THE INFLUENCES OF INTELLECTUAL CAPITAL AND INNOVATION DRIVERS ON COMPETITIVENESS IN THAI MANUFACTURING INDUSTRY SECTOR

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ABSTRACT: This study sought to: (1) analyse the effect of intellectual capital on innovation drivers, (2) explore the indirect influence of intellectual capital on competitiveness via innovation drivers, (3) evaluate the impact of innovation drivers on competitiveness, and (4) examine the causal relationships among intellectual capital, innovation drivers, and competitiveness within the Thai manufacturing sector. Intellectual capital includes knowledge that may be transformed into value or employed as a resource for intellectual endeavours, comprising information, expertise, intellectual property, and experience, all of which facilitate wealth creation. Innovation drivers encompass the creation of novel products and strategies, improvements to existing offerings, progress in management and digital marketing, and the incorporation of comprehensive and constructive work processes. Intellectual capital is considered a vital strategic asset, whereas innovation drivers are essential for improving competitiveness. The research sample consisted of 236 enterprises in the Thai manufacturing sector, with executives and accounting managers acting as primary informants. Data were gathered by a survey questionnaire, and the study utilised Descriptive Statistics, Correlation study, and Structural Equation Modelling. The study's results indicated that: (1) intellectual capital positively influenced innovation drivers; (2) intellectual capital positively impacted competitiveness via innovation drivers; (3) innovation drivers were positively correlated with competitiveness; and (4) the causal model elucidating the effects of intellectual capital and innovation drivers on competitiveness in the Thai manufacturing sector exhibited a strong alignment with the empirical data ($\chi^2 = 29.424$, $p = 0.060$, $df = 19$, $\chi^2/df = 1.549$, GFI = 0.977, RMSEA = 0.048). The model explained 87.60% of the variance in innovation drivers and 56.50% in competitiveness. This study and its proposed model offer a theoretical framework for examining the causal links between intellectual capital, innovation drivers, and business competitiveness from a resource-based viewpoint.

Keywords: Intellectual Capital, Innovation Drivers, Causal Relationships, Competitiveness, Manufacturing, Industry Sector.

1. Introduction

The global economic environment is undergoing significant transformation, marked by shifts in globalisation, trade patterns, employment trends, income distribution, inflation rates, interest rates, productivity levels, and wealth accumulation. These changes profoundly influence both consumer and institutional purchasing behaviours, compelling organisations to adapt to macro-environmental factors (Xu et al., 2019). Such dynamics necessitate that businesses and their leadership devise innovative strategies to navigate intense competition and address potential future challenges effectively. In this context, intellectual capital has emerged as a pivotal strategic resource in organisational management, with innovation playing a critical role in sustaining competitive advantage. Companies are increasingly allocating substantial resources to cultivate their intellectual capital, focusing on enhancing innovation capabilities and creating value (Zemlyak, Kiyashchenko, & Ganicheva, 2022).

Employees are instrumental in driving innovation, which is vital for establishing and sustaining a competitive advantage (Aljuboori et al., 2022). The evaluation of knowledge, often linked to revenue generation, has become increasingly intertwined with the concept of intellectual capital (Achim, Rus, & Mirza, 2024; Hartono et al., 2019; Weqar et al., 2021; Xu & Zhang, 2021; Yaseen, Dajani, & Hasan, 2016). The growing prominence of knowledge-based economies has further elevated the significance of intellectual capital. Initially introduced to explain discrepancies between market capitalisation and book value, intellectual capital has evolved into a fundamental framework for assessing organisational value (Allameh, 2018). Consequently, it is now widely recognised as a crucial driver of value creation and competitive advantage (Nadeem, Dumay, & Massaro, 2019; Revellino & Mouritsen, 2024).

Intellectual capital comprises various assets and processes that conventional financial statements often

overlook, frequently described as an organisation's hidden value (Achim et al., 2024). These intangible assets make a substantial contribution to a firm's overall worth (Gomezelj Omerzel & Smolčić Jurdana, 2016; Jardon & Martinez-Cobas, 2021). They are embedded in organisational knowledge, expertise, and managerial practices, encompassing human capital, structural capital, stakeholder networks, and strategic activities such as policy development, strategy formulation, and continuous improvement planning (Ali et al., 2021; Saraswati et al., 2024; Weqar et al., 2021). Furthermore, Carson et al. (2004) highlight that scholarly discussions on intellectual capital primarily focus on its applications within accounting and management, reinforcing its growing relevance in these domains.

The development of intellectual capital and innovation serves as the foundational mechanisms driving organisational success (Uriguen Aguirre & Avolio Alecchi, 2023). For any organisation to achieve its objectives and thrive, it must utilise its resources in the most efficient and cost-effective manner possible (Skhvediani et al., 2023). Intellectual capital encompasses capabilities, processes, information, and knowledge that collectively enhance competitive advantage. It is considered one of the lowest-risk assets and comprises three key components: human capital, which relates to the skills and problem-solving abilities of owners and employees in addressing consumer needs; relational capital, which focuses on customer satisfaction, attraction, and profitability; and structural capital, which pertains to the organisation's ability to adapt to market demands.

