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# Entrepreneurial and Human Capital Competences in Organizations

Edited by

Anna Ujwary-Gil
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# Employer attractiveness in start-ups: Evidence for the instrumental-symbolic framework and the role of protean career orientation

***Theresa U. Zimmer*[1], *Cornelius J. König*[2]**
***Valentin Hemm*[3], *Nida ul H. Bajwa*[4]**

***Abstract***

***PURPOSE**: Employer branding is increasingly critical for start-ups seeking to attract qualified talent under severe resource constraints. While the instrumental–symbolic framework of employer attractiveness is well established in large organizational contexts, its applicability to start-ups remains underexplored. This study examines the transferability of this framework to start-up contexts and investigates whether protean career orientation (PCO) influences perceptions of employer attractiveness.* ***METHODOLOGY**: The study employs a scenario-based experimental design with a sample of 551 participants recruited via Prolific. Participants were exposed to fictitious start-up websites in which instrumental attributes (job security and compensation) and symbolic attributes (innovativeness and meaningfulness) were systematically manipulated. Employer attractiveness served as the dependent variable. Hierarchical linear modeling was used to analyze the main and interaction effects of employer attributes and PCO.* ***FINDINGS**: The results demonstrate that both instrumental and symbolic attributes significantly increase perceived employer attractiveness in start-up contexts. Protean career orientation was positively associated with employer attractiveness, suggesting that individuals with higher PCO generally evaluate start-ups more favorably as potential employers. However, PCO did not moderate the effects of instrumental or symbolic attributes on employer attractiveness.* ***IMPLICATIONS**: The findings support the transferability of the instrumental–symbolic framework to start-up employer branding by highlighting the continued importance of instrumental attributes alongside symbolic signals. The results further suggest that PCO functions as an independent predictor rather than a boundary condition. Practically, start-ups should emphasize credible instrumental employment conditions while complementing them with symbolic cues to enhance attractiveness among diverse career-oriented individuals.* ***ORIGINALITY AND VALUE**: This study extends employer branding research by empirically testing the instrumental–symbolic framework in a start-up context and by integrating PCO as an individual-level factor. It contributes to the literature by clarifying how career orientations shape employer evaluations in emerging and resource-constrained organizational settings.*

***Keywords:** employer branding, employer attractiveness, start-ups, instrumental attributes, symbolic attributes, job security, compensation, innovativeness, meaningful work, meaningfulness, organizational image, recruitment, applicant attraction, job pursuit intentions, job search behavior, career orientation, hierarchical linear modeling, health-tech start-ups.*

1 Theresa U. Zimmer, Dr., Universität des Saarlandes, Campus A1.3 66123 Saarbrücken, Germany, e-mail: theresa.zimmer@uni-saarland.de (ORCID: https://orcid.org/0009-0005-2504-9833).
2 Cornelius J. König, Prof. Dr., Universität des Saarlandes, Campus A1.3 66123, Saarbrücken, Germany (ORCID: https://orcid.org/0000-0003-0477-8293).
3 Valentin Hemm, B.Sc., Universität des Saarlandes, Campus A1.3 66123 Saarbrücken, Germany (ORCID: https://orcid.org/0009-0001-6619-3699).
4 Nida ul H. Bajwa, Dr., Universität des Saarlandes, Campus A1.3 66123 Saarbrücken, Germany (ORCID: https://orcid.org/0000-0001-9943-8042).

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## INTRODUCTION

Start-ups play a vital role in the economy by creating numerous job opportunities (Acs, 2006; Decker et al., 2014). However, from the perspective of job seekers, there is substantial uncertainty regarding the attractiveness of a job at a start-up. On the one hand, they may seem attractive due to the autonomy they typically offer in work and the opportunity for experimentation (Moser et al., 2017; Roach & Sauermann, 2024). On the other hand, they are also marked by the limitations of being new, small in scale, and often lacking the resources to offer benefits comparable to those of established companies (Cardon & Stevens, 2004). To overcome these constraints, start-ups must develop strategies for effectively using limited resources to attract initial employees. This can be achieved through thoughtful employer branding that highlights the employer's attractive attributes (Backhaus & Tikoo, 2004; Navis & Glynn, 2011).

Prior research has examined employer attractiveness by investigating the influence of various types of attributes. One of the most prominent approaches is the instrumental–symbolic framework, which classifies these attributes into instrumental and symbolic categories (Lievens & Highhouse, 2003). Instrumental attributes offer tangible benefits to job seekers, whereas symbolic attributes reflect the organization's personality. Past research also shows that instrumental attributes underpin an organization's attractiveness, whereas symbolic attributes enhance it by highlighting differences from other organizations (Lievens et al., 2007; Lievens & Highhouse, 2003; Rai, 2019). However, the influence of these attributes may differ in start-ups, given their fundamental differences from established firms. For example, start-ups experience rapid and frequent changes in team composition (Ucbasaran et al., 2003). These circumstances might reduce the impact of instrumental attributes while increasing the importance of symbolic attributes. Moreover, start-ups may attract a different type of employee than established companies (Sauermann, 2018; Volkmer et al., 2024), as careers are typically less structured: Early-stage start-ups are for instance small, employees assume substantial responsibility for the business's success (Roach & Sauermann, 2015; Tumasjan et al., 2011), and advancement depends less on formal career paths than on proactive behavior and increased involvement in the venture (e.g., Gerber et al., 2009, Briscoe et al., 2006; Hall, 1976; Hall et al., 2018). Although research exists on both the attractiveness of start-ups (e.g., Moser et al. 2017) and the characteristics of start-up employees (e.g., Sauermann, 2018), a gap remains in integrating these areas to investigate the interplay between start-up-specific attractiveness attributes and career orientations of job candidates considering employment in start-ups. Therefore, this study first aims to investigate differences in the contribution of instrumental and symbolic attributes to the attractiveness of start-ups. Symbolic attributes (e.g., innovativeness and meaningfulness), are expected to have a stronger impact on start-up employer attractiveness compared to instrumental attributes (e.g., job security and compensation). Second, this study aims to examine whether high levels of protean career orientation (PCO) influence the relationship between symbolic attributes and attractiveness, hypothesizing that higher levels of PCO will strengthen this relationship. Furthermore, this study seeks to replicate past research (Van Hooft et al., 2021) demonstrating a positive connection between employer attractiveness and subsequent job search behavior. Specifically, it examines whether greater employer attractiveness is associated with a stronger intention to seek further information about the respective start-up.

This paper is structured as follows. First, the relevant theoretical and empirical foundations are reviewed, organized around four thematic areas: employer attractiveness in start-up contexts; instrumental and symbolic employer attributes in start-ups; applicants' career orientations; and perspectives extending beyond employer attractiveness. The subsequent section describes the research methodology. The empirical results are then presented and discussed, beginning with an interpretation of the findings. This is followed by a synthesis of the key results, a discussion of the study's limitations, directions for future research, and practical implications. The paper concludes with a final summary of the main contributions.

## LITERATURE REVIEW

### Employer attractiveness of start-ups

During the hiring process for new ventures, entrepreneurs are typically confronted with the start-up's smallness, newness, and resource constraints (Cardon & Stevens, 2004). First, in the early stages, start-ups are typically small-scale. This leads to job seekers lacking familiarity with organizational and job characteristics when considering potential employers (Aldrich & Auster, 1986). Additionally, their newness suggests that organizational characteristics may not yet be established, thereby increasing uncertainty about the company as an employer and the work environment. Furthermore, entrepreneurs often

contend with resource scarcity, particularly time and capital (Cardon & Stevens, 2004; Williamson et al., 2002). As a result, start-ups might struggle to use traditional methods, such as advertising, job fairs, or walk-ins (Zottoli & Wanous, 2000) to raise awareness as a potential employer. These obstacles significantly impact the initial phase of employment: attracting potential candidates. If a sufficient applicant pool cannot be generated, this limits later recruitment stages, as there may be too few candidates with the right competencies (Turban & Cable, 2003). Therefore, entrepreneurs need to carefully strategize how they present themselves to create a unique employer value proposition that attracts employees.

The backbone of every employer value proposition is good employer branding (Moser et al., 2021). Employer branding as an attraction strategy entails that job applicants evaluate a potential employer's attractiveness by considering various signals it conveys, which collectively form the employer's image (Theurer et al., 2018). Furthermore, employers who align their branding strategy with the desired characteristics of potential employees gain an advantage in attracting them (Kristof, 1996). Hence, entrepreneurs should, on the one hand, consider their distinctive qualities as employers and, on the other hand, carefully consider the type of employees required (Maheshwari et al., 2017; Moser et al., 2021; Navis & Glynn, 2011).

Lievens and Highhouse's (2003) employer attractiveness framework - one of the most widely used models in employer branding (e.g., Rai, 2019; Van Hoye et al., 2013) - distinguishes between instrumental and symbolic employer attributes across organizational contexts. These attributes represent organizational characteristics and shape a specific employer image when communicated to potential job candidates (Lievens et al., 2016). Whereas instrumental attributes include tangible benefits for the job seeker, such as compensation or learning opportunities, symbolic attributes represent more intangible benefits. They are akin to the organization's personality, such as innovativeness or prestige. Hence, it is often the symbolic attributes that signify the alignment between the person and the organization (Lievens & Highhouse, 2003).

Instrumental and symbolic attributes serve different purposes for prospective employees. Whereas instrumental attributes are more consumption-related, symbolic attributes target social needs, such as self-enhancement or a sense of belongingness (Park et al., 1986). Traditional symbolic attributes, as identified in Lievens et al.'s (2003) research on banks, include sincerity (e.g., honest employers), competence (e.g., intelligent employers), prestige (e.g., respected employers), robustness (e.g., strong employers), and innovativeness (e.g., exciting employers). Ample evidence supports these symbolic attributes across various job sectors (Lievens et al., 2007; Rai, 2019) and different cultures (e.g., Van Hoye et al., 2013). Despite its strong explanatory power across organizational contexts, it remains unclear whether and how this framework can be transferred to the start-up context.

## Instrumental and symbolic attributes in start-ups

Applying these attractiveness attributes to the context of start-ups, it becomes apparent that they differ from those found in established companies (Barber et al., 1999; Moser et al., 2017; Roach & Sauermann, 2024; Tumasjan et al., 2011). First, start-ups are still in the organizational formation phase. Consequently, there is uncertainty about the types of instrumental attributes they can offer at the critical early stages, so that some attributes may simply not be available yet. For instance, cultivating a positive and successful team climate requires considerable time for development (Price et al., 2002), or delegating tasks to employees can prove exceedingly challenging for many entrepreneurs due to their strong psychological ownership of the business (Zhu et al., 2024). As a result, it remains unclear whether flat hierarchies truly exist in the early stages or whether the entrepreneur still bears the majority of responsibilities. Second, certain instrumental attributes, such as job security or high salaries, are highly valued but are more commonly found in established companies (Lievens & Highhouse, 2003). Therefore, a deficiency in these attributes could result in a reduced or constantly changing overall influence of instrumental attributes, and crafting an employer branding strategy that emphasizes symbolic attributes may prove more advantageous for start-ups.

Similar to instrumental attributes, start-ups may offer specific symbolic attributes compared to established companies. For example, innovativeness as an attribute may convey novelty and originality, particularly in the nascent stages of start-ups to investors and/or customers (Mason & Stark, 2004; Rosenbusch et al., 2011; Shepherd & Zacharakis, 2003). Furthermore, this innovativeness is fueled by flexibility, as start-ups operate with less rigid routines, enabling them to adapt to their environment swiftly. In addition, they are often receptive to new technologies, which is also linked to higher innovation and success (Hyytinen et al., 2015; Lumpkin & Dess, 1996; Rosenbusch et al., 2011). Consequently, although not all start-ups embody high levels of innovation, many still might project a sense of symbolic innovation as employers, setting themselves apart from similar competitors. Meaningfulness seems to be another key attribute of the start-up work environment, as start-ups typically involve task variety, task identity, and task significance, which are central drivers of

meaningful work in Hackman and Oldham's (1976) job characteristics model. These aspects are reflected in the changing conditions of start-ups, small teams with holistic responsibilities, and the promotion of innovative products with significant societal impact (Moser et al., 2017; Steger et al., 2012; Tumasjan et al., 2011; Wrzesniewski & Dutton, 2001). Recent research extends this view by suggesting that meaningfulness in start-ups arises not only from the work environment but, more importantly, from the existential integration of the individual with the work itself. Accordingly, start-ups are associated with professional, psychological, and societal dimensions of meaningfulness (Dirik & Özdoğan, 2025).

Given differences in employer attractiveness between start-ups and established companies, symbolic attributes should exert a stronger influence on attractiveness in start-ups than instrumental attributes. Start-ups often seem to struggle to provide consistent instrumental benefits because they lack resources, are small and new (Cardon & Stevens, 2004), and face rapidly changing conditions in their early stages of growth (DeSantola & Gulati, 2017), whereas established companies can typically offer diverse instrumental attributes (Rai, 2019; Van Hoye et al., 2013). This may also be one of the reasons why entrepreneurs prioritize an employee's alignment with the overall organization over merely meeting job requirements (Heneman et al., 2000), as symbolic attributes reflect the organization's personality more than instrumental attributes do (Lievens & Slaughter, 2016). At the same time, entrepreneurs were found to typically gain advantages from utilizing symbols to build their corporate identity, which extends to enhancing employer attractiveness through symbolic attributes (Clarke, 2011; Zott & Huy, 2007). Moreover, joiners of start-ups simply do not seem value instrumental attributes as much as employees in established companies (Roach & Sauermann, 2024). For start-up joiners, symbolic attributes may play a relatively larger role. Lastly, start-ups need to use an employer branding strategy to distinguish themselves from other organizations (Moser et al., 2017; Navis & Glynn, 2011), and symbolic attributes tend to be more effective than instrumental benefits in distinguishing one company from another (Lievens & Highhouse, 2003). Therefore, we hypothesize:

Hypothesis 1. Symbolic attributes (i.e., innovativeness and meaningfulness) exert a stronger influence on employer attractiveness of start-ups compared to instrumental attributes (i.e., job security and compensation).

## Career orientation of applicants

Preferences that distinguish employees in start-ups from those in established companies may also lie in their varying career orientations. Whereas traditional career orientations typically entail an organization's responsibility for an employee's career development, with well-defined hierarchical career paths within a company (Gerber et al., 2009), recent trends show a rise in new career orientations, where more individuals are prioritizing professional growth and job mobility over physical capital (Hall et al., 2018; Markman et al., 2002). One of these new career orientations, the "protean career" is described as a career "in which the person, not the organization, is in charge, the core values are freedom and growth, and the main success criteria are subjective (psychological success) vs. objective (position, salary)" (Hall, 2004, p.4). This career orientation thus refers to individuals who strive to maintain autonomy over their career trajectory and ensure it resonates with their personal values (Li et al., 2022). High-PCO individuals are also anticipated to navigate uncertain and evolving environments adeptly (Briscoe et al., 2006; Hall et al., 2018; Li et al., 2022). Moreover, they are typically open-minded and proactive in seeking opportunities for self-improvement, leading to greater knowledge of their strengths and weaknesses (Li et al., 2022). Taken together, high-PCO individuals approach their career choices in a more self-directed and values-oriented manner.

The behaviors and characteristics observed in individuals with high PCO align well with the dynamics observed in the early stages of start-up environments (Roach & Sauermann, 2015; Sauermann, 2018; Volkmer et al., 2024). For instance, start-ups provide ample opportunities for autonomous work and taking on responsibility for comprehensive tasks (Tumasjan et al., 2011). Furthermore, alignment with values can be assessed through the symbolic attributes that start-ups promote. These symbolic attributes may be more noticeable than instrumental ones and can help individuals determine their fit with the organization based on its personality. For individuals with high PCO, understanding these values is particularly crucial as they make career decisions based on their personal values (Briscoe et al., 2006; Hall, 1976; Hall et al., 2018). In contrast, individuals with low PCO may place less importance on symbolic attributes when evaluating how well an organization fits them, as matching their personality traits and values is less crucial to their decision-making. Therefore, symbolic attributes will also have a limited influence on their perception of the start-up's attractiveness. Thus, we hypothesize:

Hypothesis 2. PCO moderates the relationship between symbolic attributes and employer attractiveness. Specifically, higher levels of PCO will strengthen the correlation between symbolic attributes and the rating of employer attractiveness.

### Beyond employer attractiveness

Finally, meta-analytic results indicate that employer attractiveness is positively associated with recruitment outcomes such as job pursuit intentions, job choice, and job offer acceptance intentions (Chapman et al., 2005; Santiago, 2019; Slaughter et al., 2004). Job search can be considered as a self-regulatory process, and the intensity of job search behavior has been identified as a leading predictor for subsequent employment (Van Hooft et al., 2021). The more job seekers engage in activities such as networking, reviewing job postings, visiting employment agencies, or seeking advice about job opportunities, the more likely they are to secure employment (Van Hooft et al., 2021). Therefore, we suggest that this relationship also applies to start-ups' employer attractiveness and influences subsequent job search behavior:

Hypothesis 3. The higher the employer attractiveness in the early phase of the recruitment process, the higher the intention to obtain further information about the company.

## METHODOLOGY

### Overview

This study used a 2×2 within-subject design. As predictors, we manipulated the level of symbolic attributes (high vs. low) and instrumental attributes (high vs. low). Innovativeness and meaningfulness were designated together as symbolic attributes, while compensation and job security were categorized together as instrumental attributes (similar to Moser et al., 2021). The dependent variable was employer attractiveness. Moreover, PCO was regarded as a moderator of the relationship between symbolic attributes and employer attractiveness. Additionally, employer attractiveness was considered as a predictor for participants' intention to obtain further information about the presented start-up as a potential employer. The health-tech sector was selected due to its current prominence and the high prevalence of start-ups (Djurickovic, 2025; Muhos et al., 2019; Silicon Valley Bank, 2025), thereby enhancing the realism of the stimuli. In addition, restricting the study to a single industry minimized potential confounding effects of sector-specific interests and perceptions (e.g., prestige differences across industries). Because this meant that the study materials featured fictitious health-tech start-up websites, participants' interest in the health-tech sector was assessed as a covariate to control for individual differences in sector-specific interest. The pre-registration for the study is available on the platform aspredicted.org (a deanonymized link: https://aspredicted.org/fkzw-6y9c.pdf). Ethical approval was not required for this study, in accordance with local legislation and the institutional requirements of Saarland University. The datasets generated and analyzed during the current study are available in the OSF repository (https://osf.io/xwcr2/?view_only=bbaf5761ecb64c49a29be1f461beeb44).

### Sample

To determine the sample size, an a priori power analysis was conducted using Monte Carlo simulations for linear mixed-effects models that reflect the planned design, with four fully crossed profiles nested within participants. The focal parameter was the cross-level interaction between symbolic attributes and PCO. The interaction effect was set to $\beta = 0.10$, representing a small but meaningful cross-level effect. The intraclass correlation coefficient was assumed to be 0.60, consistent with typically high ICCs (0.40–0.70) in organizational research (Bliese, 2000). Target power was $\beta = 0.80$. Main effects for symbolic ($\beta = 0.17$) and instrumental framing ($\beta = 0.13$) were based on prior work (Lievens & Highhouse, 2003; Lievens et al., 2007). The effect of PCO was set to $\beta = 0.22$ (typical range 0.20–0.25) (Hirschi et al., 2017; Waters et al., 2014), and the effect of a standardized covariate was assumed to be $\beta = 0.20$. Predictor correlations were set to zero, and moderate random-slope variances (0.05) were assumed in the data-generating process. For each candidate sample size, 1000 datasets were simulated and analyzed using likelihood-ratio tests ($\alpha = 0.05$). This analysis indicated that a sample size of $N = 550$ participants was required to achieve at least $\beta = 0.80$ power for detecting the symbolic × PCO interaction.[5]

5 In the preregistration of the study, an a priori power analysis was conducted were conducted for the respective hypotheses. Regarding to the potential moderating effect in hypothesis 2, a small effect size of $f^2 = 0.02$ was assumed. A power of $\beta = 0.80$ and a significance level of $\alpha = 0.05$ were applied by convention. Based on these assumptions, the power analysis indicates that a minimum of 647 subjects is required to achieve the desired statistical power. Therefore, the number of subjects is fixed at 647. It emerged that the preliminary power analysis was incompatible with the chosen calculation model. Therefore, a revised power analysis was conducted after the initial data collection round, the results of which dictated the parameters for a subsequent round of data.

## Sample recruitment

The present study used Prolific, a web-based platform for recruiting research participants (Palan & Schitter, 2018). To ensure a sample with comparable working conditions, we recruited participants only from the United States. Given that people typically start searching for a job after completing their education and that new businesses tend to appeal more to younger people as potential employers (Ouimet & Zarutskie, 2014), the present study was restricted to participants aged 18 to 30 years. Unlike previous studies on employer attractiveness in start-ups (Roach & Sauermann, 2015, 2024), we intentionally included all participants within this age range to examine how individual differences might affect attractiveness ratings, without reducing variance. In addition, an attention check item ('Please answer this item with "strongly disagree"') was included, and participants were excluded if they did not answer the item correctly or did not finish the survey. Furthermore, we anticipated that participants would spend a minimum of 7 minutes completing the survey, based on the average reading speed suggested by Carver (1992). Overall, 1101 people participated in the study. However, 59 participants were excluded due to the mentioned criteria. Additionally, participants were required to access multiple company websites. We tracked this by monitoring whether participants genuinely clicked on the provided links using JavaScript. Those who did not click on the links to the websites were subsequently excluded. This criterion resulted in the exclusion of another 491 participants.

Due to the substantial number of participants excluded from the final sample, additional analyses were conducted to identify potential systematic differences between the excluded and included groups. However, a comprehensive comparison was constrained by the fact that 307 participants revoked their consent after their submissions were rejected on Prolific (primarily due to failure to visit all required external links). Because the withdrawal of consent precluded the use of any recorded information, no demographic or study-related data were available for this subset. Among the remaining excluded participants for whom data were available, 100 were male and 76 were female; one participant declined to disclose their gender, and one value was missing. Additionally, two cases were removed due to expired data. The excluded group spent an average of 15.7 minutes completing the study ($SD$ = 70.0 minutes). This high standard deviation indicates extreme variability in completion times, suggesting inconsistent engagement or significant outliers within the excluded cohort. Furthermore, while the excluded participants reported a mean interest in the health-tech sector of 3.73 ($SD$ = 1.27), this figure is based on a sample of only 11 individuals and must be interpreted with caution. Consequently, a robust statistical comparison between the final and excluded samples was not feasible due to the extensive missing data resulting from consent withdrawals.

## Sample description

The final sample consisted of $N$ = 551 (213 female, 196 male, 4 preferred not to say, 138 did not indicate their gender). On average, participants were 25.131 years old ($SD$ = 3.11). As the fictitious start-up websites were themed around health-tech, participants' interest in this field was accounted for as a covariate in our calculations. On average, participants displayed an interest level of 3.32 ($SD$ = 1.23, on a 5-point Likert scale).

## Procedure

Participants were directed to our survey following a link in Prolific. Initially, participants were instructed to envision themselves in a job search scenario. Subsequently, they were directed to click on links to four fictional start-up websites, with the order of the website links randomized. To ensure thorough engagement, a minimum processing time of 90 seconds for each survey page was enforced. Following their visit to each website, participants were prompted to rate the innovativeness, meaningfulness, compensation, and job security. This served as a manipulation check for the various employer attractiveness attributes: symbolic (innovativeness and meaningfulness) and instrumental (compensation and job security). After visiting each website, participants were asked to rate the attractiveness of the start-up and to indicate their intention to obtain further information about it. Towards the completion of the survey, participants were invited to assess their PCO and their interest in health-tech. On average, it took about 12 minutes (754.22 seconds, to be precise; SD = 374.66 seconds) to complete the experiment, and participants were paid at a rate of 7.51 British pounds per hour.

## Material

To operationalize the symbolic and instrumental attributes of new businesses as realistically as possible, a total of 4 websites for fictitious start-ups were created using the online platform Wix.com (www.wix.com). This approach was chosen due to the fact that company websites are commonly used media for communicating employer branding and are among the most frequent sources of information for job seekers (Banks et al., 2019). The structure of each website was the same: about us, who we are, vision, why work for us, and our benefits (see also Figure 1). The number of words and pictures was also held equal (3 pictures and 230-238 words per website). On these websites, a combination of both symbolic and instrumental attributes was manipulated to examine their effects on employer attractiveness. For each attribute, we established two conditions: high, indicating elevated levels, and low, indicating diminished levels. This results in four types of websites, each representing combinations of start-up-specific symbolic attributes (meaningfulness and innovativeness) at high and low levels, along with classic instrumental attributes (compensation and job security) at high and low levels.

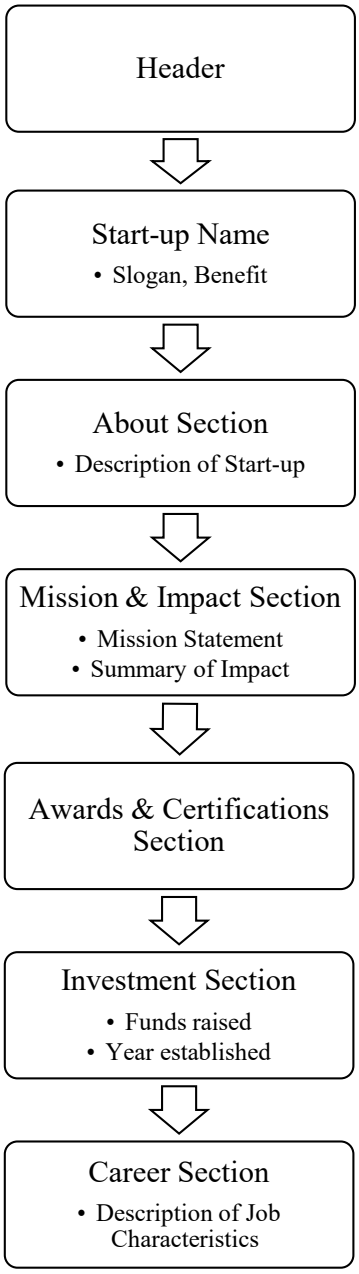


**Figure 1**. Structure of fictional start-up websites

The manipulation of attributes was implemented through different statements of the fictional start-up placed on the websites. The development of statements was representative of each attribute and was based on a previous study that identified a variety of words considered particularly meaningful for specific attributes (Theurer et al., 2022) and those found on websites of actual start-ups (e.g., Loom, 2024; MikMak, 2024; reCup GmbH, 2024). To achieve a very high level of realism, and given the difficulty of finding purely quantitative expressions for certain attributes, we opted to include both quantitative and qualitative expressions to represent high and low levels of the conditions. Overall, drawing on these materials led to the identification of start-up-specific attributes related to job security, compensation, innovativeness, and meaningfulness Table 1. These attributes differ from those typically used in these categories but are more plausible in a start-up context, as specifying exact monetary compensation, for example, is often not feasible because it depends on a start-up's funding situation and may change rapidly. Links to the websites of the fictitious start-ups can be found at https://osf.io/xwcr2/?view_only=2bafaa0b54fd494a9165e9b2ad3f3753.

**Table 1.** Manipulation of instrumental and symbolic attributes

| Level | Instrumental attributes | | Symbolic attributes | |
|---|---|---|---|---|
| | Qualitative | Quantitative | Qualitative | Quantitative |
| High | 2 × job security (e.g., we are part of a fast-growing industry) | 1 × job security (e.g., 15 Mio € in funding) | 2 × innovativeness (e.g., we are a new and exciting health-tech start-up) | 2 × innovativeness (e.g., we allocate 30% of our annual revenue to research and development purposes) |
| | 2 × compensation (e.g., remote work: you decide where you want to work from) | 3 × compensation (e.g., gym membership in your area: Stay fit & healthy) | 2 × meaningfulness (e.g., fulfillment starts with meaningful work) | 2 × meaningfulness (e.g., we already impacted > 10 Mio people by using [Start-up name] to live healthier and better lives) |
| | Quantitative | | Quantitative | |
| Low | 2 × job security (e.g., 500 k € in funding) | | 2 × innovativeness (e.g., we were nominated for the Global Start-up Awards in the category Most Innovative Start-up) | |
| | 2 × compensation (e.g., outdoor sports sessions every two weeks for the whole team) | | 2 × meaningfulness (e.g., for a better life: We already impact > 5k people by using [Start-up name] to ensure restful sleep and therefore more energy for daily life) | |

*Note:* The provided numbers correspond to the number of statements regarding the respective attributes posted on the websites, resulting in 8 for high levels and 4 for low levels.

## Measures

Employer attractiveness was the primary dependent variable for H1-H2 and served as a predictor for H3. It was measured with three items from a scale from Highhouse et al. (2003). Items were: "For me, COMPANY NAME would be a good place to work," "COMPANY NAME is attractive to me as a place for employment", and "A job at COMPANY NAME is very appealing to me." Participants were again asked to rate this item on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The internal consistency of this scale was $\alpha = 0.94$, indicating very good reliability.

Intention to obtain more information about one of the start-ups as employers was the specific dependent variable for H3 and was measured with one item ("I would click on 'FIND OUT MORE' to obtain further information about working at COMPANY NAME"). Participants were asked to rate this item on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

PCO was measured using seven items from a scale from Baruch (2014). Participants rated the items on a 7-point Likert scale (1 = "strongly disagree", 7 = "strongly agree"). Example items are: "For me, career success is how I am doing against my goals and values, or "I take responsibility for my own development. Internal consistency of this scale was $\alpha = 0.76$ and thus acceptable.

Participants' interest in the health-technology industry was assessed as a covariate and measured using one item ("How interested are you in the health-technology industry?"). Participants were asked to rate this item on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

## Manipulation check

To ensure the manipulation of the attributes on each company website, we implemented a manipulation check after each website. Participants were asked to rate the different start-ups of the websites on a 6-point Likert scale from 1 (strongly disagree) to 6 (strongly agree) for innovativeness, meaningfulness, compensation, and job security. Assessment of innovativeness was measured with one item from the "PORGI-scale" from Hurt and Teigen (1977) ("COMPANY NAME is receptive to new ideas"). Meaningfulness was measured with one item adapted from the Work as Meaning Inventory from Steger et al. (2012) („The work the employees of COMPANY NAME do serves a greater purpose"). Compensation was measured with an item based on Highhouse et al. (2003) („COMPANY NAME has a good benefit package"), and job security was measured with one item based on Lievens et al. (2007) („COMPANY NAME offers job security"). Descriptive statistics are shown in Table 2. Detailed results of the paired-samples *t*-tests are reported in Table 3.

To assess the difference in perceptions of symbolic and instrumental attribute levels, we conducted pairwise directed and non-directed *t*-tests. The results indicate that 9 of 12 *t*-tests confirmed our manipulation of symbolic and instrumental attributes across different websites. Although three within-category manipulation checks (high–high or low–low) did not demonstrate the expected outcomes, this does not compromise the manipulation's validity, as the manipulation targeted high–low contrasts between symbolic and instrumental attributes, all of which were significant and in the expected direction, with no reversals observed.

**Table 2.** Descriptive statistics for the manipulation checks

| | **CareMe** | | **HealthConnected** | | **SymptomGuard** | | **SleepWell** | |
|---|---|---|---|---|---|---|---|---|
| Symbolic attributes | high | | low | | high | | low | |
| Instrumental attributes | high | | high | | low | | low | |
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Symbolic attributes | 4.86 | 0.91 | 4.71 | 0.93 | 4.78 | 0.94 | 4.52 | 0.91 |
| Instrumental attributes | 4.83 | 0.88 | 4.72 | 0.93 | 3.98 | 1.10 | 3.60 | 1.13 |

*Note:* $N = 551$. "High" and "low" indicate the conditions of manipulation. "CareMe," "HealthConnected," "SymptomGuard," and "SleepWell" are fictitious names of start-ups.

**Table 3.** Manipulation check: Paired *t*-tests

| **Comparisons** | ***t*** | ***df*** | ***p*** | ***d*** |
|---|---|---|---|---|
| Symbolic attributes: High (CareMe) vs. Low (HealthConnected) | 4.20 | 550 | <0.001** | 0.18 |
| Instrumental attributes: High (CareMe) vs. High (HealthConnected) | 3.33 | 550 | <0.001** | 0.14 |
| Symbolic attributes: High (CareMe) vs. High (SymptomGuard) | 2.17 | 550 | 0.031 | 0.09 |
| Instrumental attributes: High (CareMe) vs. Low (SymptomGuard) | 19.80 | 550 | <0.001** | 0.84 |
| Symbolic attributes: High (CareMe) vs. Low (SleepWell) | 13.02 | 550 | <0.001** | 0.55 |
| Instrumental attributes: High (CareMe) vs. Low (SleepWell) | 25.40 | 550 | <0.001** | 1.08 |
| Symbolic attributes: Low (HealthConnected) vs. High (SymptomGuard) | -1.51 | 550 | 0.065 | -0.06 |
| Instrumental attributes: High (HealthConnected) vs. Low (SymptomGuard) | 15.87 | 550 | <0.001** | 0.68 |
| Symbolic attributes: Low (HealthConnected) vs. Low (SleepWell) | 5.57 | 550 | <0.001** | 0.24 |
| Instrumental attributes: High (HealthConnected) vs. Low (SleepWell) | 23.70 | 550 | <0.001** | 1.01 |
| Symbolic attributes: High (SymptomGuard) vs. Low (SleepWell) | 6.58 | 550 | <0.001** | 0.28 |
| Instrumental attributes: Low (SymptomGuard) vs. Low (SleepWell) | 9.34 | 550 | <0.001** | 0.40 |

*Note:* $N = 551$. Paired *t*-tests compare conditions that differ in symbolic or instrumental attribute levels (e.g., high vs. low). Cohen's *d* refers to paired-samples effect sizes. *$p < 0.05$, **$p < 0.01$.

## RESULTS

All analyses were conducted using R (version 4.5.2).[6] Hypotheses 1 and 2 were tested using hierarchical linear modeling (HLM). At Level 1, symbolic and instrumental start-up attributes were entered as fixed effects, varying within participants across scenarios. Random intercepts as well as random slopes for symbolic and instrumental attributes were specified at the participant level. At Level 2, PCO and interest in the health-technology sector were included as between-person factors, with interest in the health-technology sector serving as a covariate. Continuous predictors were grand-mean centered and standardized prior to analysis, whereas within-person binary predictors were effect-coded (-0.5/+0.5) and not standardized. The use of HLM was appropriate given the nested structure of repeated scenario evaluations within participants (Raudenbush & Bryk, 2002). Hypothesis 1 was tested using a planned contrast comparing the fixed effects of symbolic and instrumental attributes on employer attractiveness. Hypothesis 2 was examined by estimating cross-level interactions between PCO and both symbolic and instrumental attributes. Hypothesis 3 was tested using a linear mixed-effects model predicting intention to seek further information from employer attractiveness, with random intercepts and random slopes for attractiveness specified at the participant level. Table 4 reports means and standard deviations of employer attractiveness for symbolic versus instrumental attribute conditions, and Table 5 presents the results of the HLM analyses.

**Table 4.** Descriptive statistics for employer attractiveness for symbolic vs. instrumental attributes (1102 observations)

| **Predictors** | **Employer attractiveness** | | | |
|---|---|---|---|---|
| | High | | Low | |
| | *M* | *SD* | *M* | *SD* |
| Symbolic attributes | 3.75 | 1.02 | 3.47 | 1.13 |
| Instrumental attributes | 3.99 | 0.96 | 3.23 | 1.07 |

The planned contrast revealed a significantly stronger effect of instrumental than symbolic attributes on employer attractiveness, $\Delta\beta = 0.48$, $t = 10.65$, $p < 0.001$. Because both predictors were effect-coded and not standardized, this contrast reflects a direct comparison of the two manipulation effects. Thus, Hypothesis 1, which stated that symbolic attributes would contribute more to the attractiveness of start-ups than instrumental attributes, was not confirmed. Moreover, the cross-level interaction between the fixed Level 1 factor "symbolic attributes" and random Level 2 factor "PCO" was also not significant, $p = 0.514$, disconfirming Hypothesis 2.

In addition, the results of the mixed-effects model for H3 revealed a significant positive association between employer attractiveness and the intention to seek further information, $\beta = 0.88$, $t = 43.76$, $p < 0.001$. Thus, Hypothesis 3 was supported.

**Table 5.** Hierarchical linear modeling results, with the dependent variable being employer attractiveness

| **Predictors** | **β** | ***95% CI*** | ***SE*** | ***t*** | ***p*** |
|---|---|---|---|---|---|
| Fixed effects | | | | | |
| (Intercept) | 3.61 | 3.55 – 3.67 | 0.03 | 123.47 | <0.001** |
| Symbolic attributes | 0.28 | 0.22 – 0.34 | 0.03 | 9.45 | <0.001** |
| Instrumental attributes | 0.76 | 0.69 – 0.83 | 0.04 | 21.08 | <0.001** |
| PCO | 0.14 | 0.08 – 0.20 | 0.03 | 4.56 | <0.001** |
| Interest for health-tech | 0.32 | 0.26 – 0.38 | 0.03 | 10.56 | <0.001** |
| Symbolic attributes × PCO | -0.02 | -0.05 – 0.09 | 0.03 | -0.65 | 0.514 |
| Instrumental attributes × PCO | 0.02 | -0.05 – 0.09 | 0.04 | 0.54 | 0.591 |
| Random effects | | | | | |
| $\sigma^2$ | 0.35 | | | | |
| $\tau_{00\ id}$ | 0.38 | | | | |
| $\tau_{11\ id.symb}$ | 0.14 | | | | |

6 The R packages used were: lme4 (Bates et al., 2015), lmerTest (Kuznetsova et al., 2017), parameters (Lüdecke et al., 2020), effectsize (Ben-Shachar et al., 2020), dplyr (Wickham, François, et al., 2014), tidyr (Wickham, Vaughan, et al., 2014), psych (Revelle, 2007), car (Fox et al., 2001), sjPlot (Lüdecke, 2013), performance (Lüdecke et al., 2019).

| Predictors | β | *95% CI* | *SE* | *t* | *p* |
|---|---|---|---|---|---|
| $\tau_{11\ id.instr}$ | 0.37 | | | | |
| $\rho_{01\ id.symb}$ | -0.18 | | | | |
| $\rho_{01\ id.instr}$ | -0.15 | | | | |
| ICC | 0.59 | | | | |
| *N* id | 551 | | | | |

*Note:* Observations = 2204. Marginal $R^2$ = 0.265; conditional $R^2$ = 0.699. PCO = protean career orientation; *$p < 0.05$, **$p < 0.01$.

## Exploratory results

In addition to the preregistered tests, an exploratory analysis was conducted in which PCO was included in the hierarchical linear model as a Level-2 (between-participants) predictor. This analysis revealed a significant main effect of PCO on perceived employer attractiveness of start-ups, $\beta = 0.14$, $t = 4.56$, $p < 0.001$.

Another exploratory analysis examined whether symbolic attributes explain incremental variance in start-ups' employer attractiveness beyond instrumental attributes, as has been shown in prior research on more traditional organizational contexts (e.g., Lievens et al., 2007; Rai, 2019). To this end, two nested linear mixed-effects models were estimated and compared using likelihood-ratio tests. The baseline model included instrumental attributes and interest in the health-technology sector as fixed effects, along with random intercepts and random slopes for instrumental attributes at the participant level. The extended model additionally included symbolic attributes as fixed effects and allowed their slopes to vary across participants. Both models were estimated using maximum likelihood to enable model comparison.

The model comparison indicated that adding symbolic attributes significantly improved model fit, $\chi^2(4) = 122.92$, $p < 0.001$. In addition, the inclusion of symbolic attributes increased the proportion of variance explained by the fixed effects, as reflected in an increase in marginal $R^2$ from 0.23 to 0.25 ($\Delta R^2 = 0.02$). Together, these results suggest that symbolic attributes provide incremental explanatory value for employer attractiveness over and above instrumental attributes. Estimates of conditional $R^2$ should be treated with caution due to indications of singularity in the random-effects structure of the baseline model; therefore, interpretation should focus on marginal $R^2$, which reflects variance explained by the fixed effects.

## DISCUSSION

In this study, we investigated whether symbolic attributes exert a stronger influence on start-ups' employer attractiveness than instrumental attributes. Furthermore, we examined whether this affects individuals with high levels of PCO and, in the context of start-ups, sought to replicate findings on the link between employer attractiveness and job search behaviors. Our findings suggest that symbolic attributes did not have the anticipated stronger impact on employer attractiveness than instrumental attributes. Instead, instrumental attributes emerged as the primary predictor of employer attractiveness, even in the context of new ventures. Additionally, exploratory analysis revealed that PCO significantly predicts employer attractiveness for new businesses. However, PCO did not moderate the relationship between symbolic attributes and employer attractiveness. Furthermore, this study confirmed a positive relationship between attractiveness and job search behavior in the context of start-ups. Lastly, exploratory analyses revealed that, consistent with previous findings (e.g., Lievens et al., 2007), symbolic attributes explained incremental variance in start-up employer attractiveness beyond instrumental attributes.

This study aimed to examine whether symbolic attributes outperform instrumental attributes in employers' attractiveness strategies for new ventures. The results indicate that both symbolic and instrumental attributes significantly influenced employer attractiveness; however, symbolic attributes did not outperform instrumental attributes. In addition, the exploratory analyses revealed that symbolic attributes contributed incremental explanatory variance in start-up employer attractiveness. This finding is consistent with prior research conducted in more traditional employment sectors (Lievens et al., 2007; Slaughter et al., 2004). One possible explanation for these findings is that potential applicants may perceive start-ups as risky employers (Shepherd et al., 2021). As a result, they may be unwilling to consider employment with start-ups unless fundamental instrumental attributes are adequately provided, even though entrepreneurs often rely heavily on symbolic attributes to promote organizational identity.

