

Entrepreneurial Orientation and New Venture in Thailand's Railway Industry: The Moderating Role of Opportunity Recognition

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Abstract

Aim/Purpose: This study examined the relationship between entrepreneurial orientation (EO) dimensions—innovativeness, risk-taking, and proactiveness—along with opportunity recognition, and new ventures in Thailand's railway industry, which has undergone significant transformation from a state monopoly to increased private sector participation. The research aimed to understand how entrepreneurial capabilities function within a highly regulated, capital-intensive industry in an emerging market context, and how opportunity recognition potentially enhances these relationships.

Introduction/Background: Despite the importance of EO in organizational success across various industries, there is limited research on its role in highly regulated and capital-intensive sectors such as the railway industry, particularly in emerging markets like Thailand. This study addressed this gap by investigating how EO dimensions influence new venture performance in Thailand's railway industry and how opportunity recognition moderates these relationships. The railway industry presents distinctive challenges for entrepreneurship due to high entry barriers, government regulation, complex stakeholder relationships, and substantial capital requirements. These industry-specific factors create a unique context for testing the boundary conditions of entrepreneurial orientation theory and examining how entrepreneurs can succeed despite regulatory constraints.

Methodology: This quantitative study employed survey methodology, collecting data from 174 companies involved in Thailand's railway industry (43.50% response rate). Respondents included company owners, senior executives, and managers from various railway-related businesses such as infrastructure developers, equipment suppliers, operators, and logistics service providers. The questionnaire used 5-point Likert scale items to measure EO dimensions (innovativeness, risk-taking, proactiveness), opportunity recognition, and new venture performance. The research model was tested using SmartPLS 4.0 to analyze factor loadings, reliability, validity, and hypothesis testing, with appropriate model fit indices (SRMR = .071, Chi-square = 387.002, NFI = .800) confirming the model's validity.

Findings: The results showed that all three dimensions of EO positively influenced new venture performance in Thailand's railway industry, with varying effect sizes. Proactiveness demonstrated the strongest direct effect ($\beta = .643, p < .010$), followed by risk-taking ($\beta = .322, p < .001$) and innovativeness ($\beta = .001, p < .001$). More importantly, opportunity recognition positively moderated the relationships between innovativeness and new venture performance ($\beta = .702, p < .001$) and between risk-taking and new venture performance ($\beta = .669, p < .004$). However, opportunity recognition did not significantly moderate the relationship between proactiveness and new venture performance ($\beta = .513, p = .073$). Interaction analyses revealed that innovativeness and risk-taking primarily enhanced performance when coupled with strong opportunity recognition capabilities, while proactiveness created benefits regardless of opportunity recognition levels. The control variables of company age and size also showed small but significant positive effects on new venture performance ($\beta = .089, p < .05$ and $\beta = .104, p < .05$, respectively).

Contribution/Impact on Society: This study advances understanding of EO and opportunity recognition in regulated industries within emerging markets. It demonstrates how companies can leverage entrepreneurial capabilities despite regulatory constraints, particularly in sectors with significant government involvement. The findings highlight the importance of opportunity recognition as a strategic capability that enhances the effectiveness of entrepreneurial approaches, especially for innovation and risk management in regulated contexts. By identifying which entrepreneurial dimensions benefit most from strong opportunity recognition, the study provides a more nuanced understanding of entrepreneurship in complex regulatory environments. This contributes to both theory development and practical guidance for entrepreneurs in infrastructure sectors undergoing regulatory transition.

Recommendations: For entrepreneurs entering or operating in Thailand's railway industry, developing robust opportunity recognition capabilities is crucial for enhancing innovation outcomes and effectively managing risks. Companies should establish systematic processes for monitoring changes in market demands, technological environments, economic conditions, and regulatory frameworks. These opportunity recognition processes should be particularly connected to innovation and risk management functions, while recognizing that proactive approaches may derive value primarily through execution advantages rather than superior opportunity identification. For policymakers, the study suggests that regulatory frameworks should be designed to create "entrepreneurial space" within necessary safety and operational regulations, potentially through regulatory sandboxes that allow controlled experimentation with new technologies and business models. Industry associations should facilitate knowledge sharing about successful entrepreneurial approaches within regulatory boundaries.

Research Limitations: The study's focus on Thailand's railway sector may limit generalizability to other emerging markets or regulated industries. The reliance on self-reported data from single respondents within each company may introduce common method bias. Additionally, the cross-sectional design limits causal inferences about the relationships examined. The unusually small coefficient for innovativeness requires careful interpretation, though its strong interaction effect suggests its impact primarily manifests through opportunity recognition.

Future Research: Future studies could extend this framework through comparative analyses across different emerging markets or transportation sectors, employ longitudinal designs to examine how entrepreneurial orientation evolves over time in regulated environments, or explore potential negative consequences of entrepreneurial approaches in safety-critical sectors. Research could also investigate the organizational mechanisms that enable effective opportunity recognition in highly regulated contexts and examine how different types of regulations (safety standards, market entry requirements, pricing controls) differentially impact EO dimensions. As digital transformation continues to affect the railway industry, studies could explore how technological disruption creates new entrepreneurial opportunities within regulatory frameworks.

