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AI Product Management Personnel Demand Study - Based on Analysis of Chinese Market Recruitment Information

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ABSTRACT

In the rapid development of artificial intelligence (AI), the demand for AI product managers is increasing. The rapid expansion of the AI market has created a huge demand for talents with "AI+product" backgrounds, but the specific competency standards of AI product managers are still unclear. This study analyzes the recruitment information of Chinese market, combines data mining and statistical analysis methods, and constructs a competency model of AI product manager career including Forward Thinking. It also delves into its job content, types, sources and distribution. The research results not only provide valuable references for job seekers, but also provide guidance for relevant educational institutions in formulating training objectives and curriculum systems. This study fills the research gap in the demand for AI product managers and lays the foundation for the development of talent standards for this emerging position.

Keywords: AI product manager, competency model, professional skills.

INTRODUCTION

What is an AI product manager?

Product managers, are colloquially seen as the general managers of products. They are required not only to understand technology but also to be proficient in business, familiar with finance, and fully grasp the company's strategy. Product managers also need the ability to handle interpersonal relationships between departments (Gorchels, 2003). In the online industry, the functions of product managers are mainly reflected in five aspects: market research and user study, product planning and design, project management, product operation, and market promotion (Wei, 2013). As the overall person in charge of the product (line). Product managers play a crucial role in guiding the creation and management of online products, especially at the intersection of corporate goals, societal values, and ethical standards. They set the strategic direction for the product, orchestrate its development, prioritize key features, and supervise its market introduction (Lev Ari, Roichman, & Toch, 2024). Therefore, they are also known as "miniature CEOs" in teams (Singh 2018).

With the advancement of technology fields such as big data, artificial intelligence, agile frameworks, requirements engineering, data insights, rapid prototyping, A/B testing, and AI business, the means that can be used in product development have become more diverse (Singh, 2018). Currently, companies such as Baidu, SenseTime, and iFlytek are actively engaged in developing AI products, with numerous experts and scholars across various disciplines contributing to the research on artificial intelligence (Cath *et al.*, 2018). The creation of numerous AI products tailored for the Chinese market has not only demonstrated the robust vitality of the AI sector but also highlighted a significant demand for professionals with expertise in both AI and product development.

The position of AI Product Manager is a key role in the development and iteration of AI products, possessing dual attributes of using and developing AI. This requires AI Product Managers not only to have traditional product management skills but also professional knowledge related to AI technology. Since 2022, the AI product market has experienced explosive growth, leading to a significant demand for AI professionals in the human resources market. Current research tends to explore the competencies related to AI technology for product managers, such as exploring how professionals use AI products to unearth user needs (Ogundipe, Babatunde & Abaku 2024), prototype design (Bot, 2023), and the potential in product usability assessments (Ghorbani, 2023). The above research tends more towards exploring competencies related to AI technology, however, under current job market demands, what other competencies should AI Product Managers possess is less studied. In order to understand this problem, this paper introduces the concept of competency model. By mining online recruitment information in China, the detailed competency model and competency factor are constructed for the employment needs of AI product managers. Then, according to the online recruitment information, the job content, types, sources and job distribution of AI product manager are described in detail. Through the above research, this paper provides specific employment requirements for job seekers of AI product managers, and also provides theoretical support for relevant educational institutions to offer courses.

