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An Evaluation Computing on Automobile Transaction Process by FAHP with CMMI3: A Case Study of the H Company

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Abstract: *The traditional automobile trading market is subject to several factors, including personnel training, technology application, Leading and Lagging Indicators,non-standard transaction approval process, market size, and industrial policies, which pose challenges to the informatization of the automobile trading market in the optimization of transaction and management process and other aspects. It is necessary to adapt to the increasingly fierce market competition by promoting the enterprise's informatization process and optimizing information management. This paper built a new evaluation model of the automobile market business informatization management process based on the Capability Maturity Model Integration(CMMI) model. Based on FAHP research method and MATLAB analysis tool, the questionnaire was designed. According to involve gathering and analysing data. Through the empirical analysis of the valid sample data of the questionnaire for the evaluation of the capability level of the business informatization process of the H automobile trading market, the overall capability of the H automobile trading market is evaluated by the analysis of the valid sample of the questionnaires. The optimization and improvement measures for the evaluation indicators are put forward according to the evaluation results.*

Keywords: *CMMI FAHP Trading informatization Process optimization*

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I. Introduction

With the rapid development of the domestic automobile market, A.C. Auto News (2019) pointed out the business informatization process of the automobile market was facing many problems: Establishing and improving the market development system and mechanism, speeding up the development of the automobile business informatization construction, improving the management level of automobile business informatization, and continuously optimizing the automobile business informatization process. After years of business informatization in management and process optimization, the H automobile trading market, one of the major auto markets in east China, the informatization level in the business management has made significant progress; Regarding business informatization optimization, the H market still faces issues in the optimization of transaction information management, information infrastructure, and organizational management process.

The maturity model come from the Capability Maturity Model (CMM) proposed by Carnegie Mellon University. Musawwer Khan et al.(2021) proposed that business enterprises invest huge money in information systems that serve their key functions like Human Resources, Marketing, Finance, Sales, Transportation, etc. Xu Limin (2022) pointed out that the core concept of CMMI was to establish an effective infrastructure through the development of software engineering process standards and improve the process to solve the problems encountered in software development. Its essence was a new management idea and method, that is, to use CMMI to guide process improvement and achieve organizational management objectives through process standardization and continuous improvement. Sharma Rekha and Dadhich Reena(2021) studied that It could occur due to incorrect assessment of user-requirements, fallacious estimates of overall development cost, improper project schedule, or quality specifications that are unattainable within the software-specific constraints. Kapil Jaiswal and Minakshi Garg(2019) studied analyse the linkage between total quality management (TQM) implementation and CMMI, both of which promotes continuous improvement, CMMI being, one of the most popular method of continuous improvement in Software industry. Agenjo Eduardo et al.(2018) pointed out that CMMI is theoretically related to the generation of dynamic capabilities.

The CMMI model of the informatization process focuses on improving the overall process of informatization development. The model divides the whole informatization process into several phases. Each

phase contains a different number of process areas and then describes each process domain so that the informatization development activities are divided and described systematically. On this basis, CMMI provides a method for continuous improvement of informatization development activities. Shuangyan Li(2012) used the analytic hierarchy process to build a Hierarchical analysis model of critical factors in multiple dimensions, including organizational, technical, technical, and personnel factors, to verify the key factors affecting the implementation of CMMI. CMMI focuses on the overall process and divides the process domain into three categories: management, R & D, and service support. At the same time, the stages of the process domain are divided into five levels, with hierarchical improvement objectives. CMMI has improved from the second level project level planning and tracking process to the third level project management level to form a standard procedure, then to the fourth level quantitative management to quantitatively predict and control the process. The fifth level is the continuous improvement of the process to accommodate the organization's overall strategy.

Mingfeng Zhao(2019) mentioned two central representations in the CMMI model evaluation system: phased representation and continuous representation. The evaluation system reflects the advantages of the CMMI model in terms of integration, and it also meets the needs of different organizations for the CMMI system. Also, Meiqin Lu and Helan Chen (2011) analyzed the factors influencing the implementation of CMMI process improvement from organizational and project factors perspectives. In tailoring and expanding the implementation model based on the CMMI model, the organization should comprehensively and objectively combine the factors of the organization's scale, human resources, cost, objectives, and so on, and formulate guidelines conducive to the organization's achievement of stage objectives.