Keywords: *Entrepreneurial orientation, opportunity recognition, railway industry, Thailand*

Introduction

Entrepreneurial Orientation (EO), which consists of Innovativeness, Risk-Taking, and Proactiveness, is widely recognized as a key factor affecting organizational success across various industries (Covin & Wales, 2019; Lumpkin & Dess, 2001). However, the role of EO in the specific context of the growing railway industry has not been extensively studied. This industry has distinctive characteristics such as high entry barriers, government regulation, complex relationships with stakeholders, and substantial capital requirements, all of which may affect opportunity recognition and the success of new ventures. These industry-specific factors create a challenging environment that may require reconsidering and adapting traditional entrepreneurship theories.

Previous research has indicated that companies with an EO are better positioned to identify and exploit new opportunities, even in heavily regulated industries. For example, a research study focusing on the renewable energy industry in Indonesia found positive effects on project performance, enabling companies to navigate regulatory complexities and leverage creative solutions (Firman et al., 2018). Similarly, companies with entrepreneurial mindsets in the railway industry can drive innovation and create new business models, overcome market entry barriers, and achieve competitive advantages (Hranický et al., 2019). In emerging markets, EO can also impact new ventures through opportunity exploitation (Anwar et al., 2022; Saleh & Athari, 2023).

However, the role of EO in transforming regulated industries, such as Thailand's railway sector, remains underexplored. This research gap is particularly significant given that Thailand's railway industry is currently experiencing unprecedented transformation through government modernization initiatives worth over 1.9 trillion baht, designed to position Thailand as a regional transportation hub within the ASEAN Economic Community (Board of Investment of Thailand, 2024). The industry presents unique challenges for entrepreneurship and may require reconsidering traditional entrepreneurship theories, as research has demonstrated that costly regulations significantly hamper new firm creation (Klapper et al., 2006).

To address these gaps, this study aimed to: (1) examine the influence of entrepreneurial orientation dimensions (innovativeness, risk-taking, and proactiveness) on new venture performance in Thailand's railway industry, (2) investigate the moderating role of opportunity recognition on the relationships between EO dimensions and new venture performance in a regulated industry context, and (3) extend the Resource-Based View theory to infrastructure-intensive, regulated sectors in emerging markets, particularly regarding how entrepreneurial capabilities function as strategic resources under regulatory constraints.

This study contributes to both theory and practice in several ways. Theoretically, this study extends the understanding of EO and opportunity recognition in the context of transforming industries in emerging markets, especially in sectors with significant regulatory oversight and government involvement. The research extends the application of the Resource-Based View to explain how entrepreneurial capabilities function as valuable, rare, inimitable, and non-substitutable resources in regulated environments. By identifying which entrepreneurial dimensions benefit most from strong opportunity recognition, the study provides a more nuanced understanding of entrepreneurship in complex regulatory environments.

Practically, this research provides timely insights for entrepreneurs and policymakers involved in developing Thailand's railway industry during this critical transformation period. The findings offer guidance on utilizing EO capabilities to discover and exploit opportunities in a developing sector characterized by regulatory complexity and substantial capital requirements. Given similar railway development initiatives across Southeast Asia and other emerging markets, the insights have broader regional relevance for infrastructure development and entrepreneurship policy.

The urgency of this research is underscored by the current momentum in Thailand's railway development, where understanding how entrepreneurial approaches can succeed within regulatory frameworks is essential for maximizing the economic benefits of infrastructure investments and ensuring successful private sector participation in traditionally state-dominated sectors.

Literature Review

Theoretical Framework: Resource-Based View

The Resource-Based View (RBV) serves as the theoretical foundation for this study, offering a framework for understanding how companies create and maintain competitive advantage through unique resource configurations (Barney, 2001). In the context of Thailand's railway industry transformation, RBV explains how entrepreneurially oriented companies differentiate themselves as the market evolves from a state monopoly to increased private sector participation. According to this theory, sustainable competitive advantage stems from resources and capabilities that are Valuable, Rare, Inimitable, and Non-substitutable (VRIN).

Critical VRIN resources include specialized technical knowledge, regulatory expertise, stakeholder relationship networks, and system integration capabilities. These resources are significant given the industry's high market entry barriers and substantial resource requirements. Successful railway ventures require substantial financial capital and specialized human capital with industry-specific technical knowledge and regulatory expertise. The ability to navigate complex regulations and build relationships with multiple stakeholders represents intangible resources that align with RBV's emphasis on non-substitutable capabilities.

