

Article

Understanding Factors Influencing Whole-Process Consulting Service Quality: Based on a Mixed Research Method

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Abstract: To address the fragmentation in the engineering consulting industry, whole-process consulting (WPC) has undergone rapid development in China. Engineering consulting companies are actively transitioning towards WPC and aiming to enhance whole-process consulting service quality (WPCSQ). However, research on WPCSQ and its influencing factors is still lacking. This paper adopts a mixed research approach combining qualitative and quantitative methods. Initially, the grounded theory (GT) method is used to determine the influencing factors of WPCSQ, and the TEOK model is constructed. Then, Partial Least Squares Structural Equation Modeling (PLS-SEM) is utilized for model validation. The results show that WPCSQ is most affected by knowledge management and least affected by organizational factors. Based on the above analyses, recommendations for improving WPCSQ are provided from the viewpoints of engineering consulting companies and governments. These suggestions are aimed at fostering the healthy and sustainable progression of WPC.

Keywords: whole-process consulting; quality of service; grounded theory; partial least squares structural equation modeling; influencing factors; mixed research method



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1. Introduction

In the context of China's comprehensive promotion of the sustainable and healthy development of the construction industry, improving organizational models for the industry creates new opportunities for Chinese engineering consulting companies. At this stage, the demand for a whole-process consulting service (WPCS) from owners and builders is becoming stronger [1], and engineering consulting companies in China have begun to develop a WPCS. At the same time, relevant governments have pointed out that companies should establish business departments and allocate professional consultants that are appropriate for the WPCS, as well as cultivating the comprehensive ability of one-stop integration services for construction projects. Therefore, improving companies' WPCS capability and quality is a key and effective way to achieve their service transformation.

A WPCS refers to a comprehensive intellectual service activity for the implementation phase of a construction project, including organizational, managerial, economic and technical aspects [2]. A WPCS is not the simple addition of traditional consulting services but an integration of different consulting services in the implementation phase of a project. Moreover, in terms of project objectives, a high WPCSQ is essential. In recent years, many scholars have been involved in the WPC research field, and how to improve the performance of the WPC project has become a hot issue in this field. Scholars have

explored this problem from macro and micro perspectives, respectively. For example, Zhuo et al. explored the game relationship between social capital, government incentives and engineering consulting companies from a macro perspective [2]. Li et al. also studied the game relationship of opportunistic behavior among social capital, government and engineering consulting companies from a macro perspective [3]. In addition, there is more research conducted from the micro point of view, in which WPC project knowledge management is the focus. Wang and Ding explored the impact of digital management on the willingness to share knowledge [1]. Gao et al. developed an LF-CASREL model to optimize existing knowledge management techniques [4]. Gu et al. proposed a text knowledge classification method [5]. In addition, Shang et al. introduced knowledge sharing as a mediating factor in exploring the relationship between cross-organizational control and WPC project performance [6,7]. However, few scholars have explored how to improve consulting service ability from the perspective of engineering consulting companies. In addition, Huang et al. believe that policies, market and industry environments, organizational management, and company and employee capabilities all have an impact on the promotion of the WPCS model [8]. Nevertheless, there is a lack of overall research on how to improve WPCSs from the perspective of engineering consulting companies. Furthermore, customer satisfaction is an important criterion for evaluating WPCS performance. It has also been proven that service quality and customer satisfaction have a close relationship [9]. In addition, service quality is one of the key factors for service providers in improving performance and increasing competitiveness [10]. Therefore, improving WPCSQ is crucial for engineering consulting companies. WPCSQ is a comprehensive output of a WPCS, which is a typical knowledge-intensive service model. Although WPCSQ is affected by different factors, an exploratory study on influencing factors is still lacking. For engineering consulting companies, it is urgent for them to explore WPCSQ and its influencing factors so as to improve service quality and client satisfaction.

To improve WPCSQ and accelerate the service transformation of engineering consulting companies, it is of great theoretical and practical significance to explore the factors affecting WPCSQ. In this study, the factors affecting WPCSQ were determined, and a TEOK theoretical model was constructed. Specifically, this paper carries out a mixed study by adopting qualitative and quantitative methods. In the first step, the GT qualitative method is used to identify the influencing factors of WPCSQ and build a theoretical model. The second step is to test the theoretical model with the quantitative method of PLS-SEM.

2. Literature Review

2.1. WPCSQ

There is no unified definition of WPCSQ, and the existing literature is divided into two perspectives: the connotations of a WPCS and the concept of service quality. The WPCS refers to the activities of engineering consulting companies who accept the commission of construction clients. In the implementation phase of a construction project, the companies provide integrated consulting services, such as bidding agency, design, cost consultation, project management, etc. This mainly includes three types of consulting services: engineering survey and design, engineering bidding and procurement, and engineering supervision and project management. As a knowledge-intensive service, a WPCS is oriented towards the needs of the construction employer. In addition, a WPCS involves integrated project management as the logic behind consulting services. By making synergy and cooperation inherent requirements, a WPCS aims to improve project performance.

