TECHNOPRENEURSHIP AND DIGITAL TECHNOLOGY ADOPTION FOR STRATEGIC ADVANTAGE IN RESIDENTIAL CONSTRUCTION PROJECTS IN INDONESIA AND MALAYSIA

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Technopreneurship and Digital Technology Adoption for Strategic Advantage in Residential Construction Projects in Indonesia and Malaysia

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DECLARATION

I hereby affirm that this dissertation titled "Technopreneurship and Digital Technology Adoption for Strategic Advantage in Residential Construction Projects in Indonesia and Malaysia" is my original work, except for the portions cited in the references. This thesis has not been submitted for any other degree and is not currently being considered for any other degree program..

Signature :

Name : Ibnu Suryo

Date : May 12th 2025

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Doctor of Philosophy.

Signature :

Supervisor Name : Associate Professor Dr. Juhaini Binti Jabar

Date :. May 12th 2025

DEDICATION

My cherished family, whose unwavering support and encouragement have been a constant source of strength and inspiration. To my late father Alm. Trimo Susilo Handoko, whose memory continues to guide me, and to my dear mother Tumini, whose prayers and love have always uplifted me.

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ABSTRACT

Technopreneurship the integration of technological innovation and entrepreneurial initiative is transforming Indonesia's construction sector by modernizing practices and enhancing competitiveness. This study examines the main drivers of technopreneurship within the high-tech residential property market, focusing on how entrepreneurship, innovation, and strategic business approaches influence the adoption of advanced technologies. Research was conducted among residential property developers in selected Indonesian regions, applying strategic management frameworks such as SWOT analysis, Porter's Five Forces, balanced scorecards, value chain analysis, and scenario planning to evaluate industry conditions, assess organizational performance, and anticipate future challenges.

Results show that entrepreneurship, technological innovation, and business strategies significantly encourage technology adoption, which subsequently strengthens competitive positioning in the market. The competitive advantage of property developers is most influenced by industry and competitor dynamics, followed by macro-external and internal environmental factors. Conversely, the primary enabler of high-tech adoption is the internal environment, ahead of industry and external influences.

This study contributes to the strategic management literature by highlighting the importance of aligning internal capabilities with industry conditions to maximize technological adoption and sustain market leadership. It underscores the role of strategic management in guiding innovation-driven growth and equitable development across Indonesia's provinces. Integrating technology-focused entrepreneurship with robust strategic planning not only accelerates modernization in the residential property sector but also fosters resilience in an increasingly competitive and technologically evolving marketplace.

Keywords: Technopreneurship, Construction Industry, Technological Innovation, Entrepreneurship, High-Tech Solutions, Sustainability.

TECHNOPRENEURSHIP AND DIGITAL TECHNOLOGY ADOPTION FOR STRATEGIC ADVANTAGE IN RESIDENTIAL CONSTRUCTION PROJECTS IN INDONESIA AND MALAYSIA

ABSTRACT

Teknopreneurship, iaitu gabungan inovasi teknologi dan inisiatif keusahawanan, sedang mengubah sektor pembinaan di Indonesia dengan memodenkan amalan serta meningkatkan daya saing. Kajian ini meneliti pemacu utama teknopreneurship dalam pasaran hartanah kediaman berteknologi tinggi, dengan memberi tumpuan kepada bagaimana keusahawanan, inovasi, dan pendekatan perniagaan strategik mempengaruhi penerapan teknologi canggih. Penyelidikan dijalankan dalam kalangan pemaju hartanah kediaman di beberapa wilayah terpilih di Indonesia, dengan menggunakan kerangka pengurusan strategik seperti analisis SWOT, Lima Daya Porter, kad skor seimbang, analisis rantaian nilai, dan perancangan senario bagi menilai keadaan industri, mengukur prestasi organisasi, serta menjangka cabaran masa depan.

Hasil kajian menunjukkan bahawa keusahawanan, inovasi teknologi, dan strategi perniagaan memberi dorongan yang signifikan kepada penerapan teknologi, yang seterusnya mengukuhkan kedudukan daya saing dalam pasaran. Keunggulan daya saing pemaju hartanah paling banyak dipengaruhi oleh dinamika industri dan pesaing, diikuti oleh faktor persekitaran makro-eksternal serta dalaman. Sebaliknya, pemacu utama penerapan teknologi tinggi ialah faktor persekitaran dalaman, mengatasi pengaruh industri dan luaran.