Recent extensions of RBV emphasize dynamic capabilities—the ability to reconfigure resources in rapidly changing environments (Teece et al., 1997; Eisenhardt & Martin, 2000). This dynamic perspective is especially relevant to Thailand's developing railway industry, where companies must continuously adapt to technological advances, regulatory changes, and evolving market demands. Opportunity recognition functions as a key dynamic capability that enables firms to sense, seize, and reconfigure resources in response to environmental changes. In this theoretical framework, entrepreneurial orientation dimensions can be conceptualized as dynamic capabilities that enable firms to identify and capitalize on opportunities despite regulatory constraints, while opportunity recognition serves as the sensing mechanism that activates and directs these capabilities.

Thailand's Railway Industry Context

Thailand's railway industry represents a critical component of the country's transportation infrastructure, with approximately 4,845 kilometers of track covering 47 provinces. The State Railway of Thailand has traditionally managed this network, but the industry has faced significant challenges, including aging infrastructure, declining passenger numbers, and operational inefficiencies. The government has initiated comprehensive railway improvement projects to modernize the system and enhance its competitiveness (Ministry of Transport, 2019). Key development initiatives include double-tracking main routes to increase capacity and efficiency, developing high-speed railway systems such as the Bangkok-Nakhon Ratchasima route (part of a network connecting to China through Laos), and expanding urban mass transit systems in Bangkok to improve inner-city connectivity and reduce congestion. These projects aim to transform Thailand into a regional transportation hub, supporting economic growth and urban mobility (Buthphorm et al., 2024).

Despite these advances, the industry faces funding limitations, technological challenges, and implementation delays. The government has established a transport infrastructure investment framework to address these issues, exploring various public-private partnership models to attract private investment. This evolving landscape creates challenges and opportunities for entrepreneurial companies seeking to enter or expand within the railway sector.

New Ventures in Regulated Industries

Operating new ventures in regulated industries, particularly in the railway sector, represents a distinct challenge compared to general markets. Adomako and Danso (2014) found that businesses in regulated environments face unique performance constraints and must consider factors beyond financial indicators, including operational efficiency and stakeholder satisfaction. Performance assessment in regulated industries often incorporates compliance-based indicators, creating specific challenges for entrepreneurs attempting to balance commercial success with regulatory requirements (Guo et al., 2014; Rahman et al., 2020). The regulated nature of the industry means that entrepreneurs must navigate complex regulatory frameworks while pursuing innovation and growth, creating a unique context for studying EO and new venture performance.

Entrepreneurial Orientation and New Ventures

Entrepreneurial Orientation (EO) represents a firm's strategic approach to introducing new production processes, developing new products, or producing existing products in new ways (Lumpkin & Dess, 1996). Following Miller (1983) and Covin and Slevin (1989), this study conceptualizes EO through innovativeness, risk-taking, and proactiveness. Previous research has established that

companies with strong entrepreneurial orientation tend to achieve better profitability, growth performance, and market success, though environmental and industry-specific factors often moderate these relationships.

EO plays a crucial role for new ventures throughout the business lifecycle—from initial market entry and opportunity identification to establishing competitive positions and developing sustainable advantages. This is particularly challenging when resources are limited, and market uncertainty is high, requiring entrepreneurs to balance different EO dimensions to align with market conditions and organizational capabilities (Covin & Lumpkin, 2011; Covin & Wales, 2019; Dayan et al., 2023). In the railway industry context, each EO dimension is manifested in distinct ways.

Innovativeness represents a company's creative process and experimentation approach, leading to new products, services, or technological solutions. In the railway industry, innovation may involve developing new maintenance methods, implementing advanced signaling systems, creating novel security approaches, or introducing innovative passenger experience models and pricing structures.

Risk-taking involves committing significant resources to opportunities with uncertain outcomes. This dimension is particularly critical given the capital-intensive nature of the railway industry and the long payback periods typical of infrastructure investments. Railway entrepreneurs must evaluate complex risk factors, including regulatory changes, technological obsolescence, and market demand uncertainties.

Proactiveness reflects a company's tendency to anticipate and act on future needs and opportunities before competitors. In the railway industry, proactive companies position themselves strategically for coming market developments, rapidly adopt emerging technologies, and respond anticipatorily to regulatory changes and market trends.

Research has shown that companies with potent EO can better navigate complex regulatory environments while identifying and exploiting market opportunities (Wales et al., 2020). EO helps companies develop and maintain competitive advantages through continuous innovation (Rauch et al., 2009) and responsive market adaptation. Proactive approaches enable companies to establish strong market positions before competition intensifies (Covin & Slevin, 1989).

Based on these theoretical foundations, this study proposes that despite regulatory constraints and industry-specific challenges, railway companies with entrepreneurial mindsets will achieve superior performance through enhanced innovation capabilities, prudent risk-taking, and proactive operations within the industry's regulatory framework. This leads to the following hypotheses:

Hypothesis 1: Innovativeness positively correlates with new venture performance in Thailand's railway industry.

Hypothesis 2: Risk-taking positively relates to new venture performance in Thailand's railway industry.

Hypothesis 3: Proactiveness positively correlates with new venture performance in Thailand's railway industry.

