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Research on the New Citizen Transformation Training System of Construction Industry Under Digital Construction Qualitative Research Based on Grounded Theory

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Abstract

The modernization of construction industry requires the deep integration of construction industrialization and digitalization, which puts forward new requirements for the skills of construction workers. This paper conducts a qualitative study with text analysis on the transformation training system for new citizens in the construction industry. Conducting the grounded theory, this research analyzes 16 influencing factors, summarizes 5 core categories, builds a model of influencing factors of the transformation training system for new citizens in the construction industry under digital construction, and puts forward countermeasures and suggestions, providing a reference for subsequent relevant research.

Keyword: *New citizens of construction industry, Transformation training, Influencing factor, Grounded theory, Qualitative study*

1. Introduction

Since 2013, the added value of the construction industry has always accounted for more than 6.85% of China's GDP, reaching 6.89% in 2022, and the status of the construction industry in the pillar industry of China's national economy is stable (Zhao et al., 2023). The modernization of the construction industry has realized the deep integration of construction industrialization and digitalization, and has put forward higher requirements for the knowledge, skills, innovation ability and cultural literacy of the construction front-line workers (Y. Ke, 2019). The transformation and upgrading of China's construction industry is closely related to economic development and changes, so corresponding adjustments must be made in a timely manner (L. Li, 2015).

In December 2020, the Ministry of Housing and Construction of the People's Republic of China issued the "Guiding Opinions on Accelerating the Training of Construction Industry Workers in the New Era" (S. Ke, 2021, Vaez et al, 2021), while affirming that construction workers are an important part of China's industrial workers and have made significant contributions to China's economic development and urbanization, it is also pointed out that the current construction workers still have practical problems such as large disorderly mobility, prominent aging phenomenon, low skill quality, and inadequate protection of rights and

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interests, which have restricted the sustainable and healthy development of the construction industry (X. Wu, 2023). At the same time, new citizens in the construction industry do not want to enter the construction industry of "dirty, tired, bitter and dangerous" due to the high characteristics of employment expectations, material and spiritual demands, and the disappearance of demographic dividend, resulting in "labor shortage and labor difficulties" and other situations are increasing.

Cultivating workers in the construction industry in the new era is a key link to realize the transformation of China's construction industry from labor-intensive to technology-intensive, transforming traditional rural migrant workers in the construction industry into new construction industry workers, and cultivating a large number of high-level construction craftsmen, which is conducive to optimizing the labor structure of the construction industry, accelerating industrial reform, and promoting industrial upgrading. It is clear to take digital construction as the basic, promote the industrialization, digitalization and intelligent upgrading of buildings, accelerate the transformation of construction methods, and promote the high-quality development of the construction industry (Yao, 2021; Sharifian et al, 2021).

At the same time, McKinsey's research report shows that China's demand for skilled workers will increase by 28% in 2030 due to the use of artificial intelligence and automation technologies (McKinsey, 2021), therefore, in the context of digital construction, China's construction industry urgently needs to increase industrial training. In addition, through the empirical analysis of manufacturing labor productivity, it is found that every 1% increase in per capita training costs, labor productivity will increase 0.607% (Tang et al., 2016). for every 1% increase in the proportion of employees trained on the job, the labor productivity of enterprises will increase by 0.6% (Dearden et al., 2006). Therefore, with the transformation and upgrading of the construction industry and the continuous advancement of new construction industrialization, the training of modern construction industry workers has become the central task to accelerate the transformation of the construction industry, adjust the structure and promote the upgrading (Y. Ke, 2019).

Training construction workers with "high skills", "high salary" and "sound social security" in the new era is the key to solve the shortage of technical talents in the current construction industry (Su & Xing, 2022). In 2020, the Ministry of Housing and other departments issued the "Guidance on Accelerating the Cultivation of a New Era of construction industry workers" pointed out that by 2025, it is necessary to train more than 10 million intermediate and above construction industry workers, and by 2035, it is necessary to build a grand knowledge-based, skilled and innovative construction industry workers (S. Ke, 2021). In 2022, the "14th Five-Year Construction Industry Development Plan" issued by the Ministry of Housing and Urban-Rural Development also clearly regards the training of construction industry workers as the main task (Han et al., 2022).

2021 is the beginning year of the "14th Five-Year Plan" and the new journey to comprehensively build a modern socialist country, and it is also the first year for all industries to seize the momentum, accelerate industrial transformation and high-quality development into a new stage (Ju, 2021). Therefore, it is urgent to establish a new industrial workers team with digital construction knowledge, and it is a realistic and urgent topic to study the transformation training system of rural migrant workers in China's construction industry.

