the present study engages with fund management in RE. It focuses on the peculiar challenges of FM in RE and the strategies to mitigate them. By its dual engagement and proposed technology-based solutions to the challenges confronting FM in the RE industry, the study uniquely contributes to the thematic concerns and fosters the realization of improved, efficient or optimized fund management in the industry. The expected results would lead to improvement, optimization, productivity, safety and quality in service delivery, operations, transactions and infrastructural management in the RE industry.

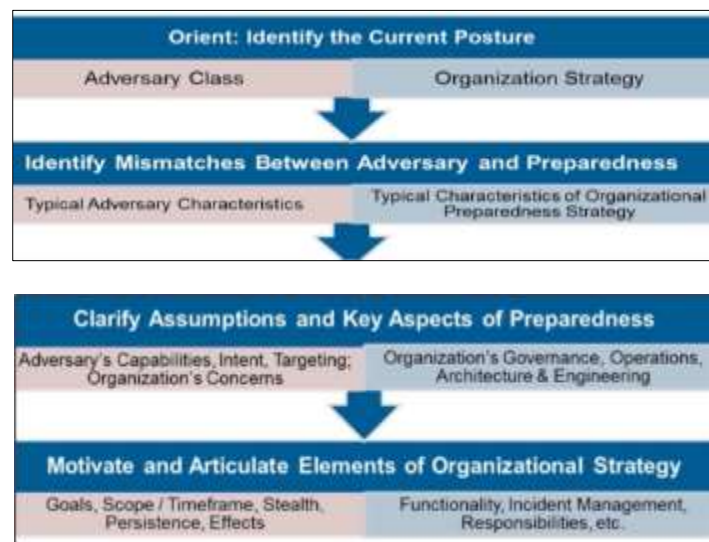
3. Cybersecurity Challenges to Fund Management

The common challenges of FM include difficulties in acquiring and allocating capital, technology integration, taxes, rates, tariffs and regulations that all require compliance, issues of valuation and investment analysis, cyberattacks, the complexities of managing risks, and dealing with cash flow (Securities and Exchange Commission, 2022; Kuzmenko et al., 2021; Florakis et al., 2020; Stine et al., 2020; Boitan, 2019; Idoko et al., 2024;). Consider following diagrams:



Source: Bodeau and Graubart (2017)

Figure 3 Representation of cyber threats



Source: Bodeau and Graubart (2017)

Figure 4 Cyber threats and organizational characteristics



Source: Bodeau and Graubart (2017)

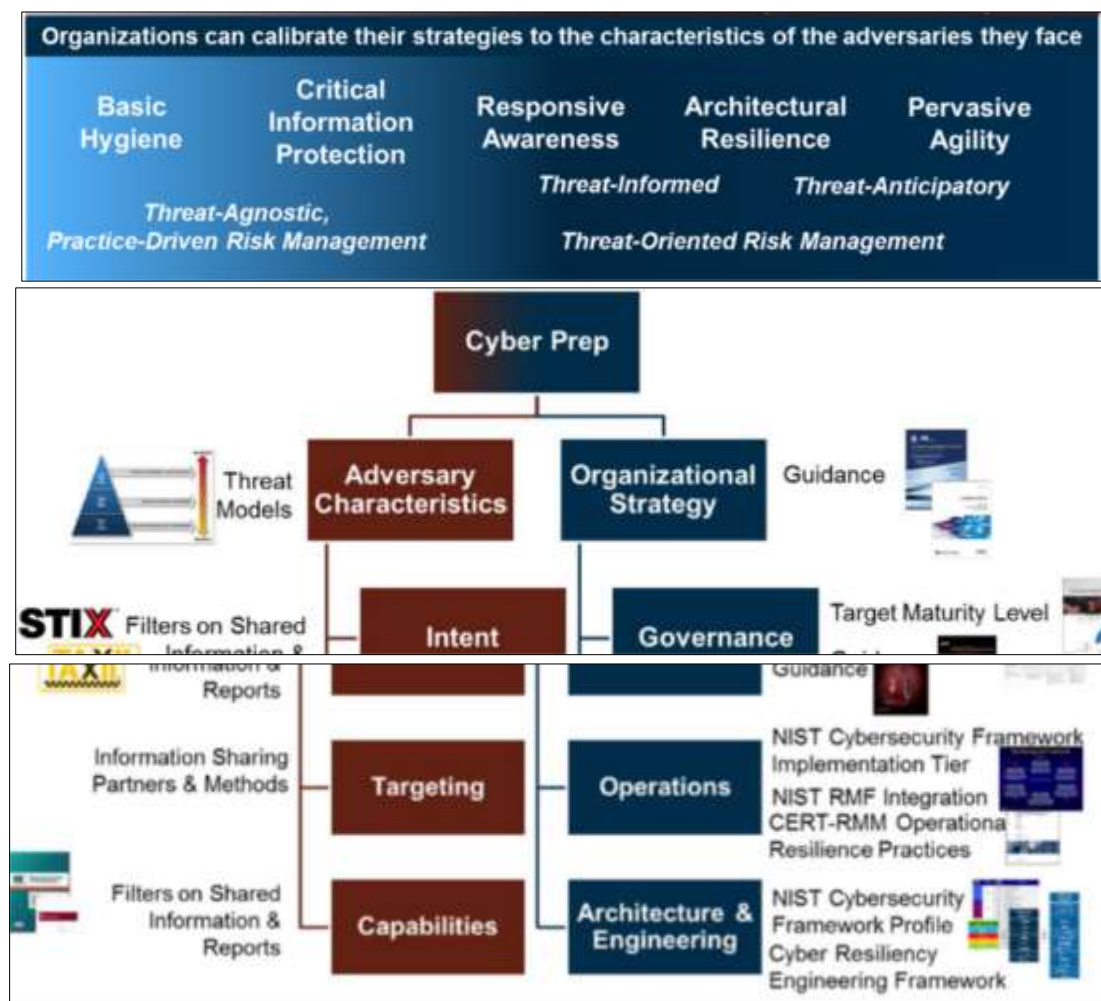
Figure 5 Threats mitigation at international levels