Entrepreneurial Orientation, Opportunity Recognition, and New Venture

Opportunity Recognition is a critical capability for entrepreneurial success, enabling entrepreneurs to identify and capitalize on market gaps and potential value-creation channels. Entrepreneurial opportunities encourage entrepreneurs to allocate sufficient capabilities to respond to market conditions and achieve sustainable business growth (Patel, 2019). Effective opportunity recognition requires experience and expertise, enabling entrepreneurs to comprehensively track, observe, and explore markets to create, deliver, and respond to customer needs and perceptions (Lim et al., 2023; Makhoulfi et al., 2024).

Opportunity recognition is a key driver in identifying valuable capabilities essential for creating unique competitive advantages through entrepreneurial market leverage (Teece, 2016). Kim et al. (2018) noted that capable entrepreneurs understand profitable opportunities, which is fundamental for business survival and growth. Tshiaba et al. (2021) found that entrepreneurial opportunity

recognition helps entrepreneurs track market demands, product positioning, and delivered value, significantly influencing sustainable performance.

Within the RBV framework, opportunity recognition represents a sophisticated dynamic capability that enables firms to sense environmental changes and reconfigure resources accordingly (Teece, 2016). This capability becomes particularly crucial in regulated industries, where traditional market signals may be distorted by government intervention, and where regulatory changes can rapidly create or eliminate business opportunities. In Thailand's railway context, opportunity recognition involves monitoring changes in government policy, technological developments, regional connectivity initiatives, and evolving customer expectations.

This capability enables companies to adapt and respond to market needs through creative resource integration to deliver superior and unique value (Clark & Ramachandran, 2019). Makhloufi et al. (2024) demonstrated that opportunity recognition enhances entrepreneurs' capability to drive business growth, serving as an essential moderator in the relationship between entrepreneurial capabilities and business outcomes. The relationship between opportunity recognition and EO dimensions is multifaceted.

Innovativeness and Opportunity Recognition: Innovative companies are better positioned to apply emerging technologies in the railway industry. For example, innovation-oriented firms may recognize opportunities to implement predictive maintenance systems using IoT sensors or develop new passenger service models through digital platforms (Tang et al., 2012). These companies can identify service gaps and operational inefficiencies as potential business opportunities, particularly relevant in Thailand's railway sector, where new technologies and changing customer expectations are challenging traditional models (Donbesuur et al., 2020).

Risk-taking and Opportunity Recognition: Opportunity recognition plays a crucial role in risk management within the railway industry. Companies with high-risk tolerance are more likely to explore untested market segments and consider opportunities others might avoid due to uncertainty. This is especially important in emerging markets like Thailand, where the railway sector is undergoing significant transformation. Firms with strong opportunity recognition capabilities can better evaluate potential returns relative to regulatory and market risks (Kuckertz et al., 2016).

Proactiveness and Opportunity Recognition: Proactiveness enables companies to anticipate future market demands and identify emerging opportunities before competitors. Proactive companies are better positioned in the railway industry to recognize opportunities arising from policy changes, technological advancements, and evolving market dynamics. For example, proactive firms may identify opportunities such as clean energy transportation solutions or integrated mobility services before these become mainstream market demands (Wales et al., 2020).

The moderating effect of opportunity recognition may vary across different dimensions of entrepreneurial orientation. For innovation, a high opportunity recognition capability can help companies identify which innovative solutions are likely to succeed in the market. For risk-taking, effective opportunity recognition enhances risk assessment and return evaluation, resulting in more informed strategic decisions. For proactiveness, opportunity recognition capability enhances the timing and targeting of initiatives to align with emerging market opportunities.

Empirical evidence from related industries supports these moderated relationships. Tang et al. (2012) found that companies with high opportunity recognition capabilities can better translate their entrepreneurial approaches into superior performance. Similarly, Guo et al. (2014) demonstrated that the effectiveness of strategic approaches in regulated industries significantly depends on a company's ability to recognize and evaluate opportunities within the regulatory context.

Based on these theoretical foundations and empirical evidence, this study proposes the following hypotheses:

Hypothesis 4: Opportunity recognition positively moderates the relationship between innovativeness and new venture performance, such that the relationship is stronger when opportunity recognition is high.