Innovation, on the other hand, is a critical driver of economic and organisational evolution. It is widely recognised as a vital resource for creating competitive advantage and ensuring organisational success and sustainability. A firm's capacity for innovation reflects its ability to introduce timely innovations and innovative service initiatives, leveraging insights from consumers, competitors, and technological advancements (Hariyono & Narsa, 2024). The ability to innovate depends on how effectively an organisation utilises its existing resources. Key competitive capabilities, such as collaboration, research, development, and implementation, are essential for organisations to survive and thrive in highly competitive environments.

This research aimed to: (1) analyse the impact of intellectual capital on innovation drivers, (2) examine its indirect effect on competitiveness via innovation drivers, (3) assess how innovation drivers influence competitiveness, and (4) explore the causal links among these factors in the Thai manufacturing sector. Data from 236 firms were analysed using SEM to test the proposed hypotheses. The study highlights human, structural, and relational capital as key components of intellectual capital management. It underscores the role of intellectual capital and innovation drivers in enhancing competitiveness, adopting a resource-based view of value creation. Innovation drivers are assessed across four dimensions—product, process, service, and marketing innovation—while competitiveness is measured through product differentiation, cost leadership, group-specific focus, and responsiveness.

This study provides valuable insights for top managers to effectively assess and leverage their resources, enabling them to develop strategic business plans that enhance competitive advantage. Additionally, the findings on intellectual capital and innovation offer critical information for investors and shareholders, aiding them in making informed investment decisions and evaluating a firm's competitiveness. The structure of this study is organised as follows: it begins with a literature review on intellectual capital, innovation drivers, and competitiveness, covering definitions, classifications, and existing research that supports the relationships between these concepts. This is followed by an examination of relevant research conducted in Thailand and the formulation of research hypotheses, which are elaborated later in the article.

The methodology section outlines the data collection process, variable measurements, and analytical models employed in the study. Subsequently, the findings are presented and discussed, highlighting the research outcomes and their implications. The conclusion section discusses the study's shortcomings and offers suggestions for future research avenues. This methodical methodology guarantees a thorough comprehension of the relationship among intellectual capital, innovation catalysts, and competitiveness, providing pragmatic insights for both scholarly and professional audiences.

2. Literature Review and the Development of Hypotheses

Theorists and practitioners have developed various models to measure intellectual capital and its components (Jordão & Novas, 2024). Harrison and Sullivan (2000) categorised intellectual capital assessments into two broad groups: qualitative and quantitative data. Quantitative data is further divided into non-monetary and monetary measures. Among the models proposed in the literature, the Value Added Intellectual Coefficient (VAIC) model, introduced in 1998, has been widely adopted as a monetary measure (Nadeem et al., 2019). Over time, this model has gained significant traction among researchers and corporations (Dalwai & Salehi, 2021). However, it has faced criticism, particularly for its exclusion of certain aspects of intellectual capital (Nadeem et al., 2019).

Innovation drivers, on the other hand, refer to the creation of new products, methods, or improvements to existing ones, leading to positive changes. These drivers are categorised into four components: 1) Product Innovation, which involves the development of tangible products or enhancements to existing ones; 2) Process Innovation, which focuses on improving existing processes through changes in techniques, equipment, or software; 3) Service Innovation, which entails enhancing organisational services to better meet consumer or organisational needs; and 4) Marketing Innovation, which involves the continuous development of new marketing strategies to create value and meet market demands (Ferraresi et al., 2012; Jain, Khan, & Mishra, 2017; Verma & Jayasimha, 2014).

Competitiveness is defined as the unique ability of executives to plan and implement strategies that create a competitive advantage in organisational management. It is built on four key components: 1) Product Differentiation, where organisations develop unique or superior products; 2) Cost Leadership, a strategy that focuses on reducing production costs or product prices while maintaining quality standards to outperform competitors; 3) Focus Group Specific, which involves targeting niche markets with specialised products or services, leveraging unique capabilities to address market gaps; and 4) Responsiveness, where organisations demonstrate flexibility in adapting their products and operations to align with market changes. These components collectively enable firms to sustain their competitive edge in dynamic and challenging environments.

Yitmen (2011) found a favourable association between intellectual capital, competitiveness, and innovation in the construction industry via a literature review. Yaseen et al. (2016) added that intellectual capital boosts competitive advantage. Intellectual capital, organisational strategy, and competitive advantage improve organisational performance, according to Anwar, Khan and Khan (2018). When knowledge management strategies are effective, intellectual capital boosts creativity, innovation, and organisational success, according to Chen and Chen (2007). Xu and Zhang (2021) also noted that intellectual capital management, organisational culture, executive leadership, and organisational effectiveness are positively correlated. To preserve and develop knowledge management, organisations must retain and advance human, relational, and structural capital. Intellectual capital boosts this ability.