COMPETENCY MODEL FOR PRODUCT MANAGERS

Competency Model

The competency characteristic model refers to a collection of all necessary competencies for a specific position in a particular work context (Spencer & Spencer, 2008). It is a set of work task behaviors outlined according to different industries and positions (Fogg, 1999). A common competency model is the Iceberg Model, which divides competencies into five levels: Knowledge, Skills, Self-concept, Traits, and Motives. Knowledge and Skills are explicit, easily developed through education or training, representing the upper part of the iceberg. In contrast, Traits, Motives, and Self-concept are implicit, stemming from deep individual character and more challenging to develop or change through education and training. They often require identification through selection, representing the lower part of the iceberg. However, Traits and Self-concept, although at the bottom of the Iceberg Model, can still be developed through education, training, and counseling. Building on McClelland's "Iceberg Theory"，American scholar Boyatzis proposed the "Onion Theory Model"（Cao & Zhang, 2022), dividing the competency quality model from the inside out into three layers: core, middle, and peripheral. The core element of the Onion Model includes Motives, Personality, Self-image, Values, Social Roles, Attitudes, Knowledge, and Skills. The core layer is Motivation, the middle layer includes Personality, Self-image, Values, Social Roles, and Attitudes. The outer layer comprises Knowledge and Skills. Le Deist and Winterton from Toulouse Business School, after analyzing and discussing the definitions and applications of competence in countries like the UK, USA, and France, proposed an integrated type of competence for a more detailed and multidimensional clarification of competence (Le Deist & Winterton, 2005), to better synergize educational and work practices (Tang et al., 2018). According to Le Deist and Winterton's description, the required competencies for a profession include Cognitive competence and Functional competence for conceptual understanding and operational function, respectively, as well as Meta competence and Social competence for personal effectiveness, conceptual, and operational abilities. These four dimensions form the overall framework of the typology of competence.

Competence of Product Manager

Contrary to the traditional top-down organizational structure, a product-based organization structure dissolves various functional departments or teams to form multidisciplinary product development teams. These teams, composed of experts from different departments, are united for the shared goal of product creation. In this context, the product manager acts as a coordinator within a multidisciplinary professional work environment, playing a crucial role in integrating cross-functional teams.

Additionally, the product manager is responsible for different objectives at various stages of the product life cycle, planning various activities related to the product to meet user needs. In the early phase, they inspire and define product requirements for users with strong usage motivation, while in the later stages, the focus shifts to maintenance and promotion (Elshaikh, 2019). Product managers, often seen as the mini CEOs of products, engage frequently with both the organization and individuals. Their role can positively impact cross-departmental teamwork and project performance (Rauniar *et al.*, 2008). Therefore, the role of a product manager is of substantial leverage in modern industries. Unsuitable candidates can lead to severe consequences, including incorrect product planning and damage to profits and reputation (Horowitz & Weiden, 2010).

Studies on the competencies of product management personnel have categorized product manager competencies into basic qualities, advanced qualities, specific qualities for product managers, and specific qualities for product managers in high-tech companies (Cheng, Nie, & Gui, 2019). Other studies have summarized the competency model for product manager positions into explicit and implicit factors. Explicit factors include professional ability, skills, professional knowledge, and general knowledge, while implicit factors cover general competence, professional ethics, and role positioning (Gu, 2022). In addition, based on e-commerce companies, product manager competencies have been summarized as professional knowledge, skills, professional ethics, and personal traits (Li, 2023).

In the era of artificial intelligence, the role of product managers is gradually shifting towards technological understanding, market insight, and strategic execution. Product managers need to translate complex AI technology concepts into user-friendly product features, ensuring that technological innovations are not only intuitively usable but also solve real problems. In this process, product managers need to deeply understand the latest developments in AI technology, including advancements in machine learning, natural language processing, and computer vision, as well as how these technologies can help improve efficiency, reduce costs, or create new user experiences. Therefore, analyzing the competencies and abilities of AI product managers in the current environment is the primary focus of this study.

Data Acquisition and Processing

Method

To understand the general role categories and required competencies of AI product management personnel in practice, the study used the competency characteristic model of internet product managers as the final coding scheme framework (Lin, 2016). It employed Braun and Clarke's thematic analysis method (Braun & Clarke, 2006)to examine recruitment information. Thematic analysis is suitable for processing large amounts of text material without losing context (Lapadat, 2010).

Data Extraction

This research selected the domestic online industry platform BOSS Zhipin as the data source. A Python script was written to create a web scraper tool. The scraper collected the latest job postings with the title "AI Product Manager" from BOSS Zhipin between January 16, 2024, and January 18, 2024. After removing part-time and internship positions, a total of 120 formal job postings were obtained. Following data cleaning steps, such as handling outliers and missing values, splitting operations, and unifying data formats, 110 job postings were retained. Each job posting contained structured fields, including job title, city,

company field, company size, company development stage (financing situation), minimum salary, maximum salary, minimum years of experience required, minimum educational requirements, and job description.

