

IT PROJECT MANAGERS' COMPETENCIES REQUIRED ON THE MARKET – GENERATIVE AI ENHANCED ANALYSIS

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Purpose: The primary objective of this study is to investigate the competency profiles of IT project managers as demanded in the job market. To achieve this, we conducted a comprehensive analysis of job postings, focusing on the real-world competency requirements for project managers within the IT sector. This approach enables an in-depth understanding of the specific skills and qualifications that employers are actively seeking in potential project management candidates.

Design/methodology/approach: This research utilized an innovative approach by applying generative AI for the analysis of a large data set, offering a unique perspective in evaluating IT project manager competencies in the job market.

Findings: Our research identified nine distinct IT project manager profiles, which revealed communication as the most crucial of all competencies across all profiles, while competencies such as power and interest, along with procurement, were found to be less significant.

Research limitations/implications: The research was based on the data gathered during a period of three months. However, it demonstrates the possibilities of further applications of this designed research process.

Practical implications: The research highlights the diverse range of competency requirements for project managers in IT industry.

Originality/value: This article features the use of ChatGPT, an innovative tool, to augment the analysis conducted.

Keywords: IT project, project managers' competencies, competency profile, generative AI.

Category of the paper: research paper.

1. Introduction

IT projects play a pivotal role in today's rapidly evolving technological landscape, serving as the foundations for innovation and competitiveness across various industries. IT projects are definitely essential for companies to quickly develop in the digital age, enabling the

implementation of cutting-edge software, infrastructure, and systems that drive efficiency and productivity. Effective IT project management is critical not only for delivering on time or within budget, but also for ensuring that these investments align with strategy and keep pace with ever-changing technologies. Thus, the role of IT managers and their competencies seem to be undeniably important.

It is apparent that project managers (PMs) play a prominent role in all kinds of projects, and those in IT are no exception. There are numerous studies confirming the role of managers in project success: For instance, a study conducted by Toney (2001) showed that PMs have a direct influence over 35-47 per cent of project success. Similarly, Müller and Turner (2007) demonstrated a positive correlation between the PM's leadership competencies and project success. However, in order to perform their activities thoroughly and to lay the foundations for such initiatives, PMs have to develop various but complementary competencies such as personal, performance, perspective and interpersonal (Moradi et al., 2020).

Undoubtedly, nowadays employers recognize the pivotal role of PMs and their indispensable competencies in orchestrating complex projects to ensure their successful delivery. The number of job postings signals the need for PMs, and the content of postings demonstrates the expectations as to the most important competencies. These job postings offer interesting research material (Karakatsanis et al., 2017; Puolitaival et al., 2023; Zheng et al., 2020) enabling us to follow not only changes in the job market but also to investigate the structure and contingencies of the main requirements for managers in various types of projects. Due to the role of IT projects and – in consequence – IT PMs, we decided to examine if and how the peculiarity of IT ventures is reflected in the online content of IT PM job advertisements. In our research, using generative AI (chatGPT 4.0), we developed a list of IT PM job competencies, breaking down the competency components according to IPMA ICB 4.0 (International Project Management Association, 2015). This was followed by conducting a comparative analysis of these competencies providing classification into nine profiles as well as analysing the peculiarity of each profile.

Our research process was oriented towards answers to two main research questions: what are the real-world demands for PMs' competencies in the IT area? How do we classify IT PMs from the perspective of employers' expectations?

This paper is structured into seven sections. First, there is the introduction; second, the summary of the literature review on IT PMs' competencies is presented by addressing those main studies made prior in this field; third, the significance of online job postings as research data is briefly explained; The fourth is dedicated to presenting our research method, and the fifth section demonstrates research results, which is followed by a discussion with further research avenues. Finally, the seventh section provides concluding remarks.

2. IT project managers' competencies: research perspectives

According to Moradi et al (2020), the studies on PMs' competencies can be traced back to the papers by Gaddis (1959) and Lawrence and Lorsch (1967), indicating a very long and fruitful tradition of exploring projects from the perspective of their managers, along with expectations or requirements for specific tasks and competencies, and the role of those competencies in project success or failure. The studies enabled the identification of various competencies required, allowing categorization and prioritization, as well as analysis from contingency views linking expectations with sectors, types, scales, life cycles or countries of project realizations (Cha, Maytorena-Sanchez, 2019; Müller, Turner, 2007; Müller, Turner, 2010; Shenhar 2001). The research on IT PMs can be regarded as a part of the PMs' competency studies, where attention should be paid to potential distinctive features of IT projects and their consequences.

