

T-Shaped Competencies in Academic and IT Service Synergies

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Abstract: In the 21st century, education and business face increasingly complex challenges that require multidisciplinary approaches. This paper explores the concept of T-shaped competencies, which combine deep knowledge in one domain with a broad range of skills across other areas. By examining case studies from both academia and business, the paper highlights the importance of multidisciplinary education and collaboration in fostering innovation and competitive advantage. The findings emphasize the need for continuous adaptation of knowledge and skills, as well as the potential impact of AI tools on multidisciplinary competencies. The paper concludes that a synergistic relationship between academia and business is essential for addressing complex problems and driving value co-creation.

1 INTRODUCTION

In the 21st century, education faces increasingly complex problems that cannot be addressed by a single discipline alone. The traditional approach of focusing on one area of expertise is no longer sufficient to tackle the multifaceted challenges of today's world. As highlighted by Kunze, Stadler, and Greiff (Kunze et al., 2023), complex problem-solving is a crucial skill for the 21st century, requiring a multidisciplinary approach to education. Multidisciplinary teams have become essential for success in service design. These teams bring together diverse expertise, enabling innovative solutions and fostering service innovation. According to Joly et al. (Joly et al., 2019), leveraging a multidisciplinary approach in service design is key to creating new forms of value co-creation.

However, achieving a common understanding within such teams remains a core challenge. The solution lies in multidisciplinary education, which equips individuals with the skills to collaborate effectively across different fields. This approach is equally applicable to academic research, where interdisciplinary collaboration can lead to groundbreaking discoveries.

In the business world, service provision increasingly relies on multidisciplinary knowledge. Understanding how this approach is perceived and implemented in business is crucial for fostering innovation and competitiveness. Mirafzal et al. (Mirafzal et al., 2023) emphasize the importance of knowledge management in multidisciplinary service design organiza-

tions, highlighting the role of diverse expertise in improving performance. Spohrer and Maglio (Spohrer et al., 2007) also discuss the importance of service systems and the role of multidisciplinary teams in driving innovation and value co-creation.

The aim of this paper is to present both academic and business perspectives on multidisciplinary approaches. By showcasing case studies from both domains, we aim to illustrate the benefits and challenges of fostering multidisciplinary competencies in education, research, and business.

2 MULTIDISCIPLINARY AND INTERDISCIPLINARY

The terms "multidisciplinary" and "interdisciplinary" have distinct meanings. Multidisciplinary approaches involve multiple disciplines working together on a common project, each retaining its methodologies and perspectives. For example, a healthcare team might include doctors, nurses, and social workers, each contributing their expertise without blending methods.

In contrast, interdisciplinary approaches integrate knowledge and methods from different disciplines to create a unified approach. For instance, an interdisciplinary research project might combine psychology, sociology, and neuroscience to study human behavior, with researchers actively integrating their approaches.

In summary, multidisciplinary work involves parallel contributions from different disciplines, while interdisciplinary work integrates knowledge and methods to create a cohesive approach. Both have their merits, with interdisciplinary work often seen as more effective for complex problems, while multidisciplinary work offers flexibility.

3 TYPES OF KNOWLEDGE STRUCTURES

Professionals can be categorized into knowledge structures based on depth and breadth of their competencies, skills and knowledge. These knowledge structures, or knowledge profiles, are represented by different shapes (Fig. 1) with the most common being I-shaped, Dash-shaped, H-shaped, M-shaped and T-shaped profiles (Demirkan and Spohrer, 2015):

- **I-shaped:** professionals possess deep knowledge in one domain, excelling in their field but often lacking interdisciplinary cooperation and communication (Saukkonen and Kreus, 2022), which can be a disadvantage in modern challenges (Bierema, 2019).
- **Dash-shaped:** individuals, represented by a horizontal line, have broad competencies across domains but lack deep expertise, which benefits interdisciplinary collaborations (Ninan et al., 2022).
- **H-shaped:** professionals have deep knowledge in two domains, represented by two vertical lines connected by a horizontal line, symbolizing their ability to integrate both of these areas into their professional work (Saukkonen and Kreus, 2022). Their dual expertise limits expansion into other domains (Ninan et al., 2022).
- **M-shaped (comb-shaped):** individuals have expertise in multiple domains, represented by multiple vertical lines, though their knowledge is less in-depth compared to I-shaped or H-shaped professionals (Ninan et al., 2022).
- **T-shaped:** professionals combine the strengths of dash-shaped and I-shaped profiles, with deep knowledge in one domain and interdisciplinary overlaps into secondary domains (Ninan et al., 2022).

