

Dynamic Relationships Management Journal

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Aims & Scope

The Dynamic Relationships Management Journal is an international, double blind peer-reviewed bi-annual publication of academics' and practitioners' research analyses and perspectives on relationships management and organizational themes and topics. The focus of the journal is on management, organization, corporate governance and neighboring areas (including, but not limited to, organizational behavior, human resource management, sociology, organizational psychology, industrial economics etc.). Within these fields, the topical focus of the journal is above all on the establishment, development, maintenance and improvement of dynamic relationships, connections, interactions, patterns of behavior, structures and networks in social entities like firms, non-profit institutions and public administration units within and beyond individual entity boundaries. Thus, the main emphasis is on formal and informal relationships, structures and processes within and across individual, group and organizational levels.

DRMJ articles test, extend, or build theory and contribute to management and organizational practice using a variety of empirical methods (e.g., quantitative, qualitative, field, laboratory, meta-analytic, and combination). Articles format should include, but are not restricted to, traditional academic research articles, case studies, literature reviews, methodological advances, approaches to teaching, learning and management development, and interviews with prominent executives and scholars.

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LEADERSHIP, FRIENDSHIP, AND COMMUNITY ACROSS BORDERS: IN MEMORY OF “THE MAD PROFESSOR”

Matej Černe
University of Ljubljana

... with contributions from colleagues across the globe

Writing this editorial for the *Dynamic Relationships Management Journal* is both a privilege and a deeply personal sorrow. As editor, I have often written about the importance of relationships in and around management, but rarely has that theme felt as real, as immediate, and as painful as it does now. Robert Buch belonged to that rare group of scholars whose academic work and human presence were never separate things. He studied leadership, exchange, structure, support, performance, and the subtle dynamics that shape organizational life, but he also lived those dynamics with unusual integrity. He was a remarkable management scholar, a generous colleague, a gifted teacher, and, to many of us, a dear friend.

It is fitting that we remember him in this journal, because Robert's work was deeply aligned with what DRMJ stands for. His research never reduced management to abstract technique or detached performance metrics. He was interested in the relational core of work: in how leaders affect followers, how organizational structures enable or constrain human flourishing, how support and exchange shape behavior, and how management is always, in the end, a matter of people. Already early in his career, Robert published important work on triangular employment relationships (Buch et al., 2010), and later he helped advance influential research on social and economic leader–member exchange (Kuvaas et al., 2012).

In the two DRMJ articles connected to him, that same scholarly signature is unmistakable. One article explores whether there can be an upside to leader narcissism, showing how political skill can transform traits often seen as destructive into outcomes that may actually benefit followers and organizations; the other examines how increased span

of supervision can undermine leadership style and, through that, weaken performance while increasing social loafing and turnover intention (Thompson et al., 2025a, 2025b). These are not marginal questions. They go to the heart of management theory and practice, and Robert addressed them with exactly the blend of conceptual sharpness, methodological care, and intellectual curiosity that made him such a distinctive scholar.

For me, though, and for many of us in Slovenia, Robert also represents something bigger than an individual academic career. He was part of the broader Norwegian–Slovene connection that mattered so much in the development of the Slovenian Academy of Management and this journal itself. Those ties with (in particular, but not exclusively) BI Norwegian Business School and later OsloMet were crucial in the earlier years of our international conferences and exchanges, and they mattered greatly when the journal was included in the Norwegian research database early on. But what made those ties meaningful was never only institutional strategy. It was people. It was the willingness to collaborate, to travel, to read each other's work, to show up at conferences, to build something together across borders. Robert embodied that kind of international academic community. He made collaboration feel natural, not transactional; personal, not merely professional. In that sense, he belonged not only to Norwegian academia, but also to the wider scholarly friendships that helped shape management scholarship in Slovenia. Specifically, he was also one of the most vocal supporters of the DRMJ, on scholarly gatherings as well as on social media. We will not forget this. He very recently also became an editorial member of the journal, which further boosted his active support of the outlet.

And friendship matters here. Robert and I were dear friends. Ours was not only the friendship of co-authors, conference conversations, and academic exchange, but of quick messages, jokes, and the kind of easy contact that says more than formal collegiality ever could. We were on Snapchat too, and I still smile painfully at the memory of our snow challenges, in which Slovenia, predictably, stood no chance against Norway. That was Robert too: serious without being solemn, accomplished without becoming distant, playful without losing depth. He made academic life feel larger, warmer, and more alive.

The first tribute, contributed by his former PhD supervisor, captures beautifully the combination of rigor, independence, and warmth that marked Robert from the very beginning of his career:

I first met Robert when he started as a PhD student at BI Norwegian Business School, where I became his supervisor together with Anders Dysvik. He was fantastic to work with, extremely willing and able to learn, curious, but reluctant to take advice until he saw its value. After a while, he also demonstrated his creative side, where the article on chess in this issue is an excellent example. My main aim as a PhD supervisor is to help young scholars develop into first authors who take primary responsibility for high-quality research, not necessarily to help them get published while they are still PhD students. With Robert, it was very easy, and he also published highly interesting and relevant work early in his PhD education as the first author (Buch et al., 2010).

I usually don't become a personal friend of my PhD students, but Robert was an exception because of his warmth, openness, and also because he matched my broad interests in societal issues, politics, sports, and music. Thus, after he defended his dissertation in 2012 and left BI, we kept on working together and socializing until he sadly left us on January 8th this year.

*My best memories of Robert are from when he and Anders visited me in La Jolla, San Diego, during my sabbatical in 2011-2012. At SIOP in San Diego in 2012, he presented our work on social and economic leader-member exchange (LMX), which was later published in *Leadership Quarterly* (Kuvaas et al., 2012). Without Robert's willingness and ability to learn how to deal with the endogeneity problem,*

which was new to all of us, the publication would not have been possible. At the SIOP conference, he was confronted by George B. Graen, one of the originators of LMX theory, who did not understand why we needed a two-dimensional approach. To my expectations and satisfaction, he diligently explained why we did.

— Bård Kuvaas

That recollection says so much: Robert's intelligence, his patience, his ability to grow quickly into scholarly independence, and his quiet confidence when it mattered. Even when a legend of the field addresses you with a “can't you read, boy?!”

But those of us who knew him know equally well that his brilliance was never detached from kindness. The following words capture that with beautifully:

Robert was a man who, in the words of Pink Floyd, truly “shone like the sun.” Despite his formidable academic presence, he navigated the world with a profound humility that is often absent in the halls of higher learning. He didn't just teach; he served, offering a level of unwavering helpfulness that made students and colleague feel seen and supported. Like the diamond, Robert possessed a brilliance that was both luminous and delicate. He was taken from us too soon, but the light he cast was undeniable. In his living years, he managed to leave a glow that will guide those he mentored. It feels surreal that he is gone. Robert's legacy isn't found in a list of publications alone, but in the gentle, humble way he lifted others up. He was a winner who refused to act like one, a scholar who preferred to be a friend, and a light that—though extinguished here—refuses to fade from our memory. Shine on, Robert.

— Anders Dysvik

That phrase, “a scholar who preferred to be a friend,” stays with me. It also resonates with the many voices that describe Robert not merely as impressive, but as safe, fun, open, and truly present. He is remembered both as the force of his achievement and the ease of his companionship:

I met Robert first when I was a PhD student and what an inspiration he was, both as a scholar and as a person. Being the youngest Professor in Norway says something about Robert's determination, competence, and creativity. Later, we collaborated on research projects and developed a friendship. As a researcher, Robert had many ideas and was extremely effective. He was also someone who was fun and safe to be around, as he was funny, spontaneous, and truly cared for the people around him. Thanks for everything, Robert!

— Bryndis Steindorsdottir

Robert had another specialty: the ability to make academic encounters immediately human.

I first met Robert in Oslo at EAWOP in 2015, at one of those classic conference dinners where you finally get to meet the person who has written all those papers you've been reading. We chatted about our shared research interests (especially contingent workers and knowledge sharing/hiding) and compared notes about which international snacks that we liked. I continued to follow his work with interest and was happy to see him again at other conferences. I assumed we would meet many more times and have many more conversations – he was smart and kind and had so many interesting ideas. He will be very missed.

— Catherine E. Connelly

That is exactly right. Robert was one of those people who could talk about serious scholarship and international snacks in the same conversation, and somehow both would matter. He made academia less performative and more real.

Many recollections return to the way he noticed people, encouraged them, and changed the trajectory of their careers not through grand gestures, but through steady belief and concrete support.

I feel incredibly lucky to have met Robert early in my academic career, when we were both PhD students. What I valued most about him was his down-to-earth nature. Despite being a brilliant researcher,

he never saw himself as better than others and was always generous with his time and knowledge. Robert believed in me at an important moment in my career. He actively supported my application to OsloMet and put in a good word for me, which helped me secure my first permanent position in academia. That support has stayed with me ever since. Robert will always be part of my career and my daily work: the nickname he gave me, which he proudly added to the name tag on my office door, is still there. It makes me smile every time I see it. Thank you, Robert, for the support, the laughter, and the joy you brought into our work.

— Dominique Kost

Robert was a scholar, but also a citizen of an academic community:

One thing I deeply admired about Robert was how the creativity he brought to his research was always grounded in a deep understanding of the methods needed to explore his ideas. Furthermore, he was selfless in how he shared his knowledge, seeking not his own gain, but the advancement of the research and community.

— Ide Katrine Birkeland

That is an especially important point in a tribute published in a management journal. Robert's contribution to management was not only the set of findings he produced, important though those were. It was also the standard he set for how scholarship should be done: imaginatively, rigorously, and in the service of something larger than one's own reputation.

I first met Robert when we were doctoral students together at BI Norwegian Business School, and for nearly 20 years he remained a close and valued colleague, also during periods when we worked at different institutions. We collaborated academically at several points over the years, and I had the opportunity to experience his curiosity, work ethic, and ability to see new connections at close hand. He was a researcher who generated ideas and drew others into collaborative projects. Robert was a col-

league who met others with warmth and respect. He had a particular ability to notice and encourage the people around him, and he was as supportive in difficult times as in good ones. Through his conduct, he demonstrated what inclusive and trust-based leadership can look like in practice. That he himself conducted research on leader–member relations made it clear that he also practiced much of what he studied. He will be greatly missed as a colleague, collaborator, and friend.

— Karoline M. Hofsllett Kopperud

Extending that same picture, his teaching can also be in focus:

Robert and I first began our academic journeys together as members of the same PhD cohort in Organizational Behavior and Leadership at BI Norwegian Business School. From those early days in Oslo, it was clear that Robert possessed a rare intellectual curiosity. Throughout our years as doctoral students, he was a constant source of insight, consistently sharing deep reflections and provocative new ideas that challenged our cohort to think more expansively about our field.

What defined Robert, however, was not just the brilliance of his mind, but the generosity of his spirit. He was remarkably selfless with his time, always ready to offer help or a constructive critique whenever it was needed. His diligence and sharp critical thinking served as a personal inspiration to me and many others, setting a high standard for what it means to engage in rigorous academic inquiry.

Robert’s commitment to the academy extended well beyond his research. He was a dedicated educator who truly “walked the talk.” He believed deeply in the principles of Self-Determination Theory, investing himself fully in fostering his students’ sense of mastery and autonomy. To Robert, teaching was not merely a duty but a vital expression of his scholarship.

He was a true scholar in every sense of the word—rigorous, compassionate, and deeply principled. He will be remembered not only for his contributions to the field of organizational behavior but for the integrity and kindness he brought to our community.

He will be greatly missed, but his influence remains with those of us fortunate enough to have known him as a colleague and a friend.

With respect,

— Sut I Wong

When so many people, across roles and institutions, describe the same pattern of rigor, kindness, wit, and generosity, we are no longer looking at isolated anecdotes. We are looking at character.

And still, if one only emphasized Robert’s kindness, one would miss his irreverence, his playfulness, and the way he resisted narrow boxes. This side is also vividly remembered by his dearest friends:

Robert was playful, sharp, and wonderfully impossible to fit into ordinary boxes. He hated narrow-mindedness and proudly called himself “The Mad Professor.” I’ll always remember the wild adventures we shared—our endless academic conversations, travels abroad, and hiking trips into the Norwegian wilderness. For me, Robert was a refuge: a rare kind of friendship where I felt completely accepted, and where life grew quiet and calm. I miss him more than I can say.

— Anders Gautvik-Minker

Robert could also profoundly shape other people’s lives:

Robert opened a door for me, professionally and personally, and then he kept opening doors. What began with a job interview became one of the most meaningful friendships of my life. We shared high highs and low lows, and we carried each other through more than I can really name here. Robert could be messy, funny, generous, and deeply encouraging, sometimes all at once, and he had a way of making life bigger for the people around him. He helped me make a life in Norway. I am rooted here now, and he is a big part of why. I just wish he still was a part of it. I am deeply thankful for Robert, and I miss him with my whole heart, with a force that still feels unreal. Goodbye, my friend.

— Jan Malte Runge

For me, Robert was not only a colleague, but also a close friend. His passing is still difficult to comprehend. Through our collaboration, I learned a great deal from Robert. He had a rare ability to combine sharp academic insight with creative curiosity, and working with him made me a better researcher. At the same time, he shared his knowledge and ideas with a generosity that made collaboration both natural and inspiring. Robert was ambitious on behalf of the research itself, but never in a way that placed himself at the center. He cared deeply about the ideas, the collaboration, and the people around him.

What I will remember most, however, is not only the academic discussions or the work on articles, but the moments around the work—the conversations at conferences, the laughter, and the boat trips where research and life flowed naturally into each other. Robert had a special ability to make such moments lively, meaningful, and memorable. He made academia a warmer and more human place to be. I will always be deeply grateful for everything I learned from him—and for the friendship we were fortunate to share. I often find myself thinking about what Robert would have said about a new idea or a piece of research we were working on.

Thank you for everything, Robert. Your friendship, generosity, and spirit will stay with us. We miss you deeply.

— Geir Thompson

That line about making life bigger for the people around him feels exactly right. It also explains why so many younger colleagues remember Robert not simply for advice, but for confidence, perspective, and emotional steadiness.

I got to know Robert Buch in 2024 when I joined Oslo Business School at OsloMet as an Associate Professor, just after completing my PhD. I had hoped imposter syndrome would fade with the new title, but it lingered. As my office neighbor, Robert quickly made me feel that I belonged. He treated my work as meaningful, reminded me that my role mattered, and invited me to the occasional ping-pong break when I needed perspective. He had a generous way of believing in my work, often more than I did my-

self, and made sure others saw it too. On the morning of the first lecture of my very own course, I arrived early, both excited and nervous. Robert was already there. He offered to show me the classroom, helped me set up, and asked to see my slides (which somehow he even found interesting). He was by definition a supportive leader. He will be deeply missed, and I hope to carry some of his spirit with me.

— Lewend Mayiwar

Robert and I first met a few weeks into my PhD. We were in the same research group and were to attend a meeting together. Before the meeting, a colleague told me that Robert would be there and described him as an immensely respected researcher. I was a bit intimidated, expecting someone who was strict and withdrawn. What I realized as soon as I met him was that he was completely the opposite - his warmth, humour, and intelligence shone through in every conversation. Soon after that, he surprised me on my first birthday in Norway, leaving a Banksy-inspired birthday card on my door. I immediately felt so welcomed and included that it lessened the sadness of being so far away from home. This is just one small example of his kindness and thoughtfulness, and there are many more. Whenever we worked together, he was always available with advice and support, for which I will always be deeply grateful. I admired how he was always so genuinely interested in research presented by others, asking thoughtful questions and readily offering encouragement.

I am so thankful to have met Robert. His dedication to research and his kindness toward those around him will always be remembered, and he will be deeply missed.

— Aleksandra Durovic

Robert was a fantastic researcher, colleague, and friend. When I started as a PhD student at OsloMet, Robert was one of the people who truly made my PhD life enjoyable. Despite, or maybe because of his early career success, he always had time to help, chat, and connect, regardless of a packed inbox. Most memorably, he always had time to drag you into a ping pong

game in the OsloMet basement, where the point was never about winning, but about connecting while having fun and learning something new — which is how Robert approached life, work, and research. When teaching together, he made every effort to transform dry material into something exciting, whether through a well-placed joke about a complex phenomenon or through creative use of new tools. Robert was generous with his energy and encouragement. I always had the sense that he was at least as happy for my successes as I was, if not more so. Thank you, Robert, for being a fantastic colleague and friend. You left us far too early, and you are deeply missed.

— August Nilsson

What emerges from all these voices is not a fragmented portrait, but a coherent one. Robert was brilliant, yes, but also warm. Productive, but never self-important. Methodologically serious, but creatively restless. Internationally respected, yet always available to the person next door. He helped build careers. He built friendships. He built confidence. He built bridges across institutions and countries. In management terms, one could say that he was an extraordinary relational resource. In human terms, one simply says: he was dear to us.

That is why his loss reaches so far. It is also why this editorial belongs in DRMJ, even above the fact that he was an author publishing in this outlet, its vocal supporter, and editorial board member. Robert's life reminds us that the study of management is ultimately impoverished if it loses sight of friendship, trust, care, collegiality, and community. He contributed to management scholarship not only by publishing excellent research, but by showing that the best academic communities are built through generosity, intellectual openness, and human decency. He showed that leadership is not only a construct to be measured, but a way of being with others. He showed that support can be rigorous, that kindness can coexist with high standards, and that genuine scholarship often grows best in climates of trust, humour, and mutual respect.

For those of us connected through Slovenia and Norway and beyond, through conferences and collaborations, through journals and institutions,

Robert's absence will be felt for a long time. But so will his presence. It remains in the articles he wrote, in the students and colleagues he encouraged, in the careers he helped shape, in the laughter he created, in the intellectual standards he embodied, and in the friendships he made possible. His family, too, naturally, above and beyond everything else. It remains in all those small moments that never enter a CV but define a life: an encouraging message, a birthday card, a hallway conversation, a shared meal at a conference, a ping-pong break, a joke before class, a snow challenge on Snapchat.

Robert Buch made academia better not only because he was a great scholar, but because he made it feel more like a community worth belonging to. That may be the deepest contribution of all.

Robert, thank you for your scholarship, your friendship, your generosity, your humour, and your light. We miss you deeply. We will remember you with admiration, gratitude, and affection.

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IN MEMORIAM

Robert Buch (1982-2026)

Robert Buch passed away suddenly on January 8, 2026, in his home just outside Oslo, Norway. He was 43 years old. Robert had been a professor of organizational psychology at Oslo Business School of Business, Oslo Metropolitan University, since 2017. Robert was originally trained as an electrician. But Robert had many talents and interests, and soon it was apparent that academic work was one of them. Robert obtained his bachelor's degree in psychology (2005) at the University of Oslo and his master's degree and doctorate (2012) at BI Norwegian Business School. After a couple of years as a researcher at the Norwegian School of Sport Sciences, he joined us at Oslo Business School in 2015. Robert was only 34 when he was appointed full professor.

Robert was very popular among the students both at bachelor's and master's level. He put all his effort into his lectures, and he distinguished himself as a committed and energetic lecturer and thesis advisor. Our students emphasized that as a teacher Robert stood out among his peers and it did not come as a surprise that students frequently nominated Robert for teacher of the year award at the university. For instance, during Robert's first year with us, the students wrote in the nomination letter that Robert was inspiring, engaging, skilled at listening to the students, and was a funny lecturer. The students also pointed out that Robert made sure that the students understood the material, for instance by using good examples and showing practical applications. Robert had a distinct style and was at the same time professional and dedicated to evidence base also in the lecture hall.

Robert also excelled as a researcher. Among his areas of expertise were leadership (particularly leader-member-exchange) and motivation. One important topic was the contrast between and consequences of intrinsic motivation (typically being motivated by the job itself) and extrinsic motivation (motivation through external rewards, such as bonuses). For instance, Robert's most cited article (Kuvaas et al., 2017) compares the effects of intrinsic and extrinsic motivation on key outcomes such as performance, commitment, turnover intention,

burnout, and work–family conflict. Recently he explored new topics such as the possible upside to leader narcissism, published in this journal (Thompson et al., 2025) and the downside of increasing span of control (Thompson, Buch & Thompson, 2025). Robert's publication list includes around 50 scientific articles, most of which were published in major international journals. In recent years he was the most cited researcher at the Business School. Robert enjoyed working with research partners in his wide network in Norway and internationally. In 2022, the research group in organizational psychology, headed by Robert, was rightly awarded the university R&D prize for research of high quality, international recognition, and practical relevance.

Robert was very ambitious and at the same time was inclusive and supportive of less merited colleagues. He was sociable, creative and liked to chat and have fun with his colleagues. Although he was well established as a full professor, he was curious and eagerly learned new academic topics and techniques, and he generously shared his enthusiasm for new ideas and methods.

We lost Robert far too soon. We are grateful for time we had with Robert and for his many valuable contributions to Oslo Business School.

Erik Døving

Ingvild S. Reymert

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WHEN FAST BECOMES RESTFUL: THE PROFESSOR'S PARADOX AND THE TIME-PRESSURE ADAPTATION MODEL

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Abstract

Occupational recovery theories traditionally emphasize psychological detachment and low-arousal states as necessary for restoring depleted resources. However, this framework fails to explain why certain high-tempo, cognitively demanding activities appear to facilitate recovery for skilled practitioners. Originating from an auto-ethnographic observation involving over 50,000 games of speed chess played during a period of high academic workload, this paper develops the Time-Pressure Adaptation Model (TPAM). We propose that brief, voluntary engagement in high-tempo activities forces a switch from deliberative (System 2) to automatic (System 1) processing, mechanically displacing rumination. Crucially, we theorize that expertise functions as a boundary condition: only when automaticity is high does time pressure reduce cognitive load; otherwise, it amplifies strain. We synthesize research on dual-process cognition, the “choking under pressure” phenomenon, and default mode network suppression to generate testable propositions regarding workload, rumination, and active recovery.

Keywords: Occupational recovery, expertise, cognitive load, rumination, time pressure, automaticity

1 INTRODUCTION: WHEN THINKING TOO MUCH STOPS WORKING

As organizational psychologists, we have long studied how people think and feel at work, how motivation, control, and social context influence behavior. Yet during our periods of intense workload, reflection itself began to fail. Calm was found, not in deliberate relaxation techniques or mindfulness, but in thirty-second games of online chess. To outsiders this may seem paradoxical. Standard occupational health theories posit a straightforward relationship between demands and resources: stress arises when demands exceed capacity (Lazarus & Folkman, 1984), and recovery requires the cessation of demands to allow systems to return

to baseline (Sonnentag & Fritz, 2007). Specifically, effective recovery is thought to require psychological detachment—a state in which the individual mentally disengages from work-related problems (Sonnett, 2018). However, a persistent anomaly exists within this framework. Knowledge workers frequently report restorative effects from high-intensity, cognitively demanding leisure activities, such as improvisational music, rapid-fire video games, or speed sports. If recovery requires resting depleted cognitive resources, why does adding further cognitive loads specifically under time pressure—often feel more restorative than passive rest?

This theoretical inquiry began with an auto-ethnographic observation. During a four-year period of escalating administrative and research workload,

the lead author engaged in high frequency “bullet” chess (games lasting under one minute). Conventional recovery theory predicts that adding time pressure and competitive evaluation to an exhausted mind should amplify strain. Yet, the lead author observed the opposite: brief, violent bursts of cognitive exertion successfully interrupted the ruminative cycles that passive rest failed to quell.

We argue this “Professor's Paradox” reveals a gap in current recovery models. While dominant frameworks focus on *what* resources are used (content), they often overlook *how* those resources are deployed (processing mode). Building on Dual-Process Theory (Kahneman, 2011) and the neuroscience of flow (Dietrich, 2004), we introduce the Time-Pressure Adaptation Model (TPAM).

TPAM posits that time pressure acts as a regulatory switch that forces cognition from high-cost deliberative processing (System 2) to low-cost automatic processing (System 1). Crucially, we identify domain expertise as the moderating variable that determines whether this switch is restorative or depleting.

2 THEORETICAL BACKGROUND

2.1 Thinking Fast, Failing Slow: Dual-Process Cognition under Pressure

Throughout the paper, three time-related constructs are separated. Time pressure refers to the objective time constraint per decision (e.g., seconds available to select a move), which directly limits reflective computation. Tempo refers to the overall speed of activity—decisions or action cycles per unit time—shaping the sustained demand to keep acting without extended evaluation. Bout duration refers to the total uninterrupted time spent in the episode (e.g., a 45-second game vs. a 20-minute session), which determines dosage and the likelihood of fatigue or carryover arousal. Two recovery constructs are also distinguished. Active recovery is defined here as a short, voluntary episode of high-absorption engagement that shifts processing away from evaluative self-monitoring and thereby reduces perseverative cognition; it is conceptualized as a mechanism (mode switching) that produces a state (reduced rumination / increased detachment) and an experience (renewed agency/competence).

Mode detachment refers specifically to disengagement from an evaluative, self-referential control mode (System 2 / DMN-dominant processing) into a task-coupled automatic mode (System 1 / task-positive coupling). Mode detachment is not relaxation, not avoidance of problems, and not mere distraction; it is a functional reallocation of cognitive control. Finally, expertise threshold denotes the minimum level of domain-specific automaticity required for time pressure to be performance-adaptive (rather than chaotic). Empirically, this can be operationalized using (a) validated skill indices (e.g., rating bands) and/or (b) behavioral markers of automaticity (e.g., stable accuracy under shortened decision times; reduced fixation dispersion; reduced response-time variability under constraint).

Dual-process theory (Kahneman, 2011; Stanovich, 2021) divides thinking into two interacting systems: System 1, which is fast, automatic, and experiential; and System 2, which is slow, deliberate, and reflective. While the distinction has intuitive appeal, it is better conceived as a continuum of cognitive control (Evans, 2019). Under ideal conditions, System 2 supervises and corrects System 1; under pressure, control shifts toward automaticity. Cognitive Load Theory (CLT) sharpens the mechanism behind this control shift by treating working memory as the binding constraint under time pressure. Intrinsic load (task complexity) remains largely fixed (e.g., chess rules or analytic reasoning demands), but expertise reduces experienced intrinsic load via chunking and schema automation. Extraneous load captures avoidable mental noise—self-monitoring, evaluative threat, and ruminative intrusions—that competes for limited capacity and amplifies stress. Germane load reflects deliberate investment in refining schemas (effortful System 2 engagement), which is valuable for learning but costly during constrained performance. Under time pressure, the effective capacity for germane processing collapses, so cognition defaults to automatized schemas when available; when schemas are weak, overload manifests as breakdown, impulsivity, or freezing. In TPAM terms, rumination can be conceptualized as chronic extraneous load that sustains System 2/DMN engagement after work, whereas brief high-tempo absorption can reduce extraneous load by suppressing evaluation and forcing procedural retrieval (Sweller, 1988; van Merriënboer & Sweller, 2005; de Jong, 2010).

The shift between two systems is not simply cognitive but physiological. Damasio (2021) argues that reasoning is inseparable from interoceptive “feeling signals” that guide decisions before reflection. Predictive-processing models (Körding, Bogacz, & Gershman, 2022) likewise portray cognition as probabilistic inference bounded by time and energy. We propose that adaptive cognition depends on rhythmic alternation between reflective and intuitive processing modes. When time is abundant, the brain can afford to compute error corrections; when time is scarce, it relies on prior experience. Thus, expertise—and not raw intelligence—often predicts success under time pressure (Gobet & Simon, 1996). Neuroimaging studies corroborate that time pressure changes neural control patterns. Deliberation recruits fronto-parietal executive networks, whereas intuitive execution engages sensorimotor and limbic systems (Pessoa, 2019; Miller, Freedman, & Wallis, 2018). Flow experiences, where action and awareness merge, coincide with transient hypofrontality—a temporary reduction in prefrontal activity enabling seamless perception–action coupling (Dietrich, 2004). During speed chess, experts show this shift explicitly: decreased dorsolateral prefrontal activation and increased occipito-temporal pattern recognition (Bilalić et al., 2019; Wan et al., 2020). Cognition simplifies itself in service of tempo. In this sense, time is not merely a boundary condition; it is a cognitive ecology. Gigerenzer and Gaissmaier (2011) describe heuristics as “fast and frugal” adaptations to environmental constraints. The temporal ecology of chess shows why: identical rules yield divergent cognitive strategies depending on the clock. For the expert, speed does not degrade thought but activates a different architecture optimized for rapid pattern recognition.

Psychometric evidence shows that general mental ability (GMA) correlates positively with chess skill (Burgoyne et al., 2016), but only in tasks that allow deliberation. In classical formats, fluid reasoning and working memory predict success (Grabner, Neubauer, & Stern, 2019). In blitz or bullet formats, those correlations collapse (Kim & Hambrick, 2023). This pattern supports Sternberg’s (2023) claim that intelligence is adaptive, not absolute: its utility depends on context. Ceci’s (1996) bioecological model explains why: cognitive poten-

tial manifests only when environmental demands align with the skill being measured. Under extreme pressure, deliberation is impossible, rendering analytical capacity irrelevant. Performance depends instead on pattern density, motor precision, and experience.

Ironically, those with the highest reflective capacity may suffer most under temporal constraint. Campitelli and colleagues (2025) found that individuals high in cognitive reflection performed worse under pressured move limits. The problem was overcontrol: reflection induced hesitation. Beilock and Gray (2012) call this “choking under pressure,” a breakdown of automatized skill due to explicit monitoring. In effect, intelligence can inhibit intuition when intuition is the only viable system. These findings mirror the first author’s experience. In academia, reflection is rewarded; hesitation is protection. But at the chessboard, the same habits cripple performance. The realization was humbling: the skills that make me effective as a scholar—deliberation, planning, evaluation—were precisely those that failed me under stress. If intelligence falters under time, expertise compensates. De Groot’s (1946/1978) classic protocols revealed that grandmasters differ not by calculating more deeply, but by recognizing meaningful configurations instantly. Gobet and Simon’s (1996) template theory and Logan’s (1988) instance theory describe how repeated exposure converts declarative knowledge into automatic retrieval. Grandmasters lose little accuracy when moving from classical to blitz formats, while intermediates deteriorate sharply (Van der Maas & Wagenmakers, 2005). Eye-tracking confirms that experts’ fixations are shorter and more selective (Bilalić et al., 2019). Neuroscientifically, skill consolidation reduces prefrontal load and strengthens sensorimotor coupling (Wan et al., 2020). Expertise, therefore, represents cognitive economy: accurate performance with minimal control cost. When stress or time removes deliberation, expertise preserves function.

TPAM complements but is distinct from adjacent frameworks. Unlike Job Demands-Resources (JD-R) theory (Bakker & Demerouti, 2007; Andolšek et al., 2026) and Conservation of Resources (COR) theory (Hobfoll, 1989), which emphasize resource depletion/accumulation broadly, TPAM specifies a

within-person control-allocation mechanism (deliberative ↔ automatic) through which time pressure changes both performance and recovery. Unlike Effort–Recovery (Meijman & Mulder, 2013) and stressor–detachment models (Sonnentag & Fritz, 2015), TPAM explains how detachment can occur without cognitive quiet by distinguishing content detachment from mode detachment. Unlike flow theory (Csikszentmihalyi et al., 2014), TPAM treats flow as an outcome profile of successful mode detachment (under sufficient expertise and volition), not the primary explanatory mechanism. Unlike SDT, TPAM does not center needs as the mechanism of switching; rather, need satisfaction/frustration shapes whether the switch is experienced as eustress (restorative) versus distress (depleting). Unlike challenge–hindrance models (Cavanaugh et al., 2000), TPAM does not classify demands by appraisal category; it predicts when the same demand (time pressure) reallocates cognitive control adaptively versus maladaptively as a function of expertise, evaluation salience, and dosage.

2.2 Stress, Rumination, and the Cognitive Costs of Never Letting Go

For years, we have taught our students that stress was a function of perceived demands exceeding resources. We still believe that—but what we underestimated was how stress continues long after work stops. During demanding semesters, the cognitive system had not disengaged from role expectations. In occupational health terms, this reflects continuing “off-job demands,” where relational obligation and evaluative threat persist after formal work hours (ten Brummelhuis & Bakker, 2012; Sonnentag & Fritz, 2015). Even leisure was occupied by work. What I experienced has a name in the recovery literature: work-related rumination (Cropley & Zijlstra, 2011). Rumination refers to repetitive, intrusive thoughts about work during off-job time that maintain sympathetic activation and prevent psychological detachment (Brosschot, Gerin, & Thayer, 2006). The process is now well-documented: workload predicts rumination through psychological need frustration—the thwarting of autonomy, competence, and relatedness needs (Deci & Ryan, 2000; ten Brummelhuis & Bakker, 2012). When demands

frustrate these needs, people mentally re-engage with work after hours, attempting to restore a sense of control (Sonnentag & Fritz, 2015).

A longitudinal cross-lagged study by Vahle-Hinz, Mauss-Stegmann, and colleagues (2022) in Motivation and Emotion confirmed this mechanism: higher workload predicted increased need frustration, which in turn predicted higher rumination and lower detachment over time. Importantly, the relationships were reciprocal—rumination also predicted subsequent need frustration, creating a self-perpetuating cycle. These spillover effects suggest that stress is not simply imported from work to home; it is reconstructed nightly through thought. Neuroscience provides a mechanism for this persistence. Meta-analyses of functional imaging studies (Hamilton et al., 2015; Nejad, Fossati, & Lemogne, 2013) reveal that rumination is associated with over-activation of the default mode network (DMN)—particularly the medial prefrontal cortex and posterior cingulate cortex—regions responsible for self-referential processing and mental time travel. The DMN is active when the mind wanders, inactive during focused attention. In chronic ruminators, the DMN fails to down-regulate, even during rest, linking sustained rumination with depressive symptomatology. For academics, this neural trap is familiar: even at rest, the mind is preparing, revising, anticipating. The problem is not mental work per se but its continuity. Recovery requires detachment, defined as psychological distance from work-related thoughts (Sonnentag & Fritz, 2015). Without detachment, physiological systems cannot return to baseline (Brosschot et al., 2006).

Self-determination theory (Deci & Ryan, 2000) frames stress not merely as overload but as need deprivation. When autonomy and competence are frustrated—through excessive control, unclear goals, or social disconnection—individuals experience diminished vitality. Empirical research consistently links need frustration to rumination (Van den Broeck et al., 2016; Vahle-Hinz et al., 2022). In the case of the first author, administrative reforms and endless emails represented not physical workload but loss of agency. The result was cognitive entrapment: long evenings of internal arguments and mental justifications. Ironically, even rest became instrumental—something to optimize—further erod-

ing autonomy. Only when playing hyper-bullet chess did autonomy and competence return simultaneously. That sense of mastery, however trivial, was restorative. It matched what self-determination theory would predict: brief re-satisfaction of frustrated needs (Ryan & Deci, 2017).

From a physiological perspective, rumination is not benign. Each episode reactivates the hypothalamic–pituitary–adrenal (HPA) axis, maintaining elevated cortisol and sympathetic arousal (Arnsten, 2009). Arnsten, Wang, and Paspalas (2023) show how chronic cortisol exposure weakens prefrontal dendritic integrity, reducing cognitive flexibility. Shields, Sazma, and Yonelinas (2017) found reliable stress-induced decrements in working memory and inhibition across more than a hundred experiments. The implications are cyclical: prefrontal impairment limits detachment, impaired detachment maintains cortisol, and the loop tightens. Experimental work supports this continuity. Brosschot et al. (2006) demonstrated that even anticipating stressors prolongs cardiovascular activation. Rodriguez-Stanley, Thayer, and Brosschot (2024) further showed that perseverative cognition, not event intensity, predicts heart-rate variability (HRV) reductions. Stress becomes a cognitive habit, independent of objective load.

2.3 Detachment and the Search for Effective Recovery

Despite vast interest in work stress, relatively few studies address what truly restores depleted resources. Sonnentag and Fritz (2015) proposed four recovery experiences: psychological detachment, relaxation, mastery, and control. Yet meta-analyses reveal that detachment—the absence of work thoughts—is the most potent predictor of next-day well-being (Wendsche & Lohmann-Haislah, 2017). However, complete detachment is often unrealistic for people whose identity is intertwined with work. For academics, the boundary between professional and personal cognition is porous. The question becomes: what kinds of mental engagement can mimic detachment’s restorative function without requiring disengagement from thought itself? This question aligns with recent calls in the work-recovery literature to identify break activities that genuinely replenish resources rather than merely

distract. Many leisure activities—scrolling through social media, for instance—occupy attention but do not reduce cognitive load or sympathetic arousal. Others, like moderate physical activity or creative hobbies, have shown stronger recovery effects because they induce *flow* (Csikszentmihalyi, 2014; Martarelli, Pacozzi, & Niedenthal, 2021). Flow experiences merge concentration and enjoyment, producing transient hypofrontality (Dietrich, 2004). When cognitive resources are low, flow offers recovery precisely because it replaces evaluative self-monitoring with automatic action. My hyper-bullet games produced that effect: full engagement without evaluation, deep focus without reflection. Post-game HRV measurements in controlled studies of speed-chess players (Fuentes-García et al., 2019) show a similar pattern—rapid sympathetic activation followed by accelerated parasympathetic rebound. Though preliminary, these findings suggest that brief, high-absorption activities can facilitate physiological resetting. In that sense, fast chess does not contradict stress theory - it completes it. The same time pressure that undermines deliberation may paradoxically restore balance when used intentionally. The crucial difference lies in volition. Voluntary exposure to controllable stressors can activate adaptive mechanisms without triggering need frustration (Keller et al., 2021).

2.4 Integrating Rumination, Flow, and Temporal Cognition

Taken together, these findings connect two previously separate literatures: the rumination–detachment cycle from occupational health and the flow–automaticity mechanisms from cognitive neuroscience. Both describe opposite poles of the same attentional spectrum. At one end lies perseverative cognition—involuntary, repetitive thought maintained by the DMN. At the other lies flow—voluntary, task-focused absorption characterized by DMN deactivation and sensorimotor engagement (Ulrich et al., 2016). The transition from rumination to flow, therefore, represents not escape from thought but reallocation of neural resources. It is the same shift observed between System 2 and System 1 during time-pressured performance. This alignment suggests a unifying model: time pressure, expertise, and

motivation determine which attentional network dominates; stress physiology modulates the cost and recovery of that engagement. In both work and play, the goal is not constant calm but flexible switching between cognitive modes. In TPAM terms, adaptive cognition entails meta-awareness of tempo. Under chronic workload, deliberate reasoning (System 2) saturates resources and fuels DMN-driven rumination. Intentional immersion in fast, automatic tasks (System 1) temporarily suppresses that network, allowing recovery. The art lies in timing: knowing when reflection helps and when it harms. The TPAM formalizes this timing problem as a general mechanism of cognitive regulation under stress.

3 THE INTEGRATED MODEL WITH PROPOSITIONS

TPAM proposes that time pressure functions as a cognitive regulator that reallocates control between two systems of goal pursuit: a reflective, deliberative mode (System 2) and an automatic, experience-based mode (System 1). As temporal demands intensify, individuals lose the ability to engage in extended, prefrontal, evaluative processing and increasingly rely on automatized, pattern-based responding. This shift is adaptive when sufficient expertise exists to support accurate rapid responding, and maladaptive when such expertise is absent. TPAM therefore integrates two pathways that are typically discussed separately: a strain pathway in which reflective control persists after work and sustains rumination, and an active-recovery pathway in which brief, voluntary, high-tempo engagement enables mode detachment and short windows of down-regulation (cf., Deci & Ryan, 2000; ten Brummelhuis & Bakker, 2012; Sonnentag & Fritz, 2015; Hamilton et al., 2015; Vahle-Hinz et al., 2022).

A core premise of the Time-Pressure Adaptation Model (TPAM) is that the effects of time pressure on strain and performance depend on the mode of cognitive processing required by the task. Whereas time pressure is commonly conceptualized as a demand that taxes executive resources, TPAM proposes that, under specific boundary conditions, extreme temporal constraints may instead function as a regulatory constraint that limits access to maladaptive forms of cognitive control. When task exe-

cution is highly proceduralized, time pressure can suppress reflective monitoring, rumination, and corrective overcontrol, thereby stabilizing performance rather than impairing it.

This mechanism can be described as executive quieting. In tasks characterized by extensive practice and high automaticity, effective performance relies primarily on pattern recognition and rapid action selection rather than deliberative reasoning. In such contexts, reduced executive involvement does not indicate impairment but rather prevents interference from explicit monitoring processes that are known to disrupt expert performance (Beilock & Carr, 2001; Beilock, 2010). TPAM therefore predicts that reductions in executive control—whether arising from situational constraints such as extreme time pressure or from general resource depletion—will not necessarily degrade performance when task demands are fully absorbed by automatic expertise. Instead, performance may remain stable or even improve when time pressure enforces reliance on procedural systems and eliminates opportunities for perseverative cognition.

Crucially, TPAM conceptualizes executive quieting as a nonlinear and conditional effect. The same reduction in executive control that stabilizes performance in highly proceduralized, high-tempo tasks is expected to become detrimental when task requirements shift toward planning, abstraction, error correction, or novel problem solving. Under such conditions, the suppression of controlled processing impairs adaptive regulation, leading to performance decrements and increased strain. Thus, executive quieting represents a boundary condition under which time pressure transitions from a source of cognitive load to a mechanism of active regulation. This distinction helps reconcile inconsistent findings in the time-pressure literature and clarifies why identical temporal constraints may be experienced as either depleting or restorative, depending on the alignment between task demands and expertise (Kahneman, 2011; Logan, 1988).

TPAM is a temporal process rather than a static claim. During demanding workdays, workload and relational demands increase perceived loss of control and elevate evaluative monitoring, frustrating autonomy and competence; this makes off-job cog-

dition more likely to re-engage with work and persist as perseverative thought (ten Brummelhuis & Bakker, 2012; Sonnentag & Fritz, 2015). As persevering cognition persists, physiological activation is prolonged, which further impairs reflective control and makes detachment harder to achieve, tightening the cycle (Brosschot et al., 2006; Arnsten, 2009; Shields et al., 2017; Arnsten et al., 2023). In occupational health terms, this is the core mechanism by which demanding days become cognitively “unclosed” evenings: need frustration predicts rumination, and rumination predicts reduced detachment over time (Vahle-Hinz et al., 2022).

Proposition 1. On days with higher workload/relational demand, individuals will report higher autonomy/competence frustration, which will predict higher evening work-related rumination and lower psychological detachment (within-person indirect effect), controlling for baseline trait rumination.

TPAM further argues that the same cognitive architecture that produces failure under pressure can also produce recovery when time pressure is introduced intentionally and under bounded conditions. Under chronic work demands, reflective control does not always serve the individual; it can sustain rumination, activate the default mode network (Hamilton et al., 2015), and prevent detachment (Sonnentag & Fritz, 2015). By contrast, a brief, voluntary, high-tempo episode introduces acute time pressure at the decision level and raises tempo, which functionally constrains extended evaluation and shifts processing toward procedural responding. When this shift occurs in a context experienced as chosen and absorbing, it can temporarily suspend evaluative self-monitoring, reduce perseverative cognition, and permit physiological down-regulation (Fuentes-García et al., 2019; Martarelli, Pacozzi, & Niedenthal, 2021). In this sense, TPAM links performance science and occupational recovery: fast, automatic engagement is not restorative because it is “easy,” but because it changes what cognition is doing—away from evaluation and toward action coupling.

Proposition 2. Engagement in a brief, voluntary, high-tempo, high-absorption episode will predict a post-episode reduction in state rumination (Δ rumination) and an increase in mode detachment (Δ mode detachment), which will mediate improve-

ments in recovery markers (e.g., higher post-episode HRV; steeper cortisol decline; higher next-hour vitality).

Crucially, TPAM treats expertise as the gatekeeper that determines whether time pressure produces smooth automaticity or chaotic loss of control. If automatic responding is accurate enough, the episode is experienced as competence and agency rather than threat, which accelerates mode detachment and strengthens the recovery pathway; if accuracy collapses, the same episode can amplify self-monitoring, frustration, and post-episode rumination (“I can’t even do my hobby right”), undermining recovery. This is why TPAM is not “time pressure is good,” but rather “time pressure reallocates control, and the consequences depend on readiness in the form of domain-specific automaticity.”

Proposition 3. The indirect effect in Proposition 2 will be moderated by domain expertise such that the mode-detachment and recovery benefits are positive when expertise exceeds an operational threshold (e.g., stable accuracy under constrained decision times) and null or negative when below threshold.

TPAM also specifies that active recovery is dosage-sensitive: tempo and bout duration jointly determine whether the episode ends with relief or with sustained arousal. Too little intensity may fail to disrupt ruminative evaluation; too much intensity or too long a bout may maintain sympathetic activation and carry arousal forward into the next hour (or into sleep), reducing net recovery. Thus, the model predicts nonlinearity rather than monotonic benefit.

Proposition 4. Tempo $\times$ bout duration will show an inverted-U association with recovery outcomes: moderate dosage will maximize post-episode detachment/HRV rebound, whereas high dosage will sustain arousal and reduce sleep quality/next-day energy.

In addition to dosage, TPAM identifies evaluation salience as a key failure point. If the episode is experienced as judged, identity-relevant, or socially comparative (ranked ladders, spectators, stakes), self-monitoring returns and extraneous cognitive load increases, reintroducing the very evaluative processing the episode is meant to interrupt (cf. the

role of self-monitoring and choking under pressure; Beilock & Gray, 2012). Under such conditions, time pressure is less likely to produce mode detachment and more likely to produce threat-driven reflection.

Proposition 5. External evaluation salience during the high-tempo episode (e.g., ranked stakes, audience, social comparison) will weaken or reverse the effects in Proposition 2 by increasing self-monitoring (extraneous load), thereby reducing mode detachment.

Finally, TPAM treats timing as a boundary condition because recovery is defined by its net downstream consequences, not only immediate relief. Episodes close to bedtime may feel subjectively detaching yet still impair sleep onset or sleep depth via residual arousal, offsetting short-term gains with next-day fatigue. The model therefore predicts that the same episode can be restorative earlier in the evening but neutral or harmful when it interferes with sleep, unless buffered by low evaluation salience and short bout duration.

Proposition 6. The net benefit of high-tempo episodes will depend on circadian timing: episodes closer to bedtime will show smaller net recovery gains due to sleep interference, unless buffered by short bout duration and low evaluation salience.