The organization shall formulate the process management specification according to the actual situation and fully consider the cost and benefit of process optimization and improvement. Huili Chen and Cao Jie (2019) believe that the organization should plan the construction of the CMMI system from a strategic height and a long-term perspective, define the specific objectives of the organization's implementation capability improvement within the organization in various forms, envision the results, determine the course of action. Further, concretize the strategic objective of implementation capability optimization, which is relatively abstract, into executable and standardized management processes.

Doss Adrian Daniel et al (2021) examined a variant of the capability maturity model integrated (CMMi) through the lens of market engineering process improvement. Eman Yassien (2020) studied CMMI enhances the organisational and functional capabilities to guarantee a competitive advantage. Wang Can (2011) put forward suggestions on the correlation factors in improving the CMMI implementation process by analyzing the trusted correlation factors that affect each other, including software availability, reliability, security, timely processing, maintainability, and survivability. Qingfei Min(2005) put forward improvement suggestions for the above influencing factors through the analysis of critical success factors, including senior management support, business process reengineering, project management, business process restructuring, and external professional support, as well as situational factors such as enterprise scale, nature of enterprise ownership, number of implementation modules and type of suppliers.

To sum up, as for the organizational factors, the CMMI implementation improvement proposal is put forward mainly by administrative personnel, corporate strategy, and organizational culture. The project puts forward improvement suggestions from the implementation methods, strategies, implementation tools, and technologies for CMMI process improvement.

We summarize the main contributions of our work as follows:
First, the CMMI model has been successfully applied to the process improvement of automobile transaction informatization.
Second, the CMMI model was innovated and tried.
Third, the practicability of the model construction was studied through case studies.
Last, suggestions and measures were put forward for process improvement of H company.
The remainder of this paper is organized as follows from the second phase to the fourth phase.

II. CMMI-based evaluation system

Based on the CMMI theory and the practice of business informatization, an evaluation system for business informatization management process is established based on the CMMI model, including IT-based implementation & management process, informatization application & management process， personnel management process, organizational strategy management, and security management process. A business informatization management process evaluation system based on the CMMI model is divided into the evaluation indicators and best practices at all levels according to classification. The fuzzy analytic hierarchy process and Likert five-point scale are used to build a data model for calculation and quantitative analysis. Likert scale method and questionnaire survey were used to collect sample data. FAHP, widely used in quantitative research, is used to introduce fuzzy values and establish the evaluation pointer and judgment matrix of the evaluation

model. The weight ratio of each evaluation index level isset by matrix calculation.

Under the guidance of the CMMI model theory, a comprehensive, concise, purposeful, measurable, scientific, and practical evaluation system for optimizing the business informatization management process of the automobile trading market is established. The Evaluation index classification, assortment, coding, and indicator description of the evaluation indicators are shown in table2-1 to build a comprehensive and intuitive model system for subsequent quantitative analysis and research.

Table 2-1 evaluation index system and its grading index and code

Primary index X	Secondary indicator Y	Level III indicator Z
It is a basic configuration management process X1	Basic .T.I.T. configuration Y1	Internal system integration Z11
		Software usage support capability Z12
		Network support performance Z13
		Computer performance level Z14
		Server configuration performance Z15
	Informatization budget support Y2	The proportion of informatization budget Z21
		The rationality of informatization budget Z22
Business informatization management process effect X2	Informatization effect Y3	Business informatization degree Z31
		Collaboration between business systems Z32
		Improvement of business execution efficiency Z33
	Business informatization coordination capability Y4	Related business information processing capability Z41
		Business information flow efficiency Z42
	Business informatization processing capacity Y5	Business maturity Z51
		Decision control degree Z52
		Business integration capability Z53
		Business standardization degree Z54
Talent construction management process X3	Talent quality Y6	The proportion of business professionals Z61
		Education level of talents Z62
	Professional competence Y7	Emergency handling capacity Z71
		Business understanding Z72
		Business skills Z73
	Organization construction Y8	The rationality of post-setting Z81
		Job training level Z82
Organization management process X4	Specification and system construction Y9	Completeness of executive specifications Z91
		Rules and regulations support Z92
	Organizational strategy Y10	Degree of organizational decision Z101
		Information management role Z102
		Organization strategy coordination degree Z103
	Outsourcing management capability Y11	Service outsourcing management level Z111
		Service outsourcing efficiency Z112
Safety assurance management process capability X5	Operation guarantee security strategy Y12	System quality specification level Z121
		Business process rationality Z122
		System safety monitoring capability Z123
		The standard degree of data interface Z124
	Data security capability Y13	Security policy definition degree Z131
		Business data and data backup Z132
		Business recovery capability Z133

