

LEVEL 7 ASSESSMENT SPECIFICATION

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Research Portfolio – Impact of Machine Learning on Cybersecurity Operational Efficiency in Banking of Hong Kong Banking Sector

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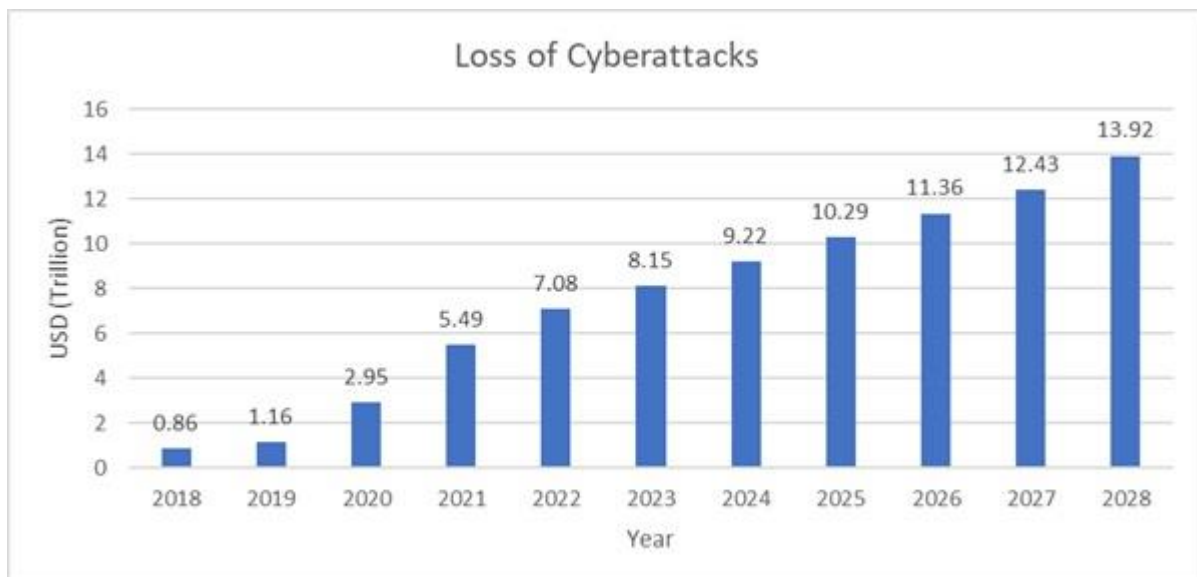
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1. Summarize of Research Proposal

This study proposal examines the impact of machine learning (ML) on the cybersecurity of the Hong Kong banking sector. The study focuses on the uptake of sophisticated technologies, such as Machine Learning, to detect increasing cybersecurity threats and make bank operations efficient.

The proposition states that organizations must regularly adapt to evolving technologies to stay competitive in changing environments. In recent years, emerging technologies such as cloud computing, artificial intelligence (AI), and machine learning (ML) have transformed the way businesses operate (Chen, Wu and Zhao, 2023). While these technologies bring an opportunity to create a new generation of business systems, they also introduce new challenges, particularly in cybersecurity. Since financial information is sensitive, banks in Hong Kong are increasingly vulnerable to cyberattacks incorporating AI techniques (Romei, 2024). According to the research report, cyberattack price is probably to extend a lot over the subsequent four years (Statista, 2024). As of October 2022, losses were projected to range from approximately USD \$9 trillion to \$14 trillion, as shown in Figure 1.1. This study seeks to investigate the application of machine learning in the improvement of cybersecurity in this field.

Figure 1.1: Loss of Cyberattack from 2018 to 2028



The research purpose has three research objectives. Use it to determine how ML can be leveraged and optimize the detections and responses to threats. Moreover, the study

emphasizes the role of leadership in nurturing the acceptance of innovative technologies such as ML in banking operations.

This study has three main research questions:

1. What features of machine learning can be applied to cybersecurity operations?
2. How does machine learning influence cybersecurity efficiency in the banking industry?
3. What is the position of ML in cybersecurity operations?