Kajian ini menyumbang kepada literatur pengurusan strategik dengan menekankan kepentingan penyelarasan keupayaan dalaman dengan keadaan industri bagi memaksimumkan penerapan teknologi serta mengekalkan kepimpinan pasaran. Ia menegaskan peranan pengurusan strategik dalam membimbing pertumbuhan berasaskan inovasi serta pembangunan yang adil di seluruh provinsi Indonesia. Integrasi keusahawanan berfokus teknologi dengan perancangan strategik yang kukuh bukan sahaja mempercepatkan pemodenan sektor hartanah kediaman, malah turut membina ketahanan dalam landskap pasaran yang semakin kompetitif dan berevolusi secara teknologi..

Kata kunci: Teknopreneurship, Industri Pembinaan, Inovasi Teknologi, Keusahawanan, Penyelesaian Teknologi Tinggi, Kemampanan

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LIST OF PUBLICATIONS

The followings are the list of publications related to the work on this thesis:

Ibnu Suryo, Profesor Madya Dr Juhaini Binti Jabar, & TS. Dr. Nurulizwa Binti Abdul Rashid. (2025). TECHNOPRENEURIAL FACTORS IN THE HIGH-TECH-BASED CONSTRUCTION INDUSTRY: A STUDY OF RESIDENTIAL PROPERTY DEVELOPERS IN SURAKARTA. *International Journal of Economics, Business and Accounting Research (IJEBAR)*, *9*(1). https://doi.org/10.29040/ijebar.v9i1.16723

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CHAPTER 1

INTRODUCTION

1.1.Background

This thesis examines the adoption of high-tech digital technology in residential construction projects, particularly among major contracting companies and property developers. In the context of residential properties, developers play a crucial role in planning, executing, and managing construction projects. Technopreneurship factors in residential property development include developers' capacity to understand and adopt cutting-edge technologies, as well as to generate innovative solutions that enhance efficiency and sustainability in the construction industry. Residential property developers can also act as catalysts for technological innovation in the sector, fostering synergy that promotes the implementation of high-tech digital technology across all aspects of construction projects, including logistics processes.

Technopreneurship refers to the integration of technological innovation and entrepreneurial initiative to create value and drive industrial transformation (Sepasgozar & Davis, 2019; Madsen & Vidgen, 2009). In the construction sector, technopreneurship emphasizes the strategic adoption of digital technologies to improve competitiveness.

Given their central role, residential developers provide a clear lens to explore how digital technologies can be integrated across construction stages. Such integration can make projects more efficient, innovative, and responsive to both market needs and technological change. In this research, technopreneurship is considered a key factor in ensuring the successful adoption of digital technology.

1.2.Problem Background

The construction industry, which encompasses the operation of various

construction projects, involves numerous stakeholders forming temporary and complex organizational networks in each new project (Lapidus et al., 2023; Dubois et al., 2019; Surucu-Balci et al., 2024). The adoption of high-tech digital technology in this context has the potential to address several inherent challenges within this industry. Construction projects often face high levels of uncertainty, influenced by factors such as the environment, technology, project uniqueness, and extended completion times (Redyantanu, 2023; Tetik et al., 2019). Confronting the complexity of the construction business environment, the adoption of high-tech digital technology can be crucial in enhancing efficiency, reducing uncertainty, and improving the performance of construction projects. One significant stakeholder group playing a crucial role in this industry is residential property developers. In integrating the adoption of high-tech digital technology, residential property developers can act as catalysts in driving positive changes. Solid collaboration among developers, contractors, and other stakeholders can create a conducive working environment for the implementation of cutting-edge technology, there by enhancing the quality and efficiency of construction projects. Therefore, it is important to consider the role of residential property developers in the context of adopting high-tech digital technology to achieve improved performance in construction projects. Efforts to improve performance in construction projects focus on optimizing the logistics process, aiming for greater efficiency. Research by Chen et al. (2022), Yao (2022), and Obi et al. (2023) highlights common weaknesses in the logistics process of construction projects, particularly in delivering essential resources like materials, equipment, and machinery at the right time and in the right amounts. Inefficiencies in logistics are responsible for 80 percent of delays, which in turn lead to budget overruns (X. Chen et al., 2022). For instance, Thunberg et al. (2017) observed that less than 40 percent of goods were delivered correctly to construction sites—proper quantity, timing, location, and condition. A significant challenge in logistics management is the lack of coordination

between main contractors, subcontractors, and suppliers (Dubois et al., 2019; Redyantanu, 2023). Additionally, inadequate communication and information flow between the main contractor and suppliers remain critical obstacles (Thunberg et al., 2017). In addressing these challenges, the use of high-tech digital technology is considered a critical solution. By harnessing digital technology, residential property developers, and other relevant parties can enhance coordination, transparency, and communication in the construction logistics supply chain. Therefore, updates and improvements in the logistics process are expected to contribute positively to the overall performance of construction projects (Chen et al., 2022; Chen et al., 2021; Costa et al., 2023). Facing the increasingly complex dynamics of the residential property industry, the utilization of high-tech digital technology becomes key to achieving a robust and sustainable business continuity (Soluk & Kammerlander, 2021).