After completing the optimization evaluation system for the informatization management process of the automobile market business, the five levels of the evaluation system are defined according to the CMMI phased representation. In the implementation, the enterprise will optimize the performance or dynamic demand for the business informatization management process and continue to optimize the business informatization management process & implementation capability. Figure 2-1 shows the CMMI phased representation:

Figure 2-1 CMMI stage expression of the evaluation system

2.1 Construction of a comparison matrix

The survey group used fuzzy values(M1-M9) to describe their preferences for each indicator at the same level. By investigating the CMMI model evaluation system for automobile market business informatization management process constructed by N relevant personnel, and after the processing of the collected sample data from the investigation of appropriate personnel, the comparative judgment matrix of each level is constructed, and the weight value of each evaluation index at the same level is calculated.

According to the collected sample data, the weights of the primary, secondary and tertiary evaluation indicators of the evaluation system model constructed in this paper are calculated, respectively.

Table 2-2 shows the comparative matrix for the first level evaluation indicators of the automotive market business informatization management process based on the CMMI model.

Table 2-2 comparison matrix of primary evaluation indicators

Index / Ratio / Index	.T.I.T. infrastructure implementation	Informatization application effect	Personnel management process	Organizational strategy	Operational guarantee
.T.I.T. infrastructure implementation	1	2	3/2	1	4/3
Informatization application effect	3/4	1	4/3	3/2	1
Personnel management process	2/3	3/4	1	4/3	3/2
Organizational strategy	1/2	2/3	1/2	1	3/2
Operational guarantee	1	1	3/2	1	1

According to table 2-2, the comparison matrix of first-level evaluation indexes is constructed:

$$A=\begin{bmatrix} 1 & 2 & 3/2 & 1 & 4/3 \\ 3/4 & 1 & 4/3 & 3/2 & 1 \\ 2/3 & 3/4 & 1 & 4/3 & 3/2 \\ 1/2 & 2/3 & 1/2 & 1 & 3/2 \\ 1 & 1 & 3/2 & 1 & 1 \end{bmatrix}$$

Through the conversion of MATLAB data analysis software, the conversion judgment matrix for the first level evaluation index is obtained as follows:

$$A=\begin{bmatrix} 1.0000 & 2.0000 & 1.5000 & 1.0000 & 1.3333 \\ 0.7500 & 1.0000 & 1.3333 & 1.5000 & 1.0000 \\ 0.6667 & 0.7500 & 1.0000 & 1.3333 & 1.5000 \\ 0.5000 & 0.6667 & 0.5000 & 1.0000 & 1.5000 \\ 1.0000 & 1.0000 & 1.5000 & 1.0000 & 1.0000 \end{bmatrix}$$

According to the index weight of the evaluation system, in order to directly reflect the influence weight of each index weight in the whole evaluation system, a multi-level surface grid diagram based on the index weight matrix is constructed, as
shown in Figure 2-1.

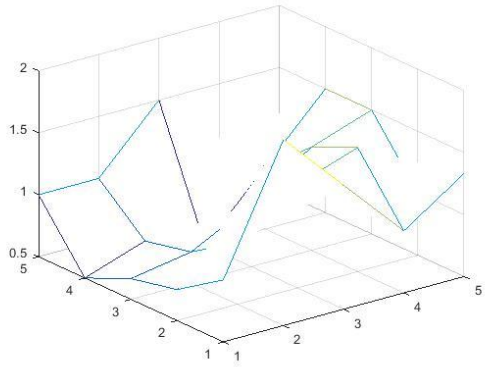

Figure 2-1

By analogy, a comparative judgment matrix is constructed for all the secondary evaluation indicators corresponding to the primary evaluation indicator of the evaluation model and the tertiary evaluation indicators corresponding to the secondary evaluation indicators.

2.2 Calculating eigenvectors and maximum eigenvalues

By establishing the judgment comparison matrix, we calculate the eigenvector of the judgment comparison matrix through the summation method and conduct the consistency test of the judgment comparison matrix.