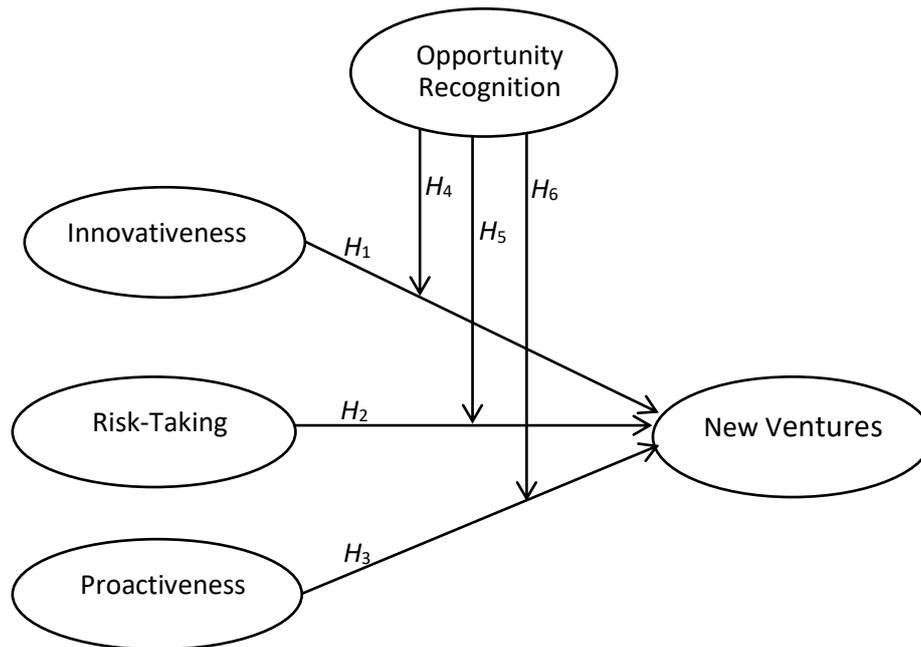
Hypothesis 5: Opportunity recognition positively moderates the relationship between risk-taking and new venture performance, such that the relationship is stronger when opportunity recognition is high.

Hypothesis 6: Opportunity recognition positively moderates the relationship between proactiveness and new venture performance, such that the relationship is stronger when opportunity recognition is high.

Research Framework

The study's conceptual framework is shown in Figure 1 below.

Figure 1 Conceptual Framework of the Research



Methodology

Sample Group

This study employed a quantitative research approach using cross-sectional survey methodology to examine relationships between entrepreneurial orientation dimensions, opportunity recognition, and new venture performance in Thailand's railway industry. A cross-sectional design was selected over a longitudinal approach due to the practical constraints of data collection in the highly regulated railway sector and the need to capture relationships at a specific point during Thailand's railway transformation period. The target population comprised companies involved in Thailand's railway industry, including both private firms and public-private partnerships operating within the railway ecosystem. Based on government registrations and industry association memberships, approximately 400 companies were identified as actively engaged in railway-related business activities.

A stratified purposive sampling approach was employed to ensure representation across different railway industry segments, including railway infrastructure developers and maintainers, railway equipment suppliers, railway operators, railway logistics service providers, railway technology and signaling companies, and railway consultancy and engineering firms. From the total population of 400 companies, questionnaires were distributed to all identified firms through electronic (email) and physical delivery methods. The final sample consisted of 174 companies, representing 43.5% of the total population. This response rate compares favorably with similar studies in business-to-business research contexts (Baruch & Holtom, 2008).

To minimize non-response bias, early and late respondents were compared across key variables, with no significant differences identified. Since EO studies require insights from decision-makers,

respondents included owners (17.82%), senior executives (47.13%), and departmental managers (35.06%). The detailed demographic characteristics of the sample are presented in Table 1.

Table 1 Demographic Profile of the Respondents

Characteristics	Category	Frequency	Percent
Owners/Managers	Owner	31	17.81
	Senior executive	82	47.13
	Manager	61	35.06
	Total	174	100.00
Nature of Company	Railway infrastructure developer/maintainer	29	16.67
	Railway equipment supply	40	22.99
	Railway operator	5	2.87
	Railway logistics service provider	17	9.77
	Railway technology and signaling	24	13.79
	Railway consultancy and engineering	38	21.84
	Others	21	12.07
Total	174	100.00	
Period of Operation	Less than three years	42	24.14
	3 to 6 years	56	32.18
	7 to 10 years	36	20.69
	10 years or more	40	22.99
Total	174	100.00	
Size of Firm	10–50 employees	96	55.17
	51–200 employees	45	25.86
	More than 200 employees	33	18.97
Total	174	100.00	

Tools and Measurement Methods

Questionnaires were the research tool used to collect data from the sample group. The questions were referenced from previous studies (Existing Scales). Since the referenced questions were in English, the researchers translated them into Thai and verified their accuracy through Double-blind back-translation (Sinaiko & Brislin, 1973). Additionally, the Thai language was adjusted to make it easier for respondents to understand. The referenced questions on applied innovation were adapted from studies on EO, including new ventures adapted from Anwar et al. (2022), innovation creation, risk-taking, and proactive implementation used in previous studies (Covin & Slevin, 1989; Shirokova et al., 2016). The measurement of opportunity perception was derived from a study by Guo et al. (2016). All questions asked for respondents' opinions using a 5-point Likert scale (1 = Strongly Disagree and 5 = Strongly Agree).

Content validity was confirmed through expert review by three investment and logistics specialists, with all Index of Item Objective Congruence values exceeding .50. A pilot study with 30 participants from similar companies established reliability, with all Cronbach's alpha coefficients exceeding .70 (Nunnally & Bernstein, 1994).