Data Analysis and Results

Job Content Analysis

In assessing the reliability and relevance of the results, a deeper content analysis of the dataset is conducted to understand the semantics of the original text in the dataset. The first step is to extract thematic words related to AI product managers. Using the Jieba library in Python, all text related to AI product manager positions is segmented and stopwords are removed before part-of-speech tagging. All nouns are extracted and their frequency is counted. Nouns with a frequency greater than 5 are selected as candidate thematic words. After manually filtering out irrelevant candidates, the remaining ones are used as thematic words for AI product managers. The formula for word frequency calculation is as follows:

$$tf_{t,d} = \frac{f_{t,d}}{n_d} \tag{1}$$

In this context, $tf_{t,d}$ represents the frequency of term t in a specific document d. $f_{t,d}$ denotes the count (frequency) of the feature term in document d, while n_d represents the total number of terms in document d. After obtaining the term frequency for each term, the inverse document frequency for each term is calculated, thereby determining the importance of each term within the documents:

$$idf_t = log\frac{N}{df_t} \tag{2}$$

idf_t is the inverse document frequency of term t, N is the number of all documents, and df_t is the document frequency, representing the number of all documents in which term t appears.

Finally, in order to evaluate the importance of each term to each document in the document set, the $tfidf$ (Ramos, 2003) value of each term is obtained, and the calculation formula is as follows:

$$tfidf = tf * idf \tag{3}$$

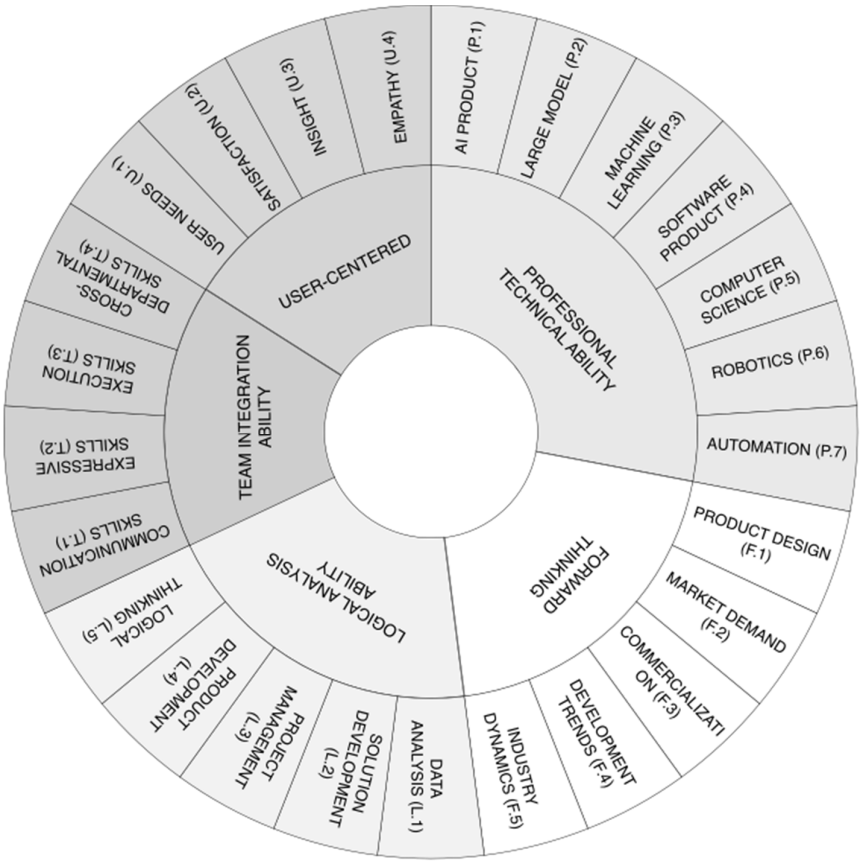
Through literature analysis, we classified the competency factors of practitioners into team integration ability, professional technical ability, forward-thinking, user-centered thinking, and logical analysis ability. For details, see the following table.