With respect to service quality, scholars have conducted a lot of research on its meaning and characteristics. Parasuraman et al. defined service quality as “the gap between customers’ expectations and their actual perception of the service that the service provider

is able to provide” [11]. According to Zeithaml et al. [12], service quality is defined as “the characteristics and attributes that a service exhibits to meet customer expectations and to meet or exceed customer needs”. Based on the above analyses, service quality is not only reflected in customers’ expectations and perceptions of the service but also covers the process and results of the service. Moreover, some scholars have proposed that there is a close link between consulting service quality and customer satisfaction [9], and WPCSQ is no exception. In summary, WPCSQ can be defined as the degree to which the WPCS provided by companies can fulfill the demands and expectations of the construction employer, as well as the achievement level of project objectives.

2.2. Influencing Factors of WPCSQ

There are two forms of existing methods to measure and determine the influencing factors of service quality. One is to introduce all or some factors in the existing service quality model into a specific context. The SERVQUAL (Service Quality) model has been widely used to measure service quality in various contexts [11]. The other is to determine the influencing factors of service quality according to the existing literature and interviews in a specific context. Although the use of existing models can bring about many benefits for researchers, it has been widely criticized for its limitations [13]. In addition, research on WPCSQ is still in its infancy. Due to limited references, it is considered appropriate to adopt the GT method to identify factors influencing WPCSQ [14]. This method is also a common approach in the field of service quality research to identify the influencing factors of service quality [15–17].

Researchers have delved into the factors affecting WPCSQ from several perspectives and analyzed them. These influencing factors can be mainly divided into two categories. One category refers to external factors influencing WPCSQ; the other category focuses on the intrinsic factors within a WPCS. The external factors mainly focus on industry standards and honorarium calculation methods [2]. Industry standards can be used to standardize a consulting service process and improve the overall level of the WPCS. Good remuneration methods can improve the cooperation mode of a service and regulate the market environment. Regarding the internal factors of a WPCS, they mainly focus on knowledge and management styles. Gu believes that knowledge management has an important influence on a WPCS [5]. Wang and Ding pointed out that digital management improves the quality of consulting services and project performance by enhancing the willingness of project members to share knowledge [1]. Shang et al. found that consulting service quality and program performance could be improved by promoting knowledge sharing among project members [6]. Ye et al. believed that technical factors such as the level of information management platform construction also greatly affected WPCSQ [18]. In addition, Huang et al. found that the policy, market and industry environments were external driving factors of WPCSs; moreover, the organizational management mode and talent ability level also affected the promotion of the WPCS model [8].

2.3. Grounded Theory

GT, as a qualitative research method, was proposed by Glaser and Strauss [19]. It aims to provide an in-depth understanding and explanation of phenomena and is considered to be a scientific approach for qualitative research [20]. The method of GT is to grasp key concepts and categories based on qualitative data and form a theory through continuous comparison, analysis and summary [19,21]. The basic steps include four aspects: identifying the problem, collecting the data, then conducting open, axial, selective coding, and finally, completing the model construction [22]. GT is widely used to capture the influencing factors of a new research field or topic [20,23,24]. However, research in the field of WPCSQ

is still lacking, and previous research has not established a theoretical model to explore the influencing factors of WPCSQ. Based on the above analyses, the GT approach is used to fill this research gap [14].

To summarize, there are few studies on the influencing factors of WPCSQ, and existing studies have not been conducted from an overall perspective. In addition, it is worth noting that most of the existing research focuses on consulting projects, not consulting companies. Although WPCSQ companies are direct participants in consulting services, research from the company's perspective is still lacking.

3. Qualitative Research

3.1. Data

A theoretical sampling method was used to select the respondents. Respondents were chosen according to the following criteria: (1) possessing practical experience in WPCSs; (2) having a relevant educational background; and (3) being capable of clear and logical expression. The original data were collected by face-to-face or telephone contact, and the average interview time was 20–30 min. Before the formal interview, the interviewees were informed of the interview outline in advance to ensure that the subsequent interviews went smoothly. The collection of interview data followed the principle of “theoretical saturation”. By the time the twentieth interviewee was interviewed, no new content appeared, and then six more interviewees were added to ensure content saturation. Finally, a total of 26 managers, chief engineers and project management engineers were interviewed, who had a deep understanding of WPCSs.

The interviews centered on the following questions: (1) What kind of opportunity made you work in the WPCS? (2) In order to carry out the WPCS business, what efforts have been taken in information technologies? (3) What are the issues of WPCS that need to be focused on in your companies? (4) What are the issues of WPCS that need to be concentrated on outside your companies? (5) What experience have you gained in the WPCS business? (6) What are your expectations and suggestions for the WPCS? The basic information of respondents is shown in Table 1.

Table 1. The respondents' basic information.

Characteristics	Attribute	Frequency	Percentage (%)
Gender	Men	19	73.08
	Women	7	26.92
Educational background	Bachelor and below	21	80.77
	Master	4	15.38
	Ph.D.	1	3.85
Position	Junior management	11	42.31
	Middle management	4	15.38
	Senior management	11	42.31
Working experience	3 years and below	3	11.54
	4–10 years	7	26.92
	11–15 years	9	34.62
	15 years or more	7	26.92

3.2. Data Analysis

The author compiled the interview data into text materials and obtained more than 20,000 words. Subsequently, the materials were coded by using NVIVO (v12.2) software. Based on GT, the influencing factors of WPCSQ were determined through programmatic

rooted steps. The programmatic steps were divided into open coding, axial coding and selective coding.