Machine Learning is a subset of AI, machine learning is noted for its capacity to absorb and mine massive amounts of data for patterns and potential threats (Taha, 2023). These capabilities allow it to work well with the complex, fast-growing nature of cybersecurity problems. The review also points out that conventional banking systems utilize traditional security methods, which are vulnerable to attacks (Shwede, Malaka and Rwashdeh, 2023). While machine learning presents a pathway to transforming these systems to enhance their ability to identify and remediate threats efficiently (Martínez Torres, Iglesias Comesaña and García-Nieto, 2019), these studies' findings are focused on ML's capabilities and recognition rate, not how ML impacts cybersecurity operations. This research aims to address the gaps mentioned above and the unavailability of this type of study from a geographical perspective. Another element of literature review is leadership, a management approach that encourages innovation and adaptability (Korejan and Shahbazi, 2016). Leaders inspire their teams to adopt innovative technologies and solve unique challenges creatively. This supports a culture of innovation, vital for scaling machine learning within banking operations.

The concepts of study machine learning, cybersecurity efficiency, and leadership can be linked together by the diffusion of innovation (DOI) framework (Shaikh *et al.*, 2023). It determines machine learning methods for reducing human involvement and interaction in cybersecurity daily operations by detecting and responding to threats automatically. It not only reduces human error but also improves response time and ultimately increases the operation efficiency of cybersecurity. Leadership is another factor in the framework that influences the adoption and implementation of ML technologies, and it will play a crucial role in driving organizational change.

The research adopts a mixed-methods approach that combines qualitative and quantitative methods to provide a comprehensive understanding of the topic (Santos *et al.*, 2017). Qualitative data is collected from the opinions or views of cybersecurity experts through interviews or group discussions. Meanwhile, quantitative data can identify patterns and predict

trends by statistical analysis. This mixed-methods approach can cross-validate both types of data and ensure a comprehensive result and practical and applicable solutions to improve cybersecurity in the banking sector.

The study expected several main findings. First, it identifies that machine learning could improve the cyber defense of banks in Hong Kong. It enhances threat detection rates, decreasing response times and minimizing human participation in daily operations. This can result in a more secure and efficient banking system. Also, the study would indicate that leadership affects the adoption and use of machine learning. Leaders influence innovation and adaptability that can create an environment for supporting technological advancements (Yating, Arshad and Mengjiao, 2024), ultimately improving cybersecurity practices in the banking industry.

In summary, this study addresses the urgent need for improved cybersecurity in Hong Kong's banking sector by exploring the potential of machine learning technologies. It also determines the importance of leadership in forming an atmosphere of innovation and adaptability in technology transformation. The study provides credible insights and action recommendations for enhancing cybersecurity operational efficiency in the banking industry by combining advanced technologies and effective management practices. This research has the potential to not only improve cybersecurity but also contribute to overall stability and trust in the financial sector.

2. Evaluation of Research Proposal

The research addresses an essential problem in the current technological and financial ecosystem. It provides innovative insights into leveraging machine learning (ML) capabilities to improve cybersecurity for the banking sector. The review below summarizes the proposal's strengths, weaknesses, and limitations in the context of existing literature.

2.1. Strengths of the Proposal

a) Relevance of the Topic

The research topic is relevant to the latest situation the banking sector faces. As cyber threats integrated with AI become more common in financial institutions, especially since Hong Kong, an international financial center, research into machine learning and its potential to combat this issue becomes crucial. The choice of the banking sector, a particularly sensitive industry when it comes to cybersecurity risks (Lukonga, 2018), also highlights the pragmatic importance of the research. Following this line of thinking, the importance of reference is amplified through the incorporation of leadership, acting as a moderate variable and bringing a managerial perspective to a very technical theme.

b) Integration of Machine Learning and Cybersecurity

The value proposition effectively demonstrates the power of ML to improve cybersecurity. ML can process large volumes of data through different types of models, establishing patterns or non-patterns in a dataset for recognizing threats in real-time, thereby reducing human interaction while increasing operational efficiency (Sarker, 2021). This topic of using ML functions to facilitate automation of threat detection and response processes is well-established in literature at the moment, as the domain of cybersecurity continues to evolve.

c) Inclusion of Leadership

The addition of leadership as a moderate factor is novel and commendable. While Leadership styles are ignored in most of the technical research, this study considers that it is the leaders who makes technological adoption and innovation happen (Korejan and Shahbazi, 2016). Only technical dimensions are not enough to adopt or adapt new technology; labor competence is

also an essential factor in its success (Yu, 2021). The inclusion leader factor provides a complete picture of the elements affecting cybersecurity operational efficiency.