Jain et al. (2017) found that innovation processes are driven by learning from the environment and leveraging existing resources, which determine the nature and form of innovation in response to external conditions. Verma and Jayasimha (2014) identified a positive relationship between innovation and sustainable competitive advantage. Ferraresi et al. (2012) noted that effective knowledge management, from a resource-based perspective, plays a critical role in fostering innovation. Similarly, Cui and Wu (2016) found that information resources significantly influence technological and innovation capabilities. Strengthening technology, human resources, knowledge, innovation, and marketing orientation is essential for strategic planning and resource allocation, leading to sustainable growth and competitive advantage. Riyadi and Munizu (2022) highlighted that external environmental factors and business management practices significantly impact competitive advantage. Entrepreneurs should adopt systematic work plans and ensure safety across all aspects of operations.

Individuals with diverse characteristics possess varying levels of human capital, suggesting that well-equipped human resources—whether in terms of knowledge, skills, attitudes, or other attributes—can effectively plan and execute operations in alignment with or exceeding organizational objectives. These capabilities enhance management effectiveness, operational efficiency, and innovation, enabling organizations to outperform competitors and create added value. Based on these insights, the following hypotheses are proposed (Figure 1).

H1: Intellectual capital positively influences innovation drivers
H2: Intellectual capital indirectly influences competitiveness through innovation drivers
H3: innovation drivers positively influence competitiveness
H4: The causal relationship among intellectual capital, innovation drivers, and competitiveness in the Thai manufacturing industry sector fits empirical data.

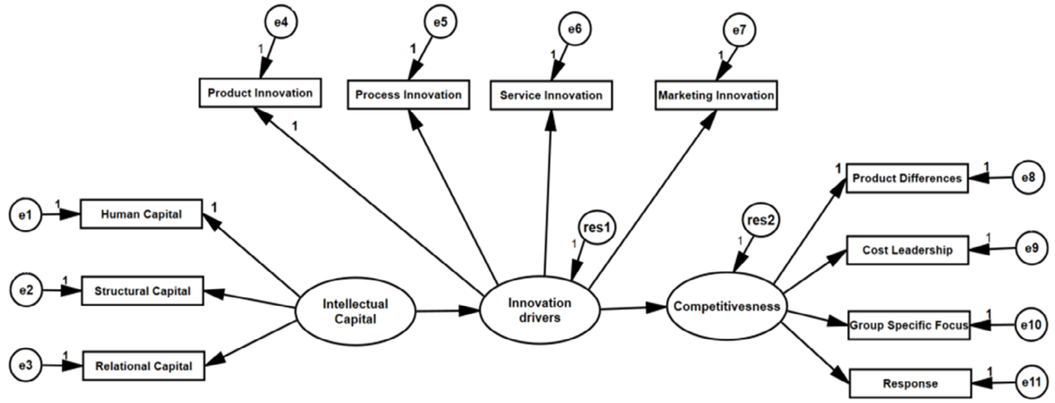

Figure 1: Influences on the Conceptual Framework of Intellectual Capital, Innovation Drivers on Competitiveness.

3. Methodology

3.1. Sample and Data Collection

The population for this study comprised 76,506 Thai manufacturing firms listed in the Department of Business Development (DBD) database as of November 30, 2021. These firms were selected due to their complex operational structures, diverse systems, multi-layered responsibilities, and exposure to competitive challenges. The Thai manufacturing industry encompasses various sectors, including petroleum and petrochemicals, automotive and auto parts, steel and metals, plastics, electronic components, and electrical equipment. This industry plays a pivotal role in driving Thailand's economic growth and stability. The study targeted executives and accounting managers as key informants. A sample of 398 firms was selected at a 95% confidence level. Questionnaires, with a cover letter outlining the research objectives, were mailed on 15 January 2022. Of these, 240 were returned, with 236 complete and valid, yielding an effective response rate of 59.30%. To assess non-response bias, Armstrong and Overton's (1977) method was applied, comparing firm demographics such as business period, authorised capital, total assets, and annual value between 118 early and late respondents. A 95% confidence level t-test found no significant differences, confirming the absence of non-response bias and enhancing study validity and generalisability.

3.2. Measurement

The constructs in the conceptual measurement model, as presented in Table 1, are assessed using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), with control variables excluded. Each construct has been developed based on its definition, relevant theoretical frameworks, and a review of prior literature. Accordingly, the measurements for the dependent, independent, and moderating variables in this research are summarised as follows:

3.3. Dependent Variable

Competitiveness is measured using a thirty-item scale encompassing four dimensions: product differentiation (eight items), cost leadership (eight items), group-specific focus (eight items), and responsiveness (six items). The construct for this variable was developed based on its definition and theoretical foundation, with newly designed question items to ensure alignment with the research framework.

3.4. Independent Variable

Intellectual capital is measured using a seventy-item scale across three dimensions: human capital (20 items), structural capital (25 items), and relational capital (25 items). The construct was developed using newly designed question items, ensuring alignment with its definition and theoretical framework.

3.5. Moderator Variable

Innovation drivers are measured using a twenty-five-item scale structured across four dimensions: product innovation (six items), process innovation (six items), service innovation (seven items), and marketing innovation (six items). The construct was developed using newly designed question items, ensuring alignment with its definition and theoretical foundation.