3.2.1. Open Coding

Open coding was needed to reassemble the original data so that sentences could be classified to form the initial concept. This process involved discarding existing concepts and ideas, thereby reducing the influence of personal subjectivity on the initial concepts. In addition, to reduce the contingency of the extracted concepts, concepts that occurred less than 3 times were deleted. Finally, through the repeated refining and selection of the original data, a total of 44 initial concepts and 18 initial categories were obtained. The open coding results are shown in Table 2.

Table 2. Open coding results.

Initial Categories	Concepts
A01 Technical management A02 Technical innovation A03 Technical security A04 Technical compatibility A05 Technical simplicity	a01 Technology development strategy, a02 Technology resource management a03 Research and development, a04 Application of new technologies a05 Information storage security, a06 Data encryption a07 Hardware compatibility, a08 Software compatibility a09 Technical operability, a10 Technical intelligibility
A06 Policies and regulations A07 Social environment A08 Market environment A09 Cultural environment	a11 Policies, a12 Industry standards, a13 Legal norms, a14 Government supervision a15 Corporate social responsibility, a16 Social network relations a17 Competitive environment, a18 Market demand a19 Corporate culture, a20 Social culture
A10 Executive support A11 Communication and coordination A12 Organization size A13 Management system A14 Talent system	a21 Participation in decision-making, a22 Resource input, a23 Resource allocation a24 Function division, a25 Power and responsibility definition, a26 Cooperative willingness, a27 Personnel stability, a28 Cohesion a29 Number of employees, a30 Business scale a31 Organizational structure, a32 Service development mode a33 Talent training, a34 Talent introduction, a35 Talent allocation
A15 Knowledge acquisition A16 Knowledge integration A17 Knowledge sharing A18 Knowledge application	a36 Conference discussion, a37 Theoretical learning, a38 Practical training a39 Knowledge classification, a40 Knowledge depth analysis a41 Sharing knowledge, a42 Learning from experience a43 Practical and theoretical application, a44 Theoretical application

3.2.2. Axial Coding

Axial coding was carried out to establish a logical relationship between the basic categories obtained by open coding. Through axial coding, we divided the 18 categories into 4 main categories: technical factor, environmental factor, organizational factor, and knowledge management. The axial coding results are shown in Table 3.

3.2.3. Selective Coding

Selective coding was used to further summarize the axial coding. It was carried out to extract the core category from the main category and analyze the relationship between the core and main categories. Through selective coding, we identified the core category of “influencing factors of the WPCSQ”. Technical factors, environmental factors, organizational factors, and knowledge management are the four main categories that directly affect WPCSQ. The results of selective coding are shown in Table 4.

Table 3. Axial coding result.

Main Categories	Initial Categories	Scope Connotation
B1 Technical factor	A01 Technical management	Technical management level of engineering consulting company
	A02 Technical innovation	Engineering consulting company's investment in technologies and the degree of application of new technologies
	A03 Technical security	The security degree of the technologies used by the engineering consulting company
	A04 Technical compatibility	The compatibility of the software and hardware used by the engineering consulting company
	A05 Technical simplicity	Whether the software and hardware used by the engineering consulting company are easy to operate
B2 Environmental factor	A06 Policies and regulations	The policy environment in which engineering consulting firms operate
	A07 Social environment	The social environment of the engineering consulting company
	A08 Market environment	The degree of competition in the WPCS market
	A09 Cultural environment	Internal culture of engineering consulting company and WPC industry culture
B3 Organizational factor	A10 Executive support	The attitude of consulting firm leaders towards WPCS
	A11 Communication and coordination	The effectiveness of the coordination mechanism within the engineering consulting company
	A12 Organization size	Scale of engineering consulting firm
	A13 Management system	The organizational structure and business development mode of engineering consulting companies to carry out consulting services
B4 Knowledge management	A14 Talent system	Talent management system of engineering consulting company
	A15 Knowledge acquisition	The level of knowledge acquisition in engineering consulting companies
	A16 Knowledge integration	The level of knowledge integration in engineering consulting companies
	A17 Knowledge sharing	The level of knowledge sharing within engineering consulting companies
	A18 Knowledge application	Knowledge application level of engineering consulting companies

Table 4. Selective coding results.

Path Relation	Meaning of Path
Technical factor → WPCSQ	Technical factors are important factors affecting WPCSQ, and the technical level and technical strategy of consulting companies directly affect WPCSQ.
Environmental factor → WPCSQ	Environmental factors include external and internal aspects (e.g., cultural environment), which can directly affect WPCSQ.
Organizational factor → WPCSQ	Organizational factors, reflecting the level of organization and management of engineering consulting companies, directly influence WPCSQ.
Knowledge management → WPCSQ	Knowledge management is an important factor affecting the development of WPCSs, which reflects the knowledge management ability of engineering consulting companies and directly affects WPCSQ.

Influencing factors of WPCSQ were identified by the GT method. However, the relationship between each influencing factor and WPCSQ was not verified. Therefore, we need to use quantitative methods to verify the possible path relations. Considering that PLS-SEM method is widely used in the field of empirical research, it has advantages in processing small sample data and multivariate estimation [25]. Therefore, this study will adopt the PLS-SEM method for empirical testing.

4. Research Hypotheses and Theoretical Model

Based on the above results, we further explored the influence of the different factors on WPCSQ and constructed a theoretical model.