According to the Statistical yearbook of China's construction industry in 2022, although the number of people employed in the construction industry is 51.840.2 million, it has been

reduced for four consecutive years, and it is 989,200 fewer than the end of the previous year, a decrease of 0.31% (Zhao et al., 2023). At the same time, the labor productivity calculated by the total output value of the construction industry reached a new high, reaching 493,526 yuan/person, an increase of 4.3% over the previous year, but the growth rate was 7.60 percentage points lower than the previous year, which is the lowest point since 2018 (Zhao et al., 2023). Although the existing training system has played a certain role in promoting the professional quality and social quality of new citizens in the construction industry, it is still necessary to build a scientific and effective transformation training system for new citizens in the construction industry to better achieve their transformation goals.

China's construction industry has not yet formed a scientific training system for the transformation of new citizens in the construction industry. There are many problems in relevant training measures, such as policy leadership, lack of legislation, lack of system, lack of supporting policies, training in a mere form, and low willingness of migrant workers as the main body. Specifically, the policy is not systematic and operability is not strong, the training system is not complete, and the content is out of line with the reality. The service after training is not in place, the lack of long-term effective supervision and management mechanism, the lack of training funds, difficult to implement, the willingness of enterprises to undertake training responsibilities is low, the willingness of new citizens to train is high, but the participation rate is low, the training lacks effective legal protection, the lack of top-level design, etc. Therefore, the existing training is not effective in improving the human capital such as knowledge, ability and quality of construction workers, and their comprehensive quality has not been significantly improved, and migrant workers are still migrant workers.

The key path for the transformation training of new citizens in the construction industry under the digital construction is systematic training. This part is based on the research paradigm of grounded theory, combined with literature research method and behavioral event interview and other research methods, and uses Nvivo20 software to decompose, encode and analyze relevant data. Then, according to the analysis results, the paper puts forward the influencing factors model of the transformation training system for new citizens in the construction industry, which lays a good foundation for the operation of the transformation training system.

The transformation training of new citizens in the construction industry involves a lot of interest subjects. According to the demands of different interest subjects and methods such as literature research, the influencing factors of the training system are identified and analyzed and summarized, which is the premise of exploring the next issue and lays an important foundation for the follow-up content. Since the establishment of the impact factor system for systematic training of new citizens in the construction industry needs to go through the process of factor identification, extraction and system construction, it is necessary to introduce the research paradigm of rooted theory in addition to the demands of relevant stakeholders, the research of literature and the opinions of authoritative experts in the industry. The unknown variables in the training system are mined, the relationship between variables is found, and qualitative analysis is carried out, so as to build the impact factor system of systematic transformation training.

2 Literature Review

In view of the technological development and organizational management changes brought about by the construction industrialization, migrant workers in the construction industry must

improve their vocational skills and comprehensive literacy to transform into industrial workers to adapt to the new development of industrialization (Z. Li et al., 2021). The academic circle has conducted a lot of discussion on the transformation training of new citizens in the construction industry, among which there are many researches on the systematic training model and the factors affecting the transformation training.

The training strategy should be determined in the training process, and that the evaluation of learning should not only target at the learning needs, but should target at all aspects of training, that is, the evaluation of training results and the evaluation of training process should be used at the same time, and it is believed that only in this way can the whole training process produce a virtuous cycle (Hu, 2017).

The operating guide of the systematic training mode in the eight-Step Method of Training Talents. The eight steps designed for the systematic training mode are: Strive to promote learning, focus on improving performance, carefully organize learning, make full preparations, improve teaching efficiency, engage students, obtain information feedback, and constantly improve (Tom.W.Gott, 1999).

In *The Wealth of Nations* that if individuals can be fully developed, then society will also make great progress (Kates, 2022). The vocational training policy and training mode in the United States, summarized the development experience of vocational education in the United States, and emphasized the benefits of vocational training to the surplus rural labor force (Levesque & Nelson, 2000). Training is the process of providing or teaching employees the basic skills they need to perform their jobs (Stewart & Brown, 2019).

With the development of economy and society, vocational training plays an increasingly important role in stabilizing employment and promoting economic growth (Van Wieringen & Attwell, 1999). Vocational training plays an important role in improving social productivity and the skill level of workers (Clarke & Winch, 2007). By comparing the vocational training policies of different countries such as Britain, France, and the United States, she analyzes the extent to which vocational training policies promote labor market progress and social equity.