It needs to be emphasized that the term "competencies" possesses multifaceted meanings, as it can refer to the diverse range of skills, knowledge, and abilities essential for PMs' professional success. The interpretation can vary depending on the context: according to Stevenson and Starkweather (2010), there has been a long debate in HR research on understanding the term "competency". However – as a summary – when discussing competencies, we underline the importance of knowledge, skill, ability, or characteristics associated with high performance on a job. Although these definitions differ in particular points, they have a similar main message: competency is a range of different characteristics, behaviours, and traits that are required for effective job performance (Abraham et al., 2001). Regarding projects, we can understand the competency of PMs with the capability to use skills, knowledge and personal characteristics that enhance the efficiency and effectiveness of their job performance, and subsequently increase the likelihood of project success (Moradi et al., 2020).

As it was indicated above in extensive literature on the subject, it is possible to find important references on PMs' general competencies. Similarly, there are standards or frameworks like ICB, the APM Body of Knowledge, PMBOK and Project Manager Competency Development that have focused attention on PMs' competencies. For instance, IPMA ICB 4 introduces 28 competencies of PMs divided into three main groups – people, practice and perspective (International Project Management Association, 2015). However, the discrepancies between the results of previous studies and standards of practice have been also explored (Moradi et al., 2020), indicating some notable differences such as in appraising importance, priorities, or impact of context.

What seems to be important from the perspective of our research is the distinction of the studies of PMs' competencies into two streams – studies from the supply side or the demand side (Crawford, 2005; Zeng, 2020). In general, literature is dominated by research focused on

the supply side, and numerous studies have attempted to identify essential competencies, and so providing insight into which competencies should be indispensable in PMs' education and training. Another growing stream of research attempts to identify PMs' key competencies from the perspective of industry demand. For instance, Ahsan et al. (2013) show that industry job advertisements emphasize "soft skills" and competencies in a manner different to those in literature, and differences are found across countries and between industries.

With the growing quantity of studies on required and expected PMs' competencies, we can observe the increasing number of lists presenting prospective templates for the exemplary and 'best' PM. For instance, Moradi et al. (2020) indicated 98 PMs' competencies, structuring them into four categories: personal (27 competencies), performance (26 competencies), perspective (8 competencies) and interpersonal (11 competencies). As for IT project studies, Stevenson and Starkweather (2010) performed two-phased research investigating the characteristics necessary to achieve project success. First, after identifying and rating preferred IT project management competencies, they created an index which comprised fifteen of the most valued project management competencies. Next, they asked executives in the US to rank their preferences in terms of importance on a seven-point Likert scale. The results indicated that executives valued six critical core competencies: leadership, the ability to communicate at multiple levels, verbal and written skills, attitude, and the ability to deal with ambiguity and change, as opposed to other competencies such as experience, work history, education, and technical expertise.

The findings of these subsequent studies provided disparate conclusions, e.g., Varajão et al. (2019), when exploring features of information system PMs, demonstrated the register of the top twelve competencies: communication, engagement and motivation, project requirements and objectives, leadership, reliability, results orientation, conflict and crisis, project orientation, teamwork, interested parties, resilience, and ethics. In resembling studies, Cha and Maytorena-Sanchez (2019), when analysing the software project life cycle, discovered the importance of cognitive, functional, and social competencies, as well as added meta-competences, which are understood as managing self-knowledge.

The advancement of IT projects and the diverse outcomes of prior research provide the rationale for delving deeper into the proficiencies of IT PMs. Our inquiry seeks to extend beyond a mere revision of the register of anticipated competencies, and aims to delve into the contextual analysis of the contemporary picture of the IT industry.

3. Job postings as research material in PMs' competencies studies

Frequently, inquiries into the necessary project management competencies were founded upon surveys administered among practitioners and executives tasked with the implementation of IT projects (Stevenson, Starkweather, 2010; Varajão et al., 2019). Thus the subjectivity, sample size and contextual aspects of the results were repeatedly shown as major points in the research limitation sections. In eliminating the bias related to opinion surveys, some new studies (e.g., Zeng, 2020; Puolitaival et al., 2023) adopted an approach based on analysing job advertisements as a direct observation of firms' demands for PMs' required responsibilities and competencies.

