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DOI
10.1016/j.plas.2024.100120

Publication date
2024

Document Version
Final published version

Published in
Project Leadership and Society

Project Leadership and Society 5 (2024) 100120

Contents lists available at ScienceDirect

Project Leadership and Society

journal homepage: www.sciencedirect.com/journal/project-leadership-and-society

Empirical Research Paper

The future of digitalized project practices through data-savvy talent: A digital competence formation perspective

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ARTICLE INFO

Handling Editor: Martina Huemann

Keywords:
Digital transformation
Project management professionals
Talent management
New talents
Structural equation modeling

ABSTRACT

Amidst the disruptive backdrop of the COVID-19 pandemic, organizations are navigating toward a new normal, leveraging digital technologies to reconfigure business processes and operational practices. This study delves into the transformative effects of digitalization on project management, with a focus on integrating data-savvy talent in a data-rich era. Employing a mixed methods approach, data were collected from June to November 2022, providing a comprehensive blend of various perspectives. Quantitative and qualitative methods were adopted successively in this study to explore the formation mechanism of digital competence of talents in project management and analyze the practical experience and expectations on the impact of data-savvy talents on project management. This study highlights the crucial role of organizations in actively shaping digital competencies to align with the changing demands of project management. It also emphasizes the increasing importance of data-savvy talents, whose intrinsic understanding of digital technologies and business models is essential in transforming the project management landscape. The outcomes of this study offer both theoretical insights into the nexus of digital competence, talent management, and project management, and practical guidelines for effectively integrating new talents into project management practices.

1. Introduction

Our world has entered a society of 'projectification', which means that project work is now the fundamental unit and driver of economic action (Jensen et al., 2016; Schoper et al., 2018). This rapid increase in projectification is also accompanied by a simultaneous increase in digitalization and datafication. Digitalization refers to the ways in which social life is organized through and around digital technologies, while datafication is defined as the paradigm of the practice of taking an activity, behavior, or process and turning it into meaningful data (Leonardi and Treem, 2020). Due to the accelerated development of digital technologies and data science, digital innovations have gained traction. The power of digital innovations has made massive quantities of data available and manageable in recent years, and the capacity to capture, store, process, share and visualize data is advancing (Santana and Díaz-Fernández, 2023; Schlegel and Kraus, 2023). The rich data can have an influence on the project manager's competencies, whether it can improve their performance if they have the competencies to manage and understand data or vice-versa (Janssen et al., 2017). The disruptive nature of the COVID-19 pandemic also served as a catalyst for innovation and transformation, as many industries and organizations were compelled to change. After worldwide lockdowns, many organizations are heading to the new normal, reconfiguring their business processes and operational practices through digital technologies, communication platforms, and information systems (Ejohwomu et al., 2021; Kamal, 2020). This shift carries profound implications for project management, necessitating a re-evaluation of traditional approaches and an emphasis on integrating digitalization in project management practices to cope with dynamic environments, control performance and enhance their capabilities (Papadonikolaki et al., 2022).

Marnewick and Marnewick (2021) attested that digitalization is not only changing how projects are managed, but it is also changing the very

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https://doi.org/10.1016/j.plas.2024.100120
Received 20 December 2023; Received in revised form 13 February 2024; Accepted 21 February 2024
Available online 7 March 2024

nature of project management. They call for recognizing the digitalization of project management as a distinct school of thought in its own right. Existing research on digital transformation in projects has mainly focused on what technologies can help organizations and people achieve (Dou et al., 2023) without connecting to the disruptions that technologies bring to projects' human and social capital as well as organizational capabilities. There is a need to go beyond the prevailing technical line of thought and think about people's issues in project settings (Xu et al., 2022).

Project management practices are being profoundly changed due to a combination of demographics, such as the educational expansion creating a pool of high-skilled employees entering the market (Stier and Herzberg-Druker, 2017) and technical such as the rise of digital innovations (Nambisan et al., 2017) causes. These changes lead to new jobs and roles, new professional accountability, and greater integration across professional functions. COVID-19 has widened the digital divide (Zheng and Walsham, 2021) and called into question how we educate, attract, develop, and retain project management professionals. Project management professionals must become more sensitive in virtual interaction and better understand each other's behavior and thinking patterns.

Thus, the preceding trends lead us to question how our project management professionals are changing in the data-rich era, which in turn raises the following research question (RQ).

RQ1. What are the key aspects of developing data-savvy talents, and what is the mechanism of forming digital competence in a data-rich era?
RQ2. How do project management professionals experience and improve the impact of data-savvy talents on project management practices?

We focus on both demographic and technological changes, mainly how talent management and project management interact. We give special attention to the question of how the data-rich era is transforming (will transform) the talent pipeline in project management. In this research, we would distinguish talent management from human management as we put more emphasis on new talents. New talents bring experience and familiarity with digital technology and have a better understanding of emerging business models. The article aims to produce novel and timely insights into project management professionals' diverse needs and contributions to support the reconfiguration of project work in the data-rich era. To this end, this study explores how the data-rich era influences the project management profession, focusing on the new data-savvy talent entering the market.

The rest of the paper is organized as follows. The next section presents the theoretical background of digital competence in project management and the interaction between talent management and project management in the data-rich era. The methods, results, and analysis are presented in the third and fourth sections. The paper concludes with a discussion and conclusion section, including theoretical contributions, managerial implications, limitations and future research directions.

2. Theoretical background

2.1. Digital competence in project management

Competence, a concept popularized by David McClelland in 1973, focuses on a broad set of characteristics beyond traditional intelligence quotient testing for predicting work performance (McClelland, 1973). This competence framework, vital in academic research and industrial practice, underscores the importance of various knowledge areas, skills, traits, and motivations in effective project management. The study of project managers' competencies is with foundational work dating back several decades. Two studies from Gaddis (1959) and Lawrence and Lorsch (1967) marked the beginning of a more nuanced understanding of project management competencies, moving beyond the traditional focus on technical skills to include interpersonal, strategic, and integrative abilities. This evolution reflects the increasingly complex nature of projects and the diverse environments in which project managers operate today. To further analyze project competence in a structured and quantitative way, Crawford (2005) developed an integrated competence model and systematically explored the relationship between project management competence and organizational performance. Since then, project management competence has been widely discussed and continuously studied, including further development of models, industry comparisons and practices in different countries and regions (Chen et al., 2019; Chipulu et al., 2013).

Digital competence is an evolving concept linked to advancements in digital technology and the political aims and expectations of citizenship in a knowledge society, and it is recognized as a boundary concept for policy and educational research (Ilomäki et al., 2016). The projectification and its emergence at the societal level reflect the increasing trend of organizing work and initiatives in project-based formats across various sectors of society (Wagner et al., 2021). Within the new scope and trends of project management, the requirements for the competencies of project managers need to be radically revised, with the need to take into account the digital component of the project manager (Lukianov et al., 2021). Therefore, digital competence in project management is increasingly vital in the current rapidly evolving digital landscape, where technological advancements and work dynamics require a continuous update of competencies.

Another essential reason digital competence is increasingly gaining attention in research is the emergence of a new generation of digital talent (Dan et al., 2021; Nair, 2019; Stander et al., 2022). Nair (2019) mentioned that half of the surveyed organizations in her research agreed that there is a significant gap in employees' digital talent compared to organizational needs and that this gap increases daily with the introduction and adoption of new technology. Barinova et al. (2020) discussed that traditional human resource management strategies are proven to be inefficient in attracting professionals with digital competencies who can quickly adapt to the digital environment. Therefore, an appropriate and promising understanding of digital competence is essential for attracting and developing digital talent, not limited to the project management domain.