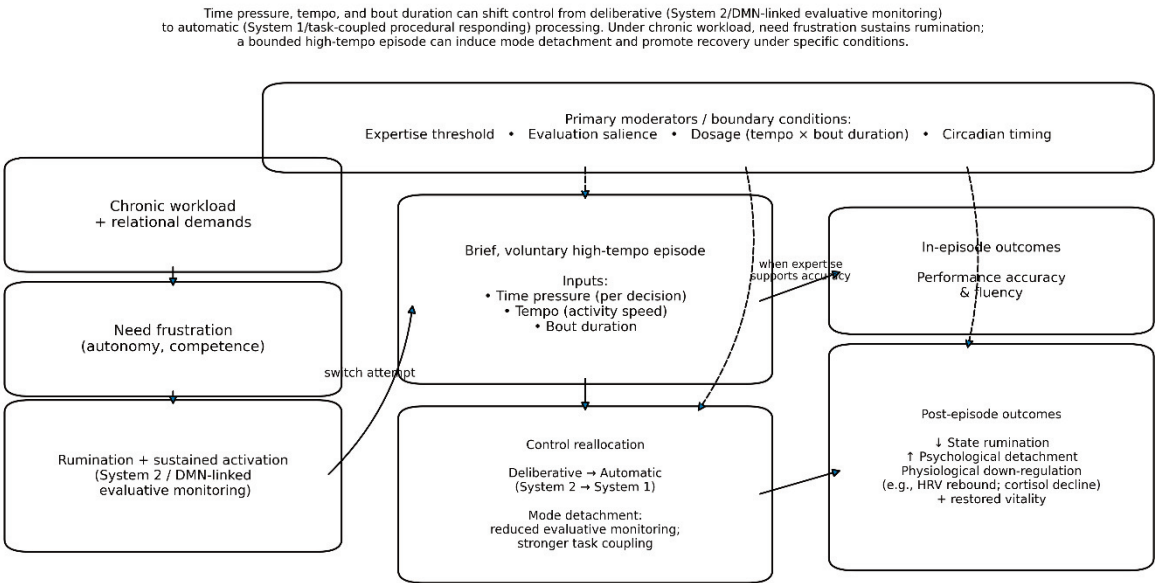
Time pressure (per decision), tempo, and bout duration shape reallocations of control between deliberative (System 2/DMN-linked evaluative monitoring) and automatic (System 1/task-coupled procedural responding) processing. Under chronic workload, need frustration increases rumination and sustained activation. A brief, voluntary high-tempo episode can induce mode detachment and promote recovery when expertise exceeds threshold and evaluation salience/dosage are bounded. Primary moderators (expertise, evaluation salience, circadian timing) and outcomes (performance accuracy; rumination/detachment; physiological down-regulation) are shown in Figure 1.

4 DISCUSSION

4.1 Relational Demands, Stress Thresholds, and Switching Costs

This paper challenges the assumption that “rest” implies “slow.” For the knowledge worker trapped in analyzing complex problems, “slow” often means “more time to think about work.” We argue that active recovery is a regulatory skill. Knowledge workers do not experience time pressure in isolation; they experience it within ongoing relational demand. TPAM implies that four interacting dimensions — time con-

Figure 1. Time-pressure adaptation model (TPAM)



trol, intelligence, expertise, and motivational-stress context — jointly determine which cognitive system is active at a given moment. In organizational terms, this means cognitive overload is not only about task complexity, but also about continuous social availability: being answerable to students, clients, colleagues, and superiors keeps reflective monitoring active and prevents full psychological detachment even after work hours.

The model also maps neatly onto the rumination–flow continuum: rumination reflects maladaptive, involuntary System 2 persistence; flow represents adaptive, voluntary System 1 immersion. Stress has long been viewed as an impediment to optimal functioning, but within TPAM it serves an adaptive purpose—it reallocates control. Under moderate stress, cortisol release suppresses prefrontal deliberation, thereby favoring faster, habitual responses (Arnsten, 2009). This shift can protect performance in high-tempo settings, provided the individual possesses sufficient expertise to rely on automatic schemas. Under chronic stress, however, this same mechanism becomes maladaptive. When the DMN remains hyperactive, rumination replaces reflection; energy once used for action sustains mental rehearsal (Hamilton et al., 2015). The individual remains cognitively “on,” even during rest. TPAM reframes this pattern through stress thresholds. Below a critical threshold, stress enhances intuitive performance (eustress). Beyond it, stress erodes flexibility, trapping cognition in the DMN’s self-referential loops (distress). Recovery occurs not when stress is absent, but when switching between systems becomes possible again.

TPAM also has boundary conditions. First, dosage may be non-linear: tempo $\times$ bout duration can follow an Inverted-U, where too little intensity fails to disrupt rumination, but too much intensity (or too long a bout) sustains arousal and delays recovery. Second, evaluation salience can backfire: if the high-tempo episode becomes identity-relevant or externally judged (ranked ladders, spectators, stakes), the activity may reintroduce extraneous load via self-monitoring and thus fail to produce mode detachment. Third, time-of-day constraints matter: late-night bouts may impair sleep onset via residual arousal, offsetting short-term relief with next-day fatigue. Fourth, insufficient expertise is a

primary failure point: when automaticity is below threshold, time pressure yields errors, threat, and increased rumination (“I can’t even do my hobby right”), undermining the recovery pathway.

4.2 Motivation, Mastery, and Recovery

Motivation dictates which system individuals choose to engage when both are available. Achievement motives favor analytic persistence; recovery motives favor spontaneous absorption (Ryan & Deci, 2017; Sonnentag & Fritz, 2015). When the first author played hyper-bullet chess as an evening ritual, it was not a strategic intervention—it was impulse. Yet retrospectively it fit all known predictors of effective recovery (Sonnentag & Fritz, 2015): clear boundaries, full absorption, intrinsic motivation, and sense of mastery. Each game was both trivial and total: high stakes in miniature. The limited duration prevented over-involvement, while the intensity induced flow. Empirical evidence (e.g. Vahle-Hinz et al., 2022) shows that autonomy frustration and competence frustration drive rumination. In this sense, bullet chess became a micro-intervention for need restoration—reinstating control (autonomy) and capability (competence) without external evaluation. TPAM predicts that any activity reproducing this structure—short, voluntary, skill-based, temporally bounded—will yield similar benefits.

TPAM extends the recovery framework (Sonnentag & Fritz, 2015) by specifying when and *how* automatic engagement facilitates replenishment. Traditional recovery theory emphasizes psychological detachment, yet complete detachment is infeasible for individuals whose professional identity depends on cognition. TPAM therefore distinguishes between content detachment (ceasing work thoughts) and mode detachment (shifting cognitive systems). A person may still “think” but in a fundamentally different way—pattern recognition instead of analysis, sensation instead of reflection. This distinction resolves a long-standing paradox in the literature: why some cognitively demanding hobbies (e.g., chess, music) restore energy while others drain it. It is not the cognitive content but the mode of engagement that matters. In neural terms, recovery corresponds to DMN down-regulation and task-positive network rebalancing (Ulrich et al., 2016).

Flow activities achieve this balance transiently, creating short windows of reduced self-referential processing that allow physiological systems to reset. The same mechanism likely underlies the benefits of brief, high-absorption leisure observed in experimental settings (Fuentes-García et al., 2019; Martarelli et al., 2021).

4.3 Practical and Research Implications

TPAM invites researchers to reconceptualize work recovery not as the absence of demand, but as adaptive alternation in cognitive tempo and control. This shifts the recovery conversation from “how do we eliminate stressors?” to “how do we regain flexibility in cognitive mode?”—a move that both corroborates and extends occupational recovery models linking workload, need frustration, rumination, and detachment (ten Brummelhuis & Bakker, 2012; Deci & Ryan, 2000; Brosschot et al., 2006). Where prior accounts typically treat detachment as the content outcome (less work-related thought), TPAM clarifies an additional mechanism: mode detachment, a functional reallocation away from evaluative, self-referential processing and toward task-coupled automaticity. This is why the model separates time pressure (per decision), tempo (sustained activity speed), and bout duration (dosage): recovery effects are not predicted by “activity intensity” in general, but by the specific temporal ecology that constrains evaluation and enables a switch in control architecture. By integrating CLT's distinction between intrinsic, extraneous, and germane load with dual-process cognition, TPAM further specifies how time pressure makes reflective control collapse and why experts can maintain function when novices overload: expertise reduces effective intrinsic load through schema automation, whereas rumination and self-monitoring operate as chronic extraneous load that sustains System 2/DMN engagement after work (Kahneman, 2011; Sweller, 1988; van Merriënboer & Sweller, 2005; de Jong, 2010; Hamilton et al., 2015). In doing so, TPAM aligns Kahneman's (2011) cognitive architecture with Deci and Ryan's (2000) motivational systems and Brosschot's (2006) physiological model of perseverative cognition, while also adding a temporal process account of when “thinking more” becomes maladaptive.

TPAM also contrasts with—and in some cases quietly debunks—assumptions that have become conventional across adjacent streams. First, it challenges the implicit idea that recovery is best supported by low-demand states (e.g., passive rest) by proposing that, for some forms of chronically evaluative work, System 2–dominant “calm” can paradoxically preserve rumination rather than interrupt it; recovery may require a bounded episode that suppresses evaluation by forcing procedural, automatic responding. This reframes flow not as the primary causal explanation, but as an outcome profile of successful mode detachment under volition and sufficient automaticity (Dietrich, 2004; Csikszentmihalyi, 2014; Martarelli, Pacozzi, & Niedenthal, 2021). Second, it complements broad resource theories (e.g., JD-R, COR) by adding a concrete within-person mechanism—control allocation between deliberative and automatic processing—through which time pressure can be simultaneously performance-adaptive for experts and recovery-supportive for ruminating knowledge workers. Third, it departs from challenge–hindrance logic by predicting that the *same* temporal demand (time pressure) can produce opposite outcomes depending on expertise threshold, evaluation salience, dosage (tempo $\times$ bout duration), and circadian timing—thereby formalizing failure points (e.g., overcontrol/choking; evaluation backfire; inverted-U dosage; bedtime interference) that make the theory more realistic and testable (Beilock & Gray, 2012; Fuentes-García et al., 2019; Sonnentag & Fritz, 2015).

Empirically, TPAM offers a tightly specified agenda. Cross-lagged diary designs can test the strain pathway by linking daily workload and need frustration to evening rumination and detachment (ten Brummelhuis & Bakker, 2012; Vahle-Hinz et al., 2022), while event-contingent sampling around brief high-tempo episodes can test the active-recovery pathway by estimating within-person changes in mode detachment and rumination as mediators. Objective markers such as HRV and cortisol decline can provide physiological validation of down-regulation beyond self-report (Brosschot et al., 2006; Fuentes-García et al., 2019; Arnsten, 2009; Shields et al., 2017). In organizational contexts, the practical implication is not that employees should “add more stimulation,” but that recovery interventions may

need to diversify beyond relaxation and mindfulness (both typically System 2–dominant) toward a menu that includes voluntary, time-bounded, expertise-matched micro-activities capable of interrupting evaluative self-monitoring. The central insight is that adaptation lies not in stability, but in flexible oscillation between thought modes—knowing when reflection helps, when it harms, and how temporal structure can be used to regain control. The implications for organizational behavior are significant. Wellness programs often prescribe mindfulness or relaxation, which require executive control that stressed employees may lack. TPAM suggests that organizations should support “active detachment” strategies—providing spaces or permission for brief, high-intensity engagement in activities where employees possess mastery.

However, the boundary conditions are strict. The activity must be **voluntary** (satisfying the need for autonomy; Deci & Ryan, 2000) and **non-evaluative** (free from external performance pressure). If a manager mandates speed chess, it becomes a task, not a recovery tool.

of psychological research, yet these domains have largely developed in isolation from one another. Cognitive psychology examines how dual processes operate under varying constraints; expertise research documents how proficiency develops across domains; occupational health psychology investigates stress, recovery, and well-being; stress physiology clarifies the neural mechanisms through which chronic stress impairs cognition. Despite their relevance to a common set of phenomena—how people perform and maintain well-being under time-pressured conditions—these literatures have not substantially integrated their findings into coherent theoretical frameworks. The “Professor’s Paradox” is resolved when we view the brain not as a muscle that simply needs rest, but as a dual-engine system. When the main engine (System 2) overheats, the solution is not always to idle the car, but to shift gears into the efficient, automatic hum of System 1. Time pressure, often the enemy of well-being, can be transformed into a tool for psychological liberation—provided one has the skill to keep up.

5 CONCLUSION

We began this exploration seeking to understand why fast chess soothed a mind that could not stop working. The study of human performance under time pressure cuts across multiple domains

EXTENDED SUMMARY/IZVLEČEK

Teorije okrevanja po delu tradicionalno poudarjajo psihološki odklop in stanja nizke vzbujenosti kot nujna za obnovo izčrpanih virov. Vendar ta okvir ne pojasni, zakaj nekatere hitre, kognitivno zahtevne aktivnosti očitno pospešujejo okrevanje pri usposobljenih izvajalcih. Ta članek, ki izhaja iz avtoetnografskega opazovanja več kot 50.000 partij hitrega šaha, odigranih v obdobju velike akademske obremenitve, razvija Model prilagoditve na časovni pritisk (TPAM). Predlagamo, da kratkotrajna, prostovoljna vključenost v hitre aktivnosti povzroči preklap z deliberativnega procesiranja (Sistem 2) na avtomatično procesiranje (Sistem 1), s čimer mehansko izrine ruminacijo. Ključno je, da teoretiziramo ekspertizo kot mejni pogoj: le kadar je avtomatiziranost visoka, časovni pritisk zmanjša kognitivno obremenitev; sicer obremenitev še poveča. S sintezo raziskav o dvoproceni kogniciji, pojavu »blokade pod pritiskom« in supresiji omrežja privzetega načina delovanja oblikujemo preverljive propozicije glede delovne obremenitve, ruminacije in aktivnega okrevanja.

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INTEGRATION OF PERSONAL COMPETENCIES OF MANAGERS IN THE BUSINESS OF ORGANIZATIONS: A CASE STUDY OF BUSINESS AND SUSTAINABILITY REPORTS OF SLOVENIAN ORGANIZATIONS

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Abstract

Sustainable awareness and increasing focus on this area has led many researchers to look for ways to best ensure that this mindset is transferred to all stakeholders within the organization. Leaders have the greatest role in this, so their personal competencies are also our main focus of the research. We discuss the recognition of personal competencies defined by other authors through sustainable leadership, the theory of sustainable leadership and competency models, and in the business and sustainability reports of large organizations in Slovenia, we look for the occurrence of recognized personal competencies – ethics, emotional intelligence and personal integrity. The theoretical framework of the research provides some important findings in the field of sustainable management, on the basis of which we carried out a qualitative and quantitative phase and thematically analyzed the business and sustainability reports of large companies in Slovenia and looked for the frequency of occurrence of individual personal competencies. The results provide leaders with insight into the awareness of the competencies that are exposed through the reporting of organizations and in a way set a mirror for them to improve in the field of achieving reporting practices. We found that the awareness of personal competencies is insufficiently shown through business and sustainability reports, which is not yet an indicator of what is the actual awareness of the importance of these competencies in the implementation of sustainable practices. Nevertheless, the research provides some original starting points for further researchers and the basis for conducting in-depth interviews among the heads of larger companies or quantitative research among management bodies.

Keywords: Leadership, Competencies, Sustainability, Sustainable Leadership, Emotional Intelligence, Ethics, Personal Integrity

1 INTRODUCTION

Focusing on climate and social change, which is increasingly affecting the business environment, is becoming a constant on the organization's agenda. Not only from the point of view of competitiveness,

but also in order to avoid possible volatile situations that arise as a result of climate change, social diversity and management challenges. We are talking about sustainability, i.e. a concept that defines the integration of care for the environment, air and water on the one hand and society and all its stake-

holders on the other (Luna-Nemecio, Tobón, & Gribran, 2020, p. 2) and through the management aspect dictates that organizations work towards a commitment to implement sustainable practices. Directing the organization towards restructuring and the search for organizational forms that shape the economic process in such a way that they contribute to social and ecological problems, changing and not depleting and destroying human and environmental resources is a problem that we will encounter more and more often in the study of contemporary paradigms. Understanding how organizations navigate all these aspects of management, however, is often placed on the shoulders of managers to decide whether to implement a sustainability policy and transfer it primarily to employees, later to all stakeholders in the interaction of their work, or whether their management practices will not go in the direction of integrating sustainability (Zacher, Kühner, Katz, & Rudolph, 2024, p. 383). In this context, the concept of “sustainable management” emerges, which can help to define sustainability leadership more precisely. Despite the growing visibility of sustainable management, it remains an open question to what extent organizations actually identify, develop and communicate these competencies in their strategic documents, especially in business and sustainability reports.

Tian and Wang (2023, p. 3) define sustainable leadership as leadership that supports sustainable practices at both the organizational and societal levels while meeting the still key goal of each organization, making a profit, and dictating a more sustainable approach to management, the long-term operation of organizations, and care for all stakeholders (Bencsik & Pangsy-Kania, 2023, p. 4). The literature specifies that sustainable leadership follows patterns of behavior that are believed to result in a different sustainability-oriented mindset (Zacher, Kühner, Katz, & Rudolph, 2024, p. 367), but it is about the ability of leaders to influence individuals and the organization in order to achieve a long-term vision of sustainability (Khan, Saqib, Abbasi, Mikhaylov, & Pinter, 2023, p. 2; Hu, et al., 2023, p. 3). Such thinking is also supported by Boeske (2023, p. 6), who says that sustainable leadership is about focusing on people, the environment and profit, and about the shared responsibility of different

stakeholders, shaped by the behavior, values, and moral and ethical commitment that defines the culture of the organization. However, Ryan and Cross (2024, p. 147) conclude that sustainable leaders have the power to transform an organization either positively or negatively, so it is important that they are aware of the competencies and behaviors they use in their work.

The need to evaluate the competency-based leadership approach of leaders is urgent and has a significant impact on the effectiveness of sustainable leadership. Olugboyega, Ejohwomu, Omopariola, and Omoregie (2024, p. 192) have built their theory on previous research that has examined leadership through the competencies of inspiring and motivating, integrity, and responsibility, which translates into personal growth. By upgrading this research, the correlation between managerial competencies and transformational leadership style was measured, while not neglecting the mechanisms that affect the formation of these competencies and are subject to constant change and development. And it is precisely this breadth that Olugboyega, Ejohwomu, Omopariola, and Omoregie (2024, p. 193) have shown through leadership orientation that means that leaders, due to their competencies, begin to prioritize those beliefs that have been created by their personality and are in line with their leadership orientation, which ultimately shapes the culture and direction of the organization and influences the behavior of all followers. Their research also proves the importance of competencies in the effectiveness of sustainable leadership, which attracted our attention even more for further research.

Most studies of sustainable leadership and related leadership competencies are mapped into competency models in order to find those that ensure the effective implementation of sustainable practices. Initially, the models were focused on expertise, but later evolved in the direction of personal motivation and networking (Wells, 2022, p. 24). Fry and Egel (2021, p. 3) have developed a global leadership model for sustainability based on aligning vision and values, empowering teams, and addressing economic, social, and environmental issues. Altman and Fry (2024, p. 12) emphasize that sustainable leadership is only effective in organiza-

tions where leaders are focused on developing their competencies and having a holistic understanding of sustainability practices. Competency models therefore recognize an environment that enhances self-development, strengths and important aspects of leadership, while the recognition of competencies through competency models also becomes crucial for the development of leaders and the framing of leadership potential.

Although many organizations publicly support sustainable values, it remains unclear whether and how they express awareness of the personal competencies required for sustainable leadership in their strategic documents (e.g. sustainability and business reports). Therefore, this research addresses the question of how these competencies – especially ethics, emotional intelligence and personal integrity – are presented in the discourses of organizations through business and sustainability reports. Such reports are a strategic communication tool through which organizations shape their identity, values and attitudes towards social and environmental issues. In the context of Slovenia, where organizations are increasingly committed to non-financial disclosure, such reports provide insight into how leaders express their sustainability through personal competencies such as ethics, emotional intelligence, and personal integrity.

2 THEORETICAL STARTING POINTS

2.1 The role of sustainable leaders through the sustainable management model

The concept of sustainability is becoming the focus of many debates around the world, while simultaneously opening up the gaps caused by the modern way of life of organizations due to rapid development, better living conditions, increased educational opportunities, limited natural resources, a warming atmosphere, water, air and soil pollution, and the unequal distribution of wealth (Afridi et al., 2023, p. 13; Fisher et al., 2023, p. 3), which represents an intensely researched topic in the recent period. Sustainability, which we are talking about through the aspect of organizations and its operation, comes from the definition of the Brundtland Commission in 1972 and is based on maintaining

and improving the ecological, social and economic position for human development and the development of organizations in general, which will be our starting point for further research. In short, definitions that look at the development of organizations through all three areas of sustainability (environmental, social and economic) and transferring this mindset to other stakeholders, which we want to examine from a leadership perspective, remains our central focus. (Mensah, 2019, str. 15)

This transfer of a sustainable mindset to other levels belongs to leaders and their function of working in the organization. The new field of sustainable leadership, which is developing in parallel with the development of sustainability in organizations, is considered in the literature as a confrontation with the challenges posed by sustainable development and falls under the modern management mindset (Ruwanika & Massyn, 2024, p. 5), and the organization must remain agile and responsive to change in the face of many challenges. The concept of sustainable leadership has been increasingly present in academic discourse in recent years, but it is not uniformly defined. Some authors understand it as integrating economic, environmental, and social goals into leadership practices (e.g., Tian & Wang, 2023), while others emphasize leaders' personal values such as integrity, emotional intelligence, and moral awareness (Armani, Petrini & Santos, 2020; Visser & Courtice, 2011). In short, competencies, which, according to Boyatzis' definition (1982, p. 12), represent certain qualities or abilities of a person with which he demonstrates success in his actions in the work environment, and later definitions of the term touch on the reflection of actions and attitudes that leaders show in the effectiveness of the performance of their tasks, but also include personal qualities and circumstances, actions, knowledge, skills, attitudes, values and beliefs, through which managers influence employees, consumers, suppliers, and other stakeholders in the process (Eberz et al. 2023; Papademetriou, Ragazou, Garefalakis, & Passas, 2023; Visser & Courtice, 2011). In this research, we follow an approach that emphasizes personal competencies as a key aspect of sustainable leadership, as we want to explore whether and how they appear in the communication documents of organisations.

2.2 Competencies of sustainable leaders through a competency model of leadership

The development of paradigms has changed or upgraded directions over time, and throughout the development of organizational theories, people and the dilemma of how to lead them have been important. Sustainability has further upgraded and targeted this mindset, primarily through the expansion of business models that require the integration of social interests and environmental awareness, and consequently this means the involvement of all stakeholders and their appropriate management. Although it is a matter of multifaceted and different definitions of concepts in the field of sustainable management and competences related to these concepts, which the authors highlight according to the area of interest, we will draw on some of those authors (García Martín, Duran-Heras, & Reina-Sánchez, 2023; Tian & Wang, 2023; Visser & Courtice, 2011), whose models emphasize the personality characteristics of leaders and represent the basis for the formation of a sustainable leadership style and the implementation of sustainability in the practice of organizations.

The literature emphasizes that leaders are key because they provide vision, set direction, and motivate followers to change and take different actions, ones that are more related to sustainable action, valuing economic, social, and environmental issues, and if we talk about a sustainable leader, Umair, Waqas, Mrugalska, and Al Shamsi (2023, p. 7) describe as such that leader who strives for sustainability. It is concerned with the conservation of resources and the prevention of environmental and social damage, while encouraging others to take actions that lead to sustainability. Similarly, Visser and Courtice (2011, p. 4) define a sustainable leader as a mix of leadership characteristics that encompass new ways of thinking and interacting that lead to innovative and more sustainable solutions combining multiple factors into a sustainable leadership model.

Sustainable leaders value human development and are aware of the importance of environmental impact, strengthen the internal resources of the organization, create value, are responsible for the development of the community, without neglecting the economic aspects of the organization's operations

(Armani, Petrini, & Santos, 2020, p. 821), and at the same time take on a key role of facilitator in the relationship between environmentally-oriented leadership, quality and performance of organizations (Mulyani & Basrowi, 2024, p. 473). Such leaders have a sustainable perspective, recognize the concerns that sustainability brings, promote green initiatives, and adopt sustainable management practices (Khan, Saqib, Abbasi, Mikhaylov, & Pinter, 2023, p. 2), i.e. they have certain competencies. We will use the term competency to define the key elements that characterize a sustainable leader, and in reviewing the literature, we came across a number of terms that can be equated with the one under consideration, such as characteristics, behaviors, skills, roles (Armani, Petrini, & Santos, 2020, p. 823). We were interested in how competences are defined in relation to sustainability, so in order to understand the essential areas of sustainable management, we examined some models that are the subject of research in the existing literature. In principle, the models are based on new sustainable leadership theories derived from moral values, conscious leadership, ethics and strengthening responsibility in order to contribute to the solution of social and environmental needs (García Martín, Duran-Heras, & Reina-Sánchez, 2023, p. 4) and represent a set of mechanisms that underpin the formation of a sustainable leadership style (Tian & Wang, 2023, p. 2).

For example, Papademetriou et al. (2023, p. 16) highlight those sustainable competencies that pursue experience, one's own beliefs, are learned and adaptable at the same time, but here we did not encounter a clear demarcation between personality competencies. On the other hand, Altman and Fry (2024, p. 8), based on a review of the existing literature, highlighted five competencies in their model that they categorized as strictly necessary and encompass organizational development and process competencies that represent collaboration with stakeholders. The competencies that they recognized as key to the development of a sustainable leader and appropriate cooperation are relationship empowerment, process change management, joint decision-making, conflict management, entrepreneurial approach, influencing and motivation. Again, it has not been studied whether these competencies stem from personality traits or whether

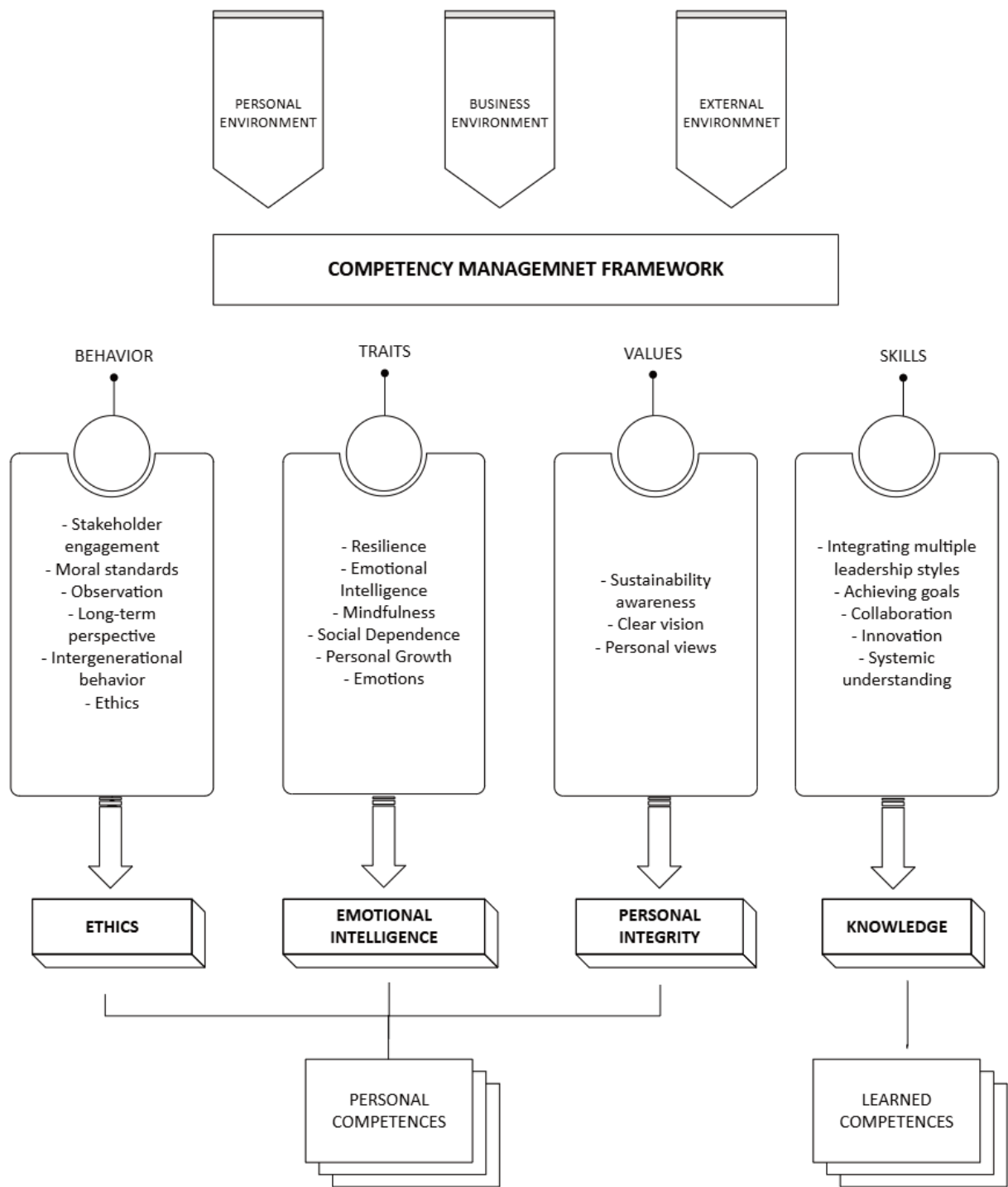
they may be general beliefs and following the vision of the organization. The research, conducted by Armani, Petrini and Santos (2020, pp. 827-830), aimed to understand the competencies that characterize the profile of a sustainable leader and reveals what is essential for leaders for whom sustainability is paramount. They highlighted the seven areas that were most often mentioned by the interviewees, namely leadership, skills, focus, orientation towards change, alignment with organizational culture, values and moral principles, and visionary through the realization of the vision, which only briefly touches on competencies as such. Eberz and his colleagues (2023, p. 4), on the other hand, examine the competencies that Wiek et al. have positioned as a model for the study of competencies for the development of academic programs and are considered as a fundamental work in the field of sustainability, as they are one of the more referenced studies (3134 citations, Google Scholar, August 12, 2024). Based on the interviews conducted, they tried to determine which competencies decision-makers need when dealing with sustainability challenges in their daily decisions. It's about systems thinking, which means being aware of global thinking, being able to focus on the organization's vision, developing transformation for sustainability, and being able to see challenges as an opportunity. All this is accompanied by the awareness that the need for interconnection, which must reach a heterogeneous circle of stakeholders, is adequate communication, cooperation and involvement of the wider community, while mutual cooperation and systemic thinking were most often highlighted in terms of the number of statements. The research is extensive and interesting, but personal competencies are touched on in passing, so for our research we focused on the model presented by Visser and Courtice (2011, p. 5) and refers to the context of leadership in which leaders operate, i.e. the external and internal environment of the organization, the personality characteristics of the leader and the actions of leaders that are manifested through decision-making, providing strategic direction, accountability, empowerment and inclusion. Each of the three areas represents one piece of the puzzle in the overall sustainable management model and allows for broad options in research. This breadth of the presented model was narrowed down through the research by focusing only on the person-

ality area of leaders, where Visser and Courtice's model highlights characteristics or competencies, leadership style, skills and knowledge.

In the model, the skills of leaders are directly intertwined with knowledge, as we are talking about solving complex issues, responding to risk, uncertainty, following a vision, making decisions, adopting innovations and long-term thinking, which is directly related to the knowledge of sustainable development, which leaders must constantly upgrade (Visser & Courtice, 2011, pp. 9-10). Numerous leadership competencies, as building blocks of the competency model, represent an important part of the sustainable development of leaders, and therefore represent an important step in the model of understanding this area. To highlight only those competencies that Visser and Courtice (2011, p. 8) devote the most attention to, these are moral or ethical leadership, interconnection and interdependence at all levels, openness to different opinions, a high level of emotional intelligence, reflexivity, creativity, optimism, inspiring relationships and vision. The basis of this model, with a focus on personal competencies highlighted by other authors, is the basis of our research. In order to synthesize the presented models and identify the most frequently mentioned personality competencies of a sustainable leader, we have designed the scheme below (Figure 1). The diagram shows which competencies appeared in different models, how they relate to the personality traits of leaders, and which were most often emphasized in the literature. Special emphasis is placed on those that occur multiple times and in different research environments.

As can be seen from Figure 1, there are some consistencies between the models, especially in competencies such as ethics, emotional intelligence, and integrity, which occur in different contexts and are often recognized as fundamental. It is also interesting that some competencies, e.g. systems thinking, visionary (Eberz, Lang, Breitenmoser, & Niebert, 2023) dominate in more strategically oriented models, while others, reflexivity, creativity (Visser and Courtice, 2011) come out from more personality-psychological approaches. These findings were the basis for the decision to focus on personality competencies in our research, as we are interested in how organizations present them in their communication documents.

Figure 1: Competence framework for sustainable management



In doing so, of course, we must take into account the environment, both business and external, as well as the personal environment of the leader, that is, his internal thinking and attitudes, which was also confirmed by Visser and Courtice (2011). Based

on this synthesis, the research focused on personal competencies, which are most often highlighted by various authors and which are recognized as a key factor in leading sustainable changes within the organization. Thus, ethics, emotional intelligence and

personal integrity formed the starting point for the design of the research goals and served as the basis for the formulation of research questions and the search for these competencies in the business and sustainability reports of large companies in the Republic of Slovenia. We were interested in whether and how these competencies appear in the business and sustainability reports of Slovenian organizations (RV1 and RV2) and whether there are differences between sectors in terms of their discursive presence (RV3). In doing so, the research directly contributes to the understanding of the extent to which organizations recognize and communicate the personality competencies of leaders as part of their sustainability narratives.

2.3 Research questions

The research questions arise from the aim of the research, which is to examine whether and how Slovenian organizations discursively present selected personal competencies of leaders – ethics, emotional intelligence and personal integrity – in their business and sustainability reports, and to what extent differences between sectors occur.

Research question (RQ1): How are the personality competencies of leaders (ethics, emotional intelligence, integrity) discursively presented in business and sustainability reports?

The aim is to analyse whether these competencies are presented as concrete actions, normative values or mere general statements.

Research question (RQ2): How often do business and sustainability reports of Slovenian organizations contain content related to ethics, emotional intelligence and personal integrity of managers?

The purpose is to identify the presence of these competencies quantitatively and qualitatively.

Research question (RQ3): Are there differences in the representation of personal competencies of sustainable leadership between organizations from the manufacturing and service sectors?

The research questions arose from research gaps that were identified during the literature review. The main purpose of the research was to determine how Slovenian organizations include the personal competencies of leaders in their business and sustainability reports, with a special emphasis on ethics, emotional intelligence and personal integrity.

3 RESEARCH METHODOLOGY

The paper is based on a qualitative research paradigm, using the approach of thematic analysis with elements of discourse analysis, supplemented by a descriptive presentation of the incidence of selected categories, and quantitative research of incidence was carried out below. Thematic analysis, as defined by Braun and Clarke (2006, p. 4) as a fundamental method for qualitative analysis, remains crucial, allows for the systematic identification and interpretation of patterns of meaning within qualitative data, and is particularly suitable for the analysis of discursive sources (Ussher & Perz, 2014), such as annual reports, sustainability reports, and other forms of organizational communication. In accordance with their guidelines and recommendations of Lamut and Macur (2012) on conducting thematic analysis and reporting, qualitative research is taken into account as closely as possible in the preparation of qualitative research.

Since the topic of research is constructed through a subjective view and social interactions, we strive to understand complexity and multi-layeredness. The choice of thematic analysis with elements of discourse is justified in the goal of the research, which is aimed at understanding the content, meanings and manner of talking about a particular phenomenon Braun and Clarke (2006, p. 5), while supplementing it with a descriptive presentation of the occurrence of selected categories contributes to greater transparency and provides insight into the distribution of certain topics or discourses within the analyzed corpus, without distracting attention from the qualitative nature of the research. Thematic discourse analysis, according to Braun and Clarke (2006, p. 10), defines patterns or topics within data in order to unify the mode of expression as constructive and social meanings, so the research took into account the analyticity of the

meaning of concepts from different perspectives. In the research, we use the concept of “discourse”, which Fairclough (2010, p. 56) understands as a structured way of speaking that shapes what can be said, thought and done about a particular phenomenon. Such an approach contributes to a richer understanding of the research problem and provides insight into both the frequency and qualitative nature of phenomena, which will further increase the contribution to science, as we expect to obtain data on how organizations talk about leadership, leaders and their competencies. Thematic analysis was used in order to identify topics that express discourses and representations of personal competencies of leaders as they appear in business reports. The representations that Hall (1997, p. 15) defines as the creation of meaning through language have been sought in leaders and treated as linguistically constructed images that include certain competencies such as emotional intelligence, ethics, integrity. These concepts serve as analytical tools for understanding how the personality competencies of leaders are formed through language practices in official documents.

The empirical environment of our research is Slovenia. By focusing on only one geopolitical environment, we tried to remove cross-border influences that could complicate the analysis and, due to the diversity of legislation, lead to inequality in the data collected. The analysis was based on a sample of 30 business and sustainability reports, which serve as communication and narrative sources for the analysis of leaders’ personality competencies, i.e. they represent the urns within which we analyze discourses. The number 30 was chosen because it allows for sufficient breadth and diversity of data, while remaining analytically manageable within time and research constraints. The sampling was not random, but targeted and based on purposeful sampling, which in qualitative research is more appropriate than random sampling, when we want to gain an in-depth understanding of specific phenomena in a particular context. The documents were publicly available on the websites of Slovenian organisations or through national databases (Ajpes)(Patton, 2002). The main objective was not statistical representativeness, but to provide a theoretically informed set of documents that allows for

an in-depth analysis of discourses on leadership competencies in the context of sustainable management. The reports were selected on the basis of substantive and contextual criteria that enabled the identification of relevant narratives and representations. Such an approach has enabled the creation of a meaningful analytical unit suitable for synthetic qualitative analysis, while maintaining contextual diversity within the Slovenian business environment. We also took into account that the reports were published in 2023 and belonged to large organizations under the Companies Act from two different sectors – manufacturing and services, as this represents the essence of the data to carry out a descriptive representation of incidence in Q3 response. A heterogeneous sample was consciously chosen, as the purpose of the research is to understand the different ways of expressing personality competencies in diverse organizational contexts, and not to test the hypothesis on a representative sample. Such an approach allows for greater transferability of findings to a similar social and organizational context, which is often the goal of qualitative research (Lincoln & Guba, 1985).

After a selection of documents and careful reading, we set up the coding scheme that is listed in Table 1. It is used to assign codes based on the initial understanding derived from the data in the integrated reports. All analysed reports were tagged with internal codes in order to maintain the anonymity of the organisations, while allowing the traceability of the origins of the citations used in the analysis. In the analysis of the reports, we considered that terms such as ethics, integrity, and emotional intelligence are discursive representations of personality competencies that occur in specific linguistic, stylistic, and symbolic contexts. We follow an understanding of representation as a practice of meaningfulness, where an organization does not merely “describe” but actively shapes meaning (Hall, 1997; Barthes, 1972). In addition, we analyzed the narrative structures by which companies shape narratives about their sustainable operations, leadership, and values in reports (Boje, 2001; Ricoeur, 1984). At the forefront of interest are those records that construct the identity of a sustainable leader and define the organization as a bearer of social responsibility. The data coding process was carried out

according to the recommendations of Braun & Clarke (2006) for the implementation of a thematic analysis, in which we used the examined broader assumptions of the three personality competencies of the leaders as a basis for what is actually presented in the reports.

We recorded prevalence at the level of each data source, by checking the number of times a particular topic appeared for each report. Thus, we were able to find out in what proportion of the analyzed reports the topic was present. The coding was carried out in the Atlas.ti program, which enables systematized and transparent management of qualitative data, especially when working with a large number of text documents, and through the review of records and keywords, we sought a connection between recognized personality competencies and publications that are directly related to managers. The analysis was performed using a combination of directional (deductive) and open (inductive) coding. In the first step, we designed an initial coding framework based on the literature, which was based on three selected personality competencies: ethics, emotional intelligence and personal integrity. In the reviewed reports, we then searched for phrases and terms that thematically fall into these three categories, taking into account semantic variants and synonyms. In emotional intelligence, we paid attention to terms such as the presence of emotions, empathy, soft skills, social identity, self-reflection, mindfulness, compassion. Expressions such as personal growth, self-worth, self-awareness, doing the right thing, compliance with actions, unity

of words and actions, focus on vision were associated with personal integrity.

In the following, we conducted a thematic analysis, in which we classified the designed codes into broader topics, combed through them, compared them and, if necessary, combined them. The thematic clusters developed iteratively, with each coding phase contributing to the refinement of the thematic framework, with reference to research questions all the time. The last step of the analysis included a quantitative calculation of the incidence of codes (frequency statistics), which determined the extent to which individual competencies are present in the reports. This combination of qualitative insight and quantitative support has enabled a rich interpretation of the data and the reliable formulation of research findings.

4 RESULTS

4.1 Discourses on personality competencies of ethics, emotional intelligence, and personal integrity in reports

The analysis of business and sustainability reports has shown that ethics in decision-making is one of the most common topics when it comes to the representation of personal competencies of leaders. In many documents, terms such as code of ethics, social responsibility, responsible conduct, compliance and corruption appear most often in connection with ethics: *“our leaders ensure strong corporate governance and set and implement goals and act as an ex-*

Table 1: Coding scheme

Thematic section	Assigned code	Code descriptor
Ethics	Personal liabilityHonestyCode of EthicsCare for rights	A textual description, image, or diagram that mentions ethics in direct relation to leadership or leaders
Emotional intelligence	EmpathyThe presence of emotionsSoft skillsSelf-reflectionHearings	A textual description, image, or diagram that mentions emotional intelligence in direct relation to leadership or leaders
Personal integrity	Personal growthSelf-valuesSelf-awarenessCompliance with actionsFocus on vision Leading by example Doing the right thing	A textual description, image, or diagram that mentions personal integrity in direct relation to leadership or leaders
Discourses of personal competencies of leaders	Ethics as ComplianceEmotional intelligence as a culturePersonal integrity leader as an example	A textual record that directly addresses any of the three personality competencies in relation to leaders

ample of value and good business ethics and integrity" (PP K2 23-13), which are often placed in the context of strategic decisions, attitudes towards stakeholders or sustainable management. These are terms that were directly related to employees or heads of organizations in the reports, especially most often the company's top management, and reflect a focus on ethics, compliance and responsible conduct, which is reflected in statements such as: "We emphasize leaders and leadership, we build on taking responsibility, working by example, inspiring change and mutual trust" (PP M2 23-20). Together, these concepts form a framework of values and practices that support organizations in their transition to sustainability and ethical performance, with leadership playing a key role in guiding employees and setting an example through their own actions. The vast majority of the organizations studied have an accepted code of ethics "we address the code of ethics *at the level of principle for the purpose of our engagement in our daily business...*" (PP K2 23-13), which speaks in general about justice and moral responsibility, especially of senior management, but much less about ethics as personal competence. Interestingly, ethics often appears in connection with transparency and social responsibility and compliance, which points to the so-called "external" dimensions of ethical leadership: "Our managers play a key role with regard to compliance. Given their position within the company, they bear a special responsibility to set an example for their staff" (TP H1 23-08). An important insight of the research is also the gap between the frequent citation of ethical principles and the rare presence of concrete descriptions of practices on how these standards are incorporated into decision-making processes. Only a handful of reports included cases where ethics would be described in relation to decision-making processes, for example by referring to indicators measuring compliance and fairness in relation to accountability.

The presence of emotional intelligence as a personality competence of leaders in the analyzed reports was noticeably much less explicit than ethics or integrity. Nevertheless, it has emerged several times through discourse on personal development, the presence of emotions and education: "As part of the project partnership, we have prepared a series of workshops for our leaders on empowerment,

stress management, emotional intelligence and leadership strengthening" (PP M2 23-20), which shows indirect references to its key components – empathy, personal skills of leaders, suitcases and emotional intelligence, which is our central concept studied. Emotional intelligence as a leadership competency was highlighted only in one organization, where they wrote: "We place great emphasis on the development of behavioral and emotional competencies of leaders to lead subordinates as much as possible..." (TP M 23-19). Keywords such as empathy, personal growth, education, and coaching emphasize organizations' focus on strengthening leadership skills and personal development. Particular emphasis is placed on skills that include such soft competencies as communication skills, emotional intelligence, and systems thinking, which organizations recognize as useful, but do not place them in the formulas among the key leadership competencies.

In the case of integrity, the word integrity itself was highlighted, along with the concepts of doing the right thing, leading by example, and the consistency of personal conduct. Integrity, both personal and corporate, is emphasized as a key element that combines honesty, transparency and consistency between values and actions: "Leaders at all decision-making levels are an example to other employees in concrete actions with their integrity, transparency, accountability and professionalism" (TP H2 23-09). Frequently used terms such as code, conduct, integrity, and compliance emphasize the importance of establishing clear rules and standards that guide the actions of organizations and their employees, which is reflected in records such as: "We emphasize leaders and leadership, we build on taking responsibility, working by example, inspiring change, and trusting each other" (TP Z23-30). In many cases, it has been possible to discern that organizations perceive integrity as a fundamental personality trait of leaders, but this trait is often presented as self-evident rather than explicitly defined. Integrity appears in discourse primarily in the context of trust, personal example, and the harmony between words and actions. A typical emphasis is placed on the fact that leaders embody the values of the organization through their actions and thus set standards for others. Statements such as "personal responsibility is the foundation of leadership" (PP A-23-02) or "integrity guides us in our

work; we say what we think and do what we say” (PP M2 23-20) emphasize the role of moral leaders, but without specifying how this is measured or developed. It is portrayed as a constant and unchanging trait, which may indicate an idealized notion of leaders that leaves no room for the real complexities and conflicts that leaders face.

According to the research question (RQ1), most of the references to the mentioned competencies were of a principled and normative nature, which means that they are often presented as values that the organization supports or promotes, rather than as concrete competencies that would be systematically developed, verified or reflected. Ethics is often associated with organizational responsibility and a code of ethics, while personal integrity is portrayed as an individual trait that acts as a moral compass, but rarely as part of the planned development of managerial personnel. Emotional intelligence, on the other hand, appears discursively as a soft skill that improves the work climate and is often the subject of education, but rarely as a formal criterion of leadership. In this sense, we can speak of the predominance of a discourse that emphasizes values rather than behavioral indicators of these competencies.

4.2 Prevalence of the occurrence of the personality competencies studied

In the following, we present a quantitative distribution of the occurrence of selected personal competencies – ethics, emotional intelligence and personal integrity – in the analyzed business and sus-

tainability reports of Slovenian organizations. Table 2 shows the frequency distribution by individual reports according to the number of detections of those terms. For each of the three selected personality competencies, ethics, emotional intelligence and personal integrity, we recorded the number of occurrences in individual documents. Frequencies are displayed to indicate the proportion of reports in which a particular competency occurs 0 times, 1 time, 2 times, etc. In this way, we get an overview of the prevalence and intensity of the occurrence of these competencies in the analyzed material.

We can see that the concept of ethics did not appear even once in thirteen documents, which represents 43.3% of all analyzed reports. Only once was the concept of ethics mentioned in six documents, which is 20% of all reports, and twice was ethics mentioned in ten documents. In total, the concept of ethics appears in seventeen reports, which represents 56.7% of all analyzed reports, on the basis of which we can conclude that organizations focus on ethics in relation to leadership in the preparation of reports, which indicates a good beginning of knowledge of the importance and awareness of this competence among the leaders of their organizations. However, we cannot ignore the fact that ethics in reports is often conceived as a normative expectation, but not necessarily as an operational leadership competence. Therefore, we can conclude that the presence of ethics in discourse is strong, but at the same time often limited to the level of symbolic expression, rather than concrete leadership.