This study's cross-sectional design and self-reported data could be prone to common method bias (CMB). To address this, the researchers followed Podsakoff et al. (2003) by using different measurement anchors and assuring respondent anonymity. CMB was further assessed using Harman's single-factor test (Podsakoff & Organ, 1986), which showed the first factor accounted for 48% of the total variance, which was below the 50% threshold, and indicated no substantial evidence of CMB.

Structural Equation Modeling (SEM) using Partial Least Squares (PLS) was selected as the primary analytical method using SmartPLS 4.0 software. PLS-SEM was chosen over covariance-based SEM due to its superior performance with smaller samples, suitability for exploratory research extending existing theory to new contexts, robustness to non-normal data distributions, and capability to handle model complexity, including moderation analysis (Hair et al., 2022). The analysis procedure included

measurement model assessment (factor loadings, internal consistency reliability, convergent and discriminant validity), structural model evaluation (model fit indices, path coefficients, significance testing), moderation analysis using established PLS-SEM procedures, and robustness testing through bootstrap resampling with 5,000 iterations for confidence interval estimation (Hair et al., 2022).

Results

In this study, the researchers used SmartPLS 4.0 to test the model fit, model consistency, and the hypotheses. Table 2 presents the descriptive statistics, factor loadings, reliability measures, and validity indicators. All factor loadings exceeded the minimum threshold of .40 (Hair et al., 2005), ranging from .718 to .883, indicating that observed variables adequately reflect their respective constructs. Internal consistency reliability was confirmed through multiple indicators. Cronbach's alpha coefficients ranged from .758 to .895, exceeding the .70 threshold (Nunnally & Bernstein, 1994). Composite reliability (CR) values ranged from .770 to .908, further confirming internal consistency. Average Variance Extracted (AVE) values ranged from .523 to .731, surpassing the .50 minimum requirement (Fornell & Larcker, 1981).

The variance inflation factor (VIF) results showed that the VIF values of the indicators ranged from 1.66 to 2.40, and the error values ranged from .42 to .60. Therefore, all variables were within acceptable threshold levels (VIF < 3.3, error value > .20) as recommended by Hair et al. (2011), indicating that there was no problem of multicollinearity among independent variables affecting the dependent variable.

Table 2 Cronbach's Alpha, Factor Loading, Composite Reliability, and Average Variance Extracted

Items	Factor Loading	CR	AVE
New Venture Cronbach's Alpha = .771			
1. Return on investment	.861		
2. Return on assets	.842	.793	.523
3. Return on equity	.718		
4. Sale growth	.857		
Opportunity Recognition Cronbach's Alpha = .877			
1. Identifying opportunities from customer demand changes	.833		
2. Identifying opportunities from technological changes	.883	.908	.674
3. Identifying opportunities from economic changes	.867		
4. Searching and identifying opportunities from changes in the political environment	.743		
Entrepreneurial Orientation			
Innovativeness Cronbach's Alpha = .758			
1. Focus on research & development, technology, innovation	.871		
2. Having new products or services in the past 5 years	.828	.770	.537
3. Clear changes in product lines or services	.781		
Risk-taking Cronbach's Alpha = .895			
1. Investing in high-risk projects	.866		
2. Taking actions to achieve company objectives	.883	.866	.731
3. Making uncertain decisions to increase business opportunities	.739		
Proactiveness Cronbach's Alpha = .807			
1. Initiating new activities before competitors	.847		
2. Introducing new products/services, management techniques, operational technologies, etc.	.861	.798	.593
3. Taking actions to outperform competitors	.856		

Table 3 Mean, Reliability, Standard Deviation, and Correlation Values Variables

Variables	Mean	SD	1	2	3	4	5
1. New Venture	4.397	.976	.500**				
2. Opportunity Recognition	4.550	.903	.101**	.692**			
3. Innovativeness	3.658	1.295	.091**	.031*	.393**		
4. Risk-taking	4.987	.982	.568**	.532**	.659**	.805*	
5. Proactiveness	4.094	.895	.672**	.479**	.517**	.731*	.655**

Note. From a sample of 174 samples, SD = Standard Deviation ** p -value < .01; * p -value < .05

Table 3 presents the correlation matrix, means, and standard deviations for all study variables, providing initial support for the hypothesized relationships. The correlation analysis showed that new venture performance demonstrated positive correlations with all entrepreneurial orientation dimensions: innovativeness ($r = .091, p < .01$), risk-taking ($r = .568, p < .01$), and proactiveness ($r = .672, p < .01$). Opportunity recognition showed significant positive correlations with new venture performance ($r = .101, p < .01$) and all EO dimensions, while inter-construct correlations among EO dimensions ranged from moderate to strong (.500 to .731), suggesting related but distinct constructs. The relatively modest correlation between innovativeness and new venture performance ($r = .091$) suggests that innovation alone may not directly translate to performance benefits, potentially requiring moderating conditions such as opportunity recognition for effective implementation.