Digital competence in project management refers to integrating digital technologies, skills, and mindsets within the project management discipline. It encompasses the adept use of project management software, digital communication tools, data analytics, virtual collaboration, understanding digital security risks, and the ability to manage projects in a digital environment (Lukianov et al., 2021). Digital competence also involves cybersecurity awareness and ethical considerations in the digital sphere (Marnewick and Marnewick, 2021), highlighting the multifaceted nature of modern project management roles. While AI (Artificial Intelligence)-oriented and RPA (Robotics Process Automation)-oriented skills and competencies have been systematically discussed in other research domains (Santana and Díaz-Fernández, 2023; Schlegel and Kraus, 2023), existing research in the project management domain typically focuses on partial aspects of digital competence. For example, Obradović et al. (2018) conducted a study on 52 project managers from the most renowned companies in Serbia, highlighting a significant shift from a focus on technical skills to an emphasis on soft skills, including analytical skills, decision-making, and interpersonal abilities, reflects broader changes in the workplace and project environments brought about by digital transformation. Besides that, Lukianov et al. (2021) proposed a conceptual model to integrate digital components into the existing competence models of project managers to cope with new requirements; there is a notable lack of systematic analysis and mechanism explanation of the formation of digital competencies, particularly when considering the characteristics of the digital talent.

Actually, digital competence formation is a widely discussed and evolving topic that originated in the education field. For instance, Altynay et al. (2015) explored the idea of competence as an integrated personal quality, reflecting the general ability and readiness for activity based on knowledge and experience gained during training and socialization. Further, Demkina et al. (2019) explored the development of approaches to form professional competence for future specialists in the digital environment. They studied the organizational conditions for improving the efficiency of professional competence formation, proposing a model based on principles related to fundamentality, professional orientation, and the integration of psychological and pedagogical concepts. In recent years, a series of research continues to develop measurement models and methods of digital competence in education (Cattaneo et al., 2022; Gümüş and Kukul, 2023; Mattar et al., 2022).

Therefore, in the field of project management, research on digital competencies should also draw from its originating disciplines to advance further, primarily including the mechanisms behind the formation of digital competencies. Considering the emergence of the new generation of digital talent, the formation of digital competence in project management needs more explorations considering both demographic and technological changes, particularly how the fields of talent management and project management interact.

2.2. Impact of talent management on the project management profession

Talent management is one of four critical levers found to aid in developing innovative project teams (Guinan et al., 2019). Talent management is defined as a collection of human resource management practices and processes, including attracting, developing and retaining people with the required skills and aptitude to meet current and future organizational needs (Lewis and Heckman, 2006). Guerra et al. (2023) distinguished between attracting and retaining talents and considered the development and deployment of talents as connected to attracting and retaining talent. Currently, there has been sufficient research on the impact of three processes of talent management at the firm level. However, with the increase of projects in business nowadays and the rise of emerging digital technologies, we would like to figure out how these processes interact with organizational talent support.

The continued growth of digital transformation means that traditional jobs can become susceptible to obsolescence (Frey and Osborne, 2017). Thus, for project management professionals, the failure to equip employees with a range of analytical tools and digital skills can lead to the thriving of specific sectors (e.g., ICT and financial sectors) while threatening the talent pipeline in more traditional ones, e.g., the Architecture, Engineering, Construction (AEC) sector. Furthermore, there is a need to take into account how digital transformation will reconfigure inclusion and diversity at the workplace, as project management professionals will comprise not only those senior project management professionals who ‘accidently’ fall into the role and have to learn on the job (Savelsbergh et al., 2016), but also those who ‘digital natives’ in the so-called Millennials (born in or after 1980) (Ng et al., 2010) and Generation Z (born in the mid-1990s through the late 2010s) (Turner, 2015). As digital technologies continue to advance, they enable more varied and flexible approaches to work, collaboration, and project management. This can lead to more diverse teams that are not only geographically dispersed but also bring a rich mix of cultural backgrounds, skills, and experiences, such as crowdsourcing projects (Karachiwalla and Pinkow, 2021). Moreover, the emphasis on digital skills and competencies as critical assets in project management opens the door to younger generations who are digital natives (Fossen and Sorgner, 2019; Opland et al., 2022) and those from different sectors or disciplines who possess transferable skills for inter-organizational learning (Y. Liu et al., 2021). The digital transformation strategies to enhance diversity and inclusion are encouraged to be proactively designed (Soto Setzke et al., 2023), ensuring that these efforts are not just about adopting new technologies but also about rethinking organizational cultures and practices to support a more inclusive and dynamic project management profession.

There has been some evidence that agents who champion digital innovations cross project, organizational and hierarchical boundaries between soft and hard routines, encourage reverse mentoring and show boundary-spanning leadership in the AEC (Azzouz and Papadonikolaki, 2020). Whereas digital technologies, such as Building Information Modelling (BIM), radically alter collaborative work, they are considered more as tools affecting work structure and less as socio-technical systems affecting structure and agents (Papadonikolaki et al., 2019). This research, therefore, aims to examine appropriate talent management initiatives, to be more precisely, organizational talent for professional development includes a number of professional development for new talents and existing employees.

2.3. Impact of digital transformation on the project management profession

Because of the accelerated development of digital technologies and data science, digital innovations have gained interest in recent years. According to Wijayasekera et al. (2022), disruptive technologies, for example, cloud solutions, Artificial Intelligence (AI), cyber-physical systems, BIM and blockchain, are affecting most project-based organizations. Using new information technology tools and processes have generated several benefits, increasing project efficiency and profitability by reducing uncertainty, costs, and delays and improving information sharing (Bryde et al., 2013). For example, the application of blockchain can transfer the trust among the construction project stakeholders from people to the system to realize reliable and immutable collaboration (Du et al., 2024; Lin et al., 2024) and access to distributed resources by invoking the Common Data Environment (CDE) in a secure way (Ye et al., 2023). Increasingly pervasive digital information is changing what projects deliver and how projects are delivered, and the digitally integrated solutions (the third generation of integrated solutions) share digital information across the life cycle and to/from end users' cloud-based systems, triggering increasing and in-depth digital supports (Whyte, 2019). Project management professionals must adapt and prepare for radical changes by developing new digital-ready project skills. This requirement may accelerate the pace of project management professionals to enhance their personal digital competence.

New technologies become associated with new occupational groups, new kinds of professional accountability, and greater integration across professional roles (Jaradat et al., 2013). Because of the belief that every project is unique, project management professionals tend to focus on making incremental improvements and avoid scaling up new ideas. As project-based firms are principal sources of human resources in a project, the renewal of skills through training and innovation is severely undermined due to the episodic nature of projects and the casualization of work (Winch, 2014). Nevertheless, the COVID-19 situation where project team members have to collaborate in an online environment becomes the catalyst that society needs to begin a large-scale transformation (Rachmawati et al., 2021). The emphasis on digital transformation has so far been on what technologies can do for us, often neglecting how such transformation can radically change what people and organizations do (Robinson et al., 2016). There leaves room for imagination that how personal project competence is influenced by their digital competence and added digital management function assignment.

3. Methodology

The research employed a mixed methods approach (Johnson and Onwuegbuzie, 2004) and collected data between June and November 2022, ensuring a rich amalgamation of diverse data and perspectives. It consists of the following five stages: 1) problem identification, 2) method selection and research design, 3) quantitative analysis, 4) qualitative analysis, and 5) discussion and conclusion, as shown in Fig. 1.

