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Article

Research on the Composition of Talent Competencies for Digital Transformation of Industrial Enterprise Management

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Abstract: Management digital transformation is a necessary path for industrial enterprise management upgrading. But industrial enterprises can implement the management of digital transformation and upgrading of the number of talents required for the level and quality level is relatively low, which largely limits the speed and process of China's industrial enterprises management of digital transformation road. Focusing on the direction of digital transformation of industrial enterprise management, considering the reasons for the shortage of talents for management digital transformation needs, starting from the four aspects of comprehensive ability, professional knowledge, technical skills, engineering practice, the establishment of a digital talent training system for management, the division of talent competency level, aiming at the digital upgrading of industrial enterprises to provide the talent competency and job setup standards for the enterprise to cultivate with management and digital knowledge to provide the direction. The aim is to provide standards for talent ability and job setting for the digitalization upgrade of industrial enterprises, and to provide directions for enterprises to cultivate compound talents with management and digital knowledge.

Keywords: digital transformation; talent development; management digitization; composite talent

1. Introduction

In recent years, the State Council, the Ministry of Industry and Information Technology (MIIT) and local governments have introduced a series of policies and measures to promote the digital transformation of enterprises. For the digital transformation of small and medium-sized enterprises (SMEs), Shi Yupeng [1] and others mentioned in their research that the difficulties of digital transformation of SMEs include "insufficient digital knowledge reserves of management and employees", and the focus is on "solving the talent problem in a variety of ways". Zhu Wenmei [2] scholars in the digital development path of state-owned enterprises pointed out that the digital talent team is an important guarantee for the realization of the digital transformation of state-owned enterprises, enterprises should do a good job in the recruitment of external talent and internal talent training focus. Zhu Wenjing scholars pointed out [3], for small and medium-sized enterprises, talent structure, organizational structure and other aspects of adaptive adjustment is closely related to the digital transformation of enterprises, if the talent, organizational adaptive adjustment can not be followed up, the digital transformation of enterprises will be greatly hindered. The State Council's "14th Five-Year" Digital Economy Development Plan and the Ministry of Industry and Information Technology's "Guide to Digital Transformation of Small and

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Medium-sized Enterprises" both emphasize that digital talent is the core element to crack the "can't turn" and "don't dare to turn" conundrum. The core elements of the difficult problem. It can be seen that the shortage of digital transformation talent is a major barrier on the road of enterprise digital transformation. Liu Junmei and Tao Limin [4] scholars believe that the update of the education concept and training mode of universities, as well as the construction of the social system is to grasp the opportunities for the development of digital talent key initiatives. In addition, many scholars focus on overseas countries and enterprises [5, 6], research and interpretation of the digital capacity of other enterprises, and based on this, summed up the effective countermeasures for the training of digital talents suitable for the characteristics of China's enterprises. After summarizing the above research can be found, from the current education system, the main reasons for the shortage of digital transformation composite talents are:

(1) The singularity of talent training objectives leads to a mismatch between talent capabilities and enterprise digital transformation needs;

(2) The disciplinary barriers have not been broken, and the knowledge structure and practice content are based on a single discipline and training;

(3) The curriculum content lags behind, and the digital transformation demand is limited.

Comprehensive view, academic research on the training of talents for digital transformation of industrial enterprises is relatively small, the lack of a complete set of "training-assessment-improvement" digital talent training system, IE and IT theoretical system of digital talent training system is even less. There are even fewer digital talent training systems that combine the theoretical systems of IE and IT.

2. Managing Digital Transformation Meanings

In the deepening stage of digital transformation, enterprise management digitalization has been upgraded from the application of tools to systematic change. Management digitization emphasizes management thinking as the kernel, through digital technology empowerment to achieve operational efficiency leap. At present, although industrial enterprises have access to advanced technology, there is a lack of composite talents who "understand management + technology", and the phenomenon of "two skins" often occurs when technology and processes are disconnected.

Adhering to the idea that "the digital transformation and upgrading of industrial enterprises needs to be oriented to management, led by industrial enterprises, and integrate digital technology with management theory", we introduce the professional knowledge system of industrial engineering, systematically strengthen and complete the knowledge of talents in management and technology, and set up the talent ability and job standards for the digitalization of industrial enterprise management. It helps enterprises to cultivate compound talents with both management and digitalization capabilities.

