

Engineers Turned Entrepreneurs: Unlocking Talent Retention through Entrepreneurial Orientation

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DOI: <https://dx.doi.org/10.47772/IJRISS.2025.9010155>

Received: 30 December 2024; Accepted: 03 January 2025; Published: 08 February 2025

ABSTRACT

The dual role of engineers as entrepreneurs is rarely utilized, often leading to inadequate in-house entrepreneurial orientation (EO) activities. This oversight hampers the development of potential entrepreneurs needed to drive organizational advancements in high technology and innovation. Rapid technological changes have reshaped engineers' career expectations, emphasizing the need for enhanced skills and broader competencies to meet evolving industry demands. A decline in individual-level EO has been linked to engineers' increased intention to leave their current roles. The objectives of this study are to investigate the role of engineers as entrepreneurs and to develop a conceptual framework that elucidates the relationship between individual dimensions of EO dimensions including innovativeness, proactiveness, autonomy, and risk-taking, and talent retention among engineers. This quantitative study adopts purposive sampling methods among manufacturing engineers located in Southern Region of Malaysia. The data will be analyzed using PLS-SEM approach with Smarts. The findings highlight that engineers' entrepreneurial roles are crucial for addressing engineering challenges, with these dual roles enhancing both technical and non-technical skills. Strong evidence supports using individual EO dimensions to assess engineers' entrepreneurial behaviors and predict positive intentions to remain employed. Understanding these behaviors is essential for boosting career satisfaction and retention, thereby fostering organizational innovation and growth.

Keywords: Entrepreneurial orientation, engineers, entrepreneurs, retention, talent

INTRODUCTION

The term entrepreneur in the context of engineers highlights their role in driving organizational profitability by fostering in-house entrepreneurial activities (Fortes, Tenera, & Cunha, 2023; Kharbanda & Stallworthy, 1990; McDonnell & O'Neill, 2009; Menzel, Aaltio & Ulijn, 2007; Tremblay, Wils, & Proulx, 2002). The term entrepreneur typically describes an individual who engages in independent entrepreneurial activities. In the organizational context, this definition expands to include engineers practicing entrepreneurial behaviors while contributing to their technical roles (Sahoo & Panda, 2019). Entrepreneurs are characterized by their ability to take initiative, assume responsibility, manage risks, seize opportunities, remain committed to their tasks, work independently, and proactively develop innovative ideas (Satar & Natasha, 2019).

This role requires engineers to exhibit unique behaviors and attitudes such as creativity, innovativeness, and proactiveness, critical factors influencing their positive behavioral intentions toward remaining in current employment (Fortes et al., 2023; Kharbanda & Stallworthy, 1990; McDonnell & O'Neill, 2009; Menzel et al., 2007; Tremblay et al., 2002). A crucial link exists between these behaviors and employment expectations, forming the foundation for internal entrepreneurial development while sustaining autonomy and innovation within the organization (Fortes et al., 2023).

However, limited research explores the dual role of engineers as entrepreneurs, particularly regarding its relationship with behavioral intentions (Menzel et al., 2007; Williamson, Lounsbury, & Han, 2013). Discussions in this area are often fragmented, with current efforts to leverage the engineer-entrepreneur potential seen as temporary measures within strategic human resource planning. The organizational long-term focus lies in

determining whether aligning engineers-entrepreneur dual roles is useful for predicting their tenure in specific roles.

Previous studies on this dual role have primarily focused on engineering performance, career satisfaction, and entrepreneurial intentions (Ramayah, Lo, Amri & Noor, 2011). Scholars such as Fortes et al. (2023) have concluded that engineers possess significant entrepreneurial potential. Despite extensive discussions on entrepreneurial roles, much of the debate remains limited to career management and entrepreneurial intentions, without fully integrating entrepreneurial orientation (EO) theory into analyses of retention decisions (Hazeen Fathima & Umarani, 2023).

EO theory provides a framework for understanding entrepreneurial behaviors, yet its application to engineers' retention and satisfaction remains under-explored. Low correlations between entrepreneurial behaviors and retention (e.g., intention to stay or leave) have further discouraged deeper investigation (Hazeen Fathima & Umarani, 2023). Despite these challenges, interpreting engineers' entrepreneurial behaviors can enhance autonomy, creativity, innovation, and provocativeness, as key competencies for organizational success.

Highlighting the dual role of engineers as entrepreneurs requires a nuanced understanding of how their behaviors, attitudes, and traits influence employment expectations (Kharbanda & Stallworthy, 1990; Tremblay, Wils, & Proulx, 2002). A strong alignment between these factors is critical for developing engineers with high entrepreneurial potential while avoiding contamination by unrelated variables. Technology is a significant driver in this dynamic, reshaping labor market demands and influencing engineers' performance and behavioral intentions (McDonnell & O'Neill, 2009; Liu, Gan, & Chen, 2024). Technological advancements narrow performance gaps, enhance technical expertise, and solve complex engineering problems. This fosters competitiveness, enabling engineers to acquire new skills and competencies while contributing to global talent competitiveness.