4 T-SHAPED PROFILE

The term 'T-shape' can be traced back to 1991, when Guest (Guest, 1991) described the need for a 'renais-

sance man', that would combine IT skills with business expertise (Conley et al., 2017). Amber (Amber, 2000) expanded this idea, calling for T-shaped individuals with deep expertise in one area and the ability to extend into unknown fields, enabling them to solve multidisciplinary problems. Tim Brown, CEO of IDEO, later popularized the term (Brown, 2010).

The detailed design for this knowledge profile has been adjusted by multiple researchers (Barile et al., 2014; Saviano et al., 2016; Gardner, 2017; Saukkonen and Kreus, 2022), leading to a mostly unified design presented in Figure 2. The skills in the horizontal part of the T can depend on interpretation, however they usually enable the person to collaborate with professional from another domain without difficulties. These skills can include project management, communication and soft skills, creative thinking, teamwork, and they can be also from other scientific or engineering disciplines, such as statistics, economics, arts, etc. However, the breadth of these skills does not match the depth of expertise found in the vertical bar (Kruusmaa, 2017).

4.1 Academia Perspective

Social and economic changes, like globalization, have led to specialized roles and educational paths. While specialized knowledge addresses specific problems, these models struggle with modern challenges due to overlapping dimensions and rapid changes (Saviano et al., 2016). Educating students with a multidisciplinary focus is key for future organizations. However, the current educational system still emphasizes single-domain expertise, creating I-shaped professionals (Demirkan and Spohrer, 2018).

4.1.1 Adapting T-Shape into Curriculum

The research results of universities introducing T-shape into their educational curriculum show that being a T-shaped professional can prove beneficial in various domains.

The University of Southern California identified weaknesses in their I-shaped software engineering master's students, recognizing the need for multidisciplinary thinking. They adapted their courses to support the development of T-shaped professionals by having students work on real-life service development projects, engaging with the entire service design process from client negotiation to maintenance planning (Boehm and Mobasser, 2015).

Tallinn University of Technology highlights the need for T-shaped professionals in the mining sector, emphasizing the importance of developing these skills

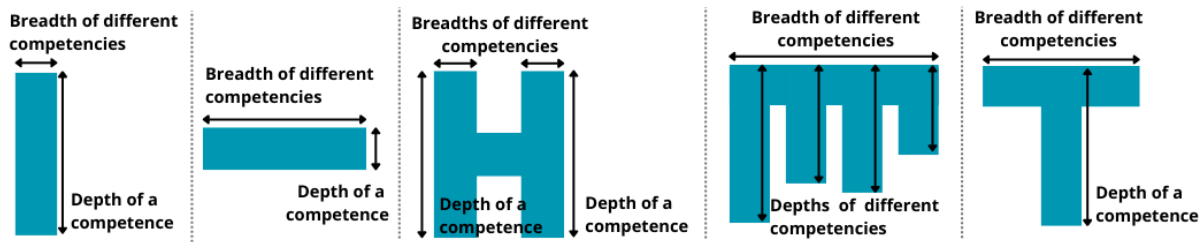


Figure 1: I-Shaped, Dash-shaped, H-shaped, M-shaped and T-shaped profiles. Adapted from: (Ninan et al., 2022).

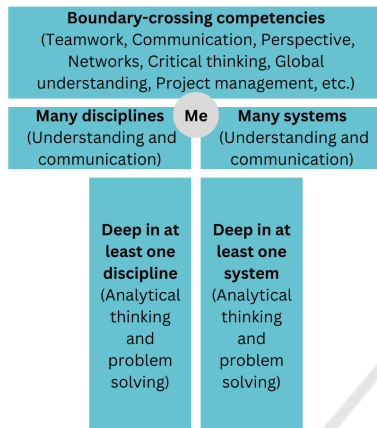


Figure 2: Detailed design of the T-shaped knowledge architecture. Redrawn from: (Freund et al., 2024).

in master's students and creating suitable work environments to retain them (Robam et al., 2023).