By introducing the market competition mechanism, the advantages of the government and the market were fully utilized, and the quality of training was improved.

The main influencing factors of industrial worker training include industry training assessment and appraisal system, national macroeconomic situation and relevant policy orientation, etc (Y. Li, 2017). It is necessary to seize the development opportunity of digital construction, accelerate the reform of the demand side of the labor force and accelerate the construction of professional training bases (S. Li, 2021). Su and Xing (2022) took the transformation of traditional labor service enterprises as the entry point for industrial worker cultivation, introduced the incentive mechanism of local government into it, built an evolutionary game model between local government and labor service enterprises, and analyzed the dynamic interest relationship and behavioral decision-making mechanism between them in the process of industrial worker cultivation.

According to the Ministry of Human Resources and Social Security, PRC, "In addition to 'migrant workers', it is difficult to find an accurate, concise, and universally recognized term for those who are still registered in rural areas but engaged in non-agricultural industries", but many cities have switched to terms such as "remote/migrant/urban migrant workers" and "new citizens". It aims to weaken the attribute of rural hukou, and

highlight the attribute of entering the city from other provinces or less developed areas to engage in labor (J. Wang, 2020).

Digital construction is a big data application process based on building information model (BIM), which involves the "cost reduction and efficiency increase" of the whole process of planning, design, construction, operation and maintenance of engineering construction. Its ultimate goal is to realize the integrated construction and service mode of engineering projects driven by digital chain, and building information model (BIM) is an effective carrier of digital construction. It has increasingly been highly valued by all participants in the construction industry, and has gradually become one of the necessary skills for students of various majors in civil engineering (Cai et al., 2021).

Construction industry workers refer to workers who are engaged in collective production labor in the construction industry and rely on wage income as their source of living (M. Chen et al., 2020). Generally, it refers to workers with stable occupations and positions, relatively fixed working hours, more suitable working environment, higher vocational skills and qualities, more perfect labor rights and social security, and higher social recognition (Ren et al., 2018; Yongzhang Wang, 2016).

The systematic training for the transformation of construction migrant workers into industrial workers refers to a comprehensive and systematic training activity that takes construction migrant workers as the training object, aims to realize the transformation from construction migrant workers to industrial workers, ADAPTS to the needs of construction jobs and integrates various vocational skills, social culture and civilization qualities of construction migrant workers into urban social life (J. Wu, 2019).

3 Research Method

Grounded theory is a method to build theories from the bottom up, that is, on the basis of systematic collection of data, to find the core concepts that reflect social phenomena, and then to form theories by establishing connections between these concepts (Xie & Fan, 2017). Grounded theory is a qualitative research scientific method that finds the core concept of the problem to be studied in the mass data, compares and abstracts the data repeatedly, extracts related concepts and categories and codes them, finds the internal relations among the codes, and builds an applicable theoretical framework (Zheng & Li, 2022). At present, grounded theory is divided into three schools, namely classical grounded theory, programmed grounded theory and constructivism grounded theory (R. Wu & Li, 2020).

This study adopts the programmed grounded theory, and codes the collected literature and research data on the transformation training of new citizens in the construction industry step by step, so as to build a model of influencing factors on the transformation training of new citizens in the construction industry. The specific operation is to first collect relevant data, then use data coding to decompose, conceptualize and recombine the data, then use Nvivo 20 software to conduct open coding, axial coding and selective coding analysis, and then propose a system of influencing factors for the transformation training of new citizens in the construction industry according to the results of qualitative analysis (Zu et al., 2022).

The data used in this study are mainly from text analysis, so that we can obtain the original data with high credibility and ensure that the supporting materials are composed of sufficiently accurate empirical facts. First of all, the text mainly comes from electronic databases such as

Google Academic and Web of Science, internal text materials of building associations, national policies and regulations, and news reports. Through the collection, collation and analysis of these text data, we can preliminarily get the key impact factors that affect the transformation training of new citizens in the construction industry.

This study selects the literature after 2007 (taking Google Academic as an example, the number of literatures on "migrant workers in construction industry" reached 164 in that year, which is the year with the largest number of relevant papers published so far) for text analysis. As of February 15, 2023, a total of 1155 papers were found using the "construction migrant workers". Then, input "training of migrant workers in the construction industry" + "transformation of migrant workers in the construction industry", the result is 278 articles, and select 96 journal papers and doctoral papers with 4 or more citations. Through the analysis and research of these 94 literatures (two of which are repeated), 76 articles with high correlation are finally selected, and the corresponding impact factors are obtained through analysis. From these 76 papers, 49 journal papers were selected for qualitative analysis. In addition, 10 news materials were selected for qualitative analysis.