Table 1. Factors of competency model for AI product managers

Factor	Description
Team Integration Ability	Describes the integrative role of a product manager in cross-functional teams, including task and resource allocation, team motivation, and effective handling of interpersonal relationships. This is a critical determinant of a product manager's competence.
Professional Technical Ability	Relates to computer-related technologies and agile development methods, design methods, and business skills that are widely applied in product development processes and are considered essential professional capabilities for product managers.
Forward Thinking	Refers to a clear understanding of the strategic significance of each feature and technology within a product and the ability to clearly position the company and product in the industry. It is the capacity to grasp future directions.
User-Centered Thinking	Involves having keen insight, observing or anticipating scenarios and interactions of users with the product through user research methods, accurately extracting key needs, and prioritizing requirements in need management.
Logical Analysis Ability	Involves using data analysis to deconstruct problems and the ability to express and reproduce the thought process logically, either verbally or in writing.

Source: This study.

$tfidf$ values are used to map the importance of various competencies, grouping the collected thematic words as sub-topics under corresponding competency categories. The categories and their associated competencies are as follows:



Source: This study.

Figure 1. Competency factors of AI product managers

Table 2 Word Frequency Information

Word Frequency	Keywords
> 30	Project Management (34, $tfidf$ =0.22), Solution Development (36, $tfidf$ =0.23), Data Analysis (42, $tfidf$ =0.27), User Needs (47, $tfidf$ =0.32), AI Product (57, $tfidf$ =0.42), Product Design (70, $tfidf$ =0.51)
15~30	Development Trends (17, $tfidf$ =0.14), Logical Thinking (17, $tfidf$ =0.14), Expressive Skills (18, $tfidf$ =0.14), Commercialization (18, $tfidf$ =0.14), Machine Learning (20, $tfidf$ =0.15), Market Demand (20, $tfidf$ =0.15), Large Model (25, $tfidf$ =0.18), Communication Skills (27, $tfidf$ =0.19), Product Development (28, $tfidf$ =0.19)
<15	Empathy (6, $tfidf$ =0.07), Robotics (7, $tfidf$ =0.08), Automation (7, $tfidf$ =0.08), Software Product (9, $tfidf$ =0.09), Insight (9, $tfidf$ =0.09), Computer Science (10, $tfidf$ =0.10), Satisfaction (10, $tfidf$ =0.10), Industry Dynamics (12, $tfidf$ =0.11), Execution Skills (14, $tfidf$ =0.12), Cross-departmental Skills (14, $tfidf$ =0.12)

Source: This study.

Table 2 shows the five main themes reflecting the job requirements of practitioners in the industry. The top three competencies are Product Design Ability (F.4), AI Product Professional Ability (P.1), and User Needs (U.5). Employers focus most on Communication Skills (T.1) and Expressive Skills (T.2) in the Team Integration Ability category. AI Product (P.1) and Large Model (P.2) in the Professional Technical Ability category. Product Design (F.1) and Market Demand (F.2) in the Forward-thinking category. User Needs (U.1) and Satisfaction (U.2) in the User-centered Thinking category, and Data Analysis (L.1) and Solution Development (L.2) in the Logical Analysis Ability category.

Overall, the distribution of competencies in the Logical Analysis Ability category is more even, with relatively smaller differences in percentages. In contrast, the Forward-thinking category shows larger variances, indicating the need for practitioners to not only consider current technical capabilities and user needs but also anticipate future technological directions and potential market changes. Especially in the AI field, the rapid changes in development trends and industry dynamics demand that product managers possess a high degree of foresight and adaptability. Practitioners are required to continually update their knowledge and maintain sharp insights into emerging technologies and market shifts.

In the User-centered Thinking category, employers place significant importance on practitioners' ability to uncover user needs, with this skill highly prioritized over others. This requires product managers to have a deep understanding of user thinking, viewing problems from the users' perspectives, and grasping their genuine thoughts and underlying needs.

Job type analysis

This study initially analyzed the "Job Title" field data from Lagou website, identifying five distinct AI product management positions. It is noteworthy that some job titles, such as "AI Product Partner" and "Senior AI Product Manager"， may overlap. However, due to significant differences in salary and experience/education requirements, they are treated as separate positions. The study first explored the relationship between experience and educational requirements and salary. Correlation analysis revealed a moderate relationship between the minimum years of experience required and both the minimum salary ($r = 0.502^{**}$) and maximum salary ($r = 0.470^{**}$). Furthermore, the Kruskal-Wallis non-parametric test results indicated significant differences in the minimum salary ($H = 20.161$, $p < 0.01$), maximum salary ($H = 16.311$, $p < 0.01$), and minimum educational requirements ($H = 18.221$, $p < 0.01$) among different experience levels.