Table 2: Prevalence of personality competences

Variable	Ethics		Emotional intelligence		Personal integrity	
	Frequency	%	Frequency	%	Frequency	%
0	13	43,3	17	56,7	14	46,7
1	6	20	7	23,3	7	23,3
2	10	33,3	4	13,3	5	16,7
3			3	6,7	3	10
4					1	3,3
more than 4	1	3,33				

Looking at the frequency of occurrence of emotional intelligence in the analyzed reports, we can conclude what attention is paid to this concept through the design of the reports. More than half of all reports (56.7%) did not contain the term emotional intelligence or related terms from our codes. The range of conceptions in the sequel follows from a single mention to a maximum of three. There are seven such organizations where they have a low perception of emotional intelligence (23.3%), in four organizations (13.3%) the term occurs twice, and in only three organizations the incidence is three.

Let us also look at the prevalence of the concept of integrity in the reports under consideration. In fourteen documents, the term was not detected, which means that almost half of the reports do not contain a reference to integrity. Integrity was mentioned only once in seven organizations, which amounts to 23.3%, two mentions of integrity were detected in five documents, three were mentioned three times, and only one was mentioned four times. even though it is considered a key ingredient in leadership by many authors (Javed, Niazi, Hoshino, Hassan, & Hussain, 2021; Mohi Ud Din & Zhang, 2023). Similar to ethics, the incidence of the term is in a similar proportion to non-occurrence, but it still exceeds just over half of the reports analyzed, indicating a low level of awareness among organizations about achieving personal integrity among their executives.

In conjunction with the second research question (RQ2), it turned out that ethics is the most frequently mentioned competence, which is prominently present in almost all reports, often in connection with the

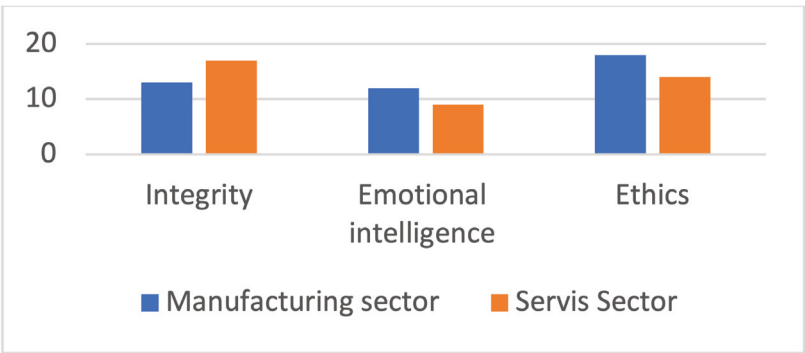
code of ethics, accountability and compliance. Integrity occurs somewhat less frequently, but it is often presented as a fundamental personality attribute of leaders. Emotional intelligence is the least explicit, but it is often reflected indirectly – through discourses about cooperation, education, and relationships.

4.3 Integrating personal competencies into business and sustainability reports across sectors

In the context of the third research question (RQ3), it was shown that there are some patterns of differentiation between sectors.

As can be seen from Figure 2, the manufacturing sector is much more inclusive of ethics and emotional intelligence in its reports, potentially suggesting a greater focus on the personal component of leadership, while the service sector places more emphasis on integrity, which is key to maintaining customer trust. While organizations in the service sector mention emotional and interpersonal competencies, especially in relation to culture, employees and stakeholder satisfaction, companies in the manufacturing sector are more focused on ethics in the context of legality, compliance and social responsibility. Integrity occurs similarly frequently in both sectors, but in the service sector it is somewhat more related to employee trust, while the manufacturing sector often places it in the context of long-term and stability. The analysis shows that the two sectors differ in the way of discursive representation of competences – reflecting different functional logics and expectations of stakeholders within each sector.

Figure 2: Prevalence of personal competencies by sector of activity



5 DISCUSSION

The categories of normative, latent, and idealizing discourse were formulated based on a combination of literature (Fairclough, 2010) and inductive insight from reflective thematic analysis. Each of these discursive strategies represents the way organizations shape the meaning of personality competencies. The results of qualitative and quantitative research confirm that although the personality competencies of managers are present in the reports, they are rarely considered by organizations as an integrated part of the systematic profile of leaders. Instead, they are more often used as value markers of organizational identity, which opens up space for further exploration of the differences between declarative discourse and actual managerial practice.

Within the framework of reflective thematic analysis, characteristic discursive strategies were identified by which organizations represent the personality competencies of leaders. The findings reveal that the way we talk about ethics, emotional intelligence, and personal integrity is not neutral, but is often related to organizational norms, values, and stakeholder expectations. Discourses shape the image of the leader and reflect the prevailing organizational interpretations of responsibility, trust, and competence.

In most reports, ethics appears within the framework of a normative or legally binding discourse, where the emphasis is on compliance with legislation, internal rules and codes of conduct: *“Our managers comply with all ethical standards of business as set out in internal and external regulations”* (PP AM 23-01). Such use points to a minimalist ethical framework, where ethics is understood as a means of risk man-

agement rather than as a reflected value or personal attribute of leaders. Less often, ethics is portrayed as part of an individual leader’s internal moral judgment, but as a mechanism for ensuring legitimacy and trust in the eyes of the public and stakeholders. This is consistent with the findings of other authors, who point out that ethics in organizational communication is often exposed through moral considerations and reflects organizational culture in general (Sebastian & Huhn, 2024, p. 5), environmental and intergenerational justice by supporting sustainable development (Sajjad, Eweje, & Raziq, 2024, p. 2856).

Emotional intelligence is less often explicitly named, but it emerges through latent discourse. The emphasis is on encouraging cooperation, personal development and advocating for an inclusive culture: *“Leaders create an environment where open communication, empathy and cooperation are key values”* (TP P1 23-23), which is most often manifested through the education plan as a possible promotion and measurement of the personal competencies of leaders. It is a softer, emotionally tinged language that is not focused on formal rules, but on atmosphere and relationships. However, due to the absence of an explicit designation, emotional intelligence often remains an invisible competence placed behind organizational values. This contrasts with the awareness of emotional intelligence of leaders that other researchers have highlighted, as they believe that leaders who have developed this competence have a positive impact on their followers (Hu, et al., 2023, p. 5; Drigas, Papoutsi, & Skianis, 2023, p. 2), therefore, this competence becomes essential for predicting leadership effectiveness (Olugboyega, Ejohwomu, Omopariola, & Omoregie, 2024, p. 192).

Table 3: Discursive features

Theme	Discursive features	Discourse through reports
Ethics	Normative discourse	Ethics is presented as something that “must” – social and personal responsibility, code of ethics, compliance and honesty are often mentioned.
Emotional intelligence	Latent discourse	It is seldom spoken of directly; It is present through terms such as “education”, “promotion of cooperation”, “personal development”, “presence of emotions in leadership”
Personal integrity	Idealizing discourse	Leaders are required to be personally responsible, consistent in words and actions, and lead by example.

Personal integrity emerges as a value marker that is most often associated with the leader's role as a moral role model. The discourse is dominated by an idealized representation, which often lacks concrete operational evidence or examples: *"Trust in leadership is based on personal integrity, which leaders exercise on a daily basis in all processes"* (TP N 23-21). Such use of integrity creates a symbolic image of the leader as an irreproachable individual. What is lacking, however, is a critical discussion of challenges or dilemmas, which may point to a moralizing discourse in which integrity is used as doing the right thing, taking care of compliance, and responsibilities, rather than necessarily as a practical guideline. Also worrying is the fact that the absence of personal integrity can lead to a negative connotation of leadership, difficulty in assessing the situations in which they find themselves and in encountering obstacles (Olugboyega, Ejohwomu, Omopariola, & Omoregie, 2024, p. 203), and leadership without integrity can mean causing harm to organizations in the design of the work environment (Javed, Niazi, Hoshino, Hassan, & Hussain, 2021, p. 2).

The results of the quantitative analysis reveal significant differences in the frequency of mentioning the selected personality competencies of managers. Despite the fact that key competencies such as emotional intelligence, integrity, and ethics are clearly highlighted in the literature (Advani & Mergenthaler, 2024; Altman & Fry, 2024; Armani, Petrini, & Santos, 2020; Eberz, Lang, Breitenmoser, & Niebert, 2023; Javed, Niazi, Hoshino, Hassan, & Hussain, 2021; Sajjad, Eweje, & Raziq, 2024), the results of the analysis show that these competencies are not so prominently represented in the reports of Slovenian organizations. Ethics is the most common, indicating that organizations still understand this area as a key component of social responsibility and compliance with standards. However, high frequency does not necessarily imply substantive depth – the discourse on ethics is often normative and focused on meeting regulatory requirements. By contrast, emotional intelligence is significantly less explicitly mentioned, for example, more than half of the reports (56.7%) contain no mention of this competence. The same is true of integrity, where mention occurs only in fragmentary form and often only in connection with the consistency of

personal conduct and leading by example. In terms of ethics, the situation is slightly better, we can see more connections of this concept with leaders, but probably at the expense of the code of ethics.

Although personal competencies play an important role in shaping sustainable leadership (Altman & Fry, 2024; Armani, Petrini, & Santos, 2020; Eberz, Lang, Breitenmoser, & Niebert, 2023; Sajjad, Eweje, & Raziq, 2024), the results of this survey show that organizations mostly treat them normatively or symbolically in their reports. This highlights the need for further research to examine how personality competencies are developed, operationalized, and reflected in actual leadership practice – not just in the discursive construction of reports. Frequency analysis has shown that the term ethics appears more frequently than emotional intelligence and personal integrity, reflecting the more established status of ethics in the context of corporate social responsibility and compliance (Armani, Petrini, & Santos, 2020). This is also confirmed by the implementation of a thematic analysis, which reveals that ethical references are often limited to a formalistic discourse, which manifests itself through a code of conduct without an in-depth reflection on the competences of managers. The notion of personal integrity, however, is more recognized as a more important trait of leaders (Javed, Niazi, Hoshino, Hassan, & Hussain, 2021, p. 2; Mohi Ud Din & Zhang, 2023, p. 2), but it appears mostly in symbolic or idealized form in the analyzed reports. In most cases, it is associated with the trust, reputation, or example of leaders, without specifying how integrity is reflected in day-to-day decision-making. Emotional intelligence is often implicitly present, but rarely explicitly named. References to empathy, personal development, the presence of emotion, i.e., soft leadership skills, indicate the presence of emotional intelligence as defined by Hu, et al. (2023, p. 3), but without a clear naming.

There are also differences between the manufacturing and service sectors, which dictate the possible development and integration of competences according to specific needs, tasks and challenges. Taken together, the results show a gap between the highlighted importance of these competencies in theory and their real occurrence in reporting practice. Although organizations may operate in accor-

dance with some values, this is not consistently articulated or reflected in their reports, which can reduce transparency, stakeholder trust and, ultimately, the implementation of sustainable practices in the organization. As Molek and Čop (2025) point out, when analysing the transition to a sustainable economy, we must not neglect the individuality or pragmatism of meanings that are formed within broader symbolic and structural frameworks, as it is not an isolated and merely discursive process, but develops through multiple interactions. In addition, various analytical models are formed that address and explore these interactions through the daily appropriation of new practices and, on the other hand, within broader structural frameworks that determine what is possible and legitimate in a particular socio-economic and political context. This dialectic of honey means the conceptualization of habitus, where cultural norms are not only reproduced, but also redefined through practice.

With such a conclusion, therefore, we should not focus solely on personality competencies (Eberz, Lang, Breitenmoser, & Niebert, 2023, p. 13; Armani, Petrini, & Santos, 2020, p. 829), but it is necessary to functionally integrate all the competencies dictated by a sustainable leadership style in order to meet the challenges of sustainability. However, we must take into account that competencies also differ in terms of factors that affect them, such as the manager's field of activity, industry activity, geographical and cultural diversity, and probably many other influences that should not be ignored, so our findings open up space for further research.

6 CONCLUSION

The prevalence of personal competencies, which we focused on in our research, sometimes appears as an important factor in the development of sustainable practices (Armani, Petrini, & Santos, 2020; Altman & Fry, 2024; Bashynska, et al., 2024; Eberz, Lang, Breitenmoser, & Niebert, 2023; Khan, Saqib, Abbasi, Mikhaylov, & Pinter, 2023; Melean, et al., 2023), and in our research, these competencies are present unevenly, and often only superficially articulated. Although ethics occurs relatively more frequently, its discourse is often formalistic, tied to conformity and normative statements, which re-

duces its transformative potential in organizational culture. In contrast, emotional intelligence and personal integrity are rarely explicitly exposed, indicating the absence of a comprehensive understanding and implementation of these competencies in the strategic communication of organizations.

Thematic research has shown that most of the statements in the reports do not have a clear link to specific management practices, metrics, or development policies. Personal competencies are presented as part of the values of the organization, and not as leadership behavior that would be subject to monitoring or strategic development. In particular, the lack of self-reflection of the organization regarding leadership styles is noticeable, which limits the opportunities for the development of sustainable and responsible leadership.

The conducted research provides us with an answer to all three research questions and consequently indicates the possibilities for improvement of organizations in upgrading reporting practices in the direction of observation and development of personal competencies. Research question Q3 was only analysed in terms of frequency, which we see as a limitation of this research that could be built upon with a deeper implication of differences and a search for the absence of competences in one or the other sector. Another limitation is the distinction between a leader's personal perspective and values, or the influence of a leader's personal perspective on implementing sustainability in their leadership style. This influence was neglected or not addressed in the research.

The personality competencies of leaders represent an essential importance in the creation of sustainable practices (Armani, Petrini, & Santos, 2020, p. 823), and our analysis has shown that the personality competencies of leaders are often addressed implicitly and deficiently in current business and sustainability reports. Guidelines for their more systematic integration can help organizations better communicate leadership values, strengthen sustainability strategies, and increase the credibility of reporting.

From the point of view of the impact on practice, organizations, society and the environment, the contribution of our research is visible in the fact that, through a combination of frequency and thematic

analysis, it opens up an insight into the qualitative and quantitative dimensions of the competencies discussed, and at the same time contributes to the understanding of how modern leadership values are realized (or neglected) in corporate reporting. The findings can serve as a basis for further research of competencies in organizational communication, as well as for the development of guidelines for the integration of personal competencies into the practice of sustainable and responsible leadership.

The research was designed as a case study based on **purposeful sampling**, allowing for an in-depth understanding of the specific context, but not a statistical generalization of the findings. The combination of thematic and frequency analysis provided insight into the quantitative and qualitative occurrence of personality competencies and revealed the discursive mechanisms of their representation. In this way, the research contributes to the understanding of how the image of the leader is formed in organizational reporting, and how the (non)articulation of competencies affects transparency, credibility and sustainability orientation. The findings can serve as a starting point for the development of guidelines for the systematic integration of competences into reporting and man-

agement practices. Publicly available documents were used, so the analysis does not include internal practices or informal discourses. In addition, there is a possibility that key competences are expressed synonymously or implicitly, which can pose an analytical challenge. We have tried to mitigate the presence of interpretive subjectivity through reflexive coding, but it cannot be completely ruled out.

We suggest that researchers explore the possibility of standardized reporting approaches, where the personal competencies of leaders would be recognized as an integral part of sustainable leadership strategies. However, we suggest that further research focus on expanding the methodological approach in this area, for example the use of some other qualitative method, which would also reveal the effects of the occurrence of personality competencies on business results, or quantitative methods, where the presence of personality competencies would be verified through surveys with the managers of large companies themselves. This would enable a deeper understanding of how and why certain personality competencies are more or less present and how they can be systematically integrated into the strategic development of organizations.

EXTENDED SUMMARY/IZVLEČEK

Trajnostna ozaveščenost in vse večja usmerjenost v to področje sta spodbudili številne raziskovalce k iskanju načinov, kako najbolje zagotoviti, da se ta miselnost prenese na vse deležnike v organizaciji. Vodje imajo pri tem ključno vlogo, zato so tudi njihove osebne kompetence glavno izhodišče naše raziskave. Obravnavamo prepoznavanje osebnih kompetenc, kot so jih opredelili drugi avtorji skozi trajnostno vodenje, teorijo trajnostnega vodenja in kompetenčne modele, ter v poslovnih in trajnostnih poročilih velikih organizacij v Sloveniji iščemo pojavnost prepoznanih osebnih kompetenc etike, čustvene inteligentnosti in osebne integritete. Teoretični okvir raziskave ponuja nekatera pomembna spoznanja na področju trajnostnega managementa, na podlagi katerih smo izvedli kvalitativno in kvantitativno fazo ter tematsko analizirali poslovna in trajnostna poročila velikih podjetij v Sloveniji ter preverili pogostost pojavljanja posameznih osebnih kompetenc. Rezultati vodjem ponujajo vpogled v ozaveščenost o kompetencah, ki se izpostavljajo skozi poročanje organizacij, in jim na nek način nastavljajo ogledalo za izboljšave na področju poročevalskih praks. Ugotovili smo, da je ozaveščenost o osebnih kompetencah v poslovnih in trajnostnih poročilih pomanjkljivo prikazana, kar pa še ne pomeni, da to odraža dejansko ozaveščenost o pomenu teh kompetenc pri uresničevanju trajnostnih praks. Kljub temu raziskava ponuja izvirna izhodišča za nadaljnje raziskovalce in osnovo za izvedbo poglobljenih intervjujev z vodilnimi v večjih podjetjih ali kvantitativnih raziskav med vodstvenimi organi.

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THE RELATIONS BETWEEN TECHNOLOGICAL, ORGANIZATIONAL, ENVIRONMENTAL, AND INDIVIDUAL FACTORS AND REMOTE WORKERS' PERFORMANCE: A COMPARATIVE STUDY OF THE IT SECTORS IN INDIA AND NORTH MACEDONIA

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Abstract

This study examines the relationships between technological, organizational, environmental, and individual factors and IT employees' perceptions of how remote work contributes to their performance, using an extended Technology-Organization-Environment (TOE) framework for comparative analysis between India and North Macedonia. A quantitative research design was employed, collecting survey data from 421 IT professionals working remotely – 213 from India and 208 from North Macedonia, which served as a basis for a multiple linear regression analysis. The findings indicate that organizational, environmental, and individual factors play a significant role in the relations between these factors and the perceived contribution of remote work to performance, whereas technological factors do not exhibit a statistically significant relation. The cross-country comparison revealed that, despite demographic and experiential differences, both countries exhibited similar trends in the determinants of remote work performance. This study contributes to the growing body of research on remote work by extending the TOE framework to include individual factors. It offers practical insights for organizations seeking to optimize remote work strategies by focusing on management support, home-work environment improvements, and employee well-being. The findings are particularly relevant for IT companies looking to enhance remote-work productivity and adaptability in diverse regional contexts.

Keywords: Remote work, Technology-Organization-Environment framework, Employee performance

1 INTRODUCTION

Driven by innovation, efficiency, and connectivity across industries, the information technology (IT) sector has emerged as a key component of the global economy. However, with the rapid transition to work from home (WFH) or remote working, particularly accelerated by the COVID-19 pandemic, the IT sector faces unique challenges and opportunities that set it apart from other industries (Olawale et al., 2024; Afrianty et al., 2022). This sector is inherently reliant on technology, making it both highly adaptable to remote working environments and vulnerable to the nuances of technological, organizational, environmental, and individual factors that can significantly influence employee performance (Hesselbarth et al., 2024). Often referred to as the new way of working, remote work represents a flexible, work-from-anywhere approach to working that involves the use of information and communication technologies, telecommuting, and distance working (Mukherjee & Narang, 2023). In this study, we use the term "remote work" to refer to work arrangements where employees perform their jobs outside of traditional office environments, typically from home. However, we recognize that the phrase "distributed work" has become increasingly popular in recent years, referring more generally to work done by geographically dispersed individuals or groups that may operate asynchronously and across time zones (Hesselbarth et al., 2024). While "remote work" focuses on working away from a central office, "distributed work" also captures the collaborative and structural dynamics of dispersed teams. In the IT sector, where virtual teamwork is common, we use "remote work" to reflect both physical distance and distributed work characteristics, aligning with terminology used in current empirical studies. Unlike traditional industries, the IT workforce focuses on knowledge-based tasks, software development, and digital infrastructure, making it reliant on cutting-edge technology and virtual platforms (Messenger & Gschwind, 2016). Adopting remote work policies in IT has been driven by technological advancements, changes in employee expectations, and a growing recognition of the benefits of remote work.

The transition to remote work in the IT sector reflects larger technological and societal changes. This level of digital preparedness has enabled IT profes-

sionals to carry out nearly all their tasks remotely while maintaining their high levels of performance and effectiveness (Oriekhoe et al., 2024; Oyewole et al., 2024; Okoye et al., 2024; Joel et al., 2024). The increasing prevalence of remote work in the IT industry has drawn attention to the variables affecting worker performance in this setting. The remote work benefits include increased productivity, improved work-life balance, and access to a broader talent pool (Haque, 2023). Moreover, organizations have observed significant cost savings due to reduced needs for physical office spaces (Johnson, 2021). Supporting the positive impact, Vesal et al. (2024) revealed that remote work is more likely to increase worker performance than financial incentives. While remote work aligns with the sector's digital nature, challenges like data security, technical infrastructure, and communication breakdowns require organizations to rethink employee management and support (Sahut & Lissillour, 2023).

A thorough lens for analyzing these elements is provided by the Technological, Organizational, and Environmental (TOE) framework. The TOE framework, originally developed by Tornatzky and Fleischer (1990), categorizes the factors influencing organizational processes into three domains: technological (tools and infrastructure), organizational (internal policies and culture), and environmental (external or contextual conditions). With organizations quickly implementing tools and platforms to support remote work, technology has emerged as a crucial enabler of WFH or remote working. Remote working in the IT sector is bringing new changes – long commutes have been replaced with applications like Zoom and other conference modes of working. More specifically, a broad range of remote technology operations has become a "new normal" for organizations in the IT sector (Grant & Russell, 2020). However, this shift has also led to new dynamics in employee performance, driven by various factors including technology, environment, and organizational practices. Yet, by only analyzing the factors that relate to the organization and the environment, we believe that we leave out a vital part of the performance of the workforce – the employees themselves. Considering this, we include individual factors such as job fulfillment, mental health, and flexibility in the analysis to build upon the existing TOE framework, thus proposing a TOE-I model. These factors are also beneficial to the inves-

tigation of the enablers and disruptors of remote workers' performance as they relate to the personal characteristics of personal job crafting, perceptions, and intentions about the job in the specific technological setting (Aligarh et al., 2021).

The performance of employees in the IT industry is highly dependent on the efficiency and efficacy of technical tools and resources. Organizational factors such as leadership support, communication, and company culture also influence how well employees adapt and thrive in remote work settings (Mihelič et al., 2021; Sahut & Lissillour, 2023). Remote options will still thrive for individual contributors and roles best suited to asynchronous work. Companies expect an increased focus on performance-based evaluations, technology for seamless virtual integration, and evolving company cultures adapting to this dynamic ecosystem (Majumdar, 2024). Cloud computing, virtual communication tools, collaboration software, and high-speed internet have become indispensable elements of the contemporary work-from-home environment. So, while these flexible working arrangements have offered flexibility and productivity boosts on a personal level, they have also brought challenges in terms of maintaining spontaneous communication between colleagues as well as team cohesion (Šešok et al., 2024). There are also other difficulties to consider, like cybersecurity threats, tech fatigue, and problems with the sufficiency of resources. It is indisputable that organizations need to use the right technology to change the way they operate now to ensure the performance of employees (Abed, 2020). Organizational factors encompass the leadership, policies, culture, and management practices that relate to remote working. The environmental factor – the home setting, which was not originally designed as a workspace, can present challenges such as inadequate ergonomic setup, distractions, and an imbalance between work and personal life. Organizational factors, including leadership, culture, and support systems, are crucial in determining the success of WFH arrangements. On the other hand, individual factors contribute to positioning the perceptions, mental health, motives, and characteristics of remote workers in this setting.

Thus, the study aims to investigate the relations of technological, organizational, environmental, and individual factors on employees' perception of how

remote work contributes to their performance within the IT sector, through a comparative analysis of India and North Macedonia. The rationale behind selecting India and North Macedonia as the subjects of this comparative analysis is their unique and perceptive differences in the growth of the IT industry, the uptake of new technologies, and remote work patterns. These two countries offer a compelling contrast due to their different stages of IT sector maturity, technological infrastructure, and organizational practices, while also displaying some similarities, which proposes an interesting juxtaposition in terms of the research context. Despite the growing research on remote work, there remains a scarcity of empirical studies specifically focusing on IT professionals' perceived performance under remote settings, especially through a holistic lens. Existing literature tends to emphasize either technological or organizational factors in isolation, often overlooking the critical role of individual-level factors such as personal well-being and job fulfillment. Additionally, few studies compare these dynamics across regions with differing IT sector maturity, leaving a gap in understanding how remote work challenges and enablers may vary across cultural and economic contexts. This research aims to address these gaps by extending the TOE framework and conducting a comparative study between India and North Macedonia.

The paper is structured as follows. Sections 2 and 3 present the theoretical framework and hypotheses development from the TOE-I framework, together with an in-depth explication and reasoning behind the chosen methodological approach. Section 4 describes research results and findings, while Section 5 presents the discussion of the findings, the implications, and pathways for future research. In the end, the conclusion summarizes the key findings.

2 THEORETICAL BACKGROUND

2.1 Performance and remote work in the context of India and North Macedonia

Considering that India is one segment of our research context, prior studies have analyzed the factors that stimulate positive employee well-being and performance as opposed to those that negatively affect it. Organizations with greater digital ma-

turity and automation through the integration of Industry 4.0 (I4.0) technologies have benefited significantly from it after the COVID-19 outbreak, as they have been able to sustain productivity levels effectively (Narayanamurthy & Tortorella, 2021). Because remote work performance relies heavily on communication technologies to coordinate the work, it is necessary to examine the relationship between the nature of the task and the effectiveness of communication technology that impacts team performance (Garro-Abarca et al., 2021). Further studies show that using digital technologies significantly improves coordination, communication, knowledge sharing, and decision-making, leading to better job performance (Duan et al. 2023). In this sense, contemporary theoretical contributions open new avenues for understanding how digital tools are used in digital work and how that affects productivity (Dincelli & Yayla, 2022). They facilitate understanding the potential of technologies and how people may adopt technology to reach that potential to accomplish their goals and perform better at work.

Moreover, it was found that the established IT infrastructure, the ability to autonomously perform tasks, and the flexibility positively influence the work-life balance, performance, and satisfaction of workers from the IT sector (Jamal et al., 2021). Yet, when they felt a higher workload pressure, were isolated from their work peers, distracted from their families at home, and believed the tasks to be interdependent, they experienced stress and exhaustion from work (Jamal et al., 2021; Noonan & Glass, 2012). Mukherjee and Narang (2023) conducted an exploration of the positive experiences associated with remote work in India. They identified several aspects contributing to the growing popularity of work-from-home practices, including greater performance and efficiency, flexibility, and reduced commutes. Therefore, a sizable percentage of workers viewed the possibility of continuing to work from home in the future with positivity (Mukherjee & Narang, 2023).

Experiences regarding performance and the employees' lives while remote working have also been analyzed in the European context, where North Macedonia is located as the second segment of the research context in this cross-country study. Technological and social trends have been especially

pronounced in the country, shifting more jobs into the country's IT sector, with recent years showing drastic employment growth in the sector (Apostolova Nikolovska & Dimitrovska, 2021). Moreover, the sector's biggest challenges involve a lack of quality staff and knowledge management practices as well as high employee turnover rates, yet it is noted that it remains one of the most attractive sectors, especially for youth, which is evident by the high job satisfaction rates (Levkov et al., 2020). Hence, remote work has become an integral part of the Macedonian sector, too, much like the cases of other countries.

As the post-COVID period has been marked with prevailing remote work practices in the country, some studies point out that Macedonian remote workers in the IT sector highly value the working space and experience as important factors for being successful in this type of working arrangement (Đukanović et al., 2022). Additionally, Macedonian remote workers tend to look positively towards this flexible work arrangement as they see it as an option for reducing stress while being more productive (Đukanović et al., 2022). Additional analysis of Macedonian digital workers and their performance showed that prior experience or job tenure, individual skills, motivation, and collaboration with team members are significant precursors to productivity (Postolov & Kitanovikj, 2024). Moreover, the well-being of Macedonian remote workers is also seen as crucial for maintaining and improving performance while remote working (Eftimov & Kitanovikj, 2024). Yet, there is still a growing gap in the literature concerning the state, attitudes, and perceptions related to the performance of employees in the IT sector who are working remotely, or which aspects they believe enhance performance in these settings.

Furthermore, in the European context, it was found that remote work is a feasible working arrangement that can generate benefits and positive outcomes for both the organization as an entity and the workforce itself (Barabaschi et al., 2022). A study focusing on Italian employees concluded that when the presence of autonomy, trust, and motivation is strong, the physical presence, per se, isn't a central tenet to ensuring high-performance levels of workers (Barabaschi et al., 2022). The resolution and willingness of employees to continue working remotely

have been emphasized by other researchers. Błaszczyk et al. (2022) explored the preferences and performance perceptions of employees in Poland who see a change in the remote working model as a positive phenomenon. Additionally, a large portion of the workforce stated that they would be willing to leave the organization if they felt forced to change the working model (Błaszczyk et al., 2022).

Connections between the model of working in question and performance have been the subject of studies in other research contexts, like Australia and Canada. The perceived individual performance is high despite the shift to working from home due to the pandemic lockdowns. Not only that, but employees who continued working remotely were also found to have higher performance, concentration, and an increased notion of organizational belonging (Durakovic et al., 2023; Chow et al., 2022). Tleuken et al. (2022) paid attention to the concept of a residential built environment on high performance in a remote work setting, which includes health and safety, the type of indoor environment, working comfort, the presence of facilities, and more. As a result, it was demonstrated that the residential built environment's indirect impact on employee satisfaction through the mediation of productivity is more fundamental than its direct impact (Tleuken et al., 2022).

While much of the existing literature explores remote work in various industries, there is limited research that specifically focuses on IT professionals. The IT sector faces unique challenges due to its reliance on technology in the remote working system. So, there is a need for more focused studies on how these challenges shape the perceived employee performance in this industry. The literature sheds light on several WFH components, including home environment, organizational support, and technology tools. However, it is unclear how these elements relate to worker performance in the IT industry. Most research that is now available concentrates on isolated factors or sectors other than IT, leaving a gap in the specific context of IT professionals who deal with expectations and challenges. Moreover, there is limited empirical research that quantifies the relative role of each factor, which is crucial for developing targeted strategies to enhance employee performance in remote work set-

tings. Further, there is a need to understand how the factors relating to the perceived employee performance in remote work differ across these two regions, especially in the context of cultural and economic differences. The present study reflects on comparing remote work experiences and challenges across different countries, particularly between India and North Macedonia, where employees reflect on how remote work contributes to their performance. While several studies focus on the technological and organizational aspects of remote work, the present study highlights the impact of the home environment as a workspace in the IT sector.

2.2 Theoretical framework and hypotheses development

In this study, the Technological, Organizational, and Environmental (TOE) framework classifies technology, organization, and environment as the three sets of factors that contribute to how employees perceive remote work shapes performance in an organization. These factors facilitate employee work performance in the context of remote work by providing the necessary infrastructure, policies, and supportive environments. As such, we believe they play an important part in the smooth transition to remote work, fostering adaptability, integrating technology, and cultural shifts within the organization.

Over the years, the TOE framework has been frequently applied in contexts beyond technology adoption, although this is the area where it was first applied. Moreover, it has been used to study e-learning systems (Alshamaila et al., 2013), mobile payments (Mahakittikun et al., 2021), e-commerce readiness (Oliveira & Martins, 2010), digital transformation, innovation, bank performance (Abdurrahman et al., 2024), entrepreneurial business performance (Singh et al., 2024), and more. These studies reflect the flexibility of the TOE model in capturing the relations of contextual factors on organizational and, more recently, individual-level behaviors. This framework provides a helpful lens for evaluating how internal (organizational) and external (technology and environmental) factors interact to create performance results in digitally intensive work contexts, such as remote work.

Although the TOE framework explains technology adoption at the corporate level, its adaptability enables it to be used to explain individual-level outcomes in digitally mediated situations (Tornatzky & Fleischer, 1990). Technological, organizational, and environmental domains shape the infrastructure, practices, and constraints within which employees work in a remote work setting (Nguyen et al., 2022).

Technological factors. Due to the nature of remote and distributed work, technology plays a massive role in the overall performance of organizations and employees (Orel et al., 2025). In this setting, technology encompasses the digital infrastructure, tools, and competencies that enable employees to work remotely, supporting task execution, facilitating communication and collaboration between team members and across the organizational structure (Ng et al., 2022). Researchers note that technological readiness and digital orientation, ensuring employees have a reliable internet connection and necessary devices, is a minimum requirement for effective WFH arrangements (Ng et al., 2022). In practice, companies that invest in solid IT infrastructure and collaboration tools (e.g., cloud-based productivity suites, video conferencing, project management software) can significantly boost remote workers' performance by smoothing communication and workflow interruptions (Yang, 2024). However, technological factors also include potential challenges that must be managed, such as technostress, technical difficulties in the form of unreliable connections, software issues, or cybersecurity concerns, which may disrupt their performance (Mariani et al., 2023). As a result, this study focuses on the sentiments of achieving a technical advantage and effectiveness during remote work while testing employees' digital orientation. Considering that, we believe that the employees in the IT industries in the two countries perceive their performance levels as higher with the presence of the right set of technological factors (e.g., network stability, digital infrastructure). Thus, we propose the following hypothesis:

H1: Technological factors are positively and significantly associated with employees' perceptions of remote work's contribution to their performance.

H1a: Technological factors are positively and significantly associated with Indian employees' perceptions of remote work's contribution to their performance.

H1b: Technological factors are positively and significantly associated with Macedonian employees' perceptions of remote work's contribution to their performance.

Organizational factors. These factors refer to the workplace policies, support systems, culture, and managerial practices that shape remote work's impact on performance, govern the motivation of employees, and the work alignment (Ng et al., 2022). A strong finding across studies is that organizational support and management readiness are pivotal for successful remote work, where companies that adapt their practices by implementing clear work-from-home policies, providing necessary equipment, and establishing guidelines (for communication, data security, performance expectations, etc.) create an environment where remote workers can thrive (Reshma et al., 2025). We believe that support from senior leadership, such as ensuring resources and training are available for remote staff and fostering a culture that values flexibility and outcome-based performance (rather than rigid micromanagement), has been linked to better workforce productivity and satisfaction. Thus, the items used for measuring this factor consider the work culture, communication with the supervisor, level of assigned workload, and work assignment diversity. Subsequently, the hypothesis related to this is as follows:

H2: Organizational factors are positively and significantly associated with employees' perceptions of remote work's contribution to their performance.

H2a: Organizational factors are positively and significantly associated with Indian employees' perceptions of remote work's contribution to their performance.

H2b: Organizational factors are positively and significantly associated with Macedonian employees' perceptions of remote work's contribution to their performance.

Environmental factors. In the context of remote workers' perceived performance, by environmental factors we understand the external and contextual elements that influence remote work, including both the physical environment of the home workspace and the broader external environment of the business or the employer (Giang et al., 2021). Remote employees work in varying home conditions where some may have a dedicated, ergonomic office with minimal distractions, while others juggle work in shared spaces or with family demands. As a result, it was demonstrated that heterogeneity in the physical home office environment helps explain differences in productivity, where employees who reported higher satisfaction with home office factors such as furniture comfort, noise levels, air quality, lighting, and overall workspace setup also reported higher productivity and lower burnout (Stroom et al., 2024). Here, we also include the influence of the family members and the collaboration with external business stakeholders and clients. As a result, we hypothesize the following:

H3: Environmental factors are positively and significantly associated with employees' perceptions of remote work's contribution to their performance.

H3a: Environmental factors are positively and significantly associated with Indian employees' perceptions of remote work's contribution to their performance.

H3b: Environmental factors are positively and significantly associated with Macedonian employees' perceptions of remote work's contribution to their performance.

Individual factors. Building on the current model, we propose the TOE-I model to incorporate individual factors such as self-management, adaptability, and mental well-being since remote work necessitated these factors (Grant et al., 2013). As a result, in this factor we measure the individual work fulfilment, the impact of the individual skills and competencies, personal work flexibility, and mental health. This extension offers a more holistic understanding of employee performance in remote settings and contributes to the theoretical coherence of our model. This theoretical expansion is aligned with recent research highlighting the interplay between external structures and individual agency in

digital work contexts (Dincelli & Yayla, 2022). Considering this, the next hypothesis is:

H4: Individual factors are positively and significantly associated with employees' perceptions of remote work's contribution to their performance.

H4a: Individual factors are positively and significantly associated with Indian employees' perceptions of remote work's contribution to their performance.

H4b: Individual factors are positively and significantly associated with Macedonian employees' perceptions of remote work's contribution to their performance.

Drawing from the TOE-I framework and the research objective, the central research question is: how do technological, organizational, environmental, and individual factors associate with the perception of how remote work contributes to the performance of employees in the IT industry?

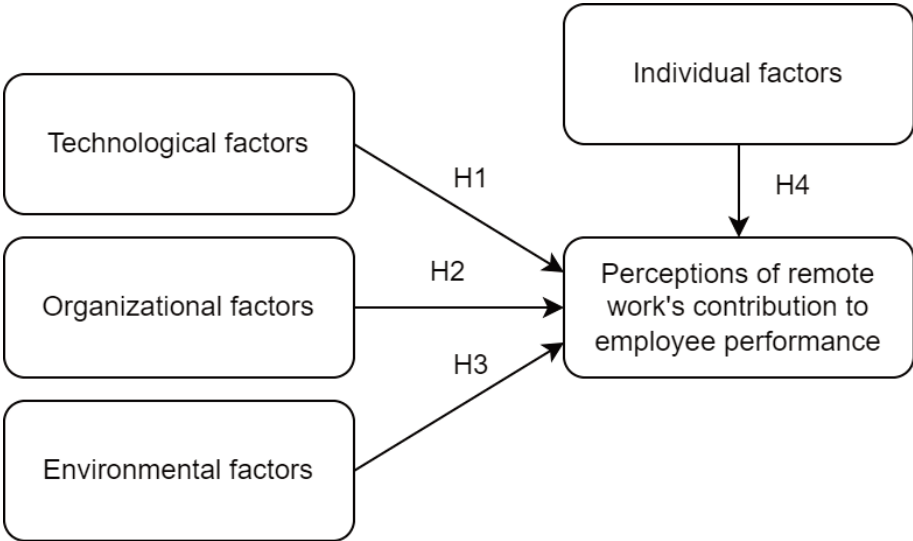
Subsequently, the conceptual model (Figure 1) visually presents the relationships between the variables, which are empirically tested.

The above conceptual model consists of several critical components, including technological, organizational, and environmental factors, which collectively relate to the employees' perceived performance levels. Similar models have been put forward by other studies, which explore performance on a firm level and in different contexts (Mahakittikun et al., 2021). In addition, we include a new set of individual factors as demonstrated by Aligarh et al. (2021). We believe these elements work synergistically to provide a comprehensive framework for understanding the dynamics of employee performance in technology-driven environments. This model underscores the importance of aligning external and internal factors to optimize remote work settings so that employees meet their performance goals.

3 RESEARCH METHODOLOGY

To fulfill the research objective of analyzing the relationships of technological, organizational, environmental, and individual factors on IT employees'

Figure 1: Research model



perception of how remote work contributes to their performance in remote working environments within the IT sector in India and North Macedonia, we collected data from employees in the IT sectors of the two respective countries, who are working remotely. Namely, the data was obtained through a questionnaire, disseminated in January 2024.

At the beginning of the questionnaire, all participants needed to provide personal consent for participation in the research endeavor. At the same time, the respondents' full anonymity was ensured. The questionnaire consisted of three distinct parts, where the first one consisted of two eliminatory questions to fit the desired criteria of the data sample. In this sense, the first two questions asked the respondents to provide the industry where they were currently working and if they were working remotely exclusively, so that we could later filter and include data from participants who worked in IT and were working exclusively remotely. Then, followed the second group of questions – the questions related to distinct aspects of technological, organizational, and environmental factors, to which the participants answered whether they believed a particular aspect related to their performance while remote working on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). In this sense, the survey items were adapted from past studies, which were grounded in the TOE-I framework, to ensure the scales were validated.

Each of the analyzed variables was measured with five items (examples of which are provided in the appendix). The items describing technological factors, such as “I believe remote work enables me to achieve technical advantage,” and “Digital orientation helps me achieve better results during remote work,” were adapted from Aligarh et al. (2021). The items referring to organizational factors and performance were adopted from Ng et al. (2022), and incorporated the likes of “My organization has a work culture that enables me to achieve better results during remote work,” and “My communication with my manager(s) is at a level that enables me to achieve better results during remote work.” The items regarding environmental factors, including “The influence of the family members in my household affects my performance during remote work,” and “The feedback from clients helps me to achieve better results during remote work,” were adopted from Nguyen et al. (2022). The items related to the individual factors were adapted from Grant et al. (2013) and consist of statements like “My individual skills and competencies help me to achieve better results during remote work,” and “My mental health improves when working remotely instead of regular work arrangements.”

Eventually, the third set of questions related to the country where they live and work, job position, gender, age, marital status, and family type were included to assess the demographic characteristics of

the participants (depicted in Table 1). To avoid the potential challenges of common method bias and to disrupt some potential interference between questions, the questions' order was randomized, and other post-hoc statistical remedies were conducted, which are explained further.

A pilot test was conducted with a sample of 27 respondents, after which the survey and the items were refined. The final survey after the pilot testing was utilized for the data collection process. After the data cleaning procedure, the final sample included 421 participants (213 from India and 208 from North Macedonia), ensuring a balanced approach

to the data analysis and interpretation. Furthermore, to enhance reliability, two items measuring the technological factors and one item from the individual factors, were removed. The final set of items is presented in full in the Appendix.

For the data analysis, we relied on multiple linear regression modeling using IBM SPSS version 25. This methodological approach finds a wide range of applications for testing the relations between one dependent variable and several independent ones (Hair et al., 2006). Table 2 presents the differences in the analyzed factors between the two countries.

Table 1: Demographic characteristics of the respondents

Demographic	India		North Macedonia	
	Frequency	(%)	Frequency	(%)
<i>Age</i>				
18-25 years	33	15.49	30	14.42
26-35 years	136	63.85	111	53.37
36-45 years	31	14.55	47	22.60
46-55 years	13	6.10	18	8.65
56+ years	0	0	2	0.96
<i>Gender</i>				
Female	96	45.07	77	37.02
Male	116	54.46	127	61.06
Other/Prefer not to disclose	1	0.47	4	1.92
<i>Job experience</i>				
0-5 years	117	54.93	65	31.25
6-10 years	49	23.00	49	23.56
11-20 years	38	17.84	59	28.37
21-30 years	9	4.23	29	13.94
31+ years	0	0.00	6	2.88
<i>Marital status</i>				
Not married	131	61.50	107	51.44
Married	81	38.03	96	46.15
Separated/Widowed	1	0.47	5	2.40
<i>Family type</i>				
Nuclear	144	67.61	143	68.75
Joint	69	32.39	65	31.25

Table 2: Mean indicators for each factor for India and North Macedonia

Country	Technological factors	Organizational factors	Environmental factors	Individual factors
India	4.122	4.014	4.072	4.155
North Macedonia	3.959	3.903	3.779	4.035

As can be seen in Table 1, most respondents in both countries belong to the 26-35 years age group (India: 63.85%, North Macedonia: 53.37%), followed by the 36-45 years age group (India: 14.55%, North Macedonia: 22.60%). This suggests that the workforce in the IT sector is predominantly young, an important factor when analyzing adaptability to remote work technology, digital skills, and performance. Yet, the presence of older respondents (46+ years) is significantly lower, indicating that younger professionals are more likely to be more engaged in remote IT work. Furthermore, the 0-5 years of experience group is the largest in India (54.93%) but lower in North Macedonia (31.25%), while a larger proportion of North Macedonian respondents have 11-20 years of experience (28.37%), and 21-30 years of experience (13.94%) compared to India. This may indicate that the Indian IT remote workforce is relatively younger in terms of experience, which might influence their perspectives on productivity, collaboration, and adaptation to remote work tools. Additionally, the nuclear family structure is dominant in both countries (India: 67.61%, North Macedonia: 68.75%). Namely, a significant portion of respondents also live in joint family setups (India: 32.39%, North Macedonia: 31.25%). This could implicate remote work efficiency, especially in joint families where shared living spaces might pose distractions and performance challenges.

4 RESULTS AND FINDINGS

To investigate the relations of each TOE-I factor per the proposed theoretical framework on the dependent variable, employees' perceived contribution of remote work on their performance, we used a multiple regression analysis approach. We believe this methodology was suitable for determining the relationships between the chosen variables, which have been explained in the existing theory of the research field.

Before the analysis assessment, we verified the state of multicollinearity and construct reliability. Considering that, to improve validity and reliability, all items that had loadings that were lower than 0.5 were not included (Hair et al., 2006), which was previously highlighted in the methodological description. The final loadings ranged from 0.518 to 0.824. Moreover, to assess the internal consistency, we used Cronbach's alpha. The final set of items all had a Cronbach's alpha coefficient higher than 0.70, as a recognized threshold, reaffirming the consistency (Nunnally, 1978). These results are presented in Table 3.

To ensure the negative effects of common method bias don't interfere with the regression model, we conducted several statistical remedies. First, the Kaiser-Meyer-Olkin (KMO) (.888) and Bartlett's Test of Sphericity ($p < .001$) analyses were

Table 3: Results of reliability measurement

Constructs	Factor loadings	Alpha coefficients
Individual factors	0.518 – 0.733	0.740
Technological factors	0.612 – 0.676	0.711
Organizational factors	0.786 – 0.797	0.877
Environmental factors	0.551 – 0.736	0.723
Employee performance	0.646 – 0.824	0.878

applied, confirming that the data meets the core pre-conditions for factor analysis and that the items are sufficiently correlated to justify extracting one or more latent factors, considering that KMO is above the 0.5 threshold and Bartlett's test of sphericity score is below the 0.05 threshold (Hair et al., 1998).

A non-response bias test has also been conducted (Armstrong & Overton, 1977). Moreover, an independent t-test and chi-square test were performed based on the inputs of the first and the last 100 respondents (Chatterjee et al., 2023). Thus, we used a one-way ANOVA to compare the means of multiple groups, which were formed by the first and last 100 respondents (Bag et al., 2021) as the factor variable, looking for non-significant results (p -value $> .05$). As a result, no value proved to be significant, meaning that there is no difference between the first and the last 100 respondents (Table 4).