This study also examined the role of protean career orientation in employer attractiveness. Conceptualizing PCO as an individual factor aligned with the identity of new ventures, we hypothesized that higher levels of PCO would strengthen the relationship between symbolic attributes and employer attractiveness. The results showed that PCO was a significant predictor of the attractiveness of new ventures as employers, but no interaction between PCO and symbolic attributes was observed.

So far, research about new venture attractiveness has predominantly focused on organizational characteristics (Moser et al., 2021; Tumasjan et al., 2011; Williamson et al., 2002), while individual-level research has largely emphasized personality traits rather than career-related attitudes (Roach & Sauermann, 2015; Schreurs et al., 2009). In this regard, the present study represents one of the first instances demonstrating the impact of career orientation on the attractiveness of new businesses as employers. Although career orientations are well established as important predictors of job choice (Hirschi & Koen, 2021), their integration into employer attractiveness research and established frameworks such as the instrumental-symbolic model remains limited. An exception is the work of Hoppe et al. (2022), who examined career ambition as a career-related attitude and argued for a preference for symbolic attributes, although this effect was not empirically supported. The present study similarly did not find the expected interaction effect, which may partly be due to difficulties in clearly distinguishing between instrumental and symbolic attributes. Interestingly, the findings also indicate that individuals high in PCO are generally more attracted to new ventures, independent of specific employer attributes. These findings suggest that start-ups are associated with opportunities for self-directed career management and can still attract individuals low in PCO when instrumental and symbolic attributes are clearly conveyed.

To replicate past findings of a positive relationship between employer attractiveness and job search behavior (Chapman et al., 2005; Santiago, 2019; Slaughter et al., 2004), we suggested that higher employer attractiveness would also lead to greater interest in gathering further information about the employer. The results of this study confirmed this connection. This highlights that employer branding can indeed be viewed as a valuable strategy, not only for attracting employees but also for increasing the likelihood that candidates actively seek employment at a start-up. By offering insights into the job and promoting employer attractiveness attributes, a start-up can become more familiar to job seekers, thereby clarifying the image of what it's like to work there (Hoppe et al., 2022; Lievens & Slaughter, 2016; Moser et al., 2021). This is particularly crucial for entrepreneurs, as prospective candidates may harbor doubts about working in a new venture due to its novelty and low recognition (Williamson et al., 2002).

Overall, our research provides insights into the influences of instrumental and symbolic employer attributes, as well as PCO, on the attractiveness of start-ups, thereby expanding the instrumental-symbolic framework introduced by Lievens et al. (2003) to the start-up context. Our results indicate that, consistent with previous research, both instrumental and symbolic attributes influence the attractiveness of start-ups as employers, with symbolic attributes accounting for incremental variance. We can therefore conclude that this framework seems to apply to a large variety of job contexts, including start-ups. Moreover, regarding the role of career orientations, PCO emerged as a significant predictor of the attractiveness of start-ups as employers. Although the interaction effect of symbolic attributes on the attractiveness of start-ups was not significant, we are among the first to connect career orientations to the instrumental-symbolic framework within the context of start-ups.

## Limitations and future research

As with any study, this research is accompanied by certain limitations. First, our study is limited by the use of the "Prolific" platform, which compensated participants for their participation. We encountered a significant dropout rate, as a substantial number of participants did not appear to have visited the websites that were integral to the study. This suggests that participants' overall effort may have been low. Therefore, we decided to include only participants we were certain had visited the websites and spent sufficient time on them. Second, this study relied on fictitious websites for start-ups in the health-tech sector; however, this approach was necessary to test the theoretical arguments experimentally. Moreover, restricting the study to a single sector allowed for greater control over sector-specific interests, which might otherwise have differed and influenced outcomes across sectors.Third, only four representative attractiveness attributes were used to operationalize the instrumental and symbolic characteristics of start-ups as employers, limiting the generalizability of the framework to these specific attributes. Furthermore, some degree of cross-loading between attribute categories may have occurred, as high levels of funding, operationalized in this study as job security, may also imply greater meaningfulness. Nevertheless, the manipulation checks indicated clearly distinct perceptions of the start-ups' attributes. At the same time, the study reflects a high degree of realism, as start-up websites are typically ambiguous, yet represent one of the most common tools for presenting organizations as employers.

This study suggests at least two avenues for future research. First, start-ups typically compete with established companies for employees, necessitating a distinct employer branding strategy (Moser et al., 2021; Navis & Glynn, 2011). While the present study focused on the employer attractiveness of start-ups, future research should directly compare start-ups and established companies with regard to specific attractiveness attributes. Second, although PCO had a main effect on the attractiveness of start-ups as employers, the specific mechanisms linking career orientations to employer-attractiveness attributes remain unclear. Future research could, for example, examine which characteristics of start-ups function as salient signals or trigger points for individuals high in PCO, thereby increasing their attraction to such organizations.

### Practical implications

This study presents evidence that instrumental and symbolic attributes enhance employer attractiveness in start-ups. When developing their employer branding strategies, entrepreneurs should recognize the importance of providing fundamental instrumental attributes alongside the more abstract, intangible symbolic values that may be easier to communicate to potential employees. Additionally, they should consider the characteristics of a new business's work culture as advantageous for individuals who prioritize autonomy in their career decisions and value intrinsic factors when selecting jobs. Such individuals can be particularly valuable assets to start-ups, as they can derive meaning from their work (Hall et al., 2018), which can facilitate the growth and development of the organizational culture within the new business. In line with this, it is advisable to seek out employees with a high PCO for start-ups.

## CONCLUSION

This study contributes to the discourse on designing a distinctive employer branding strategy tailored for start-ups to attract crucial initial employees. Despite start-ups' potential to attract employees through appealing symbolic attributes, this study underscores the importance of selecting both instrumental and symbolic attributes as a foundation for attraction. Furthermore, the study reveals that career orientations, particularly PCO, significantly influence the job search behavior of potential future employees in new businesses, with individuals with high PCO levels showing greater attraction to start-ups as employers. From a practical standpoint, the study offers valuable insights for entrepreneurs seeking to develop the initial steps of an effective recruitment strategy.

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## Biographical notes

**Theresa U. Zimmer** received her doctoral degree from Universität des Saarlandes (Saarbrücken, Germany) and is a researcher at Saarland University. Her research focuses on how new businesses evolve into sustainable organizations that generate employment and contribute to economic development and social welfare. Her current work examines new venture hiring, start-up employer attractiveness, the internal development of decision-making structures, and female entrepreneurship. She has coordinated several international capacity-building projects in countries of the Global South, including Kenya, Pakistan, Jordan, and Iraq.

**Cornelius J. König** is professor of work and organizational psychology at Universität des Saarlandes (Saarbrücken, Germany). He received his doctoral degree in psychology from Philipps-Universität Marburg, Germany. His current main research interests are personnel selection, job insecurity and firing, entrepreneurship, and electronic monitoring at work. He has published in journals such as *Academy of Management Review, Annual Review of Organizational Psychology and Organizational Behavior, Journal of Applied Psychology,* and *Personnel Psychology*, among others. He also served as Vice-President for Internationalization and European Relations at Universität des Saarlandes.

**Valentin Hemm** received a Bachelor of Science in Psychology from Universität des Saarlandes, Saarbrücken, Germany, and is currently a Master's student in Psychology with a focus on Industrial and Organizational Psychology and Applied Social Psychology. His research interests include entrepreneurship as well as personnel selection and assessment in occupational contexts.

**Nida ul H. Bajwa** received a doctoral degree from Universität des Saarlandes (Saarbrücken, Germany) and is a senior researcher in Work and Organizational Psychology at Universität des Saarlandes. His main research interests include entrepreneurship, human factors in IT security, and the research–practice gap in management. He has published in journals such as *Academy of Management Learning and Education, European Journal of Work and Organizational Psychology,* and *Journal of Vocational Behavior*, among others. He has frequently conducted entrepreneurship-related capacity-building projects in countries including Jordan, Pakistan, Iraq, Romania, Kenya, France, and Ireland.

## Author contribution statement

**Theresa U. Zimmer**: Conceptualization, Data Curation, Formal Analysis, Methodology, Project Administration, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing. **Cornelius J. König**: Resources, Conceptualization, Supervision, Writing – Review & Editing. **Valentin Hemm**: Writing – Original Draft Preparation, Investigation, Methodology. **Nida ul H. Bajwa**: Resources, Supervision.

### Conflicts of interest

The authors declare no conflicts of interest.

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# Improvement in self-assessed entrepreneurial competence following participation in the Unternehmergeist Saar Program: A pilot study

***Estella Kirsch[1], Michelle Celine Jörgens[2], Michael Belz[3]***

***Abstract***

***PURPOSE:*** *This pilot study evaluated the entrepreneurial development program Unternehmergeist Saar using the well-established Entrepreneurship Competence Framework (EntreComp). Three superordinate competence dimensions and their underlying competences were self-assessed pre- and post-program: (1) Ideas & Opportunities, (2) Resources, and (3) Into Action. The aim of this study was to measure the influence of Unternehmergeist Saar, and to derive possible improvements of the talent program.* ***METHODOLOGY:*** *A newly developed questionnaire based on the EntreComp dimensions (ComPE) was developed exclusively for this study, containing 45 statements to be numerically rated by participants. Two separate groups, totaling 92 participants, took part in the competence assessment, with testing conducted both before (N = 92) and after participation (n = 77).* ***FINDINGS:*** *Results showed significant improvements for each self-assessed superordinate competence dimension of ComPE, independently of group affiliation (all $p < 0.01$ to $< 0.001$). Eight of 15 subordinate competences improved significantly through program participation, with "Valuing Ideas," "Creativity," and "Mobilizing Resources" showing the largest improvements (all $p < 0.001$). At the same time, seven competences did not improve significantly, including "Working with Others" and "Learning Through Experience" (both $p_{adj} = 0.999$).* ***IMPLICATIONS:*** *The findings led to targeted adaptations of the Unternehmergeist Saar program, including structured self-reflection, motivational impulses led by alumni, intensified group pitch simulations, failure-reflection sessions, weekly micro-goals, and an expanded teamwork module. These changes aim to strengthen competences within the EntreComp dimensions (2) "Resources" and (3) "Into Action" for prospective cohorts. The need for future research to incorporate long-term follow-ups that combine self-assessment and objective assessments of entrepreneurial competence is discussed.* ***ORIGINALITY AND VALUE:*** *This pilot study is the first to evaluate Unternehmergeist Saar using a now freely available self-assessment questionnaire in the German language (ComPE), based on the EntreComp framework.*

***Keywords:*** *entrepreneurship education, entrepreneurial competence, EntreComp, ComPE, competence assessment, self-assessment questionnaire, instrument development, psychometric evaluation, program evaluation, challenge-based learning, experiential learning, longitudinal pre–post design, entrepreneurial talent program, agile learning, innovation competence.*

1 Estella Kirsch, M.Sc., August-Wilhelm Scheer Institut für digitale Produkte und Prozesse gGmbH, Uni Campus Nord D 5 1, 66123 Saarbrücken, Germany, e-mail: estella.kirsch@aws-institut.de
2 Michelle Celine Jörgens, M.Sc., August-Wilhelm Scheer Institut für digitale Produkte und Prozesse gGmbH, Uni Campus Nord D 5 1, 66123 Saarbrücken, Germany, e-mail: michelle.joergens@aws-institut.de
3 Michael Belz, PD, Ph.D., University Medical Center Göttingen (UMG), Department of Psychiatry and Psychotherapy, von Siebold-Straße 5, 37075 Göttingen, Germany, e-mail: michael.belz@med.uni-goettingen.de (ORCID: https://orcid.org/0000-0001-9250-6049).

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## INTRODUCTION

Entrepreneurial competences are gaining importance in an ever-evolving society (Venesaar et al., 2021). The talent program *Unternehmergeist Saar*, organized by the *August-Wilhelm Scheer Institut gGmbH*, has contributed to entrepreneurial competence development since 2022. The selection of relevant competences relies on the *European Entrepreneurship Competence Framework (EntreComp)* (McCallum et al., 2018). Oriented towards research (Azim & Al-Kahtani, 2014; Longmuß et al., 2021; Morselli & Orzes, 2023; Schuchmann & Seufert, 2013), an action-oriented learning approach in the form of project work is chosen to enable effective and sustainable competence development. Based on real-world problems, talents work on global topics such as sustainability, health, and education, with close collaboration among talents, research, and the economy. Relying on agile learning, entrepreneurial thinking and behavior are developed through specific use cases to establish relevance.

To evaluate the program, the Competence Profiler Entrepreneurship (ComPE), a German-language entrepreneurial competence assessment tool based on EntreComp, was used for the first time in this pilot study. Participants of Unternehmergeist Saar rated their competences before and after participation. Based on these results and additional analysis on personal entrepreneurial traits, promising project teams were assembled. This pilot study presents the first data on the longitudinal change of self-assessed competences before and after participation in the Unternehmergeist Saar program.

The paper begins with a comprehensive literature review, followed by a detailed description of the methodology. This includes participant selection, study design, a description of the talent program, and the ComPE assessment tool, as well as the analysis methods. Next, the results are presented and critically discussed. The study concludes with a summary of the key findings and an outlook on future research.

## LITERATURE REVIEW

The term competence is defined as the combination of knowledge, skills, and attitudes, which are seen as the prerequisite for performing a job. Entrepreneurial competences are characterized by creating either financial, cultural, or social value, or all the aforementioned (McCallum et al., 2018). To contribute to a common understanding of entrepreneurial competences, the European Commission introduced the EntreComp framework, which is not merely a static competence taxonomy but also one of the eight key competences for life-long learning (Council of the European Union, 2018). Moreover, EntreComp provides insights into its extensive application across domains and use cases (McCallum et al., 2018), making it a well-established and validated framework in practice. The flexible framework lists and describes competences relevant to citizens across all areas of life, is targeted at collecting and allocating entrepreneurial competences within so-called competence areas, thereby laying a foundation for their development. The framework consists of three superordinate competence dimensions, each including five underlying competences. In total, EntreComp encompasses 15 entrepreneurial competences within the dimensions (1) Ideas & Opportunities, (2) Resources, and (3) Into Action. The three superordinate dimensions reflect the process of entrepreneurship: (1) Ideas and Opportunities includes the competences Spotting Opportunities, Creativity, Vision, Valuing Ideas, and Ethical Thinking; (2) Resources encompasses Self-Awareness & Self-Efficacy, Motivation & Perseverance, Mobilizing Resources, Financial & Economic Literacy, and Mobilizing Others; (3) Into Action refers to Taking the Initiative, Planning & Management, Coping with Uncertainty, Ambiguity & Risk, Working with Others, and Learning Through Experience. Each subordinate competence is described by its practical manifestations and is accompanied by the EntreComp progression model, which presents four main competence levels: Foundation, Intermediate, Advanced, and Expert. Each level is broken down into two sublevels, resulting in eight sublevels in total. The progression model can be applied to all entrepreneurial competences and is intended to guide the development from the foundation to the expert level (Bacigalupo et al., 2016a).

Having entrepreneurial competences is crucial for identifying and seizing new opportunities in complex contexts (Cubico et al., 2018), making them a key factor for entrepreneurial success (Mitchelmore & Rowley, 2010). Thus, their development is highly relevant in all phases of education (Voigt et al., 2005; Wilson et al., 2009) and is gaining increasing importance in society (Yang et al. 2018). Competence-oriented development puts the learner at the center of the process (Morselli & Orzes, 2023). An important aspect of this is experience, in order to plan, execute, and reflect on actions (Miettinen, 2000). Many of the so-called progressive pedagogical approaches are based on the experiential aspect, including Project-Based Learning (PjBL), Problem-Based Learning (PBL), and Challenge-Based Learning (CBL)

(Kakouris & Morselli, 2020). These approaches are suitable for improving and developing skills. CBL is particularly appropriate for developing entrepreneurial competences, as it goes beyond subject-specific understanding and prepares learners for uncertain and complex settings. The main difference compared to PjBL and PBL is that CBL integrates social dimensions: here, it is important that learners work in groups and that external stakeholders are involved. In addition, the approach incorporates global issues and real-world challenges that focus on complex problems and support different perspectives (Gallagher & Savage, 2023). In essence, the aim of CBL is to prepare learners for the challenges of working life in a dynamic world (Morselli & Orzes, 2023). These characteristics of CBL align with entrepreneurial development programs. The focus of the latter is on interdisciplinary work and close collaboration between learners and their local communities, such as universities and business partners (Gallagher & Savage, 2023).

According to Leutner et al. (2017), assessing competence is crucial for optimizing educational interventions. Souza and Lima (2020) conducted a literature review that identified several approaches to assessing competences in medicine, education, and engineering. These approaches include evaluations by specialists using questionnaires or behavioral observations, self-assessments, and structured or semi-structured interviews. Furthermore, Lackéus and Williams Middleton (2018) collated five different methods for assessing experiential education, which is common in entrepreneurial education: performance assessment, reflective assessment, peer- and self-assessment, e-assessment, and constructive alignment. Each method has advantages and disadvantages. Self-assessment is often less accurate than objective assessment because it is biased by factors such as self-efficacy, and it is also one-dimensional (Sillat et al., 2021). Since external perspectives complement self-perceptions, both should be considered together to assess competences (Alastalo et al., 2023; Sillat et al., 2021).

Initial developments of assessment tools based on the EntreComp framework have been identified (Bacigalupo et al., 2016b). However, these tools often exhibit limitations. Many lack transparency regarding their development process, are exclusively available in English, or have modified the competences outlined by the European Commission. For instance, KompetenzPanel (n.d.) provides a German-language competence assessment tool based on EntreComp, but the development process is not transparent, and the tool is not freely accessible. Morselli and Gorenc (2022) developed and utilized a questionnaire grounded in the EntreComp framework to evaluate two entrepreneurship education courses. However, this tool is available only in English, and only excerpts from the questionnaire are published in their article. Similarly, Armuña et al. (2020) developed a tool for English-speaking participants based on EntreComp, but they modified the original competences of the framework. Next to these self-assessment questionnaires, EntreComp Europe (n.d.) introduced a workshop-based approach to assess entrepreneurial competences. This method emphasizes individual and group reflection aligned with the EntreComp framework and relies on qualitative data analysis, which is generally more time-consuming than quantitative approaches.

In light of limitations outlined for existing assessment tools, particularly with regard to transparency and language alignment (here: German) and the impractical time demands of qualitative assessment formats, none of the aforementioned tools were deemed suitable for evaluating Unternehmergeist Saar. Therefore, we developed the ComPE exclusively for this pilot study. Its items reflect all three superordinate competence dimensions and 15 subordinate entrepreneurial competencies as defined by EntreComp. We hypothesize that participants will improve in all three self-assessed dimensions of the EntreComp framework after participation in Unternehmergeist Saar: (1) Ideas & Opportunities, (2) Resources, and (3) Into Action.

## METHODOLOGY

### Participants and study design

Participants in the study were talents of the Unternehmergeist Saar program in 2024, with one group participating from May 5 to June 28 (spring cohort) and the other from November 4 to December 6 (autumn cohort).

Items for ComPE (see details below) were implemented on the platform LimeSurvey. All program participants received access keys to the questionnaire via email. They were required to complete the questionnaire before and after the program to allow comparison of their self-assessed competence levels. Responses from the spring cohort were received between May 13 and July 19, while responses from the autumn cohort were collected between October 21 and December 19. In total, $N = 92$ talents participated in the entrepreneurial competence assessment. All participants provided informed consent for the use of their data for this purpose. To ensure anonymity, the final dataset only included the variables

described below. No data that could potentially identify any individual was included. Data were analyzed exclusively at the group level. All data are anonymized and stored on local servers with restricted access, available solely to authorized people directly involved in the analysis and writing of the paper. The data will be retained only for the duration necessary to complete the research and will be securely deleted afterwards.

## Description of the entrepreneurial talent program

Unternehmergeist Saar is an innovative program developed and organized by the August-Wilhelm Scheer Institut gGmbH. It follows a talent-centric approach to entrepreneurial development. The program aims to select individuals with an interest in entrepreneurship, referred to as talents, and to support them in developing their entrepreneurial personalities through practice-oriented competence dimensions. The target group includes, on the one hand, talents interested in founding a business, and on the other hand, those facing dynamic changes in the workplace or in their private lives brought about by digital transformation. Since the program's first run in 2022, five batches have included 205 talents working in 40 teams. As shown in Figure 1, the program is based on a 5-week sprint format divided into three main phases: Onboarding, Project Work, and Cool Down.

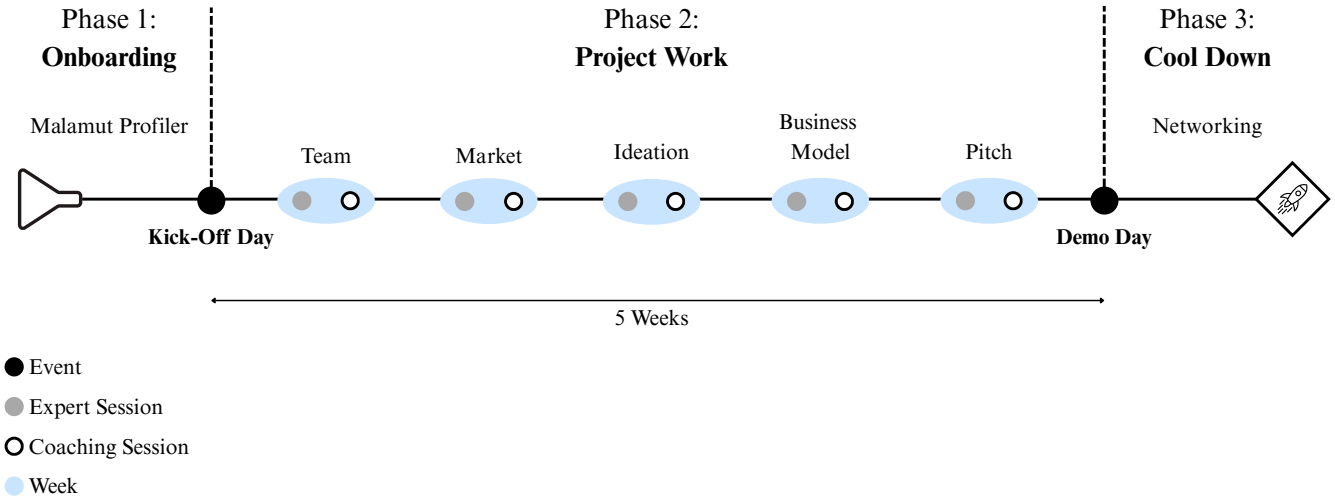


**Figure 1.** Visualization of the Unternehmergeist Saar Program

In the Onboarding phase, a specific entrepreneurial personality test, combining personality and team role analysis (Malamut Team Catalyst GmbH, 2012; Strack et al., 2013), is used to identify talents and assemble diverse, thus promising, teams. The program is based on agile methods as well as lean startup principles. Instead of knowledge sharing, the program focuses on action-based competence development by being actively engaged in relevant entrepreneurial real-world challenges. The guiding principle behind it is CBL, which focuses on the key competence of entrepreneurship. The talent program Unternehmergeist Saar uses this approach as a foundation for the learning process. Therefore, in the Project phase, the teams work on real-world challenges, inspired by input from the economy and research partners. The challenges are placed in the fields of GreenTech, HealthTech, EdTech, and Digital Sports (see Table 1 for examples). To enable the talents to act within their teams and solve the challenges, they participate in accompanied workshops, coaching, and expert sessions.

**Table 1.** Translated examples for real-world challenges (original language: German)

| Field | Real-world challenge |
|---|---|
| GreenTech | How can guests be involved in saving resources (e.g., energy, electricity, and water) in the hospitality industry? |
| HealthTech | How can digital technologies be used to support/enable gender-sensitive care? |
| EdTech | How can AI be used to create or implement interactive and collaborative learning formats in the digital space? |
| Digital Sports | How can digital technologies be used to get fans more involved in the sports experience and keep them coming back? |

Over five weeks, the program follows five themes, referred to as milestones, that guide the teamwork: Team, Market, Ideation, Business Model, and Pitch (see Figure 1). These milestones are closely linked to the competence areas and competences of EntreComp. For example, during the first week, the topic "Team" is focused on. Here, the spotlight is on the entrepreneurial competences Vision, Self-Awareness & Self-Efficacy, and Planning & Management. The sessions and methods during this week are intended to support the development of these competences. To achieve this, milestones such as "Creating a Team Agreement" are defined. A team agreement requires all members to articulate a shared vision. This collective understanding strengthens the team's ability to shape a vision and align strategically. Throughout the process, each team member reflects on their needs, working styles, strengths, and limitations. This reflection enhances self-awareness and builds self-efficacy. Additionally, the team agreement establishes structure, responsibilities, and decision-making processes. It provides a solid framework for efficient planning and management throughout the entire project. Each defined milestone directly contributes to developing the targeted competences. Additional milestones within the Team focus topic include "Developing a deep understanding of team roles" and "Establishing effective project planning and organization for the program."

To purposefully develop entrepreneurial competences, the program managers selected methods and tools that are well-established in this area. In Week 1, the primary tool for developing competences is the Team Canvas (Ivanov & Voloshchuk, 2015). Based on the individual results of the personality test, teams collaborate to complete the Team Canvas and use it as a guiding framework throughout the program. The tool helps participants clarify team roles, align expectations, and strengthen collaborative competence. In Week 2, the focus is on the market. Participants work with methods and tools such as the Mom Test (Fitzpatrick, 2013), Discovery Board, and Target Groups Profiles. These instruments support understanding user needs, market segments, and problem-solving skills. Additional methods and tools used in the remaining weeks include Design Thinking, the Business Model Canvas (Osterwalder, 2004), as well as Elevator and Startup Pitches. These tools were chosen to encourage creativity and iterative problem-solving, as well as to improve the ability to structure business models and enhance communication and persuasion. All of these methods align with the program's milestones and, consequently, with the underlying competence framework. Together, these methods provide an optimal setting for agile learning, hands-on experience, and peer-to-peer learning. The Project phase concludes with a demonstration event, in which the teams pitch their developed solutions for their assigned use case. After that, the Cool Down phase is used for networking and taking entrepreneurial initiatives.

## Description of the Competence Assessment Tool

The entrepreneurial competence assessment tool ComPE is based on the renowned competence framework EntreComp (McCallum et al., 2018) to systematically represent entrepreneurial thinking and acting. In total, ComPE comprises 45 items in German language allocated to the three superordinate competence dimensions suggested by EntreComp: (1) Ideas & Opportunities, (2) Resources, and (3) Into Action. Each area covers five subordinate entrepreneurial competences, while each competence is represented by three statements (e.g., "I can recognize problems that need to be solved"). A 5-point numeric scale with two anchors is used to rate each statement (1 = "do not agree at all" to 5 = "agree completely"). Table 2 presents a detailed overview of all translated items. Participants were required to rate all 45 statements to complete the assessment.

**Table 2.** Overview of translated questionnaire items (original language: German)

| Items | Competences |
|---|---|
| **Competence Dimension 1: Ideas & Opportunities** | |
| 1.1 "I recognize and seize opportunities that arise in order to create value." | Spotting |
| 1.2 "I can identify problems that need to be solved." | Opportunities |
| 1.3 "I forge new connections and combine different resources or ideas to create additional value." | |
| 2.1 "I develop new ideas and opportunities to create value." | Creativity |
| 2.2 "I can explore and try out innovative approaches." | |
| 2.3 "I combine knowledge and resources to achieve novel results." | |
| 3.1 "I can develop a clear vision to translate ideas into concrete, actionable steps." | Vision |
| 3.2 "I am able to imagine future scenarios and plan concrete actions based on them." | |
| 3.3 "I can imagine future scenarios in order to define and steer targeted measures and actions." | |

| Items | Competences |
|---|---|
| 4.1 "I am able to assess the value of an idea from a social, cultural, and economic perspective." | Valuing Ideas |
| 4.2 "I recognize how much potential an idea has to create value." | |
| 4.3 "I find suitable ways to get the most out of an idea and make the best use of it." | |
| 5.1 "I can assess the impact of ideas for value creation on society and the environment." | Ethical |
| 5.2 "I am able to reflect on how sustainable long-term social, cultural, and economic goals and the chosen course of action are." | Thinking |
| 5.3 "I act responsibly." | |
| **Competence Dimension 2: Resources** | |
| 6.1 "I am able to reflect on my short-, medium-, and long-term needs and goals." | Self-Awareness |
| 6.2 "I recognize and evaluate strengths and weaknesses in myself and my group." | & Self-Efficacy |
| 6.3 "I can influence the course of events despite obstacles and setbacks." | |
| 7.1 "I successfully put ideas into practice, thereby satisfying my need for achievement." | Motivation & |
| 7.2 "I can work patiently and persistently to achieve both my own goals and the long-term goals of the group." | Perseverance |
| 7.3 "Difficult situations and temporary setbacks do not impair my ability to act." | |
| 8.1 "I am able to procure and manage the various resources needed to implement ideas." | Mobilizing |
| 8.2 "I can make the most of the limited resources available to me." | Resources |
| 8.3 "I procure and manage urgently needed expertise—in technical, legal, tax, and digital areas (e.g., through partnerships or networks)." | |
| 9.1 "I can judge the costs involved in turning an idea into a value-adding measure." | Financial & |
| 9.2 "I am able to plan financial decisions and evaluate them over time." | Economic |
| 9.3 "I manage finances sustainably in order to maintain value-adding activities in the long term." | Literacy |
| 10.1 "I inspire and motivate stakeholders (interest groups) to actively participate in my project." | Mobilizing |
| 10.2 "I am able to obtain the necessary support to achieve valuable results." | Others |
| 10.3 "I can lead, communicate, persuade, and negotiate effectively both within and outside the group." | |
| **Competence Dimension 3: Into Action** | |
| 11.1 "I take the initiative and directly initiate processes to generate value." | Taking the |
| 11.2 "I set myself challenges." | Initiative |
| 11.3 "I act and work independently to achieve goals and carry out planned tasks." | |
| 12.1 "I regularly set myself long-, medium-, and short-term goals." | Planning & |
| 12.2 "I am able to set priorities and draw up implementation plans." | Management |
| 12.3 "I successfully adapt to unforeseen changes." | |
| 13.1 "Even when the outcome is uncertain or the information available is unclear, I am able to make decisions." | Coping with |
| 13.2 "I analyze value-adding processes in a structured manner at an early stage in order to reduce the risk of failure." | Uncertainty, |
| 13.3 "I can deal with complex and dynamic situations quickly and flexibly." | Ambiguity & Risk |
| 14.1 "I cooperate with others to develop ideas and implement them together." | Working with |
| 14.2 "I am able to network." | Others |
| 14.3 "I successfully resolve conflicts and face competition." | |
| 15.1 "I see every initiative to generate value as an opportunity to learn something new." | Learning |
| 15.2 "When the opportunity arises, I enjoy learning from others." | Through |
| 15.3 "I reflect and learn from my own successes and failures as well as those of others." | Experience |

In addition to the self-assessment of competence, this study collected demographic data, including age, gender, professional background, and current professional status. Moreover, participants rated their founding experience on a 5-point ordinal scale (1 = "no points of contact" to 5 = "already founded"). Furthermore, the personal reason for participating in the program was assessed, which could be "participation as part of a study program," a "recommendation by the employer," or "intrinsic motivation."

## Statistical analysis

The data were analyzed using the statistical software SPSS®, version 31. Descriptive statistics including frequencies, mean values (*M*), standard deviations (SD), and correlations (*r;* depending on the scale level: Pearson correlations (metric), rank correlations (ordinal) and four-field Phi coefficients (binary)) were calculated for specific items based on their scale level. To assess internal consistency, Cronbach's α was calculated for the three competence dimensions of ComPE. A confirmatory factor analysis (CFA) was performed using SPSS® AMOS, version 31 (please see results section for details). Pairwise comparisons are reported separately in the results section and corresponding tables. The analysis of the three primary endpoints, represented by the competence dimensions (1) Ideas & Opportunities, (2) Resources, and (3) Into

Action, was conducted using three general linear models (GLM) for repeated measures. Participants' numerical ratings from the pre- and post-assessments were incorporated into the respective models as two-level within-subject factors. To evaluate if the self-assessed competence dimensions were affected by the program, the repeated measures effect was tested for significance. Furthermore, the two cohorts, spring and autumn, were compared to each other as a two-level between-subject factor. This procedure was used to identify group differences (between-subject effect) and to exclude differences in competence improvement between the two cohorts (interaction effect), ensuring their comparability. Both the within-subject effect and the interaction effect were tested for significance. An exploratory analysis was conducted to test the impact of confounding variables (e.g., age or motivation) on competence development across the three competence dimensions. Furthermore, an exploratory analysis of changes between pre- and post-assessment was conducted using *t*-tests for repeated measures. The initial significance level was set at $\alpha < 0.05$ (two-sided). To account for alpha error inflation, the *p*-values from the three GLMs for our primary endpoints were corrected using the Bonferroni method. Additionally, all exploratory GLMs, as well as *t*-tests of all competences, were corrected (here: $p_{adj} = p \times 15$).

## RESULTS

### Sample description and comparison to baseline

Out of $N = 92$ participants, the majority identified as male ($n = 60$, 65.2%), had an average age of 27.89 years (SD = 7.54, min: 19, max: 54), and were located in the fields of law and economics ($n = 55$, 59.8%). Employed participants were the minority ($n = 22$, 23.9%), with students being the majority. Most participants had no prior founding experience (n = 62, 67.4%) and participated in the program as part of their studies ($n = 55$, 59.8%). At the respective baselines, n = 52 talents participated in the first program run in spring, and n = 40 in the second run in autumn 2024. No significant differences in demographic data and baseline additional variables were found between the cohorts (Table 3). In total, 77 of the 92 talents took the post-assessment, resulting in a drop-out rate of 16.3%. With respect to the drop-out rates, no significant differences were found between the cohorts ($p = 0.386$). Details of the sample are shown in Table 3 ($M \pm$ SD, frequencies).

**Table 3.** Description of participants (baseline)

| Variables | Total sample ($N = 92$) | Program 1 ($n = 52$) | Program 2 ($n = 40$) | $p$ [b] |
|---|---|---|---|---|
| Gender (% male [a]) | 60 (65.2%) | 31 (59.6%) | 29 (72.5%) | *0.198* |
| Age (in years) | 27.89 ± 7.54 | 27.10 ± 4.75 | 28.97 ± 10.19 | *0.268* |
| Study Program vs. Profession (% Study Program) | 70 (76.1%) | 38 (73.1%) | 32 (80.0%) | *0.440* |
| Professional Background | | | | - [d] |
| Law/Economics | 55 (59.8%) | 35 (67.3%) | 20 (50.0%) | |
| Natural Sciences/Engineering | 13 (14.1%) | 07 (13.5%) | 06 (15.0%) | |
| IT | 10 (10.9%) | 06 (11.5%) | 04 (10.0%) | |
| Education/Social Sciences | 02 (02.2%) | 02 (03.8%) | 00 (00.0%) | |
| Arts and Culture | 03 (03.3%) | 00 (00.0%) | 03 (07.5%) | |
| Other | 09 (09.8%) | 02 (03.8%) | 07 (17.5%) | |
| Founding Experience [c] | | | | *0.984* |
| No points of contact | 62 (67.4%) | 35 (67.3%) | 27 (67.5%) | |
| Yes, already working on own idea | 13 (14.1%) | 06 (11.5%) | 07 (17.5%) | |
| Yes, entrepreneurial activities | 02 (02.2%) | 01 (01.9%) | 01 (02.5%) | |
| Yes, member of a start-up team | 06 (06.5%) | 05 (09.6%) | 01 (02.5%) | |
| Already founded | 09 (09.8%) | 05 (09.6%) | 04 (10.0%) | |
| Motivation for Participation | | | | *0.505* |
| Study program | 55 (59.8%) | 29 (55.8%) | 26 (65.0%) | |
| Recommendation by employer | 13 (14.1%) | 07 (13.5%) | 06 (15.0%) | |
| Intrinsic motivation | 24 (26.1%) | 16 (30.8%) | 08 (20.0%) | |

*Note:* ± = standard deviations; [a] Gender was recorded as m/f/d, participants only indicated binary categories (m/f); [b] Pairwise comparisons between the subsamples Program 1 vs. 2 depending on scale level, p-values for: t-test (1×), $\chi^2$-tests (3×), and U-test (1×) for the ordinal-scaled variable [c] Founding Experience; [d] a significance test was not performed for the variable Professional Background due to the small number of cells (6 cells with expected frequency < 5; 50% of all cells).

## Characteristics of ComPE

The competence assessment took $M$ = 4.90 min (SD = 3.18 min). At the baseline, the three competence dimensions showed good internal consistency: Ideas & Opportunities (α = 0.84), Resources (α = 0.81), and Into Action (α = 0.81). Pre-test values were in the top third of the 5-point numerical scale, indicating that participants already rated their competence dimensions as high before the program (M1 = 3.77, $M_2$ = 3.65, $M_3$ = 3.94 of 5). A significant positive correlation was found among the superordinate competence dimensions ($r$ = 0.662 to 0.778, all $p < 0.001$). In addition, the competence dimensions were correlated with demographic data and additional variables, along with founding experience (ordinal, from 1 = "no points of contact" to 5 = "already founded"), as shown in Table 4 (* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$).

**Table 4.** Correlations of the EntreComp competence dimensions (baseline)

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Program Run: Spring (1) vs. Autumn (2) | – | | | | | | |
| Gender (1 = male, 2 = female) | -0.134 | – | | | | | |
| Age (in years) | 0.123 | 0.144 | – | | | | |
| Study Program (1) vs. Profession (2) | -0.080 | 0.019 | 0.610*** | – | | | |
| Founding Experience | -0.017 | -0.178 | 0.246* | 0.210* | – | | |
| Dimension 1: *Ideas & Opportunities* | -0.142 | -0.146 | 0.181 | -0.006 | 0.358*** | – | |
| Dimension 2: *Resources* | -0.035 | -0.036 | 0.193 | -0.016 | 0.188 | 0.722*** | – |
| Dimension 3: *Into Action* | -0.002 | -0.098 | 0.199 | 0.096 | 0.245* | 0.662*** | 0.778*** |

A significant correlation was identified between the founding experience and the competence dimensions (1) Ideas & Opportunities ($r$ = 0.358, $p < 0.001$) and (3) Into action ($r$ = 0.245, $p$ = 0.019).

A CFA was performed on the baseline sample ($N$ = 92) using a model based on the EntreComp framework (see below). Due to the limited sample size, the model was simplified to two levels: mean ratings for the 15 subordinate entrepreneurial competences (see Table 2; mean values included three items per dimension) were entered as indicator variables. Three superordinate competence dimensions were entered as latent factors ((1) Ideas & Opportunities, (2) Resources, (3) Into Action). Five subordinate competence dimensions were then assigned to each latent factor. The maximum likelihood method was used for model estimation. Estimated factor loadings and estimated correlations between the latent factors are shown in Figure 2.

Overall, the estimated correlations between the latent factors were high (all exceeding 0.8). Factor loadings exceeded 0.5 in all cases except for the subordinate competences "Financial & Economic Literacy" for factor (2) Resources (0.348). The root mean square error of approximation (RMSEA; Xia & Yang, 2019) was used as the absolute fit index and was found to be 0.135. This was thus outside the limit of ≤ 0.06 for a good model fit (Hu & Bentler, 1999). The comparative fit index (CFI; Bentler, 1990) was used as an incremental fit index, and reached 0.774. Therefore, it failed to meet the 0.95 threshold for a good fit of the hypothesized model relative to a baseline model (Hu & Bentler, 1999).

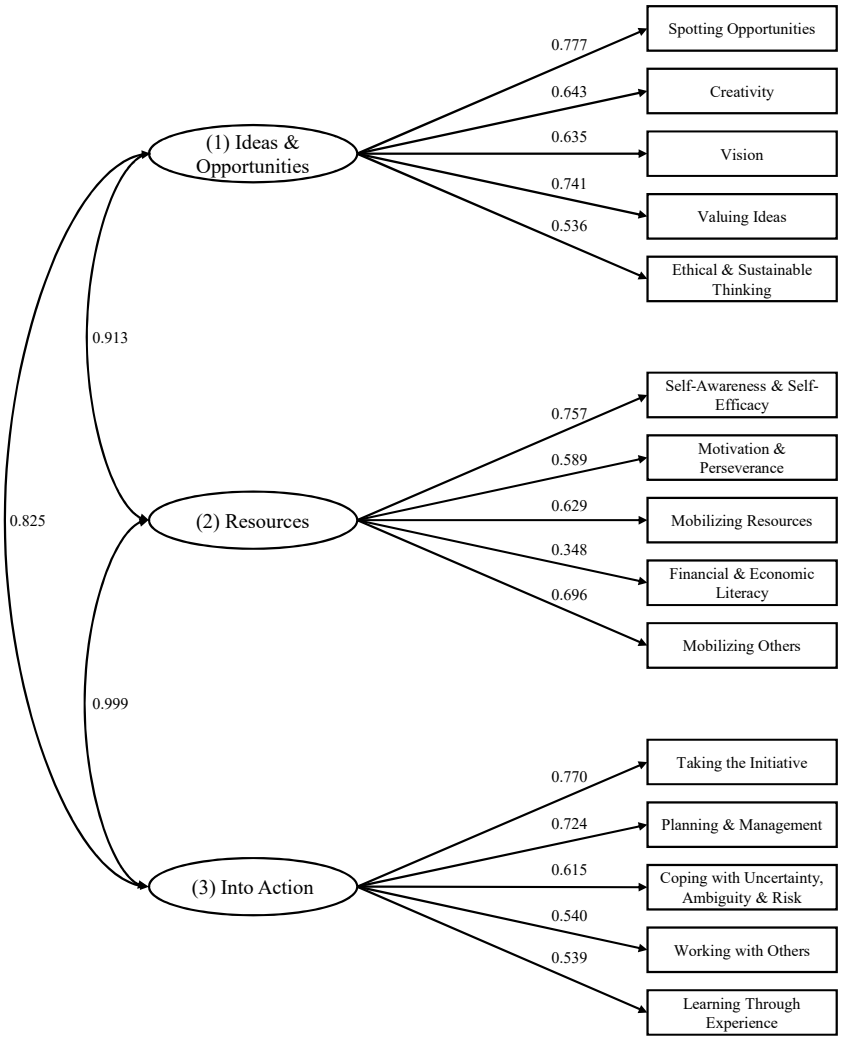


**Figure 2.** Confirmatory factor analysis of ComPE

*Note:* CFA according to the EntreComp framework; (1) *latent factors*: three superordinate competence dimensions *Ideas & Opportunities*, *Resources*, *Into Action*, numbers represent estimated correlations between the latent factors; (2) *indicator variables*: ratings (mean values) for 15 subordinate competences, numbers represent estimated factor loadings (standardized regression coefficients); RMSEA = 0.135, CFI = 0.774 ($N$ = 92).