d) Theoretical Framework and Research Questions

The diffusion of innovation (DOI) framework is a mature theory linking ML capabilities, cybersecurity efficiency, and leadership dimensions (Hasani *et al.*, 2023). It is suitable for implementing cutting-edge technology and spreading it throughout organizations. The research questions are clear and concise, addressing specific aspects of ML's role in cybersecurity and its impact on operational efficiency in the banking sector. These questions provide a solid foundation and direction for the study and ensure a focused approach to the research problem.

e) Mixed-Methods Research Design

This proposal is pragmatic about research philosophy and combines qualitative and quantitative methods. This mixed-methods approach was appropriate due to the complex nature of ML applied in cybersecurity, as a practical guide can involve both theoretical and practical analyses. Incorporating diverse methodologies enhances the study's findings potential validity and applicability (Ijadi Maghsoodi *et al.*, 2024).

2.2. Weaknesses of the Proposal

a) Lack of Depth in the Literature Review

The literature review covers key aspects of ML and cybersecurity but lacks an exploration of the recent advancement and challenges in the field. For instance, the proposal does not sufficiently discuss the limitations of ML technologies, such as potential biases in training the models, ethical concerns, or data privacy and security concerns. The proposal would comprehensively explain ML's role in cybersecurity operations if these aspects were included.

b) Insufficient Focus on Banking-Specific Challenges

The proposal insufficiently discusses the cybersecurity challenges that banks in Hong Kong face. Challenges such as legacy systems, regulatory requirements for using cutting-edge

technology, and customer data privacy issues are substantial barriers to adopting ML technologies in the banking sector (Rahman *et al.*, 2021). Considering different contextual aspects, the research will be sounder and industry-specific for the target audiences.

2.3. Limitations

a) Overreliance on Established Theories

While the theoretical framework is well-constructed, it relies heavily on established theories without exploring newer or alternative perspectives. For example, the proposal could have considered adaptive leadership or other contemporary leadership theories that may better suit the dynamic nature of technological adoption.

b) Ethical and Privacy Concerns

While the proposal includes some mention of ethical and privacy issues related to using ML in the field of cybersecurity, this is not sufficiently addressed. In literature today, concerns with data privacy, algorithmic bias, and automation's effects on employment are all issues worth discussing. These concerns would have warranted more discussion to gain a better perspective on the ramifications of ML adoption.

c) Regional Specificity

Although the study focuses on Hong Kong, the proposal does not explore the region-specific factors that could impact the adoption of ML in banking cybersecurity. For instance, the regulatory environment, cultural attitudes toward technology (Mohd Al_hazimeh, Walid Al-Smadi and Walid Al-Smadi, 2024), and the competitive landscape in Hong Kong are not adequately discussed. Including these aspects would enhance the study's contextual relevance.

In summary, this research proposal is significant and well-structured. It explores how machine learning can enhance cybersecurity operational efficiency in Hong Kong's banking sector. The strengths lie in its timely topic and address important issue, integration of leadership concepts, and mixed-methods approach. However, it has some weaknesses, including a lack of depth in

the literature review, insufficient discussion of banking-specific challenges, and a limited discussion of practical applications. There is room to improve the study that would significantly enhance its academic and practical contributions. By incorporating the suggested improvements, the research has the potential to provide valuable insights into the effective adoption of ML technologies and the role of leadership in driving cybersecurity innovations.

3. Improvement of Research Design

The previous section identified some weaknesses and limitations of the proposal. A few components of the proposal can be improved to make them more comprehensive and relevant to academics and practitioners. The following section proposes recommendations for improving the research scope and content proposal.

I. Expanding the Literature Review

Although the proposal elaborates on the role of machine learning (ML) in cybersecurity, it is somewhat lacking technical detail when it comes to recent advancements in ML technologies. The review could include applications that are relevant to cybersecurity operations (Handa, Sharma and Shukla, 2019), such as deep learning, neural networks, and anomaly detection systems, for instance. In addition, the proposal will show the limitations of ML (i.e. biases in algorithms, dangers of adversarial machine learning, and problems of putting ML into current systems). Such insights are important in delivering a balanced view to understanding ML's promise and concerns in cybersecurity.