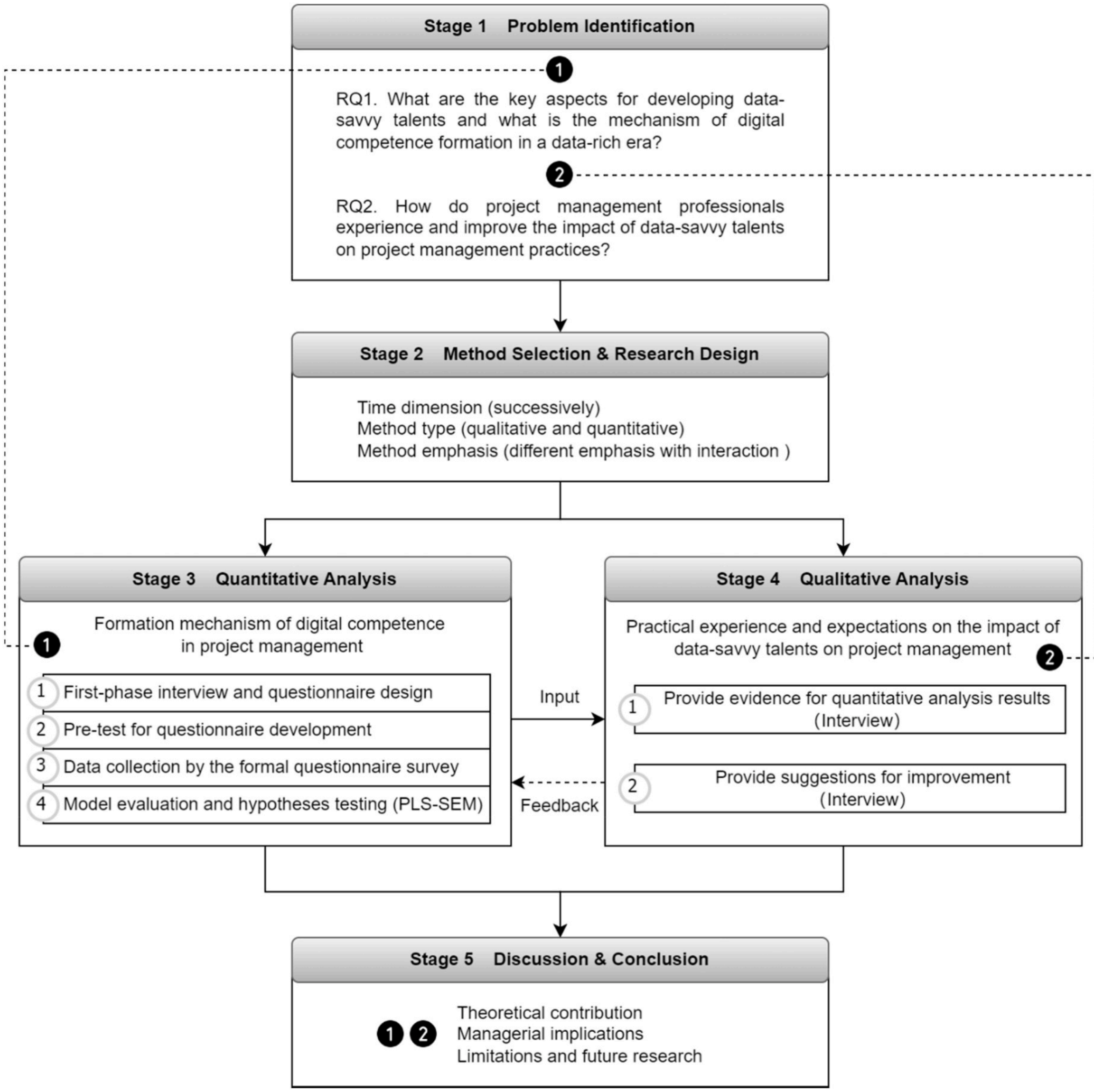

Fig. 1. Overview of research methodology and research process.

(1) Problem identification. The first interaction with industry experts aimed to extract the research problems and capture the emerging requirements of talent and project management in the data-rich era.
(2) Method selection and research design. Quantitative and qualitative methods were adopted successively in this study to explore the formation mechanism of digital competence of talents in project management and analyze the practical experience and expectations on the impact of data-savvy talents on project management. These methods had different research emphases and supported diverse outcomes from each other.
(3) Quantitative analysis. The challenges of the project management profession in the data-rich era were captured by a systematic literature review and a series of industrial engagement activities, e.g., observations and interviews. After that, we undertook an international survey to investigate the trends in digital transformation and data-driven innovation that are affecting the project management profession and talent management and key points of attention so that we can understand what digital transformation means for attracting talent, developing (existing) talent, and retaining talent in the project management profession. The survey mapped these trends along with the competencies framework (Verzuh and Association, 2021). The data were derived from the Likert scale survey. Considering the regional culture, we sought different demographic groups at a global level. A total of hundred twenty-four (124) questionnaires across hierarchical levels were collected from an international sample in this stage. In the PLS-SEM model, the critical relationship and linkages were investigated based on the collected data to assess the strength of the interaction and influence of the variables. The following four-step method was explained in detail for this quantitative analysis:

i. First-phase interview and questionnaire design: An initial questionnaire with 24 questions was grounded in the literature and combined with the results from the industry interviews. The questionnaire includes questions about the perception of data-rich settings, digital innovations, societal change and project management professional development from new talents and senior practitioners in the project-based part of the organization. The questions centered around the following topics: (a) personal digital competence and its importance in the organization; (b) organizational talent support strategies, including attracting, developing and retaining new data-savvy talents; (c) personal project competence and digital management functions.

ii. Pre-test for questionnaire development: A pre-test with 35 valid samples for questionnaire improvement was conducted after the questionnaire was refined.
iii. Data collection by the formal questionnaire survey: A formal questionnaire with 17 questions was conducted to collect a larger sample.
iv. Model evaluation and hypotheses testing: PLS-SEM was employed in this study to validate the research model and test the proposed hypotheses. The method was chosen because this research was more exploratory than confirmatory (Zeng et al., 2021).

(4) Qualitative analysis. In this stage, the analysis of how the data-rich environment transforms the talent pipeline was deepened through a qualitative research phase by engaging participating organizations in this second-phase semi-structured interview. This qualitative analysis has two objectives. First, these interviewees can provide valuable interpretations and empirical feedback for the quantitative results in the previous stage. Meanwhile, these interviews are also designed to collect more data on how the data-rich environment is changing the everyday work that project management professionals do and how project management professionals are coping with this transformation by exploiting opportunities and overcoming challenges. The semi-structured interview questions were about the following topics: (a) the educational and professional background of the interviewee, (b) experiences and perspectives of digitalization and the project management profession, (c) organizational perspectives of digitalization and project management, (d) digital talent management and (e) external support for the digital transformation of the project management profession. The data were analyzed through qualitative data analysis and a combination of content analysis, featuring both thematic (qualitative) analysis and quantification of data (e.g., counting instances of codes) via the Atlas.ti tool and applying both protocol/deductive and inductive coding (Saldana, 2021). Two circles of coding were employed by different researchers for internal validation of the findings. A purposive sample of 24 diverse participants with diverse project management experience was interviewed. They were recruited by the researchers' professional networks, and they came from three main categories of stakeholders: industry, academia and professional institutions, such as the Project Management Institute (PMI), Association for Project Management (APM) and International Project Management Association (IPMA). The profiles of the interviewees can be seen in Table 1.

In this study, interim analysis and continuous adjustments were conducted with the execution of the survey analysis and semi-structured interviews, employing insights from each to mutually enhance and solidify the understanding of the formation mechanism of digital competence. This abductive research approach supported research validation and cross-fertilization of research approaches.

4. Analysis and results

4.1. Descriptive analysis of survey respondents

A total of hundred and twenty-four (124) respondents took the questionnaire survey. The respondents are also recruited from authors' professional networks from three main stakeholder categories: industry, academia and professional institutions, including PMI, APM and IPMA. The demographic details of survey respondents are presented as follows.

(a) Most of the respondents were males with N = 86 (69%), followed by females with N = 36 (29%) and the least identifying as non-binary with N = 2 (2%).
(b) Most of the 124 respondents who took the survey were between the age of 26–35 with N = 54, followed by those aged between 36 and 45 with N = 39, those aged between 46 and 55 with N = 17, followed by those who were 25 years or below with N = 7, than those aged between 56 and 65 with N = 6, the least respondents were of the age 65 and above with only 1 respond in this age bracket.
(c) Most of the respondent's highest education qualifications attained were at the masters level with N = 87 (70%), followed by those with bachelor's degree level qualification with N = 18 (15%), then PhD level with N = 16 (13%). Those who had educational qualifications other than listed levels (Bachelor, Master/MBA, and PhD) were the least with N = 3.
(d) The survey respondents were from an international sample from countries such as the United Kingdom, Netherlands, China and Croatia. Most respondents stated that their country of work in China, with N = 47 (38%), followed by those whose work country is Croatia, with N = 39 (31%). Those who worked country are the Netherlands with N = 20 (16%), then the United Kingdom with N = 11 with the least of respondents with N = 7 (6%) with their country of work other than the mentioned countries.
(e) Most of the respondents who took the survey had 5 years or less of work experience with N = 33(27%), followed by those who had 20 years of work experience or greater with N = 28(23%), then those with 6–10 years and 11–15 years of work experience each having N = 25(20%), the least of respondents had 16 to 20 work of experience with N = 13(10%).