## Changes in self-assessed competence dimensions over time

Numerical improvements were identified across the three competence dimensions, as indicated by pre- and post-assessment values. The assessed competence level of the competence dimension (1) Ideas & Opportunities significantly improved from pre- ($M$ = 3.73, SD = 0.48) to post-assessment ($M$ = 4.03, SD = 0.48). A detailed overview is provided in Figure 3.

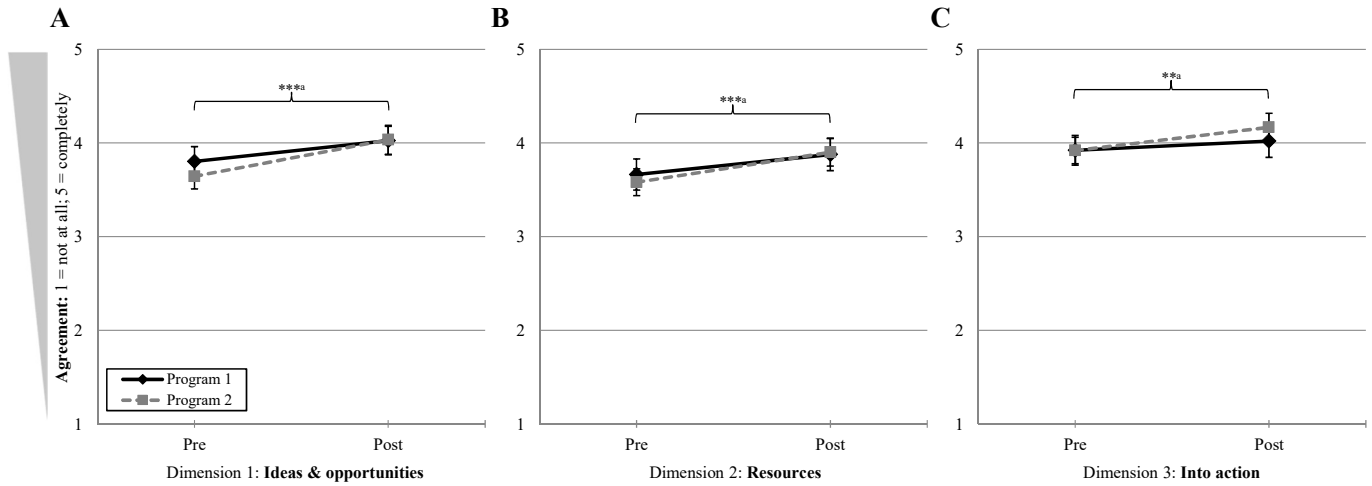


**Figure 3.** Changes in competence dimensions over time

*Note:* Mean values with 95% confidence intervals. Ratings from 1 = "do not agree at all" to 5 = "agree completely" for the pre- and post-time points (before and after program participation), differentiation between Program 1 (spring 2024, $n$ = 42) and Program 2 (autumn 2024, $n$ = 35); A: Competence Dimension 1: Ideas & Opportunities; B: Competence Dimension 2: Resources; C: Competence Dimension 3: Into Action. a Stated significance refers to the repeated measures effect (GLM) for the total sample from pre- to post-time point (*** $p < 0.001$ ** $p < 0.01$, $n$ = 77).

An associated repeated measures effect was found in the GLM ($F(1,75) = 36.34, p < 0.001$, partial $\eta^2 = 0.33$). Furthermore, no systematic or competence improvement differences between the two cohorts were identified. Both the between-subject effect (GLM: $F(1, 75) = 0.60$, *ns*) and the interaction effect (GLM: $F(1, 75) = 2.74$, *ns*) were non-significant, with all pairwise comparisons being non-significant. To summarize, a significant improvement in the competence dimension (1) Ideas & Opportunities was found, with both cohorts and program runs being comparable. A similar result was found for the competence dimension (2) Resources. Participants' competence levels increased from pre- ($M$ = 3.63, SD = 0.50) to post-assessment ($M_t$ = 3.89, SD = 0.52), as shown in Figure 3B. The associated repeated measures effect was significant (GLM: $F(1, 75) = 23.35$, $p < 0.001$, partial $\eta^2 = 0.24$), while no significance was found for between-subject effect (GLM: $F(1, 75) = 0.084$, *ns*) and interaction effect (GLM: $F(1, 75) = 0.91$, ns). All pairwise comparisons were non-significant. The competence dimension (3) Into Action also showed a positive development. Participants improved from pre- ($M$ = 3.92, SD = 0.48) to post-assessment ($M$ = 4.09, SD = 0.53). Detailed results are provided in Figure 3C. Similar to the previous competence dimensions, a significant repeated measures effect was found (GLM: $F(1, 75) = 11.37$, $p = 0.001$, partial $\eta^2 = 0.13$). The between-subject effect (GLM: $F(1, 75) = 0.49$, *ns*) and the interaction effect (GLM: $F(1, 75) = 2.12$, *ns*) were both non-significant, along with all pairwise comparisons. In sum, the competences of all competence dimensions examined in this study showed significant improvements.

Additional exploratory analyses were conducted to investigate the possible influence of categorical variables on changes in the three competence dimensions from pre- to post-assessment, using subgroups of sufficient size. GLM analyses on gender, professional status, and motivation for participation did not reveal any significant between-subject or interaction effects, and all corrected pairwise comparisons were also non-significant. However, all GLMs showed a significant repeated-measures effect (all $p \leq 0.001$), indicating that all analyzed groups benefited equally from participation in the entrepreneurial program.

## Changes in self-assessed entrepreneurial competences over time

Exploratory analyses were conducted to investigate changes in the 15 competences. Results are summarized in Table 5 (* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$, $M \pm$ SD, effect size Cohen's $d_{emp}$).

**Table 5.** Changes in competence levels pre- and post-program participation

| Competences | Pre-Test | Post-Test | $M_{diff}$ | $t(76)$ | $p$ | $d_{emp}$ | Competence dimensions |
|---|---|---|---|---|---|---|---|
| Spotting Opportunities | 3.87 ± 0.60 | 4.07 ± 0.58 | 0.20 | 2.78 | 0.103 | 0.32 | |
| Creativity*** | 3.57 ± 0.74 | 3.95 ± 0.70 | 0.38 | *4.91* | ***< 0.001*** | *0.56* | |
| Vision* | 3.84 ± 0.62 | 4.07 ± 0.59 | 0.23 | *3.09* | ***0.042*** | *0.35* | Ideas & Opportunities |
| Valuing Ideas*** | 3.61 ± 0.64 | 4.01 ± 0.58 | 0.41 | 5.57 | ***< 0.001*** | 0.63 | |
| Ethical & Sustainable Thinking** | 3.76 ± 0.59 | 4.04 ± 0.58 | 0.28 | 3.84 | ***0.004*** | 0.44 | |
| Self-Awareness & Self-Efficacy | 3.91 ± 0.64 | 4.10 ± 0.56 | 0.19 | 2.44 | 0.255 | 0.28 | |
| Motivation & Perseverance | 3.80 ± 0.57 | 3.96 ± 0.63 | 0.16 | 2.23 | 0.428 | 0.25 | |
| Mobilizing Resources*** | 3.58 ± 0.65 | 3.96 ± 0.67 | 0.37 | 4.44 | ***< 0.001*** | 0.51 | Resources |
| Financial & Economic Literacy** | 3.23 ± 0.87 | 3.61 ± 0.82 | 0.37 | 3.92 | ***0.003*** | 0.45 | |
| Mobilizing Others | 3.60 ± 0.81 | 3.82 ± 0.80 | 0.22 | 2.44 | 0.253 | 0.28 | |
| Taking the Initiative | 3.94 ± 0.74 | 4.17 ± 0.63 | 0.23 | 2.97 | 0.060 | 0.34 | |
| Planning & Management** | 3.84 ± 0.65 | 4.09 ± 0.63 | 0.25 | 3.72 | ***0.006*** | 0.42 | |
| Coping with Uncertainty, Ambiguity & Risk** | 3.57 ± 0.66 | 3.88 ± 0.65 | 0.31 | 4.05 | ***0.002*** | 0.46 | Into Action |
| Working with Others | 4.00 ± 0.64 | 4.09 ± 0.67 | 0.08 | 1.28 | 0.999 | 0.15 | |
| Learning Through Experience | 4.25 ± 0.59 | 4.21 ± 0.59 | -0.04 | -0.52 | 0.999 | 0.06 | |

After Bonferroni correction, eight self-assessed entrepreneurial competences showed significant improvements from pre- to post-assessment. The largest increases were identified for the competences "Valuing Ideas, Creativity," and "Mobilizing Resources" (all $p < 0.001$, $d_{emp}$ 0.51 to 0.63). Overall, four out of five competences of the superordinate competence dimension (1) Ideas & Opportunities showed significant improvements. Both in the competence dimensions (2) Resources and (3) Into Action, two of five competences improved significantly. Numerically, a minimal decrease in the competence "Learning Through Experience" was found, which, however, was non-significant ($p = 0.999$).

## DISCUSSION

This pilot study evaluated the influence of the Unternehmergeist Saar entrepreneurial talent program by analyzing longitudinal changes in self-assessed entrepreneurial competences before and after participation. These self-assessed competences were based on the EntreComp framework and were measured via a self-developed questionnaire (ComPE): (1) Ideas & Opportunities, (2) Resources, and (3) Into Action. For both the spring and autumn cohorts, significant improvements across all superordinate competence dimensions were noticed. Furthermore, eight out of 15 subordinate self-assessed entrepreneurial competences showed significant improvement from pre- to post-assessment.

Significant improvements were found in four out of five self-assessed competences within the dimension (1) Ideas & Opportunities. This indicates that the entrepreneurial program may especially foster competences related to identifying opportunities, developing innovative ideas, and realizing them. In line with that, the program focuses on practice-oriented exercises and methods that foster creativity, idea generation, and evaluation. One of the major approaches behind the program is CBL. This approach should particularly promote skills related to innovation and creativity (Yang et al. 2018). For example, participants engage intensively with ideation techniques and methods, such as Design Thinking and Business Model Canvas. These require them to explore problems from multiple perspectives and develop novel solutions iteratively. This observation aligns with previous studies' findings that methods such as Design Thinking foster key entrepreneurial competencies, such as creativity and the ability to recognize opportunities (Baltador et al., 2024; Linton & Klinton, 2019). Furthermore, the program's initial milestones in the focus areas Team, Market, and Ideation create a structured environment in which participants are encouraged to question assumptions and translate these insights into specific opportunities. The program's experiential, iterative design should thus provide favorable conditions for enhancing the Ideas & Opportunities dimension. In sum, this provides a possible explanation why competences related to curiosity, openness, and creativity have shown the largest improvement. The specific improvement of (1) Ideas & Opportunities may thus be carefully interpreted in favor of the program.

For both the competence dimensions (2) Resources and (3) Into Action, significant improvements were observed in only two out of five entrepreneurial competences, which indicates a possible selective competence improvement. In the competence dimension (2) Resources, the competences Self-Awareness & Self-Efficacy, Motivation & Perseverance, as well as Mobilizing Others, showed no significant changes. An explanation could be that these competences are not only classical competences as per definition; instead, they represent long-term attitudes and behavioral patterns (Morselli & Orzes, 2023). Based on experience, both attitudes and behavioral patterns are harder to develop within short-term interventions. In particular, the competence Mobilizing Others strongly depends on mutual motivation and support within the team. The mobilization of others was experienced as especially challenging within the program, which, on the one hand, could be explained by the heterogeneous group composition, and, on the other hand, by the program's short duration and, consequently, the limited time for the team project. Based on the results presented here, we have expanded Unternehmergeist Saar by adapting several program components to more effectively foster these competences. For the dimension (2) Resources, to strengthen Motivation & Perseverance, we introduced short motivational impulse sessions led by alumni and facilitated discussions about coping strategies. To improve Self-Awareness & Self-Efficacy, we integrated structured self-reflection formats into the weekly coaching sessions. In these sessions, participants completed guided reflections to gain a clearer understanding of their individual behavioral patterns and personal development processes. To strengthen the competence Mobilizing Others, the program incorporated more intense group pitch simulations, during which participants practice presenting their ideas and receive targeted feedback from their coaches.

For the dimension (3) Into Action, no significant improvements were found for the competences Learning Through Experience, Taking the Initiative, and Working with Others, which may be due to the fact that these competences develop over time within a learning process and are particularly shaped by accumulated experiences (Kakouris & Morselli, 2020). Furthermore, Learning Through Experience is not merely a competence, but rather a combination of a learning method, focused on how competences are developed, and the ability to learn in this way (Morselli & Gorenc, 2022). The teams work on real-world challenges, many of which are highly complex (see Table 1), thereby increasing the importance of sharing experiences. Therefore, the aforementioned competences should be further promoted by shifting the program's focus more strongly toward experience-based, cycle-oriented learning and by incorporating targeted reflection phases. For future cohorts, we have modified Unternehmergeist Saar by integrating structured failure-reflection sessions to the weekly coaching meetings. These sessions provide participants with a dedicated space to discuss setbacks openly. Systematic reflection enables them to translate insights directly into the next development cycle, enhancing learning through experience. To further strengthen the competence Taking the Initiative, participants were encouraged to set weekly micro-goals to advance specific elements of their projects autonomously. To improve Working with Others, we expanded the first expert session on teamwork to allow for a deeper exploration of individual team roles and how these roles can be leveraged throughout the program. By clarifying expectations and highlighting the strengths associated with each role, teams were better equipped to collaborate effectively.

ComPE demonstrated good internal consistency, satisfactory sensitivity to change, and good measurement accuracy. Objectivity can be assumed due to the use of numerical scales. Further results indicate sufficient (construct) validity, as the ComPE mainly detected competence improvements within the dimension (1) Ideas & Opportunities, which was clearly focused in the program (see above). However, there are major limitations regarding ComPE and the underlying EntreComp framework. First, the absolute improvements across the self-assessed competence dimensions and competences were significant, but small (e.g., Ideas & Opportunities: total delta of 0.3 on a numeric scale from one to five). As reported within the results section, associated effect sizes were – except for one case – within the range of medium to large, mainly driven by small variances of intrapersonal measurement-pairs within our dataset (superordinate competence dimensions: partial $\eta^2 = 0.13$ to 0.33; subordinate competences: $d_{emp} = 0.35$ to 0.63; see Ellis, 2010). Although statistical significance and sufficient effect sizes were found, the total deltas remained too small to adequately assess the influence of Unternehmergeist Saar. One possible explanation may be the high starting values of the self-assessed competence dimensions and entrepreneurial competences, as the talents were selected by experts based on criteria such as motivation and prior knowledge of entrepreneurship. To minimize biases that might lead to overly positive assessments, the instructions for participants could be modified. For example, participants could be instructed to emphasize their own strengths and weaknesses in the competence assessment. Furthermore, another way to reduce bias is to ipsatize the data, though this complicates the categorization of individual scores across the surveyed competence dimensions. Second, self-assessment itself can be considered limited because ability estimates do not necessarily correlate with actual performance (Karpen, 2018; Sillat et al., 2021). In our case, however, developing a short questionnaire seemed the most

suitable way to ensure compliance among participants. Third, the CFA, according to the EntreComp framework, yielded poor fit indices (RMSEA and CFI). What stands out here are very high estimated correlations between the superordinate competence dimensions, which may hint to insufficient discriminant validity: It is possible that these latent factors from the EntreComp framework measure a common construct. In other words, modelling a strong general competence factor rather than the three-factor structure postulated by the EntreComp framework may yield better results. Clearly, more empirical data is be needed to draw conclusions on this matter.

This pilot study has general limitations. The competence assessment tool ComPE is based on EntreComp, the most official and widely used entrepreneurial competence framework. It includes a wide range of competences relevant to entrepreneurship. Nonetheless, other research and competence frameworks may include additional competences considered important in the context of entrepreneurship but not included in ComPE. Furthermore, external factors may have affected the results of the study. Some participants indicated that they had invested more time in the program than others. A systematic assessment of the time invested should be added to future assessments to account for this factor in the analysis. Ideally, a control condition should be added to the design presented here to assess the effectiveness of Unternehmergeist Saar, even though this would be challenging to implement. Additionally, competences at post-assessment were recorded right after the program had concluded. Further studies should investigate the long-term effects of the program by conducting a follow-up assessment after a set period to evaluate the sustainability of the competence development. Although if it may not be applicable in this setting, implementing a sham program as a control group could help distinguish specific effects from nonspecific ones. Finally, for practical reasons, only quantitative data were collected through a self-assessment. However, enriching the insights would be possible if qualitative data were collected, such as from open-ended questions or interviews. Based on this data, the entrepreneurial program could be further optimized. In addition, a larger sample would allow for the examination of different sub-samples (e.g., gender differences, educational level) from pre- to post-measurement.

## CONCLUSION

The results of this study indicate that an entrepreneurial competence development program like Unternehmergeist Saar could have a significant influence on self-assessed competence development, particularly in identifying opportunities and generating ideas. These competences can be fostered within a short period of time by utilizing practice-oriented methods and content. However, to enable holistic competence development, programs must be designed to have a longer duration and be more intensive, targeting the individual needs of participants and purposefully focusing on specific competences. Based on the results, several adaptations have already been implemented for future cohorts: To strengthen Motivation & Perseverance, we added alumni-led motivational impulses and discussions. Self-Awareness & Self-Efficacy are now supported through structured self-reflection and Mobilizing Others through more intense group pitch simulations. Additionally, failure reflection sessions were introduced, weekly micro-goals were added to foster Taking the Initiative, and the team expert session was expanded to improve Working with Others. These adjustments aim to align the program more closely with the EntreComp framework. In addition to these modifications, it remains unclear whether the factor structure postulated by the EntreComp framework can be accurately captured by a questionnaire, or whether it should be simplified, e.g., into a single general competence factor. Along with the program, the ComPE will be further developed, as first data from this pilot study yielded promising results regarding its ability to evaluate self-assessed competence development. The current German version of the ComPE is freely available upon request from the authors of this study.

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## Biographical notes

**Estella Kirsch** is a Senior Digitalization Professional and Researcher at the August-Wilhelm Scheer Institut für digitale Produkte und Prozesse gGmbH. Her work centers on entrepreneurial education, competence development, and innovation management. She has contributed to numerous projects on entrepreneurial competence development, particularly in the assessment and development of entrepreneurial skills, and has published research in the field of entrepreneurship education.

**Michelle Celine Jörgens** is a Digitalization Professional and Researcher at the August-Wilhelm Scheer Institut für digitale Produkte und Prozesse gGmbH. With a background in Education (B.Ed.) and Educational Technology (M.Sc.), she supports digital transformation in companies and advises aspiring entrepreneurs. Her research focuses on competence development and assessment, as well as the use of AI in education, with several publications on these topics.

**Michael Belz** is a postdoctoral lecturer, researcher, and psychotherapist in the Department of Psychiatry and Psychotherapy at the University Medical Center Göttingen (UMG). His research focuses on psychiatric topics such as electroconvulsive therapy, neuropsychology, dementia, and PTSD, as well as on topics from social psychology and work and organizational psychology.

## Author contributions statement

**Estella Kirsch**: Literature Investigations, Visualization, Proofreading and Editing, Writing Original Drafts, Resources, Research, and Conceptualization. **Michelle Celine Jörgens**: Literature Investigations, Visualization, Proofreading and Editing, Writing Original Drafts, Resources, Research, and Conceptualization. **Michael Belz**: Proofreading and Editing, Writing Original Drafts, Software, Resources, Formal analysis, Data Curation.

## Conflicts of interest

The authors declare no conflicts of interest.

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# Entrepreneurial competencies and the conceptual dimension of intentions: Insights from a hybrid machine learning approach

***Tomasz Skica*[1], *Teresa Mroczek*[2], *Esra Sipahi Döngül*[3]**

***Abstract***

***PURPOSE:*** *This study examines the relationship between entrepreneurial competencies and intention-related characteristics among university students, addressing the need for a deeper understanding of how psychological traits shape entrepreneurial tendencies in young populations. Focusing on students at the University of Information Technology and Management (UITM) in Poland, the research explores how adaptability, problem-solving, and cognitive flexibility contribute to the conceptual configuration of entrepreneurial intention.* ***METHODOLOGY:*** *A hybrid methodological approach was adopted, combining bibliometric analysis using SciMAT with data-mining techniques. A survey of 1,520 students provided the empirical basis for the analysis. Rough set theory was used to address incomplete data, while the C5.0 decision-tree classifier and feature interdependency analysis were applied to identify informative item-level patterns in the dataset. Demographic variables were incorporated to examine group-differentiating structural patterns across student groups. The study draws on TPB and self-efficacy as theoretical lenses for interpreting the conceptual patterns identified, without modelling TPB constructs as predictive variables.* ***FINDINGS****: The analysis highlights that adaptability (A12), problem-solving ability (A19), goal orientation (A18), and cognitive flexibility (A13) recur in the most informative branches of the decision-tree structures, indicating their central role within the broader configuration of entrepreneurial competencies. The results reflect how these attributes cluster within intention-related patterns rather than forming predictive relationships. The study also reveals distinct competency profiles across gender, age, nationality, and field of study, underscoring the heterogeneous nature of entrepreneurial characteristics in the student population.* ***IMPLICATIONS:*** *The findings contribute to the entrepreneurship literature by demonstrating conceptual coherence between intention-related attributes observed at the item level and dominant thematic patterns identified in recent research. Rather than testing or extending formal intention theories, the study offers an interpretative perspective on how adaptability, resilience, and problem-solving attributes cluster within student populations. From a practical standpoint, the results highlight the importance of entrepreneurship education initiatives that foster adaptive learning, coping with difficulty, and problem-solving skills. The use of data-driven decision-support tools may further assist educators in designing personalized learning environments that respond to heterogeneous student profiles.* ***ORIGINALITY/VALUE:*** *This study offers a novel contribution by integrating bibliometric validation with machine-learning-based pattern discovery. By mapping the conceptual landscape of intention-related attributes rather than predicting entrepreneurial intention, it provides a distinctive analytical perspective and actionable insights for educators and policymakers seeking to cultivate entrepreneurial competencies among university students.*

***Keywords:*** *entrepreneurial intentions, entrepreneurial competencies, rough set theory, decision tree classifier, attribute dependency analysis, cognitive flexibility, problem-solving, resilience, entrepreneurship education, self-efficacy, machine learning, bibliometric analysis.*

1 Tomasz Skica, Ph.D., D.Sc., Prof. UITM, Department of Entrepreneurship, University of Information Technology and Management in Rzeszow, Sucharskiego 2, 37-300 Rzeszow, Poland, e-mail: tskica@wsiz.edu.pl (ORCID: https://orcid.org/0000-0002-5620-610X).
2 Teresa Moczek, Ph.D., D.Sc., Eng., Prof. UITM, Department of Artificial Intelligence, University of Information Technology and Management in Rzeszow, Sucharskiego 2, 37-300 Rzeszow, Poland, e-mail: tmroczek@wsiz.edu.pl (ORCID: https://orcid.org/0000-0002-6064-9528).
3 Esra Sipahi Döngül, Assist. Prof., Department of Social Work, Aksaray University, Bahcesaray, 68100, Aksaray, Center, Türkiye, e-mail: esrasipahidongul@aksaray.edu.tr (ORCID: https://orcid.org/0000-0002-6495-4378).

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## INTRODUCTION

The globalization of the business world has made the establishment of new ventures both more important and worth investigating (Mueller, 2001). Entrepreneurship is considered as one of the main determinants of the growth and innovation capacity of modern economies in the context of the process of transforming individuals' innovative ideas (Braunerhjelm & Henrekson, 2024) into economic and social products (Sendra-Pons, Comeig, & Mas-Tur, 2022). The stronger the entrepreneurship ecosystem, the more efficient the technology becomes, thereby increasing its impact on economic growth (Zahra, Liu, & Si, 2023). In this context, entrepreneurs act as a bridge, transforming innovative ideas into economic growth by bringing them to market (Acs, Estrin, Mickiewicz, et al., 2018). When literature is examined, it is evident that entrepreneurship research largely focuses on adults, and studies of young individuals are insufficient (Anwar & Saleem, 2019). In particular, the entrepreneurial tendencies of young individuals are of strategic importance for combating unemployment, fostering innovation, and advancing local development policies (Mutarubukwa, 2015). In this context, it is believed that this study will provide valuable information for examining the entrepreneurship competencies and tendencies of university students, for developing education policies and support mechanisms, and for filling the gap in this field. Entrepreneurial competencies are influenced by multidimensional variables such as individuals' intrinsic characteristics, psychological tendencies, environmental factors, and demographic structures (Maheshwari et al., 2023). Accurate analysis of this complex structure is possible not only with traditional statistical methods but also with more powerful analytical approaches, such as data mining techniques (Shu & Ye, 2023). In this study, a hybrid analysis method was adopted using rough set theory to handle incomplete data, the pattern discovery method for pattern inference, and the C5.0 algorithm for classification (Bujlow et al., 2012). The aim of this study is to reveal the relationships between entrepreneurial competencies and entrepreneurial intention among the students at the University of Information Technology and Management (UITM) in Poland. The research was carried out using data from 1,520 students, and the main variables affecting students' entrepreneurial tendencies were identified. Although this study was theoretically inspired by TPB, rather than an empirical design aimed at testing a TPB-oriented structural model, this study examines entrepreneurial intent and related characteristics using the entrepreneurial potential tool, which does not include standard TPB components as separate constructs. Accordingly, the present study aims to (i) examine the conceptual structure of entrepreneurial competencies among university students using pattern-mining and science-mapping techniques, (ii) explore how adaptability, resilience, problem-solving, and related attributes cluster within this structure, and (iii) identify how these attributes conceptually align with the thematic evolution of the entrepreneurship literature revealed through SciMAT analysis. The study ultimately seeks to provide an integrated understanding of intention-related characteristics by linking survey-based item patterns with bibliometric thematic development.

In the following sections, the article first situates the study within the existing literature on entrepreneurial competencies and intention-related attributes, highlighting conceptual gaps that motivate the present analysis. The methodological section then outlines the hybrid research design, including the bibliometric validation procedure and the machine-learning techniques applied to the student dataset. The results section presents the thematic structures emerging from SciMAT and the item-level patterns identified through decision-tree modelling. This is followed by a discussion that interprets these patterns considering contemporary entrepreneurship research. The article concludes by summarizing the main contributions and outlining implications for future studies and educational practice.

## LITERATURE REVIEW

Entrepreneurship research has identified key personality traits that lead individuals to engage in entrepreneurial behavior (Awwad & Al-Aseer, 2021). In this context, the two characteristics that stand out the most are internal locus of control and innovativeness (Nisula & Olander, 2025). While the internal locus of control refers to the belief that individuals can direct events in their lives through their own efforts (Tentama & Abdussalam, 2020), innovation is the ability to generate and implement new ideas, as emphasized in Schumpeter's definition of an entrepreneur. According to Fong et al. (2016), culture is one of the factors that shape the behavior of individuals. Hofstede's (1980) theory of cultural dimensions has been a guide to understanding differences between countries in values, beliefs, and ways of doing business. In this context, how entrepreneurial characteristics differ across cultures and the reasons for these differences emerge as important research questions (Mueller, 2001). According to Heredia-Carroza et al. (2024), entrepreneurship is an important tool for economic and social development in rural areas and mobilizes local potential. In this respect, it offers a promising

opportunity to revitalize rural areas and ensure sustainable growth. In their study, Heredia-Carroza et al. (2024) examined the factors that increase entrepreneurial intentions among university students in Comarca Sierra Sur, Andalusia, a rural region of Spain. They also emphasized that individual values and psychological factors should be considered to promote entrepreneurship in rural areas, and suggested that entrepreneurship education, gaining a sense of personal control and supporting entrepreneurial role models in the family should be supported. While supportive tax policies encourage entrepreneurship (Tsou et al., 2023). In some cultures, rewarding risk-taking, viewing failure as a learning process, and emphasizing individual success are among the factors that strengthen entrepreneurial intention. In cultures with a high fear of failure and dominant collectivist structures, the tendency toward entrepreneurship may be relatively low (Henriquez-Daza et al., 2023). Henriquez-Daza et al. (2023) found that fear of failure negatively affects entrepreneurs' growth targets. They also noted that collectivist culture significantly mitigates this negative impact in developing countries. This situation underscores the need for culturally aware education and policy approaches to develop entrepreneurial competencies. Accordingly, entrepreneurial competencies should be considered as a multidimensional structure (Tetteh et al., 2024). Understanding this structure is critical for developing effective entrepreneurship policies, supporting entrepreneurial individuals, and achieving sustainable development goals.

Despite the increasing number of studies on entrepreneurial intention among students, literature lacks an integrated perspective that connects item-level behavioral patterns with the evolving thematic structure of entrepreneurship research. No existing study simultaneously examines (i) how intention-related traits cluster together within student populations and (ii) how these clusters align with thematic trajectories identified in recent bibliometric analyses. Therefore, a clear gap exists in bridging individual-level response patterns with the macro-level evolution of entrepreneurship knowledge, which the present study aims to address.

## Entrepreneurial competencies, intention, and tendency

Entrepreneurship is not just the process of starting a business. It is also the capacity to create value through innovation and is one of the key drivers of economic development (Sedeh, Pezeshkan, & Caiazza, 2022). Schumpeter (1934) defines entrepreneurs as „people who try to change the production model by using untested technical possibilities to produce an invention or a new product, or to produce an old product in a new way." This definition emphasizes that entrepreneurship is not a static activity but a dynamic, creative process. Especially in today's digital age, qualities such as technological literacy, innovation capacity, and rapid adaptation skills have become important determinants of entrepreneurship (Baron & Shane, 2008). It can be considered as a reflection of individuals' entrepreneurial intentions, potential, and competencies. When considered within the framework of Ajzen's planned behavior theory (1991), entrepreneurial intention is a combination of factors such as attitudes, perceived behavioral control, and social norms that shape an individual's desire to be an entrepreneur, and it is a phenomenon that has micro-level effects (Morales-Pérez et al., 2022). Studies conducted especially among university students associate entrepreneurial intentions with factors such as risk-taking, innovation, and autonomy of individuals in this group (Liñán et al., 2011).

Entrepreneurial intention is defined as an individual's desire and determination to become an entrepreneur in the future. It is considered the starting point of the entrepreneurial process and a psychological factor that strongly affects the probability of entrepreneurship (Krueger et al., 2000). The most widely used theoretical framework in entrepreneurial intention research is Ajzen's theory of planned behavior (Ajzen, 1991). TPB was developed to describe the intention of individuals to perform a certain behavior. In this model, in the context of entrepreneurship, attitude indicates that entrepreneurship is seen as beneficial and meaningful for the individual (Baba et al., 2025), while perceived behavioral control reflects an individual's self-confidence in entrepreneurial skills and access to resources (Liñán & Chen, 2009). Liñán and Fayolle (2015) examined a large number of studies on entrepreneurial intention and found that TPB components have high explanatory power in understanding entrepreneurial intention. In a study by Liñán and Chen (2009), the scales developed within the TPB framework were found to be reliable and valid for measuring entrepreneurial intention. Studies conducted especially on university students have shown that attitude and perceived behavioral control are the most determining factors in entrepreneurial intention (Fayolle & Liñán, 2014).

Entrepreneurship tendency is considered as a basic determinant that affects the entrepreneurial intention of individuals and the processes of transforming this intention into behavior. Research conducted especially on university students reveals that this trend plays an important role in shaping future entrepreneur profiles (Zhao et al., 2005; Lüthje & Franke, 2003). In this regard, various studies conducted among students show that individual characteristics and demographic factors influence entrepreneurship tendencies and yield meaningful findings on their effects (Anwar & Saleem, 2019).

Numerous studies among university students show that this group exhibits a high level of entrepreneurship. In comparative analyses, especially among students studying in different academic fields such as business, economics, engineering and social sciences, significant differences in entrepreneurship tendency have been observed (Wilson et al., 2007). In addition, it is emphasized that entrepreneurship courses, seminars, and practical training significantly increase students' entrepreneurial orientation (Fayolle & Gailly, 2008). Gender is one of the main demographic factors influencing the propensity for entrepreneurship. The literature generally indicates that male students exhibit higher entrepreneurial tendencies than female students (Zhao et al., 2005; Wilson et al., 2007). Zhao et al. (2005) found that self-efficacy perceptions among American college students have a strong effect on entrepreneurial intention. Business management students had higher entrepreneurial tendencies. In addition, applied entrepreneurship programs (incubators, competitions, mentoring, etc.) have been shown to significantly increase students' motivation to become entrepreneurs at many universities in the USA. Lüthje and Franke (2003) demonstrated, in studies conducted at German technical universities, that engineering students are highly entrepreneurial but that environmental factors limit the transformation of this potential into an intention to start a business. Among these factors, risk perception, uncertainty, avoidance and financing difficulties stood out. In studies conducted among university students in Spain, it has been found that entrepreneurship tendency is closely related to cultural values. Entrepreneurial intention was observed to be stronger, especially in students with a high level of individualism (Liñán et al., 2011). For this reason, it is thought that entrepreneurship training carried out with interdisciplinary approaches can increase the entrepreneurship tendencies of students in different fields.

### Use of data mining methods in social sciences

In the social sciences, data mining offers a variety of technologies that allow previously undetected patterns (Shu & Ye, 2023) and autonomous decision-making (Kusiak, 2001). In this way, it becomes possible to generate innovative ideas and develop new theoretical approaches in different disciplines (Shu & Ye, 2023). According to Shu and Ye (2023), to increase predictive power and manage causal diversity, data mining methods evaluate many variables – whether cooperating or independent – systematically and often automatically. Data mining is an emerging field of computational intelligence that is often used to go beyond traditional analysis and reveal complex relationships among multiple variables (Kusiak, 2001).

The rough set theory developed by Pawlak (1982) is an effective method for handling incomplete data. Rough clusters provide a solid foundation for decision support systems in data sets where uncertainty and incompleteness are intense. Rough set theory is a tool for data mining and knowledge discovery (Mroczek, 2023). Missing data can be estimated effectively using the maximum consistent blocks (MCB) method (Sun et al., 2021; Kryszkiewicz, 1998; Leung & Li, 2003). The C5.0 algorithm is a decision tree-based classification technique that provides high accuracy, especially when working with categorical data (Quinlan, 1993).

## METHODOLOGY

### Research sample and data collection process

The aim of the study is not to generalize to all university students, but to identify conceptual and behavioral patterns within a well-defined student population.

The data source for the research was an original survey questionnaire developed in collaboration with experts in economics, sociology, and psychology (see Appendix 1). The research was conducted between 17.01.2023 and 21.03.2023 and covered students of all fields of study offered at the University of Information Technology and Management in Rzeszów, UITM (Poland), i.e. Computer graphics and multimedia production, Programming, Computer science, Cybersecurity, Data science, Game design and development, Dietetics, Cosmetology, English Philology, English Philology with Chinese, Finance and accounting in management, Aviation Management, Global aviation management, Graphic design, Management, International business management, Journalism and social communication, Logistics, Nursing, Physiotherapy and Psychology in management), both modes of study (full-time and part-time studies), as well as both study paths (Polish and English) and both levels of education (first and second cycle studies).

In the research process, it was assumed that each field of study must be represented by at least 20% of students. As a result, a sample of 1,520 respondents (i.e., research participants) was obtained (i.e., 29.8% of all UITM students), which was representative of all fields of study and the population of students studying at UITM (see Appendix 2).

The first part of the survey (A), consisting of 28 questions, examined the characteristics of respondents' entrepreneurship. The second part of the survey (B) included a set of questions on gender, age, professional situation, mode and path of study, country of origin, level, and field of study. Cronbach's alpha was used solely as a basic reliability indicator; the study does not aim to validate latent constructs or test measurement invariance across language versions (see Appendix 3).

Since this study does not include Ajzen's TPB scales, attitude, subjective norm, and perceived behavioral control structures are not measured separately. The empirical analysis is based on a trait- and attitude-based survey instrument designed to capture entrepreneurial competencies and intention-related characteristics. In this context, the term "pattern-level analysis" refers to identifying recurring configurations of responses within the Likert-type items, rather than to product-level or market-related patterns. The analytical focus is therefore on conceptual and behavioral structures emerging from students' psychological attributes.

To ensure easy access to the survey and the largest possible study scale, data was collected using the LimeSurvey online platform. The platform allowed all students to access the survey in both language versions (Polish and English). This was important due to the dual nature of the courses of study offered at the university. The solution used eliminated language barriers and thus removed limitations in the study.

Although the sample size is large and covers all programmes at UITM, the data come from a single university in Poland. Therefore, the findings should not be generalised to "university students" globally. Rather, they reflect patterns observed among students in this specific institutional and cultural context. Future studies should incorporate multi-institutional or cross-country samples to enhance generalizability and test the robustness of the patterns identified in this research.

The survey was distributed among the student population through three channels. First, use a link sent directly to students' email accounts with an invitation to the survey. Second, by providing students with QR codes connecting to the LimeSurvey platform. Finally, a direct approach was also used, inviting students to take part in the survey during breaks in subject classes. The research design was discussed with the Research Ethics Committee at UITM and subsequently approved for implementation. In line with the adopted approach, the privacy and confidentiality of participants were strictly maintained, and the collected data was used only for research purposes.

### Bibliometric analysis–based validation of the research questionnaire

This bibliometric procedure serves as a conceptual validation of thematic relevance, not as a psychometric validation of the survey instrument (Cobo et al., 2012; as cited in Vila-Lopez & Küster-Boluda, 2021). Based on this approach, a bibliometric analysis was conducted using the SciMAT software (Cobo et al., 2012), incorporating a systematic literature review focused on factors influencing students' entrepreneurial intentions. As a result of the search based on competency-related keywords and entrepreneurship-related terms, a total of 7,424 studies published in English and available in open access through the Web of Science (WOS) database were identified.

The Web of Science search was conducted using the following Boolean structure applied to titles, abstracts, and author keywords (TS): ("entrepreneur*" OR "entrepreneurial intention*") AND ("adaptability" OR "resilience" OR "cognitive flexibility" OR "self-efficacy" OR "problem solving" OR "grit" OR "initiative" OR "goal orientation" OR "open-mindedness").

The restriction to open-access publications was applied to ensure full-text accessibility required for reliable keyword standardization and thesaurus construction in SciMAT. While this introduces a systematic selection mechanism that may affect topic distributions, the bibliometric analysis in this study is used for conceptual validation and thematic alignment rather than for estimating population-level research prevalence.

The bibliometric analysis identified 22,421 keyword groups related to entrepreneurship. Keyword standardization was performed using a manually curated thesaurus, following SciMAT guidelines. Singular–plural forms, spelling variants (e.g., British/American English), acronyms, and semantically equivalent expressions were merged into unified word groups. As a result of this preprocessing, the number of keyword groups was reduced to 1,139, enabling more accurate thematic analysis and strategic mapping in SciMAT. Because these standardization decisions directly affect cluster density and centrality values, the bibliometric results are interpreted at a conceptual rather than a strictly quantitative level.

## RESULTS

In the first step of the SciMAT analysis, keywords are aggregated into "word groups," which represent conceptually similar terms and act as the basic units for subsequent analysis (Table 1). In the second step, SciMAT uses these word groups

to generate thematic clusters based on co-occurrence networks and the strategic diagram (Tables 3–5). Thus, "word groups" are the building blocks of the analysis, while "clusters" represent higher-level thematic structures formed from these groups.

In SciMAT, "word groups" represent standardized keyword units created during preprocessing, while "clusters" refer to higher-level thematic structures formed from co-occurrence networks of these word groups. This two-stage process is consistently applied throughout the analysis.

**Table 1.** Groups of words

| Group name | Number of docs | Group name | Number of docs | Group name | Number of docs |
|---|---|---|---|---|---|
| Innovation | 1305 | Technology | 375 | Opportunities | 261 |
| Impact | 1149 | Perspective | 374 | Intentions | 253 |
| Model | 677 | Capabilities | 351 | Orientation | 247 |
| Business | 671 | Organizations | 336 | Enterprise | 236 |
| Firms | 584 | Behavior | 336 | Resources | 231 |
| Strategy | 578 | Networks | 336 | Social-Entrepreneurship | 215 |
| Knowledge | 503 | Dynamic-Capabilities | 336 | Market | 210 |
| SMEs | 389 | Framework | 283 | Identity | 199 |

The clusters in Table 1 represent key concepts identified in the literature, along with the number of articles associated with each. *"Innovation"* and *"impact"* are the most frequently discussed topics, confirming their central importance in the research landscape. Other significant concepts include *"model," "business," "strategy,"* and *"knowledge,"* encompassing both theoretical and practical dimensions (e.g., SMEs, social-entrepreneurship). The analysis reveals a balanced research structure grounded in a multidisciplinary approach. Topics with fewer associated documents, such as *"market"* or *"identity,"* point to potential gaps and emerging directions for future research.