The literature review provides insufficient discussion of ethical and privacy issues. A more comprehensive study will include analysis of potential biases introduced by algorithms as well as the security risks associated with automated decision-making processes (Sun, Nasraoui and Shafto, 2020). Moreover, while the review predominantly highlights leadership, it could also explore other leadership theories that may yield a deeper understanding of how to handle technological adoption in such a dynamic environment, for instance adaptive leadership or distributed leadership. Identifying research gaps and linking them explicitly to the aims of the study would help improve the structure and focus of the literature review even further.

II. Broadening the Research Scope

The research proposal on cybersecurity operational efficiency is a starting point, but it has the potential to be expanded to cover a wider range of topics within cybersecurity operations. Currently, the focus is quite narrow, and by broadening it, the study can explore more dimensions that are equally important and relevant. For example, instead of just looking at how machine learning (ML) improves efficiency and could also study how the adoption of ML affects employee roles, training needs, and even the overall culture within banking institutions.

These areas are critical because they help us understand not just the technical side of ML, but also how it impacts the people and the organization as a whole (Soulami, Benchebkroun and Galiulina, 2024). When employees' roles change due to new technologies, it often requires them to learn new skills, which in turn affects how the organization operates. By including these aspects, the research will provide a more complete picture of how ML is transforming cybersecurity in the banking sector.

Another metric to look at is customer trust. While banks' use of ML for cybersecurity has potential positive effects, so too do potential adverse effects: in particular, customers may feel more secure with their data stored in their bank's servers, provided it is protected with ML (Aldboush and Ferdous, 2023), while also being concerned about how their information might be used. It might also be interesting to explore this balance between improved security and customer trust, which would be another avenue that could add substantial value to the research. The banking industry faces another major issue, which is regulatory compliance. Banks are subject to strict data privacy regulations to safeguard the data of their customers; banks can utilize ML to adhere to these regulations more efficiently, but we must also consider whether ML creates any new compliance challenges (HKMA, 2019). For example, regulators may need to revisit their guidelines as ML systems become more sophisticated to ensure banks are deploying technology responsibly. Therefore, adding these subjects will provide a more comprehensive perspective of the effects of ML in banking cybersecurity.

Even though this is a broad study covering various aspects, it would raise the quality of this study by introducing comparisons among other financial industries (insurance, securities, etc.) to examine the effects in the banking sector. By comparing, the result would be able to see how ML is applied in cybersecurity on various segments of the financial landscape. For instance, the kinds of data that insurance companies work with and the specific cybersecurity threats facing them are different from those of a bank, by analyzing these differences to determine what best practices are shared across industries and what challenges are unique to broad sectors. Not only would this expand the scope of the research, but it would also make the findings more relevant to a broader audience. So, when the finding reveals that ML works particularly well for one aspect of the financial sector, other sectors may be able to use comparable principles.

Finally, the study would greatly benefit from a more forward-looking analysis. This involves figuring out how advancements in ML might transform the landscape of cybersecurity, including leading to new tools or techniques for detecting and preventing cyberattacks (Kalash *et al.*, 2018; Apruzzese *et al.*, 2023). On the flip side, malicious actors can also leverage ML to launch more advanced attacks. This will ensure that the research remains relevant for years ahead of time while incorporating a discussion of this prospective future evolution. It will also assist banks and other financial institutions in preparing for what is next in cybersecurity.

Thus, the research topic is proposed and renamed as follows: **“Impact of Machine Learning on Cybersecurity Operations in Banking, Financial Services and Insurance Sector”**. The new name is more inclusive of the study's content and therefore applies to more sectors than just the finance sector in the financial services industry. By expanding the focus in this way, the research will not only contribute to academic knowledge but also provide practical insights that can help organizations improve their cybersecurity strategies. Overall, these changes will make this proposal more comprehensive, relevant, and impactful.

III. Incorporating Real-World Examples

The study would benefit significantly from the inclusion of real-world examples and case studies. For instance, analyzing banks that have successfully implemented ML in their cybersecurity frameworks could provide practical insights into challenges and solutions. These case studies could highlight the steps taken to integrate ML technologies, the outcomes achieved, and the lessons learned, making the research more actionable for practitioners in the banking sector.