Individual behavior is a critical element in the entrepreneurial process, characterized by flexibility, unpredictability, and continuous evolution (Al-Kwafi, Petrovska, Parast, & Safari, 2023). In today's competitive talent market, engineers' behaviors adapt rapidly to meet organizational and technological demands (Hazeen Fathima & Umarani, 2023). These behaviors are pivotal in addressing technical challenges, improving knowledge and skills, and aligning with organizational goals.

Organizations face high costs when replacing engineering talent, particularly when skills are unique and non-imitable (Liu et al., 2024). Investing in the development of existing talent is therefore essential. However, theoretical and practical discussions on the dual roles of engineers as entrepreneurs and talent retention often lack clarity and validity. This gap underscores the need for further exploration of the connections between in-house entrepreneurial behaviors and talent retention strategies.

Therefore, this study aims at discussing the following objectives:

1. *To investigate the relationship between EO and talent retention among engineers*
2. *To develop a conceptual framework based on the relationship between EO and talent retention among engineers*

By exploring these objectives, the study seeks to provide a deeper understanding of how engineers' entrepreneurial potential can be harnessed to enhance retention, improve organizational outcomes, and align with the growing demands of the engineering industry. Developing a comprehensive framework for engineers-entrepreneurs will contribute to bridging theoretical gaps and addressing practical challenges in talent management and organizational innovation.

LITERATURE REVIEW

When an engineer decides to move to a new job, a gap often emerges between their personal career orientations and behavioral expectations (Abdull Rahman, 2012; Alavi, Moteabbed & Arasti, 2012; Andrée, & Hansson, 2015). Bridging this gap is critical, as engineers' ability to align their career trajectories with their expectations

directly impacts job satisfaction and performance (Bigliardi, Petroni & Dormio, 2005). The rationale for updating specific technical knowledge, generating innovative ideas, gaining new experiences, and enhancing general competencies forms the foundation for meeting engineering job requirements.

Optimally aligning engineers’ behaviors with their career expectations stimulates the transformation of innovative ideas into tangible outcomes, contributing to sustained business performance and a positive work environment (Doh, Smith, Stumpf & Tymon, 2011; Fathima & Umarani, 2023). However, when either behavioral alignment or employment expectations are weak or absent, efforts to evaluate and leverage engineers’ behaviors can be significantly hindered. To address this challenge, adopting hybrid strategies that combine technical and entrepreneurial systems is crucial. Integrating these systems into core engineering tasks fosters a deeper understanding of engineers’ behavioral expectations and career orientations. This is where the dual role of engineers as entrepreneurs becomes particularly valuable. Engineers equipped with advanced technical knowledge can incorporate entrepreneurial skills to solve engineering-related problems, thereby enhancing the overall entrepreneurial value within an organization.

A. The Dual Roles of Engineers-Entrepreneurs

The journey toward becoming entrepreneurs begins with identifying and nurturing their career anchors, namely core values and competencies that shape their career decisions. Engineers who excel in technical domains often develop complementary managerial competencies, autonomy, stability, dedication, a passion for challenges, lifestyle integration, and entrepreneurial creativity (Hazeen Fathima & Umarani, 2023; Tremblay et al., 2002). These attributes allow engineers to effectively balance technical expertise with entrepreneurial responsibilities. Engineers are increasingly classified as knowledge workers, professional workers, and talented workers, a recognition of their ability to acquire elite knowledge and advanced skills, operate with a high degree of autonomy, manage uncertainty and complex situations, demonstrate leadership and innovation, and excel in education and professional development.

This classification underscores the evolving role of engineers as dual contributors, both technical specialists and entrepreneurial leaders. Their capacity to navigate rigorous challenges, manage large-scale projects, and handle non-technical responsibilities positions them uniquely within organizations. To establish whether engineers are entrepreneurs, Table 1 provides the specific characteristics of describing those dual roles.