4 Results

4.1 Open Coding

Open coding, also known as initial coding or first-level coding. Open coding has the strongest openness and is the process of defining the data content, so it often needs to be completed by word-by-word, line-by-line, event-by-event coding (Zhang, 2019). In the process of open coding, we should try our best to put aside or discard personal prejudices and theoretical opinions, keep an open mind and vision at all times, integrate the acquired data into a relatively standardized and orderly original description or declarative statement, and log in according to the state presented, dig and discover the concept category, and name the relevant concept category. To determine their attributes and dimensions, and then to study the phenomenon to name and categorize (F. Wang, 2018). The purpose of open coding is to assign conceptual labels and form categories to any events and fragments that can be encoded in the original interview data, and to require all data to be logged in according to its own state (X. Chen, 1999).

The data of this study mainly come from scholars' opinions and news interviews of relevant institutions in the field of construction. In the process of data sorting, Nvivo 20, a coding software commonly used in rooted theory, is used for open coding. By using coding software Nvivo 20 to encode news materials and scholars' opinions, 1006 original text sentences and corresponding initial concepts are obtained. Since the initial concept contains a lot of colloquial statements, Nvivo 20 software is used to analyze the frequency of the initial concept statements and after many times of induction and classification, 47 initial codes are finally extracted, including financial budget, working with a certificate, establishing a training school for migrant workers, and innovating training modes. Innovative training assessment methods, working experience, on-the-job training plan, enthusiasm, skills and knowledge, family, supervision of training and assessment work, establishment of centralized training bases, employment environment, joint enrollment between schools and enterprises, assessment level and salary matching, media publicity, age, training motivation, etc., as shown in Table 1 below.

Table 1 Identification of Impact Factors of the Transformation Training System for New Citizens in the Construction Industry.

Variable	Influence factor	Variable	Influence factor
1	Financial budget	25	Training information network construction
2	Work with a certificate	26	Training requirement
3	Establish training schools for migrant workers	27	Training intention
4	Innovative training assessment methods	28	Training and engineering evaluation
5	Innovative training mode	29	Training and enterprise evaluation
6	Working experience	30	Training and Enterprise transformation
7	Job training plan	31	Training and enterprise qualification
8	Enthusiasm	32	Training and bidding
9	Skill and knowledge	33	Special funds for training
10	Family	34	Evaluate training and assessment institutions
11	Supervise the training and assessment work	35	Evaluate the training effect
12	Establish a centralized training base	36	Social responsibility
13	Employment environment	37	Social capital works with training institutions
14	Joint enrollment training between schools and enterprises will be carried out	38	Social capital works with government
15	Match the assessment level with the salary	39	Practical ability
16	Media publicity	40	Online training school
17	Age	41	Cultural level
18	Training motivation	42	Jobseeker APP
19	Training institutions curriculum system construction	43	Industry access
20	Training and employment expectation	44	Construction of employment and employment market system
21	Train teachers	45	Government planning guidance
22	Training time	46	Government policy
23	Training revenue forecast	47	Career path
24	Training system		

4.2 Spindle Coding

The main task of spindle coding, also known as focused coding or secondary coding, is to discover and organize various connections between conceptual categories in order to represent the organic relationship between various parts of the data. Researchers only need to conduct in-depth analysis around one conceptual category at a time and look for correlations (Yangmei Wang, 2019). On the basis of classifying and integrating the data formed by the initial code, researchers need to further improve the conceptual categories and find the correlation between the codes, and finally abstract a core category. The correlation analysis of concept categories should consider the correlation of concept categories themselves, explore the inner intention and motivation of the subjects expressing these concept categories, and put them in the current context and the background to conduct a comprehensive examination.

The analysis object of spindle coding is the native code formed according to the initial coding and categorization in the first stage, that is, many slightly disordered initial concepts. Its main task is to discover and establish various connections between conceptual categories to show

the organic correlation between various parts of the data (Liu, 2017). Through analysis, the specific coding statistics of influencing factors of the new citizen transformation training system in the construction industry are shown in Table 2.

Table 2 Coding Statistical Analysis of Influencing Factors of the Transformation Training System for New Citizens in the Construction Industry.