4.2. Quantitative analysis

4.2.1. Model design and measurement model evaluation

According to the systematic literature review and industrial engagement (see Table 2), the research model for digital competence formation in project management with seven essential hypotheses was developed (see Fig. 2).

From the perspective of the impact of talent management on the

Table 1
Interviewee profiles.

Int No.	Current role	Company	Years in industry
1	Project Manager	Design & Engineering consultancy	5
2	Digital Transformation Coordinator	Contractor	5
3	Vice Dean & Professor	Academia	20
4	Project Manager	Contractor & Consultancy	6
5	Risk Manager	Contractor & Consultancy	6
6	Project Manager	Engineering consultancy	7
7	Head of projects (Project Manager)	Design, Engineering & PM consultancy	20
8	Specialist Project Manager	Design & Engineering consultancy	20
9	Professional Researcher	Design & Engineering consultancy	8
10	Information Manager	Engineering consultancy	14
11	Associate Director	PM consultancy	13
12	Civil Engineer	Railway company	>10
13	Technical Director Railways	Engineering consultancy	42
14	Service Director	Engineering consultancy	17
15	PhD Candidate	Academia	1
16	Associate Professor	Academia	2
17	Associate Professor	Academia	4.5
18	Assistant Professor	Academia	2
20	Vice-President	Professional Institution	20
21	Project Delivery Director)	Professional Institution	>20
22	Project Manager	Professional Institution	45
23	Consultant on Information Management	Design & Engineering consultancy	1
24	BIM Modeller	Contractor	4

Table 2
Key constructs for digital competence formation in project management.

Code	Construct	Definition	Reference
ANT	Attracting new talent	refers to the strategies and processes organizations use to identify, engage, and recruit potential employees who possess the desired skills, knowledge, and attributes. It involves marketing the organization as an attractive employer, reaching out to suitable candidates, and convincing them to join the organization.	(Alvarenga et al., 2020; Chen et al., 2019)
DTT	Developing and training talent	Involves enhancing the skills, knowledge, and abilities of employees through various learning and development initiatives. It includes formal training programs, mentoring, on-the-job training, and other educational activities aimed at improving employees' performance and preparing them for future roles.	(Alvarenga et al., 2020; Chen et al., 2019; Chipulu et al., 2013; Ekrot et al., 2016; Kier and Huemann, 2022; H. Liu et al., 2022; Nijhuis et al., 2018)
RET	Retaining existing talent	Focuses on strategies to keep valuable employees within the organization. It encompasses efforts to maintain employee satisfaction, engagement, and loyalty, often through career development opportunities, competitive compensation, positive work culture, and recognition of employee contributions.	(Chen et al., 2019; Chipulu et al., 2013)
OTS	Organizational talent support	Refers to the support provided by an organization to its employees to help them develop and utilize their talents effectively. It includes providing resources, creating a conducive work environment, offering career development opportunities, and fostering a culture that values and nurtures talent.	(Bredillet et al., 2015; Chipulu et al., 2013)
RDC	Required digital competence	Refers to the set of digital skills and knowledge required to perform specific tasks or roles within an organization. It includes the ability to use digital tools and technologies effectively, understanding digital data, and applying digital solutions to solve problems or improve processes.	(Alvarenga et al., 2020; Demkina et al., 2019; H. Liu et al., 2022; Papadonikolaki et al., 2022)
PDC	Personal digital competence	Refers to an individual's ability to use digital technologies and tools effectively for personal purposes. It includes skills like using the internet, digital communication tools, basic software applications, and understanding digital safety and security principles.	(Alvarenga et al., 2020; Demkina et al., 2019; Kier and Huemann, 2022; H. Liu et al., 2022)
DMF	Digital management function	Pertains to the role within an organization responsible for overseeing and managing digital resources, strategies, and initiatives. It involves planning, executing, and monitoring digital projects, managing digital teams, and ensuring the alignment of digital strategies with overall business goals.	(Chen et al., 2019; Ejohwomu et al., 2021; Kier and Huemann, 2022; Papadonikolaki et al., 2022)
PPC	Personal project competence	Refers to an individual's ability to manage and execute projects effectively. It encompasses a range of skills including project planning, resource management, risk assessment, communication, and leadership, as well as the ability to deliver projects on time, within budget, and to the required quality standards.	(Alvarenga et al., 2020; Bredillet et al., 2015; Chen et al., 2019; Chipulu et al., 2013; Ekrot et al., 2016; H. Liu et al., 2022; Nijhuis et al., 2018)

project management profession, the following hypotheses were proposed.

Hypothesis 1. (H1). The high degree of attracting new talents is likely to influence organizational talent support.

Hypothesis 2. (H2). The high degree of developing and training talents is likely to influence organizational talent support.

Hypothesis 3. (H3). The high degree of retaining existing talents is likely to influence organizational talent support.

Hypothesis 4. (H4). The high degree of organizational talent support is likely to influence personal digital competence.

From the perspective of the impact of talent management on the project management profession, the following hypotheses were proposed.

Hypothesis 5. (H5). The high degree of required digital competence is likely to influence personal digital competence.

Hypothesis 6. (H6). The high degree of personal digital competence is likely to influence personal project competence.

Hypothesis 7. (H7). The high degree of digital management function assignment is likely to influence personal project competence.

PLS-SEM develops a series of empirical test criteria to evaluate the reflective and formative measurement models, respectively (Hair et al., 2011). The research model in this paper applied the reflective type for all indicators. Therefore, an evaluation of the reflective indicators is

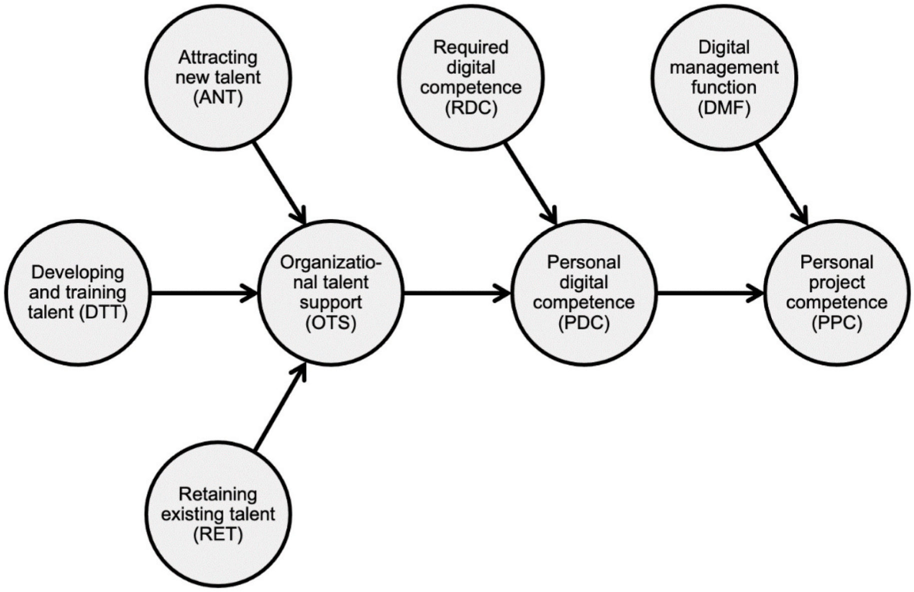

Fig. 2. Research model for digital competence formation in project management.

employed, i.e., the indicator reliability, internal consistency reliability, convergent validity, and discriminant validity are required to be evaluated. The evaluation results are shown in Appendix Table A.

The indicator reliability can be evaluated by the factor loadings, which are empirically suggested to be more than 0.7 with an acceptable significance, i.e., two-tailed t-values larger than 2.58 ($p < 0.001$) (Hair et al., 2011). In the reflective measurement model, all indicators' loadings are higher than 0.7 and significant. For the internal consistency reliability, the values of Cronbach's α are required to be higher than 0.7, and values of the composite reliability (CR) higher than 0.60 in the exploratory study are acceptable (Hair et al., 2011; Ringle et al., 2020). All the reflective indicators represent good internal consistency and reliability. The average variance extracted (AVE) is required to evaluate the convergent validity (Fornell and Larcker, 1981), and the empirical acceptable minimum value is around 0.5 (Fornell and Larcker, 1981; Hair et al., 2011). Consequently, the measurement model has qualified indicator reliability, internal consistency reliability, and convergent validity. The cross-loadings and Fornell-Larcker criterion are suggested as two main measures to evaluate the discriminant validity of reflective indicators (Fornell and Larcker, 1981; Hair et al., 2011). In the Appendix, Table B shows the results of the discriminant validity evaluation.