In the case of self-reported data, such as the one in this study, there is a potential for common method bias due to consistency motif and the respondents' willingness to improve their social desirability (Podsakoff et al., 2003). To assess whether this type of bias is present, besides randomizing the questions'

order, statistical analyses were also conducted. Namely, a Harman single factor test (SFT) was performed post hoc as suggested by Kock (2020) and Aguirre-Urreta and Hu (2019). The result indicated that the first factor explained just 44% of the variance, which is below the recommended value of 50% (Kock, 2020), demonstrating that the obtained results are more likely to reflect the true relations between the variables in question rather than being influenced by one common method factor.

Table 5 presents descriptive statistics, including the mean and standard deviation for each item, along with the correlation matrix, illustrating the degree of linear relationship among the independent variables and their correlation with the dependent variable. The findings reveal that all bivariate correlations among the independent variables remain below 0.9, aligning with the recommendations of Hair et al. (2006). Furthermore, the variance inflation factor (VIF) was utilized to evaluate multicollinearity, with values ranging from 1.824 to 2.222, all below the threshold of 5, which is in line with the suggestion outlined by Hair et al. (2006). This indicates that multicollinearity is not a significant concern in this study.

Table 4: ANOVA results

		Sum of Squares	df	Mean Square	F	Sig
Individual factors	Between groups	0.329	1	0.329	0.491	0.483
	Within groups	128.078	199	0.643		
	Total	128.407	200			
Technological factors	Between groups	0.142	1	0.142	0.301	0.573
	Within groups	93.687	199	0.471		
	Total	93.829	200			
Organizational factors	Between groups	0.786	1	0.786	1.169	0.268
	Within groups	149.673	199	0.752		
	Total	150.459	200			
Environmental factors	Between groups	0.08	1	0.08	0.13	0.83
	Within groups	117.34	199	0.589		
	Total	117.42	200			
Employee performance	Between groups	0.161	1	0.161	0.215	0.645
	Within groups	140.804	199	0.707		
	Total	140.965	200			

Table 5: Descriptive statistics and correlation matrix

Variables	IF	TF	OF	EF	EP
Mean	4.096	4.076	3.967	3.948	4.068
S.D.	0.692	0.716	0.697	0.671	0.757
Individual factors	1				
Technological factors	0.686**	1			
Organizational factors	0.662**	0.692**	1		
Environmental factors	0.712**	0.702**	0.722**	1	
Employee performance	0.724**	0.669**	0.779**	0.721**	1

Note: **Correlation is significant at the 0.01 level (two-tailed).

The results of the regression analysis of the association of technological, organizational, environmental, and individual factors and the contribution of remote work in employees' performance in IT companies, together with the model summary, are presented in Table 6. The adjusted R Square demonstrates that these factors explain 83.6% of the variance in the dependent variable, while the remaining 16.4% can be attributed to other variables.

The individual factors' coefficient $B = 0.300$ with a t-value of 6.535 and p-value < 0.001 suggests that individual factors significantly contribute to the dependent variable. The standardized beta coefficient ($Beta = 0.275$) indicates a moderately strong association compared to other variables. On the other hand, the results for the technological factors indicate that these factors do not have a statistically significant relation at conventional significance levels ($p < 0.05$). The low $Beta = 0.063$ further suggests a weak relation with the dependent variable. We be-

lieve this may be likely due to the assumption that technology does not play a drastically significant role in how employees perceive remote work's contribution to their performance in the IT sector, considering they heavily rely on technology during the in-office work arrangements, as well. The variable referring to the organizational factors shows the strongest association, with $B = 0.469$, $Beta = 0.432$, and a highly significant t-value of 10.108 ($p < 0.001$). With $B = 0.191$, $Beta = 0.169$, and a significant t-value of 3.753 ($p < 0.001$), the environmental factors also significantly relate to the dependent variable, though to a lesser extent than organizational factors.

Thus, it can be summarized that H1 is not supported, while H2-H4 are supported after the bivariate correlations and multiple linear regression operation. More precisely, in the case of technological factors (H1), although the zero-order correlation is significant, the effect is no longer significant once the other three factors are entered in the regression

Table 6: Regression model based on the data from India and North Macedonia

Variables	B	SE B	Beta	t-value	Sig.	VIF
Individual factors	0.300	0.046	0.275	6.535	<0.001	1.947
Technological factors	0.067	0.045	0.063	1.480	0.140	2.111
Organizational factors	0.469	0.046	0.432	10.108	<0.001	1.824
Environmental factors	0.191	0.051	0.169	3.753	<0.001	2.222
Model Summary	R-square			0.836		
	Adjusted R-square			0.832		
	Std. error of the estimate			0.4168		
ANOVA Regression	F = 242.207, Sig = < 0.001					

model. In terms of the other factors (H2-H4), the positive relationship persists after adjusting for the other variables with a relatively strong effect.

Generally speaking, the F-statistic ($F = 242.207$, $p < 0.001$) indicates that the overall regression model is statistically significant, meaning that the independent variables collectively associate with the dependent variable.

To go deeper into the country comparison, we conducted two separate regression models to assess whether some significant contrasts emerge, or the situation is similar for both remote workers in India and North Macedonia. Table 7 presents an overview of the regression model based on the data acquired from Indian remote workers ($N = 213$).

The model was significant, $F(4, 208) = 169.075$, $p < .001$, and explained 76.5 % of the variance (Adj. $R^2 = .760$). Organizational factors ($\beta = .374$, $p < .001$), individual factors ($\beta = .365$, $p < .001$), and environ-

mental factors ($\beta = .206$, $p < .001$) emerged as positive predictors, whereas technological factors were non-significant ($\beta = .027$, $p = .642$). No issues with multicollinearity ($VIFs < 3.1$) or autocorrelation (Durbin-Watson = 2.06) were detected. This is in line with the findings from the main model that reflected both countries and remote work perceptions (H1a = not supported; H2a-H4a = supported). Yet, some differences are evident, one of the most prominent ones being that both organizational and individual factors have the strongest relations with a near equal degree of strength. This signals that the support from the organizational structure and the individual characteristics can strongly shape remote workers' perceptions, whereas additional aspects of the broader environment remain less significant.

On the other hand, Macedonian remote workers' beliefs are contrasted. The regression model for this part of the dataset is provided in Table 8.

Table 7: Regression model based on the data from India

Variables	B	SE B	Beta	t-value	Sig.	VIF
Individual factors	0.394	0.058	0.365	6.759	<0.001	1.581
Technological factors	0.030	0.065	0.027	0.466	0.642	2.025
Organizational factors	0.404	0.062	0.374	6.497	<0.001	1.728
Environmental factors	0.222	0.060	0.206	3.696	<0.001	1.738
Model Summary	R-square			0.765		
	Adjusted R-square			0.760		
	Std. error of the estimate			0.35736		
ANOVA Regression	F = 169.075, Sig = < 0.001					

Table 8: Regression model based on the data from North Macedonia

Variables	B	SE B	Beta	t-value	Sig.	VIF
Individual factors	0.266	0.063	0.258	4.240	<0.001	1.239
Technological factors	0.149	0.057	0.157	2.620	0.009	1.189
Organizational factors	0.418	0.059	0.411	7.120	<0.001	1.015
Environmental factors	0.132	0.055	0.130	2.420	0.016	1.753
Model Summary	R-square			0.665		
	Adjusted R-square			0.658		
	Std. error of the estimate			0.42575		
ANOVA Regression	F = 100.675, Sig = < 0.001					

Evidently, the model was significant, $F(4, 203) = 100.68$, $p < .001$, explaining 66.5 % of the variance (Adj. $R^2 = .658$). Technological factors ($\beta = .157$, $p = .009$), organizational factors ($\beta = .411$, $p < .001$), individual factors ($\beta = .258$, $p < .001$), and environmental factors ($\beta = .130$, $p = .016$) are all positively related to the perceived performance. Multicollinearity was low ($VIFs < 2$), and residuals showed no autocorrelation (Durbin-Watson = 2.05). Hence, H1b-H4b are supported, meaning that all aspects are mostly significant with varying degrees to Macedonian remote workers in the IT sector. Considering the contextual background, which is different from India, economically, technologically, politically, and societally, we can deduce that this type of workers still relies on a variety of factors when thinking of distributed work and flexible work arrangements' influence on their performance.

Both regressions fit their national subsamples very well, but the Indian model is notably stronger based on the percentage of explained variance. Organizational conditions are the single most powerful driver in both countries ($\beta \approx .41$), confirming that leadership, culture, and HR practices are pivotal for remote work success regardless of context. Individual factors rank second everywhere, but their role in the relation is stronger in India ($\beta = .365$) than in North Macedonia ($\beta = .258$), suggesting that personal attitudes and competencies matter more where large-scale remote work has matured. Environmental factors play a modest yet significant role in both settings ($\beta \approx .13-.21$), reflecting that macro-level (and familial) support, such as regulation, infrastructure, and societal norms, adds incremental but not dominant value. The sharpest contrast lies in technology, though. In North Macedonia, the technological construct is a small yet significant predictor in the relationship, indicating that access to robust digital tools and IT support still differentiates performance. In India, by contrast, the technological coefficient is nearly zero and statistically nonsignificant. A plausible interpretation we posit is that when high-quality technology is broadly available, as is typical for mature IT-services hubs, the marginal return of additional tech diminishes, leaving organizational and human enablers to carry the load. In less technologically saturated environments, on the other hand, closing the digital gap still pays off.

5 DISCUSSION AND IMPLICATIONS

The research sought to investigate the relations of technological, organizational, environmental, and individual factors with employees' perceptions of remote work's contribution to their performance in the IT sector in North Macedonia and India. Based on the research findings, the proposed hypotheses H2, H3, and H4 have been supported while H1 was not supported. More precisely, when the two countries are analyzed separately, H1a is not supported, yet H2a, H3a, and H4a are supported (findings from the Indian context), echoing the situation with the total sample, when seen holistically. All hypotheses related to North Macedonia (H1b-H4b) were supported. Subsequently, the contextual background and the implications of the study are provided as follows.

Moreover, while previous studies have explored the influence of technological, organizational, and environmental factors on work outcomes (Ng et al., 2022), this study has made several theoretical and empirical contributions to the emerging literature on remote work performance, as outlined in the next subsection. This research endeavor is one of the first ones that employs the TOE framework in remote work settings as a cross-country comparison between two countries. Additionally, it provides new value by expanding the TOE framework with individual factors and a direct assessment of the relationship between the surrounding factors and the perceived effect of remote work on employees' performance in IT companies. The overall results (for the entire model and India) point out that within the TOE-I factors, the strongest positive association is attributed to organizational, environmental, and individual factors, while the technological ones were not significantly affiliated with the performance. We believe that this is because technology does not play a drastically significant role in remote workers' performance in the IT sector, considering they heavily rely on technology during in-office work, too. Nevertheless, all these factors explain 83.6% of the variance in the model. However, this set of factors still plays a major role in North Macedonia, which we attribute to the long road the country has towards higher digitalization and overall technological saturation.

Comparatively, contextual distinctions between the two analyzed countries exist that might explain the similarities and differences. As previously showcased in Table 2, the Indian part of the sample ranked the factors generally higher as predictors of their perceptions of performance, yet without major differences, as the Macedonian average ranged from 3.78 to 4.03, whereas the Indian one was between 4.01 and 4.15.

Moreover, Indian companies were able to shift quickly to remote or hybrid modes because national labor statutes leave the “place of work” largely to contractual agreement; during the pandemic, this gap was filled by firm-level policy improvisation (Mukherjee & Narang, 2023). North Macedonia, by contrast, amended its Labor Law in 2020 so that any home-based or telework arrangement must be specified in the employment contract and reported to labor authorities, thereby formalizing employer obligations for health and safety outside the office (Apostolova Nikolovska & Dimitrovska, 2021). Hence, these different regulatory trajectories may help explain why technological factors do not play a major role in shaping employees’ perceptions of remote work and how it affects performance in either sample. IT professionals in both countries have already normalized work-anywhere arrangements, so marginal changes in infrastructure have added little to the collective situation once minimum connectivity is in place.

Culturally speaking, evidence shows India scores lower on uncertainty avoidance than most European societies, whereas the Western-Balkan cluster (including North Macedonia) is among the highest (Kumar et al., 2023; Tomovska Misoska et al., 2024). Indian IT teams, therefore, may tolerate ad-hoc scheduling improvisation, while Macedonian teams seek explicit rules and timetables. Both cultures are high in power distance (Kumar et al., 2023; Tomovska Misoska et al., 2024), so employees may tend to depend strongly on managerial direction. Hence, we believe this may shed light on why organizational factors emerged as the strongest driver of the employees’ beliefs, as supportive leadership and clear goal setting offset hierarchical distance in India (Venumuddala & Kamath, 2023), while policy clarity reduces uncertainty in North Macedonia (Apostolova Nikolovska & Dimitrovska, 2021).

Regarding the economic complexity and the motivation for choosing distributed work, it has been found that in India, the economic value of remote work is tied to avoiding costly mega-city commutes and enabling relocation to lower-cost regions (Mukherjee & Narang, 2023). In North Macedonia, where domestic IT wages trail Western European rates, remote work is attractive because it opens access to better-paid international contracts (Đukanović et al., 2022). Considering this, we also found that environmental factors, especially the quality of the home workspace, significantly relate to the perceptions of remote work’s role in enhancing performance, where savings on travel and/or housing in India and cross-border income gains in North Macedonia both depend on having a functional home office.

5.1 Contribution to literature

This study contributes to the literature in the following ways. First, by modifying the classic TOE framework (Tornatzky & Fleischer, 1990) to examine employee performance in a remote work setting, it goes beyond its initial scope of explaining organizational technology adoption. While previous research has applied TOE to firm-level adoption results (Abed, 2020; Mahakittikun et al., 2021), this study shows its applicability at the individual level, providing a new theoretical lens to examine how remote work systems shape perceptions of performance levels.

Second, the study strengthens recent recommendations for integrating personal dimensions in work performance research by integrating individual factors like flexibility, mental health, and job fulfillment into the TOE-I framework (Grant et al., 2013). This fills a significant gap in the model’s literature, which has often ignored behavioral and psychological factors. Third, by identifying organizational and environmental factors as stronger indicators of employee perceptions shaping how they view remote work and performance than technological ones, the study adds to the growing body of research on remote work performance. This suggests a change in performance factors as technology becomes more pervasive, unlike past research that focused on digital technologies as the main facilitators of remote work (Duan et al., 2024; Garro-Abarca et al., 2021).

Fourth, this study provides a comparative cross-country perspective between India and North Macedonia. While much of the remote work literature is based on data from Western economies, this study provides evidence from two culturally and economically distinct IT sectors, responding to the lack of geographic diversity in existing studies (Barabaschi et al., 2022; Đukanović et al., 2022). Despite contextual differences, the consistency of findings supports the broader generalizability of the TOE-I model.

Finally, the study challenges assumptions that technology is always a significant driver of performance in digital work settings. For IT professionals, technology is more of a baseline requirement than a differentiating performance factor (Narayanamurthy and Tortorella 2021). This has implications indicating that future frameworks should shift attention toward organizational and human-centric variables in digital work design.

5.2 Practical implications

The findings offer practical guidance for IT organizations, managers, and policymakers aiming to optimize remote work arrangements. These implications are particularly relevant given the varying institutional, economic, and cultural landscapes of India and North Macedonia. While India's IT sector is characterized by a younger workforce and rapid digital growth, North Macedonia's IT industry is smaller and more evolved in terms of employee experience within the European framework of digital transformation. Despite these differences, the findings reveal similar patterns in both nations, emphasizing the universal importance of organizational support, individual readiness, and environmental conditions in shaping perceptions of remote work's role in performance.

Among the TOE-I factors, organizational aspects had the strongest positive association. This underscores the importance of leadership and communication in remote and workplace culture. The results indicate that clear communication, management support, and well-structured remote work policies should be prioritized by organizations for better employee engagement and productivity. This finding

echoes the work of Garro-Abarca et al. (2021), who found that effective communication and strong managerial support enhance team performance in virtual settings. Furthermore, organizations that support training and development programs and structured performance evaluations are better positioned to sustain productivity and job satisfaction in remote environments (Ng et al., 2022; Barabaschi et al., 2022).

The study reveals that environmental factors play a major role, too. This supports previous research indicating that an employee's home setting, workspace design, and family support influence productivity (Tleuken et al., 2022). Organizations can help reduce distractions by promoting ergonomic work environments and providing financial assistance for home office arrangements. Promoting work-life balance is essential to avoid burnout and enhance long-term performance outcomes (Đukanović et al., 2022; Eftimov & Kitanovikj, 2024).

The inclusion of individual factors such as personal characteristics, skills, job fulfillment, and mental well-being in the TOE-I framework proved to be a valuable addition in this study. This is in line with research highlighting that autonomy, motivation, and job crafting enhance employee productivity in remote settings (Grant et al., 2013). Given these findings, organizations should prioritize mental health support, provide professional development opportunities, and encourage flexible work arrangements to maximize individual potential.

Finally, while technological factors were not statistically significant in the model when the two countries were considered together as one, and in the case of India, too. This does not imply that technology is unimportant. Instead, it illustrates how digital infrastructure is a constant in the "work equation" for IT professionals. Therefore, organizations should focus not just on providing tools but on ensuring their seamless integration and minimizing digital fatigue through streamlined platforms and cybersecurity support (Narayanamurthy & Tortorella, 2021; Duan et al., 2024).

The comparative nature of this study offers insights into the different remote work experiences between India and North Macedonia. The demographic data suggest that the IT workforce in India is younger, with a higher proportion of employees hav-

ing 0-5 years of experience, whereas North Macedonia has a more experienced IT workforce. This difference may change perceptions of remote work, as younger professionals might be more adaptable to digital work environments, while experienced employees may require additional support in transitioning to remote settings (Apostolova Nikolovska & Dimitrovska, 2021). Despite these differences, both countries exhibit similar trends in the significance of organizational, environmental, and individual factors, reinforcing the universality of their roles in how remote work can influence performance.

Namely, for Indian firms, investments should concentrate on organizational culture and employee development, while Macedonian organizations, however, can still gain measurable benefits from upgrading collaboration platforms and IT support while simultaneously strengthening organizational and individual capabilities. The findings also caution that the salience of the “T” pillar in the TOE-I framework is context-dependent, as it can behave like a performance lever where diffusion remains uneven. Additionally, organizations should enhance leadership training, establish clear communication channels, and develop structured policies to support remote workers. They may even consider offering financial assistance for home office setups and encouraging employees to create distraction-free work environments. With a growing focus on mental health and employee well-being, companies should integrate wellness programs, mental health support, and professional development opportunities to enhance job satisfaction and performance. Eventually, while technology is a necessary enabler, organizations should focus on improving the usability and integration of remote work tools rather than simply providing access to them.

5.3 Limitations and future research

Although this study provides valuable insights, it does not come free of some limitations, which at the same time represent potential avenues for future research. First, the study focuses on IT professionals, which may limit its generalizability to other industries. Second, the study relies on self-reported data when it comes to employees’ perceptions of how remote work shapes performance and the fa-

cilitating factors. So, even though post-hoc statistical remedies are applied, future research could measure performance using more objective indicators or triangulated with supervisors’ assessments. Third, while the study identifies key factors relating to performance, qualitative research methods such as interviews could provide additional insights into employee experiences. In this sense, future research can implement a mixed-methods approach to analyze this research problem. Lastly, longitudinal studies may help assess how these factors evolve as remote work practices continue to develop. To further enhance, future research could incorporate macro-level institutional indicators (e.g., cultural values, labor laws, digital policy maturity) to deepen comparative insights.

6 CONCLUSION

With this research endeavor, we set out to investigate how technological, organizational, environmental, and individual factors relate to IT employees’ perception of how remote work contributes to their performance. Moreover, this study extends the TOE framework by incorporating individual factors and provides empirical evidence on the determinants of remote work beliefs on performance in the IT sector. Using a quantitative research approach, data were collected from 421 remote IT professionals in India and North Macedonia through structured surveys. The multiple regression analysis revealed that organizational, environmental, and individual factors are positively and significantly associated with employees’ perceptions of remote work’s contribution to their performance, while technological factors have a more limited direct relation in the case of India, while in the Macedonian context, all factors contributed to remote work’s perceived effect on performance with varying degrees of significance. These insights offer guidance for organizations seeking to optimize remote work strategies, ensuring that employees remain engaged, productive, and satisfied in an evolving digital work environment. The comparative analysis between India and North Macedonia highlights notable differences in workforce demographics, with India exhibiting a younger, less experienced IT workforce, whereas North Macedonia features more seasoned professionals.

Overall, this research contributes to a deeper understanding of the factors relating to remote work perceptions and performance and highlights practical steps organizations can take to enhance employee outcomes. As remote work continues to shape the future of the IT sector, we believe companies should adopt proactive strategies that address organizational culture, employee well-being, and environmental support to maximize the benefits of this evolving work model. Moreover, the

study contributes to theory by applying the TOE-I framework to include individual factors and by applying it to employee performance as an area where this model is underutilized. It also enriches empirical understanding by demonstrating that organizational and environmental dimensions play a stronger role than technology in shaping remote work perceptions, particularly in the IT sector of more developed countries as opposed to less developed ones.

EXTENDED SUMMARY/IZVLEČEK

Ta študija preučuje razmerja med tehnološkimi, organizacijskimi, okoljskimi in individualnimi dejavniki ter zaznavami IT-zaposlenih o tem, kako delo na daljavo prispeva k njihovi uspešnosti, pri čemer uporablja razširjen okvir tehnologija–organizacija–okolje (Technology-Organization-Environment; TOE) za primerjalno analizo med Indijo in Severno Makedonijo. Uporabljen je bil kvantitativni raziskovalni načrt z anketnimi podatki 421 IT-strokovnjakov, ki delajo na daljavo – 213 iz Indije in 208 iz Severne Makedonije. Ti podatki so bili podlaga za večkratno linearno regresijsko analizo. Rezultati kažejo, da imajo organizacijski, okoljski in individualni dejavniki pomembno vlogo v razmerjih med temi dejavniki in zaznamim prispevkom dela na daljavo k uspešnosti, medtem ko tehnološki dejavniki niso izkazali statistično pomembne povezave. Primerjava med državama je razkrila, da kljub demografskim in izkustvenim razlikam obe državi kažeta podobne trende v določanju dejavnikov uspešnosti dela na daljavo. Študija prispeva k rastočemu obsegu raziskav o delu na daljavo s tem, da okvir TOE razširi z vključitvijo individualnih dejavnikov. Ponuja praktične vpogleda za organizacije, ki želijo optimizirati strategije dela na daljavo s poudarkom na podpori managementa, izboljšavah domačega delovnega okolja ter skrbi za dobrobit zaposlenih. Ugotovitve so posebej relevantne za IT-podjetja, ki želijo povečati produktivnost in prilagodljivost dela na daljavo v različnih regionalnih kontekstih.

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Appendix

Survey items used in the research study

Factors	Items	Source
Technological factors	I believe remote work enables me to achieve technical advantage.	Adapted from Aligarh et al. (2021)
	I believe technology makes me more effective during remote work.	
	Digital orientation helps me achieve better results during remote work.	
Organizational factors	My organization has a work culture that enables me to achieve better results during remote work.	Adapted from Ng et al. (2022)
	My communication with my manager(s) is at a level that enables me to achieve better results during remote work.	
	My organization provides employee training opportunities that enable me to achieve better results during remote work.	
	My organization gives me an adequate amount of responsibility that enables me to achieve better results during remote work.	
	My manager(s) assign(s) me diverse work assignments that enable me to achieve better results during remote work.	
Environmental factors	The influence of the family members in my household affects my performance during remote work.	Adapted from Nguyen et al. (2022)
	The feedback from the environment helps me to achieve better results during remote work.	
	Working with multiple stakeholders helps me to achieve better results during remote work.	
	Trust from my surroundings affects my performance during remote work.	
	The feedback from clients helps me to achieve better results during remote work.	
Individual factors	Work fulfilment helps me to achieve better results during remote work.	Adapted from Grant et al. (2013)
	My individual skills and competencies help me to achieve better results during remote work.	
	Flexibility affects my performance during remote work.	
	My mental health improves when working remotely instead of regular work arrangements.	
Perceptions of remote work's contribution to employee performance	Remote work improves my working practices and processes.	Adapted from Ng et al. (2022)
	Remote work makes my work more objectively evaluated and recognized.	
	Remote work has been beneficial regarding financial rewards and benefits.	
	Remote work improves my plans and goals setting.	



ARTIFICIAL INTELLIGENCE AND JOB RECRUITMENT: WHAT APPLICANTS SHOULD HAVE TO WIN THE JOB

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Abstract

As interest in artificial intelligence expands, organizations are increasingly focusing on attracting talented job applicants who can enhance organizational performance by leveraging the advantages of AI. The purpose of the present paper is to develop a scale to identify the skills that are most aligned with the requirements of future jobs, which applicants should possess. Factor analysis, both exploratory and confirmatory, was employed to analyze future job skills. Based on relevant literature, respondent feedback, and revisions from specialized academics, 40 measurement items were developed, resulting in six factors extracted through an electronic survey involving 250 respondents in primary survey, and 239 in confirmatory stage, from various sectors. The results revealed the extraction of six factors representing the essential skills for future job candidates. These factors, listed according to the eigenvalues and explained variance, are: technical skills, mathematical skills, programming skills, critical thinking, creativity, and adaptability. The factors were named according to the direction of the elements. The originality of the research lies in its systematic presentation of a set of skills suitable for artificial intelligence jobs. The research provides value to practitioners in the field of human resource management by offering guidance for the recruitment process.

Keywords: Artificial Intelligence, AI, Job Recruitment, HR professionals, job stability, Future Skills

1 INTRODUCTION

Today, world is witnessing a significant development in the field of artificial intelligence (AI). This field is no longer exclusive to the realm of information technology; it now permeates most other academic and professional disciplines. In fact, the integration of AI with various aspects of life represents a revolutionary phenomenon, fostering a profound shift in understanding how humans interact with machines to achieve optimized outcomes. Recently, and not too long ago, AI has made significant advancements in various fields such as machine learning, complex algorithms, diverse computer applications, robotics, and more (Soori et al., 2023).

This chain of successes has extended to other non-computing domains, including healthcare, banking services, e-commerce, graphic design systems, and applications, among others. It is almost certain that the post-artificial intelligence era will be unlike anything before it, as expectations for improved outcomes across various fields have steadily risen (Koman et al., 2024). This is due to the positive results AI has delivered in numerous other domains.

In the business world, AI has become an essential tool for data analysis and strategic decision-making. It can be used to analyze big data and guide companies toward better strategies. Additionally, AI can improve customer experiences through smart

support and quick responses to their needs. It may be difficult to pinpoint and define the areas where AI comes into play in the world of business, but there is no doubt that it has positive implications and effects for both organizations and employees, as well as undoubtedly negative aspects. It is natural for organizations and their leaders to increasingly focus on AI because it contributes to improving the effectiveness of achieving sub-goals. At the sub-business level, AI can assist in solving and addressing many sub-issues in marketing, human resources, planning, knowledge management, and more.

The statistics and recent research indicate that AI will have a significant impact on the job market in the future (Adigwe et al., 2024; Hui et al., 2024; Zarifhonarvar, 2024). AI will enable the automation of many tasks previously performed by humans, leading to changes in job structures and required skills. However, alongside the challenges that this technology faces, it is also expected that AI will open new doors for job opportunities and contribute to the creation of new jobs. This development in the field of AI raises many questions about its impact on the job market and employment. In addition, it is crucial to examine and understand the potential impact of artificial intelligence on job seekers' efforts to secure employment. A deeper understanding is needed of the mechanisms through which technological advancements influence the job market and what both organizations and individuals should do in response. In line with the findings of (Kambur & Akar, 2022; Wang et al., 2023) studies, developing a specialized scale to identify job applicants' skills from the perspective of human resource management is of paramount importance. We also aim to address the concerns presented by (Köchling et al., 2023) in his research regarding job applicants' affective response to AI-driven recruitment processes. Based on the aforementioned debate and discussion, it is crucial to take these issues seriously by identifying and verifying the most relevant skills for AI-related jobs. Accordingly, this study aims to develop an effective measurement tool to assess the skills required for AI-related positions, using a sample from selected private sector companies. More must certainly be done to explore the effects of AI on the labor market, including the skills of applicants for new jobs. Our current paper seeks to an-

swer the following question: What are the most essential skills that applicants for AI-related jobs should possess?

In the current paper, we aim to develop a tailored scale to identify the skills most relevant to AI-related positions. Unlike (Yuan et al., 2024) approach, which aimed to identify the elements of general AI literacy, we seek to validate this scale in order to contribute to the growing body of knowledge and practical applications in this field. It is essential to highlight the distinction between the three levels of jobs for which this scale is designed. The first level includes jobs that are entirely generated by artificial intelligence, such as data analysis, visual design, and language models. The second level, which is the primary focus of this paper, consists of jobs where AI enhances performance. Examples include marketing campaign design, e-learning, content creation, and translation. The final level comprises jobs that AI fully replaces, such as data entry, basic content analysis, autonomous driving, and self-management. More specifically, we focus on the skills that new job seekers in today's business world must possess, as it is greatly influenced by the advancement of new information technology. The current paper also reveals the challenges of human resource management in improving productivity efficiency versus talent acquisition and retention.

2 LITERATURE REVIEW

The integration of AI into public life represents a profound technological advancement and is regarded as one of the most impactful transformations in contemporary society. This advancement is attributed to the increasing ability of intelligent systems to process data and information quickly and accurately, a capability that was not possible in the past (Lee & Yoon, 2021). The impact of AI transcends industrial boundaries (Dwivedi et al., 2021) and extends to a variety of aspects of our daily lives, ranging from home technology such as smart voice assistants and connected household appliances to medical applications, environmental fields, transportation, and education (Stone et al., 2022; Vieira et al., 2022; Zhang et al., 2022). It has become increasingly common today for AI to be a part of everyday life (Jones et al., 2018), raising complex questions about how to balance the ben-

efits of these new interventions with the ethical considerations they may bring (Bankins & Formosa, 2023; Kamila & Jasrotia, 2023; Zeide, 2019). In any case, ensuring the safe use of AI in our lives is essential. This would maximize the benefits of AI without sacrificing ethical principles or fundamental human values.

Organizations increasingly need to leverage AI as a means to maintain competitiveness and progress within the rapidly changing global business environment (Buntak et al., 2021; Wamba-Taguimdje et al., 2020). Indicators related to AI interventions in the business sector send positive signals about its role in enhancing competitiveness and strengthening key differentiators and advantages (Patil, 2019; Salau et al., 2022). AI offers unique advantages in the field of big data analysis with unparalleled speed and accuracy (Lv et al., 2022). It provides effective foundations for predicting market trends and demand concentrations (Lee & Jung, 2019), while enhancing customer satisfaction by facilitating immediate and personalized responses (Daqar & Smoudy, 2019; Mariani et al., 2023). Moreover, AI strengthens manufacturing and production activities through automation, driving operational efficiency (Kumar et al., 2019). While it is challenging to precisely identify the specific fields where AI excels, it is undeniably an essential tool for strengthening competitive advantage and driving success in increasingly complex markets. (Kovačić et al., 2022). However, it is unlikely that everything will be perfect with AI, given the various challenges that require attention. Among the most significant are research and development, handling big data, privacy concerns, and other related issues. Kruse et al. (2019) and Wang et al. (2020) highlighted the importance of organizations taking these challenges seriously and addressing them in a scientific and systematic manner to achieve satisfactory results.

Within a more focused scope, the integration of AI applications into organizations' internal operations—particularly in human resource management and recruitment—stands as one of the most transformative technological advancements, fundamentally reshaping the processes of employee selection and hiring. According to Mer (2023) the utilization of AI in HRM relies on the capabilities of intelligent systems and advanced software to analyze vast amounts of data to extract precise insights and recommendations. According to (Gong et al.,

2022; Jia et al., 2018; Strohmeier & Piazza, 2015) smart technologies contribute to improving the search and recruitment processes by swiftly and accurately analyzing resumes and extracting crucial information. Agrawal and Agarwal (2022), and Chowdhury et al (2023), and Koechling et al (2023) added that the AI systems also assist in guiding recruitment processes towards selecting suitable candidates based on predefined criteria, reducing the likelihood of human errors, and enhancing the efficiency of the hiring process. Then apparently, AI can be employed in the assessment and testing of candidates' skills and technical abilities. Intelligent systems can design customized tests that precisely align with a company's needs and job requirements, ensuring a more accurate evaluation of candidates.

What truly matters is the quantity, type, and nature of the skills that applicants must possess to secure the job. It is not simply any skills, nor at any given time, but those that strategically support organizational leaders in leveraging AI in an era defined by speed and automation. In the era of AI, there is a set of essential skills that have become increasingly important in various fields of work. It may be challenging to precisely define these skills according to the literature, but they are generally related to (1) understanding technology and programming, such as a basic understanding of AI, machine learning techniques, and fundamental knowledge of programming languages (Verma et al., 2022; Wirtz & Müller, 2019). (2) Data Science and Data Analysis, where applicants Proficient in data manipulation, cleaning, and preprocessing (Jaiswal et al., 2022). (3) Logical thinking and problem-solving skills (Geetha & Bhanu, 2018). (4) Self-directed learning focused on staying informed and continuously keeping up with technological advancements and their applications to enhance job activities (Kapoor, 2023; Lee & Choi, 2021). (5) Collaboration and communication skills encompass written and verbal communication, teamwork, and the ability to use computers effectively. Additionally, these skills contribute to enhancing the effectiveness of both internal and external communications (McCormack et al., 2020). The unique ability to address workplace issues and develop proactive solutions for current and anticipated challenges, as well as to design and implement supportive applications for future forecasting (Hutchinson, 2020). Additionally,

recognizing and understanding the ethical challenges associated with AI-based jobs is crucial. This includes comprehending the ethical implications, ensuring privacy, and verifying data security data (Charlwood & Guenole, 2022; Thamik & Wu, 2022). Finally, the last group of skills pertains to strategic thinking and foresight, as well as the ability to develop business strategies that align with environmental changes and are compatible with growth and sustainability objectives (Jarrahi, 2018).

According to Kobbacy (2012), basic knowledge of technology and programming languages is a crucial characteristic of the skills required for AI-related job applicants. The importance of these skills may vary depending on the specific job type. AI relies significantly on programming, as well as the understanding and analysis of data, with more complex connections yielding greater results. Moreover, foundational technical knowledge enables individuals to address technical workplace challenges, ensuring the continuity of tasks (Bravo et al., 2014; Capatina et al., 2020; Criado & Gil-Garcia, 2019). Cox, (2021), and Tariq et al (2021) noted that AI itself will enable differentiation in the development of routine work applications, deep learning, intelligent systems, and more. the businesses will rely heavily on data to make informed decisions. This necessitates a solid understanding of data, as well as the ability to analyze and present it effectively (Wamba-Taguimdje et al., 2020). There are many arguments stated that AI technologies provide a framework for leveraging data to enhance operational efficiency (Dubey et al. 2020; Enholm et al. 2022). Moreover, the appropriate use of data aids in understanding customer needs and desires, analyzing future market trends, and effectively meeting demand (Bharadiya, 2023).

According to Power et al. (2019), logical thinking as a crucial factor in understanding data structures and systematically simplifying their analysis, leading to more relevant decisions. Meanwhile, Van Aken and Berends, (2018) identified the urgent need for problem-solving in the face of unprecedented challenges, including technological difficulties and changes in work patterns. the creative thinking abilities and enhanced problem-solving skills make job applicants more valuable in the job market (Dwivedi et al. 2021; Verganti et al. 2020). According to Asatiani et al.

(2021), and Brock and Von Wangenheim, (2019), technical skills alone are insufficient for obtaining and succeeding in a job unless they are accompanied by other essential—often soft—skills such as effective communication, collaboration, and the ability to build productive working relationships. The integration of these skills reflects adaptability and success in overcoming challenges. The importance of effective communication for understanding and solving complex problems in innovative ways. These skills are particularly suited for high-dynamic work environments (Paschen et al., 2020). Ethics are also essential considerations when introducing new technologies in the business sector, particularly AI (Baum, 2020). AI applications involve data from employees, customers, and partners, making data security a critical concern.

Moreover, strategic thinking emerges as a crucial factor in AI functions. It enables professionals and practitioners to comprehend the surrounding context, analyze trends, and anticipate challenges in both the near and distant future (Kula & Naktiyok, 2021; Pedro et al., 2019). It's worth to mention here that a deep understanding of the technology and its users contributes to aligning goals, setting priorities, and optimizing resource allocation (Borges et al. 2021; Huang & Rust 2021). According to Branch (2018), strategic thinking skills support the development of more comprehensive plans, which may include AI adoption projects themselves. Strategic thinking is also likely to enhance the interaction and collaboration of teams within the organization, as well as between the organization and external entities (La Torre et al., 2021). This unifies efforts toward a common goal more effectively. Abulsaoud Ahmed Younis & Adel (2020), and Jarrahi (2018) clearly stated that strategic thinking is now more essential than ever for the success of AI-related functions.

3 METHODS

3.1 Scale development

To start developing scale, it is important to theoretically review aspects of the scale, including its objectives as (Ruslin et al., 2022) stated. In alignment with the visions of (Lintner, 2024) we first began with qualitative analysis by conducting a series of interviews with human resource managers and their assis-

tants in various industrial sectors, which we will refer to later. We are attempting to identify critical issues relevant to the scales through semi-structured interviews. We selected a non-probabilistic sampling of 37 HR managers and assistant managers. We conducted interviews using a principal question that stated, "In your opinion, what are the most important human resource skills required for positions related to artificial intelligence?" At the same time, we discussed with them a wide range of AI-related skills, based on an extensive review of the existing literature.

Almost all of those interviewed pointed out that the recruitment process has become more challenging as a result of the impact of artificial intelligence on the job market. A significant number of respondents noted that job interviews now place greater emphasis on skills related to interacting with AI applications. During the discussion, there was a consensus that the ability to use AI effectively increases the number of tasks an individual can perform, indicating the potential for a substantial expansion in performance. Some respondents pointed out that their goal is not only to hire individuals who can handle AI applications, but also effective users who can achieve more significant results by utilizing the same applications. When discussing the ethical implications of AI in the job market, respondents expressed genuine concerns about the increasing potential for deceptive practices. While most of the discussion focused on the technical aspects of AI, respondents clearly emphasized the importance of complementary skills, including interaction and adaptability.

The selected sample focused on the following sectors: health, education, retail trade, telecommunications, banking services, financial transfer companies, tourism, and consulting. Thematic content analysis was used to analyze the interview data. This helped in identifying similarities and repetitions in responses, thus improving the preparation of the scale's components. Later, a new sample consisting of 26 researchers and specialized academics in the field of human resource management was selected. We conducted the interviews in the same manner as before and performed theoretical analysis once again. Eventually, we identified the elements that received the highest frequency and included them within the scale's items. In the final stage, we presented the scale and its primary elements to a group

of experts and university professors specializing in human resource management. We made several revisions and modifications to the initial model before proceeding to the verification stage. Based on an extensive literature review, including scales developed in a similar context, the initial elements of the scale were selected. This choice is supported by feedback from both professional and academic reviewers.

3.2 Scale validation

In the next step, we selected the initial sample consisting of 250 participants based on (Hair et al., 2009) recommendation, which emphasizes the importance of having at least 10 responses for each item of the scale. Thus, we contacted the initial sample to test the scale across 250 participants to validate the scale, specifically, the participants included HR managers, HR assistant managers, job applicants, individuals leaving their positions, freelancers, remote workers, recruitment agents, and consultants across earlier mentioned sectors. We conducted an exploratory factor analysis (EFA) to verify the validity of the psychological measurements. We examined the correlation coefficients between scale items, then matrix determinant, and finally tested the sample adequacy to ensure the possibility of completing the analysis. To extract factors, Principal Component Analysis (PCA) was utilized. then when the matrix was deemed factorable, eigenvalues and the percentage of variance explained by each factor were examined. Graphical plots were then drawn, and parallel analysis was conducted to determine the number of factors to be extracted. Alpha Cronbach was used to verify the consistency, accuracy, and reliability of each scale factor. The statistical software used in these analyses was the Statistical Package for the Social Sciences (SPSS), v.26.

Google and Microsoft Forms were used to distribute the survey online. We focused on obtaining responses from human resource managers as much as possible. Another group of professionals, specializing in artificial intelligence, neural networks, and programming, were requested to answer the questionnaire. as well as academics in the field of human resource management, also participated in the response. We reviewed the outputs of the exploratory factor analysis, taking into account the reviewers'

comments from various disciplines, the correlations between the items, and the model quality indicators, including the fit indices and comparison measures. As a result, we excluded 21 items from the scale due to their weak representation of the factors. In that case, the total number of survey items is 47, distributed according to 5-point Likert scale, varying from (I fully agree=5 to I fully disagree=1).

4 RESULTS

4.1 Exploratory Factor Analysis

The outputs of quantitative analysis confirmed that the sample is ready for analysis adequately, with a Kaiser-Meyer-Olkin (KMO) value of approximately 0.898, $p=0.000$ indicating high adequacy. Additionally, the number of variables is higher than the number of factors. We defined the acceptable values based on the eigenvalues that are equal to or less than 1.5, explained variance percentage above 2.5% of each factor. Six factors were extracted using the principal components method according to the aforementioned criteria, which were inputted into the program. Due to the acceptable loading value of 0.5 or higher, 7 elements with lower loading values have been deleted. Accordingly, the scale in its final form consists of 6 components formed from 40 items. The tables below illustrate the extracted components, the factors shaping them, and loading values.

Further examination and observation were conducted to frame the relationship between the elements and factors. The focus was given to examining elements with similar contexts according to the values of correlation and loading. The emphasis was placed on common features among the elements, which ultimately formed independent factors. It was logical for diverse factors to form, differing in context but linked to the necessary AI skills for modern jobs. The following tables summarize the elements of the scale and the loading values for each element. The explained variance value for the entire model was reported at 60.39%. Additional data about the extracted factor was presented at the end of each table.

Table 1 presents the outputs of the first factor. The context of the elements that have composed the factor refers to the technical side related to functions. The elements of the first factor reveal the knowledge and technical capabilities of respondents towards the effective use of AI in the business aspect. According to the context of the elements that focus on programming languages, machine learning, data structures, unfamiliar operating systems, and so on, the first factor somehow refers to the technical skills necessary to deploy AI effectively in businesses. According to the foregoing, the first factor was named initially as the “Technical Knowledge”. We believe that this name encompasses the essential elements of the factor.

Table 1: Factor 1 outcomes (Technical Knowledge)

Item	Code	Statement	Loading
1	Q34	I am familiar with the programming languages necessary for developing artificial intelligence applications.	0.58
2	Q35	I have a deep understanding of machine learning concepts and techniques, as well as neural networks.	0.67
3	Q36	I have a deep understanding of data structures and algorithms.	0.50
4	Q37	I can extract and analyze data efficiently using tools such as Python, R, and data libraries.	0.51
5	Q38	I have the necessary system design skills for developing artificial intelligence applications.	0.68
6	Q39	I have research skills and a commitment to continuous learning to keep up with developments in the field of artificial intelligence.	0.59
7	Q40	I can apply the principles of software engineering in software development.	0.71
Explained variance= 14.20%, Eigenvalue=8.00			
Note: This factor comprised seven items and demonstrated a reliability of 0.901 in EFA (Cronbach's α) and 0.842 (Guttman Split-Half Coefficient)			

Table 2 shows the outputs of the second factor. The context of the elements refers to mathematical-related skills. The elements of the factor reveal the respondents' capabilities in applying mathematical concepts and techniques in problem-solving and data analysis. According to the context of the elements that focus on differential and integral calculus, solving complex mathematical equations, and understanding statistics, probability theory, and data analysis through mathematics, the first factor is closely related to the mathematical skills necessary for effective decision-making and analysis in business. The second factor was named 'Mathematical Skills' accordingly.

Table 3 illustrates the outputs of the third factor. The context of the elements refers to the programming-side skills of the job. The elements of the factor

reveal the sample's capabilities in various aspects of programming and data handling. According to the context of the elements, which focus on knowledge of machine learning techniques and artificial neural networks, proficiency in programming languages such as Python, Java, and C++, and the ability to analyze and organize data using tools like Pandas and NumPy, the third factor is closely related to the programming skills necessary for developing and implementing machine learning algorithms and managing artificial intelligence projects. Thus, we believe that "Programming" will fit as a name for this factor.

Table 4 showcases the outcomes of the fourth factor. The context pertains to the critical thinking skills essential for the role. The elements of this factor reflect the respondents' abilities in various aspects of critical analysis and information assessment. These el-

Table 2: Factor 2 outcomes (Mathematical Skills)

item	Code	Statement	Loading
1	Q8	I can apply differential and integral calculus in problem-solving.	0.57
2	Q9	I can solve complex mathematical equations.	0.61
3	Q10	I understand the concepts of statistics and probability.	0.63
4	Q11	I understand the concepts of probability theory.	0.63
5	Q12	I can understand and analyze data using mathematics.	0.50
Explained variance= 13.29%, Eigenvalue=7.44			
Note: This factor comprised five items and demonstrated a reliability of 0.806 in EFA (Cronbach's α) and 0.805 (Guttman Split-Half Coefficient)			

Table 3: Factor 3 outcomes (Programming)

item	Code	Statement	Loading
1	Q13	I have good knowledge of machine learning techniques and artificial neural networks.	0.76
2	Q14	I can write and program in various programming languages such as Python, Java, and C++.	0.64
3	Q15	I can efficiently analyze and organize data using tools and techniques like Pandas and NumPy.	0.70
4	Q16	I have the ability to develop and implement machine learning algorithms and improve them.	0.64
5	Q17	I can effectively handle artificial intelligence projects from planning and development stages to implementation and evaluation.	0.60
6	Q18	I can work with big data efficiently.	0.69
Explained variance= 12.54%, Eigenvalue=7.02			
Note: This factor comprised six items and demonstrated a reliability of 0.791 in EFA (Cronbach's α) and 0.704 (Guttman Split-Half Coefficient)			

ements emphasize the importance of analyzing information from diverse sources, assessing the accuracy and reliability of that information, and identifying biases and assumptions. Additionally, understanding how to apply critical thinking to the design and implementation of intelligent models is crucial. Skills such as estimating probabilities, evaluating performance based on data, analyzing results, and making informed decisions are highlighted. Identifying unexpected behaviors and patterns in data is also a key aspect. For all the above-mentioned conceptions, the fourth factor is named "Critical Thinking".