Table I Engineers-Entrepreneurs’ Characteristics

Engineers’ Characteristics	Entrepreneurs’ Characteristics
<ul style="list-style-type: none"> ✓ Autonomy ✓ Flexibility, adaptability and the capacity to cope with and manage change ✓ Self-motivation and drive ✓ Analytical ability and decision making ✓ Communication and interpersonal skills ✓ Team working abilities and skills ✓ Organization, planning and prioritization abilities ✓ Ability to innovate ✓ Mental and physical resilience ✓ Leadership ability 	<ul style="list-style-type: none"> ✓ Vision ✓ Initiative ✓ Internal motivation ✓ Autonomy ✓ Risk-taking ✓ Internal control ✓ Commitment and persistence ✓ Market knowledge/customer orientation ✓ Knowledge of organizational structures and willingness to cross-functional borders ✓ Flexible problem solving

<ul style="list-style-type: none"> ✓ Managing long term projects ✓ Time management ✓ Risk-taking ✓ Creativity ✓ Agent of change 	<ul style="list-style-type: none"> ✓ Visionary thinking style ✓ Resistance to change (openness to change) ✓ Orientation to innovation ✓ Agent of change
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Commenting on the behaviors of engineers-entrepreneurs, Williamson et al (2013) educating engineers as entrepreneurs often emphasizes the integration of business acumen and market knowledge to meet the dynamic demands of modern engineering environments. Incorporating technology entrepreneurship into engineering practices provides engineers with greater opportunities for self-determination, enabling them to take ownership of their career paths, make task-related decisions autonomously, and lead major organizational projects with confidence.

A key reason why engineers are increasingly regarded as entrepreneurs lies in the alignment of their unique personalities and traits with entrepreneurial demands (Fathima & Umarani, 2023; Fortes et al., 2023). To transition engineers into roles focused on technical innovation and product development, traits such as intrinsic motivation, introversion, flexibility, creativity, and analytical ability are pivotal. These qualities enhance engineers' capacity to seize innovation opportunities and respond rapidly to evolving technological demands. Creativity and non-routine problem-solving are foundational for driving engineering management success, ensuring consistent advancements in innovation and product development.

When faced with resistance to change, engineers-entrepreneurs play a critical role in navigating uncertainty. They define strategic priorities by closely monitoring market shifts, including technological advancements and evolving technical knowledge, and aligning these changes with functional strategies that optimize the use of available resources. This adaptability allows engineers-entrepreneurs to sustain organizational resilience in challenging environments.

B. Entrepreneurial Orientation Theory and Engineers' Entrepreneurial Behaviours

Entrepreneurial Orientation (EO) theory is often linked to the processes, practices, and decision-making activities that guide a company when entering a competitive marketplace (Covin & Slevin, 1986; Covin & Slevin, 1991). These activities are typically characterized by an entrepreneur's ability to act autonomously, innovate, take risks, demonstrate competitive aggressiveness, and proactively seek out new opportunities within the market (Lumpkin et al., 1996). In the context of organizational behavior, the dimensions of EO include autonomy, innovativeness, risk-taking, proactiveness, and competitive aggressiveness, which are crucial in shaping an organization's approach to competition and market dynamics (Bilal & Fatima, 2022; Bolton & Lane, 2012).

These EO dimensions can be influenced by both environmental and organizational factors (Entebang, Harrison & Run, 2010; Lumpkin & Dess, 1996). Environmental factors such as market dynamism, munificence, complexity, and industry characteristics play a significant role in shaping the entrepreneurial behavior of an organization (Kollman, Christofor & Kuckertz, 2007; Rauch, Wiklund, Lumpkin, & Frese, 2009). Additionally, internal organizational factors, including firm size, structure, strategy, strategic decision-making processes, available resources, culture, and the characteristics of the top management team, also contribute to how EO is manifested within the organization (Corrêa, Queiroz & Shigaki, 2021).

Together, these factors directly impact the overall organizational performance, including metrics such as sales growth, market share, profitability, and stakeholder satisfaction. External factors like market trends and industry disruptions, along with internal factors such as organizational strategy and business practices, are all critical in determining the entrepreneurial posture of an organization. A strong entrepreneurial orientation is essential for organizations to remain competitive, innovate continuously, and achieve long-term success in dynamic markets

(Lumpkin & Dess, 1996).

Table 2 presents the definitions of the key dimensions of EO, which offer valuable insights into the strategic decisions organizations make to enhance their competitive edge and drive growth in the marketplace. By aligning their strategies with these EO dimensions, companies can better navigate the challenges of the modern business landscape, optimize performance, and secure a sustainable market position.

Table II Eo Dimensions and Definitions

EO Dimensions	Definitions
Innovativeness	✓ Support new ideas, novelty, experimentation for new products and services
Proactiveness	✓ Act in anticipation of future problems, needs or changes
Risk-taking	✓ Proclivity to engage in risky projects and prefer bold actions for achieving firms' objectives
Autonomy	✓ Actions of individuals or teams are relatively independent
Competitive Aggressiveness	✓ Intensively challenges its competitors for improving position in the marketplace

The willingness of an entrepreneurial organization to take high risks in completing major projects and aggressively pursuing business opportunities will impact organizational high return performance. Furthermore, an entrepreneurial organization who leads in technology, research and development tends to capture new market opportunities over the late movers. Strong evidence of the positive impact of EO on organizational performance has increased in number of the existing empirical studies that have examined this relationship. Published studies on EO and organizational performances found that, innovativeness, proactiveness, risk-taking, autonomy and competitive aggressiveness behaviours enhance organizational strategic orientation and commitment to obtain high returns in the marketplace.