3. Definition of Talent Competencies Required to Manage Digital Transformation

3.1. Digital transformation Talent Capabilities

The essence of digital transformation is to realize the systematic upgrading of management through digital technology, and its core lies in the deep integration of management ideas and digital tools. In the rapid iteration of technology, but the management of the value of the transformation of the contradiction lags behind, enterprises are in urgent need of both lean management, industrial engineering (IE) program and other methodologies, but also master the data modeling and system architecture technology of the composite talent. However, the technical ability can be acquired through training, but the management thinking needs to be long-term practice accumulation, IT talent is stronger than technology but lack of industrial site knowledge, IE talent is good at management but weak in the application of digital technology, the disciplinary barriers lead to digitalization projects are often caught in the technical solutions and business needs of the misalignment of the predicament.

Industrial engineering (IE) has the advantages of strong synthesis, multidisciplinary integration, engineering method orientation, and strong practicability, which is an important technical and theoretical support for

industrial enterprise management. From the point of view of IE and IT training programs and curricula in China's colleges and universities, the IE professional training system pays more attention to the cultivation of students' systematic thinking, interdisciplinary integration, and management ability, etc., which prompts students with IE background to be more prominent in the overall view, interdisciplinary integration, and management perspective than those with IT background; however, the cultivation of the IE knowledge system is comprehensive but not precise, and the cultivation of its special IT knowledge is slightly weaker. Weakness in the cultivation of IT-specific knowledge [7,8].

In order to meet the management upgrading under the digital transformation of industrial enterprises, enterprises need the support of IT and IE talents, but the difference in disciplines leads to the problem of cognitive bias between the two types of talents in the practice of digital transformation. As a result, it is proposed to combine information technology (IT) and industrial engineering (IE) to establish a management digital talent training system, break the cognitive barriers between IT and IE, improve the comprehensiveness and completeness of digital talent training, and meet the needs of digital transformation of enterprises. The knowledge of IE can supplement the thinking and management ability of management digital talents, and help the digital transformation talents to realize the effective combination of the manufacturing site and digital technology, while the knowledge of IT can supplement the data of the talents. IE knowledge can supplement the thinking and management ability of management digital talents, and help digital transformation talents realize the effective combination of manufacturing site and digital technology, while IT knowledge can supplement their data modeling and intelligent algorithm development ability, and provide a technical realization path for process optimization.

3.2. Managing Digital Transformation Talent Competency Structures and Knowledge Systems

3.2.1. Managing Digital Talent Determination Principles

"Knowing, believing and acting" incorporates 'believing' on the basis of Wang Yangming's theory of 'unity of knowledge and action' [9]. From the perspective of cognitive sequence, knowing, believing, and acting are not linear progression, but the deepening of cognition is promoted through dialectics, knowledge strengthens the belief through practice, and the belief feeds the exploration of new knowledge and practical innovation, which forms the internal and external cognitive double cycle and promotes the learner's cognition and mastery of the things (as in Figure 1). "Knowing" refers to knowing about knowledge; 'Believing' refers to believing in knowledge, establishing correct cognition, and internalizing it into insights; 'Acting' refers to action and practice. This logic echoes Katz's model of managerial skills, in which managers at the grassroots level rely on technical skills-acting, those at the middle level focus on interpersonal skills-knowing, and those at the top level need conceptual skills-believing, which together constitute the cognitive component of managerial competence progression. Together, they form the cognitive foundation for the advancement of management skills. In the digital transformation scenario of industrial enterprises, talents with different cognitive paths are matched with differentiated management:

Grassroots managers: Knowing → Acting → Believing is the cognitive path. This type of talent can internalize knowledge into beliefs and concepts through practice in the actual work, but they are easy to be low-skilled, so they are more suitable for training as field-level management talents.

Middle-level managers: Actions→knowledge→belief as the cognitive order, with a certain management ability and strong action, but management ideas and concepts are slightly deficient, need to master knowledge and establish concepts through practice, easy to limit the development of cognitive level, lack of high-level talent of the overall situation and strategic view, more suitable for the training of management personnel as a business-level management personnel;

Senior managers: those who take faith→action→knowledge as the order of cognition have the quality of overcoming difficulties and innovation, have strong faith, have a global view and a strategic view, and are able to discover and master new knowledge with the support of faith and action, which is more suitable for training as management talents.