Table 5 illuminates the results of the fifth factor. This segment delves into the creativity and innovation skills vital for the role. The elements of this factor reflect respondents' prowess in thinking outside the box, devising new solutions to intricate technical challenges, and fostering innovative approaches in AI projects. These elements underscore the significance of creative experimentation, connecting disparate concepts, and transforming ideas into groundbreaking solutions. Additionally, mastering the art of designing and implementing novel technological solutions is paramount. Skills such as embracing new projects

Table 4: Factor 4 outcomes (Critical thinking)

item	Code	Statement	Loading
1	Q19	I can analyze information from various sources critically.	0.58
2	Q20	I can assess the accuracy and reliability of information.	0.49
3	Q21	I can identify biases and assumptions in information.	0.67
4	Q22	I understand how to apply critical thinking in designing and implementing intelligent models.	0.66
5	Q23	I can estimate probabilities and evaluate performance based on available data.	0.59
6	Q24	I am able to analyze results and make intelligent decisions based on data evaluation.	0.61
7	Q25	Identifying unexpected behaviors and patterns in data.	0.70
Explained variance= 9.03%, Eigenvalue=5.06			
Note: This factor comprised seven items and demonstrated a reliability of 0.885 in EFA (Cronbach's α) and 0.727 (Guttman Split-Half Coefficient)			

Table 5: Factor 5 outcomes (Creativity)

item	Code	Statement	Loading
1	Q26	I excel at thinking outside the box and innovating new solutions to complex technical challenges.	0.51
2	Q27	I master experimentation and testing processes to enhance performance and efficiency in artificial intelligence projects.	0.64
3	Q28	I can design and implement innovative technological solutions in the field of artificial intelligence.	0.76
4	Q29	I can creatively connect different concepts.	0.58
5	Q30	I can work on new projects without fear of failure.	0.51
6	Q31	I can work independently and within a team.	0.76
7	Q32	I can turn ideas into innovative solutions.	0.64
8	Q33	I identify work challenges and find solutions for them.	0.57
Explained variance= 6.69%, Eigenvalue=3.90			
Note: This factor comprised eight items and demonstrated a reliability of 0.902 in EFA (Cronbach's α) and 0.851 (Guttman Split-Half Coefficient)			

without fear of failure, working both independently and collaboratively, and navigating challenges with inventive solutions are accentuated. Identifying and addressing unexpected patterns and behaviors in data is also a critical aspect. Given these notions, the fifth factor is termed “Creativity”.

Table 6 highlights the findings of the sixth factor. This section explores the adaptability skills essential for the role. The aspects of this factor reflect respondents’ ability to adjust to changes in the work environment, swiftly acquire new skills, and communicate clearly and effectively with others. These skills include managing unexpected situations, dealing with diverse cultures and customs, and adapting to technological advancements. The importance of understanding and integrating new technologies, particularly in the realm of AI, is emphasized. The ability to embrace change, both independently and collaboratively, and to navigate unforeseen challenges with agility is crucial. Recognizing and addressing unexpected patterns and behaviors in data is also a significant part of this factor. Hence, the sixth factor is termed “Adaptation.”

4.2 Confirmatory Factor Analysis

The good results of the exploratory factor analysis highlight the importance of conducting a confirmatory factor analysis to validate the extraction of factors and the validity of the theoretical construct. After verifying the measurement validity, we selected a new sample to conduct confirmatory factor analysis. The goal was

to match the size of the original sample, but this was not possible. We received 239 responses from the new sample. Using AMOS software, the components and their factors were formed. Figure 1 shows that the correlation values of the elements with the components were all good and statistically acceptable, indicating the quality of the measurement. In the CFA conducted, the chi-square (χ^2) test yielded a value of 6340 with 1225 degrees of freedom. The associated p-value was 0.000 (less than 0.001), indicating that the null hypothesis can be rejected. This suggests a significant discrepancy between the observed data and the model’s expected data, implying that the model may not fit the data well. However, it should be noted that the chi-square test is sensitive to sample size, and large samples may result in significant chi-square values even for models with good fit. Now with 239 responses, chi-square may be less meaningful in good fit testing. The model fit has been evaluated via several fit indices to determine how well the proposed model may match the observed data. The Goodness-of-Fit Index (GFI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA) have been reported to test the fit indices.

The Goodness-of-Fit Index (GFI) was 0.957, suggesting that the model has a very good fit to the observed data, indicating that the model adequately represents the data structure since the index ranges from 0~1, with higher values indicating a better fit (usually higher than 0.09). Comparative Fit Index (CFI) value, on the other hand, was 0.914, which was considered an acceptable value, meaning that the model has an acceptable fit when compared to an indepen-

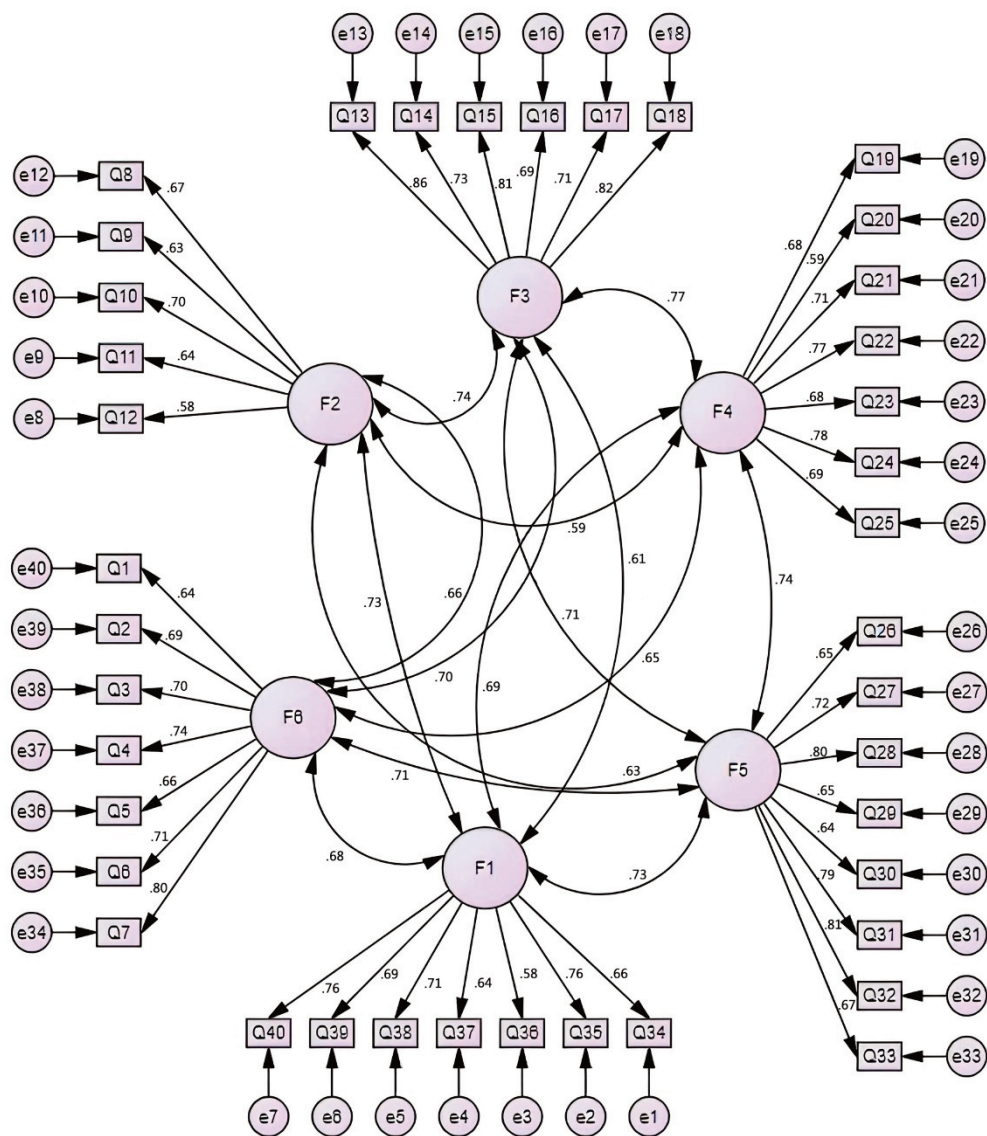
Table 6: Factor 6 outcomes (Adaptation)

item	Code	Statement	Loading
1	Q1	I can adapt to changes in the work environment.	0.49
2	Q2	I can learn and acquire new skills quickly.	0.71
3	Q3	I can communicate clearly and effectively with others.	0.61
4	Q4	I can handle unexpected situations.	0.59
5	Q5	I can deal with different cultures and customs.	0.54
6	Q6	I can adapt to changes in technology.	0.61
7	Q7	I understand the utmost importance of technological advancements in the field of artificial intelligence.	0.60
Explained variance= 4.26%, Eigenvalue=2.38			
Note: This factor comprised seven items and demonstrated a reliability of 0.739 in EFA (Cronbach’s α) and 0.712 (Guttman Split-Half Coefficient)			

dent model. The CFI also ranges from 0~1, with values closer to 1 indicating a superior fit (usually higher than 0.09). Most importantly, the reported Root Mean Square Error of Approximation (RMSEA) value is 0.069. which signifies that the model fits the data reasonably well, falling within the acceptable range for a good model fit. As known in statistical literature, RMSEA measures how well the model would fit the population covariance matrix, with values less than 0.05 indicating a good fit, values up to 0.08 representing reasonable errors, and values up to 0.10 indicating a mediocre fit.

Based on the aforementioned results, the model can be utilized to measure the essential human resource skills required for securing employment in the age of artificial intelligence, according to the surveyed sample within the sector. The model can also be adapted for new sectors or samples with the necessary modifications. The results demonstrated the model’s measurability and its suitability for use in both academic and professional fields.

Figure 1: CFA outcomes



$X^2= 6340$ $df= 1225$ $P. 0.000$ $GFI= 0.957$ $CFI= 0.914$ $RMSEA= 0.069$

5 DISCUSSION

Naturally, the conditions accompanying jobs change as the surrounding environmental factors change. It is highly likely that the criteria for job applicants will change due to shifts in labor market trends, industry concentrations, and the adoption of new knowledge-based jobs. However, human resource management remains at the center of the storm. HR managers will need to adapt effectively and respond swiftly to changes in the job market, realigning recruitment requirements accordingly. Human resources professionals (HR professionals) tend to believe that possessing artificial intelligence skills positively impacts job seekers' chances of securing new employment. AI is considered a vital skill in the modern job market. Such skills enhance applicants' ability to handle advanced technologies, making them more attractive to employers who aim to bolster their technological capabilities and improve operational efficiency. Six factors expressing job applicants' skills in the era of AI have been identified. Of course, there may be other factors in different samples or environments. In the current study, the extracted factors have achieved a high degree of interpretation and verification.

Initially, the first extracted factor expresses the technical nature of the skills possessed by the job applicant. The emphasis here is on advanced computer skills, surpassing traditional usage. Computer skills are of utmost importance nowadays for jobs, but not in the traditional sense. It is almost assumed that applicants should possess computer skills that exceed achieving traditional outcomes in performing daily tasks. It is likely that job performance methods will evolve in a way that renders traditional skills inadequate. Therefore, in future jobs, there will be greater emphasis on AI applications. Prospective applicants must possess the technical skills that qualify them for real job opportunities. This factor had achieved the highest explanatory variance, perhaps indicating its utmost significance among the skills required for contemporary jobs. Based on theoretical support in literature, many researchers have emphasized the importance of technical skills in securing employment in the era of AI (Bruun & Duka, 2018; El Hajal & Rowson, 2020; Verma et al., 2022). While in this part, the findings of the current paper differ from

those presented by (Verma et al., 2022), as they suggest that technical knowledge skills are more closely aligned with machine learning roles rather than artificial intelligence, although their strong relevance to AI is not denied.

The second factor points to the importance of mathematical and algebraic skills for future jobs. While the relationship between mathematical skills and job performance appears unclear in traditional roles, AI jobs heavily rely on the ability to solve mathematical equations. In fact, innovation in mathematical equation analysis indicates a promising future in AI-based jobs. It is crucial to assert that mathematics and algebra serve as a strong foundation for developing the skills necessary to work in the era of AI. They are likely to significantly enhance critical, analytical, and creative thinking abilities, facilitate the comprehension of new technologies, and foster innovation in advanced technological fields. Verma et al. (2022) argues for the importance of mathematical skills for machine learning jobs rather than AI, though he does not negate their importance. Conversely, Hersh et al. (2023) finds mathematical skills to be a cornerstone in AI jobs. These discussions highlight the importance of programming as a crucial factor in AI jobs. Individuals with advanced technical skills and deep mathematical abilities are more qualified to possess the necessary programming skills for AI roles. Samek et al. (2021) reported that programming skills are considered "must-haves" for AI jobs.

Regarding the remaining three factors, they collectively focus on essential soft skills necessary for success in future jobs. Verma et al. (2022) have emphasized the generality of skills required for AI jobs, giving greater attention to personal skills over technical ones. Jaiswal et al. (2023) acknowledged that even with the shift towards robotic in jobs, personal skills such as logical thinking, learning ability, and others will remain highly important for employees. Recognition must be given that technical or computer skills alone are insufficient for future jobs. Conversely, personal skills are more prevalent in literature. This presents new challenges for HR professionals in identifying candidates who achieve a good balance between technical and personal skills. Critical thinking, creativity, and adaptability are the remaining three factors. Working in the field of AI requires the ability to deeply analyze and comprehend complex data, ne-

cessitating precise and logical interpretation. Moreover, enhancing the capacity for informed decision-making based on evidence and analysis ultimately facilitates making more accurate and effective decisions in AI applications. The findings of our paper support (Li, 2023) conclusion on the necessity of considering critical thinking as a distinctive skill for future jobs. This aligns with (Spector & Ma, 2019) perspective, although he emphasized that the focus on artificial intelligence should not overshadow the importance of human intelligence.

Additionally, creativity aids in finding new solutions to complex problems that were previously nonexistent. The ability to think outside the box and generate new ideas enhances the potential for utilizing smart technologies in innovative and efficient ways. Despite the debate over whether creativity supports artificial intelligence or vice versa in the workplace (Jia *et al.*, 2024), we focus on individual creative skills to enhance the use of AI in improving job performance. Additionally, we actively highlight ethical issues in alignment with (Vinchon *et al.*, 2023) perspective. Moreover, adaptation constitutes a fundamental aspect in AI domains, where variables change rapidly, necessitating agility and adaptability to effectively navigate new environments. While (Bahadure *et al.*, 2024) views adaptation in the age of artificial intelligence as the creation of more jobs to replace those lost due to AI, our current paper highlights adaptation as the ability to develop skills and persist despite the rapid shifts in employer requirements. With broad-ranging research contributions in defining future job skills, HR professionals will encounter varying degrees of challenges within the same HR roles. The characteristics of HR roles are likely to undergo significant changes in the near future, becoming more adaptive and requiring AI capabilities. It will be essential to inform senior management early about these developments, prepared to develop or modify business organization strategies.

6 CONCLUSION

Contrary to what (Pinski & Benlian, 2023) have proposed, the focus of the current paper is on job applicants' skills rather than their general knowledge of artificial intelligence. The current paper investigates the key skills that job applicants must possess

in the era of artificial intelligence. Across various sectors, semi-structured interviews were conducted with a group of HR professionals holding different job positions. To ensure the validity of the results, we also interviewed academic experts in human resources to establish a suitable procedural basis for conducting the research. The focus on jobs related to AI received greater attention during the interview, including the challenges faced by HR professionals concerning recruitment and talent acquisition. We aim to develop a specialized scale to identify the skills required for future job applicants, enabling researchers and professionals to utilize it in measuring the skills necessary for future employment.

Based on previous literature, reviewers' comments, and sample responses, we conducted both exploratory and confirmatory factor analyses. Six factors representing the skills required for future jobs related to AI were identified. We thoroughly verified the validity and reliability of the model for measurement and application. An interesting discovery is that the six factors are distributed across two fields: "technical" and "soft" factors. The three technical factors extracted were technical, mathematical, and programming skills. These factors represent the essential computer skills necessary to perform tasks effectively. They include, but are not limited to, programming languages, neural programming, designing AI applications, as well as skills in solving complex mathematical problems and probability theory. The remaining three factors encompass critical thinking, creativity, and adaptivity skills. This set of skills focuses on deep understanding, analysis, discovering unique solutions, and effectively adapting to evolving conditions in the work environment, including technological advancements.

According to the ranking of factors in terms of their ability to explain variance within the model, those with complex technical skills are most likely to secure jobs in the near future. Furthermore, it is likely that there will be a shift in wage rates, prioritizing individuals whose skills align with AI-related tasks. Even with soft skills, we are witnessing a shift towards skills based on analysis and logical thinking. Overall, these skills are expected to create new ways of working, new job tasks, or even entirely new professions. The impact of the skills extracted from the model extends to human resource management professionals them-

selves. It is now essential for HR professionals to possess adequate technical and analytical knowledge to effectively evaluate candidates. Additionally, it is crucial for HR management to reconsider job descriptions and analyses in accordance with changing employment trends and market needs.

6.1 Limitations and Directions for Future Research

This study was conducted in Iraqi companies and their foreign branches (within a limited scope) in the Middle East only. It is difficult to generalize the results of the study to different regions of the world without making adjustments. The study was limited to different sectors through random samples. Therefore, we believe that the AI job skills assessment model we developed in the current study is suitable for use by local companies similar to the selected sample. Consequently, expanding the sample size and including new sectors in the survey are among the most important limitations of the current study. It is essential to note that some respondents did not have sufficient knowledge of the elements they addressed in the survey. To increase the accuracy of the results, the sample

should be well-versed in job market changes and the nature of the required skills. The experience of AI within job functions remains a recent phenomenon within the surveyed sample. Conducting further empirical studies may reveal additional factors that are more relevant to the experience of the sample

6.2 Implications

For practitioners, the current paper provides insights into the skills required for artificial intelligence roles. The findings of this paper offer a detailed examination of the skills most relevant to future jobs. HR professionals and practitioners can take additional measures to ensure the availability of the skills identified within the model of this paper. Additionally, HR professionals can benefit from the recommendations presented in this paper for developing a new strategy for the implementation and adoption of AI applications within their organizations. The current paper outlines the skills necessary for securing future job opportunities. This is beneficial for job applicants or those seeking employment that better matches their skills, thereby increasing their chances of job stability.

EXTENDED SUMMARY/IZVLEČEK

Z naraščajočim zanimanjem za umetno inteligenco se organizacije vse bolj osredotočajo na privabljanje nadarjenih kandidatov, ki lahko izboljšajo organizacijsko uspešnost z izkoriščanjem prednosti umetne inteligence. Namen tega prispevka je razviti lestvico za prepoznavanje spretnosti, ki so najbolj usklajene z zahtevami prihodnjih zaposlitev in bi jih morali imeti kandidati. Za analizo spretnosti prihodnjih zaposlitev je bila uporabljena faktorska analiza, tako eksplorativna kot potrditvena. Na podlagi relevantne literature, povratnih informacij udeležencev in revizij strokovnjakov je bilo oblikovanih 40 merskih postavk, kar je v elektronski anketi, v kateri je sodelovalo 250 udeležencev v primarni raziskavi in 239 v potrditveni fazi iz različnih sektorjev, privedlo do izločitve šestih dejavnikov. Rezultati so razkrili šest dejavnikov, ki predstavljajo bistvene spretnosti kandidatov za prihodnje zaposlitve. Ti dejavniki, razvrščeni glede na lastne vrednosti in pojasnjeno varianco, so: tehnične spretnosti, matematične spretnosti, programske spretnosti, kritično mišljenje, ustvarjalnost in prilagodljivost. Dejavniki so bili poimenovani glede na usmerjenost elementov. Izvirnost raziskave je v sistematični predstavitvi nabora spretnosti, primernih za delovna mesta, povezana z umetno inteligenco. Raziskava ponuja vredne usmeritve praktikom na področju managementa človeških virov pri oblikovanju postopkov zaposlovanja.

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A BIBLIOMETRIC AND TOPIC MODELING ANALYSIS OF ENTREPRENEURIAL EDUCATION AND ENTREPRENEURIAL INTENTION FORMATION

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Abstract

We examine the field of Entrepreneurship Education (EE) and Entrepreneurial Intention (EI) through bibliometric analysis and topic modeling to map its current intellectual landscape. Drawing on 390 documents from the Scopus database published between 2018 and 2023, we conduct a comprehensive analysis incorporating performance metrics, bibliographic coupling, topic modeling, and methodological assessment. Our findings reveal a growing scholarly focus on entrepreneurial education and intention formation. Bibliographic coupling analysis identifies six distinct research clusters addressing: the dynamics of entrepreneurial education and innovation, gender's role in entrepreneurial education, self-efficacy, antecedents of entrepreneurial intention, and applications of the theory of planned behavior. Complementing this structural analysis, Latent Dirichlet Allocation (LDA) topic modeling of article abstracts uncovers fifteen significant thematic areas that signal promising directions for future research. We advance understanding of the field's intellectual evolution by systematically mapping its knowledge structure and emerging themes. Our findings offer valuable implications for researchers, educators, and policymakers seeking to strengthen entrepreneurial education and cultivate entrepreneurial intentions among learners.

Keywords: Entrepreneurial education, Entrepreneurial intention, Bibliometric analysis, Bibliographic coupling, Topic modeling

1 INTRODUCTION

To foster the development of entrepreneurs globally, it is crucial to improve education related to entrepreneurship. Peter Drucker quoted in (Kuratko, 2003) has said, "The entrepreneurial mystique? It's not magic, it's not mysterious, and it has nothing to do with genes. It's discipline. And, like any discipline, it can be

learned." In the realm of research on university entrepreneurship, the focus has consistently been on the entrepreneurial intention (EI) of students in higher education, specifically their inclination to create new ventures. The influence of Entrepreneurship Education (EE) can be gauged by the shift in students' EI. Simultaneously, in alignment with the Theory of Planned Behavior (Ajzen, 1991), behavioral intention serves as a

robust predictor of actual behavior, suggesting that individuals with high entrepreneurial intentions are more prone to emerge as future entrepreneurs. In the realm of entrepreneurship literature, it is widely acknowledged that entrepreneurial intention serves as the most effective tool for anticipating entrepreneurial conduct. Considering this, academic endeavors have concentrated on elucidating the factors that precede and influence this intention. Most studies on entrepreneurship education suggest a positive correlation between entrepreneurial education and the actual rates of entrepreneurship (Fayolle & Liñán, 2014; Lima et al., 2015).

Entrepreneurship education presents a potential avenue for nurturing the factors influencing entrepreneurial intentions and enhancing entrepreneurial skills (Bae et al., 2014). Numerous academic institutions have incorporated entrepreneurship-related courses and seminars into their curricula to cultivate entrepreneurial attitudes, skills, and personal traits. This approach equips individuals with the essential tools required to initiate and manage a new business (Fayolle, 2018; Wu et al., 2022). The impact of entrepreneurship education on entrepreneurial intentions has sparked a plethora of studies connecting both concepts. However, the outcomes haven't been as definitive as anticipated. Despite this surge in research, a notable deficiency in systematization and coordination persists, necessitating a fresh start with each new study (Fayolle & Gailly, 2015).

Our study is relevant to understanding how crucial entrepreneur education is in forming students' intentions to start a venture. Also, there is a need for evidence-based insights to improve the educational frameworks and policymaking on the part of educational institutions. Incorporating recent literature is crucial in any research field to ensure that the study reflects the current state of knowledge and addresses contemporary issues.

The field of entrepreneurship education is getting notable attention in terms of research studies and the domain, the reason being the significance of entrepreneurship at all levels. This encompasses various reviews of entrepreneurship education that advance a thorough comprehension of this discipline. Galvão et al., (2018) reviewed 383 studies of entrepreneurial

education published during the period 1973-2016 and suggested a fresh, comprehensive viewpoint for upcoming research and emphasis on the co-dependence of universities, industries, and governments. After reviewing 159 studies that were released during 2004-2016 in top journals for management and entrepreneurship. Nabi et al. (2017) criticized a few shortcomings of entrepreneurship education research, which are concerned with intention-action gaps, and suggested new research directions. In more recent times, the research trajectory of entrepreneurship education, the identification of new research horizons, and the exploration of emerging trends in literature were investigated by (Tiberius & Weyland, 2023). A comprehensive literature review and bibliometric analysis by (R. T. Syed et al., 2023) attempted to identify a relationship between entrepreneurial education and entrepreneurial intention. Nevertheless, the substantial global growth of entrepreneurship education necessitates a more exhaustive and detailed analysis of studies on the subject. The rapid growth of the dynamics of entrepreneurship education calls for a comprehensive analysis of the development path and recent and upcoming trends in the field of entrepreneurial education.

The study will answer the following research questions:

RQ 1: What are the emerging research directions and trends in the field of entrepreneurial education and entrepreneurial intention?

RQ 2: What is the intellectual structure and key research themes in the field of entrepreneurial education and entrepreneurial intention?

RQ3: What are the methodological limitations of the existing literature on entrepreneurial education and entrepreneurial intention?

RQ 4: What are the research gaps and scope for future studies in the field of entrepreneurial education and entrepreneurial intention?

Addressing the above research questions, we present a comprehensive analysis of global literature to understand the evolution of contemporary research in the domain. This study contributes to

the literature in terms of key themes and significant topics of the domain, which are underexplored, i.e., STEM education and industry interface, the impact of E-learning and innovative pedagogies, the role of social entrepreneurship, and gender perspective in entrepreneurship education. The methodological analysis in the current study has also contributed to the literature by identifying the methods that need to be used to get the measurable impact of entrepreneurial education on intention. The current study has used techniques such as bibliographic coupling, citation analysis, and topic modeling to determine the intellectual structure, key themes, and significant topics of the recent times. Bibliometrics analysis offers a systematic, comprehensive visualization of themes and clusters of the domain. It has also applied topic modeling to complement the bibliometric coupling technique for better results. Secondly, we pinpoint areas within entrepreneurial education and entrepreneurial intention that require heightened attention, such as a growing focus on innovative pedagogies and the significance of dynamics in entrepreneurial education. Upcoming research should aim to explore the dynamics in entrepreneurial education, and the intentions-actions gap among university students, because it is crucial to enhance the rate of entrepreneurship and own ventures to get the potential financial outcomes that could be realized for national growth.

2 LITERATURE REVIEW

A country's elevated level of entrepreneurship corresponds to heightened economic growth, development, and innovation (Sánchez, 2013). Entrepreneurship contributes significantly to societies, contributing to heightened economic efficiency, the expansion of employment options, and the transmission of innovation to the market (Shane & Venkataraman, 2000). With the growing importance of entrepreneurship, it becomes necessary to acquire the skills and knowledge required. Peter F. Drucker (1953) incorporated the idea of innovation in entrepreneurship education.

As per Deveci (2022) the initial article on entrepreneurship education within an academic setting, as per the inclusion and exclusion standards, was established in 1991. The quantity of articles has

risen since the year 2000. Numerous studies have investigated the most effective methods for teaching entrepreneurship. Nabi et al. (2017) in their study discussed pedagogies and their importance in entrepreneurial education and intention for university students. They analyzed 159 studies based on empirical evidence, published between 2004 and 2016, investigating the effects of entrepreneurship education in university education on diverse entrepreneurial achievements. The authors have used the research framework based on pedagogies in a systematic review (Fayolle & Gailly, 2015) and the measures of impact (Henry & Lewis, 2018) utilized in entrepreneurship education. They emphasize studies that refer to the temporary subjective indicators of lower impact levels of pedagogies in entrepreneurial education.

The literature has also shown that gender perspective is significant in the entrepreneurial intention domain. Many studies have examined gender roles in the formation of entrepreneurial intention. Gabrielsson et al. (2020) analyzed 1341 articles in the domain of entrepreneurial education and found that this field is getting significant attention from research scholars. According to Gabrielsson et al. (2020), Research focusing on teaching methods in entrepreneurial education has evolved into a notable research stream within the domain of entrepreneurial education studies. This development is characterized by a discernible knowledge structure in key topics and seminal research works, alongside several primary journal outlets for discussions and circulation of research outcomes. Syed et al. (2023) reported that a notable surge in publications over the past decade aligns with the period during and following the global economic downturn of 2008–2010. During this previous decade, governments and Higher Education Institutions (HEIs) worldwide have increasingly prioritized and invested in the development of entrepreneurial HEIs. He listed the USA, UK, and European countries among the top 5. The study reveals that 'Research commercialization and venture creation' and 'Entrepreneurial mindset and skills development' are the most prominent clusters in his study of 1072 articles for the period of 1996–2020.

The 'Education and Training' journal represents the most extensively studied theme within the en-

entrepreneurial education and intentions domain, a finding of Deveci (2022), which aligns with the results of our study. Research on ethnic entrepreneurship within the framework of market expansion predominantly occurred in industrialized countries from 1988 to 2018, with a lesser proportion in emerging nations, particularly in Asia. Rodriguez-Ulcuango et al. (2023) discussed different factors that determine entrepreneurial intention, and entrepreneurial education is one of them.

Batista-Canino et al. (2024) in their review note a growing interest and emerging focus on women's entrepreneurial intention and the effects of digital transformation. The study addresses the significance of diverse and underrepresented regions and encourages the use of interdisciplinary frameworks. Another review (Chaudhary, 2024) discovers that in ASEAN+3 countries, entrepreneurship education is crucial for economic growth and innovation, but still, many higher education institutions are facing challenges due to scarce resources in comparison to other Western countries. Haji (2025) highlighted the factors such as personal motivation, social influences, and perceived self-efficacy that consistently affect entrepreneurial intention. Emerging research is focusing on contextual variances, digital influences, and policy interventions.

A growing number of studies on entrepreneurial education are emerging. Nevertheless, a structured review can encompass a limited number of these studies. The current study addresses this gap by offering a comprehensive, quantitative and structured evaluation of the entrepreneurial education domain, the education–industry interface, current topics in entrepreneurial education studies, and prospects for future research in the field of entrepreneurial education with a significant influence of technology.

3 METHODOLOGY

We have analyzed the period 2018–2023 to confine the most recent and relevant developments in the field of entrepreneurship education and intention. Although articles in this domain have been indexed in Scopus since 1997, the overall volume of research remained very limited until 2017, with

fewer than 80 articles published. To ensure that our analysis highlights the contemporary trends, themes, and directions, we deliberately focused on the 2018–2023 period, which represents the most dynamic phase of this domain. Furthermore, bibliographic coupling, one of the techniques used in the study, works better for shorter periods (Zupic & Čater, 2014).

To understand the most significant influences of entrepreneurial education on entrepreneurial intention, and how the available literature is structured, we performed a bibliometric study. Bibliometrics methods are more significant in current times when comprehensive databases and critical analysis technologies are available. These methods are helpful in integration with traditional methods. Bibliometrics provides a broader overview of a research domain, which includes publications, journals, and authors (Merigó & Yang, 2017). Bibliometrics analysis is a part of scientific methods that uses statistical and mathematical techniques to examine the scientific events within a research domain (Callon et al., 1991). Scientific mapping and performance analysis are the two major approaches applied under bibliometrics analysis (Noyons et al., 1999).

Performance analysis is the technique to measure and evaluate the performance of different elements with published output in terms of the country, authors, affiliated institutions, and trends throughout time. The number of research publications and citations per year is the most significant measure of performance (Donthu et al. 2021). In a particular research domain, performance analysis also defines the contribution by authors and journals by measuring the frequency of citations to specific research (Heradio et al., 2016).

However, bibliometric or scientific mapping analysis investigates the relationships between publications, revealing the composition and development of the research field (Ding & Yang, 2022). Bibliographic analysis, co-word analysis, and citation analysis are a few techniques of scientific analysis. These techniques are significant in providing the intellectual structure of the research domain (Donthu et al., 2021). The goal of science mapping is to depict the configuration and evolution of scientific domains (Zupic & Čater, 2014).

Table 1: Review studies on entrepreneurial education and entrepreneurial intention

Year	Author	Title	Journal
2025	Anton Stuwart, Mansingh Paul	Entrepreneurial self-efficacy among students: a bibliometric mapping and topic modelling approach	Entrepreneurship Education
2024	Saloni Chaudhary	Mapping the Scientific Landscape of Academic Entrepreneurship in ASEAN Plus Three Countries: A Scientometric Exploration	Journal of Scientometric Research
2024	Rosa M. Batista-Canino, Lidia Santana-Hernández, Pino Medina-Brito	A holistic literature review on entrepreneurial Intention: A scientometric approach	Journal of Business Research
2023	Olga Rodríguez-Ulcuango, Cristian Guerra-Flores, Gabith Quispe Fernandez, Dante Ayaviri-Nina, José Miguel Giner-Pérez	Bibliometric Analysis of Determining Factors in Entrepreneurial Intention	Academic Journal of Interdisciplinary Studies
2023	Victor Tiberius, and Michael Weyland	Entrepreneurship education or entrepreneurship education? A bibliometric analysis	Journal of Further and Higher Education
2022	Hiranya Dissanayake, Anuradha Iddagoda, Catalin Popescu	Entrepreneurial Education at Universities: A Bibliometric Analysis	Administrative Sciences. An Open Access Journal from MDPI
2022	Juan-José Najera-Sánchez, Cristina Pérez-Pérez, Thais González-Torres	Exploring the knowledge structure of entrepreneurship education and entrepreneurial intention	International Entrepreneurship and Management Journal
2022	Gao Tingting, Yang Jiangfeng and Ye Yinghua	A bibliometric analysis of college students' entrepreneurial intention from 2000 to 2020: Research trends and hotspots	Frontiers in Psychology
2022	Syed M. Afraz Hassan Gillani, Aslan Bin Amat Senin, Jürgen Bode, Muniba, Syed M. Ahmad Hassan Gillani	Bibliometric Analysis of Digital Entrepreneurial Education and Student Intention; Reviewed and Analyzed by VOSViewer from Google Scholar	Dynamic Relationships Management Journal
2022	Raihan Taqui Syed, Dharmendra Singh, David Spicer	Entrepreneurial higher education institutions: Development of research and future directions	Higher Education Quarterly Wiley
2021	Carmen Florina FAGADAR, Diana Teodora TRIP, And Daniel BADULESCU	Entrepreneurial Competencies and Higher Education Institutions: A bibliometric study	Journal of e-Learning and Higher Education
2021	İsa Deveci	Review of Entrepreneurship Education Literature in Educational Contexts: Bibliometric Analysis	Participatory Educational Research (PER)
2020	Jonas Gabrielsson, Gustav Hagg, Hans Landstrom and Diamanto Politis	Connecting the past with the present: the development of research on pedagogy in entrepreneurial education	Education and Training
2019	Gloria Aparicio, Txomin Iturralde, Amaia Maseda	Conceptual structure and perspectives on entrepreneurship education research: A bibliometric review	European Research on Management and Business Economics
2018	Anderson Galvao, Joao J. Ferreira, Carla Marques	Entrepreneurship education and training as facilitators of regional development A systematic literature review	Journal of Small Business and Enterprise Development
2017	Nabi, G., Linan, F., Fayolle, A., Krueger, N., Walmsley, A.	The impact of entrepreneurship education in higher education: A systematic review and research agenda	Academy of Management Learning & Education

3.1 Data source and extraction

Scopus database has been recognized as one of the key platforms for peer-reviewed scientific research literature (Marzi et al., 2025). The Scopus database is the largest database, with over 27 million abstracts currently accessible (Burnham, 2006). We have used the Scopus database only for a few reasons. First, using a single database to avoid citation inflation and duplication of articles. Second, Scopus is the source of relevant and varied disciplinary journals, which is significant for analyzing the intellectual structure of a specific research domain inflation (Donthu et al., 2021; Plekhanov et al., 2023). Furthermore, the data available on Scopus is consistent for analyzing co-citation, co-word, and co-author analysis without manual synchronization (Wang et al., 2018).

Web of Science is a prominent database that focuses on significant research publications in the field of sciences and provides more through historical coverage (Mezquita et al., 2025). On the other hand, the Scopus provides publications, comparable journals in applied, interdisciplinary, and emerging domains (Powell & Peterson, 2017) and covers more journals than Web of Science, especially recent and international publications. We understand that single-database systems could overlook records that are exclusively indexed elsewhere; therefore, we reported complete search strings and filter boundaries. There is a large overlap between Scopus and Web of Science; both have broad coverage, and studies often use only one database (Marzi et al., 2025; Zupic & Čater, 2014). Therefore, using only Scopus database for bibliometric analysis is warranted.

Data is extracted using the Scopus database. The keywords **“entrep* education”** and **“entrep* Intention*”** were used for search criteria to identify articles. The search keywords used were confirmed based on expert recommendations and past literature. The initial search produced 1047 documents. The results show that the current domain has received more attention from researchers in the past three years.

For more precise results, we have applied five criteria to enhance the selection process. The period is defined as 2018 to 2023, as the purpose was

to map the contemporary literature from the research field. The selected articles must be related to the fields of ‘business, management, accounting’ and ‘Economics, Econometrics, and Finance’ as these fields are more relevant to the given study. The other criterion was to select only peer-reviewed research articles, as we required the articles to be scientific papers released in scholarly journals, as these are viewed as credible information sources (Podsakoff et al., 2005). The articles only in the English language are considered (Cardella et al., 2020). After applying the above-mentioned filters, we have received 390 documents. With a manual check, it was confirmed that there were no duplicate or ineligible documents in the dataset. A bibliometric review workflow adapted from (Marzi et al., 2025) is presented in Fig. 1, showcasing the steps of the data extraction process.

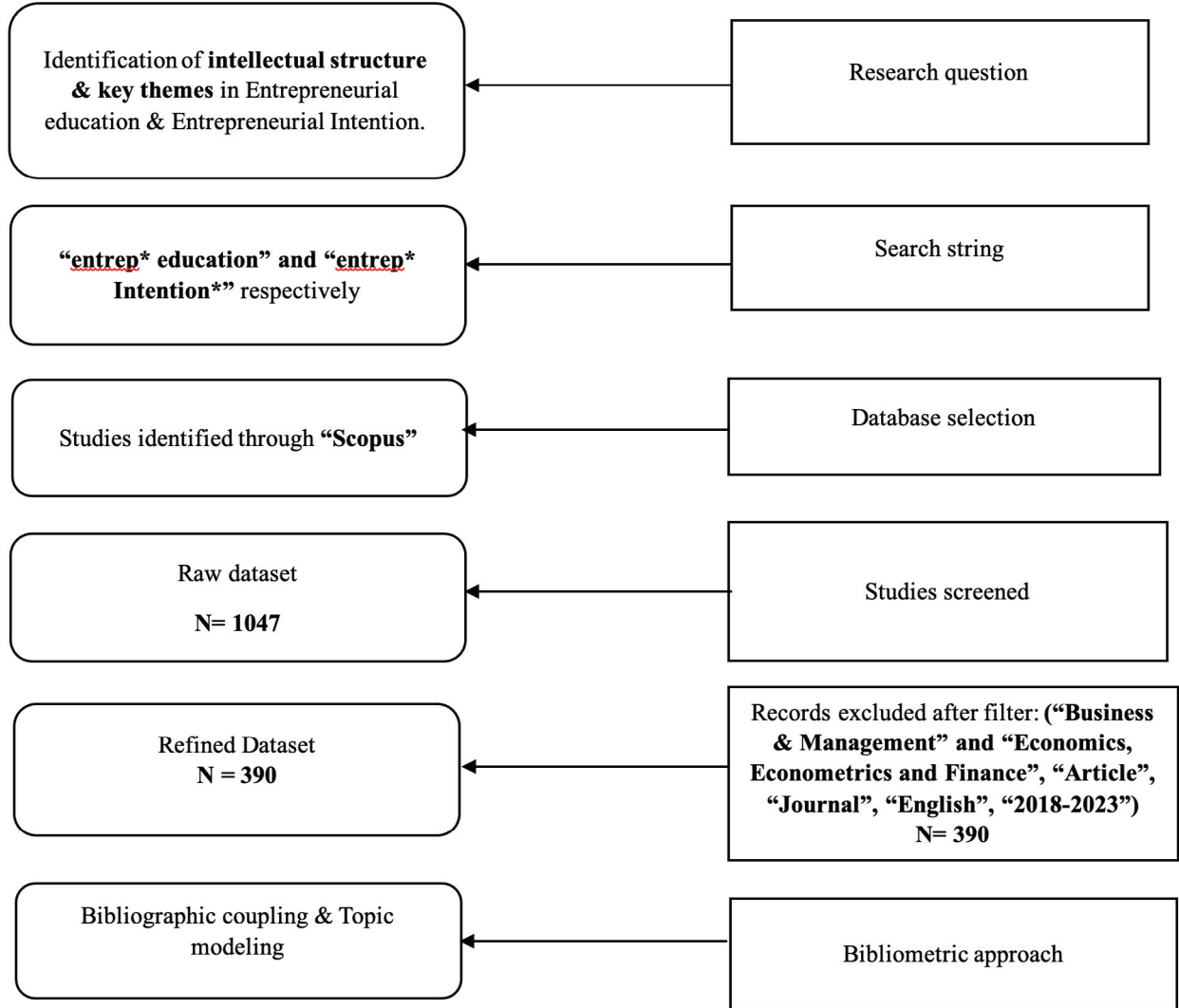
For our investigation, we used the VOS viewer program, version 1.6.10. With the use of this software’s bibliometric techniques, clusters within a strategic matrix may be graphically shown, identified, and categorized based on their likenesses and dissimilarities. Making graphical maps enables a deeper examination of the relationships between variables, improving our understanding of a research field’s features and establishing it as a crucial analytical tool (Vallaster et al., 2019).

In the current study, we have used both methods, performance analysis and science mapping. 1) Performance analysis- top 20 cited documents and journals. 2) Bibliographic coupling, 3) Methodological analysis, and 4) Topic modeling.

3.2 Performance Analysis-Top 20 cited documents and journals

Performance analysis evaluates published output by country, author, connected institution, and growth trend over time to provide insights into the performance of various constituents (Donthu et al., 2021). As a fundamental technique of bibliometrics methods, performance analysis is crucial, especially when analyzing the most cited articles and journals, as it helps the other researchers to determine the reliable channels and work that have significant contributions in the research domain. As per Teplitzkiy

Figure 1: Workflow for bibliometric review (adapted from Marzi et al., 2025)



et al., (2022) most cited journals indicate the source of significant research in the research field and high-citation publications representing the intellectual standards, influencing the later research in terms of methods and agendas

3.3 Bibliographic coupling

A bibliographic coupling mostly assesses recent scientific publications, and scholarly papers are linked and cited using references in their knowledge foundation (Zupic & Čater, 2014). Bibliographic coupling, a science mapping technique under the bibliometrics methods, has been used in various

practical contexts to help practitioners and policy-makers (Trang et al., 2023). By analyzing the shared references of documents, researchers can identify the foundational studies that have shaped a field and track how these foundations have evolved (Ma et al., 2022). Bibliographic coupling strength indicates the number of shared references between two documents. Overlapping bibliographies suggest a stronger similarity between them. Bibliographic coupling focuses on primary documents that cite identical secondary sources. Bibliographic coupling is more appropriate method to map current clusters of documents than co-citation as the coupling mea-

sure is not dependent on accumulated citations. The strength of the connection between two sources increases with the growing number of shared references (Martyn, 1964).

Bibliographic Coupling offers insights with respect to current trends and future priorities, examining the pathways, strengths, and gaps within the structure and evolution of distinct research domains. The technique of bibliographic coupling (based on documents) was employed on the database (390 documents) of entrepreneurial education and entrepreneurial intention, from which the top 250 documents with the greatest total link strength were chosen for visualization. To avoid biases in the bibliographic coupling, the number of citations is limited to zero, so that older articles cannot get the advantage of time. By using link strength as a criterion, the selection emphasizes documents that are strongly interlinked and contribute significantly to the core themes of the research domain, and this ensures that the analysis focuses on the most influential and relevant works within the dataset. Documents with stronger bibliographic coupling share more intellectual foundations, leading to more coherent and interpretable topic clusters. A smaller, high-quality subset of documents allows for more robust and meaningful topic modeling.

In VOSviewer, the resolution parameter is used to control the level of detail in the clustering process. Visualization is generated using a resolution size of 1.05 to achieve an optimal balance between interpretability and detail, avoiding both overdivision and overly broad clusters. The visualization's clarity and reliability were improved by setting the minimum cluster size at 5 to ensure that only significant clusters with adequate bibliometric weight were included. Our analysis resulted in six clusters as per the criteria given in the VOS viewer software visualization. The graphic network of visualization is shown in Fig. 3.

3.4 Topic modeling

The field of "generative probabilistic modeling" gave rise to topic modeling, which was first established in the 1980s. Topic modeling has also been

applied to the analysis of bioinformatics data, and it works especially well with text data (Liu et al., 2016). Topic modeling is a statistical algorithm that reveals the underlying word clusters in a collection of text documents based on an unsupervised machine-learning approach (Blei, 2012). It helps examine the substance of scientific publications to find links, patterns, trends, and their evolution over time that might not be immediately obvious in large and complex datasets (Yang, 2024) (L. T. Nguyen et al., 2024). Topic modeling can help in interdisciplinary research by pointing out possible areas of correlation (Arzani et al., 2023).

One of the most effective text mining methods for detecting correlations between data and text is topic modeling, which is also useful for identifying latent data. Latent Dirichlet Allocation (LDA) is among the most widely recognized in this field (Jelodar et al., 2019). The LDA method, which is the Bayesian probabilistic model, adheres to the principle that documents (comprising titles, abstracts, and keywords) function as a random collection of latent topics, where each topic represents the word distribution (Blei et al., 2003). It comprises four basic parameters: text pre-processing, selection of model parameters, the number of topics to be created, and evaluation of reliability and validity (Assmussen & Møller, 2019). As mentioned by Kaushik et al., (2023) in the LDA method, "topics" are to be identified within a set of documents. In our study, 390 documents are analysed, where each abstract acts as a document.

The LDA model has four steps proposed by Griffiths et al. (2004) as the Gibbs sampling method. The first step is text preprocessing. As a text mining technique, topic modeling requires the dataset to undergo considerable pre-processing before analysis (Maier et al. 2018). Data preprocessing includes lowercasing, removal of stop words and punctuation, lemmatization, and construction of a document term matrix (DTM) (Churchill & Singh, 2021). Under the second step, a set number of topics is defined with the conditional probabilities of both the word's likelihood within a topic and the topic's relevance within a document, governed by Dirichlet hyperparameters (Schwarz, 2018). The next step is to identify the optimal number of topics; for this, different K values are evaluated using statistical mea-

asures such as log-likelihood, perplexity, and coherence scores (Farea et al., 2024). Finally, assessing reliability and validity by assessing the consistency and interpretability of the topic through topic stability, semantic coherence, and expert review (Schroeder & Wood-Doughty, n.d.). To perform the topic modeling analysis, the body of words is created using the data from the abstracts, with each unique word serving as an analytical unit.

Bibliographic coupling and topic modeling are popular methods for quantitative literature reviews. The combination of these two methods provides better results. There are various reasons to adopt these methods. Bibliographic coupling can occasionally miss conceptual connections between publications because two papers may have the same references but distinct areas of interest. By offering a more sophisticated comprehension of document content, topic modeling can overcome this constraint. The inability of topic modeling to pinpoint a field's intellectual heritage, on the other hand, can be overcome via bibliographic coupling. While topic modeling offers a content-based perspective, bibliographic coupling offers a view of a study field's intellectual structure based on citations. When combined, these techniques can offer a more thorough comprehension of the connections between papers and the defining ideas of a topic (Chen et al., 2022). The combination of bibliographic coupling and topic modeling can enhance trend analysis and forecasting (Bzhalava et al., 2024).