This paper uses the summation method to calculate the eigenvector of the judgment comparison matrix. According to the judgment comparison matrix constructed from the collected samples, the eigenvector is calculated by the relative weight of each factor in each judgment matrix for its index at the same level.

The maximum eigenvalue and eigenvector of the primary index judgment matrix for the evaluation system are calculated by using Matlab mathematical analysis software:

Amax＝5.3648

Table 2-3 shows the calculated characteristic weight vector of the judgment ratio matrix of the first level evaluation index at the same level:

Table 2-3 feature weight vector scale of level I evaluation indicators

Xi	Weight of primary evaluation index
X1	0.1463
X2	0.2927
X3	0.2195
X4	0.1464
X5	0.1951
Cr	0.0000

Through the calculation with Matlab mathematical analysis software, theλMax = 5.3648, that is, the maximum eigenvalue and eigenvector value of the primary index judgment matrix, and the corresponding eigenvectors are (0.1463, 0.2927, 0.2195, 0.1464, 0.1951)τ

2.3 Matrix consistency test

According to the eigenvector and maximum eigenvalue calculated by the judgment comparison matrix, to test the consistency of the judgment matrix, the consistency index value (C.I) is estimated to judge whether the judgment matrix can pass the consistency test. The consistency test value in this paper is within the reference range of passing the consistency test.

C.R.＝C.I / R.I

According to the calculation results, when c.r.<0.1, it is considered that the consistency of the judgment matrix is acceptable; C. When r.>0.1, it is considered that the judgment matrix does not meet the consistency requirements and needs to be revised again; C. When r.=0, the judgment matrix is considered to be completely consistent.

According to the consistency check calculation formula, the consistency check is performed on the calculation results of the judgment comparison matrix. The calculation process is as follows:

C.I ＝ (5.3648-5)/4＝0.0912

C.R ＝C.I/R.I

＝0.0912/1.12

＝0.0814

According to the calculation results, the C.R ＜ 0.1 judgment matrix is acceptable consistency.

2.4 Index weight calculation based on CMMI evaluation system

According to the sample recovery data, the index weights of the evaluation system for the informatization management process of automobile market business are calculated level by level using the FAHP method and Matlab tool. According to the statistical principle, the sum of the weights of each evaluation indicator at the same level is 1, which quantifies the indicators at all levels, improves the objectivity of the evaluation operation, and provides more accurate data analysis support.

With reference to the calculation process and method of the primary evaluation index weight of the evaluation system, the weights of evaluation indexes at all levels are determined for the secondary and tertiary indexes according to the same calculation process. Summarize the weights of indicators at all levels, as shown in table 2-4:

Table 2-4 summary of index weights of an evaluation system based on the CMMI model

Index weight of evaluation system for business informatization management process of automobile market based on CMMI			
Primary index (XI)	Secondary index (Yi)	Level III index (Zij)	
X1（0.1463）	Y1（0.4348）	Z11（0.1911）	Z12（0.1517）
		Z13（0.2185）	Z14（0.2764）
		Z15（0.1623）	
	Y2（0.5652）	Z21（0.4377）	Z22（0.5623）
X2（0.2927）	Y3（0.3869）	Z31（0.4283）	Z32（0.2175）
		Z33（0.3542）	
	Y4（0.2435）	Z41（0.5000）	Z42（0.5000）
	Y5（0.3596）	Z51（0.2115）	Z52（0.1131）
		Z53（0.2986）	Z54（0.3768）
X3（0.2195）	Y6（0.3472）	Z61（0.5323）	Z62（0.4677）
	Y7（0.4537）	Z71（0.3775）	Z72（0.4328）
		Z73（0.1897）	
	Y8（0.1991）	Z81（0.5630）	Z82（0.4370）
X4（0.1464）	Y9（0.1305）	Z91（0.6500）	Z92（0.3500）
	Y10（0.5563）	Z101（0.5589）	Z102（0.2798）
		Z103（0.1613）	

	Y11(0.3132)	Z110（0.5788）	Z112（0.4212）
X5（0.1951）	Y12（0.6057）	Z121（0.3289）	Z122（0.1566）
		Z123（0.3488）	Z124（0.1657）
	Y13（0.3943）	Z131（0.3574）	Z132（0.2863）
		Z133（0.3563）	

III. Evaluation of the H market informatization management process

According to the established CMMI evaluation model and the matrix comparison method constructed by FAHP, the business informatization management process of the H market is comprehensively assessed.