4.1. The Influence of Technical Factor on WPCSQ

Technical factor directly affects the reliability, intensification and efficiency of a WPCS. Consideration and evaluation of technical factors can help decision makers select appropriate technical solutions, optimize system performance and effectiveness, and ensure the reliability and safety of the WPCS. The technical factors include five aspects: technical management, innovation, safety, compatibility and simplicity.

Technical management refers to the management of a business or organization using technology-related resources, including hardware, software and networks. Technology management not only helps companies to acquire and assimilate technological knowledge resources but also dynamically operates, improves and updates them. Thus, technical management can improve companies' service performance [26,27]. In addition, the positive effect of technology management on service-oriented work has been demonstrated [28].

Technical innovation refers to the improvement of existing technologies or the creation of completely new technologies through advanced methods and thinking. It aims to enhance the consulting strength of WPCS companies. Technical innovation can both enhance the ability of service supply to meet demand and optimize efficiency [29]. In addition, through technological innovation, WPCS companies can realize the innovation of business processes, promote the transformation to digitalization and intelligence and provide construction employers with better WPCSQ.

Technical compatibility refers to the ability of different technical systems, equipment or software to work together, exchange information or interoperate effectively. Compatibility between different systems can lead to the accurate communication and interpretation of information. In a WPCS, there is a need to share information among specialists and project teams. It is necessary that information from different systems should be consistent in format, structure and semantics. Compatible technologies can not only reduce information conversion efforts but also decrease the possibility of errors occurring during a conversion. Therefore, sound technical compatibility can alleviate technical problems in consulting services and improve WPCSQ.

Technical security refers to the safety of information technologies and organizational or personal data during the stages of collection, storage, processing and application. A WPCS involves a lot of customer data, including sensitive information such as trade secrets and personal privacy data. According to Ganguli and Roy (2010), technical security significantly affected customers' perceptions of hybrid service quality [30]. In addition, security affected owners' trust in the WPCS, and the effect of trust on service quality was demonstrated [31]. Therefore, the improvement of technical security can increase the owner's trust and satisfaction in the WPCS, which in turn improves WPCSQ.

Technical simplicity means the ease of understanding and using technical products or services in terms of their design and utilization. Technical products or services in a WPCS need to be easy to use and understand so that users can get started quickly and reduce the risk of misuse. It has been shown that technical simplicity has an important influence on customers' perception of service quality [32]. By improving technological simplicity, WPCSQ can be further improved. Therefore, a hypothesis about the relationship between technical factors and WPCSQ is developed below.

Hypothesis (H1). *Technical factor have a positive effect on WPCSQ.*

4.2. The Influence of Environmental Factor on WPCSQ

Environmental factor refers to external circumstances affecting WPCSQ, including four aspects: policies and regulations, social environment, market environment, and cultural environment.

Policies and regulations refer to industrial policies, development plans, regulations and standards issued by governments at different levels that WPCS activities need to comply with. They can also guarantee the legitimacy of a WPCS and enhance the professional standard of these services. It has been shown that policies affect WPCS companies' fulfillment of social responsibility. Moreover, the introduction of reasonable policies can promote the healthy and orderly development of the market [33].

Social environment refers to various social factors and conditions that affect WPCS activities, such as social responsibility and relations. It has been shown that a company's fulfillment of social responsibility can directly promote its performance [34]. In a social environment, a good social relationship network can also provide support and resources for the development of WPCS projects. Both can accelerate processes in consulting services and improve WPCSQ.

Market environment is a general term for the business operating circumstances and related market conditions in which a WPCS company operates. Competitive market environments actively promote companies' fulfillment of their customers' needs [35]. Yee argued that a competitive market environment acts as an external force that directly drives service firms to seek ways to improve service quality [36]. The market environment can accelerate the rate of technological updates and shorten the product life cycle [37]. In addition, the market environment can also improve WPCS companies' ability to strengthen their own knowledge and project achievement to enhance their WPCSQ.

Cultural environment refers to cultural factors within a WPCS company that affect WPCSQ, such as values, beliefs, codes of conduct and work atmosphere. A good cultural environment can reduce negative emotions among employees through various statutes, values and group norms. It can also change the thinking mode and behavior of employees and improve their satisfaction and sense of belonging to their work [38]. Thus, a good cultural environment can improve WPCSQ by increasing the motivation of consulting engineers. In summary, a hypothesis of the relationship between environmental factors and WPCSQ is proposed.

Hypothesis (H2). *Environmental factor have a positive effect on WPCSQ.*

4.3. The Influence of Organizational Factor on WPCSQ

Organizational factor refers to characteristics, resources and capabilities that have an impact within a WPCS company. These include five aspects: top management support, communication and coordination, organization scale, management system and talent system.

Executive support consists of the recognition and endorsement of advisory matters or decisions by senior managers, as well as support in terms of resources. Executive support guarantees that a company can successfully conduct WPCSs. Executive support increases the consultants' emotional commitment to their companies, meaning that they are more likely to improve WPCSQ. In addition, when consultants perceive high levels of executive support, they tend to provide better services to customers in return for executive support [39]. According to Jia and Reich's study, executive support can enhance teamwork and cohesion so as to establish a good service climate [40].