The use of interactive models based on real data has been shown to enhance T-shaped skills in hydrology students at a US community college. Students using real data in seminars demonstrated a better understanding of the hydrological domain, the role of hydrology specialists, and the field's impact on society (Sanchez et al., 2016). Similarly, the Institute for Water Education in Delft, Netherlands, proposed incorporating T-shaped learning into their master's programs to foster effective teamwork. This would involve students working on real-world problems in various roles, including fieldwork and discussions with professionals, with assessments designed to further enhance different competencies (Uhlenbrook and Jong, 2012).

The presented cases on modifying university curricula to foster T-shaped graduates highlight the importance of integrating real-world examples into academic experiences. Collaborations between students and industry partners extend professional roles beyond domain-specific expertise, aiding in the cultivation of essential skills for addressing complex, multidisciplinary problems. Exposure to real-world problems enhances students' capacity to manage complexity and contradiction, fostering leadership skills

(Tranquillo, 2017).

4.1.2 T-Shaped Researchers

The examples of adapting the universities' educational practices can lead to a conclusion that by fostering T-shaped skills at the undergraduate levels, the doctoral students and academic researchers in the future will be not only experts in their domain but proficient multidisciplinary collaborators as well. However, there is a gap in researching the T-shaped skills in academic research and a further exploration is still needed (Wallezky et al., 2024).

4.2 Business Perspective

In the business context, T-shaped professionals are valued for their ability to drive innovation and enhance organizational resilience by combining deep expertise in a core domain with broad, adaptable knowledge. Their effective collaboration across business functions fosters a responsive environment that aligns with changing market demands and supports long-term competitiveness.

4.2.1 The Role of T-Shaped Professionals in Business Transformation

One of the most compelling applications of T-shaped professionals is within digital and/or AI transformation, balancing specialized technical skills with effective communication across teams and disciplines (Demirkan and Spohrer, 2018). They excel in environments requiring flexibility, critical thinking, and lifelong learning, crucial for adapting to technological advancements (Bierema, 2019).

By facilitating a holistic view of customer experiences, T-shaped professionals enable organizations to move beyond product innovation towards integrated service solutions, where technology is an enabler rather than the focus. The shift towards a service focus requires changes in mindsets and behaviors. T-shaped professionals facilitate this by adopting an integrated perspective, moving organizations

beyond product innovation to innovative service solutions that cater to customer and stakeholder needs (Demirkan and Spohrer, 2015).

In essence, T-shaped professionals provide the adaptable, interdisciplinary skills that are essential for navigating the complexities of service-oriented innovation. Their ability to integrate technical proficiency with a deep understanding of human-centered needs empowers organizations to create more meaningful, sustainable solutions that align with evolving customer and market demands. T-shaped professionals contribute to dynamic capabilities by bringing cross-functional knowledge and collaborative skills, vital for sustaining competitive advantage (Barile et al., 2014). Their effective communication supports interorganizational learning, enabling businesses to develop new strategies and adapt to emerging trends (Saviano and Barile, 2013).

For example, in fields requiring project management and cross-functional teamwork, such as infrastructure development, the versatility of T-shaped professionals is particularly valuable. Infrastructure projects often face technical, social, and political complexities that demand both in-depth knowledge and a broad understanding of various stakeholder needs (Ninan et al., 2022). T-shaped professionals, with their combined depth and breadth of expertise, can manage these complexities more effectively, coordinating between technical and non-technical teams to ensure project success (Ninan et al., 2022).

5 SELECTED CASE STUDIES

Our team has initiated the research into the role and perception of T-shape in the IT domain, starting with exploring the IT academic research and IT businesses. We are conducting case studies in universities and companies located in Brno, Czech Republic. Our goal is to address the importance of T-shaped skills in these two domains and investigate its role in their mutual collaboration, knowledge and innovation sharing. We have results from one university and one company to date, which are presented in the following sections. Research in other institutions is still ongoing.

5.1 T-Shape in Academia

The first case study (Walletzký et al., 2024) focused on the role of T-shaped knowledge in IT academic research, specifically at the Faculty of Informatics, Masaryk University. A questionnaire survey targeting research groups and laboratories was conducted to assess how this concept is perceived by their members

— researchers and students alike.

5.1.1 Methodology

The case study data was collected through an online, anonymous survey sent to research group leaders at Masaryk University's Faculty of Informatics, who shared it with researchers and students. The survey included both closed and open questions, with open questions allowing respondents to elaborate. Participation was voluntary, except for an initial question gauging familiarity with the "T-shaped" concept. The survey focused on three main areas: characterizing respondents' skills and research focus, assessing their proactive learning efforts outside their primary field, and evaluating perceptions of T-shaped learning in academia.