The questionnaire for evaluating the H market's informatization management process is designed on a Likert five-point scale. The questionnaire study also includes three stages: first, before the questionnaire survey, this study is based on the CMMI model evaluation system, combined with the actual informatization implementation to decide the data be collected and the form of the questionnaire, and the questionnaire structure and survey question items were formulated accordingly. Second, researchers and relevant personnel of the H market will discuss the questionnaire, modify the content or problem description, and complete the first draft of the questionnaire. Third, we designed the questionnaire for the informatization management evaluation through the predictive survey. The questionnaire was revised after pretesting—the final questionnaire covering the entire evaluation index used to measure the survey included in this paper. In the questionnaire, all question items were measured on the Likert scale.

The H market informatization management process evaluation questionnaire mainly includes five parts and one questionnaire survey object related demographic data, including the respondents' evaluation of basic implementation, informatization application effect, personnel management process, organizational strategy, operation support ability, and the evaluation of the demographic data.

The questionnaire surveyed the relevant leaders of the H market, the personnel of business departments, the employees of the information technology department, and other respondents. The Likert five-point scale was used to obtain the evaluation data, namely, excellent, good, average, poor and very poor. According to the index weight of the evaluation system of the automobile market informatization management process based on the CMMI model, the level of the H market informatization management process is calculated. The evaluation index questionnaire structure is shown in table 3-1, and the questionnaire structure is detailed as follows:

Table 3-1 Questionnaire structure of the H market informatization management evaluation

Content	Question item	Description of evaluation method
.T.I.T. infrastructure implementation management process	6-7	Likert Likert scale
Application effect of the informatization management process	8-10	Likert Likert scale
Personnel management process	11-13	Likert Likert scale
Organizational management process	14-16	Likert Likert scale
Operation support and management process	17-18	Likert Likert scale
Demographics	Part VI	Category statistical scale

The fuzzy numerical scale is used for problem design and weight fuzzy numerical calculation of problem options. The structure design of problems and options is shown in Table 3-2:

Table 3-2 Problem and Options Structure design

Your attitude towards the basic .T.I.T. configuration in the market is [single choice]*					
Problem	Excellent	Good	Average	Poor	Very poor
Degree of integration between systems within the market Z11	○	○	○	○	○

3.1 Questionnaire

The questionnaire participants include the H market management, business departments, informatization implementation departments, and participants in the .T.I.T. infrastructure project. This paper adopts a

combination of overall sampling and stratified sampling, and the stratified sample of the market management, business departments, information technology departments, and market merchants of the study case, constitutes the distribution object of the questionnaire of the informatization management process evaluation system based on CMMI model. Through stratified sampling, the sampling error is reduced. After stratification, the isomorphism in layers increases, so the variability of observed values and the sampling error of each layer are reduced. Under the same sample size, the total standard error of stratified sampling is generally smaller than that of simple random, systematic, and cluster sampling. The stratified sampling method is flexible, and different sampling methods can be adopted for different layers according to the specific conditions of each layer.

3.2 Data collection

This paper studies the determination of the number of samples and designs a questionnaire using the Likert scale to collect the data. To facilitate and simplify the frequent calculation of time cost, the sampling number of questionnaire respondents needs to be controlled to ensure the rationality of calculation, sample consistency, and survey effectiveness analysis. Therefore, t the complex calculation cost in the research process is simplified ensure that the sample data meet requirements. According to the statistics of the final collected samples, the valid survey results are sorted out after eliminating the invalid questionnaires.

3.3 Data analysis

According to the study objective and the need to test research hypotheses, the methods used in the empirical analysis are mainly divided into the descriptive analysis of basic data and FAHP analysis. The descriptive analysis of basic data primarily uses SPSS 22.0 to carry out descriptive statistics and analysis of the data. The software matlabr2016 is mainly used for calculating judgment matrix for FAHP analysis, including statistical data analysis, reliability analysis, validity analysis, and FAHP analysis.

3.3.1 Descriptive statistical analysis

Through the descriptive statistical analysis of the collected data, we can further understand and analyze the structural characteristics of the samples. The questionnaire for evaluating the H market informatization management process is based on the Likert five-point scale. The raw data is processed into a format identified by the quantitative analysis software for quantitative analysis. By calculating each evaluation index's average and standard deviation, we can preliminarily understand the answers and opinions of the tested objects on the relevant evaluation items. According to the analysis results, the higher the average number of each question item, the higher the recognition degree of the tested object. The smaller the standard deviation of the sample data, the more consistent the answers of the tested object to the same evaluation index.