3.1. Technology Integration Strategies

Studies confirm that artificial (AI) technologies, smart technologies (ST) and other computer software, applications and algorithms can be effectively integrated into building and construction activities, just like in other endeavors, to find lasting solutions to a range of problems and achieve improvement, desired results, innovations, etc. (Obiuto et al., 2024; Roshanaei et al., 2024; Juhrich, 2023; Ivanova et al., 2023; Mazzocchi, 2023; Regona et al., 2023; Kochovski & Stankovski, 2021; Yigitcanlar et al., 2020; Idoko et al., 2024; Ijiga et al., 2024).

The essence of the integration is to allow for and achieve innovations, betterment, optimization, performance, productivity and solutions to a range of problems in the digitalized global society. Akinola (2024) and Akinola et al. (2024) show that AI and smart technologies (ST) are viable means of addressing housing challenges. The implication is that AI and smart technologies can be leveraged for solutions to various challenges confronting RE. Of course, the thrust of RE is housing (Luma, 2021; Idoko et al., 2024). Thus, AI and smart technologies are valuable result-oriented means of tackling cybersecurity challenges confronting the RE industry.

The kinds of strategies deployed by organizations and their resource governance therein are effective measures for combating security threats, such as those posed by cybersecurity threats (Mizrak, 2023; Idoko et al., 2024; Securities and Exchange Commission, 2022). As such, RE organizations deploying technology-based strategies to quell cybersecurity threats would do well, and remain rarely hit by cybercriminals (Kumar, 2022; Idoko et al., 2024; Ijiga et al., 2024). Those that do not are bound to face cybersecurity attacks on assets and funds. Bodeau and Graubart (2017) show symbolically that organizations can deploy the following diagrammed strategies to mitigate the cybersecurity challenges that face them:



Source: Bodeau and Graubart (2017)

Figure 6 Components of Cybersecurity.

3.2. AI Technologies as Strategies

Popular AI technologies making waves in various spheres include machine learning, deep learning, reinforcement learning, computer vision, natural language processing, robotic process automation, digital image analysis, automated machinery and systems, and faster R-CNN (Akinola, 2024; Akinola et al., 2024; Kodete et al., 2024; Okusi, 2024; Pasupuleti et al., 2024; Alsakka et al., 2023; Ivanova et al., 2023; Regona et al., 2023; Wusu et al., 2022; Idoko et al., 2024). The managerial functions of AI technologies are highlighted in the Table 2 below:

Table 1 Managerial Functions and Benefits of AI Technologies

Variables	Citations
Accountability	Akinola (2024)
Accurate predictions and detections	Akinola et al. (2024)
Compliance management	Bidhendi and Azizi (2021)
Effective management of businesses and risks	Bulama and Shirivastata (2022)
Effective time management– saving time	George et al. (2022)
Ensuring or increasing safety	Jarrahi (2018)
Fostering effective planning	Juhrich (2023)
Improved performance	Kamble and Gaikwad (2024)
Optimization and efficiency	Obiuto et al. (2024)
Preventing waste of resources	Regona et al. (2023)
Reducing costs	Singh (2024)
	Srivastava (2021)
	Thuraka et al. (2024a)
	Wang (2019)
	Yigitcanlar et al. (2020)
Source: Authors, 2024	

Table 2 Some Other Functions and Benefits of AI Technologies

Variables	Citations
Enhancing teaching and learning	Bidhendi and Azizi (2021)
Facilitating high performance	Kamble and Gaikwad (2024)
Growth/development opportunities	Regona et al. (2022)
Paving ways for profit maximization	Regona et al. (2023)
Proffering innovations & discoveries	Wang (2019)
Data-driven decision-making	Kamble and Gaikwad (2024)
Offering avenues for massive data sets in different fields	Singh (2024)
	Yigitcanlar et al.(2020)
Digitalization and modernization	Adefemi et al. (2023)
Influencing/increasing safe public health	Chen and Decary, 2020
Fostering the realization of environmental sustainability goals by mitigating environmental degradation	Adefemi et al. (2023)
	George et al. (2022)
Enhanced incident reporting and response	Baker et al. (2020)
	Thakkar and Lohiya (2021)

Source: Authors, 2024

The Table 2 above highlights the core managerial functions of AI technologies, which they can play to foster or ensure effective fund management in RE. Thus, given these functions, it is logical to assert that AI technologies can serve as viable strategies for combating cybersecurity fund management challenges in the RE industry. To realize their benefits from the above listed management functions of AI technologies in the context of this study, AI technologies ought to be integrated maximally into RE in general and fund management in RE in particular. Since the Table 2 contains only some of the core functions as well as benefits of AI technologies, the Table 3 below lists out some of uncategorized functions as well as benefits of AI technologies.

The above Table 3 contains some uncategorized functions and benefits of AI. The implication is that AI plays various functions. Its technologies can be applied in varied settings and fields for the realization of the huge benefits. The functions show that when leveraged for solutions to cybersecurity challenges, AI technologies can play different roles in the fund management of RE. For this study, what matters is how they are applied to the FM of RE. The extent to which these technologies are integrated into FM in RE determines the extent to which effective FM in RE obtains. The extent of FM in RE determines the extent to which cybersecurity challenges confronting fund management in RE obtain. At this juncture, it is important to make a systematic review of several previous literatures to draw evidence for the foregoing.

Furthermore, Thuraka et al. (2024a) are of the view that the prospects of AI technologies rest on their functions, since it is in the course of playing their critical and innovative roles in various spheres that their benefits are made manifest. Obiuto et al. (2024); Idoko et al., (2024) indicate that AI technologies, such as data collection, machine learning algorithms and cloud computing, can be leveraged for construction management in order to attain improvement, project efficiency and cost-effectiveness. In the same vein, these AI technologies can be leveraged as strategies for fostering, ensuring and attaining efficient FM in RE. Using these AI strategies for FM would yield huge results and reduce the current increasing incidents of cybersecurity threats to funds and fund management in the RE industry.

Since project complexity, delays, and communication barriers in construction obtain in RE, data prediction and analysis, ML algorithms and cloud computing can be leveraged for solutions to FM regarding the aforementioned variables. Efficient FM involves costs, because even the integration of technologies into the FM processes requires huge amounts of money for expenses. Although the huge expenses constitute some burdens or challenges to FM in RE, cost-effective AI technologies like the aforementioned can be deployed by RE firms to reduce costs.

Singh (2024) shows that through real-time hazard detection, improved incident reporting and response, proactive risk mitigation, data-driven decision-making, and compliance management can be achieved. It follows that AI technologies can serve as strategies for mitigating cybersecurity challenges to FM in that by applying them, fund managers as well as property-level specialists of RE would be more proactive about mitigating the cybersecurity threats or risks to FM. They would also resort to data-driven decision-making that yields huge results in FM and other aspects of RE management in general. By being able to detect real-time hazard that could threaten funds (management) in RE, the challenges can be averted or got rid of.

With improvement in incident reporting and response, fund management in RE becomes less threatened by cybersecurity challenges. In addition, it is deduced from Singh's (2024); Onuh et al., 2024 study that compliance management can be attained with the adoption of AI technologies for solutions to cybersecurity challenges. This means that FM is done strictly in compliance with established regulations. This guarantees legitimacy, transparency and trust, and thereby rouses investor confidence, more profitability, market stability, etc. Clearly, Singh's (2024); Ijiga et al., 2024 study lends credence to the position of this study on the capability of AI technologies to mitigate cybersecurity challenges to RE fund management.