However, it is apparent that nowadays the recruitment process has largely moved online, and job advertisements have become an online service creating an important part of a growing trend towards a more digitalized hiring process. Alongside increased flexibility and cost-cutting, this trend brings benefits to scholars offering large sets of research data.

First, the availability of a substantial number of job advertisements effectively addresses the limitations related to the sample size; as with the digitalization of recruiting activities, comprehensive job advertisement data sets have become available. Thus, job advertisements provide a valuable opportunity to investigate the demand for PMs' competencies at an industry level in a more direct and versatile manner (Ahsan, Ho, 2022; Karakatsanis et al., 2017). On the other hand, this approach brought some new challenges related to data analysis as a huge scale of data sets poses the challenge of efficiently mining valuable information from unstructured job-description texts. For smaller sample sizes, a combination of qualitative and quantitative content analysis methodologies, as described by Ahasan and Ho (2022), were employed, for example, utilizing NVivo software for data coding. Conversely, in cases involving larger sample sizes, data mining techniques emerged as notably beneficial and increasingly applied. Some pioneering works (Karakatsanis et al., 2017) used automatic text-mining methods to extract the major dimensions of competencies as presented in job description texts. Karakatsanis et al. (2017) demonstrated the general usefulness and applicability of the Latent Semantic Indexing (LSI) model for highlighting job trends in different industries and geographical areas, as well as for identifying occupational clusters or temporal changes in job markets.

Other studies, e.g., Zeng et al. (2020), applied topic modelling methods, a commonly used text-mining (data-mining) approach. In their study, Zeng et al. (2020) used a large data set of 243,521 job advertisements that covered nearly the whole online job market for construction PMs in China over one year, in order to track the demands for competencies at an industry level. In their research, a text-mining method called structural topic model (STM) was used to analyse the descriptions of the PM competency requirements to identify the major competency dimensions emphasized in the advertisements.

As the literature review demonstrates, the utilization of job advertisements for PM recruitment provides an avenue for analysing extensive data sets, facilitating an in-depth understanding of employer expectations regarding the essential competencies for a given position. It seems inevitable that the advancement of data-mining techniques and artificial intelligence concurrent with the escalating volumes of data, will allow for not only the acceleration of analyses but also the generation of innovative insights and predictions.

4. Research method

The research process was structured into four distinct stages. The initial stage focused on data collection, targeting websites associated with the IT industry in Poland. Key platforms for this purpose included NoFluffJobs, JustJoinIT, and BullDogJob. NoFluffJobs is notable for requiring salary ranges in job postings, thereby providing valuable compensation data. JustJoinIT differentiates itself by featuring a map pinpointing job location, while BullDogJob allows for the submission of company reviews alongside job listings. This data collection phase involved weekly visits to these three websites over the first quarter of 2023, commencing on January 15th and concluding with the final data retrieval on April 16th, 2023. The data was compiled in both HTML and PDF formats, contingent on the offerings of each website. For the purposes of this study, all job postings categorized under 'project manager' or 'project management' were included. This resulted in an aggregate of 270 job postings, with 48 sourced from BullDogJob, 105 from JustJoinIT, and 117 from NoFluffJobs.

The second stage entailed extracting data from the accumulated files utilizing the Python programming language. This step was instrumental in standardizing the diverse data formats into a unified Microsoft Word document, thereby facilitating subsequent analytical procedures. To ensure the integrity and accuracy of the data, a manual verification process was implemented. This process involved meticulously cross-referencing the content of the Word document with the original files to confirm the consistency and correctness of the extracted information.

The subsequent stage involved an in-depth analysis utilizing ChatGPT 4.0, a generative AI software. This tool played a pivotal role in augmenting examination of job offers collated in the earlier stages. The use of generative AI in text mining proved advantageous, enabling multi-faceted analysis with minimal researcher intervention. ChatGPT 4.0 individually assessed all 270 job postings, extracting and interpreting required competencies as per the standards outlined in IPMA ICB 4.0. This analysis encompassed various dimensions including compensation, contract types (either employment or B2B [business-to-business] cooperation), requisite seniority levels (junior, middle, senior), work arrangements (remote, on-site, or hybrid), and congruence with IPMA ICB 4.0 competencies. Additionally, the availability of

each job offer was documented. All gathered data was systematically consolidated into an Excel spreadsheet for ease of interpretation. Regarding compensation, figures were standardized in PLN on a monthly basis. Job offers originally listed in EUR were converted to PLN using a conversion rate of 4.47, and rates presented on a daily or hourly basis were recalculated to reflect a monthly equivalent, assuming nineteen working days per month. This comprehensive data set facilitated the identification of the most in-demand and least required competencies within the IT job market.