3.6. Validity and Reliability

To ensure the questionnaire's clarity and the constructs' comprehensiveness in addressing the variables, three academic experts with relevant experience reviewed the instrument. A pre-test was subsequently conducted using the first thirty completed questionnaires. Reliability was assessed using Cronbach's Alpha to evaluate the internal consistency of respondents' answers across all items. As shown in Table 1, the Alpha Coefficient exceeded 0.70, aligning with standard recommendations that coefficients should surpass this threshold to ensure reliability.

The construct of intellectual capital demonstrated a reliability coefficient of 0.98. Its dimensions—human capital, structural capital, and relational capital—exhibited reliability coefficients of 0.95, 0.96, and 0.93, respectively. The construct of innovation drivers achieved a reliability coefficient of 0.97, with its dimensions—product innovation, process innovation, service innovation, and marketing innovation—showing reliability coefficients of 0.94, 0.87, 0.93, and 0.92, respectively. Similarly, the construct of competitiveness had a reliability coefficient of 0.97. Its dimensions, including product differentiation, cost leadership, group-specific focus, and responsiveness, demonstrated reliability coefficients of 0.92, 0.91, 0.89, and 0.91, respectively. To assess the validity of the intellectual capital, innovation drivers, and competitiveness variables, factor analysis was conducted. The factor loadings obtained through EFA and CFA ranged from 0.570 to 0.995. These values exceed the recommended cut-off threshold of 0.40, indicating acceptable construct validity and ensuring the reliability and validity of the measures presented in Table 1.

Table 1. The Results of the Validity and Reliability Testing.

Construct	Variables	Items	Validity (Factor Loadings)	Reliability (Cronbach Alpha)
Intellectual Capital		70	0.810 – 0.995	0.98
	Human Capital	20	0.793 – 0.835	0.95
	Structural Capital	25	0.763 – 0.878	0.96
	Relational Capital	25	0.570 – 0.858	0.93
Innovation Drivers		25	0.586 – 0.795	0.97
	Product Innovation	6	0.592 – 0.673	0.94
	Process Innovation	6	0.606 – 0.674	0.87
	Service Innovation	7	0.582 – 0.728	0.93
	Marketing Innovation	6	0.619 – 0.685	0.92
Competitiveness		30	0.743 – 0.900	0.97
	Product Differences	8	0.697 – 0.781	0.92
	Cost Leadership	8	0.665 – 0.762	0.91
	Group-Specific Focus	8	0.572 – 0.701	0.89
	Response	6	0.696 – 0.758	0.91

4. Results and Discussion

The demographic characteristics of the 236 firms in the manufacturing industry sector reveal a well-established and financially robust sector. The firms are distributed across various industry groups, including petroleum and petrochemical, automotive and auto parts, steel and metal, plastic, electronic components, electrical equipment, and other manufacturers. A significant majority of these firms, 72.88%, have been in operation for more than 10 years, indicating a strong presence of experienced and established businesses. In terms of financial capacity, 80.25% of the firms have an authorized capital exceeding 100,000,000 baht, reflecting the capital-intensive nature of the manufacturing industry. Additionally, 35.9% of the firms have foreign direct investment (FDI) of more than 50%, highlighting the sector's appeal to international investors and its integration into global markets.

The workforce size further underscores the scale of these firms, with 70.34% employing more than 100 people, suggesting that the majority are medium to large-scale enterprises contributing significantly to employment. Economically, the sector demonstrates substantial revenue generation, as 59.32% of the firms report average annual revenues exceeding 500,000,000 baht. This indicates the sector's critical role in driving economic growth and its importance to the broader economy. Overall, the data paints a picture of a mature, financially strong, and internationally connected manufacturing sector with a significant impact on employment and revenue generation.

Tables 2 and 3 contain descriptive data, including means and standard deviations, as well as a correlation matrix to assess the importance of correlations among the analysed variables. A bivariate correlation study

was performed utilising a two-tailed test for statistical significance at two thresholds: $p < 0.05$ and $p < 0.01$. The research determined that multicollinearity problems occur when the inter-correlations among independent variables surpass 0.80. The correlation matrix indicated that all inter-correlations in this investigation fell below the threshold, signifying that multicollinearity is not an issue. Moreover, the study found significant correlations at the 0.01 level: competitiveness and intellectual capital ($r = 0.636$), innovation drivers and evaluations ($r = 0.581$), and innovation drivers and intellectual capital management ($r = 0.774$), indicating strong positive relationships.

The examination of the correlation matrix further confirmed significant and positive linear associations among the observed variables. Competitiveness showed correlations ranging from 0.585 to 0.805 ($p < 0.01$), innovation drivers exhibited correlations between 0.496 and 0.685 ($p < 0.01$), and intellectual capital displayed correlations from 0.629 to 0.690 ($p < 0.01$). Importantly, all correlation values were below the 0.80 threshold, reinforcing the absence of multicollinearity issues in this study. These findings highlight the strong and meaningful relationships among the variables, particularly between competitiveness, innovation drivers, and intellectual capital, while ensuring the statistical integrity of the analysis.