The essential law of digital talent training is to forge "digital arms and legs" based on technical implementation at the grassroots level, cultivate "digital nerves" based on systematic thinking at the middle level, and shape "digital brain" based on strategic beliefs at the top level. The top management takes strategic beliefs as the nucleus to shape the "digital brain". The layered training mechanism not only follows the law of cognition, but also meets the demand for competence advancement, providing a talent support framework for cracking the pain points of digital transformation, such as strategic overhang and faulty execution.

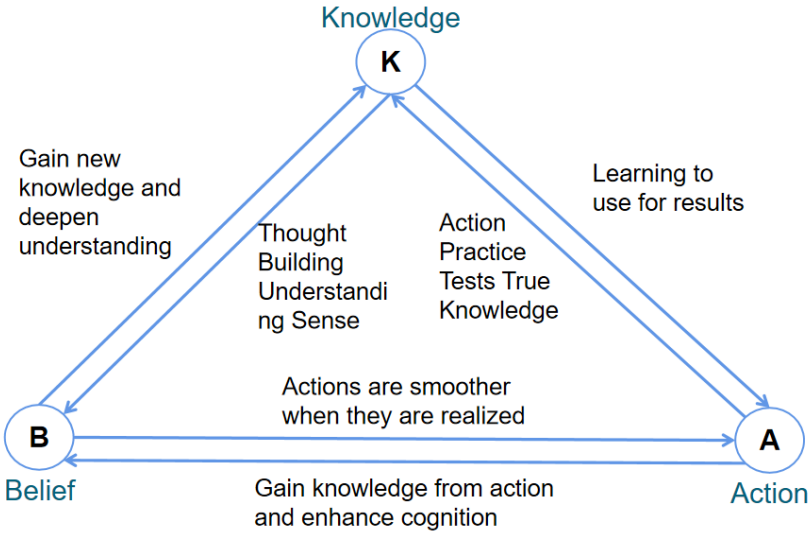

Figure 1. Mechanism diagram of the relationship between knowledge, belief and behavior.

3.2.2. Talent Competency Definition

Digital transformation requires talents to form a competency structure of "technical experts who understand business and business talents who understand technology". Facing the dual challenges of technology iteration and business complexity, the ability of digital talents is deconstructed into a 4-dimensional model: comprehensive ability is the underlying qualities to cope with the dynamic environment, covering learning adaptability, cross-discipline communication, and the ability to analyze business scenarios; professional knowledge builds a cognitive framework, bridging the cognitive gap between management and technology, including the industry standard, general knowledge of safety regulations, IE and IT monographs, etc., and technical skills focusing on the application of digital tools. Technical skills focus on the application of digital tools, including data analysis, software development and other skills, emphasizing the ability to transform theory into solutions; engineering practice to measure the ability to implement the project, through the accumulation of experience in the whole process of demand analysis, system design to value delivery. The four-dimensional capabilities form a two-way strengthening of cognitive + practical closed loop, through the professional depth and cross-border integration, to crack the traditional talent training of technology suspension and ability to break the dilemma.

Differentiated training for different levels of talents based on job characteristics. Field-level talents build their foundation with professional knowledge, focusing on mastering industrial engineering standards and digital tools to ensure that technology is put into practice; operation-level talents strengthen engineering practice and enhance systematic problem-solving ability based on existing professional knowledge; and management-level talents deepen strategic thinking and enhance the top-level design ability of digital construction through complex project management and professional knowledge iteration.

The layered training mechanism not only follows the law of capability development, but also meets the management advancement needs of the field layer, where the standard execution of the field layer is precipitated into the practice foundation of the operation layer, and the strategic decision-making ability of the operation layer is sublimated through the integration of the first two layers of capabilities, which ultimately forms a three-dimensional capability matrix to support the digital transformation of the enterprise. 4-dimensional model

breaks through the boundaries of disciplines, integrates the IE systematic methodology with the IT technology, which makes up for the technical shortcomings of the traditional IE talents, and gives the IT talents management thinking, and also gives the IT talents management thinking. The 4-dimensional model breaks through the disciplinary boundaries and integrates IE system methodology with IT technology, which not only makes up for the technical shortcomings of traditional IE talents, but also empowers IT talents with managerial thinking, cultivates a new type of digitalization leader who is well versed in the language of management and the logic of technology, and realizes the change from tool application to management.