The concluding phase of this research involved utilizing ChatGPT 4.0's generative AI capabilities to cluster the 270 job offers based on required competencies. This step highlighted the profound efficacy of ChatGPT in handling complex data set analyses. The performance of ChatGPT in this context mirrored the capabilities of established commercial software, as noted by Peng et al. (2023). A notable feature of ChatGPT is its adaptability in processing various input forms, including attachments and its integration with specialized plugins. The 'AskYourPDF' plugin, for instance, facilitated the efficient interpretation of PDF files, especially those with straightforward formatting. Similarly, the 'Advanced Data Analysis' plugin also allowed for the effective handling of more complex documents. The versatility and evolving nature of ChatGPT are evident in its frequent updates, which occur approximately every two to four weeks, continually enhancing its analytical prowess. This dynamic evolution positions ChatGPT as a robust tool in the realm of data analysis, particularly in clustering job offers based on competency requirements, as demonstrated in this research.

Figure 1 schematically represents the research process, which has been detailed in the preceding text.

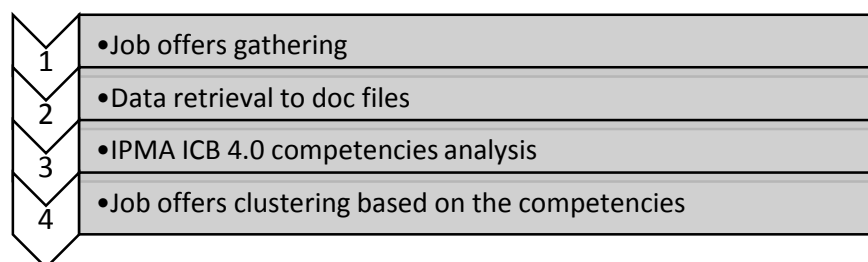


Figure 1. Data analysis procedure.

Source: Own elaboration.

It is crucial to recognise several restrictions related to the application of generative AI, particularly ChatGPT, in analytical processes. A key aspect requiring vigilant user oversight is ChatGPT's propensity for 'hallucinations', as identified by McKenna et al. (2023). These inaccuracies arise from the AI's reliance on patterns of memorization and term frequency inherent in its training model. Another significant factor is the 'discussion temperature', a concept discussed by Peng et al. (2023), which governs the level of creativity in ChatGPT's responses. A lower discussion temperature correlates with reduced creativity, yielding more precise and factual outputs. In our analysis, given the emphasis on accuracy and relevance to

the compiled data, the discussion temperature was set to zero. This setting was chosen to maximize the precision of ChatGPT's responses, aligning with the analytical objectives of this study.

5. Research results

The empirical research analysis reveals a diverse interpretation of the PM role within the job market. The job offers which were examined not only reflect varied expectations of PM competencies, but also exhibit a range of cooperation modalities, compensation structures, and work conditions. This diversity underscores the multifaceted nature of the PM role and highlights the heterogeneity in employer expectations and job offer characteristics in this field.

The initial stage of our analysis is descriptive in nature. Of the 270 job offers analysed, 105 provide options for either employment or contractual engagement. Specifically, 99 offers are exclusive to a B2B cooperation model, while 66 are solely for employment contracts. A notable divergence is observed in the remuneration ranges between these two models. For employment contracts, the salary ranges are generally lower compared to the B2B options; the minimum salary offered is consistent across both models at 4000 PLN per month. However, the maximum salary for B2B contracts significantly surpasses those of employment contracts, reaching over 56,000 PLN as opposed to the latter's 30,000 PLN maximum. This disparity is also reflected in the median salaries, as detailed in Table 1. These findings align with expectations considering the different financial implications for companies in terms of cost deductions associated with each employment model.

Table 1.
Remuneration comparison for B2B and CoE cooperation models

Description	B2B (in PLN)	CoE (in PLN)
Minimum	4 000	4 000
Lower bound median	14 000	10 830
Higher bound median	20 000	16 000
Maximum	56 060	30 000

Source: Own elaboration.

Regarding the work models, there are three options described in the job description: remote work, stationary, and hybrid. The most popular is the remote option – indicated in 145 out of 270 job offers, while only 20 required a fully stationary way of working. Seniority is another interesting element: there were only 23 job offers that junior PMs were searching for, while 126 were middle (regular) and 121 with senior expertise in the project management area.