Table 2: The Descriptive Statistics and Correlation Matrix of Latent Variables.

Latent Variables	Competitiveness	Innovation Drivers	Intellectual Capital
Mean	3.87	3.84	3.95
S.D.	0.53	0.53	0.51
Competitiveness	1		
Innovation Drivers	0.581**	1	
Intellectual Capital	0.636**	0.774**	1
**. Correlation is significant at the 0.01 level (two-tailed).			

Table 3: The Descriptive Statistics and Correlation Matrix of Observed Variables.

Observed Variables	Product Differences	Cost Leadership	Group-Specific Focus	Response	Product Innovation	Process Innovation	Service Innovation	Marketing Innovation	Human Capital	Structural Capital	Relational Capital
Mean	3.82	3.87	3.76	3.92	3.79	3.84	3.91	3.93	3.98	3.94	3.94
S.D.	0.64	0.60	0.60	0.62	0.70	0.60	0.65	0.63	0.60	0.59	0.55
Product Differences	1										
Cost Leadership	0.752**	1									
Group Specific Focus	0.624**	0.585**	1								
Response	0.805**	0.686**	0.613**	1							
Product Innovation	0.383**	0.360**	0.418**	0.326**	1						
Process Innovation	0.386**	0.293**	0.342**	0.398**	0.529**	1					
Service Innovation	0.504**	0.386**	0.393**	0.504**	0.496**	0.563**	1				
Marketing Innovation	0.490**	0.478**	0.462**	0.479**	0.497**	0.558**	0.685**	1			
Human Capital	0.414**	0.321**	0.356**	0.448**	0.583**	0.688**	0.613**	0.569**	1		
Structural Capital	0.565**	0.571**	0.401**	0.604**	0.538**	0.445**	0.541**	0.513**	0.643**	1	
Relational Capital	0.567**	0.522**	0.494**	0.624**	0.464**	0.466**	0.658**	0.540**	0.629**	0.690**	1
**. Correlation is significant at the 0.01 levels (two-tailed).											

4.1. Analysis of Structural Equation Model

The proposed model, as presented in Table 4 and Figure 2, illustrates the impact of intellectual capital on innovation drivers (H1), the indirect effect of intellectual capital on competitiveness through innovation drivers (H2), the influence of innovation drivers on competitiveness (H3), and the hypothesised causal relationship among intellectual capital, innovation drivers, and competitiveness within the Thai manufacturing sector (H4). The hypothesised relationships were tested using a sample of 236 firms ($n = 236$). Statistical analysis confirmed an acceptable model fit, with the hypothesised model yielding a non-significant chi-square statistic ($\chi^2 = 29.424$, $p = 0.060$, $df = 19$, $\chi^2/df = 1.549$).

4.2. Goodness of Fit Index Test (GFI-Test)

GFI tests showed that the hypothesised model fit empirical data well. The adjusted goodness-of-fit index (AGFI), CFI, and NFI all surpassed 0.90, suggesting outstanding fit. The GFI, CFI, AGFI, and NFI values were 0.977, 0.994, 0.920, and 0.983, exceeding the criterion. RMSEA was 0.048, which is within the allowed range, confirming the model's validity. The chi-square to degrees of freedom ratio ($\chi^2/df = 1.549$) indicated a good model fit, well below the recommended threshold of 3. The results show that the suggested model matches the data, proving its robustness. Thus, Hypothesis 4 (H4), which links intellectual capital and innovation drivers to Thai manufacturing industry competitiveness, is supported. Figure 2 shows how intellectual capital and innovation drivers boost industry competitiveness.

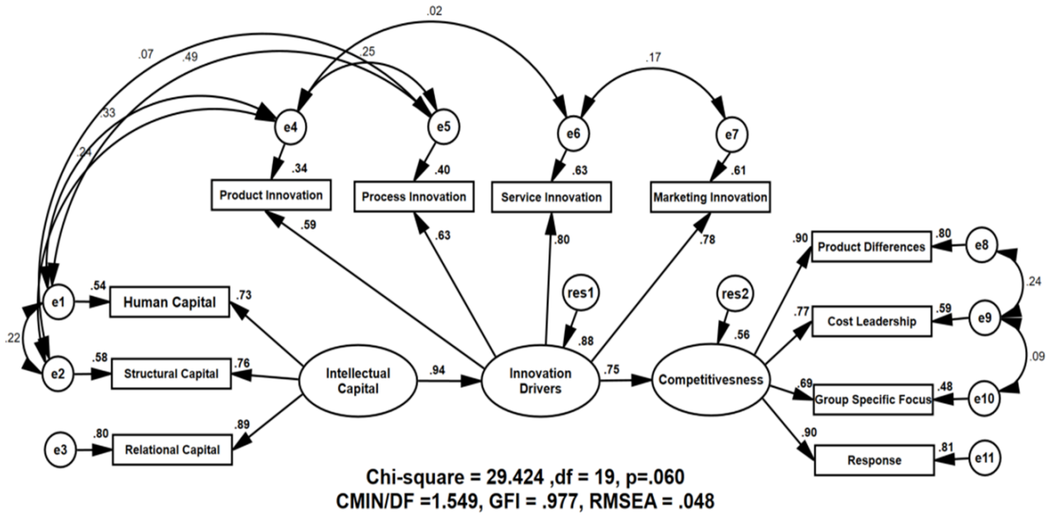

Figure 2: The Structural Equations Model of Intellectual Capital, and Innovation Drivers Influences on Competitiveness.