3.2.3. Definition of Competency Dimensions under Talent Levels

Bloom's theory of classification of educational objectives classifies learning objectives in the cognitive domain into memorization, comprehension, application, analysis, evaluation and creation [10], providing a systematic framework for teaching design and effect evaluation. Following Bloom's theory, on the basis of the 4-dimensional competence of talents, the competence of talents is divided into three levels of beginner, intermediate and advanced according to the needs of talents, and combined with the elements of competence, the digital talents of different levels are positioned in terms of their competence and responsibilities. In the process of leaping from industrial civilization to digital civilization, the enterprise has evolved into a digital life form with evolutionary ability, and the construction of its neural network requires the integration and development of digital talents and organizational levels. In order to realize the goal of digital technology penetration of production relations, the junior, middle and senior digital talents correspond to the enterprise grass-roots managers, middle managers and senior managers respectively.

Beginning, middle and senior management digital talents of their corresponding positions, responsibilities determine the degree of mastery of the three dimensions of the 4-dimensional capabilities of each dimension of the ability to focus on the division of knowledge capabilities for the beginning, middle and senior talents.

(1) Comprehensive ability.

As grassroots managers, the core of junior management digital talents is to ensure the physical implementation of digitalization through communication, coordination and execution, so they focus on the development of basic communication, teamwork and task execution capabilities at the executive level, and have a sense of responsibility, learning ability and stress resistance.

Intermediate management digital talents have the ability to manage both upper and lower levels, emphasizing risk prediction and strategic awareness in project operation, while combining the abilities of junior management digital talents.

Senior management digital talent focuses on the development of overall coordination ability, including strategic decision-making, business negotiation, and the enhancement of emotional quotient and adversity quotient.

(2) Expertise is divided on the basis of ease of knowledge understanding and application.

Elementary management digital talents need to master the basic principles of digital architecture design, and be able to use basic algorithms to solve on-site problems.

Intermediate management digital talents are the same as junior management digital talents in mastering and designing digital algorithms and structure development methods, with the difference that they need to deepen their digital transformation ability and focus on the application of advanced knowledge in architecture design.

Senior management digital talents focus on management digital ideology training, focusing on the whole system digital construction, requiring proficiency in enterprise strategy management, with platform architecture design and implementation capabilities.

(3) Technical skills: divided by the ability to apply engineering, office software operation, and methodology practice.

Elementary management digital talents need to be skilled in the application of digital system analysis methods, with the ability to diagnose basic problems.

Intermediate management digital talents need to break through the primary ability to cultivate systematic architecture construction thinking, break through the limitations of a single technology application.

Senior digital talents master decision support tools, strengthen the digital ecosystem construction technology application.

(4) Engineering practice: engineering practice ability is reflected in the primary focus on task execution, intermediate strengthening of system management, and senior focus on strategy implementation, through the integration of the first three elements of ability, and practical verification of the ability to achieve the degree of each level.

Based on the above, the talent cultivation capability model is shown in Figure 2.