Communication coordination is the process of exchanging information and resources within or outside of a WPCS company. Al Nahyan believed that communication coordination is a key factor for project success [41]. A good communication and coordination

mechanism can not only provide timely feedback on project progress [42] but also identify risks and problems in a project [43]. All this can further improve WPCSQ.

Organizational size refers to the scale of a WPCS company, including the number of consulting engineers, the size of assets, the scope of the business and the number of market shares. According to Gangopadhyay and Homroy, the organization size had a positive influence on service quality [33]. Moreover, organization size can also increase the level of business-specific applications to improve the quality of services.

A management system refers to the setting and arrangement of the composition, responsibilities, authority, workflow and decision-making mechanism of a WPCS company. This system is the foundation and framework for service supply. It not only directly determines management efficiency and effectiveness but also ensures smooth management work within an organization [44].

A talent system refers to the introduction, training, motivation and management that a WPCS company implements to achieve its strategic goals. This system provides opportunities for starting a WPCS business. It is a basic guarantee for the effectiveness of a company's service transformation strategy [45]. A good talent system can enhance the professional ability and comprehensive quality of employees, optimize the allocation of human resources in a company and improve WPCSQ. Hence, this research proposed the following hypothesis.

Hypothesis (H3). *Organizational factor have a positive effect on WPCSQ.*

4.4. The Influence of Knowledge Management on WPCSQ

A WPCS is a knowledge-intensive service activity, and knowledge management is becoming more and more prominent in improving WPCSQ. It has been shown that knowledge management significantly improves the quality of consulting services. Moreover, it is a major factor in the enhancement of WPCSQ [46,47]. Knowledge management includes knowledge acquisition, integration, sharing and application.

Knowledge acquisition refers to the process of assessing, collecting and refining the knowledge of WPCS companies. The main modes of knowledge acquisition include academic papers, research reports, training courses and seminars. Knowledge acquisition not only improves companies' innovative capabilities but also affects the performance of service development [48,49].

In a WPCS company, knowledge integration involves the combination of original knowledge, project experience and new knowledge to form a core knowledge system. Knowledge integration can promote the reorganization of corporate knowledge and help companies respond to changes effectively and optimize a service portfolio systematically to improve corporate service levels [50,51]. This integration forms a basis for knowledge sharing, creation and application, which can further be beneficial in providing high-quality consulting services.

Knowledge sharing is the process of sharing and exchanging knowledge between WPCS companies, project teams and individuals. Effective knowledge sharing can improve work styles, optimize business processes and save consulting time [52]. Knowledge sharing is particularly important for service-centered consulting companies, where knowledge sharing with clients is a distinct feature of their services [53]. Moreover, knowledge sharing can help companies gain a deeper understanding of their clients' needs and improve service quality [54].

Knowledge application involves the utilization of professional knowledge, experience and skills accumulated in WPCS companies. Knowledge application aims to utilize knowledge resources to solve problems in business development [55]. If companies have a

stronger capacity for knowledge application, they will be more efficient in transforming knowledge into innovative services [56]. Moreover, knowledge application in WPCS companies can help them improve service efficiency and quality. Hence, a hypothesis of the relationship between knowledge management and WPCSQ is proposed.

Hypothesis (H4). *Knowledge management has a positive impact on WPCSQ.*

Based on the above analyses, this paper further proposed a theoretical model concerning different influencing factors and WPCSQ. This model is shown in Figure 1.

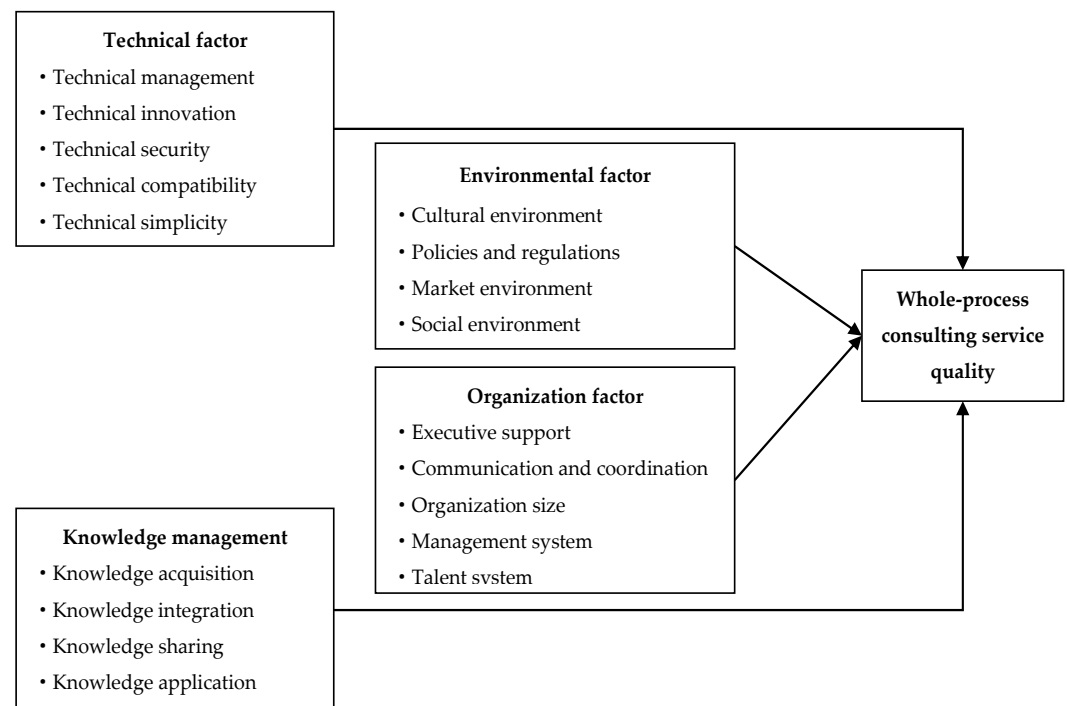


Figure 1. A TEOK model.