Table 3-3 summary of sample data description statistics

Evaluating indicator			
Name	Average Value	Standard Deviation	Median
Degree of integration between systems within the market Z11	2.720	1.051	2.000
Division of labor, monitoring, and collaboration of all software used in the market Z12	2.320	1.077	2.000
Market network fault, network speed, and stability Z13	2.200	0.904	2.000
Workstation configuration performance affecting business informatization work efficiency Z14	2.260	0.944	2.000
Server configuration and its effective support performance Z15	1.500	0.647	1.000
The proportion of automobile informatization budget in the total annual budget of Z21	2.580	0.859	2.500
Consistency between informatization budget and phased objectives Z22	1.720	0.784	2.000
Evaluation of business informatization management process Z31	2.480	0.931	2.000
Business informatization collaboration efficiency Z32	2.340	0.823	2.000
Improvement of business efficiency by informatization implementation Z33	1.940	1.114	2.000
Integration of market business information system with internal and external systems Z41	2.820	1.044	3.000
The efficiency of accurate and timely market business flow information Z42	2.160	0.792	2.000
Market business informatization maturity Z51	2.100	0.789	2.000
Business informatization decision support capability Z52	2.200	1.010	2.000
Integration and collaboration of business systems and basic data platformZ53	2.220	0.840	2.000
Realization degree of integrated business management system Z54	1.940	1.058	2.000
The proportion of talents with informatization and professional business knowledge Z61	2.700	0.909	3.000
General education level of talents in terms of academic qualifications Z62	2.600	0.833	2.000
Emergency response capability of employees Z71	2.140	1.010	2.000
Functional evaluation and use level of business knowledge and system Z72	2.140	0.990	2.000
The basis for business operation and processing capacity improvement Z73	1.980	1.020	2.000

Evaluating indicator			
Name	Average Value	Standard Deviation	Median
Relevant positions with informatization requirements Z81	2.660	0.848	2.000
Attention paid by the organization to professional training cost budget and training opportunities Z82	2.860	0.990	3.000
Support provided for the implementation of business informatization from the level of standard performance Z91	2.800	1.050	2.500
The organizational construction of universally recognized enterprise rules and regulations and cultural atmosphere Z92	2.940	1.018	3.000
Importance of the organization's top management on the strategic position of business informatization Z101	2.120	1.003	2.000
Information leaders in the process of information implementation Z102	2.040	0.903	2.000
Implementation and coordination of overall organizational strategy and business informatization strategy Z103	2.080	1.027	2.000
Organization's ability to manage business informatization outsourcing service Z111	2.540	0.862	2.500
Satisfaction with work efficiency of business informatization outsourcing service Z112	2.240	0.847	2.000
Compliance of business system implementation standards with relevant industry standards Z121	3.220	1.075	3.500
Conformity of business process determination with actual business Z122	2.600	0.990	2.000
Business information system security monitoring capability Z123	2.380	1.105	2.000
Standardization degree of system data interface definitionZ124	2.400	0.969	2.000
Implementation of relevant safety measures Z131	2.580	1.071	2.000
Timeliness of business data and data backup Z132	1.940	0.935	2.000
Accidental business data and data loss recovery capability Z133	1.720	0.904	1.500

According to the collected sample data, the unqualified and invalid sample data are excluded. The statistics of the valid samples collected in this questionnaire, the average value of the collected data, and the overall situation of the median value are made. As seen in Table 3-3, there is no abnormal value in the collected data, so the average value can be directly targeted in the analysis process of this paper.

3.3.2 Reliability analysis

Reliability analysis analyzes the accuracy and correctness of measurement methods by indicators. In this study, reliability reflects the consistency of the measurement. The higher the reliability, the basic condition for effective testing or questionnaire survey. Its purpose is to use the test items of the questionnaire as reliability indicators and evaluate the overall reliability of the system composed of single items. The research in this chapter mainly analyzes the reliability of the five major items of the evaluation system of the H market informatization management process, including its basic implementation, informatization application effect, personnel management process, organizational strategy, and security operation guarantee.