Specifically, positions requiring a minimum of a doctoral degree offered significantly higher minimum and maximum salaries (Minimum: MD = 35.0, Maximum: MD = 60.0) compared to those with no educational requirement (Minimum: MD = 9.5, Maximum: MD = 15.5), bachelor's degree (Minimum: MD = 20.0, Maximum: MD = 30.0), and master's degree (Minimum: MD = 20.0, Maximum: MD = 35.0).

Regarding minimum salary requirements, positions with no age limit offered significantly lower minimum salaries than those requiring 1 year (MD = -0.5), 3 years (MD = -5), 5 years (MD = -20), and 10 years (MD = -45) of experience. Overall, the primary educational requirement for AI product management positions is a bachelor's degree. There are no significant differences in minimum salary for candidates with a bachelor's or master's degree, but the maximum salary tends to be higher for those with a master's degree.

Competency analysis of different qualifications

In investigating the expectations of companies for AI product managers following different stages, a comparison was made based on the seniority level of the advertised positions, dividing the advertised positions into 3 categories, junior, mid-level, and senior positions, which are based on the prescribed salary level and expected work experience for each position, as shown in Table 3. In addition, temporary positions (freelancing, internships) have been eliminated, and a total of 108 qualification levels for job postings have been established: 2 entry-level positions, 2 mid-level positions and 1 senior position. By analyzing the job distribution, an independent Chi-square test was performed for each subtopic. In order to more clearly present the capabilities required by AI product managers at different stages, the intersection of words for beginning, middle and senior product managers is made. It is found that the beginning, middle and advanced user experience designers have certain overlapping abilities, including product design (F.1) thinking, AI product (P.1) ability, data analysis (L.1), project management (L.3), and execution (T.3). Obviously, these abilities are necessary at different stages.

Table 3. Current position title and salary of AI product management

Seniority	Position Title	Monthly Salary (RMB)
Junior	AI Product Manager	￥20,000 -￥28,000
Junior	Senior AI Product Manager	￥17,500 -￥30,000
Mid-level	AI Product Partner	￥47,500 -￥75,000
Mid-level	AI Product Specialist	￥50,000 -￥72,500
Senior	AI Product Director	￥62,500 -￥92,5000

Source: This study.

Table 4 represents the ability ratio of different AI product managers at the Junior, middle and senior levels. In terms of product design (F.1), there are more requirements for entry-level AI product manager positions (0.049) than senior (0.048) and intermediate AI product manager positions (0.029). In terms of AI product (P.1) capabilities, mid-level AI product manager positions (0.044) have fewer requirements than senior (0.036) and junior AI product manager positions (0.039). In the area of data analysis (L.1), the requirements for entry-level (0.034), intermediate (0.025) and senior (0.015) positions are gradually reduced. In project management (L.3), the requirements for senior positions (0.027) are higher than for junior (0.022) and mid-level (0.014) positions. In terms of executive ability (T.3), the requirements for senior positions (0.015) are higher than those for intermediate positions (0.014) and junior positions (0.011), but the overall difference is not obvious.

Table 4. Ratio of required abilities for each AI product management position

Position	Product Design	AI Product	Data Analysis	Project Management	Executive Ability
AI Product Manager	0.044	0.043	0.032	0.027	0.013
Senior AI Product Manager	0.053	0.035	0.035	0.018	0.010
AI Product Partner	0.013	0.037	0.022	0.013	0.013
AI Product Specialist	0.045	0.050	0.028	0.016	0.016
AI Product Director	0.048	0.036	0.015	0.027	0.015

Source: This study.

Job source analysis

Next, the study analyzes job sources based on the three fields of "the field of the enterprise", "the scale of the enterprise" and "the development stage of the enterprise". The field of each enterprise appears in the form of labels in the enterprise introduction. Some enterprises add multiple field labels, but the label ordering may reflect the degree of involvement of enterprises in various fields. Therefore, this study focuses on the analysis of the first field label of each enterprise, and finds that the two fields of "Internet" and "computer software" appear most frequently, and these are also hot fields in the current AI application development industry.