Leveraging the capabilities of ChatGPT 4.0, the job offers were methodically analysed for alignment with the IPMA ICB 4.0 competency framework. Each job offer was scrutinized to ascertain whether specific competencies were referenced within the job description.

This thorough analysis culminated in the creation of a comprehensive list of competencies, which is displayed in Table 2. This table categorizes the competencies within their respective competency areas and ranks them according to their frequency of occurrence in job descriptions. Such an arrangement offers a clear and quantifiable insight into the most sought-after competencies in the project management job market.

Table 2.
IT PMs' competencies as indicated in the job offers

Competency area	Competency	Number of job offers containing the competency
Practice	Plan and Control	264
	Stakeholder	249
	Organization and information	245
	Requirements and objectives	232
	Scope	228
	Time	219
	Resources	210
	Quality	166
	Risk and opportunity	161
	Change and transformation	145
	Project design	139
	Finance	132
	Procurement	30
People	Personal communication	264
	Relations and engagement	240
	Teamwork	226
	Leadership	220
	Results orientation	203
	Resourcefulness	189
	Self-reflection and self-management	165
	Personal integrity and reliability	110
	Negotiation	58
	Conflict and crisis	40
Perspective	Governance, structures, and processes	173
	Culture and values	142
	Strategy	133
	Compliance, standards, and regulations	61
	Power and interest	20

Source: Own elaboration.

Table 2 showcases that within each competency area, certain competencies are notably prevalent. 'Plan and control' and 'Personal communication' are the most frequently mentioned, appearing in 264 out of the 270 job offers analysed. Additionally, 'Governance, structures, and processes' is also significant, leading in the area of 'Perspective' competency, being mentioned in 173 offers. Notably, the 'Practice' competency area exhibits the highest average occurrence rate, standing at 178.46, with 'Plan and control' being the predominant competency. The 'People' competency area follows closely, with an average occurrence of 171.50. In contrast, the 'Perspective' competency area registers the lowest average occurrence at 105.8. The marked disparity between the 'Perspective' area and the others underscores the greater emphasis placed on 'People' and 'Practice' competencies in the project management job market.

Furthermore, the analysis extended to grouping the identified competencies into clusters, forming distinct competency profiles. These clusters were created upon the relative importance of specific competencies within the context of each job offer. This nuanced classification was enabled by ChatGPT's analysis, which took into account not only the presence of a competency, but also its level of necessity—distinguishing between essential requirements and those merely considered as 'nice to have.' As a result of this in-depth analysis, ChatGPT identified nine distinct clusters, numbered from 0 to 8. The characteristics of each cluster, including the specific competencies that define them and their relative importance within the job market, are visually represented in Figure 2. This figure, generated by the generative AI tool, provides a clear graphical representation of the competency clusters, offering an insightful overview of the competency landscape in IT project management speciality.