Also, the study by Juhlich (2023); Ijiga et al., 2024 demonstrates that internet of things (IoT), sensor technology and computer vision are popular AI technologies offering different opportunities in the construction industry, based on their critical role in bringing innovations to place in the industry. The different opportunities offered by these noted AI technologies can be exploited and leveraged for effective FM in the RE industry. In addition, Regona et al. (2023); Idoko et al., (2024) indicate that AI technologies can be leveraged ethically or in check to attain improved efficiency and productivity in construction and other spheres. By this view, the authors also affirm the position of the current study on the possibility of leveraging AI technologies for tangible solutions to the cybersecurity challenges facing FM in RE as well as other subsectors of the RE industry. The implication of their noted view in the context of this present study is that AI technologies can pave way for improvement, efficiency and productivity in fund management in RE.

4. Other Strategies

Alam (2024) identifies six major strategies for effective fund management in RE. These are balancing fund acquisition and allocation, managing cash flow, risk management, compliance with established regulations and tax payment, integrating technologies into fund management in RE, and assessment and analysis of investment. The present study observes that among these six strategies: (a) balancing fund acquisition and allocation, managing cash flow are conventional or technology-based strategies; (b) integrating technologies into fund management, risk management, and compliance with established regulations and tax payment are technology-based strategies; (c) the “assessment and analysis of investment” is an intermediary strategy between (a) and (b).

Although this study focuses on technology-based strategies, it adopts the above strategies, among others. Citing some scholarly works for back-up, this study goes on to identify conventional (non-technology-based strategies) and technology-based strategies for mitigating cybersecurity challenges to FM in RE, which are also not exhaustive:

- Technical-know-how makes it possible for fund managers alongside property-level specialists in RE to preempt, detect and act promptly against cybersecurity threats to funds vis-à-vis fund management
- Digital auditing and budgeting are viable ways of tackling cybersecurity challenges in RE fund management (Slapničar et al., 2022; Idoko et al., 2024)
- Integrating AI, smart technologies, software and applications into lease accounting would help deal with complex leases and other transactions that can make RE firms vulnerable to cyberattacks (Akinola, 2024; Akinola et al., 2024; Thuraka et al., 2024a; Ahmad et al., 2020; Cîrnu et al., 2018).
- New media can be used for wide range of information dissemination about legitimate RE activities and transactions as against illegitimate ones (Obinna et al., 2024; Nwode, 2022). By so doing, it becomes very difficult for cybercriminals to cajole and defraud estate clients, occupants and investors.
- Strategic planning (Thuraka et al., 2024a)
- Strategic management (Giuca et al., 2021; Samtani et al., 2020)
- Critical skills and techniques (Danjuma et al., 2023; Thuraka et al., 2024b; Robert et al., 2022)
- Professionalism allows for proper identification, details, and effective resource control
- Investment strategies, such diversification, facility financing and acquisition, regulating leasing, optimizing asset values, etc.
- Possession and application of skills such as financial acumen, critical and analytical thinking, market feasibility and knowledge, efficient communication and negotiation, problem-solving capabilities, attention to details, multitasking, collaboration and teamwork (Nwangene, 2024; Thuraka et al., 2024b; Danjuma et al., 2023; Robert et al., 2022)
- Portfolio diversification mitigates risks, stabilizes income, and appreciates capital (Alam, 2024)
- Effective portfolio management using long-term planning, asset allocation and regular evaluation can serve as viable strategies.
- Striking a balance between cash flow and capital growth
- Avoiding unnecessary expenses and deploying market mix for a critical examination of where to invest
- Optimization of property performance through a sustained practice of regular checks and balances, monitoring, and property maintenance
- Smooth relations and communication with tenants for tenant satisfaction and retention.

5. Empirical Grounding

Data from selected previous studies are presented hereunder for scholarly evidence:

Clearly, there are previous studies that lend credence to the thesis of this present study on the postulation that technology-based measures are more appropriate than conventional strategies for mitigating cybersecurity challenges. However, their focus is not on leveraging the cutting edge technologies for the mitigation of cybersecurity challenges to fund management (FM) in real estate (RE). The above technology-based strategies are not exhaustive.