In addition, BOSS Zhipin divides the size of the enterprise into six levels: 0-20 employees, 20-99 employees, 100-499 employees, 500-999 employees, 1000-9999 employees, and more than 10,000 employees. The enterprise development stage mainly refers to the current financing situation of the enterprise, which is divided into no financing, unfinancing, angel round, A round, B round, C round, D round and above and listed companies, reflecting different levels of enterprise strength, See table 5 for details.

Table 5. Distribution of enterprise development stages

Enterprise Size Distribution Map	
Scale of Company	
0-20	8%
20-99	23%
100-499	25%
500-999	9%
1000-9999	14%
Over 10000	21%
Enterprise Development Stage Distribution Map	
Stage	
Blank	12%
Series A financing	8%
Series B financing	7%
Series C financing	3%
Round D and above	4%
No need for financing	24%
Angel wheel	8%
Unfunded	12%
Have been listed	22%

Source: This study.

The data results show that the smallest proportion of recruitment is by micro-enterprises with fewer than 20 people (8%). Enterprises with sizes of 20-99 people (23%), 100-499 people (25%), and over 10,000 people (21%) have the highest proportions. In terms of enterprise development stages, companies that are publicly listed (22%) and those that do not require financing (24%) have the highest proportions of job postings. Companies in Series C funding (3%) and Series D and above (4%) have the least number of job postings.

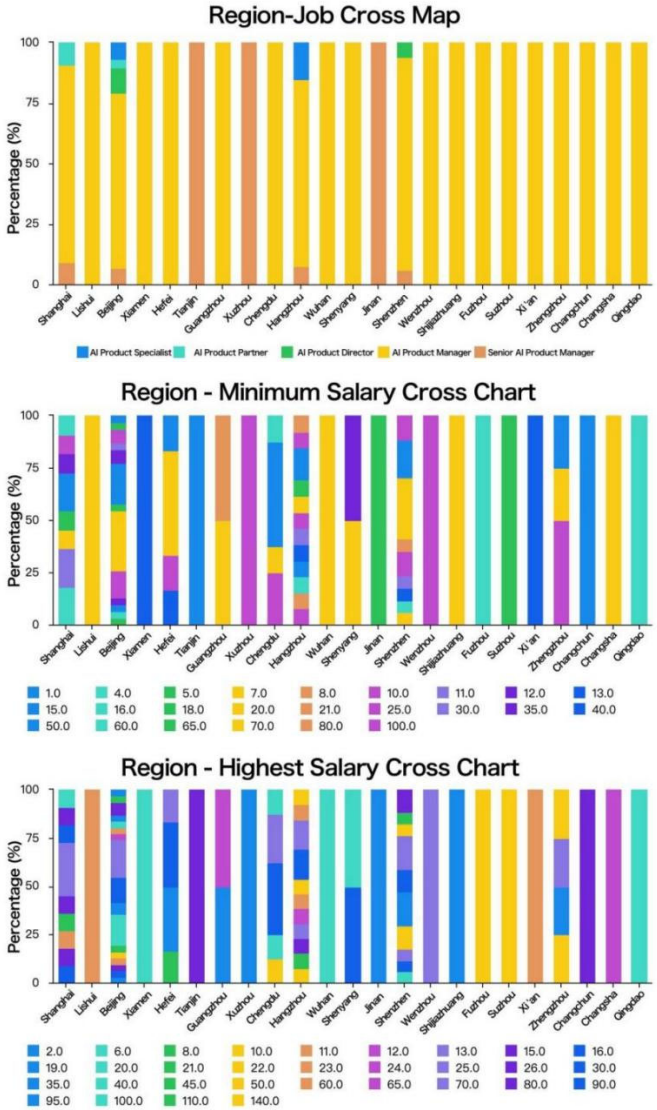
Job distribution analysis

The location of work is one of the important aspects that job seekers consider when choosing a career. The study then analyzes the urban distribution of all jobs. Firstly, Chi-square test was conducted for job categories and cities. The results showed that there was a significant correlation between different job categories and cities ($x^2 = 1318.568$, $p < 0.01$). Beijing (31), Shenzhen (17), Hangzhou (13) and Shanghai (11) had the highest demand for AI product managers. Among them, Beijing has the most types of demand for AI product managers, followed by Shenzhen, Hangzhou and Shanghai. The Chi-square test of wage and city shows that there is a significant correlation between minimum wage and city ($x^2 = 648.633$, $p < 0.01$). The average minimum salary and average maximum salary in Shanghai and Beijing rank among the top 2 in China.