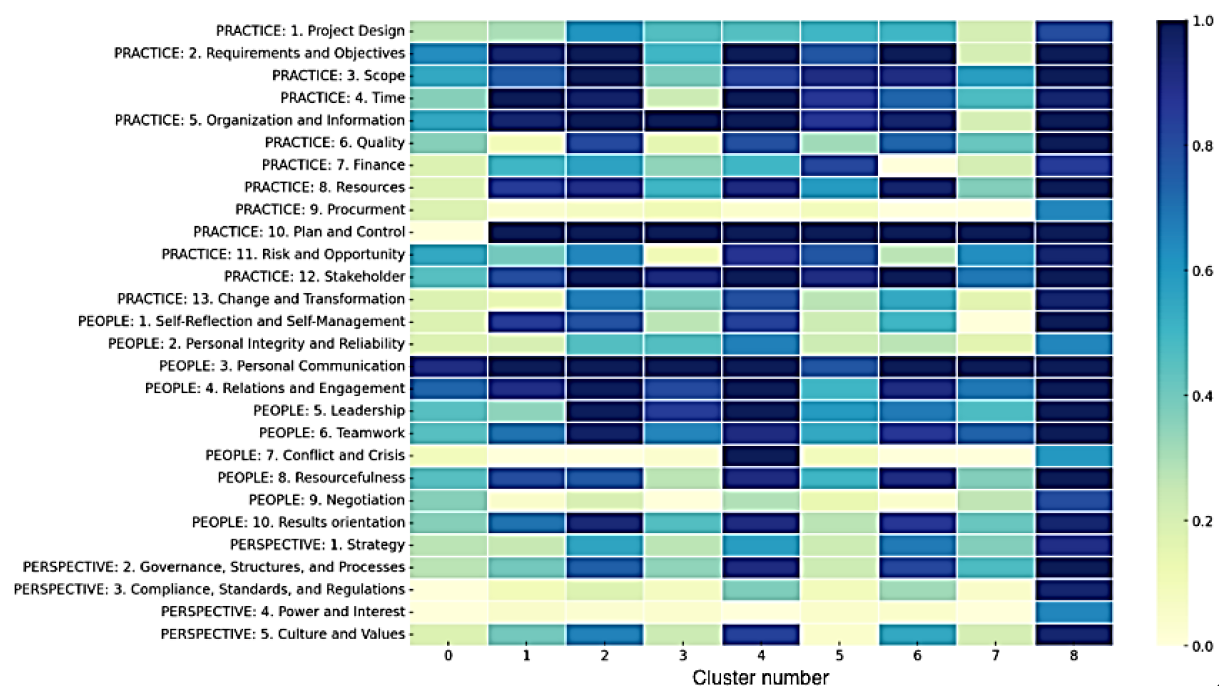


Figure 2. Cluster competency characteristics in detail.

Source: Own elaboration.

The analysis of the competency matrix yields several key insights. Notably, 'Personal communication' emerges as a universally required competency across all identified profiles. This observation strongly emphasizes the need for excellent communication skills in PMs, irrespective of their specific profile. On the other end of the spectrum, competencies such as 'Power and interest' as well as 'Procurement' are considerably less prominent, with their significance primarily confined to the eighth profile. Additionally, it is intriguing to note the relatively subdued emphasis on 'Negotiation' as well as 'Conflict and Crisis' competencies within the job market, based on this research. Such findings provide valuable indications about the competencies currently prioritized in the IT project management field.

The competency profiles discerned through the research highlight the feasibility of identifying distinct sets and combinations of project management competencies. These profiles, each uniquely characterized by a specific assemblage of competencies, have been succinctly described and named in Table 3. Additionally, this table includes the number of job offers corresponding to each profile, providing a quantitative perspective on the prevalence of these profiles within the job market. This detailed categorization not only aids in understanding the various competency demands in the field of project management but also illustrates the diverse expectations of employers in the IT industry.

Table 3.
PM competency profiles – description and structure

Profile	Denomination	Number of job offers	Description
0	Entrant	11	This cluster can be perceived as a starting point for junior PMs.
1	Project objectives oriented	20	The most important requirements are competencies related to project objectives such as scope and time, as well as planning and organizing.
2	Team management oriented	106	PMs here are expected to be team players with competencies related to leadership and teamwork.
3	Essential and team-oriented	26	PM competencies are focused on communication and organization.
4	Team management and governance	24	Communication and teamwork are strongly underlined with quite strong governance, as well as culture and values.
5	Team manager and member	22	Competencies appear to be a good fit for a project team member where the PM role is separated from the team and the leader.
6	All-embracing	22	Expected middle-level competencies, but with an orientation towards leadership and governance.
7	Relation-oriented	19	This profile is focused on communication and relationship competencies.
8	Completely professional	20	High competency is required in all of the areas.

Source: Own elaboration.

The market analysis indicates a relatively balanced demand for the various competency profiles identified, with each profile being nearly equally sought after by employers. An exception to this trend is observed in profile 2, which uniquely represents a middle-level competency across various areas yet is distinguished by a pronounced emphasis on project objectives and teamwork. In contrast, profile 0 predominantly aligns with junior-level PMs and is associated with the lowest salary ranges. At the opposite end of the spectrum, profile 8 stands out, demanding high-level competencies across the board: correspondingly, job offers within this profile tend to offer the highest salary ranges. This range of profiles from junior to highly experienced levels, each with its distinct competency and salary range, illustrates the diverse spectrum of roles and expectations in the IT project management job market.