As for the evaluation of cross-loadings, an indicator's loadings with its associated latent construct (in bold) should be higher than its loadings with all the remaining constructs (Hair et al., 2011; Ringle et al., 2020). All the indicators show qualified discriminant validity via the cross-loadings evaluation (see Table 3).

As shown in Table 3, the square root of each latent construct's AVE should be higher than its highest correlation with other latent constructs, according to the Fornell-larcker criterion (Hair et al., 2011; Ringle et al., 2020). In conclusion, the measurement model has qualified discriminant validity.

4.2.2. *Structural model evaluation and hypotheses testing*

All 5000 resamples obtained by bootstrapping are computed in SmartPLS to estimate the significance of path coefficients and test the hypotheses. The path coefficients, the significance of path coefficients, the coefficient of determination (R^2), and its effect size (f^2) are given in Table 4 and Fig. 3.

All the constructs' R^2 values are acceptable. The effect size f^2 is also given to assess how actively one exogenous construct contributes to explaining a specific endogenous construct regarding R^2 (Cohen, 1988). Most of the constructs have enough predictive relevance effect for this study.

As shown in Table 5, hypotheses related to the proposed model (H1–H7) are all supported. According to the results, personal digital competence (PDC) is highly influenced by required digital competence (RDC), with a path coefficient of 0.470. RDC refers to the digital skills and knowledge required to perform specific organizational tasks or roles. This result implies that the formation of PDC goes through a process guided by the organization and is not spontaneously formed by talents. Another insightful result is that developing and training talent (DTT) (path coefficient 0.458) is the most crucial aspect of providing organizational support, compared to attracting new talent (ANT) and retaining existing talent (RET). Meanwhile, digital management function (DMF) strongly correlates with personal project competence (PPC). DMF involves planning, executing, and monitoring digital projects,

Table 3
Fornell-larcker criterion (latent variable correlations) for discriminant validity evaluation.

	ANT	DTT	DMF	OTS	PDC	PPC	RDC	RET
Attracting new talent (ANT)	0.882[a]							
Developing and training talent (DTT)	0.747	0.867[a]						
Digital management function (DMF)	0.454	0.481	0.764[a]					
Organizational talent support (OTS)	0.764	0.761	0.518	0.792[a]				
Personal digital competence (PDC)	0.258	0.247	0.297	0.273	0.769[a]			
Personal project competence (PPC)	0.493	0.516	0.416	0.568	0.269	0.715[a]		
Required digital competence (RDC)	0.281	0.266	0.167	0.296	0.51	0.233	0.741[a]	
Retaining existing talent (RET)	0.701	0.819	0.5	0.82	0.255	0.568	0.278	0.824[a]

Note.
[a] The square root of average variance extracted (AVE).

Table 4
Structural model evaluation and key criteria.

	Original sample	t-value	p-value	f^2	R^2
Attracting new talent (ANT) - > Organizational talent support (OTS)	0.287	22.800	p < 0.001		
Developing and training talent (DTT) - > Organizational talent support (OTS)	0.458	30.346	p < 0.001		
Retaining existing talent (RET) - > Organizational talent support (OTS)	0.336	26.608	p < 0.001		
Organizational talent support (OTS) - > Personal digital competence (PDC)	0.134	9.144	p < 0.001	0.023	0.276
Required digital competence (RDC) - > Personal digital competence (PDC)	0.470	4.833	p < 0.001	0.279	
Personal digital competence (PDC) - > Personal project competence (PPC)	0.159	1.801	p < 0.01	0.029	0.196
Digital management function (DMF) - > Personal project competence (PPC)	0.369	3.921	p < 0.001	0.155	

managing digital teams, and ensuring the alignment of digital strategies with overall business goals. This shows that functional orientation is relatively influential in current digital talent-oriented teams and organizations, while capability orientation is not yet as prominent as functional orientation. This gap should narrow when personal digital competence develops to a certain stage.

4.3. Qualitative analysis: feedback and explanations from interviewees

We have seven hypotheses in this study. The survey data supports them all, but to different degrees. Data to support the hypotheses was drawn from the interviews and quotations were evidenced by using the numerical identifier of the various interviewees shown in Table 1, e.g., Int-n, where n is the number of interviewees. The interviews provide reasons why developing and training talents play a more important role than attracting new talents and retaining existing talents. The data showed that the existing strategies to attract talent were patchy but recognized that the new generations are more likely to change jobs and transfer their knowledge with them. One of the interviewees stated that,

> *"If it was my company's choice to attract those people, or if that happened organically, because obviously, new people enter the market, and because our generations are more open to changing jobs, and transferring their knowledge with them, but it is true that we try to attract, if I can call it as such, the crème de la crème of the industry, when it comes to digital skills." (Int-9)*

Even though both the survey and interviews show that retaining new talents will help organizational talent support, the interviewees reiterated the challenge of retaining younger workers who are often digital natives. As one interviewee stated,

> *"So, the focus from the main manager of the company was having a young core, which has the opportunity to develop inside the company. So, the strategy here is that seeing the growth opportunities will make you more interested. It will help, in general, to retain talent. So that is the main idea of human resources. Also, now, with age, for example, that we have, now we have more years of experience in this area, we have had people start getting offers from other jobs, so it has been more relevant to try to*

Table 5
Summary of hypotheses tests.

Hypothesis	Path	Result
H1	Attracting new talent (ANT) - > Organizational talent support (OTS)	Supported
H2	Developing and training talent (DTT) - > Organizational talent support (OTS)	Supported
H3	Retaining existing talent (RET) - > Organizational talent support (OTS)	Supported
H4	Organizational talent support (OTS) - > Personal digital competence (PDC)	Supported
H5	Required digital competence (RDC) - > Personal digital competence (PDC)	Supported
H6	Personal digital competence (PDC) - > Personal project competence (PPC)	Supported
H7	Digital management function (DMF) - > Personal project competence (PPC)	Supported

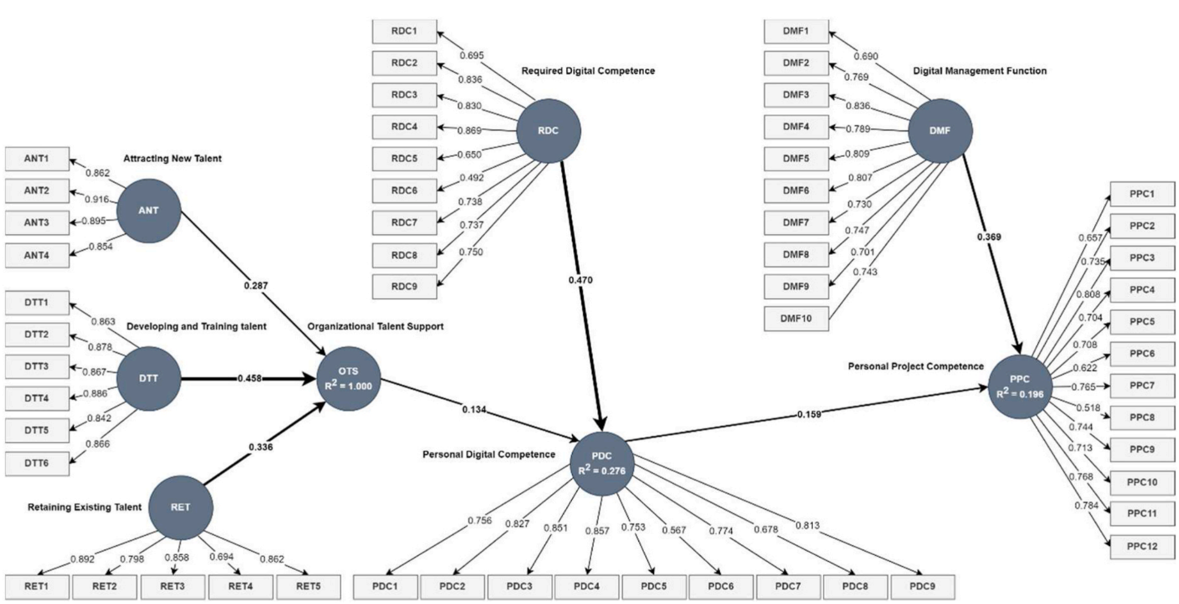

Fig. 3. Testing results of the research model.

keep a talent that has, let us mention them, data abilities or data knowledge." (Int_2)

It is agreed that the situation was more difficult to retain talent as data-savvy talent was hard to retain as they were highly sought after in the job market.