**Table 2.** Word groups statistics

| Period | Documents | Units | Mean | Standard Dev. | Variance |
|---|---|---|---|---|---|
| 2020-2021 | 2227 | 900 | 3.57 | 2.28 | 5.18 |
| 2022-2023 | 2870 | 977 | 3.96 | 2.24 | 5.03 |
| 2024-2025 (May) | 2290 | 895 | 3.76 | 2.19 | 4.79 |

Statistical information on the periodic keyword groups is presented in Table 2. The "Mean" values in Table 2 do not represent the ratio of documents to units. Instead, they reflect the average normalized frequency of keyword occurrences within each period, as calculated by SciMAT. Because SciMAT applies frequency weighting and normalization during preprocessing, the resulting means (3.57, 3.96, 3.76) are higher than the simple documents/units ratios (2.47, 2.94, 2.56). The explanation in the text has been revised to clarify this distinction. Table 2 presents the number of documents, units, and descriptive statistics for three periods. In 2020–2021, 2,227 documents were published; in 2022–2023, the number increased to 2,870 (a 29% rise); and in 2024–2025 (up to May), it decreased to 2,290 (a 20% drop). Despite the decline in the number of units, the count remains comparable, indicating sustained thematic richness. The mean normalized frequency of keyword occurrences increased to 3.96 in 2022–2023, indicating a higher concentration of research activity around core thematic units. The standard deviation (2.28 → 2.19) and variance (5.18 → 4.79) have steadily decreased, indicating a more even thematic distribution.

Figure 1 presents the temporal overlap of thematic units across periods. The continuity between periods is evaluated using a continuity ratio, calculated by dividing the number of units that persist into the subsequent period by the size of the earlier period. Between 2020–2021 and 2022–2023, 778 of 900 units continued, yielding a continuity ratio of 0.86. In the following transition, 766 of 977 units persisted, corresponding to a continuity ratio of 0.78. These values indicate a high degree of thematic stability across periods, while also reflecting the emergence of new thematic units over time.

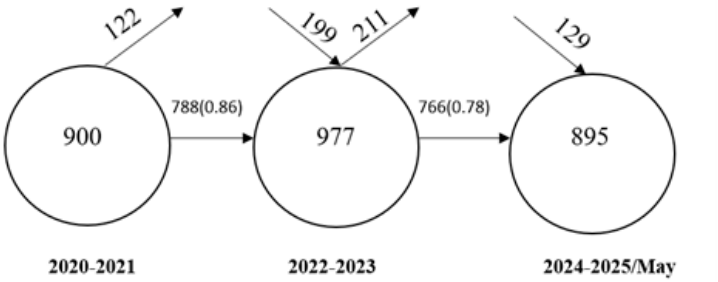


**Figure 1.** Overlapping map

Tables 3–5 present clusters of keywords by time interval. Each cluster includes four indicators: centrality (strength of the cluster's connections to the network), centrality range (normalized value between 0 and 1), density (internal cohesion of the cluster), and density range (normalized cohesion value).

**Table 3.** Cluster information (2020-2021)

| Name | Centrality | Centrality range | Density | Density range |
|---|---|---|---|---|
| Knowledge | 204.60 | 1.00 | 7.96 | 0.25 |
| Business | 168.96 | 0.99 | 8.37 | 0.29 |
| Framework | 150.62 | 0.95 | 13.47 | 0.52 |
| Opportunities | 146.83 | 0.93 | 17.09 | 0.69 |
| Market | 159.32 | 0.96 | 7.17 | 0.21 |
| Perceptions | 145.14 | 0.92 | 8.52 | 0.31 |
| Competitive-Advantage | 160.68 | 0.97 | 7.38 | 0.24 |
| Uncertainty | 134.94 | 0.91 | 3.74 | 0.07 |
| Entrepreneurs | 133.48 | 0.89 | 7.10 | 0.20 |
| Culture | 76.90 | 0.87 | 11.92 | 0.39 |

According to Table 3, "*knowledge*" is the most central concept in the network (centrality 204.60), indicating its strong connections with other concepts in 2020–2021. "*Opportunities*" is characterized by high density (17.09), while "*framework*" – despite a lower centrality (150.62) – exhibits substantial cohesion (density 13.47), reflecting a well-integrated literature. "*Knowledge*" and "*business*" form the foundation of the network structure, whereas less developed areas, such as "uncertainty," justify further research.

**Table 4.** Cluster information (2022-2023)

| Name | Centrality | Centrality range | Density | Density range |
|---|---|---|---|---|
| Innovation | 209.37 | 1.00 | 7.42 | 0.32 |
| Intentions | 109.94 | 0.92 | 9.69 | 0.45 |
| Market | 128.38 | 0.93 | 8.41 | 0.39 |
| Context | 137.15 | 0.96 | 6.45 | 0.24 |
| Risk | 141.90 | 0.99 | 5.17 | 0.18 |
| Experience | 140.70 | 0.98 | 6.67 | 0.26 |
| Ownership | 134.70 | 0.95 | 3.76 | 0.14 |
| Start-Ups | 134.25 | 0.94 | 6.90 | 0.27 |
| Field | 100.08 | 0.91 | 2.76 | 0.05 |
| Small-Business | 84.37 | 0.89 | 9.47 | 0.44 |

Table 4 shows that in 2022–2023 the thematic structure centers around "*innovation*," which has the highest centrality (209.37), indicating its key role within the network. Other important clusters include "*market*" and "*intentions*," both characterized by high centrality and density, particularly "*intentions*," reflecting the maturity of this research area. Although "s*mall-business*" has a lower centrality (84.37), it demonstrates substantial cohesion (density 9.47), suggesting strong internal connections despite its marginal position. The clusters "*field*" and "*ownership*" are less connected to the network and less developed, indicating potential for further research.

**Table 5.** Cluster information (2024-2025 up to May)

| Name | Centrality | Centrality range | Density | Density range |
|---|---|---|---|---|
| Firms | 185.20 | 0.99 | 11.17 | 0.45 |
| Behavior | 141.50 | 0.92 | 6.87 | 0.26 |
| Policy | 140.67 | 0.91 | 11.33 | 0.46 |
| Opportunities | 183.65 | 0.97 | 11.40 | 0.47 |
| Industry | 147.35 | 0.95 | 7.60 | 0.28 |
| Technology | 186.56 | 1.00 | 3.84 | 0.11 |
| Identity | 165.11 | 0.96 | 4.01 | 0.12 |
| Orientation | 145.76 | 0.93 | 5.03 | 0.19 |
| Risk | 100.56 | 0.89 | 3.70 | 0.08 |
| Social-Enterprise | 82.23 | 0.86 | 3.77 | 0.09 |

Table 5 shows that in the period 2024–2025 (up to May), research focuses on "*technology*" and "*firms*." "*Technology*" has the highest centrality (186.56) but a low density (3.84), indicating a central role but weaker internal cohesion. "*Firms*" stand out with high centrality (185.2) and density (11.17), forming a strong conceptual foundation. Similarly, "*opportunities*" and "*policy*" exhibit high density and a well-established structure in the literature. In contrast, "*social enterprise*" and "*risk*" have low centrality and density, suggesting their limited and less mature treatment in research.

SciMAT processes raw keywords by grouping semantically related terms into standardized "word groups." This word groups serve as the analytical units used to construct co-occurrence networks. In the subsequent clustering phase, SciMAT identifies thematic structures by grouping word groups into clusters. Therefore, Table 1 presents the foundational word groups, while Tables 3–5 present the higher-level thematic clusters derived from them. This two-stage process enhances interpretability and reduces noise in the keyword dataset.

The thematic clusters identified in the SciMAT analysis, such as "*knowledge*" (dominant in 2020–2021), "*innovation*" (characteristic of 2022–2023), and "*firms/technology*" (typical for 2024–2025), not only demonstrate the evolution within the scientific literature on entrepreneurial intentions but also show a clear connection with the empirical content examined in the survey study. Figure 2 presents the distribution of these elements across thematic periods, indicating conceptual continuity and alignment of the topics studied with specific characteristics and behaviors of students.

The assignment of Part-A items to the three thematic periods identified in the SciMAT analysis - 'knowledge' (2020–2021), 'innovation' (2022–2023), and 'technology/firms' (2024–2025) - reflects conceptual alignment rather than statistical linkage. The mapping expresses face-valid correspondence between item content and the dominant themes emerging in the bibliometric structure; however, it is not based on empirical associations between item responses and the thematic clusters. Accordingly, this step is intended as a conceptual coherence check that situates the questionnaire within the evolving literature, rather than as a form of psychometric validation. Item A6 ("The setbacks I experience provide me with lessons for the future") reflects a resilience- and learning-oriented mindset, emphasizing the interpretation of setbacks as opportunities for growth rather than as perceived limitations in performing tasks. The item captures students' tendency to learn from difficulties and to reinterpret negative experiences in an adaptive manner. Accordingly, A6 is treated as an indicator of resilience- and learning-oriented attributes rather than as a measure of perceived capability or task-related efficacy.

In the first period (2020–2021), the dominant theme was "*knowledge*," reflecting the literature's focus on building the theoretical foundations of entrepreneurship. The survey questions assigned to this period (i.e., A1, A2, A9, A14, A21) relate to execution-oriented engagement, reflecting perseverance and the ability to implement planned actions rather than analytical or causal reasoning. A14 ("overcoming difficulties to acquire knowledge") reflects learning-oriented engagement, while A21 ("I implement developed plans from start to finish") represents execution-oriented behavior and perseverance.

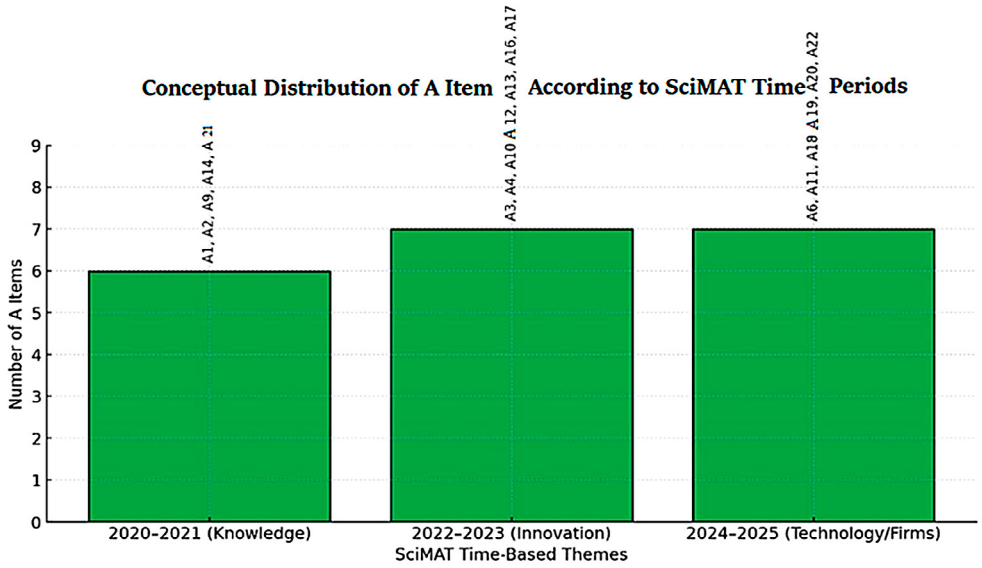


**Figure 2.** Distribution of items in the survey (Part A) according to their conceptual overlap with the periodic themes identified in the SciMAT analysis

In the period 2022–2023, centered around "*innovation*," the literature shifts toward more dynamic and functional competencies such as creativity, adaptability, and problem-solving. The survey questions in this phase (i.e., A3, A4, A10, A12, A13, A16, A17) address skills related to creative thinking, cognitive flexibility, and taking initiative in situations of uncertainty. For example, A10 ("generating more than one solution") and A12 ("adapting to new conditions") clearly reflect innovative and adaptive attitudes, which are recognized as key in shaping entrepreneurial intentions.

The third period, 2024–2025 (up to May), shows a shift toward practical applications, with dominant themes such as "*technology*" and "*firms*." The questions assigned to this stage (i.e., A6, A11, A18, A19, A20, A22) relate to the application of acquired competencies in the context of action, both individual and organizational. For example, A6 ("The setbacks I experience provide me with lessons for the future") reflects a learning-from-difficulty and resilience-oriented mindset. The item emphasizes meaning-making and adaptive learning from negative experiences rather than perceived capability to perform tasks. Accordingly, A6 is interpreted as an indicator of resilience and learning orientation rather than a measure of self-efficacy. The even distribution of questions across the three thematic periods suggests that the studied traits and competencies of students align with the main axes of knowledge development in literature. This indicates that bibliometric analysis and the developed survey questionnaire complement each other, creating a coherent picture of how various psychological, cognitive, and behavioral aspects jointly shape students' entrepreneurial intentions.

## Rough sets approach to incomplete data

Lack of response or refusal to respond is a cause of incompleteness. The simplest way to handle incomplete data is to choose the most frequent answer when the domain is discrete, or the average when the domain is continuous. More advanced approaches estimate the most probable values based on available data. In consequence, the completed data set may be inconsistent i.e. if there exist two cases with all values identical but belonging to different decisions.

Rough sets theory describes a decision in the form of a decision table (Pawlak, 1982) made under certain conditions. An example of an incomplete decision table is presented in Table 6. The rows of the decision table represent cases i.e. the answers given by the respondent. The finite set of all respondents is called the universe and is denoted by U. In Table 6, U = {1, 2, 3, 4, 5, 6, 7, 8, 9}. The independent variables (questions) are called Attributes. In Table 6, Employment status, Level of study and Mode of study are the attributes.

The dependent variable Business start is called a Decision. The set of all cases with the same decision value is called a concept. In Table 6, there are two concepts: the set {1, 2, 3, 6} of all cases for which the value of Business start is yes, and the set {4, 5, 7, 8, 9} for which the value of Business start is no.

**Table 6.** Example of incomplete data set

| Case | Attributes | | | Decision business start |
|---|---|---|---|---|
| | Employment status | Level of study | Mode of study | |
| 1 | full-time | bachelor | | yes |
| 2 | full-time | | part-time | yes |
| 3 | full-time | | part-time | yes |
| 4 | unemployed | master | | no |
| 5 | unemployed | | full-time | no |
| 6 | unemployed | bachelor | full-time | yes |
| 7 | inactive | | full-time | no |
| 8 | inactive | master | part-time | no |
| 9 | inactive | bachelor | | no |

*Bachelor* is the most common value of *Level of study* variable. Therefore, it should be selected for all the unknown values of this attribute. Result is presented in Table 7 (inserted values are italicized). Table 7 is inconsistent. Cases {5, 6} with all identical response values belonging to different concepts of decision. This approach to handling missing values does not account for the relationship between attribute values and decisions.

**Table 7.** Example of inconsistent data set

| Case | Attributes | | | Decision business start |
|---|---|---|---|---|
| | Employment status | Level of study | Mode of study | |
| 1 | full-time | bachelor | | yes |
| 2 | full-time | *bachelor* | part-time | yes |
| 3 | full-time | *bachelor* | part-time | yes |
| 4 | unemployed | master | | no |
| 5 | unemployed | *bachelor* | full-time | no |
| 6 | unemployed | *bachelor* | full-time | yes |
| 7 | inactive | *bachelor* | full-time | no |
| 8 | inactive | master | part-time | no |
| 9 | inactive | bachelor | | no |

The most common attribute value method can be restricted to the concept (Kononenko et al., 1984). The most common value of the *Level of studies* variable for the concept *yes* is *bachelor*, while for the concept *no* it is *master.* Similarly, by completing the missing values in the Study Path attribute, the results areresented in Table 8.

**Table 8.** The result of the concept's most common attribute value method

| Case | Attributes | | | Decision business start |
|---|---|---|---|---|
| | Employment status | Level of study | Mode of study | |
| 1 | full-time | bachelor | part-time | yes |
| 2 | full-time | *bachelor* | part-time | yes |
| 3 | full-time | *bachelor* | part-time | yes |
| 4 | unemployed | master | full-time | no |
| 5 | unemployed | *master* | full-time | no |
| 6 | unemployed | bachelor | full-time | yes |
| 7 | inactive | *master* | full-time | no |
| 8 | inactive | master | part-time | no |
| 9 | inactive | bachelor | full-time | no |

Taking into account causes of incompleteness, such as accidental deletion, missed insertions, or refused responses, rough set theory also provides an interpretation of missing attribute values. Missing attribute values can be interpreted as *lost* values or *"do not care" conditions* (Grzymala-Busse, 1991; Kryszkiewicz, 1998). *Lost* values are denoted by question marks and are considered unavailable for the process of data mining. *"Do not care" conditions* denoted by star are interpreted as any specified value of the same attribute. In our research, we considered missing attribute values as "do not care" conditions, asresented in Table 9.

**Table 9.** Incomplete data set

| Case | Attributes | | | Decision business start |
|---|---|---|---|---|
| | Employment status | Level of study | Mode of study | |
| 1 | full-time | bachelor | * | yes |
| 2 | full-time | * | part-time | yes |
| 3 | full-time | * | part-time | yes |
| 4 | unemployed | master | * | no |
| 5 | unemployed | * | full-time | no |
| 6 | unemployed | bachelor | full-time | yes |
| 7 | inactive | * | full-time | no |
| 8 | inactive | master | part-time | no |
| 9 | inactive | bachelor | * | no |

To find the missing value of an attribute, we repeatedly add a case with the "*do not care*" conditions to the data, replacing it with subsequent attribute values from cases belonging to the same concept as the analyzed case. However, this approach does not account for relationships in the data. First of all, the maximal collection of cases, in which all cases are indiscernible in terms of available information, should be defined. Following Mroczek (2023) and Clark et al. (2024), maximal consistent blocks (MCB), as a maximal collection of indiscernible objects, for Table 7 are: {{1, 2, 3}, {4, 5}, {5, 6}, {7, 9}, {8}}. Consequently, upper and lower approximation are determined, as follows (Leung & Li, 2003):

$$\underline{appr_A}(X) = \{x \in U \mid MCB_A(x) \subseteq X\}$$
$$\overline{appr_A}(X) = \{x \in U \mid MCB_A(x) \cap X \neq \emptyset\}$$

The lower approximation consists of all objects that *certainly* belong to the set, while the upper approximation contains all objects that *possibly* belong to the set. In Table 9, for concept *yes* X = {1, 2, 3, 6} $\underline{appr}(X) = \{1, 2, 3\}$ and $\underline{appr}(X) = \{1, 2, 3, 5, 6\}$, while for the concept *no* X = {4, 5, 7, 8, 9} $\underline{appr}(X) = \{4, 5, 7, 8, 9\}$ and $\underline{appr}(X) = \{4, 5, 6, 7, 8, 9\}$. Only certain sets are considered; therefore, case 6 is not included in the further analysis. The complete data set is presented in Table 10.

**Table 10.** Complete data set

| Case | Attributes | | | Decision business start |
|---|---|---|---|---|
| | Employment status | Level of study | Mode of study | |
| 1 | full-time | bachelor | part-time | yes |
| 2 | full-time | bachelor | part-time | yes |
| 3 | full-time | bachelor | part-time | yes |
| 4 | unemployed | master | full-time | no |
| 5 | unemployed | master | full-time | no |
| 7 | inactive | master | full-time | no |
| 8 | inactive | master | part-time | no |
| 9 | inactive | bachelor | full-time | no |

### Patterns discovering

The purpose of survey analysis is to establish patterns in the form of a set of frequently occurring responses. Finding the most frequent and relevant subsets $X$ occurring in a data set requires discovering a set of items and estimating the probability of their occurrence, as follows: $\frac{|X|}{|U|}$ where |X| is the number of transactions containing the set X and |U| is the number of cases in the data set. For Table 10 the most frequent and relevant subsets are: {(**Level of study**, master), (**Mode of study**, full-time)}, {(**Employment status**, full-time), (**Level of study**, bachelor), (**Mode of study**, part-time)}. Selecting only the highest frequency subsets reduces the large, analyzed set and allows for a more detailed exploration of the relationships.

#### Decision tree classifier

C5.0, as an extension of the published algorithm in (Quinlan, 1993), is an advanced decision tree algorithm widely used in machine learning for classification tasks. Developed by Quinlan (1993), it predicts categorical outcomes by constructing decision trees based on input features. The algorithm follows a top-down, recursive process, selecting the most suitable feature at each step to split the data. It evaluates the quality and size of the resulting subgroups using metrics such as information gain and gain ratio to determine optimal splits. Pruning techniques are applied to prevent overfitting and enhance the model's ability to generalize to new data. C5.0 effectively handles categorical and numerical variables as well as missing values. The resulting decision trees provide clear, interpretable classification results, making the algorithm a popular choice across various fields.

## EXPERIMENTS & RESULTS

Our main goal was to determine the relationship between entrepreneurial competencies and entrepreneurial intentions. To achieve this, a hybrid approach, including several of the machine learning methods mentioned above, was employed to plan the research process, conduct the research, and interpret the results.

First of all, the survey data was incomplete. For this reason, the maximal collection of cases, in which all cases are indiscernible in terms of available information, was identified. Then, the lower approximation of concepts based on maximal consistent blocks was determined. In this way, a complete, consistent data set was prepared for further analysis. It should be noted that the incompleteness of the dataset was below 1% of all observations, with missing values in six cases affecting the dependent variable (the decision). The decision variable was not imputed, as its imputation could introduce bias and distort the relationships between variables. Additionally, the applied method for handling missing data does not account for the decision variable, as it is intended solely for imputing values in explanatory variables.

The analysis used a one-hot encoder because it allows each possible Likert-scale response to be represented as a separate binary variable, ensuring that item sets are defined unambiguously without making assumptions about the level of agreement. In the following step the most frequent and significant subsets of responses were discovered in the complete data set. The subsets for which the probability of occurrence is above 30% are presented in Table 11. It should be noted that 30% is more than 456 responses in the set. The most significant subsets of responses involved either consistent "Rather agree" or consistent "Rather disagree" selections; in each case, both answers within a pattern fell into the same category. No mixed combinations were observed. This indicates a clear and decisive stance among the respondents.

The discovered patterns in the data allowed for the reduction of the data set. Demographic information (such as gender, age, employment status, mode, level and field of study) was added to the reduced data. In the C5.0 model, only the most significant variables for each metric were used.

**Table 11**. The most significant subsets of responses

| |
|---|
| [A10. In difficult and complex situations, I always find a few alternatives to solve the problem, A12. I can easily adapt to new circumstances] |
| [A10. In difficult and complex situations, I always find a few alternatives to solve the problem, A13. I am able to look at a situation from different points of view] |
| [A10. In difficult and complex situations, I always find a few alternatives to solve the problem, A19. I try to cope with solving problems no matter how difficult they are] |
| [A13. I am able to look at a situation from different points of view, A12. I can easily adapt to new circumstances] |
| [A13. I am able to look at a situation from different points of view, A19. I try to cope with solving problems no matter how difficult they are] |
| [A14. I like to find out about things even if it means handling some problems while doing so, A19. I try to cope with solving problems no matter how difficult they are] |
| [A18. I make a determined effort to achieve the goals I set for myself, A19. I try to cope with solving problems no matter how difficult they are] |
| [A19. I try to cope with solving problems no matter how difficult they are, A12. I can easily adapt to new circumstances] |
| [A22. I am open to new experiences, A20. Dealing with difficult situations strengthens and develops me] |
| [A20. Dealing with difficult situations strengthens and develops me, A6. The setbacks I experience provide me with lessons for the future] |

The obtained models were subjected to semantic analysis to determine the dependencies between the values of variables and demographic metrics. To clarify the analytical scope, the decision-tree models were not designed to predict entrepreneurial intention nor to estimate the moderating role of demographic variables. Instead, the models identify group-differentiating response patterns, showing how entrepreneurial competencies and intention-related attributes cluster within specific demographic categories. This pattern-based approach aligns with the exploratory nature of the study and complements the earlier pattern-mining results. In the C5.0 decision-tree models, demographic categories (e.g., gender, age group, nationality, field of study) were treated as dependent variables to identify the response patterns that differentiate these groups. This approach enables the extraction of group-differentiating configurations of entrepreneurial competencies and intention-related attributes, rather than predicting intention outcomes or modelling causal relationships. The main goal of this analysis was to identify which features and conditions in the models have the greatest impact on demographic indicators and what conclusions can be drawn from them in the context of students' entrepreneurial competencies. The accuracy of the developed models, evaluated through 10-fold cross-validation, was approximately 70% when employing the classifier's default parameters. The identified dependencies were visualized in Figure 3 to Figure 8. Darker colors symbolize stronger dependencies, while lighter colors symbolize weaker ones.

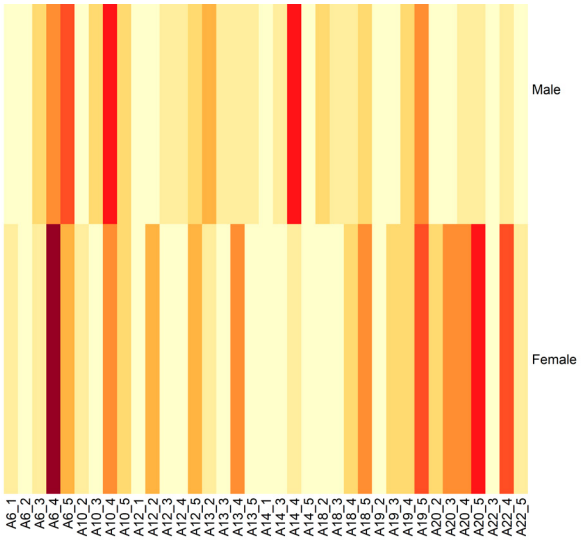


**Figure 3.** Dependencies: Attributes and the gender[4]

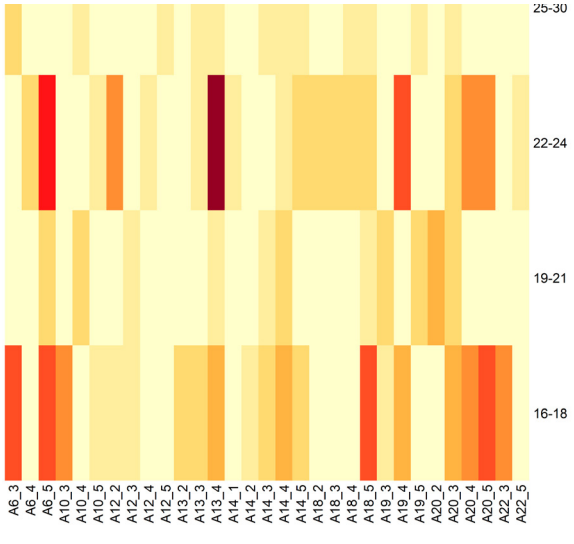


**Figure 4.** Dependencies: Attributes and the age

4 A6. The setbacks I experience provide me with lessons for the future. A10. In difficult and complex situations, I always find a few alternatives to solve the problem. A12. I can easily adapt to new circumstances. A13. I am able to look at a situation from different points of view. A14. I like to find out about things even if it means handling some problems while doings so. A18. I make a determined effort to achieve the goals I set for myself. A19. I try to cope with solving problems no matter how difficult they are. A20. Dealing with difficult situations strengthens and develops me. A22. I am open to new experiences. The answers to each question were on a Likert scale. They were as follows: 1) Definitely agree, 2) Rather agree, 3) Neither agree or disagree, 4) Rather disagree, 5) Definitely disagree. Hence, on the 0X axis, each question is accompanied by a resolution referring to the answer chosen by the students.

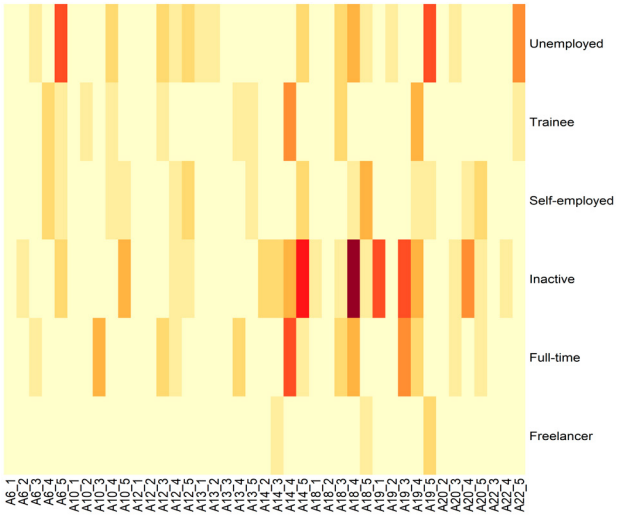


**Figure 5** Dependencies: Attributes and employment status

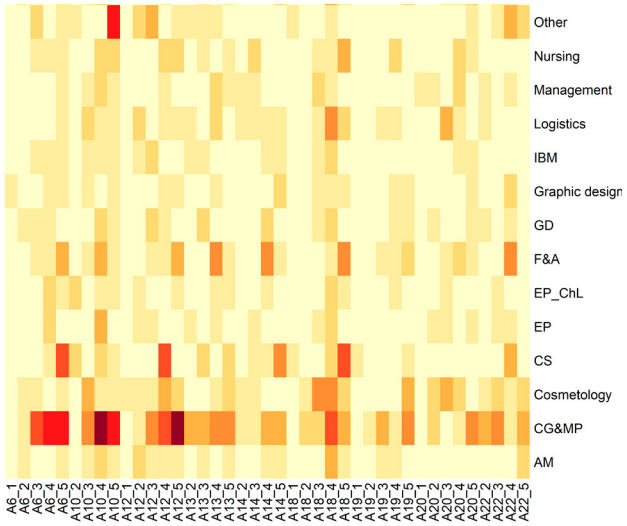


**Figure 6.** Dependencies: Attributes and field of study

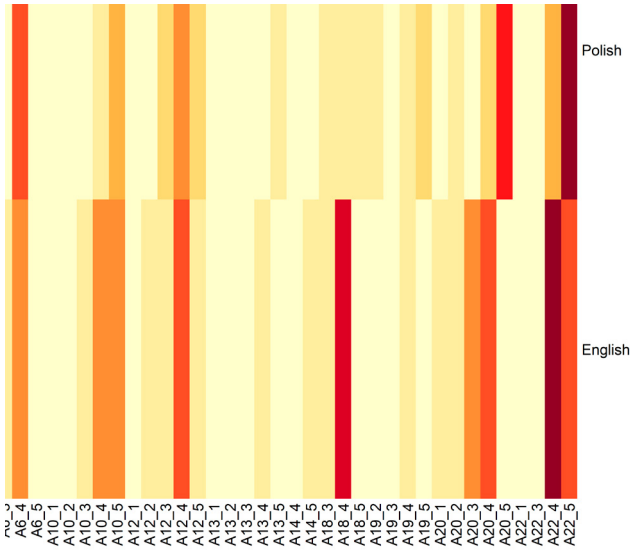


**Figure 7.** Dependencies: Attributes and mode of study

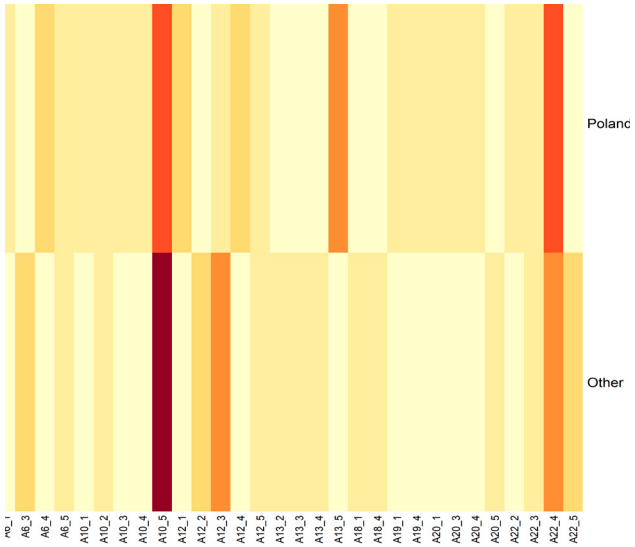


**Figure 8.** Dependencies: Attributes and country-of-origin

## DISCUSSION

Students who readily adapt to new circumstances (A12) are more likely to find alternative solutions in difficult situations (A10). Adaptation, understood as cognitive, behavioral, and emotional adjustment to change (Sheriston et al., 2019), supports problem-solving and resilience (Feraco et al., 2023b). This ability is conceptually associated with entrepreneurial readiness, enabling individuals to cope with business-related challenges (Salas Tuanama et al., 2024; Indhirapratha & Thavaraj, 2024).

Students who are capable of viewing situations from multiple perspectives (A13) are more likely to generate a variety of solutions to problems (A10). Situational self-awareness (Govern & Marsch, 2001) and innovativeness (Gözükara & Çolakoğlu, 2016) support entrepreneurial intentions (Bae, 2024). Entrepreneurial alertness mediates the relationship between innovativeness and the readiness to start a business, indicating that creative students are more likely to take action (Gözükara & Çolakoğlu, 2016). Those who engage in solving complex problems (A19) often identify alternative solutions (A10) and demonstrate determination in pursuing their goals (A18). Their adaptability (A12) reflects both resilience and creativity. Perseverance contributes to solution generation (Merrill, 2003; Hidayati et al., 2022),

while openness (Clarete et al., 2023), conscientiousness (Juhari et al., 2023), and autonomy enhance self-efficacy and entrepreneurial behavior (Brás et al., 2023).

Cognitive flexibility, stemming from perspective-taking (A13) and adaptability (A12), supports entrepreneurial intentions (Jiatong et al., 2021). Entrepreneurial self-efficacy and adaptability gain importance through education (Qiao & Hua, 2019; Zhang et al., 2022; Sun et al., 2023). The ability to take on challenges (A19) and creativity (A10) foster innovativeness and resilience (Zhao et al., 2014). Students with high cognitive flexibility are more likely to seize opportunities under uncertain conditions (Caputo et al., 2025).

Solving complex problems (A19) facilitates learning, even in the face of obstacles (A14). Action-based learning supports the development of competencies and entrepreneurial intentions (Atrup et al., 2023; Triansyah et al., 2023; Arifia et al., 2024). Resilience, understood as perceiving difficulties as opportunities (A20), is associated with openness (A22) and promotes entrepreneurial behavior (Cruz et al., 2022; Abdel-Kader et al., 2023). Moreover, students who believe that challenges strengthen them (A20) tend to view failure as a learning experience (A6). This mindset, linked to resilience, correlates with entrepreneurial intention (Cruz et al., 2022).

## The dependencies between the values of variables and demographic metrics

The developed models enabled the identification of relationships between attribute values and demographic information (i.e., decisions and their corresponding classes), highlighting group-differentiating patterns in traits relevant to students' entrepreneurial intentions.

The „gender" decision revealed that within the „female" class, disagreement with the statement that failures are a source of future learning (A6) was associated with adaptability (A12), disagreement with the notion that difficulties strengthen (A20), and low openness to new experiences (A22). While women demonstrate adaptive capacity, fear of failure negatively impacts their entrepreneurial intentions (Rahman & Mahendran, 2025) and limits opportunities for experiential learning (He & Krähenmann, 2021). Among men, there is a lack of perception in the value of failure (A6), reluctance to engage in problem-solving (A14), a limited perception of alternatives (A10), and an avoidance of challenging situations (A19). These attitudes may be culturally driven and stem from social pressure to avoid showing vulnerability (Nikolić et al., 2020). This is supported by findings on the detrimental effect of fear of failure on entrepreneurial intentions (Wimer & Levant, 2011; Mutmainnah et al., 2024).

The analysis of the „age" decision revealed differing student approaches to failure, problem-solving, and motivation. The 16–18 age group does not perceive failure as a learning opportunity (A6), struggles to identify action strategies (A10), and shows weak goal-directed motivation (A18). They are reluctant to engage in learning through overcoming difficulties (A14), which aligns with low challenge readiness (A19), confirming the findings of Fournier et al. (1995). The 19–21 age group, consistent with Allan (2017), does not view difficult situations as developmental (A20), demonstrates low engagement in problem-solving (A19), denies the value of failure (A6), has difficulty identifying alternatives (A10), and shows ambiguous attitudes toward growth through adversity (A20). The 22–24 age group exhibits three patterns: rejection of learning from failure (A6), weaker opposition to development through difficulty (A20), cognitive flexibility (A13), and a willingness to act despite challenges (A19). Moderate agreement is observed only for adaptability (A12), in line with Stephens & Gehlbach (2007). The 25–30 age group displays two distinct patterns. The first includes a negative attitude toward learning through problem-solving (A14), identifying alternatives (A10), and goal pursuit (A18), with no clear stance on learning from failure (A6) or growth through adversity (A20). The second pattern reflects reluctance to act under challenging conditions (A19), low motivation (A18), and a lack of openness to change (A12), alongside moderately negative cognitive flexibility (A13) and an undefined view on learning through overcoming difficulties (A14). These findings are supported by Lee (2009).

Responses categorized by the "nationality" decision indicate that individuals of Polish nationality more frequently report learning from failure (A6) and identifying alternative solutions in difficult situations (A10), which may reflect a stronger growth mindset and a heightened sense of agency (Cieślik et al., 2024). Students from outside Poland are more likely to report ease in adapting to new conditions (A12) (Bartkowiak & Krugiełka, 2017), likely due to their international experiences (Słowińska, 2016). In contrast, Polish respondents more often indicate the ability to adopt multiple perspectives (A13) (Błaszczak & Klocek, 2022), higher engagement in goal pursuit (A18), and greater resilience when facing adversity (A19, A20) (Surzykiewicz et al., 2019). Both groups show similar levels of cognitive curiosity (A14); however, foreign students more frequently express openness to new experiences (A22), which may stem from greater mobility and functioning in diverse environments.

Relationships between attributes and the "employment status" decision revealed that individuals employed full-time and self-employed most frequently report the ability to learn from mistakes (A6), which may result from greater exposure to professional challenges (Wilhelm et al., 2019; Tao et al., 2023). Freelancers and self-employed individuals are equally likely to indicate the ability to find alternative solutions (A10), reflecting their flexibility (Becker et al., 2014). Unemployed and inactive individuals are less likely to agree with these statements, possibly indicating lower perceived agency (Justo et al., 2021). Employed individuals, especially full-time workers and freelancers, are more likely to report ease of adaptation (A12) and the capacity to adopt multiple perspectives (A13) (Justo et al., 2021). The highest cognitive curiosity and readiness to learn through difficulties (A14) are exhibited by trainees and working students (Tumin et al., 2020). Self-employed and full-time employees score highest on perseverance (A18), coping with difficulties (A19), and perceiving challenges as growth opportunities (A20) (Feraco et al., 2023a), whereas inactive and unemployed respondents are more likely to provide neutral or negative responses (Dunn et al., 2014). Freelancers and those with flexible work arrangements achieve the highest scores in openness to new experiences (A22), likely because of the need for continuous adaptation (Frie et al., 2024).

The study also revealed differences in attribute outcomes based on the "field of study" decision. A comparison of students across different disciplines highlights significant variations in approaches to adaptation, development, and problem-solving. Students of Psychology, Nursing, and Management more frequently learn from mistakes (A6) and adopt multiple perspectives (A13), which may be attributed to the humanistic orientation of these programs (Winarko & Budiwati, 2024; Hojat, 2016). In contrast, technical and IT-related fields (Programming, Computer Science, Data Science) promote the identification of alternatives (A10) and cognitive flexibility (A12) (Sim & Wright, 2002; Bhattacherjee & Kukreja, 2023). Students in Finance and Accounting in Management and International Business Management exhibit higher perseverance (A18) and better coping with difficult situations (A19, A20), suggesting a strong goal orientation (Séllei, 2021). Meanwhile, students from artistic disciplines (Graphic Design, Game Design and Development) stand out for their openness to new experiences (A22) and cognitive curiosity (A14), reflecting the creative nature of these fields (Feraco et al., 2023b).

Differences were also observed in responses related to the "mode of study" decision. Students studying in English more frequently report openness to new experiences (A22), ease of adaptation (A12) (Drozdova & Taulean, 2022), and the perception that challenging situations support their development (A20), which may result from functioning in an international environment (Guillén-Yparrea & Ramírez-Montoya, 2023; Dunworth et al., 2021). Conversely, Polish-speaking students more often indicate perseverance in goal attainment (A18) and effectiveness in problem-solving (A10), potentially reflecting a task-oriented approach to learning (Pharaoh & Li, 2022). Differences in reflection on failures (A6) and willingness to learn despite difficulties (A14) are minimal, with a slight advantage for students studying in Polish.

This work does not directly operationalize the TPB components; therefore, the results should not be interpreted as an empirical test of the TPB model. The study does not assess latent factor structure or cross-language measurement equivalence, as the analytical focus is on item-level pattern configurations rather than psychometric scale validation. Instead, the observed relationships represent conceptual patterns related to intention that emerge within the scope of entrepreneurial potential. In this study, the relationships among elements of adaptability, resilience, problem-solving, and initiative reflect conceptual coherence in students' self-definitions and the internal clustering of these characteristics. These patterns are consistent with the dominant themes highlighted in the bibliometric structure. Direct analysis has not been performed to correlate item-level features with intention-specific responses; therefore, the findings are interpreted as thematic alignment and clustering rather than predictive evidence.