Principal category	Corresponding category	Reference point	Native code
Construction industry management	Supporting policy	36	Social responsibility, industry access
	Industry evaluation	3	Training and enterprise evaluation
	Training annual plan	36	Financial budget, innovative training assessment methods, training system
Government supervision and management	Supervision and administration	87	Supervise training and assessment work, training information network construction, evaluation of training and assessment institutions, evaluation of training effects, government planning and guidance
	Create an environment	99	Employment environment, media promotion, government policy
	Enterprise qualification management	17	Training and engineering evaluation, training and enterprise transformation, training and enterprise qualification, training and bidding
Construction enterprise employment management	Worker training program	39	Post with certificate, post training plan, training time, special funds for training, career promotion channel

Principal category	Corresponding category	Reference point	Native code
New citizens themselves	Training and evaluation system	14	Innovative training model, assessment level and salary matching
	Training base	17	The establishment of training schools for migrant workers, the establishment of centralized training bases, migrant workers learning APP
	Corporate self-perception	12	Training motivation, training willingness
	Personal factor	34	Family, age, experience, enthusiasm
	Absorption-conversion capacity	34	Skills and knowledge, practical ability, cultural level
Participation of social forces	Self-awareness training	29	Training employment expectations, training income expectations, training requirements
	Participation of training institutions	63	Training institutions curriculum system construction, training teachers, online training schools, employment and job market system construction
	School-enterprise interaction	11	Joint enrollment training between schools and enterprises will be carried out
	Social capital participation	10	Social capital works with training institutions, and social capital works with the government

4.3 Selective Coding

Selective coding, also known as core coding or tertiary coding, mainly refers to the selection of a "core category" after systematic analysis of all the discovered conceptual categories, and the analysis is concentrated on those code numbers related to the core category (X. Chen, 1999). Selective categories are usually dominant and can include most of the research results

under a relatively broad theoretical framework, promoting a more coherent and orderly data analysis process. Therefore, in the practical application of grounded theory, researchers usually choose the corresponding coding program according to the specific research needs. By extracting the research paradigm of spindle coding and constantly comparing and mining, this paper summarizes five main categories, including construction industry management category, construction enterprise employment management category, government supervision and management category, social force participation category and new citizens' own category.

After extracting the main axis category of the impact factor of the transformation training system for new citizens in the construction industry through the spindle coding, it is necessary to further explore the cumulative correlation among the main categories, link the main categories, cover the research conclusions under a relatively broad theoretical framework, and think and summarize a core that can briefly explain all the phenomena, as shown in Figure 2.



Figure 2. Impact Factor Model of Transformation Training for New Citizens in the Construction Industry.

4.4 Model Analysis of Influencing Factors of New Citizen Transformation Training System in Construction Industry

Based on the grounded theory, this study codes the relevant text data of the new citizen transformation training system in the construction industry, draws five main categories, and finally builds the influencing factor model of the new citizen transformation training system in the construction industry.

(1) Construction industry management, government supervision and management, construction enterprise employment management and social force participation are the external driving forces of the construction industry transformation training system

The rooted theory shows that the transformation training system needs the help of external forces to operate normally, and the management of construction industry, government supervision and management, employment management of construction enterprises and social forces have an important impact on the operation of the transformation training system, which is the key promoting factor of the transformation training system and promotes the efficient operation of the transformation training system.

The social responsibility of the construction industry, industry access standards and the degree of implementation of training and enterprise evaluation can significantly affect the management level of the construction industry.

Government supervision and administration of construction enterprises. Often through the introduction of corresponding industry policies in the form of emergence. In addition, the annual training plan, the management of enterprise qualification and the creation of environment all have a significant impact on the supervision and management of the government.

The training plan, training base, training assessment system and self-cognition of construction enterprises are very important to the employment management of construction enterprises.

The participation of training institutions and social capital, and the degree of integration of school-enterprise interaction directly determine the participation effect of social forces.

(2) The new citizens themselves are the internal driving force of the new citizens transformation training system in the construction industry

The rooted theory shows that the transformational training system originates from an internal motivation, that is, the new citizens themselves. Literature and interview data show that most training requires the participation of new citizens themselves in order to judge whether the transformation training system is effective. New citizens' personal factors, training self-cognition and absorption and transformation ability are the summary influencing factors and internal driving forces of the training system, which directly involve the professional training and citizenization training of new citizens in the construction industry. Among them, professional training is directly related to construction industry management, construction enterprise employment management, social participation and government supervision and management. The training of social civilization is directly related to the supervision and management of the new citizens themselves and the government.