"Or we train … Actually, attracting software developers, then we lose them very quickly, instead having people such as the one that you will meet, he is a risk manager but has digital skills, so this person, for example, can do both. He can do traditional work but then, at the same time, can innovate. Then those people will start to remain longer, and those people are the ones that can then bring innovation because they understand the industry better. They understand better the construction sector, and then they can integrate innovation slowly, maybe in the projects with their work." (Int-4)

It is clear from the survey that developing and training talents has a higher degree of influencing organizational talent support. Many interviewees explained this as professional growth and came up with several cases. For example,

"We have this guy from the technical department who is studying by himself generative design for construction. So, he learned by himself, then he brought the idea into the company, and now he has been promoted and given a specific budget to develop his own idea. So that is what I mean by growth." (Int-2)

Finding people with the skills is still a challenge. The interviewed project management professionals all had a complete picture of what benefits the digital transformation can bring to project delivery and what is required to be digitally competent. However, their digital competence was at different levels. The challenge then emerges as providing enough training for them in the long term. Two interviewees added:

"So I think it is really back to the training, back to the knowledge and the skills and availability of resources." (Int-1) and "I believe that there are huge opportunities in project management to work more with data and to work in a more digitalized manner and to develop skills that allow project managers to run analyses themselves, me being one." (Int-6)

Here we heard some discussions about the complementary between digital natives and older engineers. In the project environment, the difference between generations has been noticed as their sensitivity may lead to an unbalance in the adoption and use of emerging digital technologies, thus influencing the project delivery performance. As interviewees mentioned,

"If we have an engineer that is not a digital native, we try to provide him with a digital native engineer so that the team of the job site is well rounded, in order to do both things. However, also, digital natives engineers, since they are young, they need a lot of experience from the older engineer. So that is why what we try to do is to balance the digital abilities inside a team or inside a job site." (Int-2)

"And then things around collaborative working, so being able to do or manage work from different locations or areas. So, for instance, collocating activity in different parts of geographical areas, or even in terms of different parts of the sector." (Int-8)

It then would become necessary how to design the organizational talent management within the project to integrate the two groups' advantages, familiarity with the new technologies and experience with the practice. The organizational support and the digital requirements for the project management functions have to be tailor-made so that digital competence can be achieved to the maximum.

The data underscores a dichotomy in talent management strategies: while there is an evident effort to attract top-tier digital talent, the transient nature of the workforce, particularly among younger generations prone to job-hopping, poses significant challenges. This situation is exemplified by Interviewee 9's remarks on the industry's attempts to attract the "crème de la crème" of digital talent, which happens both organically and strategically. However, retaining these talents, especially digital natives, proves challenging, as highlighted by Interviewee 2's observation about the focus on cultivating a young workforce with internal growth opportunities. The retention dilemma is further exacerbated by the allure of external job offers for those with in-demand data skills, underscoring the need for effective retention strategies.

On the other hand, the study reveals an innovative approach to talent development and retention. As Interviewee 4 notes, training individuals who possess a blend of traditional and digital skills leads to a more stable and innovative workforce. This approach not only helps in retaining talent but also ensures continuous innovation within the organization. Additionally, the story of the self-learning employee in the technical department, shared by Interviewee 2, exemplifies how fostering a culture of self-initiated learning and acknowledging such efforts can lead to significant professional growth within the company. The study also touches upon the challenges of varying digital competencies among project management professionals, emphasizing the need for extensive training and resource allocation for skill development. Moreover, the interactions between digital natives and older engineers shed light on the importance of a balanced team composition, where the strengths of different generations are leveraged to ensure a well-rounded application of digital technologies in projects. This generational complementarity, as described by Interviewees 2 and 8, not only facilitates knowledge transfer but also optimizes the application of digital tools in project management.

In essence, the study highlights the need for a strategic balance in talent management within the digital transformation context of project management. Organizations must navigate the challenges of attracting and retaining digital talent while also emphasizing professional growth, training, and a tailored approach that aligns with digital project management requirements. This balance requires a deep understanding of generational differences and a commitment to developing a workforce that is competent in both traditional and digital skills, ensuring that digital competencies are maximized and effectively integrated into project management practices.

5. Discussion

5.1. Talent management and managing projects in the digital era

This research examines talent management initiatives for project management professionals on exploiting the inherent advantages of the data-rich era and digital transformation to build an inclusive workplace. The analysis of the survey and interviews revealed various relationships between digitalization, datafication, and project management.

The digital transformation in project management is disrupting how organizations recognize and value the skills and expertise of the new data-savvy talents in the organization's decision-making processes for improved project delivery. Our research focuses on talent management and how new talent entering the project management profession will transform project management. Our data shows that organizational talent support and precise digital competence requirements will significantly affect the development of personal digital competence. Especially developing and training talents play a more critical role than attracting new talents and retaining existing talents when supporting talent management at the organizational level. Besides, the individual digital competence and precise definition of digital applications in project management functions will enormously enhance the performance of individuals in project management.

It is interesting to note how the interviewees appear to resonate with recent scholarship that suggests that technical ability is less important than one's openness to learning from others (Guinan et al., 2019). Our study provided some directions on strengthening the development of talent management through in-house activities that promote communication or outsourced training programs and focusing on technology-in-use as opposed to technology as a tool as well as learning lessons from other sectors that can bring disruption to the traditional project management sector.

Our results show that personal digital competence is highly influenced by required digital competence, which implies that the formation of personal digital competence goes through a process guided by the organization rather than the talents themselves. Meanwhile, digital management function correlates with personal project competence more than personal digital competence. This shows that the digital competence led by the talents themselves is not yet mature at the current stage and requires more guidance and development from organizations or higher levels. Therefore, the current digital competence formation is a systematic behavior that needs to be established by the talents and the organization.

5.2. Theoretical contribution

The emphasis on digital transformation has so far been on what technologies can do for us, often neglecting how such transformation can radically change what people and organizations do (Robinson et al., 2016). To address this deficiency and harness the full potential of the data-rich era, one must go beyond the prevailing technical line of thought to think about people's issues. For example, although digital technologies, such as BIM, radically alter collaborative work, they are considered more as tools affecting work structure and less as socio-technical systems affecting both structure and agents (Papadonikolaki et al., 2019). This perspective neglects the broader implications of digital technologies on organizational behavior, culture, and the skills required from project management professionals. Analyzing digital tools as socio-technical systems requires a deeper understanding of how these technologies integrate into the social fabric of project teams, influencing communication, decision-making processes, and the development of digital competencies. It emphasizes the need for research that not only investigates the technical capabilities of digital tools but also how their use reshapes the competencies required in project management, including collaboration, digital literacy, and adaptive leadership. This approach can provide a more holistic view of the impact of digital technologies on project management, beyond their immediate functional benefits.

Compared to other disciplines or domains (Dan et al., 2021; Nair, 2019; Stander et al., 2022), the observation that the emergence of a new generation of digital talent is rarely discussed in project management literature points to a theoretical gap regarding perceptions of talent and insufficient support for digital competencies. This situation underscores the need for a more robust theoretical framework within project management to address and support the development of digital capabilities. Recognizing and integrating digital talents into project management practices not only enriches the discipline but also ensures it evolves in alignment with technological advancements and the changing workforce landscape.