3.5 Methodological analysis

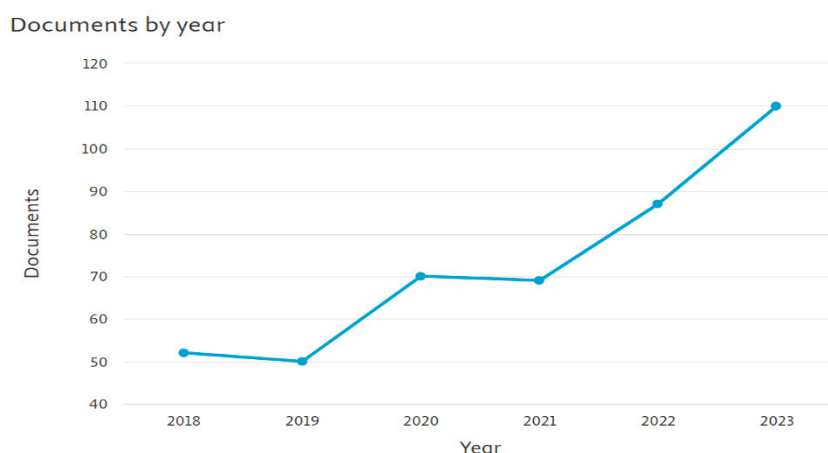
Methodological analysis ensures that the chosen methods generate data that is relevant, reliable, and practical for informing applied policy decisions (Bryman & GBurgess, 1994). Under methodology analysis, the study undertakes the different methodologies used by previous researchers and analyzes the research gap because of the methodology used. Effective use of bibliometric methods can increase the objectivity of literature reviews.

4 RESULTS

4.1 Scientific publication per year

As shown in Figure 2, the number of scientific publications on the subject is increasing in the given period, except for the year 2019. Although articles in this domain have been indexed in Scopus since 1997, the overall volume of research remained very limited until 2017, with fewer than 80 articles published. The progress in the chosen field within the selected study period remained low until 2018, when 52 publications were reported. However, the number of publications decreased again in 2019 (50), after which scientific publications increased in 2020 (70) and 2021(69) but remained almost at the same level. In the years 2022 and 2023, the publications increased rapidly, with 87 and 110 publications, respectively. The trends are showing the significance of this domain. We chose this period to analyze the contemporary research and focus on new trends.

Figure 2: Publication from 2018-2023



4.2 Top cited documents

Table 2 shows the list of the most cited documents in the field of entrepreneurial education and entrepreneurial intention. "Entrepreneurial intention among engineering students: The role of entrepreneurship education" (Barba-Sánchez & Atienza-Sahuquillo, 2018) has been cited 252 times, and it focuses on the effect of entrepreneurial education on the intentions of engineering students. Being a vast field, engineering is given more attention with respect to entrepreneurial intentions. Following this, (Nowiński & Haddoud, 2019) with 121 citations, (Şahin et al., 2019) with 118 citations, and (Ahmed et al., 2020) 103 citations are also contributing to the field with different constructs in combination with entrepreneurial education and intention.

4.3 Top-cited journals

Table 3 presents the list of the top 20 cited journals of entrepreneurial education and entrepreneurial intention based on data from VOS viewer software. "Education and Training Journal" has been cited 595 times with 31 documents. Though "International Journal of Entrepreneurial Behavior and Research" has 523 citations with only 19 documents and marks an important presence in the field. Following this, the "International Journal of Management Education" has also been contributing to the research field with 516 citations with just 24 documents. While comparing the average citation impact (ACI) we can conclude that despite having comparatively a smaller number of documents and citations 'International Journal of Entrepreneurial Behaviour and Research' has a high (ACI=27.52) significance as compared to 'Education and Training Journal' (ACI=19.19) and 'International journal of management education' (ACI=21.5) with high documents and citations.

4.4 Bibliographic coupling analysis

Cluster 1 (Red): Theory of Planned Behavior and Entrepreneurial Intention

The first cluster is the largest and comprises 80 documents. The focus of this cluster is the antecedents of intention based on the Theory of

Planned Behaviour, which emphasizes how attitudes, subjective norms, and perceived behavioral control interact to shape intentions. The research articles in the cluster emphasize that entrepreneurial education acts as a facilitator, influencing not only the entrepreneurial skills and competencies among students but also impacting the antecedents of intention as per the Theory of Planned Behaviour. The studies also shed light on the impact of personal characteristics, such as creativity, proactivity, and risk propensity, in mediating the educational influence on intention. The most cited article in the cluster is (Ndofirepi, 2020) (n=88) validate that psychological characteristics serve as mediators in the predictive link between the perceived impacts of entrepreneurship education and entrepreneurial intention.

Adelaja & Minai, (2018) and Shah et al., 2020) (69 citations), have employed the true experimental design (post-test-only control group design), to examine how entrepreneurial education influences the intention. Bouarir et al., (2023) concluded that attitude, opportunity recognition, and need for achievement are the variables that affect the intention of women entrepreneurs. As per Kallas & Parts, (2021) there are three stages in becoming an entrepreneur: entrepreneurial intention, actions, and venture creation. Women are less active than men in stages two and three.

Cluster 2 (Green): Dynamics of Entrepreneurial Education and Innovation

It is the second largest cluster, consisting of 71 documents. Most of the studies delve into how different components of entrepreneurship education, such as formal and non-formal education, e-learning activities, pedagogical approaches, and technology-supported experiential education, and exposure to entrepreneurial environments (e.g., junior enterprises) influence intention towards entrepreneurship and play a role in enhancing knowledge, skills, and psychological attributes associated with entrepreneurship. The cluster is also focused on a range of factors that contribute to entrepreneurial intention, such as contextual factors (university environment, learning), cognitive variables (self-efficacy, attitude), emotional states (inspiration), and personal traits (self-efficacy, overconfidence).

Table 2: List of 20 most cited documents of entrepreneurial education and entrepreneurial intention

S. No	Document	Title	Citations
1	Barba-Sánchez Virginia (2018)	Entrepreneurial intention among engineering students: The role of entrepreneurship education	252
2	Nowinski w. (2019)	The role of inspiring role models in enhancing entrepreneurial intention	121
3	Sahin f. (2019)	Big five personality traits, entrepreneurial self-efficacy, and entrepreneurial intention: A configurational approach	118
4	Aparicio g. (2019)	Conceptual structure and perspectives on entrepreneurship education research: A bibliometric review	104
5	Ahmed t. (2020)	Entrepreneurship education programs: How learning, inspiration, and resources affect intentions for new venture creation in a developing economy	103
6	Shahab y. (2019)	Entrepreneurial self-efficacy and intention: do entrepreneurial creativity and education matter?	98
7	Passaro r. (2018)	The impact of higher education on entrepreneurial intention and human capital	96
8	Turner t. (2018)	Entrepreneurship Unleashed: Understanding Entrepreneurial Education outside of the Business School	93
9	Takawira Munyaradzi Ndofirepi (2020)	Relationship between entrepreneurship education and entrepreneurial goal intentions: psychological traits as mediators	88
10	Hassan a. (2020)	Entrepreneurial intention of Indian university students: the role of opportunity recognition and entrepreneurship education	70
11	Iqtidar A. Shah (2020)	The moderating role of entrepreneurship education in shaping entrepreneurial intentions	69
12	Virginia Fernández Pérez (2019)	Emotional competencies and cognitive antecedents in shaping students' entrepreneurial intention: the moderating role of entrepreneurship education	67
13	Susana C. Santos (2020)	Entrepreneurial self-efficacy and intentions: Outcome expectations as mediator and subjective norms as moderator	63
14	Galvão a. (2018)	Entrepreneurship education and training as facilitators of regional development: A systematic literature review	60
15	Kai Hockerts. (2018)	The Effect of Experiential Social Entrepreneurship Education on Intention Formation in Students	59
16	Chux Gervase Iwu (2021)	Entrepreneurship education, curriculum, and lecturer-competency as antecedents of student entrepreneurial intention	58
17	Hoang g. (2021)	Entrepreneurship education and entrepreneurial intentions of university students in Vietnam: the mediating roles of self-efficacy and learning orientation	56
18	Muhammad Shoaib Farooq (2018)	Impact of support from social network on entrepreneurial intention of fresh business graduates: A structural equation modelling approach	56
19	Fragoso r. (2020)	Determinant factors of entrepreneurial intention among university students in Brazil and Portugal	55
20	Yi g. (2021)	From green entrepreneurial intentions to green entrepreneurial behaviors: the role of university entrepreneurial support and external institutional support	54"

Table 3: List of 20 most cited journals of entrepreneurial education and entrepreneurial intention

S.No	Source	Document	Citation
1	Education and Training	31	595
2	International Journal of Entrepreneurial Behavior and Research	19	523
3	International Journal of Management Education	24	516
4	European Research on Management and Business Economics	3	356
5	International Entrepreneurship and Management Journal	12	238
6	Journal of Small Business Management	4	167
7	Journal of Entrepreneurship in Emerging Economies	11	125
8	Journal of Small Business and Enterprise Development	8	120
9	Journal of Intellectual Capital	3	104
10	International Journal of Innovation Science	7	86
11	Entrepreneurial Business and Economics Review	6	79
12	Journal of Entrepreneurship	6	69
13	African Journal of Economic and Management Studies	2	63
14	Industry and Higher Education	10	50
15	Journal of Education for Business	4	43
16	Journal of International Education in Business	2	32
17	Journal of Asian Finance, Economics, and Business	3	30
18	Journal of Enterprising Communities	6	22
19	Entrepreneurship and Sustainability issues	4	20
20	Entrepreneurship Research Journal	4	12

The impact of entrepreneurial education is different among different fields of education. The highest cited (n=252) article of the cluster, (Barba-Sánchez & Atienza-Sahuquillo, 2018) is determining the significance of entrepreneurship education in fostering the entrepreneurial development of engineers. Ten percent of studies (including Cera et al. (2020), González-López et al. (2019), Ismail et al. (2018) of the clusters are using a quasi-experimental design to analyze the impact of entrepreneurship education. The cluster contains articles that explore and measure the impact of entrepreneurship education in different socioeconomic contexts, learning environments, regions, and countries, including developing and developed nations.

Cluster 3 (Blue): Role of Gender in Fostering Entrepreneurial Intention through Education

The cluster comprises a total of 48 documents and has a diverse range of research studies that in-

vestigate how gender-based differences, societal norms, and stereotypes influence individuals' inclination toward entrepreneurship. The focus of the cluster is on gender parity in entrepreneurial intention formation. The articles have some contradictory findings in the cluster regarding the role of gender in entrepreneurial intention. Gurel (2021) highlighted that the impact of education is different between genders, and further on intentions, on the other hand, Fragoso et al. (2020) revealed that gender isn't a notable predictor of entrepreneurial intentions. Ramadani et al. (2022) suggest that gender doesn't moderate the connection between entrepreneurship education and entrepreneurial intention, but van Ewijk & Belghiti-Mahut, (2019) identified a negative impact of gender stereotypes on female students' entrepreneurial intentions in the UAE, irrespective of the course. Researchers also explored the significance of personal and con-

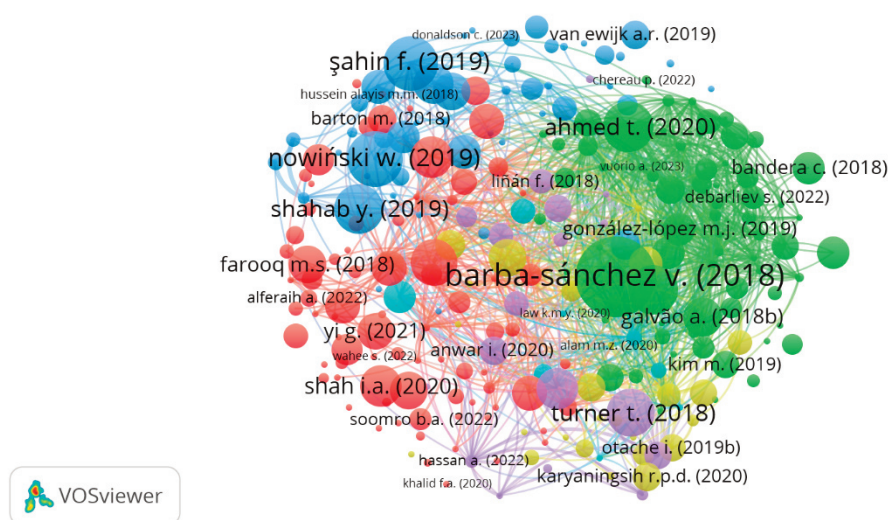
intentions. Self-efficacy among the students is one of the significant factors in intention formation, supported by entrepreneurial education.

Cluster 5 (Purple): Interplay of Personal Traits, Entrepreneurial Education, and Intentions

The cluster delves into a comprehensive exploration of the Theory of Planned Behavior with factors that indicate the individual attributes like entrepreneurial passion, capacity, self-efficacy, motivation, and individual entrepreneurship orientation, augmenting the understanding of the dynamics forming entrepreneurial intentions. Most of the articles in clusters have used the convenience sampling. The cluster contains 18 articles with a significant role of the individual attributes between entrepreneurial education and intention formation. The research articles highlight the impact of entrepreneurial education on students with diverse personal traits, including opportunity recognition competency, self-identity, creativity, and alertness. Moreover, the mediating role of entrepreneurial motivation and the moderating role of entrepreneurial education are explored by (Anwar et al., 2020) and (Hassan et al., 2020). With the highest references Turner & Gianiodis, (2018) the significant article in the cluster explores the action and experience-based entrepreneurial education beyond traditional methods.

This cluster emphasizes the significant role of self-efficacy in the research domain of entrepreneurial intention. The cluster contains 25 scholarly articles dominated by self-efficacy literature. The mediating role of self-efficacy in conjunction with components of the Theory of Planned Behaviour and entrepreneurial capacity is studied deeply by (Duong, 2022) and (Q. Do Nguyen & Nguyen, 2023). Vietnam (6 documents) and Indonesia (4 documents) are the nations that have prominence within the cluster. (Kusumojanto et al., 2020), and (Wardana et al., 2021) explored the various fields of education, including various vocational, economic, and Islamic studies. Notably, the articles in the cluster explored the impact of cultural, institutional, and university contexts on entrepreneurial

Figure 3: Bibliographic coupling maps of entrepreneurial education and entrepreneurial intention



Cluster 6 (Light Blue): Perceptions and Individual Entrepreneurship Orientation

The cluster of 8 items focuses on students’ perceptions as a significant factor. Individual Entrepreneurship Orientation is the focal point of the cluster. Martins & Perez, (2020) The highest citation within the cluster highlights the significant mediating role of Individual Entrepreneurship Orientation in the relationship between contiguous environmental factors and entrepreneurial intention. Moreover, the research by (Martins et al., 2022) reveals the impact of entrepreneurial education on entrepreneurial intention through the lens of Individual Entrepreneurship Orientation. Research article by Lopez & Alvarez, (2019) highlights the influence of the university ecosystem and entrepreneurship course on entrepreneurial intention formation. Martins et al. (2023) and Wegner et al. (2020) Dig deeper into the innovative pedagogies at the university level to foster the entrepreneurship among students. Latin America is the dominant country in terms of research in the cluster.

4.5 Methodological analysis

Methodological analysis method describes or analyses the methods used (design, conduct, analysis, or reporting) in previous literature (Mbuagbaw et al., 2020). The methodology used in research has a significant impact on research outcomes. Each methodology has its advantages and limitations. The key characteristic that sets cross-sectional studies apart from other research types is the collection of relevant data at a specific point in time. As all data are gathered and typically relate to the time of data collection or around it, cross-sectional research does

not involve a temporal dimension (Kesmodel, 2018). In a cross-sectional research design, since exposure and outcome are evaluated concurrently, there’s usually no evident temporal connection between them. This lack of temporal linkage is the primary limitation of cross-sectional studies, making it challenging to establish a genuine cause-and-effect relationship without longitudinal data (Solem, 2015). On the other hand, longitudinal-experimental studies entail conducting subsequent surveys integrated with an experimental intervention (Farrington et al., 2010). Though these studies are time-consuming, the results are more accurate.

The study analysed the methodologies used in 250 documents, and the results are summarized in Table 4. Only 37 studies have used the longitudinal and experimental methods, which are only 14.8% of our data. On the other hand, 81.2% of articles have used cross-sectional studies, which comprise 203 documents. As explained by Nabi et al., (2017) while analysing the impact of entrepreneurial education on intentions, cross-sectional data is not enough to understand the real change in students’ intentions to start a new venture. By this analysis, we conclude that cross-sectional data have their limitations when the question is to measure the gap between intention and action/ behaviour.

4.6 Topic modeling

We analyzed 390 abstracts of articles on entrepreneurial education and entrepreneurial intention using the latent Dirichlet allocation (LDA) approach. Our study discovered 15 different topics after following the recommended stages of text pre-processing, model parameter selection, topic num-

Table 4: Methodology used in the studies of entrepreneurial education and entrepreneurial intention

Types of Methodology	No of Documents	In Percentage
Cross Sectional Studies	203	81.2
Longitudinal Studies and experimental studies	37	14.8
Review Studies	9	3.6
Bibliometric Studies	1	0.4
Total No of Documents	250	100

ber determination, and reliability and validity evaluation. To assess reliability and validity coherence score is calculated. The value of the coherence score for our data set is 0.392. The coherence value typically ranges between 0 and 1, but the good value depends on data size and diversity, preprocessing quality, number of topics, and domain (S. Syed & Spruit, 2017). The *coherence score* of our study is 0.392, which is moderate. The topics are interpretable but may overlap. LDA is the most popular method in text mining, but it is still not proficient enough to produce labels for every topic, and therefore, the outputs need to be labeled by humans (Blei, 2012). By analyzing the 20 terms per topic with respect to titles and abstracts, the results are summarized in Table 5.

As per the analysis of the top 20 terms per topic and assigned topics to those terms based on abstract analysis, we concluded and identified topics that helped in getting a deeper understanding of the structure and trends covered in the undertaken area of research. Each topic examines the different aspects of specific areas with some commonalities. While analyzing, we found that a few topics are similar in some respect and therefore summarized in the broad topic categories, namely, “dimensions of entrepreneurial education, students’ traits and environment, entrepreneurial education and industry interface, entrepreneurial education and antecedents of intention”. As a result, we may acknowledge the overlapping themes and provide a succinct summary of the research within a certain field.

Dimensions of Entrepreneurial Education

Entrepreneurial education has developed in different dimensions in recent times, and researchers have remained interested in measuring the impact of these dimensions on intention. This category includes topics (*topics no. 1,5,6,14*), namely, “exposure to entrepreneurial education, entrepreneurial education through E-learning, innovative pedagogy and entrepreneurial intention, entrepreneurial learning, and creativity”. The focus of this category is on exposure to entrepreneurial education in traditional ways as well as through creativity, innovative pedagogy, and E-learning to measure the impact on the intention of students.

Student’s traits and environment

This category contains articles in which significance is accorded to students’ gender, characteristics, personality traits, environment, and educational field while measuring the impact on their entrepreneurial intention. Topics (*topics no. 8,12,13,15*) included here are “individual characteristics affecting entrepreneurial intention, students’ environment and formation of intention, the significance of educational fields (STEM), a gender-based perspective of entrepreneurial education-intention”. It has been observed that, along with education, these factors have a crucial role in shaping the intention among students.

Entrepreneurial education and industry interface

This category sheds light on a crucial aspect: the gap between the intentions and actions of students for entrepreneurship. This behavioral gap has a significant role in the direction of intention research. This category also focuses on the students’ intention for social entrepreneurship and their experiences while choosing the industry for entrepreneurial activity. Topics (*topics no. 4,7,10*), under consideration here are “significance of intention-action/behavior gap in entrepreneurship, social entrepreneurial education and intentions, entrepreneurial education, and industrial interface”.

Entrepreneurial education and antecedents of intention

The last category focuses on the link between entrepreneurial education and antecedents of intention, highlighting the significance of the Theory of Planned Behavior (attitude, perceived behavioral control, and subjective norms) in forming entrepreneurial intentions. Topics (*topics no. 2,9*) covered include “entrepreneurial self-efficacy and intentions, theory of planned behavior, and antecedents of intention”. The articles focus on the impact of different variables in combination with the theory of planned behavior.

Table 5: A topic modeling analysis of entrepreneurship education and entrepreneurial intention

No	Title	Top Terms	Description	References
1	Exposure to entrepreneurial education	Entrepreneurial, intention, education, start, exposure, motivations, culture, tested, influence, evidence, determine, model, reveal, context, total, design, finally, analyzing, vocational, pre	This topic highlights the general perspective on exposure to entrepreneurial education. Articles on this topic focus on different dimensions of entrepreneurial education.	(Lopes et al., 2023) (Turuk et al., 2021) (Tseng et al., 2022)
2	Entrepreneurial self-efficacy and intentions	Relationship, effect, efficacy, role, positive, entrepreneurial, test, moderating, direct, hypotheses, mediating, modeling, psychological, investigate, ese, education, orientation, relationships, mediated, aims	This topic contains articles pertaining to how entrepreneurial self-efficacy mediates the relationship between different factors (educational support, attitude, subjective norms, prior exp, opportunity recognition) and entrepreneurial intentions.	(Sukavejworakit et al., 2018) (Cualheta & Abbad, 2022) (Balan et al., 2018)
3	Research methodologies	Students', questionnaire, structural, equation, analysis, universities, approach, quantitative, motivation, design, impact, modelling, developed, collected, respondents, method, methods, sampling, questionnaires, contributes	The topic contains articles, terms, and the research methodology used in research related to entrepreneurial intentions and education. University vocational students are considered respondents.	(Passoni & Glavam, 2018) (Almeida et al., 2021) (Daniel & Almeida, 2020)
4	Significance of the intention-action/behavior gap in entrepreneurship	Entrepreneurs, knowledge, level, role, analysis, gap, characteristics, potential, creation, specific, understanding, venture, entrepreneur, public, factor, international, contribute, understand, development, values	There is increasing focus on the intention-action gap among university students and analysis of different factors that are reasons for non-converting intentions into new ventures.	(Yongchun et al., 2021) (Mathews et al., 2021) (Lim et al., 2023)
5	Entrepreneurial education through E-learning	Entrepreneurship, education, policy, impact, aims, higher, affect, shows, college, foster, China, online, theoretical, valuable, contribution, enrolled, shaping, achieve, main, drivers	Articles and terms on this topic focus on online entrepreneurial education and its impact on intentions. In the world of digital technologies, e-learning is significant and attracts attention.	(Ali et al., 2019) (Otahe, 2019b) (Draksler & Sirec, 2021)
6	Innovative pedagogy and entrepreneurial intention	Entrepreneurship, learning, activities, student, educational, outcomes, process, skills, focus, group, participants, effective, number, approach, experiential, field, effectiveness, programs, higher, teaching	This topic contains articles that analyze the role of innovative teaching methods (technological advancements, incorporating dynamic activities) and their positive impact on intentions to be an entrepreneur.	(Pham et al., 2023) (Ephrem et al., 2019) (Duong et al., 2024)
7	Social entrepreneurial education and intentions	Social, significant, career, personality, traits, cognitive, enterprises, achievement, present, sample, article, propensity, sustainable, future, influence, creative, antecedents, cross-sectional, enterprise, access	This topic enlightens how social entrepreneurial education encompasses students from different disciplinary backgrounds and encourages them to be more inclined to establish social enterprises.	(Aparicio et al., 2019) (Yatu et al., 2018) (Harima et al., 2021)
8	Individual characteristics affecting entrepreneurial intention	Entrepreneurial, behavior, individual, opportunity, model, theoretical, opportunities, risk, skills, provide, individuals, key, proposed, countries, recognition, ability, survey, positive, constructs, mechanism	The topic highlights the terms and articles that explain the different personality characteristics and their impact on intentions.	(Mónico et al., 2021) (Bian et al., 2021) (Loi et al., 2021)

9	Theory of planned behavior and antecedents of intent	Perceived, theory, attitude, control, planned, behaviour, subjective, norms, tpb, behavior, behavioral, model, intention, sample, programmes, significant, behavioural, pbc, antecedents, positively	The focus of this topic is the antecedents of intention based on Ajzen's (1991) Theory of Planned Behaviour, which sheds light on how attitudes, subjective norms, and perceived behavioral control interact to shape intentions.	(Oni & Mavuyangwa, 2019) (Swaramarinda et al., 2022) (Bux & van Vuuren, 2019)
10	Entrepreneurial education and industrial interface	Business, development, economic, entrepreneurship, employment, attitudes, important, graduates, youth, innovation, training, conducted, financial, country, economy, growth, schools, correlation, improve, analyze	This topic focuses on the articles that significantly correlate the knowledge from formal entrepreneurial education and experiences gained from the industry, explaining essential factors required for students to transition into entrepreneurs.	(Abdelfattah et al., 2023) (Salavou et al., 2021) (Hasan et al., 2020)
11	Research terminologies	Purpose, limited, originality, literature, design methodology approach, publishing, emerald, practical, programs, context, studies, eis, examine, limitations implications, work, aims, emerging, sample, insights, related	The topic incorporates key terms and articles deemed significant for advancing theoretical understanding and exploring diverse techniques and methodologies in researching entrepreneurial intentions.	(Shahverdi et al., 2018) (Talmage & Gassert, 2022) (Hasan et al., 2020)
12	Student's environment and formation of intention	Factors, influence, support, variables, environment, entrepreneurial, experience, university, family, studies, importance, variable, regression, contextual, significantly, aim, existing, developing, institutional, ecosystem	This topic emphasizes the University ecosystem, contextual, institutional, and family environment-related factors that play a significant role in forming entrepreneurial intention among students.	(Kobylińska & Ryciuk, 2022) (Aggarwal, 2019) (Pérez-Macías et al., 2022)
13	Significance of educational fields (STEM)	Students, university, higher, institutions, courses, universities, significant, engineering, education, south, undergraduate, management, analysis, innovativeness, conducted, impact, Africa, recommendations, contributes, science	The topic focuses on the significant impact of different fields of education. Studies emphasize how intentions are differently formed by students from engineering, management, or other backgrounds.	(Otache et al., 2021) (Santos et al., 2021) (Otache, 2019a)
14	Entrepreneurial learning and creativity	Entrepreneurial, intentions, students, education, creativity, model, personal, intent, formation, inspiration, survey, affects, relation, empirical, involved, stronger, effect, small, Inder science, educational	Studies on this topic delve into how entrepreneurial education and learning enhance creativity and intentions.	(Ali et al., 2019) (Padilla-Angulo et al., 2022) (Sitaridis & Kitsios, 2021)
15	A Gender-based perspective of Entrepreneurial education-intention	Impact, analysis, female, gender, models, differences, women, role, academic, high, develop, young, policymakers, promote, levels, school, government, program, universities, countries	The topic explores gender differences in entrepreneurial intentions and entrepreneurship education. Broadening the availability of entrepreneurship training programs can serve as a strategy to enhance female participation."	(Olutuase et al., 2018) (Chengchun et al., 2002) (Kallas & Parts, 2021)

5 DISCUSSION

5.1 Emerging research directions and trends

RQ 1: *What are the emerging research directions and trends in the field of entrepreneurial education and entrepreneurial intention?*

This study uses different methods of bibliometric analysis, i.e., bibliographic coupling, methodology analysis, topic modeling, and performance analysis, to understand the emerging research directions and recent trends in academic research related to entrepreneurial education and entrepreneurial intentions. This period (2018-23) is significant because of digital advancement and technology used in teaching methods for entrepreneurship. As per publication trends, the years 2022-23 are the most significant years and show the emergence of this domain in research. Bibliographic coupling analyzed broader themes of the area, and topic modeling provided terms that were used to determine the significance of the relevant directions. The present study has also used co-citation analysis to get the most cited documents and sources from the domain under performance analysis, which also determines the direction of the research. This research resonates with the findings of Galvão et al. (2018) saying that the journal 'Education and Training' has the largest number of documents published on entrepreneurial education and intentions.

Entrepreneurship education has been an emerging field for the past two decades, and educators are adopting the new dynamics of education in entrepreneurship. The current study indicates that innovative pedagogical approaches, such as simulations, role-playing, and project-based learning, have been used to enhance entrepreneurial skills and intentions among students (Udekwe & Iwu, 2024). In the technology era, the incorporation of e-learning platforms and digital tools in entrepreneurship education is very evident. AI and other growing technologies and their impact on education and entrepreneurial intention are getting attention from researchers.

Social entrepreneurship among students is another trend in the entrepreneurial research area. This field of study examines how educational initiatives might foster the intention to use entrepreneur-

ship to solve societal issues. Women entrepreneurship and gender dynamics are also an emerging direction in the field. Women in entrepreneurship, especially in developing nations, is a new trend (Bouarir et al., 2023). Sustainable entrepreneurship and education are other crucial trends in this field. Researchers are exploring how sustainable entrepreneurship intention can be enhanced via education. Sustainable entrepreneurship in the context of gender equality is also a significant area of research (Al-Qahtani et al. 2022).

5.2 Intellectual structure and key research themes

RQ 2: *What is the intellectual structure and key research themes in the field of entrepreneurial education and entrepreneurial intention?*

In any field of research, intellectual structure is the conceptual foundation for understanding the hows and whys. The current study identified theories that underpin to understanding of how and why entrepreneurial education influences intention formation. Intellectual structure helps to understand the field of research at a deeper level. Theory of Planned Behavior (Ajzen, 1991) given by Ajzen. Entrepreneurship education is believed to influence antecedents of intention, which include attitude toward entrepreneurship, subjective norms, and perceived behavioral control. Another significant theory is the human capital theory (Becker, 1964) given by Becker G in 1964, which argues that investment in education and skill development improves individuals' capabilities and productivity. Entrepreneurship education enhances knowledge, skills, and competencies, increasing entrepreneurial intention. Entrepreneurial Event Model (EEM) by Shapero & Sokol (1982) is another important theory that helps in forming the foundation of the literature of the current research field. Perceived desirability, perceived feasibility, and propensity to act are the factors that attract students toward entrepreneurship. Boutaky & Sahib Eddine, (2022) mentioned how Social cognitive theory highlights the role of social environment and self-efficacy in intention formation. Social cognitive theory was given by Bandura (1986).

The study, under bibliographic coupling, has extracted six clusters focusing on the different significant areas related to entrepreneurship education and its impact on entrepreneurial intention formation. Among the six clusters, “Theory of Planned Behavior and Entrepreneurial Intentions” and “Dynamics of Entrepreneurial Education and Innovation” are the dominating themes. Authors have used many other variables to test the relationship between entrepreneurial education and intentions, taking the theory of planned behavior, which has been the basis of measuring intention. Contradicting results show that a few authors concluded that gender doesn’t affect the relationship between entrepreneurial education and intentions and vice versa. Van Ewijk & Belghiti-Mahut, (2019) identified an adverse impact of gender norms on female students’ entrepreneurial intentions in the UAE, irrespective of the course. Ramadani et al. (2022) suggest that gender doesn’t moderate the relationship between entrepreneurship education and entrepreneurial intention. The impact of entrepreneurial education on entrepreneurial intention through the lens of Individual Entrepreneurship Orientation (Martins et al. 2022) is also significant.

The current study has also contributed by using topic modeling techniques to enlighten specific areas in the current field. The analysis encapsulates the topics across 15 headings, encompassing information related to “Significance of intention-action/behavior gap in entrepreneurship”, “Innovative pedagogy and entrepreneurial intention”, “Social entrepreneurial education and intentions”, “Entrepreneurial education and industrial interface”, “A gender-based perspective of entrepreneurial education-intention”, to name a few. Topic modeling also suggests that fields of education are very important and need to be focused on when measuring the impact of entrepreneurial education. Another topic under this technique is trying to identify the gap between insights gained from formal entrepreneurial education and the industry in clarifying the essential drivers for graduates to pursue entrepreneurship.

5.3 Methodological Limitations

RQ3: *What are the methodological limitations of the existing literature on entrepreneurial education and entrepreneurial intention?*

The present study uses methodological analysis to explore which are the most popular methods used in this research field. We concluded that very few studies have used longitudinal or experimental methods, and this may be the reason the studies are not able to understand the reasons for the gap between intention and action/behavior to be an entrepreneur. Articles also highlight the importance of experimental methodology (including Cera et al., (2020), González-López et al. (2019), Ismail et al. (2018)) and longitudinal studies García-Uceda et al. (2022) to understand the intentions over a period.

The study used data from post-2018, when digital advancement and technology were used in teaching methods and education. Pedagogy has a significant role to play in entrepreneurial education. (Nabi et al., 2017) has emphasized pedagogies and teaching-learning processes in education. Experiential and longitudinal methods are very significant in understanding the impact of education. However, in existing literature, it has been evident that authors have not used such methods due to the complexities of these methods. The gap between entrepreneurial intention and action taken cannot be addressed without such research.

5.4 Limitations and future research implications

5.4.1 Limitations

The study sample is restricted to the period 2018-2023. Though we have tried to take the recent data, this field is so significant that every day the amount of research is increasing. To analyze the evolution of this domain, the period could be extended. The research focused exclusively on publications from English-language journals that underwent peer review. Subsequent research endeavors may involve collaboration with authors proficient in languages beyond English. This expansion of language diversity not only facilitates the inclusion of a greater number of studies in future research but also enables authors to delve into the cross-cultural dimensions of entrepreneurship. The study relies solely on data retrieved from the Scopus database, which constitutes a limitation, even though Scopus is the largest database still. We understand that single-database systems could over-

look records that are exclusively indexed elsewhere. Future research could benefit from incorporating other accessible databases, such as the Web of Science, to achieve a more comprehensive analysis.

5.4.2 Research gaps and scope for future studies

RQ 4: *What are the research gaps and scope for future studies in the field of entrepreneurial education and entrepreneurial intention?*

As the field of entrepreneurship education is in an emerging stage, there are some research gaps this study has identified. Most of the publications focused on higher education, but as entrepreneurship becomes significant, entrepreneurship education would be highly important in the case of elementary, vocational, and secondary schools. This gap can be addressed by future researchers. Intention-action gap could be a significant research gap for further investigation. Researchers can go deeper into how E-learning is impacting the intention and behavior of students to be entrepreneurs. Academic, Government and business collaborations could also be a crucial research gap here. As entrepreneurship is crucial for economic growth, these are the three fundamental pillars of any economy

This bibliometric research emphasizes the contribution of entrepreneurial education as a key tool in growing entrepreneurial intentions for being an entrepreneur and starting own venture. This current research provides a foundation for academics intending to undertake studies within a similar domain. The study highlights specific areas that exhibit potential for further research. Topic modeling under the science mapping technique brings us many crucial areas where future research is needed. Under topic modeling, we have analyzed terms that collectively form a topic. Out of 15 topics few have great potential to be explored and investigated further. Including the intention-action gap, (Harima et al., 2021) suggest that there is a gap between intentions and action (starting their own business) because students face challenges and procrastinate. There is significant potential for further investigation into why this gap exists and what could be measured on the part of educational institutions. Methodological analysis also contributes to this, as there are very

few longitudinal and experimental studies that have explored the behavior of starting a new venture after taking the education program.

Another important topic that has a wider scope to explore further is entrepreneurial education through E-learning. In this era of technology (Industry 4.0), it's very crucial to understand that business depends on technology, and students with high adaptability to technology can be future entrepreneurs. MOOCS (massive open online courses) are a new way of learning. Researchers can go deeper into how E-learning is impacting the intention and behavior of students to be entrepreneurs. Innovation in teaching is again a field to be explored, as with technological upgradation, pedagogy is also taking different shapes. Different pedagogies and their impact on intentions (Gabrielsson et al., 2020). 'Entrepreneurial education and the industrial interface' is an area that needs to be explored continuously to get consistent results about how education is transferring the impact on intention.

We are at a time when Sustainable Development Goals (SDGs) are receiving extreme attention. Everyone around us is talking about a world that can be sustained for the upcoming generations. Social entrepreneurship is another crucial topic under topic modeling, which has a lot of scope for further research. Social entrepreneurship (Barton et al., 2018; Tan et al., 2021) the field is still in its infancy because of its growing importance. Students don't differentiate much between social entrepreneurship and traditional entrepreneurship in the early stages (Santos et al., 2021). The role of educational institutions in bringing awareness regarding social entrepreneurship is a question that needs to be answered. The link between entrepreneurial education and the industrial interface is a significant area to explore, as per the topic modeling technique in the current study. Entrepreneurial activities help in the economic development of a country. The interface between entrepreneurial education and industry is very important to explore and understand the missing link between knowledge and skills acquired from entrepreneurial education by collaborating with the industry to elucidate the necessary factors for graduates to become entrepreneurs. Our results also demonstrate that even high entrepreneurial intentions do not necessarily lead to entrepreneurial

behaviour/ actions. Future research could focus on longitudinal methods to ensure that entrepreneurial education helps to grow entrepreneurial intentions and entrepreneurial behavior, and action.

Ramadani et al., (2022) and Santos et al. (2021) highlights that gender doesn't play any role in growing intentions for entrepreneurship. But still, there is a conflict regarding the role of gender, and it still can hold importance to understand the role of gender in the intention of starting own venture in future research. However, authors can narrow their focus on innovation, AI, and pedagogy as different dimensions of entrepreneurial education. Conducting an in-depth interview-based qualitative study can highlight the recent perspectives of students and help to understand their intentions. The outcomes from this research can establish groundwork for both quantitative and qualitative studies that explore ways to bridge the gap between intentions and behavior.

In Table 6, we have discussed the future research scope underpinning the themes of topic modeling analysis. Using topic modeling analysis, we have identified fifteen topics and four themes where future research can dig deeper. The findings of this study also

offer insights for policymakers and government officials. Educational institutions, governments, and industries together can benefit from this current research by understanding the reasons behind the high intentions of entrepreneurship among students. Institutions can design courses that can help students to experience entrepreneurship, and innovative pedagogies can also aid in. The government could also frame policies that can help students foster their intentions and convert them into actions in creating new ventures.

6 IMPLICATIONS AND CONCLUSION

6.1 Theoretical Implications

The bibliometrics analysis confirms that entrepreneurial education is found to be a significant predictor of entrepreneurial intention, validating human capital theory and the theory of planned behavior as foundational frameworks in this domain (Nam & Thi, 2024), showing theoretical saturation. This study has identified variables that need to be studied further by extending the Theory of Planned Behavior. This study has identified the action-intention gap as an emerging direction (Lim et al., 2023;

Table 6: Future research scope as per topic modeling analysis

Themes	Topics	Future Research Questions
Dimensions of Entrepreneurial Education	Exposure to entrepreneurial education, Entrepreneurial education through E-learning, Innovative pedagogy and entrepreneurial intention, Entrepreneurial learning and creativity	1. How can the framework of the learning ecosystem be optimized to foster innovation and creativity in entrepreneurial education? 2. How can technology be used to integrate academia with societal needs, influencing entrepreneurial intentions toward addressing global challenges?
Student's traits and environment	Individual characteristics affecting entrepreneurial intention, Student's environment and formation of intention, The significance of educational fields, A Gender-based perspective of entrepreneurial education-intention	1. What personality traits influence the choices of entrepreneurs between profit and purpose? How does the educational ecosystem influence the growth of different entrepreneurs? 2. What are the factors influencing the funding gap for the different genders of entrepreneurs? How can educational mediation address this disparity?
Entrepreneurial education and industry interface	Significance of the intention-action/behavior gap in entrepreneurship, Social entrepreneurial education and intentions, Entrepreneurial education and industrial interface	1. How does the interaction between university, industry, and government enhance the effectiveness of entrepreneurial education programs? 2. How do collaborations between universities and the government influence the students' intentions to engage in social entrepreneurship?
Entrepreneurial education and antecedents of intention	Entrepreneurial self-efficacy and intentions, Theory of planned behavior, and antecedents of intention	1. What factors contribute to the gap between entrepreneurial intentions and actual entrepreneurial behavior over time? 2. How experiential and instrumental attitudes impact entrepreneurial intention among students."

Mathews et al., 2021), contextual factors, including self-efficacy, family economic position, and personality traits, can be analyzed as moderators between entrepreneurship education and intention on the grounds of the Theory of Planned Behavior.

The analysis also highlights, through the clusters and topics from topic modeling analysis, the interdisciplinary nature of research in entrepreneurial education, identifying the relationship between entrepreneurship and other disciplines such as sociology, psychology, and education (Yu et al., 2025). This intersection demands that traditional theories should be expanded to include constructs from other disciplines as well. The study finds variations in entrepreneurial intention according to cultural or regional and different educational contexts (Batista-Canino et al., 2024). Being a significant theme in the study, E-education and innovation are recent trends; the study suggests existing theories and practices need to be revised to include recent pedagogies and learning outputs (Draksler & Sirec, 2021). Contemporary factors like Artificial Intelligence need to be considered.

The bibliometrics analysis reveals methodological insights. The study suggests that by integrating different methodologies, such as longitudinal, experimental, and qualitative, researchers can contribute to theoretical frameworks that help to understand the complexities in entrepreneurial behavior. To address the action-intention gap, the impact of entrepreneurship learning can be seen on early entrepreneurs also.

6.2 Practical Implications

The study offers valuable insights and recommendations for the authorities of HEI, educators, and policymakers. The insights can assist higher educational institutions (HEIs) authorities in understanding the need to develop inclusive, practical, and culturally sensitive entrepreneurship curricula that foster significant psychological drivers like confidence, resilience, and creativity. Authorities can also boost the multi-country academic partnerships, and sharing best practices across regions can significantly improve the quality and accessibility of entrepreneurship education globally.

The study recommends that policymakers develop regulatory policies to prioritize funding to support the entrepreneurship education programs and student entrepreneurship start-ups. The government and policymakers can use the insights of the study to understand contemporary areas, especially digital innovation, social entrepreneurship and initiatives for gender equity in entrepreneurial training. Educators can update the pedagogies that align with the evidence-based education for students. Educators also need to enhance their competencies, and emphasis should be placed on incorporating emerging technologies and digital skills into entrepreneurship education to make students industry-ready.

6.3 Conclusion

In conclusion, this bibliometric analysis of the research literature on entrepreneurial education and its impact on intention over the period 2018–2023 exhibits a notable increase in scholarly interest and an evolving research landscape. Furthermore, trends include the growing use of digital and experiential learning models, the increasing prominence of entrepreneurial behaviour as an outcome, and the emergence of new themes such as social and STEM-oriented entrepreneurship, innovation, and pedagogies. These findings offer future directions for research, policy, and educational practice, while highlighting the importance of cross-disciplinary collaboration and continual curriculum innovation to foster entrepreneurial mindsets among students.

EXTENDED SUMMARY/IZVLEČEK

V študiji raziskujemo področje podjetniškega izobraževanja (Entrepreneurship Education – EE) in podjetniških namer (Entrepreneurial Intention – EI) z uporabo bibliometrične analize in tematskega modeliranja, da bi načrtali njegovo trenutno intelektualno strukturo področja. Na podlagi 390 dokumentov iz baze Scopus, objavljenih med letoma 2018 in 2023, smo izvedli celovito analizo, ki vključuje kazalnike uspešnosti, bibliografsko povezovanje, tematsko modeliranje in metodološko presojo. Naše ugotovitve razkrivajo naraščajoč znanstveni poudarek na podjetniškem izobraževanju in oblikovanju podjetniških namer. Analiza bibliografskega povezovanja identificira šest ločenih raziskovalnih grozdov, ki obravnavajo: dinamiko podjetniškega izobraževanja in inovacij, vlogo spola v podjetniškem izobraževanju, samoučinkovitost, antecedente podjetniških namer ter uporabo teorije načrtovanega vedenja. Kot dopolnilo tej strukturi analizi tematsko modeliranje povzetkov člankov z metodo Latent Dirichlet Allocation (LDA) razkrije petnajst pomembnih tematskih področij, ki nakazujejo obetavne smeri prihodnjih raziskav. Razumevanje intelektualnega razvoja področja poglobljamo s sistematičnim kartiranjem njegove strukture znanja in nastajajočih tem. Naše ugotovitve ponujajo dragocene implikacije za raziskovalce, izobraževalce in oblikovalce politik, ki si prizadevajo okrepiti podjetniško izobraževanje in spodbujati podjetniške namere med učenci se.

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INTEGRATING INTERNAL CAPABILITIES AND EXTERNAL SUPPORT FOR BUSINESS MODEL INNOVATION IN AN EMERGING ECONOMY

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Abstract

This study investigates how firms in an emerging economy develop innovation capacity by integrating internal capabilities with external support, focusing on technological and market features, corporate foresight, big data analytics capability and government assistance in driving business model innovation. Survey data from 255 managers in Vietnamese firms were analyzed using partial least squares structural equation modeling to assess the relationships among these factors, corporate foresight, decision-making process and business model innovation. The findings illustrate that technological and market features have a positive effect on corporate foresight, decision-making process and facilitating business model innovation. Big data analytics capability is positively associated with decision-making processes and innovation outcomes, while government is positively associated with business model innovation. Grounded in dynamic capability theory, the study clarifies how internal and external drivers jointly stimulate business model innovation in emerging markets and offers practical implications for managers and policymakers who seek to balance government support with sustained investments in foresight and data-driven practices.

Keywords: *technological and market features, foresight, decision-making, big data analytics, government support, business model innovation.*

1 INTRODUCTION

Business model innovation (BMI) is an essential strategic mechanism for enhancing firm performance and addressing complex competitive and environmental challenges. When effectively implemented, BMI enables firms to redesign value propositions, modify revenue structures, and boost internal value-creation processes (Teece et al., 2016). Evidence from emerging countries further indicates that sustainability-oriented innovation improves competitiveness (Munir and Watts, 2025). Likewise, firms are increasingly investing in big data analytics capabilities (BDAC) to transform large volumes of information into strategic insights that support both strategic and operational objectives (Sabharwal and Miah, 2021). Digital and data-driven capabilities also help institutionalize sustainability and innovation practices, which are particularly essential in developing economies (Izharuddin, 2025).

Digital transformation provides firms with numerous benefits, including greater operational efficiency from improved processes, automation, and reduced costs, as well as enhanced performance in fields such as innovation, financial outcomes, development, and competitive position (Dragičević *et al.*, 2022). Digital transformation has attracted growing scholarly attention, yet critical questions remain regarding the role of technological and market features in fostering organizational growth and renewal (Capatina *et al.*, 2024). Corporate foresight is increasingly considered a key mechanism for inspecting the external environment, anticipating change, and updating strategic choices (Fergnani, 2022). However, its integration into the decision-making process and BMI frameworks remains limited (Halinen et al., 2024). Similarly, the process through which BDAC influences the decision-making process remains underexamined, as most studies focus on outcomes rather than the mechanisms that connect data use and business model innovation (Chatterjee et al., 2023; Shamim et al., 2020). These issues align closely with dynamic capability theory, which emphasizes how firms sense opportunities, seize them, and reconfigure resources to remain competitive in turbulent environments (Abdelwahed et al., 2025; Teece, 2016; Teece et al., 1997).