However, in relation to a higher performance of an organization, Mehdi and Singh (2023) argued that the successful in-house entrepreneurial organizations that are strongly related to the organizational members' behaviours and attitudes (individuals) are those who are actively involved in any organizational business strategy activity. In their critique of using EO at the individual level, Kollman, Christofor and Kuckertz (2007) consider Gartner's (1985) four key principles of EO from an individual analysis is potentially important. A successful entrepreneurial organization must address these key dimensions:

1. individual (the persons involved in starting the organizations)
2. process (the action undertaken by the individuals to start the new venture)
3. organization itself (the kind of firm started)
4. environment in which the organization is active (the situation involving and influencing the new organization)

The role of EO behaviors in predicting individual performance and entrepreneurial intentions has sparked considerable discussion (Mohammadi, 2021; Nikitina, Licznarska, Ozoliņa-Zoola & Lapiņa, 2023). From an individual perspective, EO theory requires evaluating individual behaviors to understand entrepreneurial intentions. EOT links entrepreneurial intentions with personal behaviors, traits, and attitudes, ultimately shaping individuals into entrepreneurs within an organization (Nikitina et al., 2023). By focusing on entrepreneurial behaviors and attitudes, key individuals can develop the ability to identify opportunities, respond to competitive business demands, and utilize available resources effectively. Many scholars have argued that translating EO

into individual actions is a critical strategy for both seizing opportunities and nurturing employees into entrepreneurial roles (Naveed, Zia, Younis & Shah, 2021).

For example, Naveed et al. (2021) found that successful entrepreneurial behaviors among teachers were closely supported by learning and a positive entrepreneurial mindset, including traits such as proactivity, a positive attitude toward learning, an entrepreneurial outlook, and alignment with social norms. In the context of technology, EO has evolved to explain how individuals adopt entrepreneurial behaviors related to technology at the workplace. Research has shown that individual EO is significantly linked with perceived ease of technology adoption and a willingness to engage with it. Additionally, Corrêa et al. (2021) demonstrated that EO could be cultivated within different environments, such as cultural, political, and economic contexts, which are critical for developing entrepreneurial behaviors.

The behaviors of individual engineers who embody both engineering and entrepreneurial roles cannot be understood in isolation when analyzing IEO. As previously noted, IEO is characterized by five key dimensions: innovativeness, proactiveness, risk-taking, autonomy, and competitive aggressiveness (Martins, & Pérez, 2020). Another study by Nair, Sundar and Mangadu Paramasivam (2020) examined students' entrepreneurial intentions and emphasized four key behaviors: opportunity recognition, proactiveness, achievement motivation, and risk-taking. Instead of focusing on autonomy and competitive aggressiveness, Nair et al. (2020) used opportunity recognition and the need for achievement to explain students' entrepreneurial intentions.

While the role of competitive aggressiveness in predicting entrepreneurial intentions is still underexplored, prior research has not provided enough evidence to link competitive aggressiveness with individual entrepreneurial behavior. To date, there is limited evidence connecting competitive aggressiveness with entrepreneurial intention or performance.

This study posits that the core dimensions of innovativeness, proactiveness, risk-taking, and autonomy are crucial for predicting engineers' entrepreneurial potential and positive behavioral intentions. Several factors underscore the importance of these behaviors. First, technological advancements and evolving technical knowledge require engineers to innovate continuously and turn new ideas into practical outcomes (Kharbanda & Stallworthy, 1990; Menzel et al., 2007; Tremblay et al., 2002). Second, engineers are inherently creative problem solvers, adept at conceptual thinking and applying innovative solutions to technical challenges. Third, engineers often collaborate with project owners, advisors, and contractors to assess the feasibility of risky projects before taking on challenges (Fathima & Umarani, 2023; McDonnell & O'Neill, 2009). Lastly, autonomy fosters creativity among engineers, enabling them to work on complex and challenging tasks that require innovative thinking and problem-solving capabilities.

C. Individual EO and Talent Retention of Engineers.

A decline in EO activities is closely associated with rising turnover rates within organizations. EO plays a crucial role in shaping key talents' behaviors, influencing how they make decisions, work independently, and generate innovative ideas. Engineers require substantial autonomy, task challenges, creativity, and the freedom to transform ideas into tangible outcomes, enabling them to respond effectively to competitive demands in the engineering field. When EO is strategically integrated into organizational frameworks, it enhances engineers' positive behaviors, ultimately influencing their career satisfaction and retention decisions.