5. Empirical Research

5.1. Survey Design

Variables and items were further measured on the basis of the coding results and related studies. Prior to the formal collection of data, the scale was revised by two professors, one associate professor, and one Ph.D. student in the field of WPCS. The revised scale is more relevant to the linguistic habits and cultural backgrounds of the respondents. Then, the items were assessed and improved via 45 pretesting questionnaires to ensure the accessibility of the formal survey design. Finally, a 5-point Likert scale was used to measure the variables in the TEOK model. The variables, items and references are shown in Table 5.

5.2. Data Collection

The questionnaires were delivered to employees of WPCS companies through a network platform (www.wjx.cn, accessed on 14 February 2024). After two months of delivering this questionnaire survey, 208 valid samples were finally obtained after screening out some obviously unreasonable and blank questionnaires. Descriptive statistics of the samples are shown in Table 6.

Table 5. Variables and items of the TEOK model.

Variable	Item	References
Technical factor		
TF1	Technical resources (such as building information modeling technology and knowledge base) and development strategies can enhance WPCSQ	[38,57]
TF2	Technical research, development, and utilization can improve WPCSQ	
TF3	The companies can use technologies to protect data and private information	
TF4	Good compatibility between hardware and software are beneficial to WPCSQ	
TF5	Simple and convenient technologies can enhance WPCSQ	
Environmental factor		
EF1	Relevant policies and industry standards can promote WPCSQ	[58,59]
EF2	Good social relations can actively promote WPCSQ	
EF3	The openness and demand of the market can facilitate WPCSQ	
EF4	An adaptive company culture can enhance WPCSQ	
Organizational factor		
OF1	The support of senior managers can help to improve WPCSQ	[44,57]
OF2	A good communication and coordination mechanism can improve WPCSQ	
OF3	The company scale and employees can guarantee WPCSQ	
OF4	An organizational structure and service model can improve WPCSQ	
OF5	A good talent management system can enhance WPCSQ	
Knowledge management		
KM1	Good knowledge collection ability of the company can improve WPCSQ	[60,61]
KM2	Effective knowledge integration in the company can promote WPCSQ	
KM3	A good knowledge sharing mechanism can improve WPCSQ	
KM4	Efficient knowledge application can help to improve WPCSQ	
Whole-process consulting service quality		
WPCSQ1	The company can accurately provide the promised services	[11,62]
WPCSQ2	The company can immediately solve problems in the process of the WPCS	
WPCSQ3	The company can effectively meet the needs of clients	
WPCSQ4	The company can guarantee a high level of WPCSQ	

Table 6. Statistical descriptions of the samples.

Respondents	Classification	Frequency	Percentage (%)
Position	Senior management	53	25.48
	Middle management	57	27.40
	General staff	84	40.38
	Other	14	6.73
Educational background	Junior college and below	42	20.19
	Undergraduate	82	39.42
	Master	84	40.38
Years of working experience	<3 years	86	41.35
	3–7 years	51	24.52
	7–10 years	30	14.42
	>10 years	41	19.71
Company scale	0–100 people	60	28.85
	100–500 people	64	30.77
	500–1000 people	32	15.38
	>1000 people	52	25.00
Company type	State-owned enterprise	64	30.77
	Private enterprise	134	64.42
	Other	10	4.81

5.3. Measurement Model Testing

5.3.1. Common Method Variance Test

Because the questionnaire used in this paper was filled in by every single respondent, there may be a potential risk of common method bias (CMB). A Harman's one-factor test was conducted to test the CMB risk. SPSS (v22.0) software was used for factor analysis, and five factors with feature roots greater than 1 were obtained. The unrotated cumulative variance explanation rate of the obtained factors was 76.11%, and the single-factor variance explanation rate was the largest at 35.35%. Podsakoff and Organ (1986) believed that the single-factor explanation rate was less than 50%, indicating that the risk of CMB was not serious [63]. Therefore, it can be considered that there was no potential risk of CMB.

5.3.2. Reliability and Validity Tests

SPSS and Smart PLS (v3.0) software was used to analyze the reliability and validity of the variables. As shown in Table 7, the factor load of all variables was greater than 0.70 [25]. The Cronbach's alpha value of all variables was greater than 0.70, indicating that each variable had good internal consistency [58]. The composite reliability (CR) values were all greater than 0.70, indicating that the model has good reliability [25]. The average variance extracted (AVE) values of each variable were all greater than 0.50, indicating that the model has good convergence validity [64].

The results of discriminant validity are shown in Table 8. The diagonal values in the table are the square root of each variable's AVE, which are more than the correlation coefficients. It can be considered that all variables have good discriminant validity [65].

Table 7. Model testing results.