Cronbach's α Coefficient created the commonly used reliability test method of the Likert scale to measure the internal consistency of the questionnaire. Guieford(1965)proposed Cronbach'sαThe criteria for determining the coefficient are: α value greater than 0.7 indicates high internal consistency, and a value less than 0.35 indicates low internal consistency. Table 4-5 shows the reliability of the collected sample data. If the value is more significant than 0.95, refer to table 4-4 Cronbach'sαCoefficient value range, it can be seen that the collected sample data meet the requirements of reliability analysis. The range of coefficient values is shown in table 3-4:

Table 3-4 reference value range of reliability evaluation

Cronbach's αCoefficient value range	reliability
α <zero point three	Untrusted
0.3 < α <zero point four	Barely credible
0.4 < α <zero point five	Still credible
0.5 < α <zero point seven	Very credible (most common)
0.7 < α <zero point nine	Very credible (less common)
α >zero point nine	Very credible

According to the reliability analysis method, the evaluation indexes of the H market informatization management process evaluation system. The coefficient is shown in Table 3-5, and the comprehensive reliability coefficient is more significant than 0.95; According to the analysis results, the internal consistency of the scale has solid statistical significance ($p<0.005$).

Table 3-5 H evaluation indexes of market evaluation systemαcoefficient

Cronbach reliability analysis			
name	Total correlation of correction items (CITC)	Item deletedαCoefficient	Cronbach αCoefficient
Degree of integration between systems within the market Z11	0.290	0.954	0.953
Division of labor, monitoring, and collaboration of all software used in the market Z12	0.527	0.952	
Market network fault, network speed, and stability Z13	0.586	0.952	
Workstation configuration performance affecting business informatization work efficiency Z14	0.643	0.951	
Server configuration and its support effective performance Z15	0.360	0.953	
The proportion of automobile informatization budget in the total annual budget of Z21	0.618	0.951	
Consistency between informatization budget and phased objectives Z22	0.552	0.952	
Evaluation of business informatization management process Z31	0.440	0.953	
Business informatization collaboration efficiency Z32	0.735	0.951	
Improvement of business efficiency by informatization implementation Z33	0.762	0.950	
Integration of market business information system with internal and external systems Z41	0.514	0.952	
The efficiency of accurate and timely market business flow information Z42	0.602	0.952	
Market business informatization maturity Z51	0.444	0.952	
Business informatization decision support capability Z52	0.620	0.951	
Integration and collaboration of business systems and basic data platform Z53	0.447	0.952	
Realization degree of integrated business management system Z54	0.709	0.951	
The proportion of talents with informatization and professional business knowledge Z61	0.459	0.952	
General education level of talents in terms of academic qualifications Z62	0.729	0.951	
Emergency response capability of employees Z71	0.688	0.951	
Functional evaluation and use level of business knowledge and system Z72	0.730	0.951	
The basis for business operation and processing capacity improvement Z73	0.719	0.951	
Relevant positions with informatization requirements Z81	0.660	0.951	
Attention paid by the organization to professional training cost budget and training opportunities Z82	0.526	0.952	
Support provided for the implementation of business informatization from the level of standard performance Z91	0.503	0.952	
The organizational construction of universally recognized enterprise rules and regulations and cultural atmosphere Z92	0.364	0.953	
Importance of the organization’s top management on the strategic position of business informatization Z101	0.672	0.951	
Information leaders in the process of information implementation z102	0.673	0.951	
Implementation and coordination of overall organizational strategy and business informatization strategy Z103	0.496	0.952	
Organization’s ability to manage business informatization outsourcing service Z111	0.561	0.952	
Satisfaction with work efficiency of business informatization outsourcing service Z112	0.624	0.951	
Compliance of business system implementation standards with relevant industry standards Z121	0.448	0.953	
Conformity of business process determination with actual business Z122	0.620	0.951	
Business informatization system security monitoring capability Z123	0.685	0.951	
Standardization degree of system data interface definition Z124	0.780	0.950	
Implementation of relevant safety measures Z131	0.468	0.953	
Timeliness of business data and data backup Z132	0.716	0.951	
Accidental business data and data loss recovery capabilityZ133	0.615	0.951	
Standardized CronbachαCoefficient: 0.954			

From Table 3-5, the reliability system value is 0.953, more significant than 0.9, so the reliability quality of the sample data is very high. For deletedαCoefficient, the reliability coefficient has increased significantly after the two evaluation indexes, Z11 of the integration degree between various systems in the market and Z92 of the work efficiency satisfaction of informatization outsourcing services are modified.