Table 4: The Results of Total Effect (TE), Direct Effect (DE), and Indirect Effect (IE) between Latent Variables.

Endogenous Variables		Parameter Coefficient	Innovation Drivers			Competitiveness		
Exogenous Variables			TE	IE	DE	TE	IE	DE
Intellectual Capital		Unstandardized	0.865***	-	0.865***	0.910***	0.910***	-
		Standardized	0.936***	-	0.936***	0.704***	0.704***	-
Innovation Drivers		Unstandardized	-	-	-	1.052***	-	1.052***
		Standardized	-	-	-	0.752***	-	0.752***
Squared Multiple Correlations								
	Variables	Innovation Drivers	Competitiveness					
	R^2	0.876	0.565					
*** $p < 0.001$								

The analysis of Hypotheses 1-3 (H1-H3) using the hypothesized model in AMOS revealed significant and positive relationships among intellectual capital management, innovation drivers, and competitiveness. These relationships were evaluated based on T-Statistics and p-values, with significance measured at the levels of 0.01 and 0.001. The results demonstrated that intellectual capital has a strong and statistically significant positive influence on innovation drivers, with a direct effect value of 0.936 ($\rho < 0.001$). This indicates that higher levels of intellectual capital management directly enhance innovation drivers within the Thai manufacturing industry sector. Additionally, intellectual capital indirectly influences competitiveness through its impact on innovation drivers, with an indirect effect value of 0.704. Furthermore, innovation drivers were found to have a significant and positive influence on competitiveness, with a direct effect value of 0.752 ($\rho < 0.001$). This highlights the critical role of innovation in enhancing the competitive positioning of firms in the sector. Thus, H1-H3 were supported

Figure 2 displays the parameter estimates of the hypothesised model, assessed to ascertain the relevance of the postulated correlations. The standardised parameter estimations validate that the proposed

associations are statistically significant. These results correspond with Yitmen's (2011) research, which established a favourable correlation among intellectual capital, competitiveness, and innovation. Anwar et al. (2018) and Chen and Chen (2007) similarly emphasised that intellectual capital, organisational strategy, and competitive advantage positively affect organisational performance, whereas intellectual capital and innovation drivers augment competitiveness.

Further support is provided by Jain et al. (2017), who emphasised that innovation processes are shaped by learning within the organisational environment. Verma and Jayasimha (2014) also established a positive correlation between innovation and the sustainable competitive advantage of firms. Ferraresi et al. (2012) demonstrated that knowledge management fosters innovation, while Cui and Wu (2016) confirmed that information resources significantly impact technological and innovation capabilities. Additionally, Riyadi and Munizu (2022) found that external environmental factors and business management practices influence competitive advantage, with innovation and collaboration playing a pivotal role in shaping this advantage. Collectively, these studies reinforce the significance of intellectual capital, innovation drivers, and external factors in enhancing competitiveness, as evidenced by the hypothesised model in this research.

The findings of the study underscore the critical role of intellectual capital and innovation in enhancing competitiveness within the manufacturing industry. To leverage these insights effectively, managers should prioritise initiatives that foster skill development through targeted employee training programmes. Encouraging creativity and collaboration by implementing innovative ideas and enhancing technological infrastructure for efficient information dissemination within the organisation are also essential steps. Furthermore, aligning innovation strategies with market demands by incorporating consumer feedback, establishing cross-functional teams, and utilising Key Performance Indicators (KPIs) for performance evaluation can significantly strengthen a firm's competitive position. Collaboration with research institutions can further provide valuable insights and resources to drive innovation. By adopting these operational strategies, managers can mitigate risks and establish a sustainable competitive advantage in the global marketplace. These measures not only enhance organisational capabilities but also ensure long-term resilience and growth in an increasingly competitive environment.

To enhance the estimation and management of intellectual capital, Thai firms in the manufacturing sector can adopt several specific measures. Firstly, implementing comprehensive training and development programmes that encompass both technical skills and personal growth can foster awareness and encourage knowledge-sharing practices. Establishing robust knowledge management systems is equally important to ensure that critical information is systematically collected and disseminated across the organisation. Additionally, forming cross-functional teams can promote a culture of collaboration and unity, enabling the creation of innovative solutions to complex challenges. Investing in research and development (R&D) is essential for identifying new technological advancements and product ideas, while partnerships with universities or research centres can provide access to cutting-edge knowledge. Encouraging intrapreneurship, where employees take ownership of innovative projects, can further drive creativity. Recognising and rewarding employees for sharing knowledge and innovative ideas can also enhance engagement and participation. Lastly, integrating advanced ICT can streamline communication channels, thereby increasing the value of intellectual assets and strengthening competitiveness.