The connection between innovation and talent retention is undeniable. Highly innovative engineers are more likely to remain with their current employer, as creativity is central to their roles in innovation processes and product development. Research consistently emphasizes the importance of engineers upgrading their human capital to align with organizational goals and competitive strategies. The entrepreneurial process helps nurture engineers into proactive employees, but a lack of proactive behavior significantly hinders their ability to seek feedback, gather information, and seize opportunities to resolve engineering problems. Without a proactive mindset, identifying and addressing challenges becomes increasingly difficult, and the development of entrepreneurial skills begins to wane. When engineers' proactive behaviors are underdeveloped, their motivation to stay in the same job is negatively affected.

A strong link exists between risk-taking and talent retention, with engineers who embrace risk-taking behaviors more likely to stay in their roles. Training engineers to tackle technical problems and embrace challenges enhances their enjoyment and satisfaction in their work. Engineers who thrive on risk and are willing to engage with challenging tasks are better equipped to navigate the uncertainty of technical environments. The ability to address risk and uncertainty fosters a strong sense of commitment, and engineers become better at integrating their skills and competencies to find solutions. As a result, engineers who embrace risks are more likely to stay in their positions.

Autonomy is another key factor influencing engineers' decisions to remain with their employers. The more autonomy engineers have in making decisions related to their tasks and work schedules, the more likely they are to be attracted to and retained by the organization. Studies indicate that engineers' involvement in decision-making processes is crucial for fostering a sense of control over their work. Although full entrepreneurial practices may not always be implemented, providing engineers with autonomy significantly strengthens their commitment to the organization and encourages long-term retention.

In summary, a clear relationship exists between EO behaviors, particularly innovativeness, risk-taking, and autonomy, and engineers' decisions to stay in their current roles. Providing engineers with the freedom to innovate, the opportunity to take risks, and the autonomy to make decisions in their tasks helps cultivate a positive work environment, enhances job satisfaction, and ensures higher talent retention within the organization.

D. The Relationships between In-house EO and Talent Retention among Engineers

Talent can be defined as an asset that encompasses individuals with specialized skills, knowledge, and abilities, distinguishing them as high performers in their respective fields (Sean & Ozer, 2024). A talented person possesses qualities that set them apart, including expertise, creativity, and experience, making them integral to an organization's success (Talukder & Wang, 2023). Talent is characterized not only by individual differences such as personality but also by its rarity, value, and difficulty to replicate. Employees with exceptional competencies, skills, and experience are typically considered the key drivers of organizational success. As a result, talent retention has become a priority for organizations aiming to secure their competitive advantage. Retaining top talent is a central component of talent management, focused on encouraging high-performing employees to stay in their roles for the long term (Di Prima, Hussain & Ferraris, 2024; Talukder & Wang, 2023).

One of the primary challenges in talent retention is the issue of "brain drain," where organizations face significant costs in recruiting new talent if their current employees voluntarily leave (Di Prima et al., 2024). Retaining talent is closely linked to aligning employees' behavioral intentions and career expectations, which help create mutual understanding between the employees and the organization. This alignment plays a critical role in fostering job satisfaction and improving overall retention. By addressing career expectations and behavioral intentions, companies can better secure the loyalty and engagement of their top performers.

For engineers, a clear sense of career direction is often tied to a strong desire for achievement and security in their future career paths. Engineers who feel more certain about their career trajectories are less likely to consider job changes. However, when career determination is insufficient or when engineers perceive a lack of career growth, they are more likely to explore opportunities elsewhere. Factors influencing engineers' decisions to stay in their roles are varied. Studies have identified key motivators such as learning and development, career advancement, and the opportunity for self-growth as essential to engineers' career satisfaction and retention.

However, some scholars argue that talent retention must go beyond traditional motivational factors and be linked to behavioral dynamics that address the "war for talent" and competitive talent shortages. To prevent engineers from leaving prematurely or underperforming, it is essential for organizations to focus on fostering a culture that supports engineers' development and provides opportunities for entrepreneurial growth. Engineers who are encouraged to innovate, engage in creative problem-solving, and take proactive steps in product development are more likely to feel satisfied in their roles and remain committed to their employers.

1. Innovativeness and Talent Retention among Engineers: Retaining engineers as high performers fosters

organizational innovative behaviours (Hazeen Fathima & Umarani, 2023). Innovative Behaviour, according to Innovativeness refers to an individual employee's intention to create, introduce, and apply new ideas within their work group. These behaviours extend their benefits to leadership, decision-making, and work-group relations. Specific studies examining innovative work Behaviour and talent retention revealed a positive relationship between the two variables. An open-minded personality, characterized by a willingness to exchange ideas, enables engineers to acquire new knowledge and skills and adapt to evolving job requirements in their field (Liu et al., 2024; Williamson et al., 2013).