Variable	Item	FL	CA	CR	AVE
Technical factors	TF1	0.892	0.909	0.932	0.733
	TF2	0.787			
	TF3	0.846			
	TF4	0.825			
	TF5	0.924			
Organizational factors	OF1	0.902	0.916	0.937	0.748
	OF2	0.857			
	OF3	0.862			
	OF4	0.852			
	OF5	0.851			
Environmental factors	EF1	0.864	0.868	0.906	0.708
	EF2	0.920			
	EF3	0.856			
	EF4	0.712			
Knowledge management	KM1	0.823	0.886	0.922	0.746
	KM2	0.866			
	KM3	0.878			
	KM4	0.887			
Whole-process consulting service quality	WPCSQ1	0.869	0.894	0.927	0.759
	WPCSQ2	0.875			
	WPCSQ3	0.859			
	WPCSQ4	0.882			

Table 8. Correlations among major constructs.

Item	TF	EF	OF	KM	WPCSQ
TF	0.856				
EF	0.402	0.841			
OF	0.401	0.377	0.865		
KM	0.401	0.381	0.410	0.864	
WPCSQ	0.407	0.396	0.390	0.406	0.871

5.3.3. Structural Model Testing

Based on the PLS algorithm, we obtained the determinant coefficients, R^2 , which signify the quality of the model [64]. The value of R^2 is equal to 0.293 in the TEOK model, which indicates that 29.3% of the WPCSQ can be explained by these influencing factors. According to Haider and Kayani (2021), the R^2 result shows that the model can explain the structural variance well [66]. Then, the Stone–Geisser’s Q^2 value was calculated by using the blindfolding procedure with the cross-validated redundancy method, which was used as an indicator for the predictive relevance. The Q^2 value was 0.249, which is greater than zero, suggesting an acceptable level of predictive relevance. Finally, all the hypotheses in the model were tested with a bootstrapping operation by using a sample of 5000. The output results are shown in Figure 2.

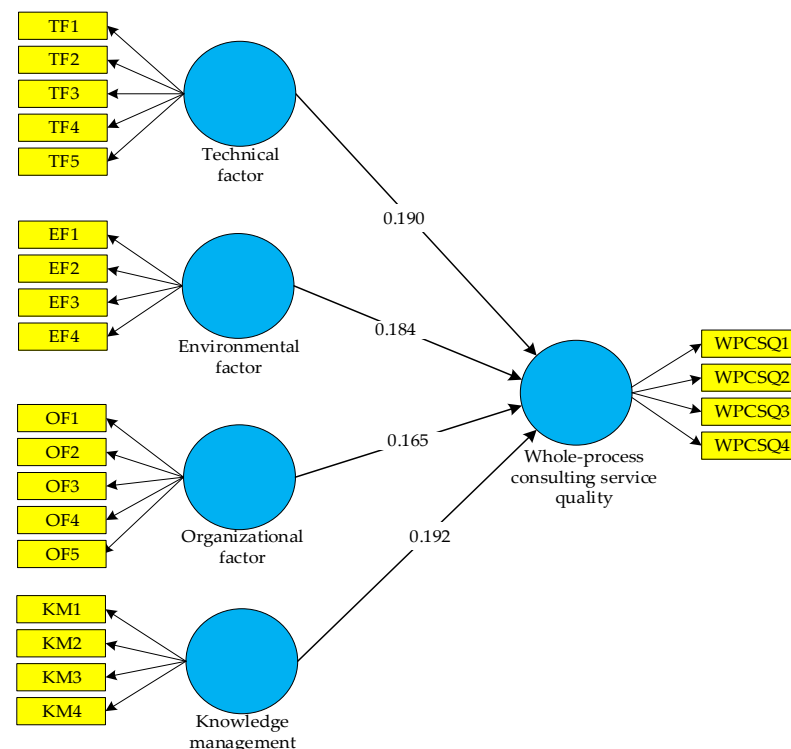


Figure 2. Measurement and structural model.

In addition, the corresponding path coefficients, t -values and p -values are presented in Table 9.

Table 9. Hypothesis testing results.

Path	Hypothesis	Path Coefficient	p -Value	t -Value	Testing Results
TF→WPCSQ	Hypothesis (H1)	0.190	*	2.148	Supported
EF→WPCSQ	Hypothesis (H2)	0.184	**	2.982	Supported
OF→WPCSQ	Hypothesis (H3)	0.165	*	2.319	Supported
KM→WPCSQ	Hypothesis (H4)	0.192	**	2.731	Supported

Note: * represents $p < 0.05$, ** represents $p < 0.01$.

As shown in Table 9, the technical factors had a positive effect on WPCSQ (t -value = 2.148), so Hypothesis (H1) is supported. In addition, the environmental factors were also positively associated with WPCSQ (t -value = 2.982), which shows that Hypothesis (H2) is supported. In terms of organizational factors, they positively influenced WPCSQ (t -value = 2.319); therefore,

Hypothesis (H3) was supported. Knowledge management was positively associated with WPCSQ (t -value = 2.731), therefore supporting Hypothesis (H4).