In this study, the internal structure of intention-related attributes among university students was examined using mining techniques and compared with the thematic evolution of entrepreneurship research. The study findings indicate that students' adaptability, resilience, and initiative-related traits often converge and are conceptually aligned with the main knowledge areas in the field. These results provide an integrative perspective on how behavioral trends at the individual level relate to broader trends in entrepreneurship.

This study makes a methodological contribution by linking micro-level patterns with macro thematic development, while emphasizing practical aspects for entrepreneurship education and the enhancement of institutional support. Future research may expand on this study by incorporating longitudinal data, additional behavioral constructs, or multi-institutional datasets to further validate and expand on the insights presented here.

## CONCLUSION

This study examined entrepreneurial intentions through a multilayered analytical framework that integrates bibliometric analysis (SciMAT) with machine learning–based decision tree classification. SciMAT was employed to situate survey items within the evolving thematic structure of the entrepreneurship literature, providing a conceptual and interpretative coherence check rather than a psychometric validation of the instrument (Cobo et al., 2012; Vila-Lopez & Küster-Boluda, 2021).

The bibliometric analysis highlighted resilience, initiative, adaptive thinking, problem solving, goal orientation, cognitive flexibility, and open-mindedness as dominant themes in recent entrepreneurship research. These themes have been widely discussed as foundational elements of entrepreneurial development (Dessyana, 2017; Feraco et al., 2023b). Their convergence with high-influence survey items identified in the decision tree analysis indicates conceptual alignment between the literature and observed student response patterns, rather than empirical validation or predictive inference.

Clarifying item interpretation was an important outcome of this study. Item A21, based on its actual wording ("I implement developed plans from start to finish"), was reclassified as an execution-oriented behavioral competency reflecting perseverance and follow-through, rather than causal reasoning. This refinement ensures internal consistency between item content and the thematic clusters derived from the bibliometric analysis. Similarly, Item A6 was interpreted as reflecting resilience and learning from adversity, consistent with prior conceptualizations of adaptive learning and growth-oriented mindsets (Feraco et al., 2023a; Rahman & Mahendran, 2025).

The temporal evolution identified in the SciMAT analysis suggests that entrepreneurial intentions are shaped by both individual attributes and changing thematic emphases in the literature. While knowledge-oriented themes dominated earlier periods, more recent years have emphasized innovativeness and technology-related competencies, reflecting broader shifts in entrepreneurship education and research agendas (Dessyana, 2017; Brás et al., 2023).

From a theoretical perspective, the findings indicate that key psychological attributes such as initiative, adaptability, and cognitive flexibility are reflected in students' behavioral patterns. These attributes cluster conceptually within intention-related configurations, rather than serving as direct indicators of perceived capability or predictive validity. In this sense, the results resonate with prior work emphasizing the multidimensional and context-sensitive nature of entrepreneurial attributes (Caliendo et al., 2023; Feraco et al., 2023b).

From a practical standpoint, the findings offer a data-driven basis for entrepreneurship education. Educational programs may benefit from focusing on the development of problem-solving ability (A19), adaptability (A12), goal-directed behavior (A18), and resilience-oriented learning, as suggested by recent studies on experiential and action-based entrepreneurship education (Qiao & Hua, 2019; Sun et al., 2023; Atrup et al., 2023). The integration of decision-support tools and AI-based analytical approaches can assist educators and policymakers in designing targeted and responsive learning environments that address diverse student profiles and evolving educational needs.

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## Biographical notes

**Tomasz Skica** (Ph.D., D.Sc.) is an Associate Professor, habilitated doctor in social sciences in the discipline of economics and finance (Maria Curie-Skłodowska University in Lublin, Faculty of Economics, Institute of Finance, 2021). Academic lecturer, associate of the Center for Postgraduate Studies at UITM and trainer of the Cisco Entrepreneur Institute (CEI). Author of courses and teaching programs in Polish and English. Author of several dozen scientific articles, monographs, and chapters in scientific monographs, reports, strategies, and expert opinions in the field of public finance, entrepreneurship

support policies, and development strategies. He conducts research on entrepreneurship support by local government units, the efficiency of the public sector, and the public finance system. Collaborator of domestic and foreign universities and scientific institutions. Editor-in-Chief of the *Financial Internet Quarterly*.

**Teresa Mroczek** (Ph.D., D.Sc., Eng.) is an Associate Professor, a habilitated doctor of engineering and technical sciences in the discipline of technical computer science and telecommunications. She conducts research on modern methods of data mining and intelligent data analysis. Her work focuses on advanced machine learning techniques and the development of expert systems that support decision-making processes. She pays particular attention to the practical applications of artificial intelligence in various areas of life, from medicine and diagnostics to the optimization of organizational and industrial processes. She has participated in numerous research and development projects funded by the National Science Centre, the National Centre for Research and Development, and the European Union.

**Esra Sipahi Döngül** (Ph.D.) is an Assistant Professor at Aksaray University, Turkey. She graduated from the Doctorate Program in Business Administration at Istanbul Gelisim University. Her areas of expertise include management, human resource management (HRM), data analysis, business, and organization. She has a strong research background in organizational behavior, corporate social responsibility (CSR), and management organization. She is also the founder of the human resources platform flexit24.com.

## Authorship contribution statement

**Tomasz Skica:** Conceptualization, Data Curation, Formal Analysis, Methodology, Project Administration, Validation, Visualization, Writing Original Draft Preparation, Writing Review & Editing. **Teresa Mroczek:** Methodology, Software, Validation, Visualization, Writing Original Draft Preparation, Writing Review & Editing. **Esra Sipahi Döngül**: Formal Analysis, Methodology, Validation, Visualization, Writing Original Draft Preparation, Writing Review & Editing.

## Conflicts of interest

The authors declare no conflict of interest.

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# Entrepreneurial decision logic profiles and firm performance during crisis: Evidence from Myanmar

***Khin Sandar Thein*[1], *Yoshi Takahashi*[2*], *Emi Makino*[3], *Aye Thanda Soe*[4]**

***Abstract***

**PURPOSE:** *This study seeks to identify the decision logic profiles of entrepreneurs and top-level managers and to determine each profile's association with firm performance.* **METHODOLOGY:** *A cross-sectional online survey collected data from members of the Myanmar Young Entrepreneurs' Association. The K-means cluster analysis was used as a person-centered approach to identify the composition of causation and effectuation-based decision logics. Structural equation modeling was employed to test the relationship between decision profiles, knowledge exploitation and exploration, and firm performance (sales decline).* **FINDINGS:** *All the entrepreneurs showed different levels of decision logics, hybridly composed of causation and effectuation. Some entrepreneurs who displayed very high levels of causation and effectuation were named as "active hybridity"; those with moderately high levels of both logics were labelled "moderate hybridity", some with a low level of causation and the lowest level of effectuation were called "passive planners", and others with a much low level of causation and low level of effectuation were termed as "passive effectuators" respectively. Moderately hybrid entrepreneurs exhibited slightly lower levels of exploration and exploitation compared to actively hybrid entrepreneurs, while passive planners and passive effectuators showed significantly lower levels of both activities. Additionally, compared with the sales of actively hybrid entrepreneurs, those of passive effectuators showed a statistically significant lower decline, whereas those of passive planners and moderately hybrid entrepreneurs displayed insignificant differences. Although exploration did not show a statistically significant relationship with sales decline, exploitation did.* **IMPLICATIONS:** *This study adds to the causation and effectuation literature from a person-centered approach, exploring the association between the different degrees of the composition of decision logics and firm performance. Furthermore, as this research was conducted with decision-makers from companies that faced multiple crises in turbulent times, it serves as a guide for entrepreneurs on how to respond to crises with resilience and sustain their businesses.* **ORIGINALITY AND VALUE:** *This is the first study to determine the decision profiles of causation and effectuation logics at an individual level in established firms.*

***Keywords:*** *entrepreneurial decision-making, causation logic, effectuation logic, hybrid decision logic, person-centered approach, entrepreneurial decision profiles, knowledge exploration, knowledge exploitation, firm performance, sales decline, crisis context, emerging economy, entrepreneurial resilience, managerial cognition, strategic behavior under uncertainty, K-means cluster analysis, structural equation modeling, causation.*

1 Khin Sandar Thein, Ph.D., School of Health Innovation, Kanagawa University of Human Services, Research Gate Building TONOMACHI 2-A 2. 3F 3-25-10 Tonomachi, Kawasaki, Kanagawa, Japan 210-0821, e-mail: khinsandar-5hu@kuhs.ac.jp (ORCID: https://orcid.org/0000-0001-6640-1198).
2 * Yoshi Takahashi, Ph.D., Graduate School of Humanities and Social Sciences, Hiroshima University, 1-5-1 Kagamiyama, Higashi-Hiroshima City, Hiroshima, Japan 739-8529, e-mail: yoshit@hiroshima-u.ac.jp (ORCID: https://orcid.org/0000-0002-2021-5653).
3 Emi Makino, Ph.D., College of International Management, Ritsumeikan Asia Pacific University, 1-1 Jumonjibaru Beppu, Oita Japan 874-8577, e-mail: emimakinojp@gmail.com ORCID: https://orcid.org/0000-0002-6717-0317).
4 Aye Thanda Soe, Ph.D., Department of Economics, Maubin University, PM25+757, Maubin, Ayeyarwady Division, Myanmar (Burma), e-mail: ayethandasoe@gmail.com (ORCID: https://orcid.org/0009-0001-7581-1233).

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## INTRODUCTION

The inherently changing nature of the business environment such as unknown outcomes regarding the creation of new products and services (Knight, 1921; Townsend et al., 2018), fluctuations in cash flow, legislation procedures, the power plays across the supply network relationships, constant change in customer requirements and demands and the unpredictable national financial systems (Bhamra & Dani, 2011) create challenges for firms to survive, grow, and remain sustainable. For emerging-market countries, environmental uncertainty is more pronounced, presenting various challenges, including weak institutional frameworks, dysfunctional competition (Bruton et al., 2013; Meyer et al., 2009), resource scarcity, and economic and political crises (Yu et al., 2018). These challenges pose significant challenges, leading firms to realign their strategies for business continuity (Fisher et al., 2020; Sirokova et al., 2020).

Following the planning school of thought, some entrepreneurs try to mitigate these uncertainties through prediction and planning, using analyses to identify and exploit opportunities and to develop strategies to achieve goals and implement plans (Ansoff, 1979; Mintzberg, 1978). This approach was named causation by Sarasvathy (2001), who contrasted it with effectuation, where entrepreneurs use available means, invest up to the extent of affordable loss, form alliances, take prior commitment from self-selecting stakeholders, and exploit contingencies to mitigate uncertainties (Chandler et al., 2011; Sarasvathy et al., 2008). Previous literature has focused on the two logics being alternatives to one another (Lascovaia et al., 2019; Nummela et al., 2014; Reymen et al., 2015). However, in a real business environment, the degree of uncertainty is unstable over time (Alvarez & Barney, 2005), and environmental dynamism determines the viability of a causal or effectual approach (Chen & Xu, 2022). Therefore, choosing a specific strategy no longer requires a single choice between causation and effectuation (Galkina et al., 2021). According to Sarasvathy (2001, 2008), the two logics can be balanced in entrepreneurial action and chosen interchangeably depending on the situation. The synergistic coexistence of the two logics has led to a stream of research in effectuation literature (Matalamäki, 2017). However, there is limited knowledge of how these logics are displayed across different levels in actual contexts (Galkina et al., 2021) and their consequences. Grègorie and Cherchem (2020) also noted that prior studies on the coexistence of causation and effectuation were mostly qualitative and called for a deeper explanation of the methodologies and circumstances under which such co-occurrence can prevail, along with its possible impact on firm performance.

Researchers also recommend finding a possible synergistic effect of causation and effectuation on firm performance, as both can coexist (Reymen et al., 2017; Smolka et al., 2018; Yu et al., 2018). Recent studies have shown that their simultaneous or alternating use creates a synergy that improves performance (Braun & Sieger, 2021; Reymen et al., 2017; Smolka et al., 2018; Yu et al., 2018). However, most of these studies have been qualitative, and in quantitative studies, subjective measures have been used to measure firm performance (Alzamora-Ruiz et al., 2021; Cherbib, 2024; Smolka et al., 2018).

The relationship between the use of causation and effectuation on firm performance has been a research trend for about two decades since Saravathy's (2001) introduction of the effectuation concept (Akemu et al., 2016; Appelhoff et al., 2016; Cherbib, 2024; Lascovaia et al., 2019; Shirokova et al., 2020; Watson, 2013; Werhahn et al., 2015; Yu et al., 2023). Among them, only a handful of studies had been conducted in the context of emerging-market countries (Lascovaia et al., 2019; Misbauddin et al., 2024; Shirokova et al., 2021; Yu et al., 2024). Grègorie & Cherchem (2020) noted in their systematic review that internal and/or external constraints may influence the prevalence of effectuation, while they also recognized the co-occurrence of effectuation and causation in prior empirical studies. Shirokova et al. (2021) argued, based on contingency theory (Morgan, 2007), that the effectiveness of decision logics is highly contingent on their fit with environmental factors, and they highlighted the importance of contextual factors in understanding the effect of decision logics on firm performance.

The way entrepreneurs and managers make decisions and choose strategies may differ in a developing-country context, and their responses to the environment may differ from those of their counterparts in developed countries (Shirokova et al., 2020). More substantively, empirical studies have shown that the relationship between planning and firm performance is highly confounded by both endogenous and exogenous factors (Brinckmann et al., 2010). While Miller and Cardinal (1994) demonstrated a strong, direct, positive relationship between planning and firm growth, Rue and Ibrahim (1998) found a weak, positive relationship between planning and sales decline. Effectuation seemed to be more effective in underdeveloped, emerging-market contexts than causation (Shirokova et al., 2021; Zhou & Liou, 2021). While causation reduced firm survival during economic crisis, effectuation was found to be viable for SME survival (Osiyevskyy et al., 2023). Because of the underexplored cases and inconclusive results, Perry et al. (2012) recommended further analysis to gain more insight into the relationship between entrepreneurial decision logic and performance.

In emerging economies, firms face a tougher environment (Bruton et al., 2013; Meyer et al., 2009; Yu et al., 2018). One current example of such a situation is Myanmar. In Myanmar, the economy had been under various devastating situations ranging from COVID-19 pandemic, to other political and social conflicts, leading to a continuous decline in GDP from -9% in 2020, -12% in 2021, and then, with a slight positive growth from 4% in 2022, again sticking at -1.1% in 2024, according to IMF (2024). Yet, the silver lining of the crisis (Grözinger et al., 2021) still brings firms opportunities to sustain their business and grow under such a trajectory (Giotopoulos et al., 2017). Hence, it is worth examining to address our research questions: how different entrepreneurs prevail under different decision logics in crises or turbulent situations, and how these decision logics affect firm performance, particularly in the current context of Myanmar.

Prior studies have used the effects of causation, effectuation, and their synergy on firm performance through a variable-centered approach (Alzamora-Ruiz et al., 2021; Cherbib, 2024; Smolka et al., 2018). Yu et al. (2024) identified a configuration approach that combines causation and effectuation. Their focus has been on exploring different compositions of effectuation components while fixing the causation component as a single factor. The study did not examine various combinations of both causation and effectuation at the individual level, but rather at the variable level. Shirokova et al. (2021) called for examining combinations of decision logics and their effects on firm performance. However, little research focuses on how contemporary entrepreneurs employ these decision logics in real-world contexts being composed at an individual level. Rather, we had only seen literature focusing on decision logics as separate variables, which may be too ideal to be found exactly at the personal level (Alzamora-Ruiz et al., 2021; Cherbib, 2024; Smolka et al., 2018). To the best of our knowledge, only one study has examined the different compositions of causation and effectuation across various profiles at the interpersonal level; yet this study was limited to student samples in a relatively stable environment (Ilonen et al., 2018). Lascovaia et al. (2019) called for greater use of the configuration approach in the causation and effectuation literature, particularly in crisis situations. Further investigation into the consequences of entrepreneurial decision logics is recommended (Smolka et al., 2018). Therefore, using a person-centered approach to identify the actual composition of decision logics among current entrepreneurs would be a distinctive method and could be used to examine the relationship between each composition and firm performance, particularly in crisis situations.

With an aim to bridge the aforementioned gap in the literature, the purpose of this study is to identify the decision logic profiles of current entrepreneurs and top-level managers and to determine the association between each profile, consisting of causation and effectuation, and firm performance. The sample includes current business owners and top-level managers responsible for making strategic decisions in firms in Myanmar. This study contributes to the causation and effectuation literature by adopting a person-centered approach and focusing on a turbulent environment, such as Myanmar, to shed light on how entrepreneurs survive and adapt to environmental turbulence.

## LITERATURE REVIEW

### Different decision profiles

To manage the inherent uncertainty, entrepreneurs seek to mitigate its negative impact through their management styles in venture creation, opportunity recognition, and other business operations, such as new product/market development, marketing, and strategy development. From a strategic management perspective, some entrepreneurs address uncertainties through prediction and planning (Nummela et al., 2014), using analyses of past data to forecast the future, setting goals and plans, and developing appropriate strategies to achieve them (Ansoff, 1979; Mintzberg, 1978). This can be called the goal-oriented approach and named as causation by Sarasvathy (2001). Founded in neo-classical microeconomics (Stigler, 1952), the causation approach means making rational choices from available information to maximize utility (Chandler et al., 2011). Causal entrepreneurs focus on market opportunities (Henninger et al., 2020) and invest in opportunities with a higher expected return. These returns are predicted through extensive research and analysis and implemented with a predetermined business plan and the acquisition of required resources (Sarasvathy & Dew, 2005). However, depending on the entrepreneurs, the way they approach strategic decision-making under uncertainty may vary by their cognitive orientation (Nummela et al., 2014).

Sarasvathy (2001) studied how expert entrepreneurs behave in real-world contexts and uncovered an effectual approach to entrepreneurship. Effectuation is an emergent approach that uses available means to control and shape the future, taking affordable loss options, securing stakeholder commitment, and utilizing contingency approaches, rather than predicting and planning in response to environmental changes (Sarasvathy, 2001; 2008). Although causation and

effectuation use different cognitive orientations such as goal and mean orientations respectively, Sarasvathy (2001) proposed that the two logics are not mutually exclusive within an individual. She emphasized that the two concepts are often used interchangeably or in a balanced manner, depending on the situation.

Haynie et al. (2010) argued that causation and effectuation are cognitive strategies (Chen & Xu, 2022) consciously chosen by entrepreneurs through their metacognitive processes. They regard an entrepreneur as "a fully engaged thinker who has multiple cognitive strategies available and chooses among them based on goals, motives, and needs" (Fiske & Taylor, 1991, p. 13). According to the entrepreneurial metacognition theory of Flavell (1979), it is also possible that entrepreneurs with higher cognition processes could use the different strategies either in combination or alternately (Fiske and Taylor, 2013). Literature also found that entrepreneurs use the combination of two logics in the real world (Berends et al., 2014; Galkina & Lundgren-Henriksson, 2017; Galkina et al., 2021). Mitchell et al. (2011) proposed that entrepreneurs recognize multiple alternative approaches to performing a specific task and may choose both causation and effectuation in an entrepreneurial action. Servantie and Rispal (2018) and Smolka et al. (2018) confirmed that entrepreneurs complementarily use causation and effectuation, and that the composition style differs from individual to individual (Sarasvathy, 2009).

A variable-centered approach in which independent variables are used to explain the variance in dependent variables (Stanley et al., 2017) is rather impractical for studying entrepreneurial decision logics. It has limitations when examining the complex interactions among multiple variables (Aguinis, Gottfredson, & Wright, 2011). Person-centered and configural approaches recognize different configurations of variables (Stanley et al., 2017). Likewise, entrepreneurs in the real world can be composed of different decision logics. Gancarczyk and Ujwary-Gil (2021) viewed decision-making as a configurational approach—a dynamic blend of logics rather than isolated types. As entrepreneurs with higher metacognitive processes are more aware of situations, cognitive adaptability operates differently across environmental contexts (Haynie et al., 2010). In response to the call by Grègorie and Cherchem (2020), it would be interesting to examine how entrepreneurs' metacognition operates in turbulent situations at the individual level using a person-centered approach.

On the other hand, individuals can be constrained or propelled through metacognition (Haynie et al., 2010). People who are more constrained are less likely to alternate strategies and adapt to the decision context. The higher the level of metacognitive processes, the more entrepreneurs can adjust their current strategy in response to the situation (Flavell, 1979). While some entrepreneurs frequently combine them (Berends et al., 2014; Galkina & Lundgren-Henriksson, 2017; Galkina et al., 2021), others may rely on a single logic. However, entrepreneurs with more constrained metacognition may cautiously limit their choice to only the most appropriate strategy to avoid making the wrong choice, particularly in times of uncertainty and dynamic situations (Haynie et al., 2010).

Hauser et al. (2020) reminded that entrepreneurs tend to be less active with none of the above-mentioned strategies, instead, putting out fires, especially when they are totally absorbed by current events and crises. As a form of firefighting (Winter, 2003), entrepreneurs lack the opportunity to develop strategies (Aram & Cowen, 1990). Ilonen et al. (2018) also found, in their cluster analysis, that after gaining experience and knowledge, entrepreneurs adopted a coping strategy that was more likely to involve a lack of both causation and effectuation, as well as a hybrid decision logic. Therefore, based on the entrepreneurial metacognition theory, we would like to explore what kind of different decision logic profiles may exist and vary in their cognition process among entrepreneurs, such as a hybrid use of both the decision logics, causation-dominant decision logics, effectuation-dominant decision logics, and coping strategies with no causation and effectuation.

## Decision profiles and firm performance

The synergistic effect of causation and effectuation has its own research stream within effectuation research (Matalamäki, 2017). Recent literature examined the effect of their simultaneous use (Braun & Sieger, 2021; Galkina & Lundgren-Henriksson, 2017; Jiang & Tornikoski, 2019; Reymen et al., 2015; Smolka et al., 2018; Yang & Gabrielsson, 2017). However, to the best of our knowledge, little is known about the mechanisms by which the two logics create a synergistic and additive effect, especially from a configurational perspective. A better understanding of how the two logics and their combination would help entrepreneurs perform better (Galkina & Jack, 2022).

Previous studies have found a positive relationship between causation and venture growth performance (Brinckmann et al., 2010). Specifically, many studies have found a positive relationship between the causation approach and firm performance in terms of innovation (Kristinsson et al., 2016), research and development (Brettel et al., 2012), and financial performance, such as sales and firm and employment growth (Mayer-Haug et al., 2013; Rue & Ibrahim, 1998). Therefore, variations in the degree of reliance on planning are expected to cause variations in the effectiveness of firm performance.

However, some researchers have questioned the benefits of causation or planning approaches (Burke et al., 2010; Chwolka & Raith, 2012; Delmar & Shane, 2003; Gruber, 2007; Honig & Samuelsson, 2014). In particular, Osiyevskyy et al. (2023) found that effectuation outperformed causation in a firm's survival during a crisis.

Effectuation is especially recommended for uncertain situations, as it enables the discovery and creation of opportunities with available resources (Wiltbank et al., 2006). Using an effectual logic, entrepreneurs engage in simultaneous experimentation with self-selected stakeholders to grasp and adjust viable opportunities in response to frequent changes (Andries et al., 2013). Additionally, partnering with others enables flexibility through expanded resources and continuous goal reconfiguration, leading to the co-creation of novel opportunities for profitability and growth (Wiltbank et al., 2006). Overall, effectuation was found to have a positive impact on firm growth, not only in normal situations but also during turbulent times, such as the turbulence of 2009–2013 in the Eurozone (Matalamäki, 2017), as well as on the subjective measures of profitability and growth (Cai et al., 2017). Additionally, Read et al. (2009) found that effectuation positively impacts firm performance. As noted earlier, Osiyevskyy et al. (2023) found that effectuation increased the firm survival rate during an economic crisis. However, effectuation can be a double-edged sword in new product development, undermining its meaningfulness (Deng et al., 2021).

Although the two concepts appear to be different and mutually exclusive, recent literature shows that causation and effectuation are not competing but complementary and synergistic (Braun & Sieger, 2021; Galkina & Lundgren-Henriksson, 2017; Reymen et al., 2015; Jiang & Tornikoski, 2019). The combined use of causation and effectuation can mitigate each other's disadvantages. Using the causation approach, the firm can clearly set its future direction (Frese et al., 2007) while simultaneously quickly adapting to the situation (Brettel et al., 2012). Yu et al. (2018) proposed combining the two approaches to harness their synergistic effects, particularly in uncertain situations, as they can complement each other's strengths while mitigating their weaknesses. After all, while effectuation creates more flexibility, better predictions can be made from the gathered information owing to causation. They concluded that a combined approach creates a positive impact on firm performance, confirming the findings of Smolka et al. (2018). Hayne et al. (2010) proposed that greater reliance on metacognitive knowledge and experience could lead to a more desirable outcome in the entrepreneurial task. This brings us, in conjunction with the previous literature, to the hypothesis:

H1: Firms classified into a hybrid form of causation and effectuation logic are associated with better performance than those firms that use other empirically classified decision logics.

## Decision profiles and knowledge exploitation and exploration

The entrepreneurship paradigm has shifted from a static, trait-based perspective to a more dynamic one based on learning (Gemmell et al., 2011; Wang and Chug, 2014). Entrepreneurial learning can be defined as the process of knowledge acquisition, sharing, integration, and utilization of business practice (Harrison & Leitch, 2005). This process can be implemented in two ways: knowledge exploitation and exploration. Knowledge exploitation involves the refinement or gaining of deeper insights into one's current knowledge and competencies by choosing, producing, striving for efficiency, implementing, and executing; exploration refers to strategies related to managing new entrepreneurial knowledge by searching, experimenting, making variations, taking risks, being flexible, and discovering (March, 1991). Both start-up entrepreneurs and intrapreneurs in established firms first have to decide between causation and effectuation, and then must make strategic choices about investing in different knowledge management or learning strategies, namely, exploitation and exploration (He & Wong, 2004).

Causation allows entrepreneurs to exploit pre-existing knowledge by developing competitive strategies for existing markets (Politis, 2005) and taking advantage of available resources and capacities. Causal components of planning and prediction (Smolka et al., 2018) help entrepreneurs exploit opportunities in a way that enables them to understand the market and demand by using projection or prediction of expected return for managing resources, and business planning as a tool for predicting or minimizing risk (Chandler et al., 2011).

Meanwhile, effectuation-oriented entrepreneurs try to control the future and explore possibilities without predetermined goals (Sarasvathy, 2001). The principles of effectuation provide entrepreneurs with more opportunities for knowledge exploration (Cai et al., 2017). Examples include experimenting with new product/service/market development (Chandler et al., 2011; March, 1991; Zahra et al., 2006); affordable loss for operating the business within resource constraints (Bruton & Ahlstrom, 2003; Gedajlovic et al., 2012); flexibility to respond to rapid changes in the environment (Dixon et al., 2010; Peng & Luo, 2000), and pre-commitment to strategic alliances (Zhao et al., 2011). Although effectuation is found

to affect exploration, its principles also contribute to exploitation (Guo, 2018). This is evident through experimentation with resource combinations to reach an optimal level (Deligianni et al., 2015; Guo et al., 2016); affordable loss by step-by-step investment to exploit feasible opportunities (Dew et al., 2010); and flexibility to reap emerging opportunities (Alvarez & Barney, 2007; Vera & Crossan, 2005).

Guo (2018) suggested that both causation and effectuation have distinct ways of acquiring and allocating resources and found that both positively affect exploitation. Nonetheless, no significant effect of their interaction on exploitation was found. However, expert entrepreneurs could leverage the knowledge of both causal and effectual logics developed over their experience to seek out additional information and process it to identify opportunities (Politis, 2005). While they use the causation approach with a central focus on planning and prediction for minimizing risk and uncertainty, and it is the best for exploiting knowledge (Sarasvathy, 2001), they will also be able to see the good in both exploitation and exploration and tend to act more ambidextrously, especially when an individual is exposed to different expertise and a wide variety of knowledge (Tempelaar & Rosenkran, 2019). Particularly in times of uncertainty, opportunity decisions are influenced by cognitive skills and personality traits, individually or through their interaction (Mensah et al., 2021). This study assumes that different levels of hybridity may trigger more distinctive utilization of strategies, exploration, and exploitation. Therefore, recalling the meta-cognition theory, we propose that entrepreneurs with higher metacognitive processes who use the hybrid approach to causation and effectuation have greater advantages in exploitation and exploration.

H2(a): Firms classified into a hybrid form of causation and effectuation exhibit higher knowledge exploitation than those firms that use other empirically classified decision logics.
H2(b): Firms classified into a hybrid form of causation and effectuation exhibit higher knowledge exploration than those firms that use other empirically classified decision logics.

### Exploitation, exploration, and firm performance

An organization's performance depends on its current capabilities (Davidsson et al., 2009; March, 1991). As exploitation helps to use current and existing knowledge to achieve competitive advantage and efficiency (Zack, 1999), it can improve firm performance. Exploratory learning is expected to improve performance by facilitating the identification of new knowledge (McGrath, 2001; Uotila et al., 2009). Cai et al. (2017) empirically proved the relationship between exploration and new venture performance. Although previous research has empirically shown that both exploration and exploitation impact firm performance (Levinthal & March, 1993; Su et al., 2011), within the constraints of an organization's scarce resources, a choice must be made to make optimal use of each component (Lee & Huang, 2012). Hou et al. (2019) found a positive relationship between exploration and exploitation, mediated by entrepreneurial orientation, and firm performance, measured by sales and other financial performance indicators. Thus, we posit the following:

H3(a): Knowledge exploitation is positively associated with firm performance.
H3(b): Knowledge exploration is positively associated with firm performance.

## METHODOLOGY

### Sample and data collection

Data were collected from October to November 2022 from firm owners and top-level managers associated with the Myanmar Young Entrepreneurs' Association (MYEA). Founded in 2009, the MYEA, a non-profit organization, serves as a platform for young entrepreneurs in Myanmar to network, exchange ideas, and interact with regional and international businesses. Although the exact number of members could not be obtained due to several crisis situations, including safety and security concerns, it had 1,714 member companies by 2019, before the COVID-19 pandemic, according to Myanmar Insider (2019). First, we contacted the MYEA's executive committee and obtained permission to conduct an online survey. This survey was conducted using Google Forms and consisted of a structured questionnaire with questions on entrepreneurial decision-making logic, knowledge exploitation and exploration, firm performance, and members' general demographic information. With the assistance of the secretariat, the purpose of the study was explained, and the Google Form link was distributed to all members via email. Once the purpose of the study was explained and the confidentiality of data was assured, members were requested to ensure that firm owners or top-level managers responsible for strategic

decision-making in the company responded to the survey. The survey was completed by November 30th, 2022, and 249 responses were received. The questionnaire was distributed to 800 members, with a response rate of 31.12%, which was relatively low owing to COVID-19 and the political situation. Some member organizations had become inactive, and a few others could not be contacted for safety concerns. Of the 249 responses, 232 (93.2%) were considered valid. When choosing companies, we limited the scope to those established before 2019 to include those that had faced both COVID-19 and other political-social crises. To check for late-response bias, we split the sample into two groups: those who responded in the first wave of questionnaire distribution (180) and those who responded in the second wave (52 valid responses), and examined main variables such as effectuation, causation, and performance. The independent-samples t-test showed no significant difference between the early and late respondents on the main variables. Participants included 128 females (55.2%) and 104 males (44.8%). Of the 170 respondents, 170 were owners, and 62 were top-level managers. Their ages ranged from 23 to 53 years. The average age of the respondents was 42.1 years.

## Measures

The questionnaire comprised four sections: (1) demographic and general information and firm performance; (2) entrepreneur's decision-making logic; (3) knowledge exploitation and exploration; and (4) manipulation check to ensure that effectuation is not considered as having any strategy at all (Hauser et al., 2020). The questionnaire was structured around previously well-established measures from the literature and developed in the Myanmar language. The double back-translation method was used to ensure linguistic equivalence and face validity. A pilot test was conducted with 10 executive members at the online meeting to validate the constructs and understandability of the language context.

### *Decision logics: Causation and effectuation*

Martin-Navarro et al. (2021) developed both causation and effectuation measures: a 7-item unidimensional construct to measure causation and 17 items across 5 dimensions to measure effectuation: means-orientation, partnership, affordable loss, contingency, and control orientations. These measures were used for measuring causal and effectual propensity. These propensity measures seem suitable for this study, as we aimed to measure decision logics rather than behaviors. Using a 7-point Likert scale ranging from "1= strongly disagree" to "7 = strongly agree," respondents were asked to recall causal and effectual propensity and orientation when making their business decisions. "I prefer to have predetermined goals and to strive to achieve the results of these goals," and "I pursue those initiatives for which I personally have the relevant competencies," are sample items pertaining to causation and effectuation, respectively. Although these measures were primarily intended for potential entrepreneurs, the authors also recommended this scale for use by entrepreneurs and managers of established companies, as they are considered able to evaluate themselves with respect to the implementation of strategic orientation.

### *Knowledge exploitation and exploration*

Entrepreneurs' knowledge exploitation and exploration behaviors were measured using Popadiuk's (2012) six-point bipolar scale. Exploitation and exploration are second-order latent constructs composed of different dimensions. The four exploitation dimensions reflect entrepreneurs' choice of strategy in competition, strategy orientation, efficiency, and partnership. The two exploration dimensions reflect the strategic choice in knowledge practices and innovation. Sample items of exploitation include "Degree of existing knowledge utilization" and "Time horizon for organizational strategy." Those of exploration include "Volume of new ideas generation" and "Focus on totally new products and processes."

### *Firm performance: Sales decline*

To measure firm performance, we used an objective measure of the percentage change in sales over a three-year period from 2020 to the end of 2022 (Zahra, 1993). This measure was chosen considering that it reflected how well a company related to its external environment in the face of both COVID-19 and other political and social crises. Following Naknok (2022) and Zahra (1993), we requested that respondents report their percentage change in sales relative to 2019, the year before COVID-19 struck. To reflect the firm survival, we just regarded 0 for no decline and/ or sales increase, 1 for sales decline up to 20%, 2 for sales decrease up to 20 to 29%, 3 for sales decrease up to 30 to 39%, 4 for a decrease up to 40 to 49%, and 5 for a decrease of 50% and above.

### Control variables

Variables affecting the choice of decisions, practices, and firm performance were treated as control variables. At the individual level, we controlled for respondents' gender, age, and years of experience because these factors may have a significant influence on the entrepreneurs' use of decision logics and firm performance (Lumpkin & Dess, 2006; Manolova et al., 2020; Schmidt et al., 2020; Werner, 2020). At the firm level, we controlled for firm size at the base year, firm age, and industry type. Industries are classified by their vulnerability during a crisis: highly vulnerable, indifferent, or more resilient (McKinsey and Company, 2020). For example, tourism, hospitality, manufacturing, logistics, commercial trade, and retail are highly vulnerable during a crisis; media services and agriculture are indifferent, while health, telecom, on-demand services, and private education sectors benefit during a crisis (Manolova et al. 2020).

### Manipulating variables

Hauser et al. (2020) suggested that the idea of effectuation may be confused with ad hoc decision-making owing to the lack of a strategy. The mean results for the two variables also showed that respondents had no practice of absence of strategy (mean = 3.207), while effectuation showed a mean of 5.752, which is moderately high, and showed a significant difference from absence of strategy ($t = 28.309$, $p < 0.000$). The mean value of causation was also high, with 5.770. Pearson's correlation coefficient among effectuation, causation, and the absence of strategy was also insignificant.

### Data analyses

Data analyses involved three steps. The first consisted of assessing the reliability and validity of first-order latent constructs and conducting a confirmatory factor analysis (CFA) to create second-order factors for exploitation and exploration variables in Statistical Package for the Social Sciences Analysis of Moment Structures (SPSS AMOS) version 23. The second involved using standardized values of causation and effectuation in K-means clustering to identify the decision logics of entrepreneurs and top-level managers, as this method is recognized as flexible, efficient, and easy to implement (Ikotun et al., 2023). To determine the optimal number of clusters, the elbow method, the most traditional approach, was used (Shi et al., 2021). The third involved using cluster dummy variables to conduct an ordinal regression analysis to test the relationship between decision profiles, ordinary least squares regression analysis for testing the relationships between knowledge exploitation and knowledge exploration, and firm performance. When forming the dummy clusters, actively hybrid entrepreneurs were treated as the reference group, assumed to be an extreme or ideal group of entrepreneurs based on metacognitive processes (Guo, 2018; Haynie et al., 2010; Smolka et al., 2018). In addition, due to unequal cluster sizes, the ordinal nature of the dependent variables, and sparse outcome-covariate combinations, we conducted Monte Carlo Simulations to assess the finite-sample performance of the ordinal regression. We re-estimated ordinal regression using 5000 replications via repeated simulations, bias, empirical standard errors, and confidence-interval coverage for the key coefficients.

## RESULTS

### Data validation

As the exploitation and exploration measurement items were taken from Popadiuk (2012), who treated them as second-order factors composed of two and four dimensions, respectively, we checked the reliability and validity of the first-order factors, including causation and effectuation. Cronbach's alpha values for causation and effectuation were 0.744 and 0.783, respectively, well above the cut-off criterion of 0.70. For exploitation, first-order factors were efficiency (alpha = 0.82), strategic orientation (alpha = 0.684), competition (alpha = 0.828), and partnership (alpha = 0.667). Although some factors were below 0.70, the other dimensions were above this level. Raharjanti et al. (2022) assumed an alpha value from 0.60 to 0.80 as deemed acceptable. For exploration, the first-order factors, knowledge and innovation practices had good reliability scores of 0.829 and 0.776. Next, confirmatory factor analysis (CFA) was conducted using the measurement model for first-order factors only. Convergent and discriminant validity were confirmed for all the first-order variables. Table 1 shows that their average variance extracted (AVE) is greater than 0.50, and the square root of the AVE is greater than the correlation. A fair level of fitness was observed in the CFA result of the measurement model with that of the first-

order with χ2 /degree of freedom (df) = 1.756, comparative fit index (CFI) = 0.926, incremental fit index (IFI) = 0.927, root mean square error of approximation (RMSEA) = 0.057. Therefore, we moved to construct the second-order model in AMOS, and the model fit indices indicated a good fit: χ2/df = 1.632, CFI = 0.935, IFI = .936, RMSEA = 0.052.

**Table 1.** Correlation matrix among first-order latent variables

| Latent Variables | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Knowledge Practices | 0.718 | | | | | |
| 2. Innovation | 0.506** | 0.775 | | | | |
| 3. Efficiency | 0.646** | 0.535** | 0.796 | | | |
| 4. Strategic Orientation | 0.494** | 0.487** | 0.609** | 0.721 | | |
| 5. Competition | 0.416** | 0.431** | 0.494** | 0.615** | 0.809 | |
| 6. Partnership | 0.362** | 0.341** | 0.387** | 0.437** | 0.461** | 0.718 |

*Note:* ** Correlation is significant at the 0.01 level (2-tailed); the square root of AVE was inserted in the diagonal boxes.

After forming the second-order constructs of exploitation and exploration, we tested the convergent and discriminant validity of the entire model. Table 2 presents the correlation matrix among the second-order construct variables. Again, convergent and discriminant validity were confirmed for the main variables. Table 2 shows that their AVEs are greater than 0.50, and their square roots are greater than the correlations. In addition, because all variables were collected from a single respondent in a single questionnaire, there is a potential for common-method bias. We checked Harman's single-factor test in SPSS, and the total variance extracted by a single factor was 21.94%, which is well below 50%, suggesting no serious common method bias.

**Table 2.** Correlation matrix of the main variables

| Latent Variables | Minimum | Maximum | Mean | Std Dev | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| 1. Effectuation | 4.47 | 7.00 | 5.752 | 0.497 | 0.737 | | | |
| 2. Causation | 3.43 | 7.00 | 5.770 | 0.620 | 0.562** | 0.727 | | |
| 3. Exploration | 1.67 | 3.90 | 3.14 | 0.452 | 0.385** | 0.387** | 0.735 | |
| 4. Exploitation | 0.96 | 2.59 | 1.913 | 0.334 | 0.350** | 0.392** | 0.574** | 0.829 |

*Note:* ** Correlation is significant at the 0.01 level (2-tailed); The square root of AVE was inserted in the diagonal boxes.

## Descriptive statistics

Before conducting further analysis, we examined the descriptive statistics of the respondents to understand the nature of the respondents and the general condition of the main variables. Mean, standard deviation, and the minimum and maximum values were reported in Table 2. The results showed that respondents exhibit high levels of both causation and effectuation, with mean values of 5.752 and 5.770, respectively. Therefore, we can generally assume that respondents practice a hybrid of effectuation and causation in reality. It was found that respondents had a moderate level of exploration (3.14) and a low level of exploitation (1.913) during data collection. Out of the total 232 respondents, 97 were in highly vulnerable industries, 50 were in highly beneficial ones, and 85 were in indifferent industries. Among them, 103 reported no sales decline, 33 reported up to 20% decline, 17 reported 30% decline, only 12 reported up to 50% decline, and 29 reported more than 50% decline.

## Cluster analysis

To further understand the composition of decision logics among respondents, a cluster analysis identifying the decision profiles of respondents was performed using the elbow method in RStudio to determine the optimal number of clusters (K). As shown in Figure 1, the line flattens with no significant difference after point 4; thus, we assumed the optimal number of clusters is 4 and proceeded to analyze the K-means clustering in SPSS 26 with 4 as the predetermined number of clusters (see Figure 2). The analysis results show that the pair of causation and effectuation significantly contributes to the different clusters, with p-values less than 0.001.