Another positive aspect of the research could be that in addition to writing about any case studies it might also be recommended to collect information from industry practitioners detailing their experience with quality. Banking executives and cybersecurity experts might have useful insights into the practicalities and effectiveness of applying ML systems. The study could also detail the best practices for integrating ML into cybersecurity operations (e.g., appropriate ML models to implement, training staff, or regulatory requirements) to add practical relevance.

IV. Addressing Ethical and Privacy Concerns

Another aspect, ethical and privacy issues, are the most critical issue and it is one of the aspects that the proposal fails to address because ethical concerns and privacy issues have also become one of the most serious aspects (Liu *et al.*, 2022). While automation may improve efficiency, the study must critically examine its ethical implications: decisions made without human oversight could lead to a compromise of accountability, and data could be misused without the right checks in place. The study also has the potential to identify strategies for assuring ethical practices, such as transparent algorithms and accountability systems.

Customer data protection and customer privacy are critical in banking cybersecurity. Building an ML model while preserving data security and adhering to laws, such as the Personal Data (Privacy) Ordinance (PDPO) or any local rules specific to Hong Kong standards, is challenging. Moreover, biases introduced to training data could cause unfair or wrong results. So, the risks of introducing biases should be aware of and examined. Exploring these issues would offer a more balanced and precise view of ML's potential in cybersecurity.

V. Focusing on Regional Context

The regional context of Hong Kong is an important dimension that deserves more attention in the proposal. It should be investigated further in terms of regulatory landscape in Hong Kong, analyzing how laws and policies at the local level affect the adoption of ML in banking cybersecurity. For instance, the research would benefit from context on the specific requirements for Hong Kong-based data protection and cybersecurity (such as regulations in the area).

Cultural attitudes toward technology adoption in Hong Kong are another aspect that could be explored. For instance, studying the organizational and societal perceptions of ML's impact on its acceptance and implementation. Additionally, comparing the banking sector in Hong Kong with other regions, such as Singapore or Europe, could provide insights into best practices and lessons learned. This regional and comparative focus would enhance the relevance and applicability of the study.

VI. Refining the Hypotheses

The current hypotheses are listed in Table 3.1. It focuses primarily on the direct impact of ML on cybersecurity efficiency, which limits the scope of the study. Expanding the hypotheses to include broader organizational and societal factors, such as employee satisfaction, customer trust, and regulatory compliance, would provide a more comprehensive framework. For example, hypotheses could explore how ML adoption influences organizational culture or the relationship between improved cybersecurity and customer confidence.

Table 3.1: Summary of Hypotheses

#	Hypothesis
H1	The compatibility of machine learning is significantly associated with cybersecurity's efficiency.
H2	The integration of machine learning, guided by leadership, significantly enhances the efficiency of cybersecurity practices.
H3	The complexity of machine learning can be reduced by leadership leaders, with a significantly positive impact on the efficiency of cybersecurity.
H4	Perceived security and privacy risk with leadership positively impact cybersecurity operational efficiency.

In addition to leadership, the study could examine other moderate or mediating variables that impact the effectiveness of ML in cybersecurity. For instance, organizational readiness, availability of skilled personnel, and technological infrastructure could be considered. Finally, including hypotheses that address ethical, and privacy concerns would provide a more balanced understanding of the factors influencing ML adoption in cybersecurity.

Overall, the research proposal sets a solid foundation for investigating how machine learning can improve cybersecurity for Hong Kong's banking industry. However, there are many areas that need to improve in order to be rate the academic and practical laboratory of their efforts. A broader literature review could have included recent developments, ethical implications, and other leadership theories to report a deeper and better-balanced overview of leadership and its effects. A better analysis would come from expanding the research scope to engage cybersecurity operations (rather than efficiency and cross-sector comparisons). Pragmatic relevance could be improved with the integration of examples of case studies, whilst contextual issues (e.g. ethical and privacy issues) would provide the reader with a well-rounded argument. All in all, these are sensible points, quite contextual and can significantly reinforce

the hypotheses if framed from a regional perspective. Following these suggestions will help the research benefit academia as well as the banking industry in Hong Kong by providing valuable insights into how to effectively use ML technologies, and how leadership plays a significant role in ensuring that Cybersecurity innovations are properly adopted.

4. Expectation Findings and Contributions

The expected findings of the research proposal have significant potential to enhance knowledge, practice, and management in cybersecurity within Hong Kong's banking sector. The study focusses on integrating machine learning (ML) with cybersecurity frameworks and examining the influence of leadership offers valuable insights that could drive improvements in multiple dimensions.