Although dynamic capability theory emphasizes how firms adapt and renew their resources over time, much of the empirical literature on business model

innovation examines capabilities such as big data analytics, foresight, or technological readiness as independent drivers of innovation outcomes. As a result, we know that these capabilities matter, but we still have a partial understanding of how they are coordinated and translated into managerial decision-making process that enables business model innovation, particularly when multiple internal and external elements are involved. This study addresses this limitation by positioning technological and market features, corporate foresight, decision-making processes, big data analytics capability, and government support within a dynamic capability framework, thereby explaining how business model innovation emerges from capability orchestration rather than isolated effects. In doing so, the study primarily contributes to the dynamic capability and business model innovation literature, while insights related to digital transformation, foresight, public policy, and emerging markets are treated as complementary contextual extensions.

Building on this theoretical limitation, several critical research gaps persist. First, although BDAC is linked to innovation, evidence remains limited on how BDAC interacts with technological and market features, corporate foresight, and government support to shape BMI in emerging economies. Second, the role of BDAC in shaping decision processes that lead to BMI remains insufficiently explained. Third, although corporate foresight is widely acknowledged as important for strategic adaptation, its integration with business model innovation and its linkage with government support remain underexplored. Moreover, most empirical evidence on technological and market features, foresight, big data analytics capability, and business model innovation is drawn from advanced economies such as Finland, the United Kingdom, and Italy (Ciacchi and Penco, 2024; Ciampi et al., 2021; Moqaddamerad and Ali, 2024). By contrast, only a few studies have explored related dynamics in developing contexts such as Pakistan and Malaysia (Aziz et al., 2024; Khan and Tao, 2022). These gaps limit understanding of how dynamic capabilities operate under the institutional constraints and uncertainty that characterize many emerging markets.

Vietnam is widely regarded as one of the fastest-growing economies in Southeast Asia. Heightened competition and environmental pressures have prompted firms to pursue innovation-oriented strate-

gies that blend local knowledge with management practices influenced by Western models. Government initiatives, including the National Digital Transformation Program 2025 and the National Green Growth Strategy, have further supported these efforts by promoting digitalization and sustainability (Huynh et al., 2025). However, Vietnamese firms still lag behind regional competitors due to resource constraints, limited digital readiness, and implementation challenges. Empirical research on how they build BDAC and foresight capabilities to support BMI remains limited.

Although dynamic capabilities and business model innovation have been widely studied, prior research has largely focused on individual capabilities or their direct relationships with innovation outcomes. Consequently, there is limited theoretical understanding of how multiple capabilities interact as an integrated configuration to support business model innovation, particularly under institutional constraints. This study addresses this core theoretical issue by conceptualizing business model innovation as the outcome of interacting capability configurations linking technological and market features, corporate foresight, data analytics, and managerial decision-making within a dynamic capability framework. By doing so, the study advances dynamic capability and business model innovation research beyond recombining established constructs or relying on contextual novelty, and instead refines theory by explaining how capability orchestration supports business model innovation in emerging economies.

Accordingly, this study examines how technological and market features, corporate foresight, decision-making processes, big data analytics capability, and government support jointly shape business model innovation within a dynamic capability framework. The study addresses the following research questions:

1. How do technological and market features influence corporate foresight and their effect on the decision-making process and business model innovation?
2. What role does big data analytics capability play in supporting the decision-making process and driving business model innovation?
3. To what extent does government support relate to corporate foresight and business model innovation?

This study is grounded in dynamic capability theory, which explains how firms gain competitive advantage by sensing opportunities, seizing them through strategic decision-making, and reconfiguring resources in turbulent environments (Teece, 2016; Teece *et al.*, 1997). By integrating this theory, the study clarifies how internal capabilities and external enablers jointly shape BMI in a developing economy and provides practical insights for managers and policymakers seeking to enhance organizational adaptability and innovation capacity.

2 LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Dynamic capability theory

Dynamic capability theory extends the resource-based view by explaining how firms adapt and renew their strategic assets to sustain competitive advantage in dynamic and uncertain environments (Barney, 1991). While the resource-based view highlights the importance of valuable and rare resources, it offers limited insight into how firms remain competitive as markets and technologies change. Dynamic capability theory addresses this gap by focusing on firms' abilities to identify opportunities, mobilize resources, and reconfigure internal processes in response to evolving conditions (Teece et al., 1997), a view supported by recent evidence on organizational dynamism in the digital era (Abdelwahed et al., 2025).

In this context, BDAC plays a pivotal role in introducing operational efficiency and innovation value. BDAC facilitates the development of dynamic capabilities by enabling real-time learning, predictive modeling, and scenario planning. Hence, it enables organizations to leverage both incremental and disruptive innovation (Mikalef et al., 2019). Technological and market features refer to a firm's capacity to sense and seize new opportunities as the market changes (Capatina et al., 2024; Teece et al., 1997). Corporate foresight and decision-making processes support the reconfiguration of organizational resources by interpreting environmental signals and converting them into timely strategic actions (Chatterjee et al., 2023; Fergnani, 2022). In parallel, government support

acts as an external enabler by strengthening firms' ability to recognize and leverage innovation opportunities, particularly in institutionally and technologically volatile environments (Huikkola et al., 2022).

2.2 Technological and market features

Technological features capture a firm's internal technical capabilities, including feasibility, scalability, and innovative potential. In contrast, market features reflect an outward-looking orientation, encompassing practices such as responding to changing customer preferences, monitoring competitors, and interpreting market trends (Capatina et al., 2024). Strong technological features enable firms to anticipate scientific and technical developments and modify their strategies accordingly, particularly when digital capabilities support sustainable innovation paths (Izharuddin, 2025). The effectiveness of such capabilities depends on how they align with external market conditions, highlighting the need to align internal and external drivers of innovation (Ciacci and Penco, 2024). On the other hand, robust market features facilitate the detection of demand shifts, reduce gaps in the adoption of innovations, and enhance agility by sustaining continuous interaction with the external environment.

2.3 Corporate foresight

Corporate foresight refers to a systematic process through which firms observe and interpret external signals to anticipate future developments and inform strategic decisions (Fergnani, 2022). Through this process, organizations can identify weak signals across markets, technologies, and institutional environments and adjust their internal capabilities in response to emerging trends. Within the dynamic capability framework, foresight is viewed as a key mechanism that supports opportunity and threat recognition in uncertain contexts (Teece et al., 1997). By embedding long-term perspectives into strategic planning, corporate foresight contributes to organizational innovation and enhances adaptability and resilience (Chatterjee et al., 2023).

2.4 Decision-making process

Big data analytics enables firms to process large volumes of information and enhance the quality of managerial decision-making (Chatterjee et al., 2023). Effective decision-making process draws on market intelligence and stakeholder feedback to support the development and adaptation of business models (Andreini et al., 2022). Together, these capabilities allow firms to design solutions that respond to evolving customer preferences and industry dynamics, thereby strengthening their competitive position.

2.5 Big data analytics capability

BDAC refers to an organization's ability to integrate technologies and expertise to manage complex data analysis (Mikalef et al., 2020). By developing this capability, firms can design new business models, automate internal processes, and respond more effectively to evolving customer needs (Dubey et al., 2020). Within the dynamic capability framework, BDAC functions as a mechanism that enhances a firm's capacity to sense opportunities and threats, improves the detection of external signals, and supports strategic responses. BDAC also promotes organizational learning through monitoring, feedback, and experimentation, contributing to long-term flexibility and resilience.

Empirical studies confirm that BDAC is tied to innovation and responsiveness, particularly under turbulent conditions (Ciacci and Penco, 2024; Ciampi et al., 2021). These findings prove that BDAC is a critical dynamic capability that enables firms to improve performance through adaptive and knowledge-based strategic actions.

2.6 Business model innovation

A business model determines how an organization generates value for customers, captures profit, and adapts to market changes to pursue innovation and differentiation (Teece et al., 2016). BMI is critical in situations of technological disruption and strategic uncertainty because it enables firms to reconfigure core business elements and their interdependencies (Trischler and Li-Ying, 2023). Through BMI, firms can establish new value propositions,

revenue streams, cost structures, and value creation processes by leveraging novel capabilities, technologies, operations, and partnerships.

2.7 Government support

Governments support eligible firms through a range of mechanisms, including funding and incentives directed toward sector-specific initiatives, innovation activities, research and development financing, and collaborations among government, industry, and academia. Such forms of support are associated with innovation-related outcomes that contribute to economic growth, employment generation, and organizational competitiveness (Truong et al., 2024).

2.8 Hypothesis development

2.8.1 Technological and market features and company vision

Previous research has emphasized the influence of users' attitudes toward technology on innovation outcomes, showing that firms can strengthen corporate foresight by managing user interactions and exploiting data-driven insights (Chatterjee et al., 2023; Fergnani, 2022). Studies of European deep-tech firms suggest that advanced technological attributes strengthen foresight by enabling firms to anticipate and respond more effectively to market and technological developments (Capatina et al., 2024).

However, technological constraints can restrict user engagement and idea generation, ultimately influencing market elements such as value propositions. Ensuring that technological capabilities align with market needs is often challenging, especially when creating sustainable solutions that depend on ongoing stakeholder input for feasibility and relevance (Andreini et al., 2022; Chatterjee et al., 2023), a challenge also observed in environmentally oriented innovation contexts (Munir and Watts, 2025). Moreover, scholars embracing the dynamic capability perspective argue that technological and market characteristics operate as enablers, allowing firms to combine internal and external resources in ways that improve responsiveness to environmental change (Capatina et al., 2024).

According to this view, corporate foresight extends beyond monitoring technological trends to include the interpretation of shifting market dynamics (Fergnani, 2022). Responsiveness to customers is crucial for this process because it helps firms recognize emerging needs and adjust their strategies accordingly (Corbo et al., 2020). Foresight is not limited to technological forecasting; instead, it connects market expectations with long-term strategic intent and guides innovation in design, delivery, and communication (Chatterjee et al., 2023). Customer engagement provides firms with feedback that strengthens foresight by improving their ability to interpret signals from the external environment (Corbo et al., 2020). Such interactions also support the joint shaping of value propositions with stakeholders, helping ensure their continued relevance as markets evolve. In this way, market-oriented capabilities embed foresight in everyday organizational practices and reinforce its role in long-term strategic positioning.

Therefore, this study investigates the relationships between technological and market attributes and corporate foresight within emerging economies. The following hypotheses are proposed:

H1: Technological features have a positive effect on corporate foresight.

H2: Technological features have a positive effect on market features.

H3: Market features have a positive effect on corporate foresight.

2.8.2 Corporate foresight, decision-making process, and business model innovation

From a dynamic capability perspective, corporate foresight contributes to the development of strategic competencies that enable firms to anticipate environmental change and sustain competitiveness (Fergnani, 2022; Teece et al., 1997). By recognizing emerging trends and evolving customer expectations, foresight supports proactive decision-making and strengthens firms' strategic alertness, scenario evaluation, and adaptive capacity in dynamic environments.

Foresight provides firms with tools to review business model components and anticipate emerging trends. Hence, this capability enables timely adaptation to emerging competitors, enhances resource allocation decisions, and facilitates the recognition of opportunities. In turbulent markets, it also encourages flexibility and innovative choices (Chatterjee *et al.*, 2023). Evidence from Finland demonstrates that foresight enhances BMI, highlighting its value as a strategic capability (Moqaddamerad and Ali, 2024).

Although the literature highlights the importance of corporate foresight in decision-making and BMI, this relationship remains underexplored in emerging markets, particularly in Vietnam. Therefore, this study proposes the following hypotheses:

H4: Corporate foresight is positively associated with the decision-making process.

H5: Corporate foresight is positively associated with business model innovation.

2.8.3 Decision-making process and business model innovation

Prior research highlights the importance of cognitive processes in decision-making for the generation of new ideas and strategies related to business model innovation. These processes guide managers in setting strategic priorities, allocating resources, and adapting to changing market conditions (Andreini *et al.*, 2022). Decision-making processes enable firms to translate data and insights into strategic actions (Chatterjee *et al.*, 2023; Teece *et al.*, 1997), a capability further supported by digital ecosystems that enhance strategic responsiveness (Izharuddin, 2025). Through opportunity recognition, risk assessment, and creative problem-solving, strategic decision-making contributes to the development and renewal of business models (Guo *et al.*, 2016). It also integrates cognitive, knowledge-shaping, and strategizing processes, which collectively enhance an organization's ability to innovate and respond to evolving market demands (Andreini *et al.*, 2022).

However, despite growing conceptual attention, empirical evidence on how decision-making processes relate to business model innovation re-

mains limited in emerging economies such as Vietnam. Hence, we propose the following hypothesis:

H6: The decision-making process is positively associated with business model innovation.

2.8.4 Government support, corporate foresight, and business model innovation

Government support strengthens the relationship between innovation and firm performance by providing legislative instruments, funding, and development strategies that foster economic growth (Thuong and Sinh, 2024). Such interventions function as external enablers that support firms in developing dynamic capabilities and adjusting to changing market conditions (Huikkola *et al.*, 2022; Teece *et al.*, 1997). Policy measures may also facilitate the commercialization of innovation and improve access to financial resources, thereby strengthening the contribution of innovation to firm competitiveness (Pyo *et al.*, 2024). Empirical evidence from Vietnam suggests that government incentives are associated with the creation of favorable conditions for innovation (Truong *et al.*, 2024).

In addition, government support may foster corporate foresight by providing resources, reducing uncertainty, and strengthening firms' capacity to anticipate market developments. In the Vietnamese context, assistance programs such as financial support, tax incentives, and technology training for small and medium-sized enterprises have been linked to improved resilience under volatile conditions (Trieu *et al.*, 2024). Public investment in technology, supported by regulatory frameworks, facilitates the adoption of big data analytics and related tools, which support digital sustainability transitions (Izharuddin, 2025).

Nonetheless, the linkages among government support, corporate foresight, and BMI in developing economies remain underexplored. Given Vietnam's emphasis on technology and innovation policy, this interaction asserts closer examination, leading to the following hypotheses:

H7: Government support is positively associated with business model innovation.

H8: Government support is positively associated with corporate foresight.

2.8.5 Big data analytics capability, business model innovation, and decision-making process

Big data is increasingly recognized as a critical asset within the dynamic capability framework, enabling firms to advance both their operational and strategic objectives. Empirical research on the relationship between BDAC and BMI reports positive associations in the United Kingdom (Ciampi et al., 2021), Italy (Ciacci and Penco, 2024), Pakistan (Khan and Tao, 2022), and Malaysia (Aziz et al., 2024). Moreover, recent research suggests that BDAC serves a dual role, acting as a mediator between external digital changes and BMI (Ciacci and Penco, 2024). These findings collectively suggest that firms with stronger BDAC are better positioned to innovate their business models.

By supporting decision-making processes, BDAC allows firms to analyze large volumes of data in real time, generate actionable insights, and enhance customer responsiveness, operational efficiency, and product development. However, evidence regarding the performance implications of BDAC remains mixed, often reflecting constraints related to limited analytical expertise and misperceptions of the strategic value of data (Mello and Martins, 2019). These challenges are particularly

pronounced in emerging economies such as Vietnam, where digital transformation is progressing, but institutional and organizational readiness vary. Accordingly, this study examines the role of BDAC in relation to business model innovation and decision-making, leading to the following hypotheses:

H9: Big data analytics capability is positively associated with business model innovation.

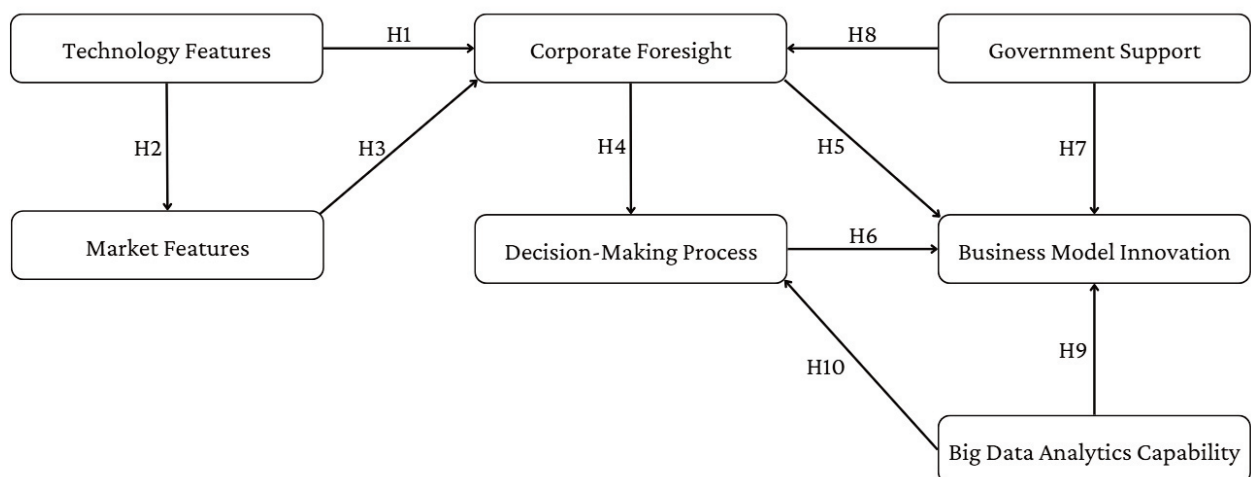
H10: Big data analytics capability is positively associated with decision-making process.

3 METHODOLOGY

3.1 Sampling and data collection

Data were collected through a structured survey administered to department heads and senior managers, selected for their involvement in organizational decision-making. The sampling frame comprised Vietnamese firms operating in the agriculture, manufacturing, construction, trade, and service sectors. Firms were identified using publicly available business directories, industry association membership lists, and the professional networks of the research team. The Center for Public Administration Ethics Committee granted ethical approval. Informed consent was obtained from all participants before data collection.

Figure 1: Conceptual framework



Because English is not the primary language in Vietnam, the questionnaire was developed in three stages. First, it was translated and culturally adapted by two English instructors. Next, it was reviewed by a panel of eight directors and two government officers to ensure contextual relevance and translation accuracy using a back-translation procedure (Brislin, 1970). Finally, a pilot test was conducted with 46 business managers to verify the clarity and applicability of the questions.

A purposive sampling strategy was employed to ensure that respondents had adequate knowledge of innovation activities, data use, and business model changes within their organizations. Eligible participants included department heads, board members, and business owners, as these roles are closely involved in strategic and innovation-related decision-making. Questionnaires were administered in person between March and June 2025.

Upon collection, survey responses were screened prior to data entry and analysis to ensure data quality. Questionnaires with missing responses were removed during the initial screening, resulting in a final analytical dataset with no missing values. Questionnaires showing uniform response patterns were also excluded. Uniform responding was operationally defined as selecting the same numeric response option across all Likert-scale items spanning multiple construct blocks, with no within- or between-block variation. This conservative criterion was applied to minimize the risk of excluding substantively meaningful but homogeneous responses.

Of the 450 questionnaires distributed, 195 were excluded, including 126 due to missing data and 69 due to uniform response patterns, representing approximately 43 percent of the original sample. This screening resulted in a final analytical sample of 255 valid responses, which was used for all subsequent analyses.

To assess whether this substantial case deletion systematically biased the sample, included cases ($n = 255$) and excluded cases ($n = 195$) were compared on observable organizational and respondent characteristics, including industry sector, firm size, firm age, and respondent role. Chi-square tests of independence revealed no statistically significant differ-

ences between included and excluded cases across any characteristic, suggesting that the data-quality exclusions did not introduce systematic exclusion bias. Detailed test statistics are reported in Appendix Table A1.

3.2 Nonresponse bias assessment

Potential nonresponse bias was examined by comparing early and late respondents within the final analytical sample of 255 observations with complete information. Late respondents were defined as those who completed the survey during the final third of the data collection period, based on the recorded data-entry order. Consistent with common survey research practice, comparisons between early and late respondents were used as an indirect diagnostic for potential nonresponse bias. Differences between early and late respondents were tested across industry sector, firm size, firm age, and respondent position using chi-square analyses. No statistically significant differences were observed between the two groups. Detailed results are reported in Appendix Table A2.

Taken together, the included-excluded case comparisons and the early-late respondent analyses provide convergent evidence that neither data quality exclusions nor nonresponse systematically biased the final analytical sample on observable characteristics.

3.3 Measurements

A five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used to assess all constructs. This study measured technological and market features using four-item scales (Capatina *et al.*, 2024). Corporate foresight was assessed using a seven-item scale (Purwanto *et al.*, 2023). The decision-making process was evaluated using five items (Chatterjee *et al.*, 2023), and BMI, four items (Malewska *et al.*, 2024). BDAC was measured using four items (Dubey *et al.*, 2019). Government support was also evaluated employing four items (Truong *et al.*, 2024). The Appendix Table A3 provides detailed information on item wording and adaptations.

3.4 Assessment method

As a comprehensive variance-based method, the PLS-SEM model estimates latent constructs and structural relationships by combining principal component analysis with ordinary least squares regression (Hair *et al.*, 2020). Its flexibility in handling complex models with small sample sizes makes it particularly suitable for predictive research and survey-based studies in organizational contexts (Hair *et al.*, 2020). Accordingly, PLS-SEM was used to assess the hypothesized relationships among the study constructs presented in Figure 1.

4 RESULTS

4.1 Demographics

Table 1 presents the demographic data of the 255 respondents. Most respondents were employed in the manufacturing and construction sector (45.49%). The most common position among participants was head of department (58.43%). Regarding company size, the largest group worked for firms with 201–500 employees (41.57%). Most businesses had been operating for more than 10 years (58.82%).

4.2 Common method bias test

The validity of this study may be affected by common method bias (CMB), which can arise when data on both independent and dependent variables are collected using the same questionnaire. To mitigate this risk, participants were informed that there were no right or wrong answers and were assured of the confidentiality of their responses.

This study also applied a full collinearity test to assess CMB (Kock, 2015). A model is considered free of CMB when the full collinearity variance inflation factor (FCVIF) for each latent construct is below the threshold of 3.3. All FCVIF values fell well under this cutoff (Table 2), indicating that neither multicollinearity nor CMB is of concern for the analysis. These results support the robustness of the conceptual framework and increase confidence in the path estimates.

4.3 Data analysis

Table 2 summarizes the criteria used to assess the reliability and validity of the measurement model. All factor loadings exceeded the recommended level of 0.6 (Marsh *et al.*, 2004). Cronbach's alpha (CA) and compos-

Table 1: Demographic attributes (n = 255)

	Respondent profiles	Frequency	(%)
Sector	Agriculture	51	20.00
	Manufacturing and construction	116	45.49
	Trade and services	88	34.51
Position	Head of department	149	58.43
	Board of directors	84	32.94
	Business owners	22	8.63
Number of employees	Less than 100 employees	19	7.45
	101–200 employees	49	19.22
	201–500 employees	106	41.57
	Over 500 employees	81	31.76
Firm age	Less than 3 years	10	3.92
	3–5 years	11	4.32
	6–10 years	84	32.94
	More than 10 years	150	58.82

Source: Created by the authors

ite reliability (CR) values were above the 0.70 threshold, confirming internal consistency. Furthermore, the average variance extracted (AVE) for each construct was

greater than 0.5 (Hair *et al.*, 2020), implying convergent validity. These results indicate that the model satisfies the standards for reliability and validity.

Table 2: Reliability and validity

	<i>Loadings</i>	<i>CA</i>	<i>CR</i>	<i>AVE</i>	<i>FCVIF</i>
Technological features (TF)		0.965	0.975	0.905	2.524
TF1	0.946				
TF2	0.963				
TF3	0.953				
TF4	0.944				
Market features (MF)		0.865	0.908	0.711	2.740
MF1	0.871				
MF2	0.880				
MF3	0.813				
MF4	0.806				
Corporate foresight (CF)		0.860	0.892	0.544	1.340
CF1	0.652				
CF2	0.691				
CF3	0.733				
CF4	0.834				
CF5	0.800				
CF6	0.701				
CF7	0.734				
Decision-making process (DMP)		0.927	0.945	0.775	1.736
DMP1	0.881				
DMP2	0.883				
DMP3	0.930				
DMP4	0.849				
DMP5	0.856				
Business model innovation (BMI)		0.795	0.866	0.620	1.629
BMI1	0.756				
BMI2	0.858				
BMI3	0.832				
BMI4	0.692				
Big data analytics capability (BDAC)	0.854	0.901	0.696	1.917	
BDAC1	0.809				
BDAC2	0.830				
BDAC3	0.875				
BDAC4	0.822				

Government support (GS)		0.952	0.965	0.873	1.280
GS1	0.912				
GS2	0.940				
GS3	0.939				
GS4	0.946				

Source: Created by the authors

Table 3 reports the assessment of discriminant validity using both the heterotrait–monotrait (HTMT) ratio and the Fornell–Larcker criterion. The HTMT ratios for all constructs were below the more conservative threshold of 0.90, indicating acceptable discriminant validity (Henseler *et al.*, 2015). The highest HTMT value observed was 0.873 between technological features and market features, which exceeds the more conservative threshold of 0.85 but remains below 0.90. This result indicates conceptual relatedness while still supporting empirical distinctiveness between the constructs. In addition, the Fornell–Larcker criterion was satisfied, as the square root of each construct’s AVE exceeded its correlations with other constructs, thereby confirming discriminant validity.

Structural model assessment

The structural model demonstrates satisfactory explanatory power and predictive relevance. The coefficients of determination (R^2) indicate that the model explains substantial variance in business model innovation ($R^2 = 0.510$) and market features ($R^2 = 0.647$), as well as moderate variance in corporate foresight ($R^2 = 0.319$) and the decision-making process ($R^2 = 0.194$). These values suggest stable explanatory power without evidence of overfitting.

Predictive relevance was assessed using the Stone–Geisser Q^2 statistic, with all endogenous constructs exhibiting Q^2 values greater than zero. Business model innovation ($Q^2 = 0.301$) and market

Table 3: Discriminant validity

HTMT ratio	BDAC	BMI	CF	DMP	GS	MF	TF
BDAC							
BMI	0.686						
CF	0.818	0.717					
DMP	0.438	0.620	0.444				
GS	0.376	0.384	0.247	0.263			
MF	0.734	0.643	0.581	0.421	0.519		
TF	0.649	0.640	0.590	0.431	0.425	0.873	
Fornell–Larcker	BDAC	BMI	CF	DMP	GS	MF	TF
BDAC	0.834						
BMI	0.559	0.787					
CF	0.691	0.601	0.737				
DMP	0.396	0.555	0.413	0.880			
GS	0.342	0.338	0.228	0.248	0.934		
MF	0.639	0.546	0.520	0.377	0.463	0.843	
TF	0.592	0.562	0.548	0.409	0.409	0.805	0.952

Source: Created by the authors

features ($Q^2 = 0.451$) demonstrated strong predictive relevance, whereas corporate foresight ($Q^2 = 0.158$) and the decision-making process ($Q^2 = 0.138$) showed moderate predictive capability.

Effect size estimates (f^2) provide further insight into the relative contribution of individual predictors. Most structural relationships displayed small to moderate effect sizes, including the effects of big data analytics capability on business model innovation ($f^2 = 0.026$) and decision-making ($f^2 = 0.029$), corporate foresight on business model innovation ($f^2 = 0.108$) and decision-making ($f^2 = 0.046$), and decision-making on business model innovation ($f^2 = 0.170$). These effect sizes indicate that each predictor contributes a modest but statistically meaningful share to the variance explained in the endogenous constructs. In contrast, technological features exerted a very large effect on market features ($f^2 = 1.835$), highlighting their dominant role in shaping market-related outcomes within the model.

Table 4 shows that most hypotheses were supported ($p < 0.05$), except for H8. The relationships among technological and market features and corporate foresight are statistically significant, supporting H1, H2, and H3. Corporate foresight has a significant positive effect on both the decision-making process and BMI, supporting H4 and H5. H6 is also supported, confirming a significant positive relationship between the decision-making process

and BMI. Government support significantly influences BMI, supporting H7. However, it has no significant effect on corporate foresight ($p = 0.658$), thus H8 is not supported. Additionally, BDAC significantly influences both BMI and the decision-making process, supporting H9 and H10.

5 DISCUSSION AND CONTRIBUTIONS

5.1 Discussion

This study examines the drivers of BMI from the perspective of the dynamic capability theory, drawing on survey evidence from managers in Vietnamese organizations. The findings provide empirical support for associations between internal capabilities and external enablers, including technological and market features, foresight, decision-making, BDAC, and government support, and BMI. Overall, nine of the ten proposed hypotheses are supported, highlighting how firms in an emerging economy align and deploy capabilities in relation to technological change and innovation-related outcomes.

The results indicate that market features are positively associated with stronger corporate foresight, which is consistent with prior research emphasizing the role of customer responsiveness, trend awareness, and stakeholder input in strategic planning (Chatterjee *et al.*, 2023; Corbo *et al.*, 2020).

Table 4: Hypothesis testing

Hypotheses	Estimates	t-values	p-values	Remarks
H1: Technology features → corporate foresight	0.373	4.903	0.000	Supported
H2: Technology features → market features	0.805	27.864	0.000	Supported
H3: Market features → corporate foresight	0.235	2.999	0.003	Supported
H4: Corporate foresight → decision-making process	0.267	2.365	0.018	Supported
H5: Corporate foresight → business model innovation	0.326	4.674	0.000	Supported
H6: Decision-making process → business model innovation	0.325	6.496	0.000	Supported
H7: Government support → business model innovation	0.128	2.463	0.014	Supported
H8: Government support → corporate foresight	-0.033	0.443	0.658	Unsupported
H9: Big data analytics capability → business model innovation	0.162	2.214	0.027	Supported
H10: Big data analytics capability → decision-making process	0.212	2.799	0.005	Supported

Source: Created by the authors

Firms that remain attentive to signals from their external environment appear better able to align foresight-related activities with changing conditions, which may, in turn, support longer-term adaptability. This pattern is consistent with prior research suggesting that the combination of market-oriented and digital capabilities strengthens firms' adaptive capacity in contexts characterized by uncertainty.

The findings further indicate that corporate foresight is positively associated with business model innovation, implying that organizations with more developed foresight practices tend to engage more actively in business model renewal. In addition, the decision-making process exhibits a strong positive association with business model innovation, in line with earlier studies emphasizing the role of timely and well-informed managerial judgment in shaping innovation-related outcomes (Andreini et al., 2022). These results are also consistent with prior evidence showing that effective decision-making supports resource reallocation and business model adaptation in dynamic environments (Guo et al., 2016).

Government support is likewise positively related to business model innovation, which aligns with existing evidence that public policies and institutional support can reduce uncertainty and improve access to financial and technological resources in emerging economies (Pyo et al., 2024; Truong et al., 2024). However, government support is not significantly associated with corporate foresight. This result should be interpreted with caution and does not suggest that public support discourages foresight development. Instead, it may reflect differences in the design, timing, or strategic deployment of support measures, as well as variation in firms' capacity to convert external assistance into internally embedded, forward-looking capabilities. Similar patterns have been reported in prior research examining the indirect and contingent role of public policy in capability development (Trieu et al., 2024).

Finally, big data analytics capability shows strong positive associations with both decision-making processes and business model innovation. Firms reporting higher levels of data analytics capability also report more effective decision-making and greater innovation outcomes, which is consistent with earlier research highlighting the role of data-driven insights

in supporting organizational responsiveness and strategic adaptation (Chatterjee et al., 2023; Ciampi et al., 2021). These findings reinforce the view that BDAC complements foresight and decision-making within broader dynamic capability systems.

Overall, the findings highlight the relevance of dynamic capability theory for explaining how internal capabilities and external resources are jointly associated with business model innovation in emerging economy contexts. At the same time, the results point to the need for further research to examine how different forms of government support shape the development of dynamic capabilities and influence firms' longer-term innovation trajectories.

5.2 Theoretical contributions

This study advances theoretical understanding of business model innovation by explaining how technological and market features, corporate foresight, decision-making processes, big data analytics capability, and government support are jointly associated with business model innovation in an emerging economy context. Rather than treating these elements as independent drivers, the findings indicate that internal capabilities and external enablers operate in combination, reinforcing the relevance of dynamic capability theory in environments characterized by uncertainty and resource constraints.

A central theoretical contribution lies in demonstrating that these elements function as an interconnected capability configuration rather than as isolated factors. The results suggest that adaptive activities within firms are mutually reinforcing, offering a more integrated explanation of how coordinated capabilities support business model innovation. This perspective refines dynamic capability theory by shifting attention from individual capabilities toward their alignment and interaction as a basis for innovation outcomes.

The study also contributes by clarifying the role of government support within dynamic capability configurations. While external assistance is associated with improved innovation outcomes, its relationship with internal foresight capabilities appears more nuanced. This finding highlights the contin-

gent role of institutional support and suggests that public interventions may shape capability development in ways that vary across firms and contexts, extending existing theoretical discussions on the boundary conditions of dynamic capabilities.

In addition, the findings help clarify the role of big data analytics capability as part of a broader capability constellation. Consistent with some prior studies (Ciacci and Penco, 2024; Ciampi et al., 2021), the results indicate that analytics capability is closely linked to informed decision-making and business model innovation when embedded within complementary organizational processes. This integration strengthens theoretical explanations of how data-driven capabilities contribute to strategic renewal.

Finally, the study contributes to open innovation research by illustrating how foresight, analytics capability, and institutional support are associated with firms' engagement in broader innovation ecosystems. These insights suggest that dynamic capabilities facilitate not only internal organizational adaptation but also firms' participation in collaborative innovation processes, which are particularly important for sustaining competitiveness in emerging market environments.

5.3 Practical implications

This study offers practical insights for strengthening business model innovation in Vietnam by highlighting the roles of corporate foresight, decision-making processes, big data analytics capability, and government support. The findings suggest that managers can enhance organizational adaptability by deliberately aligning internal capabilities with external resources in turbulent environments.

First, the findings suggest that firms benefit from taking foresight seriously as an ongoing organizational practice rather than as an occasional planning exercise. Activities such as structured scenario discussions, informal future-oriented workshops, and cross-functional strategic dialogue can help organizations remain attentive to technological and market developments. In addition, regularly revisiting strategic assumptions and incorporating feedback from across the organization may enhance flexibility when conditions change.

Second, the findings underscore the relevance of cultivating a data-oriented organizational context. Promoting data literacy, facilitating knowledge sharing, and investing in integrated analytics systems may help embed analytics capability within routine decision-making processes. The regular dissemination of insights and the encouragement of informed data use can strengthen the role of analytics in supporting strategic choices.

Third, government support appears to play a meaningful role in reducing uncertainty and improving access to financial and technological resources. Firms may benefit from engaging with available policy instruments and public-private partnerships, while maintaining a balanced approach that avoids excessive reliance on external assistance. Continued investment in internal adaptive capabilities remains important for sustaining long-term resilience.

Finally, the findings also draw attention to the role of collaboration beyond firm boundaries. In the Vietnamese context, interaction with public agencies, industry associations, and other ecosystem actors appears to offer access to knowledge and resources that individual firms may struggle to develop internally. For organizations facing resource constraints, such collaborative relationships may represent a practical way to enhance responsiveness and support business model innovation.

6 CONCLUSION, LIMITATIONS, AND UPCOMING STUDIES

6.1 Conclusion

This research contributes to the dynamic capability literature by examining business model innovation as the result of how multiple organizational capabilities work together, rather than as the outcome of any single capability in isolation. Focusing on an emerging economy setting, the study brings corporate foresight, decision-making processes, big data analytics capabilities, and government support into a single analytical framework, allowing closer attention to how internal capabilities interact with institutional conditions. The empirical results from Vietnamese firms show that foresight, decision-making quality, and analytics capability tend to move together with higher levels of business model

innovation, whereas government support is related to innovation outcomes but does not appear to be directly linked to foresight development. Viewed collectively, these findings offer a more nuanced understanding of how dynamic capabilities are associated with business model innovation in contexts shaped by institutional uncertainty and resource constraints.

6.2 Limitations and future research

Several limitations of this study warrant consideration. The use of a cross-sectional survey design, combined with reliance on managers' self-reported perceptions, constrains the extent to which causal relationships or temporal dynamics can be inferred. As a result, the findings are best interpreted as patterns of association rather than evidence of causal effects. Future research could employ longitudinal designs or multi-wave data collection to better examine how corporate foresight, big data analytics capability, decision-making processes, and government support develop and interact over time.

Second, the use of single-respondent managerial perceptions may introduce common method bias or subjective evaluation. Although respondents were chosen because of their involvement in strategic decision-making, the use of single-informant data may still introduce perceptual bias. Future research could strengthen measurement validity by drawing on multiple informants within the same organization, incorporating objective indicators of innovation or performance, or combining survey data with qualitative methods.

Third, although extensive data screening procedures were applied to ensure data quality, a relatively large proportion of the original questionnaires was excluded. While diagnostic tests indicated no systematic differences between included and excluded cases on observable characteristics, this screening process suggests that some caution is warranted when generalizing the findings beyond the observed sample.

Fourth, the empirical focus on Vietnamese firms also places limits on the broader applicability of the findings. Differences in regulatory environments, market maturity, and digital infrastructure

across countries mean that the observed relationships may not fully generalize to other contexts. Comparative studies involving firms from both emerging and developed economies could help clarify the boundary conditions under which dynamic capabilities are linked to business model innovation.

Finally, while this study concentrates on enabling factors such as analytics capability and government support, it does not directly address potential constraints associated with digital transformation. Issues related to data governance, ethical use of analytics, institutional barriers, or unequal access to digital resources remain outside the scope of the analysis. Examining these factors in future research would offer a more balanced understanding of how dynamic capabilities shape innovation outcomes across different sectors.

Declaration of generative AI use and AI assistance

ChatGPT was used solely to assist with minor grammatical and clarity improvements in the manuscript. The authors also engaged in a professional academic editing service to conduct language proofreading. All aspects of the research design, data analysis, and interpretation were carried out by the authors, who take full responsibility for the content of the manuscript.

EXTENDED SUMMARY/IZVLEČEK

Ta študija raziskuje, kako podjetja v nastajajočem gospodarstvu razvijajo inovacijsko sposobnost z usklajevanjem notranjih zmogljivosti in zunanje podpore, pri čemer se osredotoča na tehnološke in tržne značilnosti, strateško predvidevanje podjetja, zmogljivost analitike velikih podatkov ter državno podporo kot dejavnike, ki spodbujajo inovacije poslovnih modelov. Anketni podatki 255 managerjev v vietnamskih podjetjih so bili analizirani z uporabo modeliranja strukturnih enačb z metodo delnih najmanjših kvadratov (PLS-SEM), da bi ocenili odnose med temi dejavniki, strateškim predvidevanjem podjetja, procesom odločanja in inovacijami poslovnih modelov. Ugotovitve kažejo, da tehnološke in tržne značilnosti pozitivno vplivajo na strateško predvidevanje podjetja, proces odločanja ter spodbujajo inovacije poslovnih modelov. Zmogljivost analitike velikih podatkov je pozitivno povezana s procesi odločanja in inovacijskimi izidi, medtem ko je državna podpora pozitivno povezana z inovacijami poslovnih modelov. Na podlagi teorije dinamičnih zmogljivosti študija pojasnjuje, kako notranji in zunanji dejavniki skupaj spodbujajo inovacije poslovnih modelov na nastajajočih trgih, ter ponuja praktične implikacije za managerje in oblikovalce politik, ki si prizadevajo uravnotežiti državno podporo s trajnostnimi vlaganji v strateško predvidevanje in na podatkih temelječe prakse.

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Appendix

Table A1: Comparison of included and excluded observations

Characteristic	χ^2	p-value
Industry sector	0.00	1.00
Respondent position	0.00	1.00
Firm size	0.00	1.00
Firm age	0.00	1.00

Source: Created by the authors

Table A2: Early and late respondent comparison

Characteristic	χ^2	p-value
Industry sector	0.00	1.00
Respondent position	0.00	1.00
Firm size	0.00	1.00
Firm age	0.00	1.00

Source: Created by the authors

Table A3: Measurement items

Constructs/Sources	Code	Measurement
Technology Features (adapted with minor changes from Capatina et al., 2024).	TF1	We need to ensure technological feasibility to scale from the laboratory to pilot customers.
	TF2	We enhance our customer value proposition through a promising technological solution.
	TF3	The broad marketability of our deep technology should be validated through active dialogue with relevant stakeholders.
	TF4	We can deliver a quick response to disruptive market signals with our deep-tech solution.
Market Features (adapted with minor changes from Capatina et al., 2024).	MF1	We adopt penetration strategies to make a smooth transition from beta customers to large-scale early adopters.
	MF2	We are systematically assessing the problem/solution fit to validate the progress gain.
	MF3	We are aware that we need to deploy appropriate communication of innovation toolkits to evolve from the scalability stage to market stability.
	MF4	We are committed to monitoring changes in customer needs to properly address social shifts.
Corporate Foresight (adapted with minor changes from Purwanto et al., 2023).	CF1	Our company scans the external business environment regularly as 'early detection' activities toward potential changes such as government regulations, customers, competitors, technological, socio-political, and macro-economic.
	CF2	We use scenario analysis to prospect potential future conditions
	CF3	We have an internal system or procedure to formulate the company's vision and mission, combining top management's direction and bottom-up initiative
	CF4	In our company, activities related to future studies (forward-looking techniques) are linked to specific functions, such as corporate or strategic planning, product development, business planning, and marketing.
	CF5	Our company has a regular analysis of business external environment changes as an input to formulate future strategy
	CF6	To respond to business environment change, our company has a consensus with the regional office or principal company about future strategic planning regularly
	CF7	We have a periodic strategic meeting with the principal company or the regional office to discuss future product planning
Decision-Making Process (adapted with minor changes from Chatterjee et al. (2023)).	DMP1	I believe that applications of big data analytics can help in the accurate decision-making process.
	DMP2	I believe that a quick and accurate decision can help a firm to improve its bottom line.
	DMP3	We regularly utilize big data analytics applications in our decision-making process.
	DMP4	The application of big data analytics can provide businesses with real-time business insights.
	DMP5	The use of big data applications for decision-making purposes requires minimal technical expertise.

Business Model Innovation (adapted with minor changes from Malewska et al., 2024).	BMI1	Our company continually assesses the new competencies that need to be established to adapt to changing market requirements, and our employees receive ongoing training to develop these new competencies.
	BMI2	Our company maintains its technical resources up to date and regularly leverages new technical opportunities to expand our portfolio of products and services.
	BMI3	Our company seeks new collaboration partners and regularly leverages opportunities by integrating new partners into our existing processes.
	BMI4	Our company has significantly improved its internal processes, including business management and product manufacturing.
Big Data Analytics Capability (adapted with minor changes from Dubey, Gunasekaran, & Childe, 2019).	BDAC1	We use advanced tools (like optimization/regression/ simulation) for data analysis
	BDAC2	We use data gathered from multiple sources (like company reports, tweets, Instagram, and YouTube) for data analysis
	BDAC3	We use data visualization techniques to assist decision makers in understanding complex information extracted from large data
	BDAC4	Our dashboards display information, which is useful for carrying out necessary diagnoses
Government Support (adapted with minor changes from Truong et al., 2024).	GS1	Our company receives support from the government for consulting services and human resource development activities
	GS2	Our company receives support from the government for the implementation of innovative projects through tax deductions
	GS3	Our company receives support from the government for joining industry clusters and value supply chains
	GS4	Our company receives support from the government for professional coaching and training

Source: Created by the authors



CENTRALITY BIAS, RELIGIOSITY, ESCALATION OF CORRUPTION RELATIONSHIP: AN EXPERIMENTAL STUDY

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Abstract

This research investigates the moderating effect of religiosity on centrality bias and escalation of corruption relationships. This research employs a laboratory-experimental method with a 2×2 factorial design in a multi-period setting. This study involved 161 undergraduate accounting students as participants. This research employs a multi-period setting, divided into four rounds, each with sequential tasks assigned. The average score of each round is a crucial factor in determining the snowballing effect of corruption. The centrality bias is manipulated to appear both as exist and non-existent. Religiosity is measured and divided into high and low, based on the median score. This research found that centrality bias positively activates the escalation of corruption. However, religiosity may serve as an optimal filter to mitigate the positive effect of centrality bias on the escalation of corruption relationship. Surprisingly, additional analyses show that religiosity is proven effective in minimizing the snowball effect of corruption escalation that develops from exist centrality bias conditions. The results of this study show that prosocial behaviors should not be viewed as actions that support organizations solely, because those acts are not necessarily linear with attempts to avoid harmful ones.

Keywords: Antisocial Behaviour, Centrality Bias, Escalation of Corruption, Religiosity

1 INTRODUCTION

Corruption constitutes a critical factor in different types of fraud (Murphy & Free, 2016). Corruption scandals within an organization can arise as a result of cooperation among certain parties to carry

out unethical acts (Anand et al., 2004). It fosters a corruption act that lasts longer, becomes more extensive, and becomes more systematic. Nahartyo et al. (2020) elucidate that the development of systematic corruption leads to another repetitive and more dynamic form of corruption, causing the action to

escalate. Corruption is influenced by personal factors and the organizational climate and conditions (Murphy & Free, 2016; Martin & Cullen, 2006). Among the triggering factors of instrumental climate in an organization are the existing authority within the organization and the assessment procedures conducted (Bol, 2011).

Attributed to behavioral aspects, both the authority and the evaluator can bias when assessing the repercussions of systematic measurement errors (Ahn et al., 2010; Rohma et al., 2023; Rohma, 2022). It triggers demotivation and fosters dysfunctional behaviors because of bias and unfairness in assessment. Two types of bias, i.e., centrality and leniency, are systematic and confer an emphasizing effect on individual attainment (Bol, 2011; Moers, 2005). Centrality bias has a more significant, straightforward negative consequence for behaviors than leniency bias (Golman & Bhatia, 2012). Hence, investigations of centrality bias are of paramount importance to elevate. Previous research only focuses on examining the absence of bias within a subjective evaluation, therefore, the impact of bias on the evaluated party's behaviors is still rare due to the lack of empirical data and demanding access to the internal information of the organization (Trapp & Trapp 2018; Ahn et al., 2010; Berger, Harbring, & Sliwka 2013; Bol, 2011; Rohma & Nahartyo, 2025). Most research is limited in identifying how centrality bias influences dysfunctional behavior reactions (Colquitt et al., 2001; Skarlicki & Folger, 1997). Therefore, it is crucial to conduct further investigations, specifically on the primary effect of centrality bias on the dysfunctional behavior of corruption escalation.

More recent research has observed the effect of religion on prosocial behaviors and fraud (Shariff & Norenzayan, 2011; Harrell, 2012; Johnson et al., 2013; Sari & Sholihin, 2019). The effects of religion on prosocial behaviors are based on the supernatural punishment hypothesis (Bering & Johnson, 2005; Johnson & Krüger, 2004), a reflection of the supernatural punishment theory. Yilmaz & Bahçekapili (2016) explain that the presence of supernatural observers who act as supervisors of individual behaviors and their ability to punish each violation executed incentivizes individuals to comply and behave well. McGuire *et al.* (2012) explain that reli-

gion, as a form of social norms, impacts the tendency to manipulate profits. Other research has also explored the interplay between an organization's compensation scheme and religion (Conroy & Emerson, 2004; Chan et al., 2015; Sari & Sholihin, 2019). Several researchers have shed light on the finding that love, rewards, and punishment from God are likely to enhance prosocial acts (Harrell, 2012; Atkinson & Bourrat, 2011; Shariff & Norenzayan, 2011).