5.1.2 Results and Analysis

Survey was completed by 24 respondents from various research groups. The results showed that more than half of the respondents engage in applied research and more than 60 % identify themselves as interdisciplinary researchers, combining knowledge from multiple fields. Key skills outside their primary specialization included academic writing, social skills, and project management, highlighting the need for effective communication and teamwork in interdisciplinary settings.

A majority of respondents (over 75 %) actively pursued knowledge beyond their primary field, despite challenges such as time limitations and resource availability. Strategies included engaging with experts, attending conferences, and self-study through journals and online learning platforms, showcasing a strong commitment to broadening their skill sets.

The perceived value of T-shaped knowledge was particularly notable in research, where 100 % of respondents found it beneficial, with majority marking it as "very useful". It was also highly valued in studying, though perceived slightly less useful in teaching, where neutral responses reflected its varied relevance among those not involved in teaching roles. Respondents cited benefits such as enhanced communication at conferences, enriched research through cross-disciplinary insights, and improved adaptability in teaching.

Overall, this initial case study presented the importance of T-shaped knowledge in academic research and its contribution to effective collaboration and innovation.

5.2 T-Shape in Business

The second case study explores how T-shaped competencies manifest in a business context by examining the environment of a specific IT company. This study focuses on a leading Enterprise Resource Planning (ERP) provider, where the importance of T-shaped professionals in integrating technical expertise with business acumen is highlighted. Their ERP software includes programs for all core business areas, such as procurement, production, materials management, sales, marketing, finance, and human resources. This company develops standard software for business solutions and continues to offer industry-leading ERP solutions.

The case study was carried out in one specific location, which is a part of a chain of research and development entities. Since this location focuses on solutions dealing with finance, sustainability, and business intelligence and development, the employees who participated in this case study come from this specific background. The case study gathers both quantitative and qualitative data to look for possible trends and patterns as well as to better understand why and how they might arise.

5.2.1 Methodology

The data for the case study were firstly gathered by an on-line anonymous survey. During this survey, employees were asked both open and closed questions, which focused on the T-shape concept. The survey was divided into multiple sections. At the beginning, we ensured that respondents were familiarized with the concept of T-shape.

The first section then focused on the details of their job, namely on the role in the company, the amount of experience they have, the learning and multidisciplinary their job requires and the distribution and shape of their knowledge and skills.

The following section dealt with the educational background of the participants and its alignment with their current role. They were also asked about the usefulness of different educational approaches in their primary and secondary disciplines.

The last section focused on learning opportunities, exploring how encouraged they feel to widen their knowledge and focusing on their experiences when it comes to interdisciplinary learning.

Additionally, research among hiring managers is being conducted to better understand the current and future role of T-shape and interdisciplinarity. This research consists of a modified questionnaire and follow-up interviews, which could provide qualitative

data and further insight into the concept. As this research is still ongoing, no results are available yet.

5.2.2 Results and Analysis

The survey has gained 65 respondents, who came from a diverse range of roles within the company. Most of them occupied a technical position, characterizing themselves as developers, however, other roles such as product owners and quality assurance were also represented. The majority of participants reported being engaged in positions that require a mix of technical knowledge, business understanding, and communication skills.

Respondents came with a wide range of experience levels as depicted in Figure 3. Most represented groups include employees with 2-3 and 12-15 years of experience.

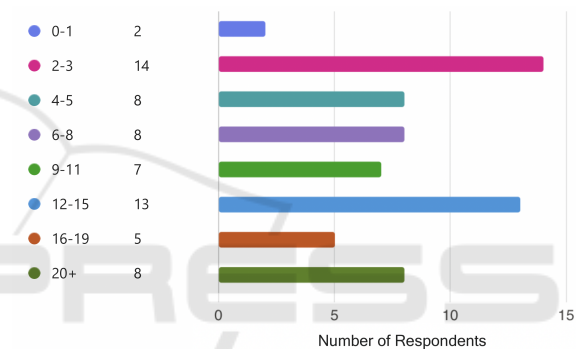


Figure 3: Years of experience.

About one third of the respondents (21) have heard of the term “T-shaped” before.