Through the analysis of the factors of the transformation training system for new citizens in the construction industry, it is found that its driving force comes from the above driving force module of the construction industry, the driving force module of construction enterprises, the driving force module of social forces, the driving force module of the government and the driving force module of new citizens themselves. The subsequent analysis and demonstration will focus on how to build the system and the relationship between each driving force module.

5. Discussion and Conclusion

The transformation training system for new citizens in the construction industry is an organic whole, involving the interests of the construction industry, government departments, construction enterprises, social forces and the interests of new citizens in the construction industry themselves. Therefore, it is necessary to fully understand the needs of these interest subjects in order to put forward corresponding suggestions to ensure that the entire transformation training system can operate normally and effectively. Grounded theory has important guiding significance for the construction of the impact factor system of the transformation training of new citizens in the construction industry. Meanwhile, grounded theory combined with Nvivo20 analysis software completes the entire qualitative analysis work, including data collection, data analysis and qualitative research. According to the system diagram of influencing factors of the transformation training system for new citizens in the

construction industry (see Figure 3 for details), it can be seen that the transformation training for new citizens in the construction industry has been affected to different degrees by factors such as the construction industry, government departments, construction enterprises, social forces and new citizens in the construction industry, which is of great help to the construction of the subsequent system.

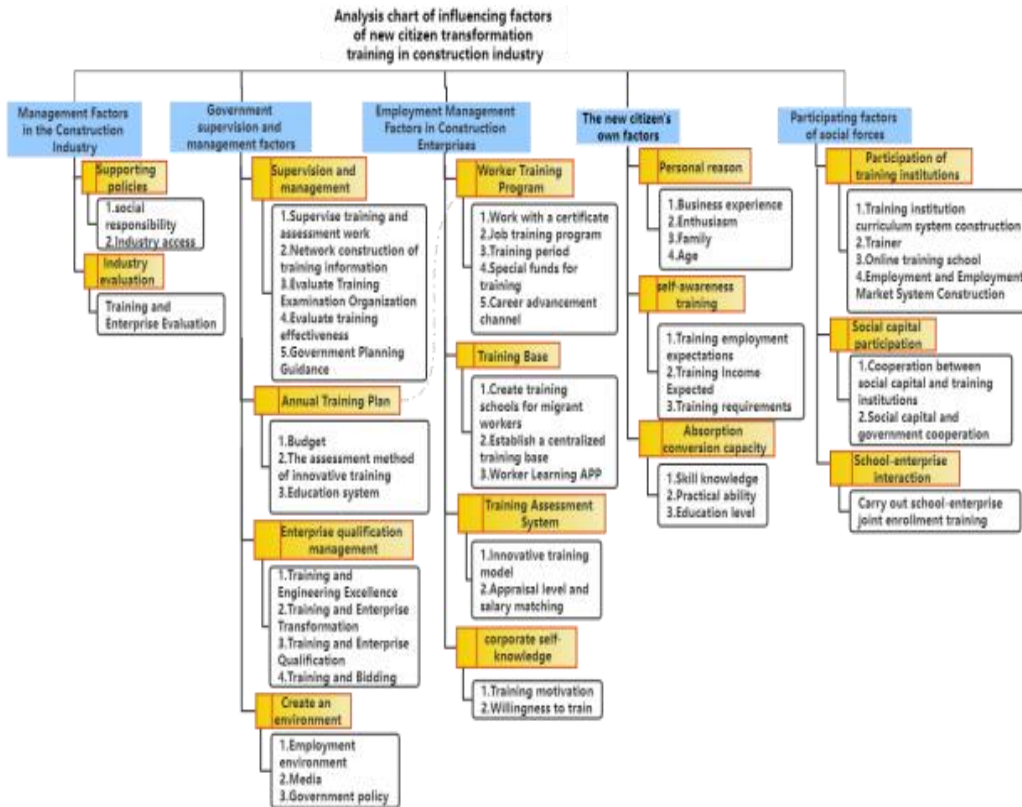


Figure 3. System Diagram of Influencing Factors of New Citizen Transformation Training System in Construction Industry.

Contribution

Conceptualization: Gao, Anan, Chonlavit.

Data curation: Gao, Anan.

Formal analysis: Gao.

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Conflicts Declaration

There is no conflicts among the authors, and all the authors agree this publication.

Data Statement

The data in this research only responsible for this study, contact the correspondence email to obtain the data.

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