Future research in the field of IC and innovation can build upon the current study by exploring several promising directions. Firstly, conducting empirical comparisons of the role of IC components and their relationships with innovation drivers across diverse industries—such as technology, services, and agriculture—would provide valuable insights into how these dynamics vary across different contexts. This would help identify industry-specific factors that influence the interplay between IC and innovation. Secondly, investigating time-varying relationships could shed light on how these patterns evolve as firms adapt to changing market conditions and innovation trends. Such longitudinal studies would offer a deeper understanding of the temporal dynamics of IC and innovation.

Another important avenue for future research is examining the impact of cultural factors on IC management and innovation in different global regions. Cultural nuances may significantly influence how IC is leveraged to drive innovation and competitiveness, making this a critical area for exploration. Additionally, focusing on specific types of IC, such as social and relational capital, and analysing their distinct effects on innovation could yield new insights into how these components contribute to competitive advantage. This would enrich the understanding of the multifaceted nature of IC and its role in fostering innovation.

5. Conclusion

This study examined the relationships among intellectual capital, innovation drivers, and competitiveness in the Thai manufacturing sector. The findings confirm that intellectual capital positively influences innovation drivers and indirectly enhances competitiveness through them. Additionally, innovation drivers play a significant role in improving competitiveness. The proposed causal model aligns well with the empirical data, reinforcing the resource-based perspective on value creation and competitive advantage. However, its scope is limited to the Thai manufacturing sector and a relatively small sample size. Future research should explore additional variables and consider other industries, such as Thailand's advanced professional services and commercial sectors, to enhance the model's applicability.

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References

Achim, M. V., Rus, A. I. D., & Mirza, N. (2024). How does intellectual capital spur innovation in economy? A cross-country survey. *International Entrepreneurship and Management Journal, 20*(4), 3125-3154. https://doi.org/10.1007/s11365-023-00931-9

Ali, M. A., Hussin, N., Haddad, H., Al-Araj, R., & Abed, I. A. (2021). Intellectual Capital and Innovation Performance: Systematic Literature Review. *Risks, 9*(9), 170. https://doi.org/10.3390/risks9090170

Aljuboori, Z. M., Singh, H., Haddad, H., Al-Ramahi, N. M., & Ali, M. A. (2022). Intellectual Capital and Firm Performance Correlation: The Mediation Role of Innovation Capability in Malaysian Manufacturing SMEs Perspective. *Sustainability, 14*(1), 154. https://doi.org/10.3390/su14010154

Allameh, S. M. (2018). Antecedents and consequences of intellectual capital. *Journal of Intellectual Capital, 19*(5), 858-874. https://doi.org/10.1108/JIC-05-2017-0068

Anwar, M., Khan, S. Z., & Khan, N. U. (2018). Intellectual Capital, Entrepreneurial Strategy and New Ventures Performance: Mediating Role of Competitive Advantage. *Business & Economic Review, 10*(1), 63-94. https://doi.org/10.22547/BER/10.1.3

Armstrong, J. S., & Overton, T. S. (1977). Estimating Nonresponse Bias in Mail Surveys. *Journal of Marketing Research, 14*(3), 396-402. https://doi.org/10.1177/002224377701400320

Carson, E., Ranzijn, R., Winefield, A., & Marsden, H. (2004). Intellectual capital: Mapping employee and work group attributes. *Journal of Intellectual Capital, 5*(3), 443-463. https://doi.org/10.1108/14691930410550390

Chen, A., & Chen, R. (2007). Design Patent Map: An Innovative Measure for Corporative Design Strategies. *Engineering Management Journal, 19*(3), 14-29. https://doi.org/10.1080/10429247.2007.11431737

Cui, A. S., & Wu, F. (2016). Utilizing customer knowledge in innovation: antecedents and impact of customer involvement on new product performance. *Journal of the Academy of Marketing Science, 44*(4), 516-538. https://doi.org/10.1007/s11747-015-0433-x

Dalwai, T., & Salehi, M. (2021). Business strategy, intellectual capital, firm performance, and bankruptcy risk: evidence from Oman's non-financial sector companies. *Asian Review of Accounting, 29*(3), 474-504. https://doi.org/10.1108/ARA-01-2021-0008

Ferraresi, A. A., Quandt, C. O., dos Santos, S. A., & Frega, J. R. (2012). Knowledge management and strategic orientation: leveraging innovativeness and performance. *Journal of Knowledge Management, 16*(5), 688-701. https://doi.org/10.1108/13673271211262754

Gomezelj Omerzel, D., & Smolčić Jurdana, D. (2016). The influence of intellectual capital on innovativeness and growth in tourism SMEs: empirical evidence from Slovenia and Croatia. *Economic Research-Ekonomska Istraživanja, 29*(1), 1075-1090. https://doi.org/10.1080/1331677X.2016.1211946