However, most of the literature still concentrates on the roles of religiosity from a prosocial perspective. Most research is limited in identifying aspects of the dysfunctional, antisocial behavior perspective, particularly psychological bias, which negatively impacts performance efficacy due to the dysfunctional, antisocial behavior of escalation of corruption. Cui et al. (2015) mention that the roles of religiosity can only be studied through behaviors in general. Additionally, studies on decision-making are scarce, while the role of religiosity is necessary, as the value of religion adheres to the individuals concerned. The existence of a centrality bias, resulting from different evaluations by evaluators, can lead to perceptions of inequality, which in turn trigger social jealousy and encourage corruption.

Meanwhile, individual religious values that put forward a supernatural relationship with God encourage individuals to minimize their dysfunctional behavior. Thus, the presence of religiosity can serve as a filter, mitigating the negative impact of centrality bias on corruption escalation behavior. Therefore, this research analyzes the impacts of religiosity on centrality bias and decisions to escalate corruption through the supernatural punishment theoretical framework.

This research employs an experimental method with a 2x2 between-subject factorial design under a multi-period setting. This experimental research aims to capture the escalation of corruption phenomena without engendering cognitive confirmation bias effects. Furthermore, this research equips accounting students with specific criteria as a practical extension to minimize the social desirability bias when using practitioners. This research is undertaken considering some reasons. Firstly, Berger et al. (2013) propose that subjective evaluation system research has been limited to considering treatments with no bias present, due to the restricted access to empirical data

from organizations. Moreover, individual cognitive constraints potentially generate bias in the evaluation process. Secondly, this research also considers the effects of centrality bias, in addition to dysfunctional and antisocial behavior factors. However, a dysfunctional antisocial behavior orientation runs systematically and continuously induces escalation. Thirdly, to be more specific, prosocial behaviors should not be viewed as actions that support organizations only because those acts are not necessarily linear with attempts to avoid harmful ones. Finally, we require adequate empirical evidence to de-escalate behaviors that harm organizations, e.g., corruption that becomes increasingly dynamic and thus exacerbates, creating a progressively more harmful snowball effect by applying the right basic concept during the experiment. Fourthly, previous research assesses the equality between spirituality and religiosity as two key constructs for understanding supernatural punishment. However, the two constructs significantly differ from each other. Spirituality connects to the psychiatric nature (spiritual and inner), whereas religiosity correlates to beliefs in God and supernatural powers above human beings. Therefore, this research suggests that supernatural punishment emphasizes that beliefs in supernatural supervision are more explicitly captured in religiosity, which influences individual behaviors to circumvent dysfunctional and antisocial behaviors.

Results indicate that religiosity effectively filters the negative impacts of centrality bias and the escalation of corruption. Additionally, escalation effects on the research activity rounds have also been found. The inclination to engage in corruption in the early rounds tends to provoke corruption in subsequent rounds, albeit to a greater extent, creating a snowball effect. Interestingly, high religiosity may mitigate the snowball effect in each round. The study demonstrates the significant impact of centrality bias on adverse behavior that is escalation of corruption. This research provides recommendations to organizations, particularly human resources departments, to consider candidates' religious orientation during the recruitment process. This way, organizations can observe behavioral patterns of employees or individuals who are able to manage dysfunctional behavior in every activity they undertake in the workplace.

2 LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Centrality bias

Centrality bias occurs when the variation in performance evaluation is less significant than expected by the performance evaluation system designer. Evaluators do not use the full range of value scales and specifically avoid marginal values (Kampkötter & Sliwka, 2016). Centrality bias results in an attempt to compress the performance value, thereby reducing the variation in value. The evaluation ratio is not optimal and proportional, as compression is achieved by deflating above-average values and inflating below-average ones (Bol, 2011). Information collecting costs and a potent relationship between employees and managers positively influence centrality bias (Bol & Smith, 2011). Slight value differences between employees due to centrality bias can be yielded by evaluators' avoidance of value inequality or misperception of individual employee performances (Trapp & Trapp, 2018).

Evaluators tend to be cautious in evaluating performance in an assignment, adjusting for perceived gaps in performance evaluation in other assignments (Bol & Smith, 2011). However, centrality bias can have adverse effects, one of which is the motivation and incentives for employees, particularly those with above-average performance (Bol, 2011; Trapp & Trapp, 2018). Employees know that evaluators will compress the evaluation results to an average one; therefore, they will be less motivated to perform better in the future (Golman & Bhatia, 2012). Thus, centrality bias may affect the psychological mechanism and have implications for behaviors (Trapp & Trapp, 2018).

2.2 Religiosity and supernatural punishment

Supernatural agents are considered a measure of each individual's moral code (Johnson, 2005). Johnson & Krüger (2004) explain that, apart from authentic evidence concerning supernatural punishment, the punishment perspective sheds light on the belief that individuals whose behaviors are supernaturally influenced are more likely to be religious. Supernatural punishments are observable in all religions and cultures, affecting people who adhere

to them (Johnson, 2005). Supernatural punishment hypotheses can be examined from two aspects, namely psychological and social (Schloss & Murray, 2011). The supernatural punishment hypothesis encompasses concepts of self-regulation and cognitive dissonance that are socially adapted. It is one of the main bases for religious individuals to behave (Wood, 2013). Shariff & Norenzayan (2011) state that supernatural punishment, comprising the concepts of sin and hell, can motivate individuals to self-regulate and avoid violating behaviors. Debono et al. (2017) explain that the concept of supernatural punishment can motivate individuals to engage in moral actions. Hence, supernatural punishment is one of the filters boosting individual attempts to behave morally and avoid dysfunctional behaviors, such as the escalation of corruption. The research model is pointed out in Figure 1.

2.3 Centrality bias and escalation of corruption

A biased performance evaluation process may fuel adverse effects and breed counterproductiveness (Moers, 2005; Trapp & Trapp, 2018; Bol et al., 2016; Bol, 2011). From the perspective of agency contracts within an organization, centrality bias negatively impacts performance motivation due to the disproportional payment ratio (Bol, 2011). Agency theories (Jensen & Meckling, 1976) elucidate that an individual is a rational economic person. Information asymmetry

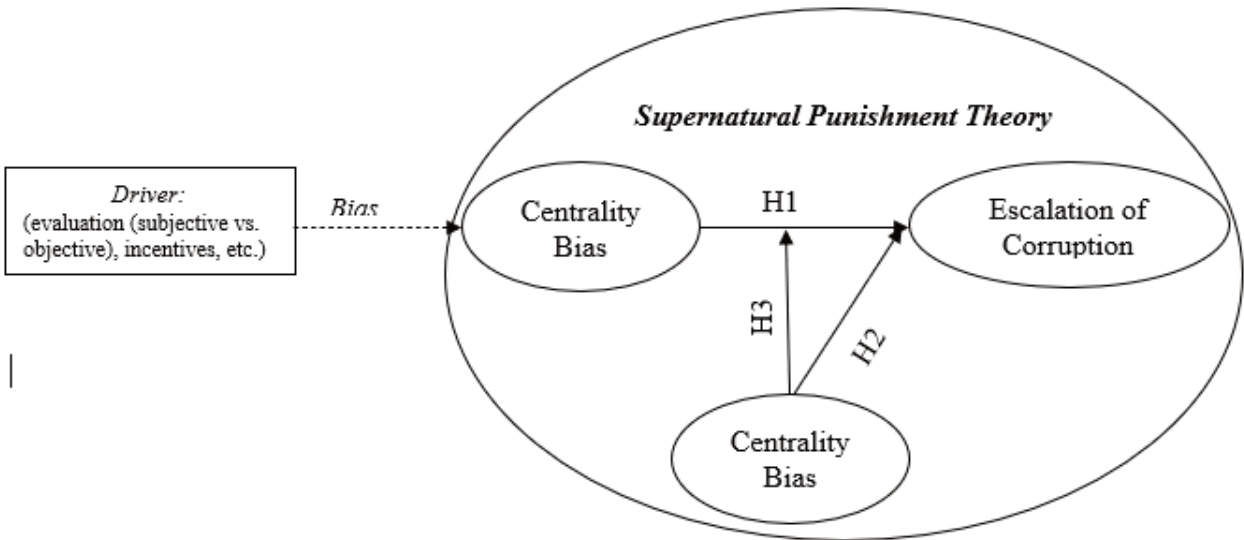
and self-interest encourage individuals to act opportunistically in pursuit of their personal and economic interests. In other words, information asymmetry, present when evaluators confer similar scores without paying attention to individual performance, may provoke a particular aversion to escalate attempts and lead to dysfunctional antisocial behaviors. One of the attempts is to escalate corruption in order to optimize the economic motive. Conversely, suppose evaluators deliver fair scores and consider work achievement without weighing. In that case, individuals will be more likely to carry out activities they are responsible for without engaging in dysfunctional antisocial behaviors, as the proportion acquired will be proportional to the efforts they put in. Hence, the economic motive has been catered to without any violation. Therefore, the first proposed hypothesis is:

H1: The escalation of corruption tends to be higher under conditions where a centrality bias than a non-existent centrality bias.

2.4 Religiosity and escalation of corruption

Supernatural supervision and punishment are two factors that trigger individuals to avoid unethical actions (Wood, 2013). Research demonstrates that individual religiosity can help us predict personality and prosocial behaviors (Jannah et al., 2023; Batson et al., 1993; Randolph-Seng & Nielsen, 2007;

Figure 1: Research Model



Saroglou, 2004). This is corroborated by findings that indicate that beliefs in the existence of a supernatural observer who can punish violating behaviors can be employed as a mechanism to control each activity (Schloss & Murray, 2011; Yilmaz & Bahçekapili, 2016). In other words, individuals with a high religiosity level tend to have more significant concerns due to a stronger belief in supernatural supervision, which encourages them to be more compliant and alert to the act of corruption, as well as its escalation. Therefore, it is crucial to circumvent supernatural punishment for dysfunctional antisocial behaviors performed. Thus, differences in religiosity levels may lead to varying perceptions of supervision and fear of punishment in each individual. Hence, the second proposed hypothesis is:

H2: The escalation of corruption tends to be lower in individuals with high religiosity than in individuals with low religiosity.

2.5 Religiosity, centrality bias, and the escalation of corruption

Centrality bias may adversely affect performance motivations and incentives, particularly for those with above-average performance (Bol, 2011; Trapp & Trapp, 2018). Anger and perceptions of unfair procedures may lead individuals to engage in retaliation (Skarlicki & Folger, 1997). Thus, it may trigger the dysfunctional antisocial behavior tendency of corruption escalation within the organization. However, the supernatural punishment theory explicates that God acts as a supernatural observer who monitors all actions and punishes any violation (Johnson, 2005). Therefore, it may induce individuals to avoid violating actions to circumvent punishment (Schloss & Murray, 2011; Yilmaz & Bahçekapili, 2016) and exhibit prosocial measures (Batson et al., 1993; Randolph-Seng & Nielsen, 2007; Saroglou, 2004).

When religion becomes the primary self-identity, religious norm violations will put cognitive and emotional states in a consonant position and thereby bringing on individuals to revert to the dissonant one, which lessens their inconvenience, by acting aligned with religious rules and virtue (Weaver & Agle, 2002; Conroy & Emerson, 2004; McGuire et al., 2012; Schloss & Murray, 2011). Hence, when there is a centrality bias that fuels dysfunctional antisocial behaviors, religiosity, which frames cognition with a belief in a supernatural observer who monitors individual actions and punishes those who violate them, may become a filter to avoid the escalation of corruption. Therefore, the third proposed hypothesis is:

H3: Religiosity moderates the causal relationship between centrality bias and escalation of corruption.

H3a: Under the exist centrality bias condition, the escalation of corruption will be lower in a high religiosity than in a low religiosity.

3 METHODOLOGY

3.1 Research design

This research used an experimental laboratory method with a 2x2 between-subject factorial design. This research manipulate the independent variables into two levels and categorize the moderating variables into two levels. The total cheating that occurs in each stage contributes to the escalation of corruption. A laboratory experiment is conducted by manipulating the independent variable and controlling another potentially interfering variable, thereby separating it from participants' daily lives (Nahartyo, 2013:3; Rohma, 2023). This experimental design is pointed out in Table 1. Furthermore, this research employs a multiperiod design comprising three periods. This design aims to capture the dynamic and repetitive nature of corruption escalation.

Table 1: Experimental Design

Factor and Level		Religiosity	
		High	Low
Centrality Bias	Exist	Cell 1	Cell 2
	Non-Existent	Cell 3	Cell 4

3.2 Variable measurement and manipulation

The Independent variable is centrality bias, which individuals experience when their above-average performances are evaluated and they receive lower incentives. In contrast, those below-average performances are evaluated and provided with higher ones. Thus, centrality bias is manipulated to create both exist and non-existent biases. An experimental condition, non-existent centrality bias, is presented through an explication in the scenario where participants have received performance-based incentives to which they are entitled (Trapp & Trapp, 2018). Conversely, an existing centrality bias condition is demonstrated by incentives or bonuses that are not aligned with actual performance.

The moderating variable is religiosity, which refers to the level of religiosity possessed by each individual. We categorize religiosity into two, i.e., high and low. Religiosity is measured using a research instrument developed by Underwood et al. (2003). Participants are required to answer the question items to indicate their levels of religiosity. Religiosity measurement is also executed using a median split by Maxwell et al. (1993) and Irwin & McClelland (2003). The median split chosen for the religiosity data is attributed to psychology rather than performance.

The dependent variable is the escalation of corruption, a dynamic act in an organization. The instrument used to measure the escalation of corruption is referred to as Nahartyo et al. (2020), and questions concerning the escalation of corruption are determined based on decisions to commit cheating. They have been distributed from the first round. To circumvent bias produced by intrinsic factors that differ in individual tendency levels to commit fraud. The escalation of corruption intention in the first round is not used as the basis for the value of escalation of corruption. The basis for assessing the escalation of corruption is the escalation of the corruption score in the third round.

3.3 Participants

The experiment participants are accounting students. Participating students have studied performance evaluation, incentive schemes, management accounting, and management control

systems, enabling them to comprehend the functions and characteristics of these activities and contribute to this research. Several conceptual reasons reinforce this preference of students. Firstly, students do not act like managers, who should be experienced in making decisions or actions (Farrell et al. 2008). Secondly, students can represent groups about to enter the workforce and soon experience a similar situation to that in our experimental case (Johansson & Wennblom, 2017).

We select student participants for two reasons, as stated by Kunz (2015) and Trapp & Trapp (2018). Firstly, students are evaluated through their learning process, which also involves a subjective evaluation. Therefore, students can understand the situation vested in this experiment (Kunz, 2015; Trapp & Trapp, 2018). Secondly, students lack ideas germane to performance measurement systems commonly applied in the world of work, so they will be inclined to accept the result without social desirability bias (Kunz, 2015; Trapp & Trapp, 2018). Additionally, the decision to select students by adjusting the selection methods to align with research objectives is strengthened by literature indicating that academic fraud can predict state corruption levels (Teixeira, 2013).

3.4 Experimental procedure

The experimental procedure consists of some stages. The first stage involves participants fulfilling the informed consent form, ensuring their willingness to participate in all experimental sessions and their understanding that they will not terminate their participation in the middle of the experiment. Secondly, the experimental materials designed, including assignments conferred during the experiment, are distributed. Thirdly, the experimental material distribution process is carried out randomly to mitigate bias due to the non-uniformity of individual factors that may lead to errors. Fourthly, concerning the experimental assignment, all participants conduct assignments commensurate with the manipulations they accept. Thus, experimental assignments are delivered in three rounds.

Data from the first round are regarded as a preliminary filter, as participants may still consider the religiosity instruments. Thus, the data used in the

assessment of the escalation of corruption are the escalation of corruption data from the third round. Fourth, demographic information is used to investigate the possibility of the influence of individual uncontrollable innate factors. Fifthly, a manipulation check is conducted to ensure that participants understand and internalize all manipulations presented. To avoid biased results, the data used are data that pass the manipulation check. The final stage is debriefing, in which participants are informed of the treatments administered to them and the specific aims of the manipulations.

3.5 Assignments and experimental procedures

The experimental assignment instrument used in this research is based on Nahartyo et al. (2019), with several modifications to a game with an academic cheating design. The assignment for this experiment was based on a paper-based approach that utilized games related to academic cheating scandals. The use of academic cheating scandals is referenced in Taixiera (2013), which explains that academic cheating is a predictor of a country's level of corruption (Teixeira, 2013). In addition, Orosz et al. (2018) analyzed 40 countries and found a strong relationship between self-reported academic dishonesty on exams and a country's level of corruption. Thus, academic cheating behavior can be considered a manipulation of the experimental task design to capture the tendency of corruption escalation behavior.

In the core assignment of the experiment, participants were placed in conditions as a student facing a final exam and met with a high level of task complexity. Participants were assigned to conditions through random manipulation and were not subject to centrality bias. Participants set conditions where there is no centrality bias to obtain information in a scenario where they will receive incentives or bonuses equal to what they are entitled to based on their actual (correct) answers (Trapp and Trapp, 2018). Meanwhile, participants in a condition with a centrality bias receive information in a scenario where they will be given incentives or bonuses not only according to their actual (correct) answers but also considering other factors, such as the speed of time, among others.

The experiment consisted of four rounds, each comprising ten general intelligence questions. General intelligence problems include logarithms and other basic intelligence equations (such as: if $x/y = 4$ and y not equal to zero, what percentage of $2x - y$ from x). Seven hints have been provided in each round to determine participants' tendency to cheat. The experiment was conducted in multiple rounds to determine the trend of increasing or decreasing the number of hints opened in each period, thereby capturing the escalation of corruption and the snowballing effect of corruption. The measurement of corruption escalation is measured by the accumulation of the number of hints opened in each experiment round. Meanwhile, the snowballing effect of corruption is measured by changes in the number of hints opened in each period.

After assigning the core experiment, the participants filled out the instrument to measure their level of religiosity. The distribution of religiosity categories is determined based on the median split value. Participants with scores above the median value will be categorized in the high religiosity group and coded with the number 1. Participants with scores below the median value will be classified in the low religiosity group and assigned a value of 0. In the final part, participants are asked to complete manipulation check questions to assess the level of internalization of the given manipulation by each participant. Next, participants were asked to fill in demographic information.

3.6 Manipulation check

A manipulation check aims to assess the internalization of the treatment by participants. The manipulation check consists of two questions proposed to each participant from four treatment groups. The criterion for passing a manipulation check is answering all questions correctly. The first relates to the incentives offered by the organization for which you are currently working (congruent with the case), specifically whether an incentive implementation system refers to the result of multiplying the total performance. The second covers employers' evaluation patterns and whether they calculate the average. If participants manage to answer the two questions correctly, they are regarded as being ca-

pable of well internalizing the manipulations afforded. Hence, data from participants with incorrect answer(s) are excluded from the subsequent data processing.

3.7 Data analysis technique

Before conducting the real experiment, we conducted a pilot test. The research instruments employed are those that have been designed to cater to validity and reliability. The real experiment data used in the test are those that pass the manipulation check. Before conducting the hypothesis test, a randomization test is performed to minimize potential errors. Two-way ANOVA is implemented to test all hypotheses, but to test H3, syntax ANOVA is used.

4 RESULTS

4.1 Pilot test

A pilot test is performed on all participants with the same characteristics as those of the research subjects to ensure that the instruments selected are valid and reliable. It is carried out three times, and the participant's qualification is equivalent to that of the real experiment participant. From the pilot tests to the real experiment, we use different participants in each stage to circumvent potential learning effects, which can lead to biased results. The first pilot test was conducted with five participants, of whom three passed and the other two failed the manipulation check. The second one is carried out on seven participants, five of whom pass (71.42%), and the others do not (28.57%). The third is 12 participants, 11 of whom pass (91.6%), and one participant does not (8.3%). The third pilot test yields good and reliable percentages, thereby passing the manipulation check. Hence, we believe that manipulations from the main effect can be well internalized. The instruments are thus attested to be reliable for the core experiment conducted with research subjects.

4.2 Experiment implementation

This research has 164 participants. However, one participant fails the manipulation check, and two others fail to provide complete demographic information, so the number of participants who can

proceed to the subsequent test is 161. The descriptive statistics of participant data encompass the following information: participants' gender, age, and Grade Point Average (GPA), as exhibited in Table 2.

4.3 Data Quality Test

A data quality test comprises construct validity tests and reliability tests. First, a bivariate or Pearson product-moment correlation analysis is used to test the construct validity of the metric variable, i.e., religiosity. Specifically, the correlation is reflected in item-total correlation scores (Green & Salkind, 2014, p. 302). The basis for a convergent validity assessment is the Pearson correlation, which measures the size of variance in the item score relative to the variable's mean score (Mayers, 2013, p. 302). As indicated, the convergent validity test of the religiosity variable manifests a high Pearson correlation coefficient ($p = 0.01$, two-tailed). Hence, items in the religiosity variable are considered valid. Second, a reliability test is conducted to assess the instrument's ability to produce consistent results (Cooper & Schindler, 2014, p. 260). Reliability is predicated on Cronbach's alpha score. A variable is reliable if it has a Cronbach's alpha score above/equal to 0.70 (Nunnally & Bernstein, 1994:269). The reliability test yields a Cronbach's alpha score of $p > 0.896$, indicating reliability.

4.4 Randomization Test

A randomization test is critical to show that participants have been randomly distributed across manipulation groups to eliminate and decrease biases brought about by different characteristics. The test is executed using a Chi-Squared test. The results, shown in Table 3, indicate significant differences in gender, age, and GPA ($p < 0.05$). Furthermore, randomization is reliable as we do not find any significant difference in gender, age, and GPA between groups. Therefore, we have a preliminary argument that the innate factor of individual demography does not cause the possible significance of the research result.

The residual normality test, using the Kolmogorov-Smirnov test, a p-value of 0.341. It indicates that all p-values are greater than 0.05, indicating a normal distribution in all residuals. Additionally, the

Table 2: Participant Demographic Characteristics

Variables	Overall Details and Each Treatment	
GENDER	WHOLE TREATMENT	
	Male: 35 respondents or 21.7% Female: 126 respondents or 78.3% Total: 161 respondents	
	EACH TREATMENT	
	CELL 1: Male: 11 respondents or 34.4% Female: 21 respondents or 65.6% Total: 32 respondents	CELL 2: Male: 9 respondents or 26.5% Female: 25 respondents or 73.5% Total: 34 respondents
	CELL 3: Male: 7 respondents or 12.1% Female: 51 respondents or 87.9% Total: 58 respondents	CELL 4: Male: 8 respondents or 21.6% Female: 29 respondents or 78.4% Total: 37 respondents
AGE	WHOLE TREATMENT	
	Minimum: 18 years Maximum: 24 years Mean: 19 years 9 months Std. Dev. 0.839	
	EACH TREATMENT	
	CELL 1: Minimum: 18 years Maximum: 24 years Mean: 19 years 8 months Std. Dev. 1.777	CELL 2: Minimum: 18 years Maximum: 21 years Mean: 19 years 6 months Std. Dev. 0.684
	CELL 3: Minimum: 18 years Maximum: 22 years Mean: 19 years 7 months Std. Dev. 2.750	CELL 4: Minimum: 18 years Maximum: 24 years Mean: 20 years 1 month Std. Dev. 0.269
GPA	WHOLE TREATMENT	
	Minimum: 2.60 scales of 4.00 Maximum: 3.97 scales of 4.00 Mean: 3.51 scale of 4.00	
	EACH TREATMENT	
	CELL 1: Minimum: 2.97 scales of 4.00 Maximum: 3.91 scales of 4.00 Mean: 3.56 scale of 4.00 Std. Dev. 0.232	CELL 2: Minimum: 2.65 scales of 4.00 Maximum: 3.86 scales of 4.00 Mean: 3.47 scale of 4.00 Std. Dev. 0.258
	CELL 3: Minimum: 2.60 scales of 4.00 Maximum: 3.97 scales of 4.00 Mean: 3.52 scale of 4.00 Std. Dev. 0.281	CELL 4: Minimum: 2.90 scales of 4.00 Maximum: 3.97 scales of 4.00 Mean: 3.52 scale of 4.00 Std. Dev. 0.269

Q-Q plot test indicates that the plots follow the fit line, suggesting normally distributed residuals. Additionally, our normality test using a detrended Q-Q plot yields evenly distributed plots above and below the horizontal line, precisely located in the middle of the chart, indicating normally distributed residuals. Tests using a Q-Q plot and detrended Q-Q plot are shown in Figure 2.

4.5 Hypothesis test

Before conducting a hypothesis test, we perform a descriptive statistical analysis of each manipulation group’s total escalation of corruption to determine the data distribution. The descriptive statistics test for the escalation of corruption in each treatment and treatment group, as well as the cells, is presented in Tables 4 and 5, respectively.

Table 3: Randomization Test

Variables	Pearson Chi-Square	Sig.
Gender	15.974	0.384
Age	19.339	0.371
GPA	224.043	0.241

**Sig. at level 5%

Figure 2: Normality Residual

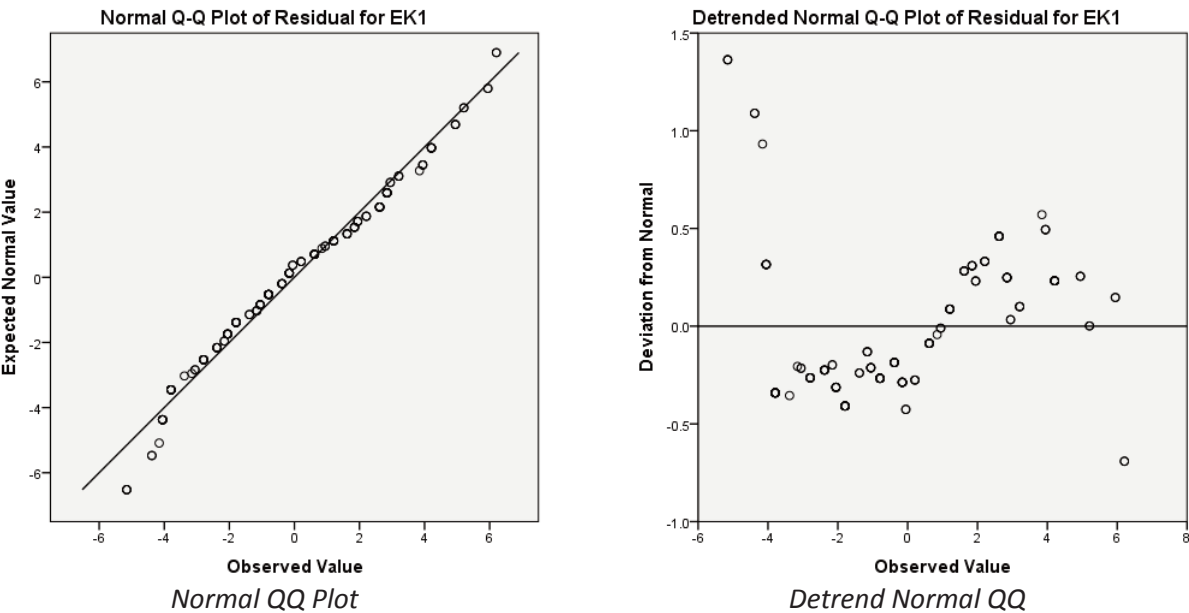


Table 4: Descriptive Statistics of Escalation of Corruption in Each Manipulation

Variable	Treatments	Escalation of Corruption
Centrality Bias	Exist	6.30
	Non-Exist	3.89
Religiosity	High	4.28
	Low	5.65

Table 5: Descriptive Statistics of Corruption Escalation in Each Treatment Group

Centrality Bias	Religiosity	
	High	Low
Exist	5.16	7.38
Non-Exist	3.79	4.05

Table 4 demonstrates that the highest number of escalations of corruption occurs in an exist centrality bias condition, whereas the lowest occurs in a non-existent one. This result is corroborated by Table 5, which shows that the highest number of the escalation of corruption is found in an exist centrality bias condition at a low religiosity level. Meanwhile, the lowest value is found in a non-existent centrality bias condition at a high level of religiosity. The descriptive analysis suggests that the data distribution provides preliminary information indicating that an exist bias condition can predict the escalation of corruption. In contrast, religiosity effectively de-escalates the adverse effects of centrality bias. However, we still need a further analysis through a hypothesis test to identify the significance of the effect. This research investigates whether centrality bias and religiosity have a significant impact on the escalation of corruption. The statistical test is manifested in Table 6.

Based on the two-way ANOVA test in Table 6, centrality bias is found to influence the escalation of corruption. It is attested to by $F = 493.629$; $p <$

0.000 at a significance level of 1%. Furthermore, religiosity affects the escalation of corruption at $F = 7.347$, $p < 0.007$ (at a significance level of 1%), and the interaction between centrality bias and religiosity impacts the escalation of corruption at $F = 4.587$, $p < 0.034$. The estimated marginal means of the escalation of corruption in each condition, either centrality bias or religiosity, are presented in Table .

Hypothesis 1 predicts that the escalation of corruption is higher in an existing centrality bias condition than in a non-existent one. The hypothesis test in Table 6 demonstrates the centrality bias's effect on the corruption escalation at $p < 0.000$. Additionally, the mean test in Table 9 also exhibits that the escalation of corruption tends to be higher in an exist centrality bias (6.269) than in a non-existent one (3.924). Hence, the escalation of corruption will be higher in a current centrality bias condition than in a non-existent one, at $F = 493.629$, $p < 0.000$, and a significance level of 1%. Therefore, H1 is supported.

Table 6: Hypothesis Testing

	Df	Mean square	F	Sig
<i>Correlated model</i>	3	103.033	12.842	0.000
<i>Intercept</i>	1	3960.531	493.629	0.000
Centrality Bias	1	209.755	26.143	0.000*
Religiosity	1	58.948	7.347	0.007*
Centrality Bias*Religiosity	1	36.804	4.587	0.034**
Centrality Bias *Religiosity <i>Compare</i> (Religiosity)	1	Contrast: 81.691 Error: 8.023	10.182	0.002*
<i>Error</i>	157	8.023		

$R\text{-square} = 0.197$

Note: *Sig at level 1%; **Sig at level 5%.

Table 7: Marginal Mean for Each Condition

Centrality Bias		Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Exist		6.269	0.349	5.580	6.958
Non-Exist		3.924	0.298	3.335	4.512
Religiosity					
High		4.475	0.312	3.859	5.091
Low		5.718	0.336	5.054	6.383
Centrality Bias	* Religiosity				
Exist	High	5.156	0.501	4.167	6.145
	Low	7.382	0.486	6.423	8.342
Non-Exist	High	3.793	0.372	3.058	4.528
	Low	4.054	0.466	3.134	4.974
Centrality Bias	* Religiosity	Compare Religiosity			
Exist	High		0.698	-3.604	-0.848
	Low		0.698	0.848	3.604

Table 8: The Intention of Continuing Corruption

Variables	F	Sig
Escalation of corruption-Round 1***	4.510	0.035*
Escalation of corruption-Round 2****	553.254	0.000**

*Sig. at level 1%; ** Sig. at level 5%;

***Dependent variable: Escalation of corruption-Round 2

**** Dependent variable: Escalation of corruption-Round 3

Hypothesis 2 predicts that the escalation of corruption is lower in a high religiosity condition than in a low one. The hypothesis test demonstrates that religiosity has an effect on the escalation of corruption at $p < 0.007$. On average, in a high religiosity condition, the escalation of corruption tends to be lower (4.475) than in a low one (5.718). Hence, statistically, in a high religiosity condition, the escalation of corruption will be lower than that in a low one, as indicated by $F = 7.347$; $p < 0.007$, with a significance level of 1%. Therefore, H2 is supported.

Hypothesis 3 predicts the interaction effect between centrality bias and religiosity on the escalation of corruption. The statistical test indicates the

interaction effect between the causal relationship of centrality bias and escalation of corruption. It is attested to $F = 4.587$, $p < 0.034$, and a significance level of 5%. Therefore, H3 is supported. That H3 is accepted points out an interaction, and we can thus proceed to a further test of the simple effects of H3a. H3a test is carried out using the syntax ANOVA. The analysis reveals that, in the presence of an exist centrality bias condition, the tendency to escalate corruption is lower in a high religiosity condition than in a low one, as indicated by $F = 10.182$, $p < 0.002$. Hence, there is empirical evidence indicating that religiosity can mitigate the escalation of corruption in the context of an exist centrality bias. Therefore, H3a is supported.

Referring to the results, we carry out several additional analyses. The first additional analysis is to examine the intention to escalate the corruption further. The hypothesis analysis reveals the impact of centrality bias on the escalation of corruption, with a significant effect at $F = 493.629$, $p < 0.000$, and a significance level of 1%. Furthermore, further analysis reveals that an intention to engage in corruption in the early stage influences the intention to escalate in the next stage, as shown in Table 10.

As demonstrated in Table 10, the escalation of corruption tendency in the first round affects the second round, with $F = 4.510$ and $p < 0.035$, which is significant at the 5% level. Additionally, the escalation of the tendency towards corruption in the second round influences the third round, with $F = 553.254$, $p < 0.000$, significant at the 1% level. Based on this result, the individual's original intention to commit corruption is one of the pivotal predictors that can encourage individuals to repeat the act. This additional analysis supports hypothesis 1, which states that individual violating behaviors in the first round significantly affect the same violating behavior in subsequent rounds. Intending to commit corruption in the first round, especially drives individuals to repeat the act in the second round. Furthermore, an intention to commit corruption in the second round significantly encourages individuals to take the same action in the subsequent round. This aligns with Zyglidopoulos (2008) and Nahartyo et al. (2020), who suggest that individuals are more likely to repeat a corrupt act if they have done it once.

The second additional analysis focuses on participants with an exist centrality bias and doesn't include data from participants without a centrality bias. It's precisely to examine the tendency of increase or decrease in the number of corruptions happening in the exist centrality bias on each exper-

imental round. Hence, in the exist centrality bias manipulation afforded in the second and third rounds, participants are asked, "If you have an opportunity to access the key answer, will you do that?" and are scored 1-10 to capture cheating tendency as a representation of the escalation effect of corruption. This analysis examines the mean number of increases or decreases in scores obtained from peers in each experimental round, without accumulating scores from all rounds. Our observation reveals that the corruption committed by participants tends to increase at an accelerated rate, as indicated in Table 9.

In the first round, the mean of corruption scores is 0.52. Interestingly, the mean corruption score increases to 6.06 in the second round and even further in the third round. This result highlights that corruption is on the rise. Furthermore, it gives us insight into the fact that attempts to avert corrupting behaviors will be more complicated and require more effort, as the behaviors will likely escalate over time. Hence, further exploration is necessary to study the significance of religiosity in confronting centrality bias, which fuels corruption and its ever-increasing snowball effects. Further analysis reveals that participants with exist centrality bias and high religiosity in each period have a lower mean score for the escalation of corruption than those with low religiosity, as shown in Table 10.

As indicated in Table 10, in an exist centrality bias condition, the mean score of the escalation of corruption in individuals with high religiosity is not higher than in individuals with low religiosity. Individuals with high religiosity achieve the highest score, namely 5.16, in the third round. Individuals with low religiosity achieve the highest score, 7.38, in the same round. Thus, even after being compared in each round, the escalation of corruption in indi-

Table 9: Snowballing Effect Under Exist Centrality Bias

	Minimum	Maximum	Mean
Round 1	0	5	0.52
Round 2	0	10	6.06
Round 3	0	10	6.30

Table 10: Religiosity Filter in the Snowball Effect Under Exist Centrality Bias

High Religiosity				Low Religiosity			
	Minimum	Maximum	Mean		Minimum	Maximum	Mean
Round 1	0	2	0.28	Round 1	0	5	0.74
Round 2	0	9	5.13	Round 2	2	10	6.94
Round 3	0	9	5.16	Round 3	3	10	7.38

viduals with low religiosity is higher than in individuals with high religiosity. This result corroborates hypotheses 2, 3, and 3a, which suggest that religiosity plays a role that cannot be disregarded, namely, in filtering the escalation of corruption.

Interestingly, even though individuals with high religiosity may have an increased score of the escalation of corruption in the respective rounds, the increase is not higher than that in individuals with a low religiosity level. Thus, increases found in the escalation of corruption scores by individuals with high religiosity manifest that religiosity does not completely negate the escalation of corruption to zero. However, religiosity can be an effective filter to decrease and de-escalate the tendency for corruption.

5 DISCUSSION

The H1 test shows that centrality bias may boost the escalation of corruption. The tendency to escalate corruption is lower without centrality bias than with it. It aligns with Trapp & Trapp (2018) and Bol (2011), who suggest that biased work evaluation is inclined to drive individuals to underperform. It is also analogous to Bol et al. (2016) in their elaborated agency theory, which suggests that a disproportional ratio of payment and performance breeds centrality bias, fueling employee aversion to increase work efforts in the following working period. Individual reluctance to behave well is one form of dysfunctional behavior that may harm the organization. This suggests that centrality bias should not be included in subjective performance evaluations. An unbiased performance evaluation encourages employees to consistently demonstrate their abilities and behave in accordance with the organization’s regulations. Centrality bias within a subjective per-

formance evaluation is a straightforward factor influencing individual vengeance intentions, as reflected in the escalation of corruption behavior toward both the supervisor as an evaluator and the organization, ultimately harming the organization. This result reinforces the previous research by Kampkötter and Sliwka (2016), which suggests that a lack of score differentiation in performance evaluations may breed adverse reactions that dominate the positive ones. It is also congruent with Bol, Kramer, & Maas (2016) and Colquitt et al. (2001) that an individual’s tendency towards harmful vengeance is a consequence of difficulties, anger, and disappointment due to inconsistencies between expectations and reality, particularly in performance evaluations between work peers. It strengthens the notion that centrality bias is inclined to provoke counterproductive behaviors that harm the organization. Unfairness perceived by individuals due to bias in a performance evaluation process triggers them to escalate corruption, which harms the organization. This result supports the referent cognition theory, which posits that individuals with good performance will perceive higher unfairness when they receive lower actual results than expected.

Hypothesis 2 testing demonstrates that the escalation of corruption is lower in a high religiosity condition than in a low one. Individuals with high religiosity tend to perceive supernatural supervision, fostering them to avoid dysfunctional behaviors, e.g., the escalation of corruption. Following Batson et al. (1993), Randolph-Seng & Nielsen (2007), and Saroglou (2004), religiosity intensity tends to enhance prosocial behaviors. In accordance with the supernatural punishment theory, the existence of supernatural observers in all individual actions may lead to control over their behaviors (Schloss & Murray, 2011). Besides, this result also corresponds with

Longenecker, McKinney, & Moore (1989), who found that religious individuals are inclined to avoid and diminish unethical actions. Religiosity guides individuals' ethical behaviors (Weaver & Agle, 2002). Individual escalation tendency is an unethical action as it may harm the organization and different parties. Hence, a high religiosity may induce individuals to avoid more dysfunctional behaviors.

The hypothesis 3 test examines the relationship between inducing religiosity and the centrality bias and escalation of corruption relationship. Centrality bias positively activates the escalation of corruption, demotivating individuals to perform optimally and motivating them to cheat on their peer assignments. However, religiosity may serve as an optimal filter. This result is in line with the supernatural punishment theory, which suggests that perceived supernatural supervision may deter individuals from escalating corruption. However, they are in a dangerous and unfair biased evaluation condition. Individual religiosity influences individual cognition, which drives individuals to consider the existence of supernatural observers when about to engage in behaviors that violate social norms, often due to centrality bias, and the acceptance of supernatural punishment. It aligns with Schloss & Murray (2011) and Yilmaz & Bahçekapili (2016) in suggesting that the presence of supernatural supervision may prompt individuals to refrain from violating actions. Thus, the escalation of corruption due to centrality bias will be mitigated by the religiosity filter, which frames individual cognition in terms of supernatural supervision and punishment.

This result of H3 has also aligned with cognitive dissonance theory that detrimental violating actions engender inconvenience of cognition and emotion, propelling individuals to avoid violating behaviors and prioritizing religious interests (Festinger, 1957; McGuire et al. 2012; Schloss & Murray, 2011; Weaver & Agle, 2002; Conroy & Emerson, 2004). In a consonant condition, religiosity prompts individuals to act more cautiously due to the perceived presence of supernatural supervision and punishment. When individuals engage in the escalation of corruption, religiosity can turn a consonant situation into a dissonant one. That is generating inconvenience as the behavior contradicts their religiosity cognition. Individuals will attempt to lessen that in-

convenience by mitigating and circumventing the dysfunctional antisocial behavior that leads to the escalation of corruption. In a centrality bias condition, religiosity, which is not accompanied by behaviors not commensurate with religious principles, will make individuals uncomfortable. The incongruity between cognition and attitudes produces it. Hence, to deal with such inconvenience, individuals will tend to reduce the escalation of corruption.

The hypothesis H3a test explicitly indicates that, in a centrality bias condition, the escalation of corruption tendency will be higher in a low religiosity condition than in a high one. This amplifies hypotheses 2 and 3. Hence, individual religiosity is an important mechanism that can filter individual behaviors and decrease the negative impacts of centrality bias. This suggests that centrality bias has adverse impacts, such as the escalation of corruption, directly. However, the psychological mechanism of individual religiosity can be optimized to de-escalate negative behaviors. Dangerous effects of bias in a subjective performance evaluation fuel individuals to undertake dysfunctional antisocial behaviors and escalate corruption, which detracts from religiosity. Consistent with the supernatural punishment theory, the existence of supernatural observers who monitor each action and punish each violating activity stimulates individuals to act more carefully (Johnson, 2005). It is also following Batson et al. (1993), Randolph-Seng & Nielsen (2007), and Saroglou (2004) that religiosity can boost individuals to show prosocial behaviors. In this research, antisocial behaviors are reflected in the reduction of corruption escalation, which may harm peers and the organization. In line with McGuire et al. (2012) and Schloss & Murray (2011), detrimental actions result in inconvenient cognition and emotion, driving individuals to avoid such behaviors and prioritize religious matters. Therefore, individuals will attempt to revert to the dissonant condition to eliminate inconvenience and act in alignment with their religious beliefs and virtues (Weaver & Agle, 2002; Conroy & Emerson, 2004). This suggests that religiosity frames individual cognition, filters the escalation of corruption, and lessens inconvenience due to conformity between religion-framed cognition and violating actions. In conformity with the cognitive dissonance theory, individuals with high religiosity apply basic reasoning

that supernatural observers supervise their corrupting acts. Therefore, an individual's tendency to commit corruption will be mitigated to reduce the inconvenience of religiosity and correspond with religiosity cognition—this behavior brings individuals back to a consonant condition. Meanwhile, individuals with low religiosity are more likely to continue engaging in acts of corruption because their corruption does not conflict with their low religiosity.

6 CONCLUSION

Goals congruence is a crucial factor of a sustainable organization. The biased evaluation process may lead to dysfunctional antisocial behavior, including the escalation of corruption, which harms the organization. Previous research has substantiated the role of religiosity in fostering prosocial behaviors (Batson et al., 1993; Randolph-Seng & Nielsen, 2007; Saroglou, 2004; McGuire et al., 2012; Schloss & Murray, 2011). However, previous research is still limited to religiosity's capability of detracting from the negative impacts of evaluators' biased behaviors. This research demonstrates that centrality bias leads to a higher escalation of corruption. It induces the escalation of corruption, which can be mitigated by religiosity and fueled by concerns about supernatural oversight. Religiosity motivates individuals to counteract the snowball effect of corrupt behavior, which is exacerbated by exist centrality bias. Based on research findings, organizations have undertaken several efforts to mitigate the potential for escalating corrupt behavior. First, to minimize the negative impacts arising from centrality bias, performance appraisal standards relevant to each employee's duties and responsibilities are necessary. This is necessary to ensure consistent assessment standards, even with different evaluators. Second, the performance measurement and assessment standards developed need to consider both financial and non-financial assessment standards, so that all employee contributions can be recorded and converted into comprehensive assessments. Third, effective organizational strategies are needed to consistently manage employee religious orientation, by providing the freedom to practice religious activities without assigning crucial weight to performance assessments; these activities must be performed during work hours. This re-

search provides implications for three main streams. Theoretically, this research applies a supernatural punishment framework as an alternative to elucidate attempts to induce religiosity effects. The supernatural punishment theory comprehensively captures the relationship between cognition and mentality, as well as supernatural powers that transcend human beings. Thus, theoretical contribution based on supernatural punishment theory suggest that this research shows individual religiosity plays a crucial role in mitigating the negative impact of individual behavior in the workplace. Religiosity can mitigate the negative impact of centrality bias on the escalation of corruption relationships. Secondly, empirically, implementing an experimental research method can induce real-time measurement of individual cognition and personality without producing biased cognitive confirmation. It addresses the weakness of the survey research method, which can potentially trigger biased cognitive confirmation. Thirdly, the practical implication, this research can be regarded as a reflection for organizations and regulators to consider the impacts and potential of centrality bias, which may harm organizations in the evaluation process. Organizations and regulators can consider the importance of elaborating efforts, optimizing, and activating individual religiosity within a social environment to eradicate dysfunctional, antisocial behaviors that are potentially systematically manifested and escalated.

Nevertheless, this research possesses limitations. Firstly, it does not participate in any competition scheme during the experiment assignment process. That competition scheme may reinforce the effect of centrality bias. Secondly, questionnaires on religiosity allow participants to be framed by questions proposed and alter their behavior and answer patterns. Therefore, we measured religiosity at the beginning of this experimental session to minimize the impact, i.e., before the manipulations were administered. Thirdly, participants' religious education level is not taken into account here. Therefore, further research may consider the influence of religious education levels. It may also explore the effect of the length of studying religions on behavioral tendencies. Moreover, further research can consider more specifically the differences in preferences of the religious orientation of each participant or subject being studied.

EXTENDED SUMMARY/IZVLEČEK

Ta raziskava analizira učinek moderatorja religioznosti na razmerje med centralnostno pristranskostjo in eskalacijo korupcije. Uporabljena je bila laboratorijska eksperimentalna metoda z 2×2 faktorskim načrtom v večobdobnem okolju, v katero je bilo vključenih 161 dodiplomskih študentov računovodstva. Eksperiment je potekal v štirih zaporednih krogih nalog, pri čemer je bila povprečna ocena posameznega kroga ključna za spremljanje učinka snežne kepe pri eskalaciji korupcije. Centralnostna pristranskost je bila manipulirana tako, da je bila v določenih pogojih prisotna, v drugih pa odsotna, medtem ko je bila religioznost izmerjena in na podlagi mediane razdeljena v skupini visoke in nizke religioznosti. Rezultati potrjujejo, da centralnostna pristranskost statistično značilno spodbuja eskalacijo korupcije. Hkrati se je pokazalo, da religioznost deluje kot učinkovit filter, ki ublaži negativne učinke centralnostne pristranskosti, ter pomembno prispeva k zmanjševanju učinka snežne kepe v pogojih obstoječe centralnostne pristranskosti. Ugotovitve raziskave opozarjajo, da prosocialnih vedenj ni mogoče razumeti zgolj kot ravnanj, ki koristijo organizaciji, saj ta niso nujno povezana s preprečevanjem škodljivih vedenj.

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AUTHOR GUIDELINES

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