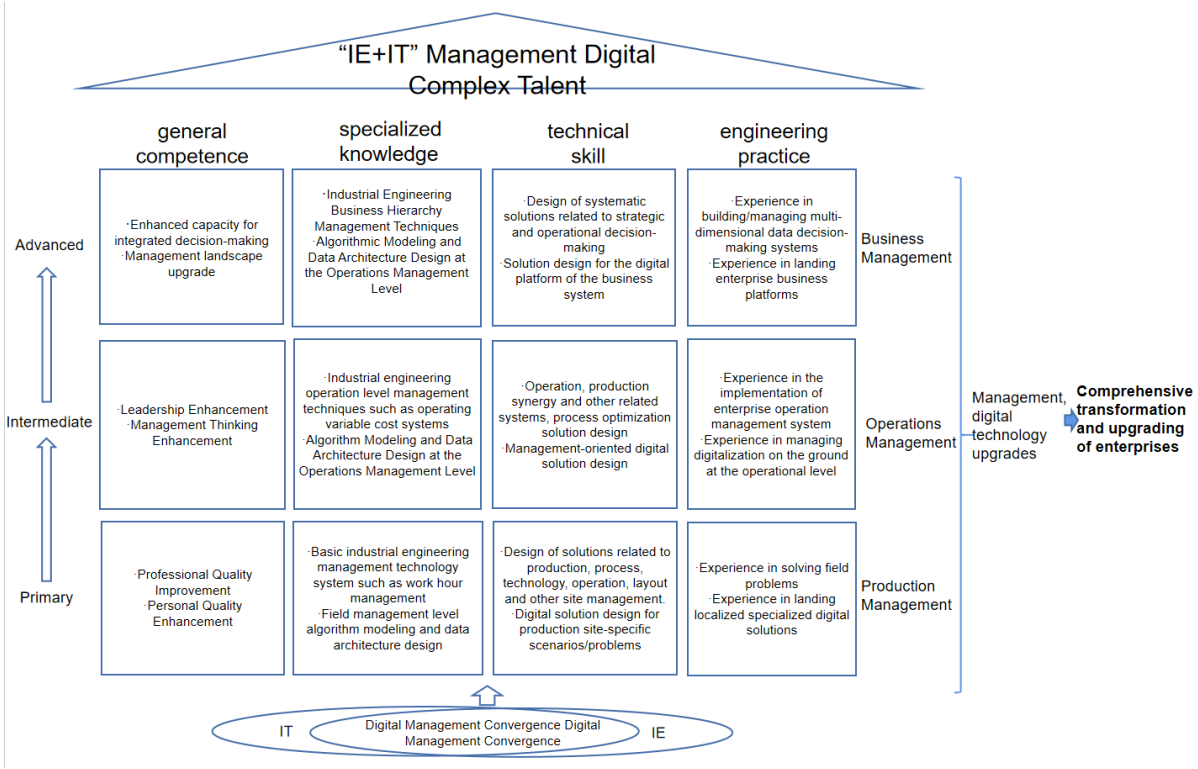

Figure 2. Digital Talent Competency Graded Training Model.

3.2.4. Competency Dimension—Specialized Knowledge Structure Division

The management of digitalized talents takes the industrial site as the cornerstone. Industrial site management to plan for the control program, production execution for the process control hand, quality control for the "all customer-centric" landing point, layout planning and equipment management for production to achieve the basic security, operational changes in cost control for the core competitiveness. Based on this, the management of digital talents need to master the 8 core disciplines. Process management to ensure the optimization and standardization of the production process; production planning and control to coordinate resources to ensure product delivery; production execution will be planned into actual production; total quality management to build a closed loop quality; facilities planning and logistics to optimize the efficiency of the use of space; full equipment management to protect the effectiveness of the equipment; cost control to reduce the cost of production; supply chain management to coordinate upstream and downstream resources. These disciplines collaborate with each other, together constitute the production and operation system of industrial enterprises, to ensure efficient and stable operation of enterprises, with industry and enterprise characteristics, is where the talent cognitive barriers.

The essence of digital software is the algorithmic encapsulation of management knowledge, process management system development relies on process management, APS development relies on production planning and control, MES development relies on production execution, quality analysis system development relies on quality management, layout simulation relies on facilities planning and logistics, equipment data mining and analysis development relies on full equipment management and maintenance, job cost system

development relies on cost control, supply chain management Supply chain management platform development relies on supply chain management. Digital software to management knowledge first, the deconstruction and analysis of the industrial site after the corresponding software development, based on management knowledge, supplemented by knowledge modeling, digital technology can help enterprises achieve high-level management analysis and rationale for upgrading.

Figure 3 shows the role of 8 major disciplines in enterprise manufacturing, is the core support for the efficient and stable operation of the enterprise production system, strengthen the management of digital talents in the mastery of these 8 major knowledge, not only to break down the barriers of industrial cognition, but also to cultivate their scene deconstruction and digital modeling capabilities, driving the experience of algorithms to feed the management of upgrading.