Thus, efforts to improve coordination, transparency, and communication in the construction logistics supply chain will be maximally supported by the adoption of high-tech digital technology solutions, including the use of Building Information Modeling (BIM) technology for residential property developers. With BIM, the planning and execution processes of construction can be enhanced through more efficient collaboration among various stakeholders (Costa et al., 2023). Additionally, the integration of cloud computing-based project management solutions can expedite decision-making and facilitate more effective real-time monitoring of project progress(Waqar et al., 2023). To enhance user experience and increase the appeal of properties offered in potential markets, the incorporation of smart home systems and Internet of Things (IoT) in the development of new residential property products is a suitable choice (Abedi et al., 2013; Affum et al., 2021). With this technology, residents can enjoy high levels of comfort and energy efficiency, while property developers can integrate sustainability aspects into their property designs. Lastly, to improve the effectiveness of property marketing and sales, the use of Virtual

Reality (VR) can provide an engaging and captivating experience for prospective buyers (Yousaf et al., 2023). By consistently leveraging these high-tech digital technologies, residential property developers and related stakeholders can achieve sustainable business continuity while enriching the value of properties and user experiences (Azmi et al., 2023). Based on the conducted research, it can be observed that the utilization of high-tech digital-based technologies plays a crucial role in enhancing information flow among stakeholders in construction projects. The implementation of such technology can significantly facilitate improvements in construction logistics processes, a key factor prerequisite for enhancing the overall performance of construction projects (Mlhem et al., 2023). As previously explained, the adoption of technologies such as Building Information Modeling (BIM), cloud computing-based project management solutions, smart home systems, Internet of Things (IoT), and Virtual Reality (VR) includes leveraging AutoCAD technology to support BIM by providing tools for creating 2D and 3D models that can be integrated into the BIM environment (Costa et al., 2023). Regarding cloud computing-based project management solutions, AutoCAD can connect with cloud platforms like Autodesk BIM 360 for real-time project team collaboration (Bortolini et al., 2019). In the context of smart home and Internet of Things (IoT), AutoCAD is used to design technical components that support the development of IoT systems and smart home applications (Naeem et al., 2023). Additionally, AutoCAD designs can be imported into Virtual Reality (VR) software to create interactive and realistic 3D visualization experiences. The integrated use of digital technologies can improve operational efficiency, strengthen stakeholder coordination, and enhance user experiences. High-tech construction, in particular, is growing rapidly and attracting increasing interest from both developers and home buyers. However, it is important to emphasize that the adoption of digital technology in construction projects still needs enhancement(X. Chen et al., 2022), indicating both challenges and opportunities to

increase digital technology penetration in the construction industry (Naeem et al., 2023). In this context, stakeholders in residential property development and related parties can view increased adoption of digital technology as a strategic step to enhance information flow, strengthen logistical processes, and ultimately improve construction project performance.

This indicates that there are challenges and opportunities to enhance the penetration of digital technology in the construction industry. In this context, residential property developers and related stakeholders can view the increased adoption of digital technology as a strategic step to improve information flow, strengthen logistics processes, and ultimately enhance the performance of their construction projects.

By combining research findings highlighting the importance of digital technology with the solutions previously described, stakeholders in residential property development can design a holistic strategy to accelerate the adoption of digital technology throughout the construction project lifecycle. In doing so, they can not only address potential hurdles in logistical processes but also achieve business sustainability through enhanced efficiency, collaboration, and utilization of high-tech tools. The technology adoption process needs to be clarified to understand its linkage with technology implementation. Technology adoption involves not only technical matters but also socio-technical aspects and is an integrated set of decisions made by decision-makers regarding the acceptance or rejection of technology utilization (Madsen & Vidgen, 2009; Hosseini et al., 2015; Wahbeh et al., 2020). The technology adoption process involves key stages: investigation, decision-making, and implementation (See Figure 1.1).