2. **Proactiveness and Talent Retention among Engineers:** Proactive Behaviour plays a crucial role in encouraging key employees to identify opportunities, pursue better career paths, and plan for future growth (Al-Kwafi et al., 2023; Alavi et al., 2012; Andrée, & Hansson, 2015). This trait positively influences work-related behaviours and attitudes, fostering an environment where individuals inspire others to take initiative. Increased proactivity, such as through information sharing and trust-building, has been shown to increase retention intentions. For organizations, proactive Behaviour contributes to enhanced cooperative behaviours and an increment in retention intentions among employees (Sahoo, & Panda, 2019).
3. **Risk-taking and Talent Retention among Engineers:** Risk-taking behaviour reflects an individual's willingness to engage in tasks and decision-making processes involving uncertainty, variability, and potential extreme outcomes. Engineers, as experts in their field, are trained to tackle technical challenges, often working in high-risk environments. These challenges shape their positive behavioral actions within organizations. Tremblay et al. (2002) argue that job challenges enhance engineers' participation in decision-making processes and risk-taking behaviours, which are closely linked to career satisfaction and negatively correlated with their intention to stay.
4. **Autonomy and Talent Retention among Engineers:** Autonomy has been identified as a significant factor influencing voluntary turnover. Fortes et al. (2023) observed that greater autonomy tends to reduce the likelihood of employees leaving their roles. Associative autonomy has been shown to alleviate work exhaustion among engineers, thereby enhancing retention rates. Autonomy had significantly reduced employees' intentions to leave their current employer (Nair et al., 2020). Furthermore, managerial autonomy has been found to enhance job satisfaction and organizational commitment, ultimately encouraging engineers to remain with their organizations for longer durations.
5. **Competitive Aggressiveness and Talent Retention among Engineers:** Competitive aggressiveness, as described by Lumpkin and Dess (1996) represents the organization's determination and intensity in striving to surpass industry competitors. Several scholars have equated competitive aggressiveness with the organization's drive to achieve leadership in performance metrics (Lumpkin & Dess, 1996). This relentless pursuit creates a highly competitive landscape, compelling organizations to enhance their market position and maintain relevance in the ever-evolving marketplace (Lumpkin et al., 1996). Skilled engineers are essential to sustain organizational competitiveness. Organizations must also embrace social responsibility, ethics, and community values to compete responsibly. This study explores how competitive aggressiveness influences engineers' decision to stay in their organizations.

Building on the relationship between EO and talent retention among engineers, the following hypotheses are proposed:

H1: Innovativeness has positively influenced talent retention among engineers

H2: Proactiveness has positively influenced talent retention among engineers

H3: Risk-taking has positively influenced talent retention among engineers

H4: Autonomy has positively influenced talent retention among engineers

H5: Competitive aggressiveness has positively influenced talent retention among engineers

Figure 2 provides the proposed conceptual framework of this study.