This study contributes by revealing how project management as a profession and skill adjusts to the developments around digitalization and datafication, supporting a data-intensive and more inclusive professional environment. The study confirms and extends the findings by Marnewick and Marnewick (2021), where more emphasis is placed on social competencies (communication and collaboration), rather than the more technical aspects of digital intelligence such as cybersecurity. This shows a recognition of the impact of digitalization on the human and social capital of projects beyond the task-oriented considerations. Nurturing a diverse and skilled workforce is key to the project management profession's long-term agenda for change.

5.3. Managerial implications

The adoption of digital technologies still needs to catch up in traditional industries such as the AEC, which is behind the traditional Gartner hype curves (Bosch-Sijtsema et al., 2021). Such sectors seem to be searching for ways of adopting new technologies to retain the old ways. We must up-skill and re-skill project management professionals in highly complex project environments. More importantly, project management professionals are encouraged to change their mindset to add digital innovation to their daily work and make digitally-informed decisions leveraging the data-rich era. The implications of our research for policy are helping to shape an agenda for a responsible transition to the new normal that lies ahead and attract and develop new talents to the project management profession.

The study also has implications for educational bodies, project management bodies, and professional institutions in aligning with the current trends shaping and being shaped by new talent entering the profession. Digital technologies challenge the project management profession through changes in functions, jobs and roles, new professional accountability and greater integration. Especially developing and training talents play a more vital role than attracting new talents and retaining existing talents when supporting talent management at the organizational level. These disruptions reveal the need for well-designed and conscious talent management strategies for attracting, developing and retaining new data-savvy talent for projects. Dan et al. (2021) pointed out that the retention of digital talent is particularly critical considering global talent shortages and the tough market competition. Our findings are consistent with their research, and key insights suggest that it involves creating a supportive work environment that values and nurtures the professional growth and personal well-being of employees. Effective strategies include offering competitive compensation, career development opportunities, flexible work arrangements, and fostering a positive organizational culture. Additionally, recognizing and rewarding contributions, ensuring employees feel their work is meaningful, such as BIM medals awarded by many countries and industry associations, and providing them with the tools and resources necessary to succeed are critical.

5.4. Limitations and future research

Despite the new insights and knowledge contribution this study put forward, there are further limitations. First, the sample of the survey participants and interviews, although diverse in terms of the experience of the experts in the industry, was not very balanced regarding geographical distribution. Although active steps were taken to improve and avert this during the data collection stage, it is not an entirely balanced sample.

This study has been accompanied by a focus group that will be included in future publications. The benefits of this mixed data collection source are that it creates a more diverse sample, including various gender orientations, ages and backgrounds. The findings of these other data collection stages will be transposed and synthesized with the present study's findings and discussed in future works.

6. Conclusion

In conclusion, this study illuminates the transformative journey of project management in the contemporary, data-centric digital landscape, highlighting the imperative for a revamped paradigm in both talent and project management strategies. It becomes evident from our findings that personal digital competence is predominantly sculpted by the strategic frameworks and guidance provided by organizations, rather than being a product of individual endeavor. This revelation accentuates the criticality of institutive and structured developmental strategies within organizations, tailored to foster and enhance digital competencies.

The observed interplay between digital management functions and personal project competence, as opposed to personal digital proficiency, sheds light on the embryonic state of talent-driven digital competence.

This insight signals a pressing need for more profound and systematic organizational involvement in cultivating these competencies. The research stresses the essential role organizations must play in crafting and nurturing digital skill sets, ensuring they are in sync with the evolving demands of project management.

Furthermore, this analysis brings into focus the significant role of the burgeoning data-savvy talent pool. With their innate grasp of digital technologies and a keen understanding of the shifting business paradigms, these individuals are instrumental in steering the course of project management's evolution. However, to leverage the full potential of these emerging talents and integrate them effectively into the fabric of project management, there is an urgent call for robust organizational support and comprehensive development programs.

Looking ahead, it is crucial for future research to delve into formulating strategies that can seamlessly integrate this new wave of talent into the existing project management frameworks. Such strategic integration is pivotal for organizations to adeptly navigate the myriad challenges and seize the opportunities that the digital revolution presents.

This study makes a substantial contribution to the expanding repository of knowledge at the confluence of digital competence, talent management, and project management. It offers insightful perspectives and practical implications for both academic inquiry and pragmatic application, serving as a beacon for navigating the dynamic and ever-evolving terrain of the business ecosystem.

Declaration

The review process of this manuscript was managed by the Editor in Chief.

CRediT authorship contribution statement

Yan Liu: Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Ningshuang Zeng:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis. **Eleni Papadonikolaki:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Kirk Maritshane:** Investigation, Formal analysis, Data curation. **Paul W. Chan:** Validation, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used OpenAI's ChatGPT to improve the text. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgments

This study is an output of the 2022–2023 PMI (Project Management Institute) Sponsored Research Grant: "How will the new talents change Project Management in a data-rich era?". Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funding agencies. This study is also supported by AliResearch's "Huoshui" Young Academics Project and the Yuxiu Young Scholars Program of Nanjing University.

Appendix

Table A
Evaluation of the measurement model.

Construct	Indicator	Indicator Reliability			Internal Consistency Reliability		Convergent Validity
		Loading	t-value	P-value	Cronbach's α	CR	AVE
ANT	ANT1	0.862	27.996	p < 0.001	0.905	0.906	0.778
	ANT2	0.916	54.569	p < 0.001			
	ANT3	0.895	40.6	p < 0.001			
	ANT4	0.854	30.305	p < 0.001			
DTT	DTT1	0.863	28.515	p < 0.001	0.934	0.934	0.752
	DTT2	0.878	40.029	p < 0.001			
	DTT3	0.867	31.361	p < 0.001			
	DTT4	0.886	41.978	p < 0.001			
	DTT5	0.842	26.997	p < 0.001			
	DTT6	0.866	29.242	p < 0.001			
RET1	RET1	0.892	46.344	p < 0.001	0.879	0.891	0.679
	RET2	0.798	19.36	p < 0.001			
	RET3	0.858	28.479	p < 0.001			
	RET4	0.694	9.144	p < 0.001			
	RET5	0.862	28.827	p < 0.001			
OTS	ANT1	0.726	13.1	p < 0.001	0.957	0.959	0.628
	ANT2	0.786	21.578	p < 0.001			
	ANT3	0.776	18.173	p < 0.001			
	ANT4	0.76	18.795	p < 0.001			
	DTT1	0.829	25.053	p < 0.001			
	DTT2	0.857	33.735	p < 0.001			
	DTT3	0.852	26.904	p < 0.001			
	DTT4	0.838	31.112	p < 0.001			

(*continued on next page*)

Table A (*continued*)

Construct	Indicator	Indicator Reliability			Internal Consistency Reliability		Convergent Validity
		Loading	t-value	P-value	Cronbach's α	CR	AVE
	DTT5	0.802	22.215	p < 0.001			
	DTT6	0.817	22.879	p < 0.001			
	RET1	0.878	34.456	p < 0.001			
	RET2	0.768	16.463	p < 0.001			
	RET3	0.765	15.645	p < 0.001			
	RET4	0.615	7.014	p < 0.001			
	RET5	0.778	16.847	p < 0.001			
RDC	RDC1	0.695	9.717	p < 0.001	0.894	0.913	0.549
	RDC2	0.836	21.355	p < 0.001			
	RDC3	0.83	22.683	p < 0.001			
	RDC4	0.869	32.406	p < 0.001			
	RDC5	0.65	9.418	p < 0.001			
	RDC6	0.492	5.801	p < 0.001			
	RDC7	0.738	14.15	p < 0.001			
	RDC8	0.737	11.329	p < 0.001			
	RDC9	0.75	15.575	p < 0.001			
PDC	PDC1	0.756	15.979	p < 0.001	0.911	0.918	0.591
	PDC2	0.827	20.125	p < 0.001			
	PDC3	0.851	24.617	p < 0.001			
	PDC4	0.857	31.565	p < 0.001			
	PDC5	0.753	14.263	p < 0.001			
	PDC6	0.567	7.941	p < 0.001			
	PDC7	0.774	19.504	p < 0.001			
	PDC8	0.678	11.181	p < 0.001			
	PDC9	0.813	18.388	p < 0.001			
DMF	DMF1	0.69	10.009	p < 0.001	0.921	0.932	0.583
	DMF2	0.769	14.702	p < 0.001			
	DMF3	0.836	21.743	p < 0.001			
	DMF4	0.789	17.091	p < 0.001			
	DMF5	0.809	18.763	p < 0.001			
	DMF6	0.807	16.314	p < 0.001			
	DMF7	0.73	12.543	p < 0.001			
	DMF8	0.747	14.853	p < 0.001			
	DMF9	0.701	11.346	p < 0.001			
	DMF10	0.743	14.432	p < 0.001			
PPC	PPC1	0.657	9.57	p < 0.001	0.912	0.919	0.511
	PPC2	0.708	12.347	p < 0.001			
	PPC3	0.622	8.251	p < 0.001			
	PPC4	0.765	19.089	p < 0.001			
	PPC5	0.518	5.477	p < 0.001			
	PPC6	0.744	14.748	p < 0.001			
	PPC7	0.713	10.971	p < 0.001			
	PPC8	0.768	16.722	p < 0.001			
	PPC9	0.784	18.356	p < 0.001			
	PPC10	0.735	14.227	p < 0.001			
	PPC11	0.808	19.535	p < 0.001			
	PPC12	0.704	13.82	p < 0.001			
	PPC9	0.784	18.356	p < 0.001			