Structural Model and Hypothesis Testing

The structural model evaluation began with assessing model fit indices, which indicated appropriate fit with empirical data (SRMR = .071, Chi-square = 387.002, NFI = .800). These values met the established thresholds for acceptable model fit in PLS-SEM analysis, which is considered satisfactory given the model's complexity and industry context (Sathyanarayana & Mohanasundaram, 2024).

To test Hypotheses 1, 2, and 3, the direct relationships between EO dimensions and new venture performance were examined. The analysis revealed that all three dimensions—innovativeness ($\beta = .298, p < .001$), risk-taking ($\beta = .322, p < .001$), and proactiveness ($\beta = .643, p < .010$)—had statistically significant positive effects on new venture performance. These findings supported Hypotheses 1, 2, and 3, confirming that EO dimensions positively influence new venture performance in Thailand's railway industry despite its highly regulated nature.

Hypotheses 4, 5, and 6 examined the moderating role of opportunity recognition in the relationship between EO dimensions and new venture performance. The interaction analysis results (Table 4) showed that opportunity recognition significantly moderated relationships between innovativeness and new venture performance ($\beta = .702, p < .001$), and risk-taking and new venture performance ($\beta = .669, p < .004$). However, the moderating effect of opportunity recognition on the relationship between proactiveness and new venture performance was not statistically significant ($\beta = .513, p = .073$). Therefore, Hypotheses 4 and 5 were supported, while Hypothesis 6 was not supported.

Table 4 Structural Model Results and Hypothesis Testing

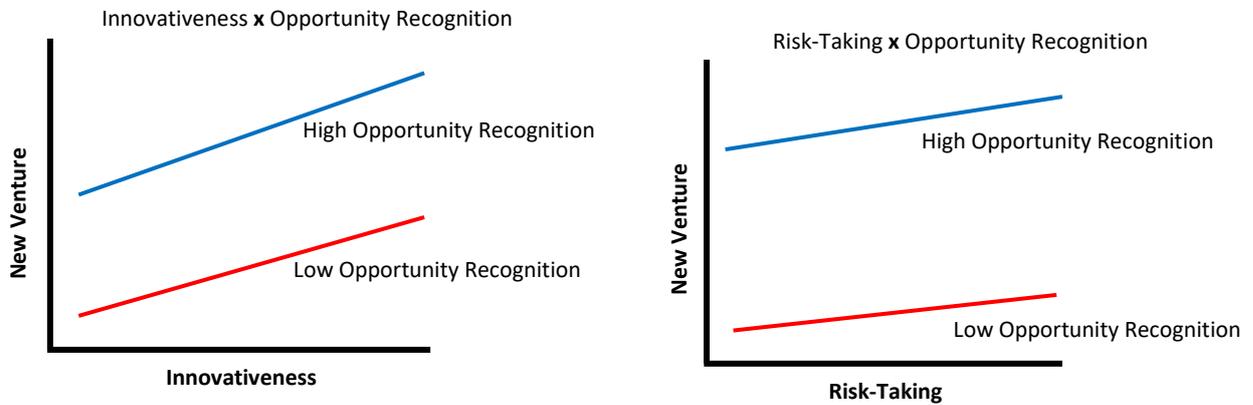
Hypothesis	Relationship	β	S.E.	p -value	Results
H_1	Innovativeness → new ventures	.298	.087	.001***	Supported
H_2	Risk-taking → new ventures	.322	.104	.001***	Supported
H_3	Proactiveness → new venture	.643	.101	.010**	Supported
H_4	Innovativeness x opportunity recognition → new ventures	.702	.080	.001***	Supported
H_5	Risk-taking x opportunity recognition → new ventures	.669	.122	.004**	Supported
H_6	Proactiveness x opportunity recognition → new ventures	.513	.112	.073	Not Supported

Note. Statistical significance levels: *** p value < .001; ** p value < .01.

Moderating Effects Analysis

To provide a more nuanced understanding of the significant moderating effects, interaction plots were created following Aiken and West's (1991) approach. This involved calculating conditional effects at different levels of opportunity recognition (mean \pm one standard deviation) and graphically representing these interactions, which are shown in Figure 2.

Figure 2 Interaction Effects of Opportunity Recognition



The interaction graphs in Figure 2 show how opportunity recognition moderates the relationships between entrepreneurial orientation dimensions and new venture performance. For Innovativeness (left graph), the slope was steeper when opportunity recognition is high (+1 SD) compared to low (-1 SD), indicating a stronger positive effect of innovativeness on new venture performance when opportunity recognition was well-developed. For Risk-taking (right graph), the slope was also steeper under high opportunity recognition, though the difference was less pronounced.