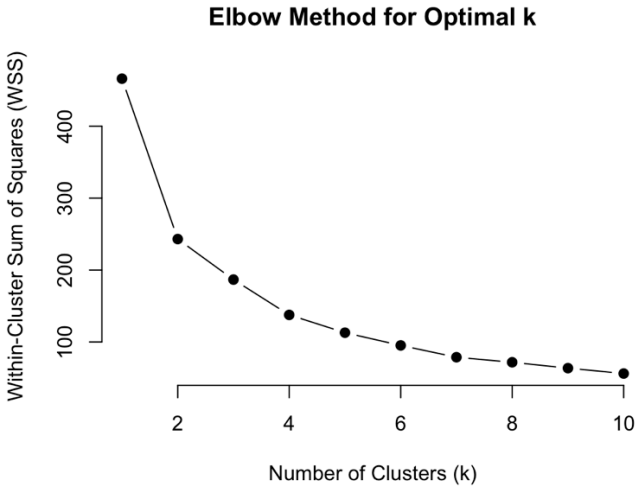
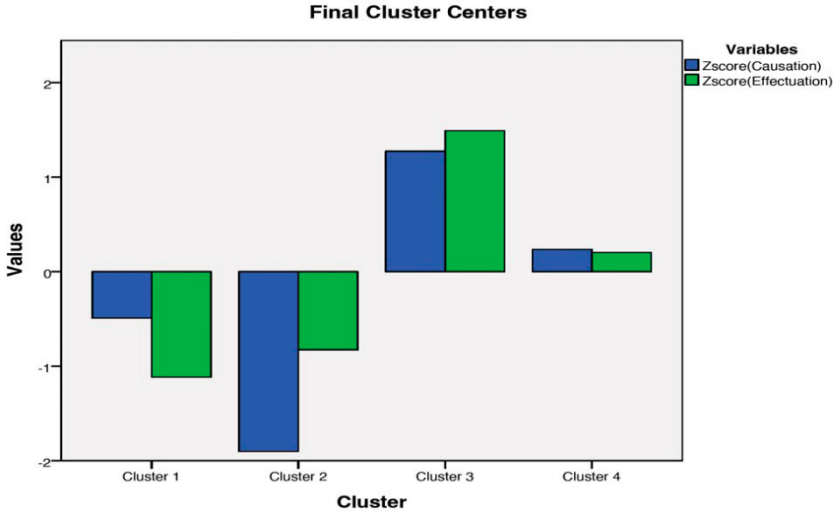



**Figure 1.** Elbow method for optimal cluster numbers




Passive planners | Passive effectuators | Active Hybridity | Moderate Hybridity

**Figure 2.** K-Means cluster analysis

Among the four hybrid clusters identified, Cluster 1 comprised 51 entrepreneurs with low levels of both causation and effectuation and a slight emphasis on causation. This group was named the "passive planners" group because the entrepreneurs displayed greater adaptability and caution, having not relied heavily on planning. Cluster 2, with 26 entrepreneurs, displayed lower levels of both causation and effectuation but was more clearly dominated by effectuation, with entrepreneurs in the group exhibiting a reactive approach. Thus, the group was named "passive effectuators." The 34 entrepreneurs in Cluster 3 displayed the highest levels of both causation and effectuation. Therefore, the group was called "active hybridity," as the entrepreneurs were both good at causation and effectuation. The group of 121 entrepreneurs in Cluster 4 displayed moderate levels of both causation and effectuation, earning it the label "moderate hybridity," as the entrepreneurs demonstrated adaptability to both logics.

The silhouette coefficient for the four-cluster K-means solution was 0.36, indicating moderate cohesion and separation among clusters (Kaufman & Rousseeuw, 1990). To further understand the cluster structure, an analysis of variance (ANOVA) test and post-hoc multiple-group comparisons for the clusters were conducted using SPSS, with the contributing variables being causation and effectuation, as well as other demographic characteristics such as age, gender,

experience, firm size, and industry. Table 3 presents the results. Although causation and effectuation were significant contributors, the post-hoc test results showed no significant difference in effectuation between Clusters 1 and 2, that is, the passive planners and passive effectuators. However, because the two clusters showed significant differences in causation, they were assumed to be distinct.

The mean age, start-up experience, and gender of the entrepreneurs were significantly different across the four clusters, indicating that younger entrepreneurs are more hybrid in nature, while older entrepreneurs are more cautious in decision-making. Additionally, the results revealed that while more males are passive planners, more females are hybrid entrepreneurs. The post hoc test also showed a significant difference in gender between the passive planners and the active hybridity groups. Furthermore, more respondents have start-up experience in the moderate hybridity, passive planners, and active hybridity groups.

**Table 3.** Cluster characteristics

| | F | P | Clusters | | | |
|---|---|---|---|---|---|---|
| | | | Passive planners | Passive effectuators | Active hybridity | Moderate hybridity |
| N | | | 51 | 26 | 34 | 121 |
| Mean causation | 201.80 | <0.001 | 5.47 | 4.60 | 6.57 | 5.92 |
| Mean effectuation | 169.13 | <0.001 | 5.21 | 5.35 | 6.49 | 5.86 |
| Mean age of entrepreneurs/managers | 3.36 | 0.020 | 42.43 | 46.12 | 40.65 | 41.32 |
| Gender: male | 3.38 | 0.019 | 37 | 12 | 14 | 65 |
| female | | | 14 | 14 | 20 | 56 |
| Experience | 1.74 | 0.160 | 10.35 | 14.58 | 12.15 | 12.10 |
| Firm size | 0.30 | 0.828 | 588 | 198 | 158 | 503 |
| Firm age | 1.22 | 0.302 | 53.18 | 13.62 | 10.94 | 13.59 |
| Industry-highly vulnerable | 0.83 | 0.481 | 14 | 4 | 6 | 22 |
| Industry-indifferent | 0.44 | 0.736 | 22 | 13 | 12 | 51 |
| Industry-most beneficial | 1.013 | 0.388 | 15 | 9 | 16 | 48 |
| Start-up - entrepreneurs | 3.090 | 0.028 | 29 | 20 | 26 | 95 |
| No start-up – managers | | | 22 | 6 | 8 | 26 |

Next, the other hypotheses were tested using ordinal and linear regression analyses in SPSS to examine relationships between decision profiles and exploitation, exploration, and sales decline as firm performance, and the mediating effects. We controlled for age, gender, work experience, start-up experience, firm size, firm age, and industry.

**Table 4.** Ordinal logistic regression results predicting sales decline

| Predictor | ß | S.E. | Wald | P | 95% CI | Odds-ratio |
|---|---|---|---|---|---|---|
| Cluster 1 (passive planners) | -0.316 | 0.461 | 0.470 | 0.493 | -1.220, 0.588 | 0.73 |
| Cluster 2 (passive effectuators) | -1.113* | 0.562 | 3.920 | 0.048 | -2.214, -0.011 | 0.33 |
| Cluster 4 (moderate hybridity) | -0.670 | 0.367 | 3.325 | 0.068 | -1.390, -0.050 | 0.51 |
| Exploitation | -0.973* | 0.473 | 4.223 | 0.040 | -1.901, -0.045 | 1.60 |
| Exploration | 0.467 | 0.352 | 1.755 | 0.185 | -0.224, 1.157 | 0.38 |
| Age | 0.024 | 0.024 | 1.000 | 0.317 | -0.023, 0.070 | 1.02 |
| Gender | -0.539* | 0.265 | 4.137 | 0.042 | -1.059, -0.020 | 0.58 |
| Experience | 0.009 | 0.024 | 0.146 | 0.695 | -0.037, 0.055 | 1.01 |
| Start-up | -0.052 | 0.309 | 0.028 | 0.866 | -0.657, 0.553 | 0.95 |
| Firm size | 0.000 | 0.000 | 0.061 | 0.805 | 0.000, 0.000 | 1.00 |
| Firm age | -0.002 | 0.003 | 0.454 | 0.501 | -0.009, 0.004 | 1.00 |
| Industry: Highly vulnerable | 0.597* | 0.282 | 4.499 | 0.034 | 0.045, 1.149 | 1.82 |
| Industry: Highly beneficial | -0.787* | 0.368 | 4.582 | 0.032 | -1.508, -0.066 | 0.46 |

| Predictor | ß | S.E. | Wald | P | 95% CI | Odds-ratio |
|---|---|---|---|---|---|---|
| LR $\chi^2$ (13) | 33.261 (p = 0.002) | | | | | |
| Nagelkerke $R^2$ | 0.140 | | | | | |
| Test of parallel lines | $\chi^2$ (52) = 45.142, p = 0.738 | | | | | |

*Note:* Reference category for clusters: cluster 3 (Active hybridity); * indicates significance at 0.001 (2-tailed), 0.01, and 0.05 levels, respectively. S.E.: Standard error; P: p-value.

**Table 5.** Monte Carlo simulations result for ordinal regression

| Predictor | True β | Mean β | Bias | Empirical S.E. | Mean model S.E. | 95% CI coverage |
|---|---|---|---|---|---|---|
| Gender | −0.539 | −0.570 | −0.031 | 0.277 | 0.270 | 0.945 |
| Exploitation | −0.973 | −1.030 | −0.056 | 0.498 | 0.482 | 0.948 |
| Exploration | 0.467 | 0.506 | 0.040 | 0.373 | 0.359 | 0.941 |
| Industry: Highly vulnerable | 0.597 | 0.642 | 0.045 | 0.295 | 0.288 | 0.944 |
| Industry: Highly beneficial | −0.787 | −0.808 | −0.021 | 0.390 | 0.378 | 0.940 |
| Cluster 1: Passive planners | −0.316 | −0.310 | 0.006 | 0.485 | 0.470 | 0.947 |
| Cluster 2: Passive effectuators | −1.113 | −1.184 | −0.071 | 0.599 | 0.576 | 0.942 |
| Cluster 4: Moderate hybridity | −0.670 | −0.687 | −0.017 | 0.383 | 0.374 | 0.946 |

*Note:* Monte Carlo simulation based on the fitted proportional-odds logit model. Outcomes were simulated using estimated coefficients and thresholds under a logistic error distribution while preserving the observed covariate structure (N = 232). Bias = mean($\hat{\beta}$) − β. Empirical S.E. denotes the standard deviation of estimates across replications. CI coverage reports the proportion of 95% Wald confidence intervals containing the true parameter.

From the ordinal regression analysis results in Table 4, regarding sales decline, the passive effectors profile (ß = -1.113, p = 0.048) showed lower sales decline, indicating better performance than the active hybridity group. Both the passive planners (ß = 0.316, p = 0.493) and the moderate hybridity group (ß = -0.670, p = .068) did not have a significant difference from the active hybridity group. Thus, Hypothesis 1, which proposed that a hybrid form of cluster performs better than other clusters, is not supported. While exploitation had a statistically significant relationship with sales decline (ß = -0.973, p = 0.040), exploration did not (ß = 0.467, p = 0.185). Thus, Hypothesis H3(a) is supported; however, and H3(b) is not supported. Odds ratios and confidence intervals are also reported in Table 4 to exhibit the effect magnitude. Exploitation is associated with lower odds of a severe sales decline (OR = 0.38, 95% CI (0.15, 0.96)). Cluster comparisons also show that lower sales decline risk for passive effectuators (OR = 0.33, 95% CI (0.11, 0.99)) compared to the reference group, active hybridity, although the results for smaller clusters need to be interpreted cautiously and exploratorily, given unequal cluster sizes. The Monte Carlo simulation results reported in Table 5 indicate that parameter estimates and confidence intervals from the ordinal regression model are well-behaved in finite samples. This supports the reliability of the reported results.

**Table 6.** Regression coefficients, standard errors, and summary statistics for the multiple linear regression model with clusters (active hybridity as the baseline) as predictor variables

| Dependent Variables | Exploitation | | | | Exploration | | | |
|---|---|---|---|---|---|---|---|---|
| **Predictors** | **B** | **S.E** | **ß** | **P** | **B** | **S.E** | **ß** | **P** |
| Cluster 1: Passive planners | -0.392*** | 0.072 | -0.437 | <0.001 | -0.475*** | 0.096 | -0.487 | <0.001 |
| Cluster 2: Passive effectuators | -0.416*** | 0.083 | -0.414 | <0.001 | -0.591*** | 0.111 | -0.393 | <0.001 |
| Cluster 4: Moderate hybridity | -0.180*** | 0.060 | -0.257 | 0.003 | -0.232** | 0.081 | -0.269 | <0.001 |
| Gender | -0.016 | 0.043 | 0.099 | 0.716 | 0.090 | 0.057 | -0.023 | 0.119 |
| Age | 0.001 | 0.004 | 0.017 | 0.845 | -0.004 | 0.005 | 0.017 | 0.402 |
| Experience | 0.005 | 0.004 | 0.111 | 0.123 | 0.008 | 0.005 | 0.111 | 0.134 |
| Start-up | -0.007 | 0.050 | -0.102 | 0.123 | 0.063 | 0.067 | -0.102 | 0.348 |
| Firm Size | -0.00 | 0.000 | -0.015 | 0.809 | -0.000 | 0.000 | -0.015 | 0.321 |
| Firm Age | 0.00 | 0.000 | -0.080 | 0.197 | 0.000 | 0.000 | -0.080 | 0.212 |
| Industry_ highly vulnerable | -0.02 | 0.047 | -0.029 | 0.675 | -0.014 | 0.063 | -0.029 | 0.820 |
| Industry_ highly beneficial | 0.058 | 0.056 | 0.072 | 0.301 | 0.060 | 0.076 | 0.072 | 0.426 |

| Dependent Variables | Exploitation | | | | Exploration | | | |
|---|---|---|---|---|---|---|---|---|
| **Predictors** | **B** | **S.E** | **ß** | **P** | **B** | **S.E** | **ß** | **P** |
| R-square | | 0.191 | | | | 0.203 | | |
| F-value | | 4.737 | | | | 5.06 | | |
| Sig | | <0.001 | | | | <0.001 | | |

*Notes.* ***, **, and * indicate significance at 0.001 (2-tailed), 0.01, and 0.05 levels, respectively; S.E.: Standard error; P: p-value; n: number of participants.

Table 6 shows that all clusters are significantly poorer than the active hybridity group in both exploitation and exploration. Compared with active hybridity group, the passive planner group (ß = -0.437, p < .000; ß = -0.487, p < 0.001) had the lowest exploitation and exploration, followed by passive effectuators profile (ß = -0.414, p < .000; ß = -0.393, p < 0.001) while the moderate hybridity group showed slight but significantly lower exploitation and exploration (ß = -0.257, p = 0.003; ß = -0.269, p < 0.001). Thus, Hypotheses 2 (a) and (b) are supported. The OLS Monte Carlo results for both exploitation and exploration indicate negligible bias and near-nominal 95% CI coverage for all coefficients.

**Table 7.** Monte Carlo simulations result for OLS regression on exploitation

| Predictor | True β | Mean β | Bias | Empirical S.E. | Mean Model S.E. | 95% CI Coverage |
|---|---|---|---|---|---|---|
| (Intercept) | 1.950 | 1.950 | −0.002 | 0.152 | 0.152 | 0.947 |
| Cluster 1: Passive planners | −0.212 | −0.212 | −0.000 | 0.054 | 0.054 | 0.949 |
| Cluster 2: Passive effectuators | −0.236 | −0.237 | −0.000 | 0.068 | 0.069 | 0.954 |
| Cluster 4: Moderate hybridity | 0.180 | 0.180 | 0.000 | 0.061 | 0.061 | 0.950 |
| Gender | −0.016 | −0.015 | 0.001 | 0.043 | 0.043 | 0.949 |
| Age | 0.001 | 0.001 | 0.000 | 0.004 | 0.004 | 0.947 |
| Exp | 0.005 | 0.005 | −0.000 | 0.004 | 0.004 | 0.949 |
| Start-up | −0.077 | −0.077 | 0.000 | 0.050 | 0.050 | 0.949 |
| Firm size | −0.000 | −0.000 | 0.000 | 0.000 | 0.000 | 0.947 |
| Firmage | −0.000 | −0.000 | 0.000 | 0.000 | 0.000 | 0.949 |
| Industry: Highly vulnerable | −0.020 | −0.019 | 0.001 | 0.047 | 0.047 | 0.951 |
| Industry: Highly beneficial | 0.0585 | 0.059 | 0.000 | 0.057 | 0.057 | 0.945 |

*Note:* Monte Carlo simulation based on the fitted OLS model. For each replication, outcomes were generated as y=Xβˆ+ε, with ε∼N(0,σˆ^2), preserving the observed covariate structure (N = 232). Bias = mean (βˆ) − β). Empirical S.E. is the standard deviation of estimates across replications. Mean Model S.E. is the average model-based standard error. CI coverage is the proportion of 95% Wald confidence intervals containing the true parameter.

**Table 8.** Monte Carlo simulations result for OLS regression on exploration

| Predictor | True β | Mean β | Bias | Empirical S.E. | Mean model S.E. | 95% CI coverage |
|---|---|---|---|---|---|---|
| (Intercept) | 3.110 | 3.110 | 0.001 | 0.203 | 0.204 | 0.951 |
| Cluster 1: Passive Planners | −0.243 | −0.243 | 0.000 | 0.073 | 0.073 | 0.948 |
| Cluster 2: Passive Effectuators | −0.359 | −0.360 | −0.001 | 0.092 | 0.092 | 0.948 |
| Cluster 4: Moderate Hybridity | 0.232 | 0.231 | −0.002 | 0.082 | 0.081 | 0.948 |
| Gender | 0.090 | 0.090 | 0.000 | 0.057 | 0.057 | 0.952 |
| Age | −0.004 | −0.004 | 0.000 | 0.005 | 0.005 | 0.946 |
| Exp | 0.008 | 0.008 | −0.000 | 0.005 | 0.005 | 0.945 |
| Start-up | 0.063 | 0.0621 | −0.001 | 0.067 | 0.067 | 0.947 |
| Firm Size | −0.000 | −0.000 | 0.000 | 0.000 | 0.000 | 0.945 |
| Firmage | −0.000 | −0.000 | −0.000 | 0.000 | 0.000 | 0.947 |
| Industry: Highly vulnerable | −0.014 | −0.01 | −0.001 | 0.063 | 0.063 | 0.942 |
| Industry: Highly Beneficial | 0.060 | 0.062 | 0.001 | 0.077 | 0.076 | 0.944 |

*Note:* Monte Carlo simulation based on the fitted OLS model. For each replication, outcomes were generated as y=Xβˆ+ε, with ε∼N(0,σˆ^2), preserving the observed covariate structure (N = 232). Bias = mean (βˆ) − β). Empirical S.E. is the standard deviation of estimates across replications. Mean Model S.E. is the average model-based standard error. CI coverage is the proportion of 95% Wald confidence intervals containing the true parameter.

## DISCUSSION

The objectives of this study were to identify the decision logics of entrepreneurs and determine their influence on firm performance through knowledge exploitation and exploration. We sought to explore entrepreneurs' decision profiles of causation and effectuation using a person-centered approach in established firms, following the previous study by Ilonen et al. (2018), which examined student entrepreneurs. Ilonen et al. (2018) found two decision-making profiles among entrepreneurs: hybrid and coping strategy, with low levels of both causation and effectuation among students after their training. A significant difference between Ilonen et al. (2018) and our study was that our research identified various configurations in which the composition of causation and effectuation differed, rather than a single hybrid form of the two logics. As the sample included experienced entrepreneurs, various hybrid profiles were identified. While some used high or moderate hybridity in causation and effectuation, others used lower levels of causation and effectuation as passive planners and passive effectuators. Entrepreneurs with the lowest level of causation and a relatively narrow gap between causation and effectuation were termed passive planners, and those with the lowest level of causation and a relatively wide gap between causation and effectuation were considered part of the effectuation-dominated profile (passive effectuators).

The findings demonstrate that causation and effectuation can coexist, as suggested by An et al. (2020), Cohen & Wirtz (2022), Galkina et al. (2021), Galkina & Jack (2021), Koller et al. (2022), Pöschl (2022), and Yu et al. (2018), among entrepreneurs and top-level managers, varying from low to very high hybridity, rather than strictly following a single hybrid form of decision logic. Somewhat similar to the findings of Ilonen et al. (2018), where students who faced stagnation and were unable to achieve hybridity turned to coping strategies, our study found that some entrepreneurs used passive approaches. These approaches are evident in the passive planner and passive effectuator profiles, but they do not represent a complete absence of strategy. Because of the multiple crises, a considerable number of entrepreneurs seemed to put out fires, as Hauser et al. (2020) mentioned, and chose to wait and see, using some extent of causation and effectuation, with relatively lower but still considerable levels of both decision logics. Instead of taking the initiative actively, as seen in the active hybridity group with extensive use of causation and effectuation, these entrepreneurs adopt a more passive approach. They tend to go with the flow and adjust their strategies (Doern et al., 2019; Saridakis, 2012), implementing passive strategies that reflect the turbulent situation faced by entrepreneurs in Myanmar, trying to put out their fire to some extent (Hauser et al., 2020).

There was a larger number of entrepreneurs in the moderate hybridity group, and a smaller proportion in the active hybridity group. This indicates that, in times of crisis, these entrepreneurs try to be both flexible and cautious at the same time. According to the descriptive statistics, especially in terms of firm size, larger firms were more modest and showed greater goal orientation as passive planners, or, if hybrid, were moderately hybrid. Smaller firms tended to prevail more in effectuation, either as passive effectuators or with active hybridity. This finding aligns with Suder (2024) and Soininen et al. (2012), who showed that small firms adjust their entrepreneurial orientation—especially risk-taking, innovativeness, and proactiveness—when faced with turbulent environments, such as the COVID-19 pandemic.

Hypothesis 1 highlights the relationship between decision profiles and firm performance. In the present study, firm performance was measured in terms of sales decline to reflect resilience during turbulent times. Firms were more resilient (i.e., had less sales decline) where entrepreneurs had passive effectuator decision profiles. In comparison, firms where entrepreneurs had active hybridity profiles were less resilient. It seems best to be modestly effective rather than very active in the market during times of crisis (Kurana et al., 2022). Passive planners and moderately hybrid entrepreneurs showed no significant differences in sales performance compared with those with active hybridity. This finding aligns with Shirokova et al. (2021), which suggests that effectuation performs better in an uncertain environment. Keeping the decision logic hybrid to some extent yields similar performance. This result still echoes Suder's (2024) conclusion that firms that proactively enhanced all dimensions of entrepreneurial orientation (risk-taking, innovativeness, and proactiveness) during recovery recorded the greatest improvements in performance. Our results validate this finding by showing that entrepreneurs who modestly integrate both effectual and causal logic—rather than relying on one in isolation—are more resilient to sales declines, highlighting the performance advantage of dynamic, dual-engagement strategies.

Hypothesis 2 tests the relationship between decision profiles and knowledge exploitation and exploration, expecting that a hybrid form of causation and effectuation profiles would be better at both exploitation and exploration. According to the results, compared to active hybridity, moderate hybridity had a slightly negative effect on both exploration and exploitation. Additionally, both passive planners and passive effectuator entrepreneurs scored lower on exploration and exploitation than those with active hybrid profiles. According to the metacognition theory, entrepreneurs who use

higher cognitive processes and a hybrid decision logic are better at knowledge exploration and exploitation. The finding of this study is that the combined use of logic can enhance entrepreneurial processes, consistent with previous literature (Laskovaia et al., 2017; Reymen et al., 2015; Smolka et al., 2018).

Hypothesis 3 examines the relationship between exploitation, exploration, and firm performance. While no significant relationship was found between exploration and firm performance, exploitation had a negative, significant relationship with sales decline. Causation and its subsequent exploitation action were found to have more negative effects on firm performance during crises than effectuation and exploration (Andries et al., 2013; Cai et al., 2017; Matalamäki, 2017; Read et al., 2009).

### Contributions of the study

Responding to the call by Galkina et al. (2021) and Grégorie & Cherchem (2020) to seek a deeper understanding of when, where, and how the decision logics prevail and to investigate their effect on firm performance, this study tries to determine the decision profiles of causation and effectuation logics at an individual level in established firms in a crisis-turbulent environment. Previous studies found a relationship between the interaction of causation and effectuation and performance in uncertain situations (Pöschl, 2022; Yu et al., 2018), including during the venture creation process (Galkina & Jack, 2022; Galkina et al., 2021; Ilonen et al., 2018; Koller et al., 2022), and dynamic (Cohen & Wirtz, 2022) and crisis situations (Harms et al., 2021; Khurana et al., 2021). However, many studies were qualitative (Grégorie & Cherchem, 2020) or variable-centered, except for that by Ilonen et al. (2018). Therefore, it was difficult to determine the actual structure of the decision logics and their effects.

This study classified entrepreneurial decision profiles using a person-centered approach with cluster analysis. Although Ilonen et al. (2018) used the same approach for the venture creation process with student entrepreneurs as samples, this study applied it to established firms with corporate entrepreneurs, extending it to examine links with knowledge exploration, exploitation, and firm performance in a turbulent environment. This can shed light on the nature of corporate entrepreneur decision-making styles and their relative impact on entrepreneurial performance. Theoretically, the findings contribute to the literature on causation and effectuation from a person-centered perspective. We found that entrepreneurs used both effectuation and causation, with varying levels of activity in crisis situations, ranging from very active to moderate or fair. Hypothesis 1 also found that a moderate level of effectuation is best during a crisis, rather than being highly proactive.

In practice, this study can guide entrepreneurs on how to respond in a crisis to survive and sustain their businesses. This study was conducted in turbulent situations on entrepreneurs and top managers from companies that faced multiple crises. The findings suggest that during these times, firms should strive to survive by avoiding excessive activity. Rather than firms that actively seek opportunities and strategies, entrepreneurs should maintain sufficient flexibility with a low level of hybridity to demonstrate better performance. During a crisis, passive strategies may play better, particularly in the short term. In other words, rather than preparing a plan, entrepreneurs should just go with the flow, with no strict strategy, while remaining flexible enough to utilize effectuation and achieving the lowest sales decline compared to other firms. However, in the long run, especially when market conditions are more stable, the more active hybrid nature of entrepreneurs may lead to better performance through greater exploitation and exploration (Hou et al., 2019). Firms should not explore much in times of turbulence, but should cautiously move with what they know.

## CONCLUSION

Business environments are uncertain and dynamic. Entrepreneurs should be able to respond properly to any situation to survive and sustain their business. As entrepreneurs and managers respond to environmental changes with their own strategies, their resilience, performance, and survival may vary. This study helps understand the decision logics adopted by entrepreneurs in the real world and their impact on firm performance in turbulent environments. By using a person-centered approach, this study could identify distinct decision profiles among entrepreneurs in a turbulent context. The study could explore four levels of hybridity in causation and effectuation, ranging from active hybridity to moderate hybridity to hybridity with a somewhat dominant role for causation and/or effectuation. Additionally, it contributes to theoretical understanding of the different degrees of composition of causation and effectuation and their relations with firm performance in general.

## Limitations and suggestions for future studies

Because this study was conducted during a highly vulnerable period, data accessibility was a major challenge in its implementation. A larger sample size would have helped provide more generalizable results. A cross-sectional survey design was the major limitation to generalizing the findings. Future studies should use the same approach with a larger sample, either in the same situation or in other contexts, such as stable, dynamic, or emerging economies, and use longitudinal data to generalize the findings. In particular, the study's respondents were entrepreneurs and top-level managers associated with the MYEA. Future studies should use a broader sampling frame to improve generalizability. Additionally, owing to limited access to the data, non-response bias could not be examined. Another limitation was lower reliability scores for two of the first-order factors of exploitation, which may have affected the accuracy of the data. We recommend that future researchers replicate to improve generalizability. A mixed-methods approach combining quantitative and qualitative methods is highly recommended to understand how entrepreneurs interact to survive/achieve prosperity. The sales data highlights differences in sales between the year before COVID-19 and the average of the three years following the pandemic, amid a politically unstable environment. Original sales data were not included or controlled, which may have influenced the potential significance of the data. Finally, this study could not prove causality rigorously, as the analysis was based on observational data. Future researchers may implement experimental research designs and analyses.

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## Bibliographical notes

**Khin Sandar Thein** received a Ph.D. in Business Administration from Hiroshima University, Japan. She is a Junior Associate Professor at School of Health Innovation, Kanagawa University of Human Services, Japan. Her research interests lie in entrepreneurship, human resource development, organizational behavior/organizational psychology, corporate social responsibility, and tourism.

**Yoshi Takahashi** is a professor at the Graduate School of Humanities and Social Sciences, Hiroshima University, Japan. His research interests are human resource management and organizational behavior in Asian countries. He has published articles in journals such as Personnel Review, International Journal of Training and Development, and Evidence-Based HRM.

**Emi Makino** is an associate professor at the College of International Management, Ritsumeikan Asia Pacific University. Her research interests include entrepreneurship, entrepreneurship education, innovation, business creation, organizational development, and the experience-sampling method. She has written about student-centric entrepreneurship and makerspaces in Japan in her book *Innovation makers*.

**Aye Thanda Soe** is a professor and head of department at the Department of Economics, Maubin University, Myanmar. Her research area lies in entrepreneurship, organizational psychology, organizational behavior, corporate social responsibility, human resource management, banking and finance, and tourism.

## Author contributions statement

**Khin Sandar Thein**: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Validation, Visualization, Roles/Writing Original Draft. **Yoshi Takahashi**: Conceptualization, Methodology, Resources, Software, Supervision, Writing - Review & Editing. **Emi Makino**: Conceptualization, Writing - Review & Editing. **Aye Thanda Soe**: Project Administration; Resources; Writing - Review & Editing.

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The authors declare no conflicts of interest.

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# Creativity at the workplace: Comparative study of tourism organizations in Lithuania, Poland, and Sweden

***Gita Šakytė-Statnickė*[1], *Anna Katarzyna Mazurek-Kusiak*[2], *Laurencija Budrytė-Ausiejienė*[3]**

***Abstract***

***PURPOSE:*** *This study examines differences in creativity at the workplace across tourism organizations in Lithuania, Poland, and Sweden. The aim of this study is to identify (1) whether creativity at the workplace differs between Lithuania, Poland, and Sweden, and (2) whether Lithuania, Poland, and Sweden differ systematically in reported creativity-supporting practices. According to the Global Innovation Index 2024 (WIPO, 2024), these countries exhibit diverse innovation ecosystems and creativity cultures, making them suitable locations for comparative research.* ***METHODOLOGY:*** *The study uses a cross-sectional, quantitative, cross-country comparative research design based on the CAWI (Computer-Assisted Web Interview) survey method. Data were collected in 2024 from tourism organizations in Lithuania, Poland, and Sweden. The final sample includes 436 tourism enterprises. Creativity at the workplace was measured using Musek's (2020) Creativity at Workplace Organization Scale. The surveys were conducted online in the respondents' native languages, with their consent. Statistical analysis was performed using Statistica 13.1 PL software, applying nonparametric Kruskal-Wallis tests to compare countries and Multinomial Logistic Regression to examine relationships between countries and organizational practices.* ***FINDINGS:*** *The results show that creativity at the workplace varies greatly between Sweden and the other two countries, Lithuania and Poland. In Sweden, creativity at the workplace is significantly higher. The study identified different creativity-supporting practices: Sweden emphasizes innovation-based problem-solving, Lithuania focuses on reflective and customer-oriented practices, while Poland relies more on motivational and task-oriented methods. The results indicate that creativity at the workplace differs across the analyzed national samples and is associated with creativity-supporting practices.* ***IMPLICATIONS:*** *The study contributes to the literature on organizational creativity by providing cross-national empirical evidence on perceived creativity-supporting practices, which can be interpreted through the Componential Theory of Creativity, the Interactionist Model of Organizational Creativity, and Social Exchange Theory. In practice, this research highlights the need for country-specific strategies to promote creativity at the workplace in tourism: Sweden's example demonstrates how integrated, leadership-driven innovation strategies can transform into perceived and actual creativity within organizations. Meanwhile, Lithuania and Poland may benefit from strengthening the national and institutional levels and from a more systematic implementation of creativity at the workplace.* ***ORIGINALITY AND VALUE:*** *This paper presents one of the first empirical, comparative studies covering three countries, examining creativity at the workplace in tourism organizations in one macro-region (the Baltic Sea region). The study provides empirical evidence of cross-national differences in creativity at the workplace and the associated creativity-supporting practices.*

***Keywords:*** *creativity, creativity-supporting practices, tourism organizations, creativity at workplace organization scale, organizational creativity, Baltic Sea region, innovation culture, quantitative survey research, CAWI methodology, creativity measurement.*

1 Gita Šakytė-Statnickė, Ph.D., Assoc. Professor, Klaipėdos valstybinė kolegija | Higher Education Institution, Faculty of Business, Jaunystės str. 1, LT-91274 Klaipėda, Lithuania, e-mail: g.statnicke@kvk.lt (ORCID: https://orcid.org/0000-0002-5320-810X).

2 Anna Katarzyna Mazurek-Kusiak, Ph.D., Assoc. Professor, University of Life Sciences in Lublin, Department of Tourism and Recreation, Akademicka str. 15, 20-950 Lublin, Poland, e-mail: anna.mazurek@up.edu.pl (ORCID: https://orcid.org/0000-0002-3786-8861).

3 Laurencija Budrytė-Ausiejienė, Lecturer, Klaipėdos valstybinė kolegija | Higher Education Institution, Faculty of Business, Jaunystės str. 1, LT-91274 Klaipėda, Lithuania, e-mail: l.ausiejiene@kvk.lt (ORCID: https://orcid.org/0000-0001-5378-3019).

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## INTRODUCTION

The concept of creativity at the workplace in tourism, which emphasises new products, services, and experiences, is becoming increasingly popular across Europe, as today's dynamic, globalised environment makes it a crucial asset for organisations, especially in the tourism sector. The sector is highly influenced by rapid changes in consumer preferences, technological advances, and intensified competition, and tourism businesses need to continuously innovate and adapt (Bascavusoglu-Moreau et al., 2013; Montañés-Del-Rio & Medina-Garrido, 2020). Creativity is essential for tourism organizations to remain competitive and adaptable to new customer demands. It leads to innovation, service improvement, and high performance, which are crucial for achieving organizational success (Hasan, 2022). Creativity at the workplace is well known as a driver of innovation (Hoang et al., 2019; Patil, 2024) and the generation of new and useful ideas, which is the first stage of the innovation process. The integration of creativity at the workplace into tourism strategies is essential for sustainable growth and innovation, particularly in meeting the evolving expectations of modern tourists (Teodorescu et al., 2015; Benhaida et al., 2024; Damiasih, 2025).

Despite the growing scholarly attention to creativity at the workplace, the existing literature continues to focus on large organizations in Western countries, without accounting for sector-specificities and cultural differences (Zhou & Hoever, 2014; Bavik & Kuo, 2022; De Bernard et al., 2022). The tourism sector is often excluded from mainstream research on the dynamics of creativity and innovation (Pikkemaat, et al., 2019; Yachin & Ioannides, 2020; Sharma et al., 2024). Moreover, few empirical studies examine how national differences determine creative practices in the sector, despite the growing evidence of the influence of cultural and institutional contexts on innovation capabilities (Sarooghi et al., 2015; Ouyang et al., 2021; Yodchai et al., 2022). Furthermore, previous studies have mostly focused on single-country settings, and therefore the understanding of how national context relates to specific organizational practices of tourism organizations to shape creativity at the workplace is limited (Chen & Yu, 2024; Miron-Spektor and Paletz, 2024). Cross-border differences in the tourism industry exist (Huang & Crotts, 2019; Park et al., 2022; Williams & Makkonen, 2024), but empirical evidence linking these differences to specific organizational practices supporting creativity in tourism organizations is lacking.

The study compares three countries, i.e. Lithuania, Poland, and Sweden. According to the Global Innovation Index 2024 (WIPO, 2024), these countries are characterized by different innovation ecosystems and creativity cultures, making them suitable locations for comparative research. Lithuania and Poland represent emerging innovation systems, while Sweden is a global innovation leader. Although all three countries share close regional ties and a certain cultural and economic proximity, they differ in organizational structures, cultural values, tourism development models, and other areas (Roman et al., 2020; Xie et al., 2021; WIPO, 2024). This choice keeps the regional context constant while ensuring sufficient diversity in creativity at the workplace, enabling us to more reliably assess how the specifics of the country's environment relate to organizational practices that promote and support creativity.

The aim of this study is to determine whether creativity at the workplace differs across Lithuania, Poland, and Sweden and whether these cross-country differences are associated with distinct organizational practices. In this paper, we examine tourism organizations' perceptions of their creativity at workplace and examine the relationship between country and creativity-supporting practices as captured by the Creativity at Workplace Organization Scale (Musek, 2020). Based on the above, we formulate two research questions (RQs) that directly correspond to our hypotheses and empirical strategy:

RQ1: Are there significant differences in the creativity at the workplace among Lithuanian, Polish and Swedish tourism organizations?
RQ2: Are there systematic cross-country differences in reported creativity-supporting practices among tourism organizations in Lithuania, Poland, and Sweden?

The research was partly carried out in the framework of the project „NordTournet-4: Developing the Creativity of Tourism Workers Through the Use of Artificial Intelligence Powered Tools to Create New or Improve Existing Tourism Services" (No. NPAD-2022/10078), while in Poland the data were collected separately using the same survey instrument.

The next section reviews the theory on creativity at the workplace in the tourism industry, national and cross-country differences in creativity at the workplace and organizational practices and national differences in creativity at the workplace, then develops H1 and H2. Then, the methodology (research design, measures, sample and sampling procedure, data collection procedure, research ethics and method of analysis) is reviewed, the results are presented (methods: non-parametric tests; multinomial logistic regression), and discusses the theoretical and practical implications, as well as limitations and future research directions.

## LITERATURE REVIEW

### Creativity at the workplace in the tourism industry

Creativity is increasingly mentioned across various fields, including business. Although creativity is crucial to any organization's innovation and survival in today's competitive business environment (Lua et al., 2024), scholars researching and writing about organizational change pay little attention to creativity at the workplace (Woodman, 2024). Creativity is usually considered in the scientific literature as a process of generating new and valuable ideas to solve problems, improve user experience, and create and implement innovations (Rampa & Agogué, 2021; Treffinger et al., 2023; Wingström et al., 2024; Gilson, 2024). Creativity at the workplace arises from the interaction of individual, organizational and cultural factors. According to componential theory of creativity (Amabile, 2011; Gong et al., 2023; Zheng et al., 2025), in addition to internal factors (domain-relevant skills, creativity-relevant processes, and intrinsic task motivation), the social environment in which the individual works is important for an employee's creativity. According to the interactionist model of organizational creativity (Woodman, 2024), it can be considered as an extension of commonly accepted definitions of individual creativity into the organizational context and the creative behavior of organizational participants is a complex interaction that is influenced not only by past events but also by the characteristics of the work environment. The integrated model of dynamic problem solving within organizational constraints (Cromwell et al., 2018) views creativity as a continuous cycle of identifying new problems, generating ideas, and solving them, all subject to organizational constraints. The theoretical approaches mentioned above allow us to understand creativity as a multi-layered phenomenon shaped by individual abilities, motivation, social environment, organizational structures, and other factors. The integration of these theories helps to reveal how creativity manifests itself not only at the individual level, but also at the organizational level, especially when it becomes a strategic resource in specific sectors. One such sector is tourism, where creativity is increasingly seen as a key factor in shaping innovative, attractive offerings.

In the context of tourism, creativity is increasingly recognized as an important component in creating unique and engaging tourist experiences that contribute to the economic and cultural vitality of travel destinations (Richards, 2020; Sharma et al., 2025). Creativity at the workplace is a key driver of competitiveness in the tourism industry, the integration of creativity into tourism strategies is linked to sustainable growth and innovation. Creative tourism has become an important trend (Benhaida et al., 2024). This approach is seen as a way to satisfy the complex needs of modern tourists and enhance the value of tourism products (Teodorescu et al., 2015).

Creativity at the workplace enhances tourism organizations' ability to innovate, adapt, and meet the evolving demands of tourists, thereby contributing to their growth and competitiveness. This relationship is evident in the way creativity influences service quality, customer satisfaction, and the overall value proposition of tourism products. Creativity at the workplace is essential for the evolution of tourism systems, allowing for the co-production of experiences between tourists and providers. This dynamic is crucial for maintaining a balance between innovation and continuity in tourism offerings (Richards, 2017). Creativity at the workplace in tourism organizations leads to innovation, improved service quality, and enhanced competitiveness. This is vital in a market where traditional methods are insufficient to meet the specialized demands of modern tourists (Hasan, 2022). Creativity at the workplace is an essential part of innovation, implying a growing need to determine methods for generating more and better ideas, which can then be commercialized and turn into innovations (Von Stamm, 2008; Meyer, Gerlitz & Klein, 2022).

Creativity at the workplace is identified as a crucial source of competitive advantage in the tourism industry, enabling organizations to differentiate their offerings and cater to the complex needs of modern tourists. This is particularly important in the context of creative tourism, which emphasizes unique experiences and innovative products (Teodorescu et al., 2015). The integration of creativity into the value chain of tourism organizations can significantly enhance the added value of tourism products, leading to increased consumer satisfaction and loyalty (Teodorescu et al., 2015). Creativity at the workplace is linked to the success of tourism organizations by fostering innovation, improving service quality, and enhancing operational efficiency. These factors are essential for maintaining competitiveness and achieving financial returns (Hasan, 2022). Creativity at the workplace in tourism can lead to the formation of competitive clusters (Odinokova, 2019; Scalabrini & Alves, 2022). The presence of creative tourism entrepreneurs significantly enhances the competitiveness and innovation of tourist destinations, thereby supporting regional development (Dias et al., 2025).

Creativity as a multifaceted phenomenon is well recognized in organizational contexts, but its expression may vary across national settings. Therefore, the next section examines how national and cross-country differences shape creativity at the workplace in tourism organizations across Lithuania, Poland, and Sweden.