Table 3 Findings of Some Extant Studies on Technology-Based Strategies

Previous Studies	Results	Remarks
Roshanaei et al. (2024)	To tackle the data privacy challenge of cybersecurity, stakeholders should make concerted efforts to train employees on AI models, how to manipulate risks, and ways of averting ethical issues of using AI.	Data privacy is one of the cybersecurity challenges confronting FM in RE. The present study subscribes to the view that employee training can produce desired results in combating cybersecurity challenges (in RE and other spheres) and in addressing some of the ethical issues of AI.
Mizrak (2023)	Strategic management can be deployed to tackle cybersecurity risks in organizations, which includes taking proactive measures, integrating technologies, and problem-solving leadership to mitigate cyber risks.	This finding lends credence to the position of the present study that strategic management, which includes strategic planning, can serve as a viable conventional strategy for mitigating cybersecurity challenges.
Jiang and Broby (2021)	AI and other multifarious (cutting edge) technologies having problem-solving capacities can influentially detect and monitor cyber invasions and attacks, thereby ensuring privacy and protecting sensitive and critical information of various businesses.	From the findings, it is quite true that AI and other contemporary technologies can be leveraged for solutions to the cybersecurity challenges confronting FM in RE. Thus, if RE firms fail to leverage cutting edge technologies for solutions to the problems facing FM, they continue to suffer cybersecurity challenges that adversely affect their funds as well as fund management. Of course, once funds are stolen and/or fund management is inadequate, a lot of organizations activities are bound to be affected.
Kuzmenko et al. (2021)	Since cyber threats are caused by increasing use of internet and cutting edge technologies like AI, there is need to wedge strong war against cyberattacks.	The implication is that since RE relies heavily on technologies, firms in the industry ought to devise means of averting cybersecurity attacks and the challenges they pose to FM and RE activities in general.
Florakis et al. (2020)	Organizations having high extent of exposure to cybersecurity risks do not perform well as a result of the extent of their attention paid to, and resources spent on, quelling the risks.	As their study shows, cybersecurity challenges cause underperformance, and the diversion of time and resources for other activities to quelling the risks or challenges. Thus, these challenges to FM in RE as well as in other industries require technology-based measures to quell them significantly.
Stine et al. (2020)	Cybersecurity risks can be reduced by using risk registers to roll out measures that can yield the desired results.	The finding emphasizes the need for recording keeping, as a strategy for mitigating cybersecurity challenges. Thus, it is beneficial to keep record of risk incidents and work out measures to foil recurrence.
Vasiu and Vasiu (2018)	Improved cybersecurity strategies, policies, and programs have to be deployed against three cybersecurity risks: damage, theft of trade secrets, and payment fraud.	These risks are some of the major cybersecurity challenges confronting FM in RE. They ought to be mitigated significantly by leveraging AI and other cutting edge technologies (technology-based measures or solutions).
Bodeau and Graubart (2017)	Organizations can leverage cyber prep, a threat-oriented approach, for solutions to cybersecurity challenges. Cyber prep allows organizations to define and articulate their threat assumptions so as to develop organization-appropriate preparedness strategies for quelling threats.	The proposed framework for quelling cybersecurity challenges is apt and practicable and has to be deployed by RE firms as a strategy for mitigating cybersecurity challenges in the FM of RE.

Source: Authors' compilation, 2024

6. Conclusion

This study has engaged with cybersecurity challenges confronting FM in RE and presented strategies for mitigating the challenges. It has shown some peculiar cybersecurity challenges confronting fund management (FM) in the real estate (RE) of contemporary times. It argues that being cybersecurity challenges, they can best be mitigated by deploying technology-based strategies, including using AI, smart technologies and new media strategically to proffer solutions to the challenges. The study categorizes the discussed challenges and strategies into conventional (non-technology-based) and unconventional (technology-based), placing emphasis on the former. The study shows evidence from extant studies that report recent incidents of cybersecurity challenges to FM in RE.

Viable strategies for mitigating the challenges are proposed, explaining how they can be deployed to realize the targeted goals. By applying the identified strategies, solutions to the challenges are bound to be realized. The impact of the study, as the aftermaths of the application of the strategies, includes change, improvement, optimization, efficiency, adequacy and high performance in FM leading to more acquisition of assets, profit maximization, market stability, more investment, clientele satisfaction, quality services, and meaningful stakeholder engagement and communication. RE organizations are charged to be proactive, tech-savvy and multifarious in devising and deploying strategies to mitigate cybersecurity challenges confronting FM in the 21st century digital era RE industry.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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