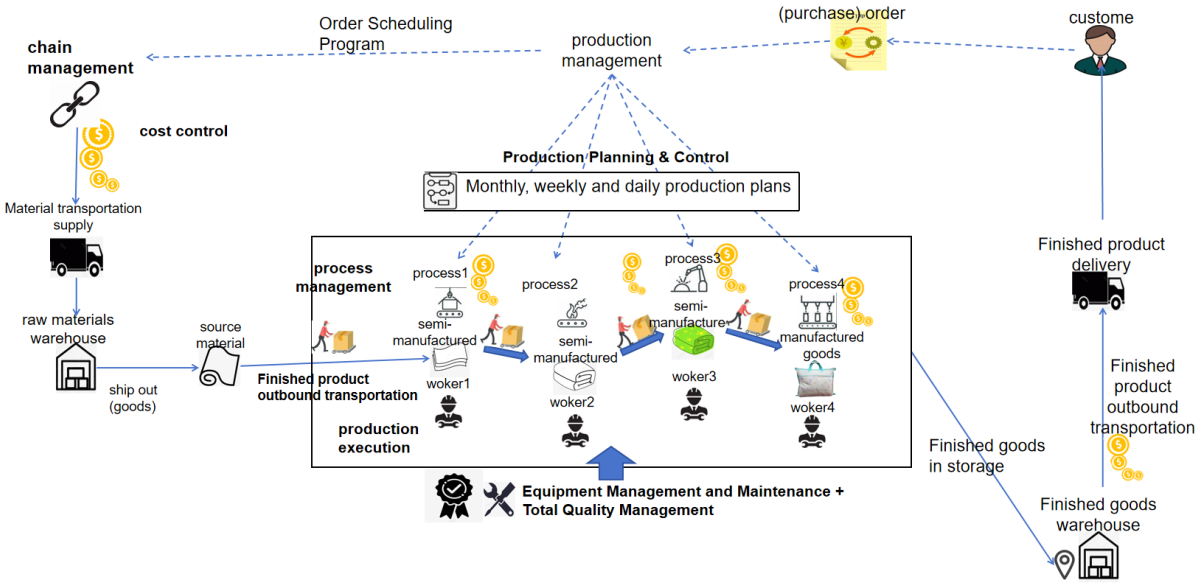

Figure 3. Mechanism map of expertise dimensions.

4. Digital Talent Job Competency Evaluation Standards

Differentiated assessment plans are formulated based on competency levels, clarifying the requirements of talents at various levels in the dimensions of technology application, process optimization, strategic decision-making, etc., supporting the precise training and management upgrading of talents.

4.1. Evaluation Weights of the Competency Level of the Management of Digital Talents' Positions

Based on the hierarchical ability cultivation model, we determine the focus of comprehensive ability, professional knowledge, technical skills and engineering practice of talents at all levels, and establish a mechanism for talent promotion and ability level evaluation and assessment.

Junior talents focus on professional knowledge to build a foundation, focusing on the construction of theoretical systems, and engineering practice requirements account for the lowest proportion, because they are in the cognitive accumulation stage, and need to lay the foundation for ability leap through standardized knowledge learning.

Intermediate talents strengthen engineering practice and comprehensive ability. As an organizational hub, they need to improve cross-sectoral coordination ability, and the weight of professional knowledge and technical skills is adjusted downward, highlighting the core ability of theory transformation + system implementation.

Senior talents balance strategic vision and practical depth, and emphasize both professional knowledge and engineering practice. Through complex project management, they can realize the synergy between management decision-making and technological innovation, and drive the digital transformation strategy to the ground.

To sum up, the evaluation weights of management digital talents are shown in Table 1. Primary level

constructs cognitive framework with knowledge input, intermediate level opens up the fault between technology and management with practice, and senior level realizes value creation with strategic integration.

Table 1. Weighting table for evaluation of the competency level of management of digital talents' positions.

Evaluation Dimension	General Competence	Specialized Knowledge	Technical Skill	Engineering Practice
Job Level	**Weighting of Points**	**Weighting of Points**	**Weighting of Points**	**Weighting of Points**
inferior	20%	45%	20%	15%
mid-level	25%	25%	20%	30%
high level	20%	30%	20%	30%

Note: The total evaluation score is 100 points, which is obtained from the total weighted score of the four evaluation dimensions: general ability, professional knowledge, technical skills, and engineering practice.