6. Conclusions and Discussion

6.1. Discussion

In this study, the influencing factors of WPCSQ were explored by using a mixed research method. Four influencing factors were determined by the GT method, including technical, environmental and organizational factors and knowledge management. Based on the above analyses, a TEOK model of WPCSQ was constructed. This model was empirically tested by using the PLS-SEM method. The results show that all these influencing factors have a significant and positive impact on WPCSQ. Firstly, knowledge management has the greatest impact on WPCSQ, and this finding is consistent with the core attributes of a WPCS. As a typical service type, WPCSs can be improved through knowledge acquisition, integration, sharing and application in specific project practices. Effective knowledge management can also enhance the competitiveness of WPCS companies. Secondly, technical factors are directly and positively associated with WPCSQ. WPCS companies need to pay attention to the supporting role of information technologies in service quality. These companies should increase their investment in technologies, improve their technical development strategies and combine new technologies with their WPCS business. During the application of hardware and software, compatibility and security also need to be focused on. Thirdly, environmental factors exert a direct and positive influence on WPCSQ. The WPCS companies need to pay attention to the construction of organizational and cultural environments within their organization. In addition, external social, policy and market aspects should be emphasized to build good social network relationships. Fourthly, although organizational factors have minimal influence on WPCSQ, they cannot be ignored. In order to better adapt to the business development of WPCSs, companies should optimize their organizational structure, provide executive support and improve their talent management system. Organizational factors affect WPCSQ by influencing internal resources, management mechanisms, etc. This reminds engineering consulting enterprises that during service transformation, they need to actively optimize the organizational structure, improve the management level, and accelerate the cultivation of composite talents to improve the quality of consulting services within the enterprise itself as the driving force.

Based on the results of the GT analysis and empirical test, the following recommendations can be made for the enhancement of WPCSQ: Firstly, WPCS companies are advised to establish an internal knowledge sharing and exchange platform to encourage project members to share their experience, specialized knowledge and best practices. In addition, an expert-supporting database could be established to record and manage the knowledge and experience of experts from various fields. It is also necessary to establish a knowledge management system for tracking customer needs and industry dynamics. Secondly, a scientific technology management system should be constructed to ensure the effectiveness and applicability of technologies in consulting services. This system could be established to assist consultants in planning, implementing and monitoring projects. Through virtual meetings and remote communication tools in the system, real-time interaction and cooperation between consultants and clients can be achieved. In addition, the consulting process could be automated with artificial intelligence and machine learning technologies. Stringent security technologies and measures should also be adopted to safeguard client information and ensure the security of the consulting process. Thirdly, companies should optimize their organizational structure and allocate sufficient resources to support their WPCS business. An open and trusting working environment should be cultivated to boost team communication and cooperation. Moreover, companies should continuously invest

in the training and development of their staff to enhance their professional capabilities, covering professional knowledge, communication skills and teamwork training. Fourthly, the government needs to accelerate the formulation of WPC-related laws, regulations and industry standards. Additionally, it is necessary for the government to supervise the qualifications and behavioral norms of WPCS companies. These companies should adjust their service strategies and innovate service models through changes in the social and market environment.

It is worth noting that the research findings of this paper were obtained through the analysis of data collected from multiple companies through questionnaires. Therefore, when using this model, a WPC company should consider its own situation, refer to the research findings of this paper and formulate a development strategy with its own preferred characteristics. Therefore, given Python's potential to facilitate model computation and simulation, WPCS managers can take full advantage of the TEOK model and Python to dynamically monitor WPCSQ and quickly adjust their management strategies.

6.2. Conclusions and Implications

From the perspective of WPCS companies, this study used a mixed research method to explore the influencing factors of WPCSQ. The GT method was used to identify four influencing factors of WPCSQ, namely technical, organizational and environmental factors and knowledge management. Moreover, a theoretical TEOK model was constructed. Then, the data obtained from the questionnaire survey were empirically analyzed by using the PLS-SEM method. It was found that technical factors, environmental factors, organizational factors, and knowledge management all have a positive impact on WPCSQ. Knowledge management had the greatest impact on WPCSQ, followed by technical factors and environmental factors, and organizational factors had the least impact on WPCSQ.

This study posits three significant implications from theoretical and practical perspectives. Firstly, this study contributes to the literature on WPC and service quality. It enriches service quality research in the WPC context and increases our understanding of WPCSQ. Secondly, a theoretical model of influencing factors and WPCSQ was constructed for the first time. The TEOK model added a theoretical explanation of different variables and WPCSQ. The theoretical contribution of this model could also provide reference for other related studies. Finally, based on the empirical results, the degree of influence of different factors on WPCSQ was varied. Hence, WPCS companies can improve WPCSQ by optimizing the service process, enhancing professional competence and improving communication efforts in practice. Additionally, this paper could also help the government take measures to promote the development of the WPCS industry.

6.3. Limitations

Research on WPCSs is still in its infancy, and there is only a small amount of research available. Most of the data were collected from companies that were initially carrying out a WPCS business; therefore, different development levels of companies were not considered enough. Furthermore, the number of data used in this paper was only 208, which might influence the generalizability of the results due to the sample size. Moreover, this research mainly explored four factors affecting WPCSQ. Nevertheless, there might be other determinants that significantly influence WPCSQ. In the future, other determinants will be further investigated with the development of WPCSQ. In addition, this study did not analyze the relationship between effective factors affecting WPCSQ, and further analysis is needed in future studies. Moreover, the number of questionnaires needs to be further increased.

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