Table B
Cross-loading evaluation results for discriminant validity evaluation.

	ANT	DTT	RET	OTS	RDC	PDC	DMF	PPC
ANT1	0.862	0.594	0.614	0.726	0.295	0.288	0.403	0.439
ANT2	0.916	0.677	0.635	0.786	0.218	0.198	0.365	0.443
ANT3	0.895	0.673	0.63	0.776	0.259	0.215	0.365	0.424
ANT4	0.854	0.69	0.594	0.76	0.223	0.212	0.472	0.435
DTT1	0.684	0.863	0.709	0.829	0.231	0.201	0.433	0.472
DTT2	0.711	0.878	0.751	0.857	0.163	0.199	0.418	0.451
DTT3	0.72	0.867	0.74	0.852	0.207	0.181	0.447	0.521
DTT4	0.646	0.886	0.736	0.838	0.25	0.198	0.395	0.443
DTT5	0.584	0.842	0.742	0.802	0.313	0.269	0.414	0.381
DTT6	0.536	0.866	0.794	0.817	0.227	0.241	0.392	0.411
RET1	0.702	0.823	0.892	0.878	0.217	0.266	0.492	0.52
RET2	0.592	0.725	0.798	0.768	0.188	0.158	0.374	0.442
RET3	0.592	0.672	0.858	0.765	0.208	0.168	0.438	0.48
RET4	0.402	0.582	0.694	0.615	0.236	0.173	0.3	0.322
RET5	0.561	0.714	0.862	0.778	0.303	0.273	0.432	0.552
ANT1(OTS)	0.862	0.594	0.614	0.726	0.295	0.288	0.403	0.439
ANT2(OTS)	0.916	0.677	0.635	0.786	0.218	0.198	0.365	0.443
ANT3(OTS)	0.895	0.673	0.63	0.776	0.259	0.215	0.365	0.424

(continued on next page)

Table B (*continued*)

	ANT	DTT	RET	OTS	RDC	PDC	DMF	PPC
ANT4(OTS)	0.854	0.69	0.594	0.76	0.223	0.212	0.472	0.435
DTT1(OTS)	0.684	0.863	0.709	0.829	0.231	0.201	0.433	0.472
DTT2(OTS)	0.711	0.878	0.751	0.857	0.163	0.199	0.418	0.451
DTT3(OTS)	0.72	0.867	0.74	0.852	0.207	0.181	0.447	0.521
DTT4(OTS)	0.646	0.886	0.736	0.838	0.25	0.198	0.395	0.443
DTT5(OTS)	0.584	0.842	0.742	0.802	0.313	0.269	0.414	0.381
DTT6(OTS)	0.536	0.866	0.794	0.817	0.227	0.241	0.392	0.411
RET1(OTS)	0.702	0.823	0.892	0.878	0.217	0.266	0.492	0.52
RET2(OTS)	0.592	0.725	0.798	0.768	0.188	0.158	0.374	0.442
RET3(OTS)	0.592	0.672	0.858	0.765	0.208	0.168	0.438	0.48
RET4(OTS)	0.402	0.582	0.694	0.615	0.236	0.173	0.3	0.322
RET5(OTS)	0.561	0.714	0.862	0.778	0.303	0.273	0.432	0.552
RDC1	0.146	0.159	0.127	0.158	0.695	0.389	0.027	0.136
RDC2	0.243	0.227	0.216	0.247	0.836	0.423	0.1	0.143
RDC3	0.194	0.175	0.24	0.217	0.83	0.397	0.12	0.152
RDC4	0.138	0.091	0.132	0.126	0.869	0.506	0.131	0.147
RDC5	0.07	0.085	0.116	0.099	0.65	0.287	0.043	0.21
RDC6	0.281	0.303	0.227	0.295	0.492	0.212	0.016	0.247
RDC7	0.243	0.238	0.275	0.271	0.738	0.377	0.172	0.249
RDC8	0.269	0.315	0.322	0.33	0.737	0.343	0.235	0.22
RDC9	0.349	0.279	0.253	0.313	0.75	0.377	0.236	0.134
PDC1	0.087	0.048	0.107	0.083	0.349	0.756	0.196	0.22
PDC2	0.195	0.193	0.21	0.215	0.461	0.827	0.273	0.181
PDC3	0.203	0.199	0.216	0.222	0.434	0.851	0.25	0.141
PDC4	0.222	0.188	0.204	0.219	0.45	0.857	0.251	0.231
PDC5	0.163	0.182	0.155	0.182	0.32	0.753	0.166	0.15
PDC6	0.299	0.292	0.221	0.294	0.261	0.567	0.149	0.205
PDC7	0.124	0.155	0.205	0.176	0.436	0.774	0.271	0.224
PDC8	0.245	0.243	0.223	0.257	0.342	0.678	0.26	0.282
PDC9	0.245	0.213	0.206	0.238	0.42	0.813	0.207	0.22
DMF1	0.375	0.43	0.436	0.451	0.144	0.302	0.69	0.32
DMF2	0.427	0.437	0.449	0.474	0.042	0.195	0.769	0.338
DMF3	0.41	0.428	0.49	0.478	0.188	0.302	0.836	0.404
DMF4	0.248	0.34	0.33	0.338	0.109	0.16	0.789	0.248
DMF5	0.381	0.385	0.401	0.42	0.19	0.286	0.809	0.411
DMF6	0.372	0.331	0.332	0.37	0.161	0.213	0.807	0.271
DMF7	0.341	0.273	0.328	0.333	0.115	0.258	0.73	0.251
DMF8	0.285	0.329	0.321	0.34	0.107	0.161	0.747	0.31
DMF9	0.113	0.238	0.222	0.216	0.057	0.118	0.701	0.136
DMF10	0.352	0.37	0.368	0.394	0.097	0.182	0.743	0.319
PPC1	0.426	0.468	0.569	0.528	0.345	0.241	0.311	0.657
PPC2	0.386	0.384	0.46	0.441	0.159	0.229	0.307	0.708
PPC3	0.258	0.276	0.326	0.31	0.226	0.249	0.273	0.622
PPC4	0.339	0.405	0.42	0.424	0.135	0.283	0.376	0.765
PPC5	0.361	0.429	0.417	0.439	0.198	0.147	0.135	0.518
PPC6	0.356	0.382	0.454	0.429	0.143	0.101	0.252	0.744
PPC7	0.304	0.303	0.351	0.344	0.131	0.201	0.244	0.713
PPC8	0.337	0.364	0.4	0.397	0.114	0.221	0.351	0.768
PPC9	0.338	0.324	0.398	0.379	0.106	0.123	0.308	0.784
PPC10	0.303	0.286	0.263	0.305	0.11	0.137	0.235	0.735
PPC11	0.383	0.329	0.39	0.391	0.18	0.152	0.294	0.808
PPC12	0.441	0.468	0.405	0.476	0.153	0.141	0.354	0.704

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