4.2. Managing the Digital Talent Cultivation Inspection Path

Based on the above cultivation and evaluation system, we design a pathway for the cultivation of digital talents. First of all, the corresponding professional knowledge courses are formulated, through which the students can systematically master the digitalization and management related professional knowledge and establish relevant cognition. At the same time, a practice platform is set up to transform knowledge into problem-solving ability through project practice, realizing the closed loop from learning to application. After completing the preliminary professional learning and practice, based on a certain degree of professionalism, students can choose the appropriate initial, intermediate and advanced certification examination according to their own ability, and can be promoted after the examination to meet the requirements. The specific training path is shown in Figure 4.

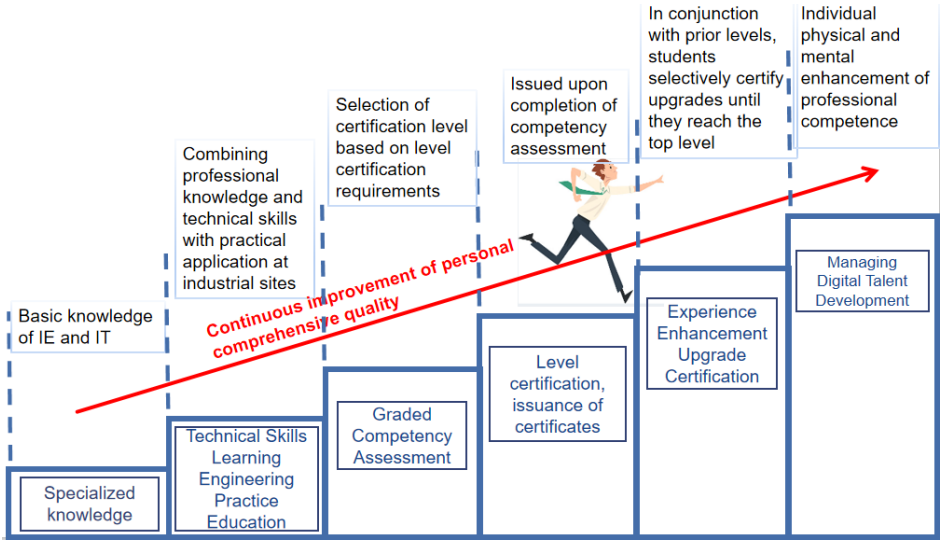

Figure 4. Digital Talent Development Examination Path.

5. Conclusions

The essence of digital transformation of industrial enterprises is the systematic reconstruction of management thinking and talent ability. This study provides a systematic solution to crack the digital "talent shortage", and builds a set of digital talent training program that covers four dimensions of competency definition, three competency levels, eight disciplines of professional knowledge, three levels of evaluation

standards and the overall cultivation path, which is adapted to industrial scenarios. On the basis of analyzing the demand for talents for digital transformation of industrial enterprises, we reveal the core contradiction of "interdisciplinary competence disconnection and imperfect cultivation system" in the shortage of talents. Combining the importance of IE and IT to the digital operation of industrial enterprise management, integrating the dual knowledge system of IE and IT, constructing a 4-dimensional competency model of "comprehensive ability, professional knowledge, technical skills and engineering practice", and introducing the "know, believe and act" model of "cognitive theory and Katz management skills". Cognitive theory and Katz management skills model are combined to define the competency standards of junior, middle and senior talents. Finally, combining job requirements and competency weights, the program establishes a talent evaluation mechanism and cultivation path.

Through the quantification of competency standards and visualization of training paths, the program has solved the drawbacks of "focusing on technology but not management" in education and "fragmentation" in enterprise training. Enterprises can carry out internal talent promotion and external recruitment based on the three-level evaluation standard, and universities can optimize the curriculum system with reference to the knowledge map, realizing the precise docking between industry and education.

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Author Contributions

J.N. participated in the writing of the project grant document for this dissertation. and was responsible for the conceptualization and design, model construction, analysis, and interpretation of this study. The authors also drafted the manuscript and approved the final version as submitted. J.L. as the instructor, led the implementation of this grant program and guided the identification and writing of the content related to this article. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

This study did not involve any human or animal subjects and therefore did not require ethics approval.

Data Availability Statement

All data used in the study were obtained from publicly available sources.

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Conflicts of Interest

The authors declare no conflict of interest. There are no financial or personal relationships that could have influenced the research presented in this manuscript.

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