When asked about the amount of coding required in their daily jobs, which was to be indication a scale from 1 (no coding) to 5 (pure coding). The results (Fig. 4) show a wide distribution. The average rating was 2.69 which would indicate that the job involves coding, but the majority of the work consists of other tasks. This highlights the varied nature of roles within the organization, from non-technical positions to almost purely technical ones, emphasizing the need for both deep expertise and a broader understanding of multiple disciplines.

A question about interdisciplinarity uncovered that a majority of employees still see one main skill or discipline which dominates for them. Participants were again asked to rate their jobs on a scale from one (only one deep skill is required) to five (multiple disciplines combined) and the average rating was 3.45 (Fig. 4).

Additionally, employees were asked about the alignment of their education with their current roles. For those whose education did not align, the re-

ported level of multidisciplinary was above average (4), suggesting they had to develop a broader skill set. This trend was also observed among respondents identifying as Product Owners or Area Product Owners, whose roles involve communicating with numerous stakeholders from diverse knowledge backgrounds.

When asked about the level of learning required, where one symbolizes none and five represents constant, continuous learning with no information reuse, the majority of employees perceive their roles as requiring frequent or continuous learning as shown in Figure 4. This highlights the importance of ongoing training and development opportunities to support employees in maintaining and enhancing their skills.

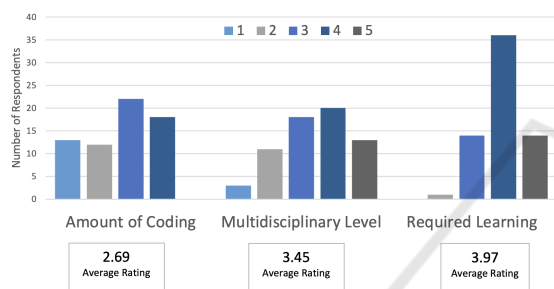


Figure 4: Level of coding, multidisciplinary, and learning required.

Upon analyzing the results grouped by experience levels, a notable trend was observed in the degree of multidisciplinary and the amount of required learning (Table 1). The data indicates that multidisciplinary increases with experience, as the highest scores are consistently reported by the most seasoned employees. However, this pattern did not manifest in the context of required learning, which remained significantly high across all experience levels. Interestingly, the least experienced group reported the lowest levels of required learning.

Table 1: Multidisciplinary and Required Learning based on Experience Levels.

Experience	Multidisciplinary	Learning
0–1 year	2.50	3.50
2–3 years	2.93	4.14
4–5 years	2.63	3.75
6–8 years	3.50	4.13
9–11 years	4.00	4.00
12–15 years	3.69	3.69
16–19 years	4.00	3.80
20+ years	4.13	4.38

The primary discipline for a vast majority of respondents could be summarized as development. When asked about which knowledge areas they

needed to incorporate into their secondary disciplines, the most common answers consisted of Social Skills (46 responses), Agile Principles (40 responses) and Finance (40 responses). This is showing that effective communication and interpersonal skills are critical for collaboration, teamwork, and stakeholder management in this company. Other frequent responses include Project Management (34 responses) and Databases (31 responses).

Another pattern was identified upon evaluating the experience-level data. Respondents were asked to assess their knowledge across multiple areas of their job. The collected data suggests that technical knowledge maturity, which is the primary discipline for most participants identifying as developers, peaked in the 9-11 years of experience group. Conversely, other disciplines, which may be considered secondary, exhibited continuous growth throughout the experience levels, reaching their maximum in the most experienced group (20+ years).

Over 80 % (53) of the participants actively seeks out opportunities to learn about subjects outside of their primary discipline. For those who do not (12), the mentioned obstacles included time constraints and limited access to resources, as many respondents cited a lack of time to engage in deep learning outside of their day-to-day responsibilities. The other reason was the lack of purpose in acquiring those skills, as there are dedicated experts in the field available or the focus could rather be on building primary discipline rather than diversifying.

Interestingly, even those who do not see the purpose of acquiring these skills reported their roles as multidisciplinary and could, therefore, benefit from education in other domains. Focusing on raising awareness of multidisciplinary education and enhancing employee motivation could provide significant benefits for the company.

The majority of respondents (60 out of 65) reported that interdisciplinary knowledge is very beneficial or beneficial in their jobs. Many respondents noted that knowledge in secondary disciplines helped them communicate more effectively across departments, especially in project management, finance, and customer interactions. Respondents emphasized that having interdisciplinary skills helped avoid common design or implementation issues. Their broader understanding often led to more creative solutions and smoother project execution.