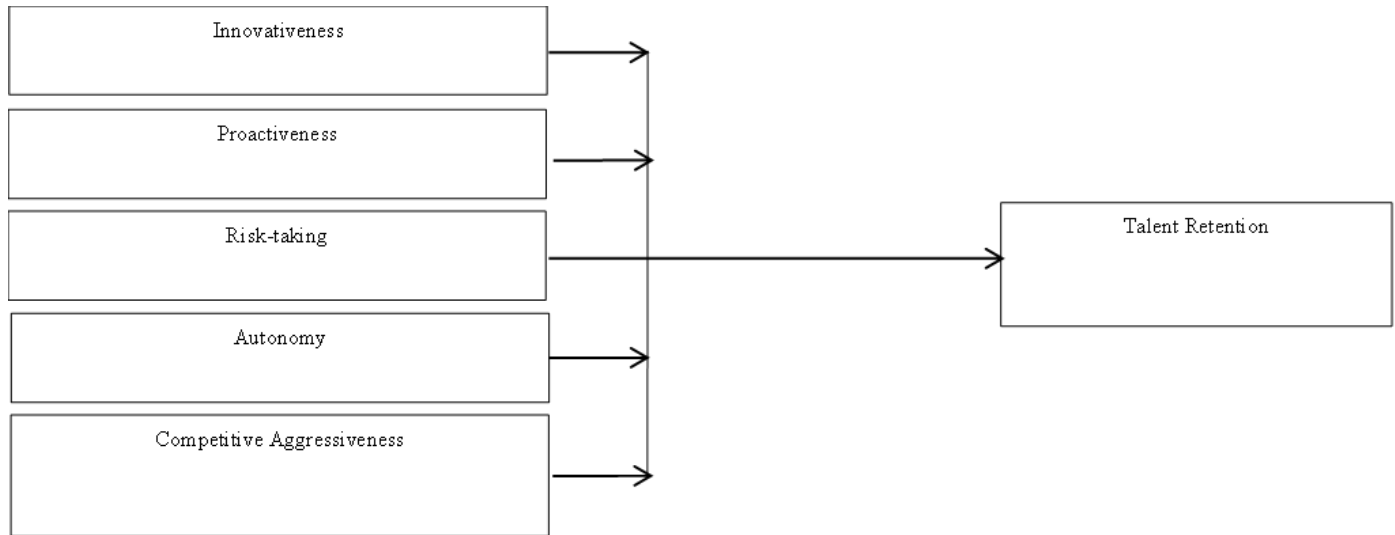


Fig. 1 Conceptual Framework

METHODOLOGY

This section provides an overview of the research process, including data collection, sampling, and survey instruments utilized for data analysis.

A. Sample and Instruments

A quantitative research design will be employed using multi-item measures on a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The study will adopt purposive sampling, targeting engineers working in manufacturing companies located in the southern region of Peninsular Malaysia, encompassing Negeri Sembilan, Melaka, and Johor Bahru. The population of engineers is sourced from the Board of Engineers Malaysia (BEM), which provides data on the number of currently registered engineers in Malaysia, categorized by state and sector. To gain access to participants, consent letters will be sent to HR managers of the selected private organizations, seeking approval for survey distribution.

Research hypotheses will be analysed using PLS-SEM approach with SmartPLS 3.2.6. PLS is known as a second-generation multivariate analysis which simultaneously evaluates the measurement model (the relationships between constructs) and the structural model, with the aim to minimise the error of variance. The main reasons of employing PLS as the primary data analysis technique are a) variance-based technique for predicting relationships among constructs of the model; b) minimal requirement of the sample size; and c) PLS deals with non-normal data distribution.

B. Variables and Measurements

Survey instruments will be adapted from established literature and tailored to align with the study objectives. The dependent variable, talent retention will be measured using five items developed by Govaerts, Kyndt, Dochy, and Baert (2011). Independent variables representing entrepreneurial orientation (EO) will be assessed from the individual engineer's perspective. The EO items, adapted from Covin et al. (1986) and Lumpkin et al. (1996), included measures of innovativeness (seven items), proactiveness (seven items), risk-taking (six items), autonomy (three items), and competitive aggressiveness (five items).

DISCUSSION

This paper provides a comprehensive examination of the dual roles of engineers as entrepreneurs, emphasizing how their behavioral traits, attitudes, and competencies align with the principles of EO Theory. It explores how engineers' entrepreneurial behaviors such as innovativeness, proactiveness, risk-taking, and autonomy are crucial

in fostering a culture of talent retention and organizational success. Furthermore, it delves into the complex relationship between individual entrepreneurial orientation and engineers' entrepreneurial intentions, providing a deeper understanding of the strategies organizations can adopt to retain top engineering talent.

The dual role of engineers as both technical experts and entrepreneurs is a growing area of interest in the business and academic world. Engineers often possess a unique blend of skills, including deep technical knowledge, creativity, and the ability to solve complex problems. When engineers adopt entrepreneurial behaviors, they are not just executing their tasks but also driving innovation, identifying new opportunities, and shaping the future direction of their organizations. This combination of skills and behaviors aligns with the definitions of entrepreneurs, individuals who act as entrepreneurs within the context of an established organization, creating value and driving change from within.

The entrepreneurial role of engineers is critical in today's fast-paced technological landscape, where organizations face the need to innovate constantly to stay competitive. By leveraging their technical expertise and entrepreneurial mindset, engineers can effectively bridge the gap between technological advancements and practical applications, ultimately leading to the creation of innovative products and solutions that benefit the organization.

EO Theory has long been associated with organizational behavior in entrepreneurial firms. It emphasizes five key dimensions: autonomy, innovativeness, risk-taking, proactiveness, and competitive aggressiveness. These dimensions form the foundation for understanding how engineers can adopt entrepreneurial behaviors to drive organizational success. However, the literature often focuses on these behaviors at an organizational level, overlooking their impact at the individual level. This paper addresses that gap by focusing on how individual engineers' entrepreneurial behaviors influence their decision to remain with an organization.

Innovativeness is central to the entrepreneurial role of engineers. Engineers must consistently develop new ideas and solutions, keeping pace with advancements in technology and engineering practices. Innovativeness also ties closely with creativity, a key trait that empowers engineers to tackle complex problems with novel approaches. Engineers who exhibit high levels of creativity and innovative thinking are more likely to stay with an organization that encourages such behaviors and provides them with opportunities to apply their creativity in meaningful ways.