## National and cross-country differences in creativity at the workplace

Integrating classical and contemporary theories of creativity (Amabile, 2011; Cromwell et al., 2018; Woodman, 2024; Zheng et al., 2025) and recent cultural research (Maimone & Sinclair, 2022; Miron-Spektor & Paletz, 2024), creativity at the workplace is not only the result of individual employee abilities and motivation, but also depends heavily on the cultural, organizational and national context. Maimone and Sinclair (2022) emphasized that national and cross-country differences are important for the development of creative processes at the workplace and noted that although the cultural dimension of creativity at the workplace has been established, studies describing creative processes in organizations often neglect national and cross-country aspects. According to Tang (2019), the main factors determining creativity are originality and usefulness, which are assessed in the specific context and may vary across cultures. Cross-country research in organizational creativity at the workplace suggests that perceptions vary significantly between national contexts due to differences in work values, institutional support, and management practices (House et al., 2004; Barth & Stadtmann, 2026). The fact that creativity is perceived, valued and promoted differently across countries is particularly relevant when analysing creativity at the workplace in the tourism sector in Europe, where cultural differences between countries such as Lithuania, Poland, and Sweden lead to varying levels of creativity.

The creativity of tourism organizations in Lithuania, Poland, and Sweden exhibits differences, influenced by various cultural, economic, and organizational factors. These differences are shaped by the unique characteristics of each country's tourism industry, the role of creativity in its economic strategy, and the specific challenges and opportunities it faces. According to the Global Innovation Index 2024 (WIPO, 2024), Lithuania, Poland, and Sweden occupy different positions in the global innovation and creativity rankings. Sweden (2nd in the overall GII ranking, with a score of 64.5) remains one of the world's innovation leaders. Sweden leads in Infrastructure (1st), Business sophistication (1st), Knowledge and technology outputs (2nd) and Human capital and research (3rd). Sweden ranks highest among the three countries examined in this paper in creative outputs, occupying the 6th position globally with a score of 57.8. According to the Global Innovation Index 2024 (WIPO, 2024), Lithuania ranked 35th overall (score 40.1) and Poland ranked 40th overall (score 37.0). These disparities reflect different levels of integration between national innovation ecosystems and the creative industries across the three countries.

The creative industries in Lithuania, as part of the Baltic Sea Region, are recognized for their potential to contribute to local and regional prosperity. The presence of cultural and creative industries (CCIs) is a significant factor in the competitiveness and economic development of the region. The integration of creativity at the workplace into tourism is seen as a driver of sustainable urban development and innovation (Klein et al., 2021). The development of tourism clusters in Lithuania is supported by European Union programs that provide financial incentives and encourage competition and cooperation among tourism organizations (Rukuižienė, 2017). In Lithuania, the ongoing development of tourism clusters and creative networks highlights the importance of creativity in shaping the future of the tourism industry.

Creativity at the workplace is a crucial factor for the socio-economic development of Polish regions. It influences regional disparities and can lead to enhanced economic performance when effectively harnessed (Kola-Bezka, 2011). Organizations that adopt a strategic approach to innovation, characterized by continuous creativity, are more likely to succeed in international markets. Despite the potential benefits, innovation processes in Polish tourist destinations are underdeveloped, with barriers including weak cooperation structures among organizations and other stakeholders (Panfiluk, 2023). However, market forces, including consumer demand, can drive innovation and creativity in the workplace in the tourism sector (Panfiluk, 2023). Polish tourism organizations are characterized by average and low innovativeness, with a focus on sustaining rather than disruptive innovations. The tourism sector in Poland tends to implement incremental, adaptive innovations that improve organizational functioning but do not significantly alter market dynamics (Panfiluk, 2021). Additionally, regional studies in Poland highlight the importance of external factors, such as customer expectations, in driving innovation in tourism organizations (Zontek, 2015).

Creativity at the workplace plays a pivotal role in the development of tourism organizations, particularly in Sweden, where it is leveraged to enhance the tourism experience and foster economic growth. In Sweden, the integration of creativity into tourism development strategies offers significant opportunities for economic growth (Gustafsson & Ijla, 2017; Eimermann et al., 2019). Sweden, as part of the Baltic Sea Region, benefits from a strong creative industry sector that contributes to its competitiveness and innovation. In Sweden, the creative atmosphere and entrepreneurial culture are particularly valued by tourism entrepreneurs, contributing to the country's competitive advantage in the tourism sector (Dias et al., 2025). The country's focus on sustainable development and the integration of creativity at the workplace into

tourism strategies is evident in its approach to fostering a creative atmosphere and quality of life, which are attractive to creative tourism entrepreneurs (Klein et al., 2021; Dias et al., 2025).

In summary, classical and contemporary theories of creativity show that creativity at the workplace depends not only on individual abilities but also on the external context, including national and cross-country differences. Research reveals that creativity at the workplace is perceived differently across countries, especially in the tourism sector, where national and cross-country differences shape creativity and innovativeness. Given differences in creativity across Lithuania, Poland, and Sweden, the hypothesis is formulated:

H1. Significant differences exist in the creativity at the workplace of tourism organizations among Lithuania, Poland, and Sweden.

## Creativity-supporting practices and national differences in creativity at the workplace

Creativity within organizations is a multifaceted phenomenon influenced by various organizational practices and structures. National differences in creativity at the workplace can stem from how organizations foster and reward creativity, which involves creating an environment that encourages innovation and supports employees in generating new ideas. This environment is shaped by management culture, organizational structure, and individual creativity, all of which interact to promote or inhibit creative processes.

A creative organizational culture is essential for fostering creativity. To better understand how this environment functions, it is essential to consider the role of organizational culture. A creative organizational culture is a key driver of innovation, and Social Exchange Theory (SET) offers a valuable framework for explaining this dynamic. According to SET, creativity is closely related to employees' perceptions of organizational support and other factors (Inam et al., 2021; Tripp, 2023). When employees feel valued and are given meaningful opportunities, they are more likely to engage in creative activities (Kassa & Tsigu, 2022; Aldabbas et al., 2023). In tourism organizations, especially those operating in culturally diverse environments, SET helps illuminate how employee-management relationships and customer expectations influence creativity and innovation (Meira & Hancer, 2021; Doğantekin, 2022; Revilla et al., 2023). In this study, Social Exchange Theory is not empirically tested through direct measurement of exchange-relational constructs, but rather used as a conceptual framework to contextualize how supportive organizational practices may relate to perceived creativity at the workplace.

Based on this theoretical framework, practical organizational strategies play a crucial role in nurturing creativity. A management culture that actively supports and encourages employees to pursue new ideas aligned with organizational goals is essential (Dennett, 2022). Organizations that integrate human resource strategies with innovation tend to foster an environment that encourages creativity. This includes practices such as providing constructive feedback, linking performance assessments to professional development, and offering incentives for collective achievements (Parolin & Albuquerque, 2010). Moreover, a supportive work environment that facilitates knowledge sharing and offers a robust support system is vital for individual creativity (Hermida et al., 2019). Recognizing and rewarding creative achievements is a critical practice for sustaining innovation (Lee et al., 2019). Encouraging employees to reflect on their tasks and performance can further stimulate creative thinking and lead to innovative outcomes (Leigh et al., 2013). Cultural structures that promote creativity, such as multicultural interactions and values that embrace both individualistic and collectivist approaches, enhance the overall creative potential within organizations (Hermida et al., 2019).

Cultural differences may influence how creativity at the workplace is perceived and valued within organizations, affecting the implementation of creative practices. Therefore, organizations must carefully balance structure and flexibility to create an environment that nurtures creativity while considering cultural and social factors that may impact creative processes. The national differences in creativity at the workplace among Lithuania, Poland, and Sweden can be associated with specific organizational practices that foster and reward creativity. These practices include fostering a creative atmosphere, making tasks more interesting, encouraging imagination, and rewarding creative achievements. The exploration of national differences in creativity at the workplace among Lithuania, Poland, and Sweden reveals a complex interplay of cultural, cognitive, and motivational factors that shape creative processes and outcomes. Each country exhibits unique characteristics influenced by its cultural dimensions, historical context, and educational system, which, in turn, affect its creative capacities.

Lithuanian creativity at the workplace is significantly influenced by national identity. Studies show that Lithuanians score higher on creativity when primed with national identity, suggesting a strong link between cultural pride and creative

expression (Tidikis et al., 2019). In the context of the Baltic countries, including Lithuania, the importance of the creative industries and the role of education in fostering creativity, especially in the fields of technology and design, is emphasised (Valantinaitė, 2015; Laurušaitė, 2016).

While specific studies on Poland's creativity at the workplace are less detailed in the provided contexts, Poland's cultural dimensions are conducive to innovation and creativity (Czerniak & Smygur, 2017). These cultural traits suggest a potential for high creative output, supported by a focus on individual autonomy and long-term orientation. Family organizations in Poland that support employee development and team integration are more likely to introduce product innovations, underscoring the importance of a supportive, trusting workplace climate (Steinerowska-Streb & Głód, 2020).

Sweden is often characterized by a high degree of individualism and low power distance, which are favorable for creativity at the workplace and innovation. The Swedish educational and professional environments encourage autonomy and self-directedness, which are critical for engaging in creative work (Chiu et al., 2018). This cultural backdrop supports a robust creative economy, as evidenced by Sweden's high rankings in global innovation indices (Jourdan & Smith, 2021). Organizations that foster a creative atmosphere tend to have a supportive cultures that encourage innovation and creativity at the workplace. This involves creating an environment where employees feel safe to express novel ideas without fear of criticism (Hermida et al., 2019; Kranich, 2022).

In summary, creativity at the workplace is shaped not only by individual abilities, but also by organizational practices and cultural contexts. Organizational support, management culture, and structures that encourage innovation are essential for fostering creativity. Social Exchange Theory (SET) helps explain how support affects employees' creative engagement, especially in culturally diverse sectors such as tourism. National differences significantly impact how creativity is perceived and practiced. These differences manifest in how organizations across countries structure their environments, support creative efforts, and reward innovation. Given differences in creativity across Lithuania, Poland, and Sweden, the hypothesis is formulated:

H2. Lithuania, Poland, and Sweden differ systematically in the reported use of creativity-supporting practices.

## METHODOLOGY

### Research design

This study draws on the Componential Theory of Creativity (Amabile, 2011; Zheng et al., 2025), the Interactionist Model of Organizational Creativity (Woodman, 2024), and Social Exchange Theory (SET)(Revilla et al., 2023; Tripp, 2023) as theoretical lenses to interpret cross-national differences in perceived creativity-supporting organizational practices. These theoretical assumptions guided the design of this study, which aimed to determine whether creativity at the workplace differs across Lithuania, Poland, and Sweden and whether these cross-country differences are related to distinct organizational practices. The tourism sector was chosen as the empirical context because it strongly depends on human creativity to co-create unique, experience-based products (Richards, 2020; Sharma et al., 2025) and because it reflects a complex interaction of individual, organizational, and cultural determinants of creativity (Dias et al., 2025).

The comparative cross-national design was chosen to capture national and cross-country differences in how creativity at the workplace is fostered, rewarded, and valued, as suggested by recent cross-country research (Maimone & Sinclair, 2022; Miron-Spektor & Paletz, 2024). Lithuania, Poland, and Sweden represent diverse cultural and economic environments within the Baltic Sea Region - ranging from emerging (Lithuania, Poland) to highly developed (Sweden) innovation systems (WIPO, 2024). This diversity allows testing of the hypotheses derived from theoretical assumptions that contextual factors significantly shape organizational creativity practices.

A cross-sectional quantitative study using the CAWI survey was conducted among tourism entrepreneurs in three countries: Lithuania, Poland, and Sweden. The study was conducted in 2024.

### Measures

Creativity at the workplace in tourism organizations was assessed using the Creativity at Workplace Organization Scale developed by Musek (2020). This scale assesses the level of creativity at the workplace - that is, the extent to which employees perceive their organization as fostering and rewarding creativity. A higher score indicates a higher level of

creativity at the workplace (Musek, 2020). A sample item from this scale is: "Fosters finding new ways of doing things". There are 20 items, measured on a 5-point Likert scale (1=not at all characteristic, 5=highly characteristic). A double-translation (forward-backward) method was used: first, the text was translated into the target language (Lithuanian, Polish, or Swedish), followed by an independent back-translation into the original language (English). The translations were done by bilingual experts to ensure semantic equivalence. Content validity was further ensured through expert review of the translated versions. The survey instrument was pre-tested with a small group of tourism organizations (n=10) to ensure clarity and contextual relevance of items.

Internal consistency reliability of the Creativity at Workplace Organization Scale was assessed in the present study to ensure its reliability within the current sample. The scale demonstrated excellent internal consistency, with a Cronbach's alpha of 0.962.

## Sample and sampling procedure

The sampling frame consisted of tourism-related entities listed in national business registers (based on the NACE classification of the tourism sector). In all three countries (Lithuania, Poland, and Sweden), electronic invitations to participate in the research were sent by e-mail to tourism-related entities included in the relevant national business registers. Data collection across all countries was carried out within the framework of the Nordplus research project, which served only as a funding mechanism (in Lithuania and Sweden) and did not influence the sampling design or the respondent survey procedures, which were the same in all countries. In Poland, the survey invitation was sent to 9,255 entities included in the national tourism business register (System Rejestrów Publicznych w Turystyce, turystyka.gov.pl), resulting in a response rate of 2.215%. In Lithuania, the survey invitation was sent to 1,509 entities included in the national Register of Tourism Service Providers (State Consumer Rights Protection Authority, Tourism Market Supervision Division, vvtat.lrv.lt), resulting in a response rate of 4.904%. In Sweden, the survey invitation was sent to 7,023 entities from the Companies Registration Office (bolagsverket.se) and the Statistics Sweden register (foretagsregistret.scb.se), resulting in a response rate of 2.236%.

436 complete questionnaires were collected (Lithuania: N=74; Poland: N=205; Sweden: N=157) (Table 1). As a result, external validity is limited, and the results should be interpreted as applicable only to the available sample. Nevertheless, the sample size is sufficient for intergroup tests of the three populations and for estimating polynomial models. The largest amount of data was collected in Poland, as it is the largest country, while Lithuania is the smallest country with relatively fewer tourism companies operating there; therefore, the smallest sample was collected (Eurostat, 2024). The characteristics of the surveyed companies are presented in Table 1. Respondents completed the survey in their native language. The survey was conducted only by owners and co-owners of tourism businesses, ensuring that each organization was represented by one respondent.

**Table 1.** Characteristics of the research sample (data in %)

| Specifications | | Lithuania N=74 | Poland N=205 | Sweden N=157 |
|---|---|---|---|---|
| The volume of employment | <50 employees | 82.43 | 87.32 | 85.35 |
| | 51-249 employees | 16.22 | 12.68 | 14.01 |
| | 250 employees and more | 1.35 | 0.00 | 0.64 |
| The year in which the organization began its activities | <2000 | 20.26 | 16.1 | 1.27 |
| | 2000-2009 | 27.03 | 41.95 | 24.2 |
| | 2010-2019 | 45.95 | 35.61 | 68.79 |
| | 2020 and more | 6.76 | 6.34 | 5.74 |

It should be noted that the dominance of micro and small tourism organizations (<50 employees) is consistent with the profile of the sector in the surveyed countries, where the majority of tourism organizations are small, family businesses (Eurostat, 2024). A small proportion of medium and large enterprises was also included in the sample, reflecting the actual structure of the tourism sector.

### Data collection procedure

The online survey was conducted over 3 to 5 months in 2024, depending on the country. This extended time frame ensured sufficient participation across tourism organizations in Lithuania, Poland, and Sweden, reflecting differences in response dynamics between countries. The survey was hosted on a secure platform and distributed via personalized electronic invitations. Two reminder emails were sent to increase the response rate, following best practices for online survey research (Sammut et al., 2021). Respondents completed the questionnaire in their native language (Lithuanian, Polish, or Swedish).

The same online survey platform, invitation structure, and contact procedure were used in all three countries; invitation emails were standardized in content and format (translated into the respective national languages), and personalized only with the organization's contact details.

### Research ethics

Participation was voluntary, and before the survey began, respondents were informed about the purpose of the study, anonymity, and data processing (Artal & Rubenfeld, 2017; Jamal & Higham, 2021). Data were analyzed in aggregate form solely for research purposes, in accordance with research integrity principles.

Before the study commenced, research teams from all three countries assessed potential ethical challenges arising from cross-national contexts and discussed them collaboratively. The final decision to conduct the study was approved by the Academic Council of Klaipedos valstybine kolegija, Higher Education Institution (KVK). The study was carried out in accordance with the KVK Code of Academic Ethics (approved by Protocol Resolution No. SV1-07 of the Academic Council of KVK on 30 September 2021) and was registered and confirmed by the KVK Applied Research and Project Activities Center (research registration No. TMV-205).

### Method of analysis

Statistical analyses were conducted using Statistica 13.1 PL software. The Kruskal-Wallis test for ranked data was used to compare creativity at the workplace across countries (to test H1). The relationship between country and organizational practices was estimated using multinomial logistic regression (MNL), with Poland as the reference category (to test H2). The study focused only on country comparisons, not on tourism organizations size or year of establishment, as no significant statistical differences were found when examining tourism organizations size or year of establishment.

Additional robustness checks were conducted. Organization size and age were included as control variables in an extended multinomial logistic regression model; the pattern of significant predictors remained stable. Multicollinearity was assessed using variance inflation factors (VIFs), which were below 4, indicating no serious multicollinearity. Internal consistency was high across countries (Lithuania: $\alpha$=0.957; Poland: $\alpha$=0.938; Sweden: $\alpha$=0.962), suggesting stable cross-national reliability of the scale. Formal measurement invariance testing (e.g., multi-group CFA) was not conducted; therefore, cross-country comparisons should be interpreted with appropriate caution.

## RESULTS

In the first stage of the research, entrepreneurs from 3 countries (Lithuania, Poland, and Sweden) were asked whether they consider their tourism organizations to be creative (Table 2).

**Table 2.** Creativity of tourism organizations in the opinion of entrepreneurs

| Country | Very creative | Partly creative | Neither creative nor uncreative | Uncreative | Completely uncreative |
|---|---|---|---|---|---|
| Sweden | 80.25 | 12.74 | 6.37 | 0.64 | 0.00 |
| Poland | 39.51 | 54.64 | 4.39 | 0.00 | 1.46 |
| Lithuania | 43.24 | 50.00 | 5.41 | 0.00 | 1.35 |

*Note:* Chi-square test=76.964, $p<0.001$; V-Cramera=0.297, data in %

Statistical analysis using the chi-square test showed a significant difference in creativity at the workplace among tourism organizations across countries (Chi-square test = 76.964; $p < 0.001$). The V-Cramer coefficient value of 0.297 indicates a moderate strength of the relationship between the variables (Table 2). It means that although there is a relationship between the country and the creativity at the workplace, it is not very strong, but it is significant enough to indicate some differences between the groups studied. The highest level of creativity at the workplace is reported by entrepreneurs from Sweden, with 80.25% rating their tourism businesses as „very creative," which significantly exceeds the results of entrepreneurs from Lithuania (43.24%) and Poland (39.51%). In Lithuania and Poland, the predominant response is „partly creative" - Lithuania (50.00%) and Poland (54.64%) - indicating moderate creativity in tourism organizations. In Sweden, this category has a much lower share (12.74%). A low percentage of those who consider their tourism organizations to be „neither creative nor uncreative" - Lithuania (5.41%), Poland (4.39%), and Sweden (6.37%). Only 0.64% of entrepreneurs in Sweden rated their tourism organizations as „not particularly creative". There were no such responses in Poland and Lithuania. The percentage of „completely uncreative" tourism organizations is also minimal - Lithuania (1.35%), Poland (1.46%), and no such responses in Sweden.

Nonparametric tests were used for the analyses because the data were derived from Likert-type scales and did not meet normality assumptions. The sample contained unequal group sizes and possible heterogeneity of variance and skewness, which violates key assumptions of classical parametric tests. The Kruskal-Wallis test operates on ranks, making it more robust to deviations from normality and outliers, and it remains accurate across diverse distribution shapes. Following a significant global result, post hoc comparisons of ranks with significance-level adjustment were used to reliably identify pairs of groups that differed (Stanisz, 2007; Mazurek-Kusiak et al., 2024).

The study compared creativity at the workplace across three countries using the Creativity Scale at Workplace Organization (Musek, 2020), which yields a sum score ranging from 20 to 100. Differences between groups were assessed using the Kruskal-Wallis test, which is suitable for ranked data and potentially non-normal distributions. The global test result indicated very significant differences between the studied countries: $H(2; N=436)=153.419$; $p<0.001$, $\varepsilon^2=0{,}350$, confirming that the distributions of creativity scores are not identical across the compared populations and that the between-group effect has significant practical importance. Mean rank indices reveal a clear order: Sweden achieved the highest mean rank (MR=317.97; N=157), while Lithuania (MR=168.55; N=74) and Poland (MR=160.35; N=205) recorded much lower and similar values. Post hoc analyses on ranks with significance level correction showed that Sweden differs significantly from Lithuania and Poland ($p<0.001$ in both comparisons), whereas the difference between Lithuania and Poland did not reach statistical significance ($p=1.000$), thereby consolidating the conclusion that Sweden > Lithuania ≈ Poland (Table 3).

**Table 3.** Kruskal-Wallis test for creativity at the workplace of tourism organizations

| Country | Sweden MR=317.97 | Lithuania MR=168.55 | Poland MR=160.35 | N | Sum of ranks |
|---|---|---|---|---|---|
| Sweden | | <0.001 | <0.001 | 157 | 49920.50 |
| Lithuania | <0.001 | | 1.000 | 74 | 12473.00 |
| Poland | <0.001 | 1.000 | | 205 | 32872.50 |

*Note:* $p<0.001$; $H(2; N=436)=153.4190$; MR-mean rank.

In light of these results, the most convincing picture emerges for Sweden, where the level of reported creativity in tourism organizations is significantly higher than in the other two countries, which may reflect differences in perceived work environments and creativity-supporting practices within the participating organizations. No differences between Lithuania and Poland suggest that in the current sample and with this operationalization of creativity, both populations are characterized by similar level of the tested construct, where the conclusions are of a ranked nature and concern the position of distributions, not means in the metric sense. Therefore, the results partially confirm Hypothesis H1. Significant differences in creativity at the workplace among tourism organizations in Lithuania, Poland, and Sweden indicate that Sweden differs significantly from the other two countries, wheras no significant difference was observed between Lithuania and Poland.

Entrepreneurs were then asked about aspects of this creativity at the workplace in tourism organizations. Twenty factors were evaluated. Multinomial logistic regression was used to examine cross-country differences. In addition, the correct specification (link choice and linearity on the logit scale on the predictor side), independence of observations,

sufficient information for each parameter (no serious separation), and no high collinearity between predictors were verified. The likelihood ratio test confirmed the global significance of the model: LR $\chi^2(40)= 336.2734$, $p<0.001$, which indicates that the included predictors significantly improve the fit relative to the null model and that the model as a whole is statistically valid. The goodness-of-fit measure is complemented by the pseudo-$R^2$ Nagelkerke = 0.6173, which indicates that the model specification captures a significant portion of the variance in the dependent variable (Table 4).

**Table 4.** Multinomial logistic regression results - significant predictors

| Comparison (vs Baseline) | Predictor | β | OR | 95% CI (low) | 95% CI (high) | p |
|---|---|---|---|---|---|---|
| Lithuania vs. Poland | Cares for customers in efficient and creative ways | 0.5938 | 1.8109 | 1.1700 | 2.8029 | 0.0077 |
| Lithuania vs. Poland | Fosters finding new ways of doing things | -1.0554 | 0.3481 | 0.1919 | 0.6313 | 0.0005 |
| Lithuania vs. Poland | Stimulates employees to think and reflect over tasks and performance | 0.8308 | 2.2952 | 1.2459 | 4.2281 | 0.0077 |
| Lithuania vs. Poland | Cares for employees who are more complex and thoughtful than others | 1.1260 | 3.0834 | 1.8160 | 5.2355 | <0.0001 |
| Lithuania vs. Poland | Avoids work that is too routine and tedious | 0.4678 | 1.5965 | 1.0222 | 2.4936 | 0.0397 |
| Lithuania vs. Poland | Cares to make the tasks and jobs more interesting and attractive | -1.4128 | 0.2435 | 0.1339 | 0.4427 | <0.0001 |
| Lithuania vs. Poland | Rewards creative achievements | -0.5155 | 0.5972 | 0.3756 | 0.9495 | 0.0293 |
| Sweden vs. Poland | Performs many new approaches in production and marketing | 1.0927 | 2.9823 | 1.6493 | 5.3927 | 0.0003 |
| Sweden vs. Poland | Is known for creative improvements | 0.7546 | 2.1267 | 1.2833 | 3.5245 | 0.0034 |
| Sweden vs. Poland | Fosters finding new ways of doing things | -1.3209 | 0.2669 | 0.1420 | 0.5017 | <0.0001 |
| Sweden vs. Poland | Cares for employees who are more complex and thoughtful than others | 1.1385 | 3.1222 | 1.7817 | 5.4713 | 0.0001 |
| Sweden vs. Poland | Cares to make the tasks and jobs more interesting and attractive | -0.6877 | 0.5027 | 0.2808 | 0.9001 | 0.0207 |
| Sweden vs. Poland | Provides positive thinking about creativity in management and executives | -0.8642 | 0.4214 | 0.2259 | 0.7860 | 0.0066 |
| Sweden vs. Poland | Finds good solutions for new problems | 1.1127 | 3.0424 | 1.6575 | 5.5847 | 0.0003 |
| Sweden vs. Poland | Rewards creative achievements | -0.5468 | 0.5788 | 0.3499 | 0.9573 | 0.0332 |

*Note:* $p<0.05$
Category: Sweden, Poland, Lithuania; Baseline: Poland; N=436;
Pseudo-$R^2$(Nagelkerke):0.6173; LR$\chi^2$:336.2734; df(LR):40; $p<0.001$;
Pseudo-$R^2$ (Cox–Snell)=0.5376; CI - confidence intervals; OR - odds ratio.

Comparing Lithuania to Poland revealed several clearly positive effects. The strongest positive effect was observed for "Cares for employees who are more complex and thoughtful than others", with an estimated odds ratio of 3.0834 (95% CI: 1.8160-5.2355; $p<0.0001$), which represents an approximately three-fold increase in the likelihood of being classified as Lithuania compared to Poland. The predictor "Stimulates employees to think and reflect over tasks and performance" also increased the likelihood of being classified as Lithuania (OR=2.2952; 95% CI: 1.2459-4.2281; p=0.0077). Similarly, the predictor "Cares for customers in efficient and creative ways" was associated with an increased likelihood of being classified as Lithuania compared to Poland (OR=1.8109; 95% CI: 1.1700-2.8029; p=0.0077). "Avoids work that is too routine and tedious" was also positively associated with Lithuania (OR=1.5965; 95% CI: 1.0222-2.4936; p=0.0397). At the same time, significant negative effects were identified: "Cares to make the tasks and jobs more interesting and attractive" was associated with a decreased likelihood of being assigned to Lithuania compared to Poland (OR=0.2435; 95% CI: 0.1339-0.4427; $p<0.0001$). A negative association was also noted for "Fosters finding new ways of doing things" (OR=0.3481; 95% CI: 0.1919-0.6313; p=0.0005) and "Rewards creative achievements" (OR=0.5972; 95% CI: 0.3756-0.9495; p=0.0293) (Table 4).

A complementary, yet clearly pro-innovation profile emerges in Sweden compared to Poland. As in the case of Lithuania, a high score in the category "Cares for employees who are more complex and thoughtful than others" increased the likelihood of being classified in the Sweden group (OR=3.1222; 95% CI: 1.7817-5.4713; p=0.0001), and the ability to "Find good solutions to new problems" was associated with a comparable, more than threefold increase

in likelihood (OR=3.0424; 95% CI: 1.6675-5.5847; p=0.0003) of being a Swedish organization. Organizations declaring that they "Performs many new approaches in production and marketing" also had a nearly threefold increase in the odds of being classified as Swedish organization (OR=2.9823; 95% CI: 1.6493-5.3927; p=0.0003). "Is known for creative improvements" also increased this probability two-fold (OR=2.1267; 95% CI: 1.2833-3.5245; p=0.0034). On the other hand, several practices showed significant negative associations: "Fosters finding new ways of doing things" was negatively correlated with being Swedish organization (OR=0.2669; 95% CI: 0.1420-0.5017; p<0.0001), just as "Provides positive thinking about creativity in management and executives" (OR=0.4214; 95% CI: 0.2259-0.7860; p=0.0066), "Cares to make the tasks and jobs more interesting and attractive" (OR=0.5027; 95% CI: 0.2808-0.9001; p=0.0207) and "Rewards creative achievements" (OR=0.5788; 95% CI: 0.3499-0.9573; p=0.0332) (Table 4).

The results of this study support hypothesis H2. Lithuania, Poland, and Sweden differ systematically in the reported use of creativity-supporting practices. In both Lithuania and Sweden, the pattern of positive effects focuses on practices that enhance reflectivity and work complexity, as well as problem-solving skills, while more declarative and motivational elements, such as making tasks more attractive, emphasizing positive thinking, or rewarding achievements, are associated with lower odds of belonging to these categories compared to Poland. This configuration may suggest that, in the analyzed national samples, practices grounded in real-world operational and competency-based activities (reflection on tasks, problem-solving, and implementing new approaches) prevail rather than an emphasis on soft, image-related, or purely motivational aspects of a creative culture. At the same time, the discrepancy between the positive effects of "Caring for complex and reflective employees" and the negative effects of "Rewarding creative achievements" may result from the model being overloaded with interdependent dimensions or from the differences in meaning between competence development and formal reward mechanisms - the former type of practices may promote autonomy and quality of solutions, while the latter does not necessarily translate into operational effects after controlling for other variables.

It is important to remember the limitations specific to this type of research. The multinomial logistic regression model assumes independence of irrelevant alternatives; although the results are consistent and theoretically sound, further work is recommended to test parameter stability across variant specifications and to consider nested versions if national alternatives can be hierarchically ordered by institutional or cultural similarity. Self-reported creativity constructs may be subject to measurement error and differences in the meaning of scale items, and covariation among predictors can lead to dispersion of effects across related dimensions. Although the total sample size is adequate for MNL estimation, further research could strengthen inferences by increasing sample sizes within individual categories, employing variable selection or dimension reduction, and assessing robustness to alternative codings and transformations. Despite these caveats, the presented pattern of effects remains consistent: practices focused on reflection, complexity, and problem-solving have an advantage, while purely motivational strategies are relatively less important after controlling for other factors.

## DISCUSSION

Statistically significant differences were found between creativity at the workplace of tourism organizations in Sweden and two other countries - Lithuania and Poland. Creativity at the workplace in the Swedish tourism organizations participating in the study significantly differs from that in Lithuania and Poland. Swedish respondents rated their organizations as very creative much more often than respondents in Lithuania and Poland. The observed differences can be further explained by cross-country research on creativity at the workplace, which highlights how national contexts are associated with differences in perceptions and practices of creativity at the workplace (McKearney et al., 2023; West & Richter, 2024). Previous studies have discussed the active integration of creativity at the workplace and innovation in tourism development in Sweden (Gustafsson & Ijla, 2017; Eimermann et al., 2019). According to the Global Innovation Index 2024 (WIPO, 2024), Lithuania, Poland, and Sweden have different positions in the global context of innovation and creativity at the workplace. Sweden remains one of the world's innovation leaders. Such contextual characteristics may offer a broader interpretive background for understanding the higher reported levels of creativity observed in the Swedish sample. The Swedish tourism sector benefits from a vibrant creative industry, a supportive entrepreneurial culture, and a national focus on sustainable development and innovation (Klein et al., 2021; Gustafsson & Amer, 2023; Dias et al., 2025). According to OECD, Sweden has actively promoted synergies between creative industries and tourism by supporting policies that encourage innovation, design thinking, and cultural engagement.

However, since this study does not assess organizational policy or innovation-related outcomes, national policy factors may be considered potential contextual explanations. The results are consistent with previous cross-country research on

creativity at the workplace, which suggests that creativity varies significantly across national contexts due to differences in work values, institutional support, and management practices (House et al., 2004; Barth & Stadtmann, 2026).

Within the analyzed sample, the observed cross-country differences appear consistent and statistically confirmed. These differences can be discussed in the context of broader conditions highlighted in previous literature; however, this study assesses only respondents' perceptions and does not directly evaluate environmental or institutional conditions.

Based on these results, an analysis of specific organizational practices provides further insights into how reported creativity-supporting practices differ across national contexts. The analysis also confirms that tourism organizations in Lithuania, Poland, and Sweden differ systematically in their reported organizational practices related to creativity support, including the extent to which they encourage and reward creativity. These findings are consistent with the theoretical understanding that creativity at the workplace within organizations is a multifaceted phenomenon (Bratnicka, 2015; Lua et al., 2024). A creative organizational culture is essential for fostering innovation, requiring leadership that encourages employees to pursue new ideas aligned with strategic goals (Dennett, 2022; Yas et al., 2022; Gupta et al., 2024).

In addition, significant differences in reported creativity-supporting practices were identified across countries and each country demonstrated different organizational practices. Compared to Poland, Lithuanian tourism organizations are dominated by creativity-supporting practices that emphasize caring for complex and thoughtful employees than others, encouraging employees to think and reflect on their tasks in terms of their results, effective and creative customer care, and avoiding overly routine or boring work. This profile shows that Lithuanian organizations promote creativity by applying reflective and competency-based methods that promote deeper employee engagement and problem-solving. Lithuania's focus on reflective practices and customer-oriented creativity at the workplace aligns with its Baltic context, where creative industries and education play a central role in fostering innovation (Valantinaitė, 2015; Laurušaitė, 2016).

Swedish tourism organizations demonstrate greater innovation and outcome-oriented, creativity-supporting practices. Swedish tourism organizations, compared to Polish tourism organizations, are characterized by a strong innovation focus, a concern for complex and thoughtful employees, the ability to find good solutions to new problems, the application of new production and marketing methods, and a reputation for creative improvements. The results support previous studies highlighting Swedish organizations' strong capabilities in creative problem-solving, positive leadership, and innovation, particularly in the tourism sector, where collaborative management, advanced technology, and open innovation play an important role (Aas, 2016; Gustafsson & Amer, 2023). Swedish organizational practices often emphasize solution-oriented thinking and employee empowerment, fostering a psychologically safe environment where creativity can flourish (Marklund, 2024).

Polish tourism organizations, compared to Lithuanian tourism organizations, show a stronger connection with practices that aim to make tasks more interesting and attractive, encourage the search for new ways of doing things, and reward creative achievements. Meanwhile, Polish tourism organizations, compared to Swedish tourism organizations, tend to place greater emphasis on seeking new approaches, encouraging positive attitudes toward creativity in management and leadership, pursuing more interesting tasks and jobs, and rewarding creative achievements. The results highlight that in Poland, the creativity-supporting practices focus on employee care and task attractiveness, reflecting a human-oriented approach. Previous research indicates that Poland offers favorable conditions for the development of business tourism products and demonstrates considerable diversity in its business tourism potential (Lipianin-Zontek & Zontek, 2021). Family organizations that support employee development and team integration are more likely to introduce product innovations, highlighting the importance of a trusting and supportive workplace climate (Steinerowska-Streb & Głód, 2020). Polish tourism sector is characterized by a structure and types of innovations comparable to those found in other countries (Panfiluk, 2021).

## CONCLUSION

The aim of this study was to identify (1) whether creativity at the workplace differs between tourism organizations in Lithuania, Poland, and Sweden, and (2) whether tourism organizations in these countries differ systematically in reported creativity-supporting practices.

First, it has been confirmed that there are significant differences in creativity at the workplace between tourism organizations in Sweden and those in the other two countries, Lithuania and Poland. The results show that Swedish tourism organizations report significantly higher creativity at the workplace than those in Lithuania and Poland, while Lithuania and Poland do not differ significantly in overall creativity scores. The absence or minimal number of indications of a lack

of creativity suggests that, across all the countries studied, entrepreneurs have a relatively positive view of creativity at the workplace in their tourism organizations.

Second, the results confirm that Lithuania, Poland, and Sweden differ in reported creativity-supporting organizational practices. The multinomial logistic regression analysis shows that specific organizational practices are differentially represented across countries, forming distinct national profiles. In Swedish tourism organizations, creativity at the workplace is integrated into everyday problem-solving, marketing, and production processes, with a strong emphasis on innovation. Lithuanian tourism organizations emphasize the importance of reflective and customer-oriented practices. Polish tourism organizations, in turn, reflect more people-oriented organizational practices, seeking to make work more interesting and to motivate creativity by rewarding creative achievements.

The findings contribute to the theoretical understanding of creativity at the workplace as a multidimensional and context-sensitive phenomenon, supporting the idea that the national context plays an important role in shaping the perception, support, and practice of creativity within the analyzed sample. The findings suggest that creativity at the workplace in tourism organizations may be shaped by organizational practices and broader national contexts.

This study, situated at the intersection of tourism innovation and creativity at the workplace, contributes to a better understanding of how creativity at the workplace is implemented across tourism organizations operating in different national contexts. This interdisciplinary perspective highlights the importance of organizational creativity as a strategic resource for tourism innovation and provides a basis for future research seeking to link creativity-supporting organizational practices with broader innovation outcomes.

## Theoretical and practical implications

The theoretical implications of the study results emphasize that creativity at the workplace in tourism organizations is a culturally rooted and strategically important phenomenon. The results obtained in the study are consistent with key assumptions of the Componential Theory of Creativity (Amabile, 2011; Gong et al., 2023; Zheng et al., 2025), the Interactionist Model of Organizational Creativity (Woodman, 2024), and Social Exchange Theory (Revilla et al., 2023; Tripp, 2023) when these theories are applied as interpretive perspectives at the organizational and national levels. The findings suggest that national context may be associated with differences in perceived creativity-supporting practices within the analyzed sample. Swedish organizations, which reported the highest levels of creativity at the workplace in the analyzed sample, may be consistent with descriptions in cross-cultural literature that characterize Sweden as a low power distance and highly individualistic context (Bennett & Nikolaev, 2021). The Swedish leadership style, which emphasizes solution-oriented thinking and employee empowerment, creates a psychologically safe environment that encourages creative expression (Marklund, 2024). These results confirm the theoretical concept that creativity at the workplace is a multifaceted construct (Bratnicka, 2015; Lua et al., 2024). In contrast, Lithuania and Poland demonstrate a more fragmented and localized approach to creativity at the workplace, which may limit its broader impact on the development of tourism organizations and competitiveness.

This study provides empirical evidence consistent with the view that creativity at the workplace may function as a multi-layered structure linking organizational, and national contexts. The study's practical implications suggest that Lithuania, Poland, and Sweden differ systematically in their reported creativity-supporting practices.

## Limitations and future research

This study provides valuable insights into creativity at the workplace in tourism organizations in Lithuania, Poland, and Sweden, but several limitations should be noted. The study was limited to only three countries, which may affect the generalization of the results.

Another limitation is related to the study design. The study uses a CAWI design, which captures relationships at a single point in time. This means that the directionality of the causal relationship cannot be confirmed. A longitudinal design would allow for the verification of causality.

The third limitation relates to the conceptual scope. The analysis focused on organizational practices and the country-level context but did not cover individual-level factors (e.g., creative self-efficacy, creative mindset). Including these aspects in future research would provide a more comprehensive and multi-layered understanding of how creativity at the workplace arises from the interaction of individual and organizational factors.

Given the low response rates (2-5%) and the voluntary nature of participation, the possibility of non-response bias and sampling heterogeneity cannot be excluded; therefore, cross-country differences should be interpreted with caution.

Future research should also employ mixed-methods, combining quantitative methods with detailed qualitative insights (e.g., interviews, case studies, or ethnographic methods) to capture the dynamics of creativity in the workplace.

Furthermore, as digital transformation continues to transform the tourism sector, future research should examine how the latest technologies, such as artificial intelligence, affect creativity in organizations, i.e., whether they enhance human creative potential or change its nature. This line of research is particularly relevant for policymakers and managers seeking to balance human creativity with the effective application of technology in order to achieve synergy.

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## Biographical notes

**Gita Šakytė-Statnickė**, Ph.D. in Management, Social Sciences, is an Associate Professor at Klaipėdos valstybinė kolegija | Higher Education Institution, Lithuania. She is a member of Lithuanian Union of Scientists (LMS), a member of Lithuanian Educational Research Association (LETA), European Association for Educational Research (EERA), Researchers' Excellence Network (RENET), LiMA. Her research interests include human resource management, employees of different generations, work engagement, artificial intelligence, and marketing. She has authored and co-authored over 40 scientific publications published in national and international scientific journals.

**Anna K. Mazurek-Kusiak** – habilitated doctor of social sciences in the discipline of economics and finance, professor at the Department of Tourism and Recreation at the University of Life Sciences in Lublin, Poland. Research projects manager: "Research and promotion of Polishness and regional traditions in the thematic villages of Eastern Poland" (NdS/536437/2021/2022) funded from Ministry of Science and Education and "An empiric model of tourist behavior on the travel agency market" (2018/02/X/HS4/02427) funded from National Science Center, Poland. She has 20 years of experience as an academic lecturer and researcher. She is also a certified professional guide in Lublin. Author of over 160 scientific publications in the field of economics, tourism, nutrition, management and marketing, as well as several scientific monographs.