When asked about the significance of T-shaped skills in light of emerging technologies like AI and machine learning, 34 respondents believed that an interdisciplinary approach will become increasingly important. They argued that as technology advances, the

ability to integrate technical expertise with broader business or domain knowledge will be crucial for staying competitive.

In response to whether companies should support T-shaped learning, 54 respondents agreed that companies should actively support interdisciplinary learning and help employees develop T-shaped competencies. 11 respondents were neutral on this issue, possibly reflecting a lack of clarity on how interdisciplinary learning might benefit them personally.

6 DISCUSSION

The growing recognition of T-shaped skills in academia and business highlights their importance in preparing individuals for a rapidly evolving world. Traditional education models are being supplemented with curricula that promote both depth and breadth of knowledge, addressing modern challenges that require specialized expertise and interdisciplinary collaboration. Universities are adapting their programs to cultivate T-shaped professionals with strong technical and soft skills. These professionals are invaluable in business environments, where their expertise and flexibility help organizations remain agile, foster innovation, and address complex challenges. As businesses prioritize adaptability and integrated service models, the role of T-shaped professionals will continue to expand, driving strategic growth and sustaining competitive advantage.

Our initial research shows that most IT professionals and academic researchers have T-shaped profiles, even if they don't recognize the term. Using soft skills, effective communication, and management practices enhances teamwork and prevents issues. Integrating T-shaped skills leads to innovative solutions and efficient task execution, crucial for addressing challenges in ICT, especially with the rise of AI and machine learning.

However, the application of the T-shaped competencies in both environments may differ. In academia, T-shaped professionals can benefit from an interdisciplinary approach, where integrating knowledge from various fields can lead to groundbreaking discoveries and innovative solutions. This approach allows academic researchers to collaborate effectively and address complex problems from multiple perspectives. On the other hand, in the business context, T-shaped professionals may need to adopt a more multidisciplinary approach to remain flexible and adaptable. Businesses often require professionals who can collaborate across different functions and domains without necessarily integrating their methodologies. This

flexibility allows businesses to respond quickly to changing market demands and maintain a competitive edge. However, this hypothesis requires further investigation to determine the optimal balance between interdisciplinary and multidisciplinary approaches in different contexts.

The presented case studies are an initial step in researching T-shape competencies across IT-based academic and professional domains. Ongoing and future case studies in various industries and universities will provide insights into the roles, challenges, and benefits of developing T-shaped professionals.

7 CONCLUSION

Integrating diverse expertise and collaborating across disciplines is essential for addressing the complex challenges of the 21st century. This paper highlights that T-shaped competencies are crucial in fostering innovation and driving value co-creation.

In conclusion, interdisciplinary or multidisciplinary education and knowledge skills are fundamental sources of competitive advantage in both academic and business contexts. Interdisciplinary approaches are more typical for academia, where the integration of knowledge from various fields can lead to innovative solutions. In contrast, multidisciplinary approaches are more typical for business, where flexibility and adaptability are crucial for responding to changing market demands. To fully leverage the benefits of multidisciplinary and interdisciplinary approaches, it is imperative to investigate the specific knowledge and skills required for success in various business domains. This investigation will help identify the key competencies needed to thrive in a rapidly evolving landscape.

Furthermore, a more intensive collaboration between academia and business is necessary to specify and continuously update the required knowledge and skills. The dynamic nature of the modern world means that the specific set of competencies will change over time, necessitating a clear mechanism for adaptation. This ongoing collaboration will ensure that both academic curricula and business practices remain relevant and effective. It is evident that no single domain, whether academia or business, can address the entirety of complex problems alone. The synergy between these domains is essential for holistic problem-solving and innovation. By working together, academia and business can better understand the challenges and develop more effective solutions.

Finally, the advent of AI tools, particularly large language models (LLMs), presents both opportuni-

ties and challenges for multidisciplinary skills. While these tools can enhance productivity and provide valuable insights, they also necessitate reevaluating the skills required for success. Understanding how AI will impact multidisciplinary competencies is a critical area for future research and adaptation.

In summary, fostering multidisciplinary and interdisciplinary education and collaboration between academia and business is vital for addressing the complex challenges of the modern world. We can create a more innovative and resilient future by continuously updating the required knowledge and skills and leveraging the potential of AI tools.

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