6. Discussion

PM competencies are a pivotal element in determining project success. However, these requirements are often not explicitly defined, leading to ambiguity for aspiring PMs in assessing whether their skills align with the role. Additionally, there is a challenge in identifying the areas in which they may need further development. Traditionally, research in this field has predominantly relied on interviews and questionnaires. This approach, while valuable, may not fully capture the actual competencies that companies seek, as evidenced by job offer analysis. The discrepancy between the competencies professed by PMs and those actively sought by employers in job postings can provide unique insights. This underlines the importance of diversifying research methodologies in this domain to include analysis of job market data, which offers a more direct reflection of the IT industry's current competency demands.

In summarizing the findings from the empirical research conducted, it becomes evident that certain competencies are highly sought after in the job market. The most critical competencies, featured in at least 80% of those job offers analysed, predominantly fall within the 'Practice' and 'People' categories, as delineated in the IPMA ICB 4.0 framework. Within the 'Practice' area, competencies such as 'Plan and Control', 'Stakeholder', 'Organization and Information', 'Requirements and Objectives', 'Scope' and 'Time' are particularly emphasized. Similarly, the 'People' category is also in high demand, with competencies like 'Personal Communication', 'Relations and Engagement', 'Teamwork', and 'Leadership' being notably prominent. These insights directly contribute to addressing the first research question, shedding light on the specific competencies that are most valued within the current project management job market.

The analysis of these job offers led to the identification of nine distinct PM profiles, underscoring the versatility and importance of this role across various companies in the IT industry. A key finding from this analysis is the paramount importance of communication skills for PMs. This competency emerged as a consistently high priority across those profiles identified. Additionally, the analysis revealed that a fully professional profile, likely signifying a requirement for extensive experience and senior-level expertise, is sought in 20 of the 270 job offers. This highlights a notable demand in the market for PMs who possess a depth of experience and advanced skills, reinforcing the value placed on seasoned professionals in this field.

The research undertaken substantiates the pivotal significance of the PM role within the IT industry, illustrating that it is perceived and defined in various ways by different employers. The volume of job offers analysed in this study indicates a robust demand, particularly for individuals with 'regular' (mid-level) and 'senior' level expertise. This trend highlights the IT industry's rigorous standards, emphasizing the need for staff who not only possess substantial expertise but also demonstrate the potential for further professional development. The industry's

inclination to engage personnel who are both highly skilled and trainable at a significant rate reflects its commitment to continuous improvement and adaptation in a fast-evolving technological landscape.

7. Contribution and concluding remarks

In conclusion, our research contributes significantly to the understanding of project management competencies in the IT industry in several ways: (1) comprehensive competency analysis: by analysing a large data set of job advertisements, our study uncovers the competencies demanded for PMs in the IT industry. This level of detail and breadth was unattainable with smaller datasets, thereby offering a more comprehensive view of the demand side of the market. (2) Diversity of PM profiles: the study identifies nine distinct PM profiles, each with its unique competency requirements. This highlights the diverse range of competencies sought in the market, with strong communication skills being a common thread across all profiles. (3) Methodology for monitoring industry demands: we propose a innovative method for tracking the evolving demands of the IT industry for PMs by analysing job market advertisements. This approach not only provides current insights but also serves as a potential inspiration for future research endeavours. (4) Innovative use of generative AI in data mining: the application of generative AI for data analysis represents an innovative aspect of our research. This approach has enabled the rapid processing of large data sets and the discovery of patterns and correlations that might be less apparent to human analysis.

From a practical standpoint, our study introduces a tool designed for talent management, tailored to bridge the gap between the specific demands of IT firms and the competencies of individual PMs. This tool is not only beneficial for organizations in aligning their recruitment and development strategies with market demands but also offers significant value to individuals aspiring to enter the project management profession. By providing insights into the current competency requirements in the IT industry, it enables prospective PMs to tailor their skill sets accordingly and chart a strategic path for their career development. This dual applicability enhances the utility of our research, making it a resource for both corporate talent management and individual career planning.

The findings of our analysis open several avenues for future research. Given the rapid development and increasing popularity of generative AI, its application in data mining, particularly with large data sets, is becoming more efficient and valuable. Future studies could replicate our methodology to track changes in the IT job market over time, providing comparative insights as the market evolves. Additionally, this approach can be extended to analyse other professional roles, potentially uncovering unique market trends and competency demands in different fields. Moreover, a comparative study incorporating traditional research

methods, such as interviews or questionnaires, could be insightful. Such a comparison would enable a deeper understanding of the market's competency requirements versus the competencies currently possessed by professionals. This could highlight potential gaps in project management education and training, suggesting areas for curricular development to better prepare future PMs for the demands of the IT industry.

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