**Laurencija Budrytė-Ausiejienė** – lecturer and head of the Tourism Business and Hospitality Service Management study programs at Klaipėdos valstybinė kolegija | Higher Education Institution, Lithuania. Her academic work focuses on tourism, cultural heritage, creativity development, intergenerational and intercultural communication in tourism enterprises, and the application of artificial intelligence in the tourism sector. Laurencija has participated as a researcher and project leader in several national and international projects, including NordPlus programs aimed at enhancing tourism education, digital competence, and service innovation. She is co-author of multiple scientific publications in the fields of tourism management, communication, and AI in tourism.

## Author contributions statement

**Gita Šakytė-Statnickė:** Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Resources, Software, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing. **Anna Katarzyna Mazurek-Kusiak:** Data Curation, Formal Analysis, Investigation, Methodology, Resources, Software, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing. **Laurencija Budrytė-Ausiejienė:** Data Curation, Formal Analysis, Funding Acquisition, Investigation, Project Administration, Resources, Software, Writing – Original Draft Preparation, Writing – Review & Editing.

## Conflicts of interest

The authors declare no conflict of interest.

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# From green talent management to organizational green image: A sequential mediation model

***Sonia Umair[1], Umair Waqas[2], Beata Mrugalska[3], Ilya Bystrov[4]***

***Abstract***

**PURPOSE:** *This study advances prior research by examining how both the organization and its employees contribute to the development of the organization's green image.* **METHODOLOGY:** *The present study employed a quantitative approach and conducted a cross-sectional survey in 5-star and 4-star hotels in Oman. In total, 325 of 390 questionnaires were included in the final analysis. The proposed hypotheses were tested using SmartPLS (4.0).* **FINDINGS:** *Green talent management (GTM) enhances employees' green commitment, which, in turn, promotes their pro-environmental behavior (PEB), thereby strengthening the direct and indirect links between GTM and PEB. Employees' PEB improves the organization's green image (OGI) and also mediates the relationship between GTM and OGI. Employees' green commitment and PEB serve as sequential mediators that explain how GTM translates into a stronger OGI.* **IMPLICATIONS:** *Organizations can implement practices, such as green training and rewards, to strengthen their green commitment and foster PEB.* **ORIGINALITY AND VALUE:** *The results of this investigation will provide useful insights into the development of strategies and policies to nurture green talent within organizations.*

***Keywords:*** *green talent management, green commitment, pro-environmental behavior, green image, sustainability, organization*

## INTRODUCTION

Achieving environmental sustainability has become a significant concern for organizations seeking to build their image and compete in the global market (Bianchi et al., 2022). For this reason, the concept of a sustainability-driven organization has attracted the attention of scholars and practitioners, given corporations' environmental and societal impacts. Such organizations balance the needs of the social groups, the environment, and the economy (Sun & Hong, 2022). Within organizations, sustainable processes are those that support innovation, sustainability, organizational image, and competitive advantage. However, these elements are effective only when there is a sufficient workforce to manage these processes. Importantly, the global competition for skilled individuals and the need to manage them demand green talent to cultivate environmentally sustainable businesses (Ma et al., 2023).

Green talent management (GTM), or more commonly "green soft talent management," in this paper, refers to a human-centered dimension of Talent Management (TM) that dynamically promotes and is dedicated to the development and retention of green talent. It can be achieved by enhancing individuals' commitment through effective communication, ensuring the inclusion of talent in decision-making processes, providing organizational support for talent well-being, and

1 Sonia Umair, Ph.D., College of Commerce and Business Administration at Dhofar University, Salalah, Oman, e-mail: soniyalatif@gmail.com (ORCID: https://orcid.org/0000-0003-1207-9310).
2 Umair Waqas, Ph.D., College of Commerce and Business Administration at Dhofar University, Salalah, Oman, e-mail: umairwaqas@gmail.com (ORCID: https://orcid.org/0000-0001-9943-8675).
3 Beata Mrugalska, Ph.D., DSc, Eng. (Eur.Erg.) Faculty of Engineering Management, Poznan University of Technology, ul. Jacka Rychlewskiego 2, 61-131 Poznan, Poland, e-mail: beata.mrugalska@put.poznan.pl (ORCID: https://orcid.org/0000-0001-9827-9449).
4 Ilya Bystrov, Ph.D., Faculty of Business and Management, American University of Phnom Penh, Cambodia, e-mail: ilya.bystrov@gmail.com (ORCID: https://orcid.org/0000-0002-8500-155X).

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implementing effective leadership practices. These practices inspire environmentally conscious team members to initiate specific ecological initiatives for promoting environmental sustainability (Gardas et al., 2019). In GTM, climate actions are commonly a result of a favorable work environment, within an adhocracy organizational culture, and through the effective provision of relevant resources (Alkhozaim et al., 2024). The positive green organizational image perceived by employees is communicated to customers and other stakeholders through interactions. As stated by Aranganathan (2018), the environmental initiatives of the organizations help them to attract green talent and advance their green image. As organizations seek to be socially responsible, they focus on sustainable initiatives to encourage their personnel to practice pro-environmental behavior (PEB) and commit to environmental sustainability to build their green image (Ali et al., 2023).

An organization's green HR management activities influence employees' PEB and environmental strategies (Elshaer et al., 2021; Ojo et al., 2022). In the last few years, the investigation of TM has gained the attention of scholars (Chaudhary, 2018) with a focus on different sectors and emerging economies, including Turkey (Glaister et al., 2018), Pakistan (Ali et al., 2019), and India (Chaudhary, 2018). However, not much work has been done on the role of GTM in employees' behavior and organizational success (Ogbeibu et al., 2022). Sustainable organizations can build their sustainable image by promoting green initiatives among their employees (Jam & Jamal, 2020). This can be achieved by adopting green practices during the talent hunt process. GTM practices can help new talent become familiar with the organizational green culture and can maintain green values (Aranganathan, 2018).

Importantly, when employees are familiar with and involved in their organizations' green initiatives, they are more committed and more likely to demonstrate PEB in the workplace (Ansari et al., 2021). Additionally, previous research has found the indirect effect of green hiring, green training & development, and green employee empowerment towards PEB by investigating mediating and moderating roles of green commitment (Ansari et al., 2021), corporate environmental strategy, green psychological climate (Mateen et al., 2022), and green self-efficacy (Waqas et al., 2025). Although these studies provide some insight into the role of green HR activities in predicting employees' PEB, the results are directly focused on PEB and thus warrant further empirical investigation. Therefore, the present study examines the employees' green commitment through which organizations' GTM activities translate into employees' PEB and green image. It is observed that people are committed to those activities that they are passionate about as they find such activities internally satisfying (Ali et al., 2023). Therefore, we propose that when organizations hire people involved in green activities and who understand the importance of environmental management, those employees are committed to the organization's green initiatives and, through their performance in PEB at the workplace, seek to build the organization's green image (OGI).

This study offers new insights into environmental management by addressing a key gap in the relationship between an organization's GTM and its green image. To our knowledge, research on this subject is minimal. Existing research has focused primarily on environmental performance (Ahmad et al., 2021) or organizational performance outcomes (Alam & Islam, 2021; Cheng et al., 2021), leaving the mechanism through which employee behaviors contribute to OGI. Understanding this process is particularly timely given the growing importance of OGI to the organization's competitive advantage and long-term survival (Ali et al., 2023). By examining the sequential mediation of employees' green commitment and PEB on GTM and OGI, this study not only advances theoretical knowledge but also offers practical implications for managers seeking to strengthen their organization's sustainability profile and enhance employees' engagement in green initiatives.

The paper's structure is as follows: After the introduction, the second section reviews related research and develops hypotheses. Section three describes the methodology, and the subsequent sections present the main results and discuss the suggested model. The final section outlines the research implications, limitations, and future research directions.

## LITERATURE REVIEW & HYPOTHESES DEVELOPMENT

The following section explains the theoretical background and concepts for developing hypotheses for this study (Figure 1).

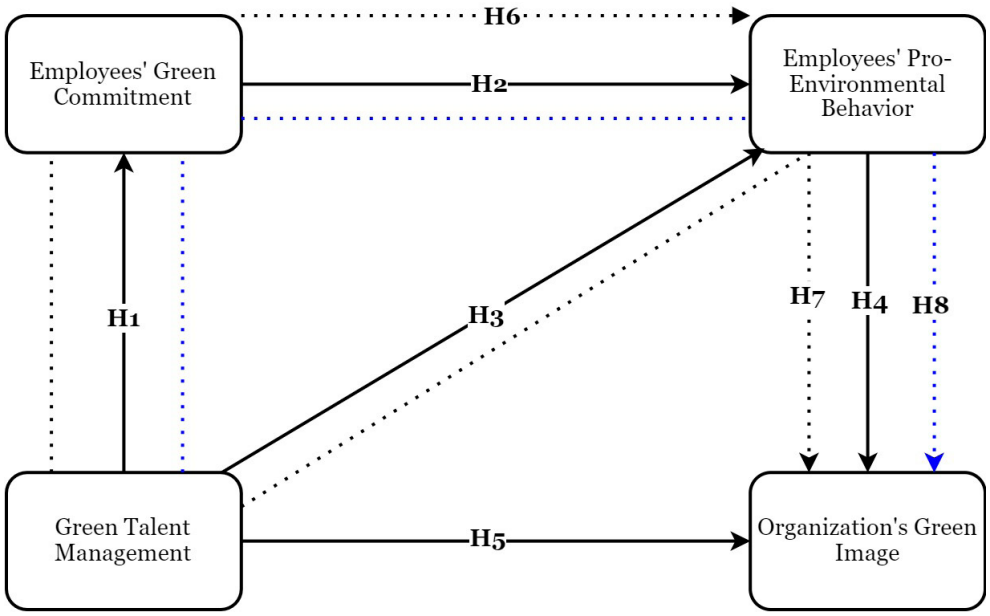


**Figure 1.** Conceptual framework

### GTM and employees' green commitment

An organization's HRM policies can affect its performance by shaping employees' attitudes and behaviors. In contrast, green HR practices can encourage employees' green behaviors and environmental commitment (Ansari et al., 2021). It can help enhance employees' abilities by providing the necessary knowledge, skills, and capabilities, and by inculcating a sense of purpose, responsibility, and commitment to environmentally sustainable actions in the workplace (Alnaqbi et al., 2024). Furthermore, organizations can attract and retain committed employees in the environment. According to social exchange theory (SET) (Blau, 1964), employees who receive economic or socio-emotional benefits from the organization will feel compelled to reciprocate. GTM is a strategy through which organizations aim to ensure the right talent is consistently attracted, trained, developed, and retained, thereby promoting their green initiatives (Gardas et al., 2019; Hong et al., 2022). Actions, including green training and development, green reward and compensation, and green employee empowerment, affect green commitment. In a sustainable environmental context, Pham et al. (2019) argued that, in green-oriented organizations, employees tend to strengthen their green commitments, values, and mindsets to adapt to the organization's green culture and goals. Moreover, if employees actively participate in environmental initiatives, it can help them better understand the organization's environmental targets and policies, thereby strengthening their green commitment. Thus, we can argue that GTM practices can stimulate employees' green commitment, and for this present study, we propose the following hypothesis:

H1: A positive relationship exists between an organization's GTM and employees' green commitment.

### Employees' green commitment and employees' PEB

The PEB is considered an employee performance that encourages environmentally sustainable practices in the workplace (Zhu et al., 2021) or addresses environmental degradation, global warming, and climate change while improving human conditions and minimizing adverse environmental effects (Ali et al., 2023). A workplace PEB depends on a person's commitment and concern for nature and mankind. Therefore, we suggest an affirmative relationship between green commitment and PEB. Following the SET (Blau, 1964), it appears that employees who are committed to green initiatives seek to maintain high-quality relationships with their organizations. They are engaged in green reward and

compensation systems that offer financial and non-financial rewards to attract, motivate, and retain the workforce and achieve the organization's green goals (Tang et al., 2018; Tulsi & Ji, 2020). Regarding the link between green commitment and PEB, it can be assumed that employees' green commitment positively affects their green-work-related outcomes. Employee commitment to green behaviors can motivate them towards green behaviors for organizational sustainability (Aboramadan, 2020). The present study argues that individuals can participate in the organization's pro-environmental initiatives when motivated by a strong commitment to environmental protection. Thus, in this study, we propose the following hypothesis:

H2: There is a positive relationship between employees' green commitment and PEB.

## GTM and employees' PEB

Based on the conservation of resources (COR) (Hobfoll et al., 2018), employees aim to acquire, maintain, and safeguard valuable resources. Thus, GTM activities can serve as an external resource to enhance employees' knowledge, skills, and abilities. This helps to effectively enrich the employee resource pool and shape their positive behaviors, including PEBs (Yu et al., 2024). Following Aboramadan (2020), employees are expected to reciprocate an organization's environmental dedication and efforts by exhibiting environmentally conscious behaviors when they demonstrate the commitment to environmental management practices through the establishment of clear green goals, green recruitment and selection, green training and development, efficient green performance appraisal, and green reward systems. Within organizations, such green HR practices inspire employees, enhance their skills to demonstrate PEB, and motivate them to develop original concepts and deliver cutting-edge, environmentally friendly solutions (Aboramadan, 2022). The organization's green HR initiatives are essential to ensure employees' participation in environmentally sustainable workplace practices, thereby helping the organization attract environmentally conscious employees who exhibit PEB (Zhu et al., 2021). To achieve this, it is emphasized that GTM strategies be developed to support the net-zero transition across the entire employment life cycle, from pre-recruitment to post-retirement (Bhushan & Singh, 2024). The organization's green HR practices can affect the PEB (Alshaabani et al., 2021; Fawehinmi et al., 2020; Zhu et al., 2021). Thus, we can argue that emphasizing green values in recruitment and selection, and becoming an environmental protection brand, enables organizations to attract and retain environmentally aware workers who can naturally exhibit PEB. In this study, we propose the following hypothesis:

H3: A positive relationship exists between the organization's GTM and the employees' PEB.

## Employees' PEB and OGI

An organization's image is a combination of factors that reflect and communicate its identity, and it is significantly shaped by its ethical and moral responsibilities in business (Yadav et al., 2016). Meanwhile, OGI could be a set of perceptions held by employees and customers about the organization that are linked to their commitment to and concerns about the environment (Chen, 2010). In this study, OGI reflects employees' internal perceptions of their organization's environmental image rather than an externally assessed corporate reputation. More and more organizations are getting involved in environmentally friendly activities to build their green image. For example, through a green shared vision, they encourage the PEB (Khai et al., 2024). Such behaviours result from individuals being increasingly aware of environmental problems and communities being pressured to establish a green image (Saran & Shokouhyar, 2021; Widyastuti, 2019). Organizations that invest in environmental issues present a better image because their efforts for society give them a favorable edge over those not involved in such activities (Chen, 2008). Employees are crucial to shaping the organization's internal and external image. When employees are engaged in PEB, they begin to view their organization as environmentally responsible. This aligns their actions with organizational values, thereby strengthening their internal perception of the green organization.

Moreover, workers can promote organizational values by serving as brand ambassadors and modeling these behaviors (Ali et al., 2023). According to social information processing (SIP) theory, individuals are adaptive organisms who seek to align attitudes, behaviors, and opinions with the social context (Salancik & Pfeffer, 1978). With reference to this, in this study, employees' exhibition of PEB shapes their perception of the OGI. Thus, it can be assumed that employees' PEB can enhance organizations' future environmental image (Zhu et al., 2021). Therefore, we suggest the following hypothesis:

H4: The employees' PEB positively influences their internal perception of the OGI.

## GTM and OGI

GTM can be considered an organizational practices that integrate environmental values into talent-related functions (Ogbeibu et al., 2022). From the perspective of SIP theory, such practices signal environmental priorities and shape employees' interpretations of the organization's environmental orientation (Salancik & Pfeffer, 1978; Pham et al., 2019). When employees consistently observe GTM practices, they perceive their organization as committed to sustainability initiatives, which builds their OGI. Similarly, SET suggests that employees interpret GTM as the organization's investment in environmental responsibility and employee development, which helps foster their positive attitude toward the organization (Blau, 1964; Ansari et al., 2021). Green HR practices are considered positively associated with organizational reputation and green image. Thus, we can argue that GTM contributes to a favorable green image as perceived by employees. For this, the present study proposes the following hypothesis:

H5: GTM is positively associated with employees' perception of the OGI.

## Mediating role of employees' green commitment

When people hold an environmentally friendly belief system, their concerns are more closely aligned with environmental issues and environmental responsibility (Zhu et al., 2021). Therefore, such commitment motivates them to behave consistently with that belief system. Employees' green commitment reflects positive feelings, and the organization's GTM practices reinforce it. An effective HR strategy can yield positive, significant workplace outcomes, such as employee commitment (Pham et al., 2019). The organization's environmental protection practices help employees become environmentally committed and could lead to their PEB at work. Within the green HR context, GTM not only directly affects PEB but also does so indirectly through diverse mechanisms. Therefore, investigating the relationship between GTM and PEB holds significant theoretical importance. However, we have found a dearth of research on the mediating mechanism of the impact of GTM and PEB. Previously, Zhu et al. (2021) found that green HR policies may convey green values and ethics to employees, prompting attention to environmental issues and influencing the PEB. This study suggests the following hypothesis:

H6: The relationship between the organization's GTM and the employees' PEB is mediated by employees' green commitment.

## Mediating role of employees' PEB

Within the SET (Blau, 1964) perspective, employees favorably view their organization's green initiatives and seek to engage in them for organizational and societal benefits. An organization's green engagement shapes employees' attitudes and behaviors (Ali et al., 2023). For the sake of green performance, organizations need to align their HR practices with employees' green behavior and their green image (Fawehinmi et al., 2020). The organizational green culture encourages employees to practice PEB in the workplace. Accordingly, we can argue that an organization's GTM activities foster positive feelings that stimulate engagement in green activities, which, in turn, help them practice PEB at the workplace. As a result, implementing GTM enhances firms' long-term competitiveness by projecting a positive image of green behavior externally and saving costs internally. Furthermore, as brand ambassadors, employees influence consumers' attitudes and behaviors by transmitting organizational culture, norms, and regulations, thereby contributing to the development of the organizational image. We can argue that employees' PEB may be influenced by an organization's pro-environmental policies, including GTM, which serves as an intermediary mechanism between GTM and OGI. It was observed that PEB acts as a mediator between an organization's CSR activities and green image (Ali et al., 2023). It is crucial to comprehend how businesses develop their green image through GTM initiatives and workplace PEB. Therefore, the present study proposes the following hypothesis:

H7: Employees' PEB mediates the relationship between the organization's GTM and OGI.

Moreover, by examining H5 and H6 jointly, the present study suggests sequential mediating roles for green commitment and PEB in the organization's GTM activities and employees' perceptions of a green corporate image. Following SET (Blau, 1964) and SIP theory (Salancik & Pfeffer, 1978), we suggest a significant connection via sequential mediation that

prior TM literature has not explored. We specifically propose that employees adhere to and exemplify their company's environmental policies and procedures. They integrate their organization's environmental conservation actions into their personal value system. They engage in green activities to protect and participate in environmental activities because of the social significance of environmental conservation, especially its implications for social welfare. As a result, they are motivated to get involved in pro-environmental activities at work. Additionally, frontline staff convey the company's environmental principles to clients by acting in accordance with these principles when interacting with customers. The present study proposes that organizations' green HR activities, particularly GTM activities, stimulate employees' green engagement, which in turn fuels employees' PEB at the workplace and eventually builds the organization's green image. Thus, we propose the following hypothesis:

H8: Employees' green commitment and PEB sequentially mediate the relationship between GTM and the OGI.

## METHODOLOGY

The oil and gas sectors are a significant source of income for Oman. However, the government is making substantial efforts to develop the tourism industry as a substitute for oil and gas as a source of economic activity (Piya et al., 2022). As a result of the government's efforts to diversify the economy, the Oman 2040 Vision initiative was launched, with tourism identified as one of the key development areas (Salem et al., 2022). Accordingly, the target population for this study comprises frontline employees in hotels engaged in green HR practices in Oman. The present study employed a quantitative approach and a cross-sectional survey. The data were collected using a purposive sampling. It enabled us to identify 5-Star and 4-Star hotels that met the inclusion criteria. To achieve this aim, we first reviewed their websites and, to establish necessary links with hotel managers, used personal networks and local knowledge. Subsequently, formal approval was obtained from the HR departments of the participating hotels. Due to the hotels' privacy concerns, the representatives of the selected hotels were able to collect data from frontline employees. The participation in this study was voluntary, confidential, and anonymous.

The questionnaire was administered in English, the primary working language at the participating hotels. Prior to full deployment, the instrument was reviewed by hospitality professionals for clarity and relevance, and minor wording refinements were made to improve comprehension. The validated scales were adapted from prior studies to assess dependent, independent, and mediating variables; therefore, the instruments' validity and reliability were already established. These measures were slightly modified to align with the study's context. A five-point Likert scale was used, where "1: represented "strongly disagree" and "5" represented "strongly agree". GTM was measured by adapting a seven-item scale from the work done by Ogbeibu et al. (2022). A sample item is "My organisation offers green training, workshop opportunities, coaching and courses that advance my knowledge on how to foster environmental sustainability." Employees' green commitment was measured with an eight-item scale adapted from Raineri & Paillé (2016). A sample item is "I would feel guilty about not supporting the environmental efforts of my company." A seven-item scale was used to measure employees' PEB. This scale was adapted from the work of Robertson and Barling (2013), and one of the sample items is " I print double-sided whenever possible." Finally, based on Martínez (2015), a five-item scale was adapted to measure employees' green image of the organization. The sample item is "The organization is well-established in its environmental concerns."

Of the 390 distributed questionnaires, 325 were suitable for final analysis. Demographic data showed that a majority of respondents were male (59.08%). The respondents were in the three age groups: 20-30 (62.51%), 31-40 (30.92%), and over 41 (6.57%), reflecting that most young adults work as frontline hotel staff. In PLS-SEM, social desirability bias may introduce common variance in responses (Kock, 2015). Additionally, Podsakoff et al. (2003) note the potential for common-method bias, as data on both independent and dependent variables were collected simultaneously from the same respondents using the same measurement instrument. This study employed the technique from Kock (2015) to assess the full collinearity among variables and items. Kock analyzed inner VIF collinearity and suggested that an inner VIF of 3.3 is an appropriate threshold. We adopted this measure, treating each variable in turn as the dependent variable, with all others as independent. As shown in Table 1, all within-group VIF values are below 3.3, confirming that no common-method bias exists in this study.

**Table 1**. Common method bias test (Kock, 2015). Full collinearity test

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| 1. Employee's green commitment | | 1.928 | 1.882 | 2.223 |
| 2. Employees pro-environmental behavior | 1.844 | | 2.055 | 1.950 |
| 3. Green talent management | 1.523 | 1.703 | | 1.676 |
| 4. Organization's green image | 1.774 | 1.633 | 1.738 | |

For the present study, the proposed hypotheses were tested using PLS-SEM in SmartPLS 4. This tool is helpful for small sample sizes, and normality is not required for its application (Hair et al., 2019). Initially, we evaluated the measurement model and then analyzed the structural model.

## Measurement model

Initially, the analysis was conducted on the reflective items' measuring model. In Table 2, Cronbach's Alphas, Rho_A, and composite reliability for all the constructs were above the threshold value of 0.70 (Hair et al., 2017).

**Table 2.** Reliability and validity

| Constructs | Reliability | | | |
|---|---|---|---|---|
| | Cronbach's alpha | CR (Rho_A) | Composite reliability | AVE |
| 1. Employees' green commitment | 0.895 | 0.895 | 0.916 | 0.578 |
| 2. Employees' pro-environmental behavior | 0.872 | 0.875 | 0.902 | 0.568 |
| 3. Green talent management | 0.924 | 0.925 | 0.939 | 0.686 |
| 4. Organization's green image | 0.823 | 0.828 | 0.883 | 0.654 |

Convergent validity was assessed by evaluating the average variance extracted (AVE) and outer loadings. As it is presented in Table 1, the AVE values for all the reflective constructs were greater than the threshold value of 0.50, which means that all the items were relevant to the respective constructs and explained more than 50% of the constructs' variance. For loading, each measurement item's loading on its corresponding construct should be greater than 0.70 (Hair et al., 2019). In this study, all loadings exceeded the recommended value. Importantly, for the OGI, one item (OGI2) was removed due to low loading. Indicators with lower loadings may be removed if deleting them increases AVE (Hair et al., 2017). The results in Tables 1 and 2 and Figure 2 show that the measurement model meets all set criteria.

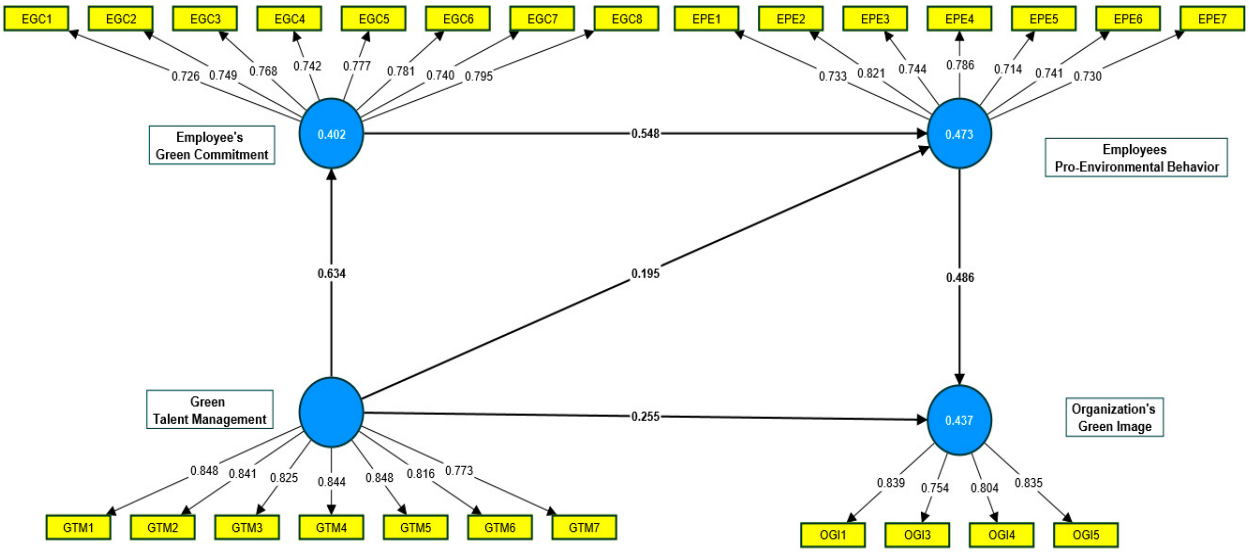


**Figure 2.** Measurement model

After this, discriminant validity was assessed using the Heterotrait-Monotrait ratio (HTMT). As shown in Table 3, all HTMT values were <0.85. The results indicate that all constructs exhibit sufficient discriminant validity (Henseler et al., 2015), indicating that the measurement model satisfies the condition for discriminant validity.

**Table 3**. HTMT ratio

| Constructs | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| 1. Employees' green commitment | | | | |
| 2. Employees' pro-environmental behavior | 0.758 | | | |
| 3. Green talent management | 0.693 | 0.602 | | |
| 4. Organization's green image | 0.677 | 0.736 | 0.591 | |

## RESULTS

### Structural model

After this, the structural model was assessed. Its assessment helps the researcher determine the model's capability to predict the target constructs (Hair et al., 2017). The hypothesised association between the constructs was assessed for significance by evaluating path coefficients. As shown in Table 4, all five direct relationships were significant. (Criteria: *p ≤ 0.05)

**Table 4**. Hypothesis testing results (Bootstraping@5000 subsamples)

| | β | t | p- values | Result |
|---|---|---|---|---|
| H1: Green talent management → Employees' green commitment | 0.634 | 9.970 | 0.000 | Accepted |
| H2: Employees' green commitment → Employees' pro-environmental behavior | 0.550 | 5.281 | 0.000 | Accepted |
| H3: Green talent management → Employees' pro-environmental behavior | 0.192 | 2.206 | 0.027 | Accepted |
| H4: Employees' pro-environmental behavior → Organization's green image | 0.490 | 5.932 | 0.000 | Accepted |
| H5: Green talent management →Organization's green image | 0.253 | 3.487 | 0.000 | Accepted |

### Mediation analysis

The mediation analysis for this study considered both direct and indirect effects (Zhao et al., 2010). Table 5 presents the direct and indirect effects, which indicate that all three mediation hypotheses are supported (H6, H7, H8).

**Table 5.** Mediation hypothesis

| Effect type | Relationships | Hypotheses | β | Confidence interval | SD | T statistics | P values | Result |
|---|---|---|---|---|---|---|---|---|
| Indirect effect | GTM → EGC → PEB | H6 | 0.349 | [0.189-0.519] | 0.086 | 4.077 | 0.000 | Accept |
| Direct effect | GTM → PEB | | 0.192 | [0.030-0.363] | 0.087 | 2.206 | 0.027 | |
| Indirect effect | GTM → PEB → OGI | H7 | 0.094 | [0.015-0.189] | 0.045 | 2.106 | 0.035 | Accept |
| Indirect effect | GTM → EGC → PEB → OGI | H8 | 0.171 | [0.073-0.303] | 0.060 | 2.860 | 0.004 | Accept |
| Direct effect | GTM → OGI | | 0.253 | [0.112-0.398] | 0.073 | 3.487 | 0.000 | |

*Note:* Abbreviations: SD – Standard Deviation, GTM - Green Talent Management, EGC - Employees' Green Commitment, PEB - Pro-Environmental Behavior, OGI - Organization's Green Image (Criteria: *p ≤ 0.05).

## DISCUSSION

The results indicate that employees' green commitment positively mediates the relationship between GTM and PEB, with both the indirect and direct effects being statistically significant. Besides, the PEB of employees also mediates the relationship between GTM and the OGI, with both the indirect and direct effects being positively and statistically significant. Finally, the sequential mediation provides support to our hypothesis that employees' green commitment and

PEB sequentially mediate the relationship between GTM and OGI. Both direct and indirect effects are positive, and evidence indicates that the type of mediation is complementary. Later, the R2 (coefficient of determination) levels were assessed. The $R^2$ value of 0.402 indicates that GTM accounts for 40.2% of the variance in employees' green commitment. Moreover, the $R^2$ value for PEB (0.473) indicates that the set of modeled antecedents (GTM and employees' green commitment) jointly explains 47.3% of the variance in employees' PEB. Similarly, the $R^2$ value for OGI (0.437) shows that its antecedent constructs collectively explain 43.7% of the variance in OGI. Consistent with PLS-SEM conventions, $R^2$ reflects the combined explanatory power of all predictors specified for an endogenous construct rather than the effect of any single path. In PLS-SEM practice, $R^2$ benchmarks are often ~0.75 (substantial), 0.50 (moderate), and 0.25 (weak). Hence, the reported endogenous $R^2$ values of 0.40-0.47 indicate moderate predictive accuracy, and we can presume that significant correlations exist between our endogenous constructions and the corresponding exogenous constructs.

The effect size ($f^2$) was used to evaluate the changes in $R^2$ values when the exogenous variable was omitted from the structural model. Four exogenous effect sizes on endogenous constructs were calculated based on the $f^2$ score interpretation of Cohen (1988), which is 0.35 as a large effect, 0.15 as a medium, 0.02 as a small, and <0.02 as a trivial effect. GTM had a large effect size (0.671) on employees' green commitment, while employees' green commitment had a medium effect (0.341) on PEB. Similarly, PEB had a medium effect (0.297) on the OGI. However, it was observed that GTM had a small effect (0.043) on the PEB of employees. Predictive relevance ($Q^2$) was assessed using the blindfolding procedure to analyze the predictive power over endogenous constructs (Geisser, 1974). All endogenous constructs had Q2 values above 0 (0.384, 0.271, 0.252), indicating the model's predictive relevance and validity.

Drawing on SET, SIP, and COR theories, this study clarifies the mechanisms by which GTM contributes to OGI. SET explains how employees interpret GTM practices as organizational investments and signals of environmental values. In response to these perceived organizational commitments, employees reciprocate by developing stronger green commitment, consistent with exchange-based obligations. However, SET alone is insufficient to explain how such commitment translates into sustained behavioral enactment. SIP theory explains how GTM practices function as salient environmental cues that signal organizational priorities and norms, shaping employees' perceptions about the organization's environmental orientation. COR theory complements this explanation by accounting for how green commitment functions as a valuable psychological resource that motivates employees to invest effort in PEB. From a COR perspective, employees engage in PEB to protect and leverage their environmental commitment, particularly when organizational practices support resource gain rather than depletion. By integrating SET, SIP, and COR sequentially, the study captures both the formation of green commitment and its translation into behavior and reputational outcomes, avoiding theoretical redundancy.

Consistent with this integrated framework, the findings of this research found that employees' perception of GTM positively influences their green commitment and PEB. The result aligns with the work of Ansari et al. (2021) and Pham et al. (2019), who found that an organization's green HR activities can facilitate employees' green commitment and PEB. Similarly, employees' green commitment shows a positive effect on PEB. Furthermore, employees' green commitment mediates the relationship between GTM and PEB. The results show that the organization's green initiatives motivate employees to engage in environmentally friendly practices at work. The findings of the study provide an important result: GTM positively influences employees' own green organization image and employees' green commitment, and PEB sequentially mediates this relationship, which was overlooked in past research and is an important contribution of the present study. The organization's claims of being pro-environment through GTM and its employees' green commitment build a positive image. It also helps to gain a competitive advantage. This study makes a novel contribution by identifying the PEB of employees as an antecedent to the OGI. The results indicate that employees' PEB directly affects their perception of the OGI. According to Ali et al. (2023), the PEB of employees affects the perception of clients about the OGI. The present study is important to take into consideration the employees' perceptions as well. These findings will provide useful insights for developing strategies and policies to nurture green talent within organizations.

Due to increasing public concern and awareness of environmental issues, organizations have recognized the importance of green talent for market competitiveness (Gardas et al., 2019; Odugbesan et al., 2022; Ogbeibu et al., 2022). GTM is a new trend that is more beneficial for organizations in terms of brand building to attract and retain people. Hence, organizations have begun to align their goals, aims, strategies, and tactics with the GTM function, as demonstrated in this study. The hotel sector plays a noteworthy role in adopting green practices and supporting eco-friendly initiatives. The study shows that the perceptions of the OGI reciprocate with the organizations, instilling green commitment and PEB among their employees. The present study identified a way for organizations to use GTM to stimulate employees' green commitment and PEB. Organizations can implement practices such as green training and rewards to strengthen

green commitment and foster PEB. Environmental concerns should be a part of the job description and design, and employees should be encouraged to implement green initiatives. Within organizations, there is a need to organize meetings, workshops, or seminars on green initiatives to promote a green image among employees. Furthermore, there should be frequent communication with employees about the organization's environmental initiatives. Moreover, although OGI is measured in this study as employees' internal perceptions, such internal image evaluations may influence how organizations are ultimately perceived by customers and other external stakeholders. As employees often act as organizational representatives in service encounters and external interactions, a positive internal OGI may plausibly strengthen external green image over time.

## CONCLUSION

This research underscores the essential role of GTM in advancing organizational sustainability. Initially, GTM elevates employees' commitment to environmental goals, promoting greater engagement in PEB. Subsequently, employees' PEB supports their dedication and improves the OGI. Additionally, employees' green commitment and PEB serve as sequential mechanisms that demonstrate how GTM enhances the organization's green reputation. These findings provide valuable theoretical insights into the connections between TM, employee behaviors, and organizational perception. In practice, companies can leverage GTM to cultivate a sustainability-focused culture, boost employee participation, and build a strong green identity among both internal teams and external stakeholders.

Although this study offers important insights for both theory and practice, several areas need further exploration. Initially, respondents were chosen using non-probability and convenience sampling methods. The data are self-reported, cross-sectional, and originate from a single source, with hotel representatives conducting the surveys internally. This setup increases the risk of social desirability bias and potential feedback loops between attitudes and reported behaviors. Future research could employ probability sampling to enhance generalizability. This study conceptualizes GTM from a soft talent management perspective, emphasizing development, empowerment, and support practices that promote employees' voluntary participation in environmental initiatives. As a result, lifecycle stages like green recruitment, selection, and performance evaluation were not included in the measurement model. While this approach aligns with the study's theoretical frame and operationalization, future research could incorporate broader, multidimensional GTM measures to explore how lifecycle-based talent management practices collectively influence pro-environmental behaviors and organizational green outcomes. Furthermore, this study investigates employees' perceptions of their organization's green image. Future studies can bring in the perception of the customers or other stakeholders as well to get a deeper understanding of the concept. They can conduct qualitative analysis with in-depth interviews or focus groups of customers and employees.

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## Appendix

## Questionnaire Items

**Employee's green commitment (EGC)** (Raineri & Paillé, 2016)
EGC1. I really care about the environmental concerns of my company.
EGC2. I would feel guilty about not supporting the environmental efforts of my company.
EGC3. The environmental concern of my company means a lot to me.
EGC4. I feel a sense of duty to support the environmental efforts of my company.
EGC5. I really feel as if my company's environmental problems are my own.
EGC6. I feel personally attached to the environmental concerns of my company.
EGC7. I feel an obligation to support the environmental efforts of my company.
EGC8. I strongly value the environmental efforts of my company.

**Pro-Environmental behavior of employees (PEB)** (Robertson & Julian Barling, 2013)
PEB1. I print double-sided whenever possible.
PEB2. I put compostable items in the compost bin.
PEB3. I put recyclable material (e.g., cans, paper, bottles, batteries) in the recycling bins.
PEB4. I bring reusable eating utensils to work (e.g., a travel coffee mug, water bottle, reusable containers, and reusable cutlery).
PEB5. I turn the lights off when not in use.
PEB6. I participate in environmentally friendly programs (e.g., bike/walk to work day, bring your local lunch day).
PEB7. I make suggestions about environmentally friendly practices to managers and/or environmental committees, in an effort to increase my organization's environmental performance.

**Green talent management (GTM)** (Ogbeibu et al., 2022)
GTM1. My organisation cares about my well-being and offers considerable support for my welfare when executing green-centered initiatives.
GTM2. My organisation offers green training, workshop opportunities, coaching, and courses that advance my knowledge of fostering environmental sustainability.
GTM3. My organisation offers me a considerable degree of autonomy when carrying out green-related tasks.
GTM4. My organisation offers me job rotation opportunities associated with environmental sustainability.
GTM5. My organisation is very supportive of green-related activities that can help me plan my future development.
GTM6. My organisation offers me challenging assignments that are grounded in environmental sustainability.
GTM7. In my organisation, green tasks are driven with several opportunities that allow me to express myself and share my opinions on green-related matters

**Organization's green image (OGI)** (Martínez, 2015)
OGI1. The organization is regarded as the point of reference for environmental commitments.
OGI2. The organization has a strong environmental reputation. (Removed)
OGI3. The organization is successful in its environmental protection.
OGI4. The organization is well-established in its environmental concerns.
OGI5. The organization is trustworthy about its environmental promises.

## Biographical notes

**Sonia Umair** is a dedicated academic and researcher with over a decade of expertise in management studies. She is currently serving as an Assistant Professor in the College of Commerce and Business Administration at Dhofar University, Oman. Her research and academic interests span human resource management, sustainability, business ethics, leadership, and organizational behavior. She has contributed extensively to reputable journals and conferences, offering valuable insights and advancing knowledge in her field.

**Umair Waqas** is a seasoned academic with over a decade of expertise in management sciences. He currently serves as an Assistant Professor in the College of Commerce and Business Administration at Dhofar University, Oman. Dr. Waqas's diverse research interests include supply chain management, sustainability, risk management, firm performance, leadership, and knowledge management. His work reflects a commitment to exploring innovative solutions and strategies that drive organizational excellence and sustainable development.

**Beata Mrugalska**, Ph.D., D.Sc., Eur. Erg. is an Associate Professor, Vice-Dean for Science, and head of the Division of Applied Ergonomics, Institute of Safety and Quality Engineering, Faculty of Management Engineering, Poznan University of Technology in Poland. She holds an M.Sc. (2001) in Management and Marketing from the Faculty of Mechanical Engineering and Management at the Poznan University of Technology, and a PhD (2009) in Machine Construction and Operation from the Faculty of Computer Science and Management at the Poznan University of Technology. She was awarded a D.Sc. (Dr. Habil.) degree in Mechanical Engineering from the Faculty of Mechanical Engineering of the Poznan University of Technology, Poland (2019). Since 2018, she has been a board member of the Center for Registration of European Ergonomists (CREE). She is also a board member of the Polish Academy of Arts and Sciences, Commission of Ergonomics, and a member of the Ergonomics Committee at the Polish Academy of Sciences, Branch Poznan. She has over 150 publications on human factors in modern organizational management. She serves on 8 editorial boards of international journals and as a Guest Editor for 5 special issues. Beata Mrugalska was honored with the Top Peer Reviewer by Publons for her contribution to the preparation of reviews of papers.

**Ilya Bystrov** is currently an associate professor in the Faculty of Business and Management at the American University of Phnom Penh, Cambodia. His academic experience exceeds 25 years, including 16 years of international experience, during which he regularly held leadership positions. In addition, his industry experience ranges from marketing-related positions at telecommunications and logistics companies to leadership roles at a consulting firm and entrepreneurial ventures. His research interests include sustainability and economic development, management, and higher education.

## Author contributions statement

**Sonia Umair:** Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Validation, Writing – Original Draft Preparation, Writing – Review & Editing. **Umair Waqas:** Investigation, Methodology, Software, Supervision, Validation, Visualization. **Beata Mrugalska:** Investigation, Methodology, Resources, Validation, Writing – Review & Editing, Funding Acquisition. **IIya Bystrov:** Formal Analysis, Project Administration.

## Conflicts of interest

The authors declare no conflicts of interest.

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