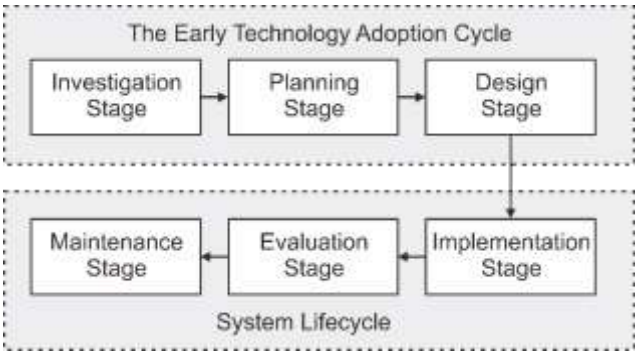

Figure 1.1. The process of adopting high-tech digital technology is developed from (Sepasgozar & Davis, 2019; Ullah et al., 2021)

The initial stage of the technology adoption cycle is the investigation phase, where construction companies identify needs and potential solutions to address those needs (Sepasgozar & Loosemore, 2017). In this stage, the use of high-tech digital technology may need to be integrated into trials as part of the planning phase for the specific design of the technology, which will later lead to implementation. This enables ongoing evaluation of the relevance of the technology in the context of the construction project (Sepasgozar & Davis, 2018). The next stage in the system lifecycle involves a form of decision-making policy, where construction companies analyze data collected from the previous stage and plan the necessary steps to transition from the investigation phase to the implementation phase. Ultimately, this leads to the evaluation of system maturity and maintenance (Sepasgozar & Davis, 2019).

In the context of the construction business industry, the technology adoption stage becomes increasingly crucial for residential property developers. The implementation of high-tech digital technology can provide opportunities to enhance efficiency, design innovative solutions, and achieve business sustainability. By incorporating high technology into the adoption process, residential property developers can position themselves as leaders in addressing the dynamic changes in the business environment (lin et al., 2016; Li et al., 2018; Liu., 2019).

The knowledge gap within the scope of the construction business industry currently indicates a lack of clarity regarding the implementation of high-tech digital technology to enhance project performance. This may be due to research focus predominantly on the technical perspective of construction companies, neglecting the socio-techno perspective of the project. Therefore, a deeper understanding is needed of how digital technology is adopted in the context of construction projects (Madsen & Vidgen, 2009; Hosseini et al., 2015; Wahbeh et al., 2020). This is crucial considering that the process of adopting digital technology is not linear and often ambiguous, especially with the time and budget constraints commonly experienced by construction projects.

The adoption of digital technology is a complex and time-consuming process, particularly in the construction industry, which tends to lag behind in innovation compared to other industrial sectors. Factors such as project-driven orientation, lack of involvement from clients or project managers, and financial challenges like high initial investments (Sotorrío Ortega et al., 2023), can all influence this adoption process. Additionally, resistance to change from parties involved in traditional projects also poses a significant barrier (Alola & Rahko, 2024). To address this, this research aims to bridge the knowledge gap related to understanding the factors influencing the adoption of digital technology in the construction context and the entrepreneurial spirit in developing suitable strategies to help accelerate the integration of technology in the practices of the construction industry, particularly among residential property developers.

Year	Percentage of Companies Adopting BIM	Percentage of Companies Using Cloud-Based Project Management	Percentage of Companies Implementing IoT	Percentage of Companies Using VR/AR
2018	15	10	5	2
2019	20	15	10	5
2020	28	22	18	8
2021	35	30	25	12
2022	42	38	33	18

2023	50	45	40	25

Table 1.1. Adoption Rates of Digital Technologies in Construction Industry (2018–2023)

Here are some statistics related to the adoption of digital technology in the construction industry, which can be used as justification in this research:

1. Building Information Modeling (BIM): The percentage of companies adopting BIM has steadily increased from 15% in 2018 to 50% in 2023.
2. Cloud-Based Project Management: The adoption of cloud-based project management tools has grown from 10% in 2018 to 45% in 2023.
3. Internet of Things (IoT): The percentage of companies implementing IoT has increased from 5% in 2018 to 40% in 2023.
4. Virtual Reality (VR) and Augmented Reality (AR): The usage of VR and AR in construction projects has risen from 2% in 2018 to 25% in 2023.

These statistics highlight the growing trend and importance of digital technology adoption in the construction industry. This increase in technology usage supports the need for research to understand the factors influencing this adoption and to develop strategies to accelerate the integration of these technologies, particularly among residential property developers. To address this, this research aims to bridge the knowledge gap related to understanding the factors influencing the adoption of digital technology in the construction context and the entrepreneurial spirit in developing suitable strategies to help accelerate the integration of technology in the practices of the construction industry, particularly among residential property developers. For instance, the adoption of Building Information Modeling (BIM) has increased from 15% in 2018 to 50% in 2023, reflecting a significant shift towards digital technology in construction. Similarly, the use of cloud-based project management tools has grown from 10% in 2018 to 45% in 2023, while the implementation of Internet of Things (IoT) technologies has risen from 5% in 2018 to 40% in 2023. Additionally, the usage