Table 6. Salary information

City	Average Minimum Salary (RMB)	Average Maximum Salary (RMB)	Median Minimum Salary (RMB)	Median Maximum Salary (RMB)
Beijing	27,579	42,053	20,000	30,000
Shenzhen	15,381	24,048	15,000	25,000
Shanghai	31,071	49,786	22,500	40,000
Hangzhou	20,786	32,143	19,000	27,500
Hefei	26,667	40,500	22,500	40,000
Chengdu	25,556	44,444	25,000	40,000
Zhengzhou	15,000	24,600	15,000	20,000

Source: This study.



Source: This study.

Figure 2. Comparison of working area with lowest salary and highest salary

CONCLUSION

This study examines AI product management roles across various job categories, qualifications, sources, and cities on recruitment websites, utilizing a competency model to analyze the demand for AI product management positions in China. It unveils specific duty requirements in this burgeoning field. In the current job market, product design ability (F.4)—understanding and leveraging design thinking to craft market-responsive and user-aligned products—is highly prized. Moreover, as the role of AI product managers evolves, employers increasingly value deep technological understanding and the professional capability to manage AI products (P.1), assessing these as critical metrics in recruitment. AI product managers must adeptly understand and adapt to user needs (U.5), ensuring products address genuine user problems effectively.

Furthermore, in their role akin to mini-CEOs, product managers' effectiveness in team integration and collaborative efforts hinges critically on their communication (T.1) and expressive (T.2) skills. These skills are imperative to navigate products from the design stage through to successful implementation. Additionally, the significant emphasis on data analysis (L.1) within the logic analysis skillset underscores its importance, as it enables product managers to monitor product performance, comprehend user behaviors, and forecast market trends. This analytical prowess forms the foundation upon which product managers evaluate potential solutions to derive optimal outcomes (L.2).

The article then conducts research on product manager positions in the current job market and finds that recruiting companies mainly recruit junior, mid-level and senior product managers with a bachelor's degree or above. But the emphasis on capabilities differs among the junior, middle and senior levels. Junior Product Managers are expected to have a strong focus on product design (F.1) and data analysis (L.1), while mid-level Product Managers prioritize AI product abilities (P.1). For senior Product Managers, project management (L.3) skills are more important. Nevertheless, all three levels of candidates are required to possess strong execution skills (T.3).

There are significant variations in the recruitment of AI Product Managers across enterprises of different sizes and development stages. Large enterprises (with over 10,000 employees) and stable enterprises (listed/ not requiring further funding) tend to recruit more such professionals to drive continuous business innovation and growth. However, enterprises in later investment stages (round C, round D) may reduce their demand for this position due to shifts in strategic priorities or optimization of capital usage. These trends reflect the changing market demand for professional AI Product Management abilities and also indicate that career planners should consider the characteristics of the enterprise when seeking employment. Additionally, small and medium-sized enterprises (with 20 to 499 employees) require the participation of AI Product Managers during their product line expansion and product competitiveness enhancement, reflecting the reliance of enterprises on professional talent in terms of technology and market demand during their development. In terms of job categories and locations, Beijing, Shenzhen, Hangzhou, and Shanghai have a higher demand for AI Product Management personnel. Among them, Beijing offers the most diverse range of job positions. Similarly, there is a significant correlation between salary levels and cities, with developed cities like Beijing and Shanghai offering higher salaries than other cities.

The above study provides valuable insights into the job market by analyzing in detail the changing demand for AI product management positions. This not only helps job seekers and career planners better understand industry trends, but also provides important guidance for companies in recruitment strategies and talent development. The current article should also have some limitations. First of all, the collection of artificial intelligence product management positions is too small. Since AI product management is an emerging profession, there is not much demand in the current recruitment market. This limits the sample size of the study, which may affect the broad applicability and depth of the findings. Second, the current study is limited to the Chinese market, and there may be significant differences in the demand for AI product managers in different regions of the world, including skill requirements, salary levels, and responsibilities. Expanding research into global markets may provide more comprehensive and in-depth insights. Given these limitations, follow-up studies could improve the comprehensiveness and applicability of the study by expanding the data collection, for example to include more job information for countries and regions. The proposal of this study is of great significance for relevant AI product management training and related practitioners, providing effective insights for course development and career planning in this field.