I. Enhancing Knowledge

In particular, this research aims to provide a theoretical foundation for the utilization of ML in cybersecurity, with a specific focus on Hong Kong's banking industry, which is currently lacking in the cybersecurity and information security literature. Existing literature recognizes the growing significance of AI and ML in protecting their systems within organizations; however, little research has explored their practical considerations, particularly within the banking industry. This would add to the existing body of knowledge by providing insights for ML algorithms regarding their application in efficient cyber threat detection and mitigation. Consider exploring ML techniques like anomaly detection and predictive analytics to see how they fit into this space in identifying risks before they materialize.

A significant contribution to knowledge is the intersection of technology and leadership. If moderation is the role of leadership, the research can provide when it comes to the seeking out and adoption success of ML technology in regard to leadership styles. This advantage is invaluable for bridging the gap between technical innovation and managerial methods and presenting a more discernible picture of cyber operations. Furthermore, these findings are likely to inform how leadership encourages an innovative culture and aids in the effective deployment of new technologies in dynamic industries like banking.

Ultimately, this study may examine emerging challenges, such as the ethical implications and data privacy concerns related to ML. Hence, taking these considerations into account, it is hoped that the results will contribute to the greater discussion of responsible use cases for AI and thereby contribute toward guide rails for responsibly deploying ML into cyber-security architectures.

II. Improving Practice

In terms of practical applications, this enables the research results to change the management of cybersecurity in the banking industry dramatically. One of the expected challenges is clarity on utilizing ML to improve operational efficiency via automating threat detection and response activities. As such, increased automation means less reliance on human interference, which lowers the risk of error and speeds up response times, reinforcing the overall security framework of banks. This would ensure financial institutions keep up with evolving cyber threats and protect sensitive customer data and financial assets.

The study might also provide pragmatic insight for adopting ML technologies in banking cybersecurity processes. For instance, it might identify the best practices for selecting and deploying ML models - training laborers to use the systems effectively and incorporating them into existing protocols designed for safety and security, among other measures. It offers guidelines to complement those applicable to the banks that want to improve their cybersecurity posture but face the challenges presented by introducing new technology.

Moreover, organizations can optimize costs by using ML solutions. ML can help process large volumes of data in real time, thus substantially reducing the reliance on massive manual monitoring and analysis. This also helps banks save money and use their resources better. Moreover, ML technologies could prevent banks from incurring the costs of data breaches and cyberattacks by offering improved reliability and accuracy for cybersecurity measures (Al-Kumaim and Alshamsi, 2023).

III. Advancing Management

The findings from the research can have implications from the management point of view as well, given the critical role that leadership can play in technological innovation. The study highlights how leadership is critical for cultivating continuous improvement and adaptability culture. Such findings could show how leaders can motivate their teams to adopt new technologies such as ML, succeed against headwinds of change resistance, and continuously think ahead. This particularly applies to the banking industry, which is often held together by decades-long precedent and, in some cases, technological inertia.

Additionally, the research study may offer practical approaches for leaders on how to manage the incorporation of ML technologies in cybersecurity infrastructures successfully. It could examine in particular how leaders can set a vision that aligns technological advancement with organizational goals, inspire employees to acquire new skills, and shape a culture of innovation. Bank executives could use these strategies as a map to navigate the complexity of digital transformation.

Lastly, the findings may have increased attention on the need for technical and management teams to work together. Their focus on the collaborative and collective vision behind a shared prediction could encourage banks to align their cyber security management practices with prescriptions to help mitigate cyber threats. This would also guarantee that the solutions to technological dilemmas are just as technically sound in practice as they are theoretically on paper while keeping in mind organizational and regulatory needs.

In summary, the expected findings of this research have the potential to significantly enhance knowledge, practice, and management in the field of cybersecurity within Hong Kong's banking sector. By addressing gaps in the academic understanding of ML's role, providing practical guidelines for its implementation, and offering insights into the role of leadership, the study could drive meaningful advancements in how banks approach cybersecurity. These contributions would not only strengthen the security of financial institutions but also foster a culture of innovation and adaptability, positioning Hong Kong's banking sector as a leader in digital transformation and cybersecurity excellence.

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