Comparing the two interaction effects, the innovativeness graph showed a more substantial difference between high and low opportunity recognition conditions, suggesting that opportunity recognition enhances the innovativeness-performance relationship more than the risk-taking-performance relationship. This implies that companies with strong opportunity recognition capabilities can especially benefit from their innovative activities, as they are better positioned to identify innovations that align with market needs and regulatory requirements in Thailand's railway industry.

The non-significant moderating effect for proactiveness (Hypothesis 6) indicated that the relationship between proactive behavior and new venture performance remains largely unchanged regardless of opportunity recognition levels. This finding may reflect the unique characteristics of Thailand's railway industry, where regulatory frameworks and government planning may limit the impact of proactive market initiatives, even with strong opportunity recognition.

Discussion and Conclusion

This research has generated new insights into the role of EO and opportunity recognition in the context of the regulated railway industry, particularly in emerging markets such as Thailand. The findings showed that innovativeness, risk-taking, and proactiveness—dimensions of entrepreneurial orientation—have positive relationships with new ventures. This is consistent with previous research by Wales et al. (2020), which found that EO is a key factor for success in regulated industries, and the study by Yu et al. (2023), which indicated that the three dimensions of EO affected the ability to make new innovative investments. These three dimensions contribute to investment success in emerging markets, where companies have utilized the benefits of monitoring technological changes and customers' needs to seize new opportunities (Anim et al., 2024).

In the context of Thailand's railway industry, these findings are significant as they demonstrate that opportunity recognition facilitates new ventures despite regulatory limitations and infrastructure challenges. This aligns with Wang et al. (2017), who found that new ventures with entrepreneurial

orientation—expressed through innovative decision-making, risk-taking, and proactive behaviors—can achieve superior performance if companies understand and follow regulations and stakeholder norms. Similarly, Guo et al. (2017) emphasized the importance of integrating strategic capabilities and opportunity recognition in regulated industries. Companies with strong opportunity recognition capabilities promote EO in innovation and are more likely to make new ventures. The research found that opportunity recognition helps entrepreneurs use resources creatively, consistent with Kuckertz et al. (2016), who emphasized the importance of opportunity recognition in managing risk in regulated industries. This research shows that companies which can efficiently identify and evaluate opportunities can better leverage their innovation capabilities and risk acceptance under regulatory constraints.

However, this research found that opportunity recognition did not moderate the relationship between proactiveness and new ventures, which may be explained by the specific characteristics of the railway industry. As Porter and Kramer (2011) have noted, companies, especially in heavily regulated industries, must integrate social and regulatory expectations into their core strategic activities. Therefore, proactive actions may be limited by regulatory frameworks, rules, and legal requirements, reducing the influence of opportunity recognition on the outcomes of proactive actions. The findings also align with Shin's (2024) study of the U.S. railway freight industry, which indicated that regulations affect competitive operations and long-term efficiency improvement in the railway transport sector. Thus, this research expands understanding of the relationship between EO and opportunity recognition in the context of regulated industries in emerging markets, particularly the findings about the different moderating roles of opportunity recognition on all three dimensions of entrepreneurial orientation.

From a theoretical perspective, the findings demonstrated that entrepreneurial capabilities function as valuable strategic resources in regulated industries, but their effectiveness depends on complementary capabilities such as opportunity recognition. This extends RBV theory by showing that resource value is contingent on sensing and deployment capabilities, particularly in institutionally constrained environments. The results supported conceptualizing opportunity recognition as a dynamic capability that enhances the effectiveness of other strategic resources (Teece, 2016). The differential moderating effects across EO dimensions suggest that sensing capabilities interact differently with various types of strategic resources, providing nuanced insights into dynamic capability theory.

This study revealed that regulatory constraints reshape, rather than eliminate, entrepreneurial opportunities, requiring different capability combinations for value creation in regulated environments. Railway entrepreneurs should develop systematic processes to monitor regulatory, technological, and market changes, while prioritizing proactive strategies that deliver the most direct performance benefits, combining innovation with strong market sensing to ensure regulatory compliance and market alignment, and leveraging opportunity recognition to guide, rather than avoid, risk assessment. Policymakers should create entrepreneurial space within regulatory frameworks through innovation sandboxes and pilot programs, provide clear regulatory roadmaps to help entrepreneurs anticipate policy changes, facilitate knowledge sharing about successful approaches within regulatory boundaries, and design procurement processes that reward entrepreneurial innovation while maintaining safety and quality standards.

Limitations and Future Research

This study focused on Thailand's railway sector, limiting the generalizability of the findings to other emerging markets or regulated industries. Future research could expand this framework through comparative studies across different markets or transportation sectors (Donbesuur et al., 2020). The reliance on self-reported data from a single respondent per company raises concerns of common method bias. Future studies could enhance validity by using data from multiple sources and more objective measures (Tang et al., 2012). Additionally, the study did not address the risks of entrepreneurial approaches in regulated industries, particularly in safety-critical sectors. Future

research could investigate both the positive and negative consequences of entrepreneurial orientations in strictly regulated contexts (Covin & Wales, 2019).

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