REFERENCES

Bot, Y. (2023, August). New trends in testing electronic products by simulation during design, using programmable rules, circuit analysis and AI. In *2023 IEEE AUTOTESTCON* (pp. 1-8). IEEE. 10.1109/AUTOTESTCON47464.2023.10296198

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Cao, C., & Zhang, Z. (2022). Machine Learning-Assisted Competency Modeling for Human Resource Management Jobs. *Mobile Information Systems*, *2022*(1), 8380307. https://doi.org/10.1155/2022/8380307

Cath, C., Wachter, S., Mittelstadt, B., Taddeo, M., & Floridi, L. (2018). Artificial intelligence and the 'Good Society': The US, EU, and UK approach. *Science and engineering ethics*, 24, 505-528. https://doi.org/10.1007/s11948-017-9901-7

Cheng, D., Nie, S., & Gui, Q. (2019). Research on the competency model construction for product managers in high-tech enterprises under the background of artificial intelligence. *China Management Informationization,* 22(08), 74-75. Retrieved from https://wenku.baidu.com/view/8799ca7188eb172ded630b1c59eef8c75ebf9538?fr (in Chinese).

Elshaikh, A. (2019). Research about product phase-out strategy practices in the Swedish software market: Case study of software product managers in Sweden. Retrieved from https://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-456528

Fogg, C. D. (1999). *Implementing your strategic plan: How to turn" intent" into effective action for sustainable change*. AMACOM/American Management Association.

Ghorbani, M. A. (2023). AI tools to support design activities and innovation processes. Retrieved from http://webthesis.biblio.polito.it/29710/

Gorchels, L. (2003). Transitioning from engineering to product management. *Engineering Management Journal*, *15*(4), 40-47. https://doi.org/10.1080/10429247.2003.11415224

Gu, X. (2022). *Construction of competency models based on text mining and optimization of corporate recruitment* (Master's thesis).

Horowitz, B., & Weiden, D. (2010). Good product manager/Bad product manager. *Adv. Res. Econ. Manage. Sci*, *15*, 627-633.

Lapadat, J. C. (2010). Thematic analysis. *Encyclopedia of case study research*, *2*, 925-927.

Le Deist, F. D., & Winterton, J. (2005). What is competence? *Human resource development international*, 8(1), 27-46. https://doi.org/10.1080/1367886042000338227

Lev Ari, E., Roichman, M., & Toch, E. (2024, May). Strategies of product managers: Negotiating social values in digital product design. *In Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1-17). https://doi.org/10.1145/3613904.3642409

Li, G. (2023). Construction and application of competency quality model for product managers at Q E-commerce company (Master's thesis). (in Chinese).

Lin, T. (2016). Constructing a competency-based prediction model for Internet product managers using social network data [Master's thesis, Tsinghua University]. (in Chinese).

Ogundipe, D. O., Babatunde, S. O., & Abaku, E. A. (2024). AI and product management: A theoretical overview from idea to market. *International Journal of Management & Entrepreneurship Research*, 6(3), 950-969. https://doi.org/10.51594/ijmer.v6i3.965

Ramos, J. (2003). Using tf-idf to determine word relevance in document queries. *In Proceedings of the first instructional conference on machine learning* (Vol. 242, No. 1, pp. 29-48).

Singh, M. (2018). Product managers for artificial intelligence and robotic world. *International Journal of Science, Engineering and Computer Technology, 8*(2-4), 68-73. Retrieved from https://www.proquest.com/scholarly-journals/product-managers-artificial-intelligence-robotic/docview/2213052471/se-2

Spencer, L. M., & Spencer, P. S. M. (2008). *Competence at Work models for superior performance*. John Wiley & Sons.

Wei, M. (2013). Research on the functions of product managers in the Internet industry. (Master's thesis). Beijing University of Posts and Telecommunications. (in Chinese).