Hariyono, A., & Narsa, I. M. (2024). The value of intellectual capital in improving MSMEs' competitiveness, financial performance, and business sustainability. *Cogent Economics & Finance, 12*(1), 2325834. https://doi.org/10.1080/23322039.2024.2325834

Harrison, S., & Sullivan, P. H. (2000). Profiting from intellectual capital. *Journal of Intellectual Capital, 1*(1), 33-46. https://doi.org/10.1108/14691930010324124

Hartono, B., Sulistyo, S. R., Chai, K. H., & Indarti, N. (2019). Knowledge Management Maturity and Performance in a Project Environment: Moderating Roles of Firm Size and Project Complexity. *Journal of Management in Engineering, 35*(6), 04019023. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000705

Jain, S., Khan, M. N., & Mishra, S. (2017). Understanding consumer behavior regarding luxury fashion goods in India based on the theory of planned behavior. *Journal of Asia Business Studies, 11*(1), 4-21. https://doi.org/10.1108/JABS-08-2015-0118

Jardon, C. M., & Martinez-Cobas, X. (2021). Measuring intellectual capital with financial data. *PloS One, 16*(5), e0249989. https://doi.org/10.1371/journal.pone.0249989

Jordão, R. V. D., & Novas, J. C. (2024). Information and Knowledge Management, Intellectual Capital, and Sustainable Growth in Networked Small and Medium Enterprises. *Journal of the Knowledge Economy, 15*(1), 563-595. https://doi.org/10.1007/s13132-022-01043-5

Nadeem, M., Dumay, J., & Massaro, M. (2019). If You Can Measure It, You Can Manage It: A Case of Intellectual Capital. *Australian Accounting Review, 29*(2), 395-407. https://doi.org/10.1111/auar.12227

Revellino, S., & Mouritsen, J. (2024). Intellectual capital, innovation and the bushy form of knowledge capitalisation. *Journal of Management and Governance, 28*(4), 957-984. https://doi.org/10.1007/s10997-023-09691-8

Riyadi, S., & Munizu, M. (2022). The external environment dynamics analysis towards competitive advantage and company performance: the case of manufacture industry in Indonesia. *International Journal of Productivity and Quality Management, 35*(2), 143-156. https://doi.org/10.1504/ijpqm.2022.121315

Saraswati, R. S., Yadiati, W., Suharman, H., & Soemantri, R. (2024). Corporate governance, intellectual capital, and organizational culture: their influence on lean manufacturing and firm value. *Cogent Business & Management, 11*(1), 2382335. https://doi.org/10.1080/23311975.2024.2382335

Skhvediani, A., Koklina, A., Kudryavtseva, T., & Maksimenko, D. (2023). The Impact of Intellectual Capital on the Firm Performance of Russian Manufacturing Companies. *Risks, 11*(4), 76. https://doi.org/10.3390/risks11040076

Uriguen Aguirre, P. A., & Avolio Alecchi, B. E. (2023). Impact of intellectual capital on organizational performance through intrinsic motivation in higher education institutions. *Cogent Business & Management, 10*(1), 2189772. https://doi.org/10.1080/23311975.2023.2189772

Verma, R., & Jayasimha, K. R. (2014). Service delivery innovation architecture: An empirical study of antecedents and outcomes. *IIMB Management Review, 26*(2), 105-121. https://doi.org/10.1016/j.iimb.2014.03.002

Weqar, F., Khan, A. M., Raushan, M. A., & Haque, S. M. I. (2021). Measuring the Impact of Intellectual Capital on the Financial Performance of the Finance Sector of India. *Journal of the Knowledge Economy, 12*(3), 1134-1151. https://doi.org/10.1007/s13132-020-00654-0

Xu, J., Shang, Y., Yu, W., & Liu, F. (2019). Intellectual Capital, Technological Innovation and Firm Performance: Evidence from China's Manufacturing Sector. *Sustainability, 11*(19), 5328. https://doi.org/10.3390/su11195328

Xu, J., & Zhang, Y. (2021). Does Intellectual Capital Measurement Matter in Financial Performance? An Investigation of Chinese Agricultural Listed Companies. *Agronomy, 11*(9), 1872. https://doi.org/10.3390/agronomy11091872

Yaseen, S. G., Dajani, D., & Hasan, Y. (2016). The impact of intellectual capital on the competitive advantage: Applied study in Jordanian telecommunication companies. *Computers in Human Behavior, 62*, 168-175. https://doi.org/10.1016/j.chb.2016.03.075

Yitmen, I. (2011). Intellectual Capital: A Competitive Asset for Driving Innovation in Engineering Design Firms. *Engineering Management Journal, 23*(2), 3-19. https://doi.org/10.1080/10429247.2011.11431891

Zemlyak, S. V., Kiyashchenko, L. T., & Ganicheva, E. V. (2022). Driving Technological Innovation through Intellectual Capital: Industrial Revolution in the Transportation Sector. *Economies, 10*(5), 100. https://doi.org/10.3390/economies10050100

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