Proactiveness is another critical dimension of EO that influences engineers' entrepreneurial behaviors. Engineers who are proactive do not wait for instructions or react passively to challenges; instead, they anticipate problems, identify opportunities for improvement, and take initiative. A proactive engineer is more likely to drive innovation within their team and contribute to the organization's overall growth. By fostering a proactive culture, organizations can ensure that engineers take ownership of their projects and are motivated to stay committed to their roles.

Risk-taking is inherent to the entrepreneurial process, particularly in fields like engineering where new technologies and ideas often involve uncertainty. Engineers who embrace risk-taking behaviors are more willing to explore uncharted territories, experiment with new concepts, and take on projects with high potential rewards but also significant challenges. Encouraging calculated risk-taking within the engineering context can lead to breakthroughs and long-term competitive advantages for organizations.

Autonomy is perhaps the most important dimension when it comes to talent retention. Engineers who are given the freedom to make decisions about their work, choose the direction of their projects, and exercise control over their tasks are more likely to feel engaged and satisfied with their jobs. Autonomy fosters a sense of ownership and responsibility, which in turn boosts motivation and job satisfaction. Engineers who experience high levels of autonomy are less likely to seek other employment opportunities, as they feel empowered and valued within their current role.

CONCLUSION

The retention of top talent, particularly in highly specialized fields such as engineering, is a significant challenge

for many organizations. Engineers who possess a combination of technical skills and entrepreneurial behaviors are in high demand, and organizations must work hard to retain these individuals (Fortes et al., 2023; Kharbanda & Stallworthy, 1990; McDonnell & O'Neill, 2009; Menzel et al., 2007; Tremblay et al., 2002). As this paper suggests, a strong connection exists between individual EO behaviors and talent retention. Engineers who demonstrate high levels of innovativeness, proactiveness, risk-taking, and autonomy are more likely to experience greater job satisfaction and, consequently, are less likely to leave their current employers (McDonnell & O'Neill, 2009; Kharbanda & Stallworthy, 1990; Liu et al., 2024).

To retain talented engineers, organizations must create an environment that fosters these entrepreneurial behaviors (Menzel et al., 2007; Williamson et al., 2013). This includes providing opportunities for engineers to engage in innovative projects, allowing them to take risks within a supportive framework, and empowering them to make decisions about their work (Doh et al., 2011; Fathima & Umarani, 2023). Organizations should also consider offering professional development opportunities that enhance engineers' skills and competencies, helping them stay aligned with technological advancements and remain motivated to contribute to the company's success.

This paper strongly argues that adopting an individual-level EO approach provides a more accurate and effective way to predict engineers' entrepreneurial intentions and positive behavioral intentions. While previous research has focused on organizational EO, it is essential to recognize that individual engineers' behaviors play a critical role in shaping their intentions to stay with the organization. Engineers' entrepreneurial behaviors, such as their willingness to innovate, take risks, and demonstrate proactiveness, should be viewed as key indicators of their long-term commitment to the organization (Bigliardi et al., 2005; Hazeen Fathima & Umarani, 2023; Williamson et al., 2013).

Furthermore, understanding individual EO can help HR managers and organizational leaders develop strategies to support engineers' career growth and satisfaction. By providing engineers with the resources, autonomy, and opportunities they need to excel, organizations can ensure that they remain engaged and motivated (Abdull Rahman, 2012; Alavi et al., 2012; Andrée, & Hansson, 2015). This, in turn, will help reduce turnover rates and foster a culture of innovation and entrepreneurship that is essential for long-term success.

RECOMMENDATIONS FOR FUTURE RESEARCH

This paper offers valuable insights into the concept of engineers as entrepreneurs and the significance of individual entrepreneurial orientation in predicting engineers' entrepreneurial intentions and retention decisions. The findings underscore the importance of fostering key entrepreneurial behaviors such as innovativeness, proactiveness, risk-taking, and autonomy among engineers to enhance organizational performance and talent retention.

The theoretical contribution of this paper is the extension of EO theory to individual engineers, highlighting the role of their behaviors, attitudes, and traits in predicting their entrepreneurial intentions and career satisfaction. Future research should focus on developing specific measures of individual EO that can be used to assess engineers' potential for innovation and their likelihood to stay with their current employer. Additionally, researchers should investigate how the organizational environment, including managerial support, resources, and culture, influences the development of EO behaviors among engineers.

Ultimately, this paper provides a roadmap for HR managers, engineering practitioners, and organizations to create environments that support and nurture engineers' entrepreneurial potential. By focusing on individual EO and providing opportunities for engineers to develop their skills, organizations can not only improve innovation and productivity but also retain their most valuable engineering talent. This approach will ensure that organizations remain competitive in an increasingly complex and dynamic technological landscape.

ACKNOWLEDGMENT

I would like to thank the reviewers for the thoughtful comments and suggestions for the improvement of this paper.

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