For the CITC value, the CITC value corresponding to the degree of integration between various systems in the market Z11 and the satisfaction with the work efficiency of business informatization outsourcing services z112 is less than 0.4. After pretest analysis, the two items are corrected, and the formal data are collected. To sum up, through the reliability analysis of the sample data, the value of the reliability coefficient is higher than 0.9. The comprehensive analysis shows that the reliability of the sample data is high and can be used for further analysis.

3.3.3 Validity analysis

Validity analysis means that the test can truly measure the degree of the ability or trait it is intended to measure, that is, correctness. Only when the purpose of measurement is achieved can it be an effective measurement. After confirming the reliability of the questionnaire, then analyze and evaluate the validity of the questionnaire.

The validity analysis of this paper is mainly divided into two steps:

Firstly, the factor load of the problem item is investigated. The factor load coefficient means that the common variance between the problem item and its latent variable is more significant than between the problem item and the error variance. Generally, the load factor coefficient should be greater than 0.5, and when the T value exceeds 1.96, each construct has convergent validity; The second step is to examine the ave value. Claes Fornell, Michael D. Johnson, Eugene W. Anderson, jaesung Cha, and Barbara Everitt Bryant (1996) pointed out that the ave value should be greater than 0.5, which means that more than 50% of the variance of the problem item is explained, thus ensuring that more effective variances can be explained.

Table 3-6 potential variable factor load of the evaluation system

Latent variable	Factor load	Ave	T value
.T.I.T. infrastructure implementation management process		0.761	
Basic .T.I.T. configuration (Y1)	0.909		44.862
The proportion of budget and investment (Y2)	0.802		15.711
Informatization application effect		0.844	
Informatization implementation effect (Y3)	0.773		6.409
Informatization business coordination (Y4)	0.925		7.541
Informatization processing capacity (Y5)	0.825		6.641
Personnel management process strategy		0.682	
Talent quality (Y6)	0.931		90.814
Professional competence (Y7)	0.515		49.439
Post management (Y8)	0.615		39.439
The organizational strategic management process		0.841	
Rules and regulations construction (Y9)	0.940		4.732
Organizational strategy (Y10)	0.902		2.536
Outsourcing management (Y11)	0.702		1.536
Safe operation guarantee management process		0.841	
Operation safety assurance (Y 124)	0.940		4.732
Data security (Y13)	0.902		2.536

From the analysis results, the problem item load of all scales studied in this paper ranges from 0.515 to 0.940 (see table 3-6), which is greater than 0.5 and has strong statistical significance ($p<0.005$), which indicates that the scale designed in this paper has good convergent validity.

3.4 H market business informatization management process evaluation

The above uses the FAHP method to calculate the weights of evaluation indicators at all levels to evaluate the evaluation system of the automotive market informatization management process based on the CMMI model. To objectively and truly reflect the optimization ability of the H market informatization management process, in the process of calculating and analyzing the evaluation results, the weight set is set as:

W＝｛W11， W12， LWk1｝

The fuzzy relation matrix of indicators at all levels shall be obtained in sequence according to the following calculation methods:

M＝(Mij)mxn＝Wi×PI

According to the above fuzzy relation matrix, for the evaluation and investigation results of the H market business informatization management process based on Table 4-3, Matlab is used to calculate the weight set value of the step-by-step index fuzzy relation matrix. Th by the capability of the H market informatization management process is evaluated through the numerical division and calculation of the overall capability of the H market informatization management process.

3.4.1 Determination of single factor fuzzy evaluation matrix

First, the evaluation results of .T.I.T. basic implementation management process are transformed into the form of a membership evaluation matrix:

Basic .T.I.T. configuration Y1 evaluation pointer conversion matrix:

$$P1=\begin{bmatrix} 0.05 & 0.125 & 0.25 & 0.375 & 0.2 \\ 0.1 & 0.425 & 0.225 & 0.175 & 0.075 \\ 0.55 & 0.175 & 0.2 & 0.075 & 0.012 \\ 0.53 & 0.225 & 0.125 & 0.011 & 0.01 \\ 0.075 & 0.55 & 0.375 & 0 & 0 \end{bmatrix}$$

Informatization budget supports Y2 evaluation pointer conversion matrix:

$$P2=\begin{bmatrix} 0.11 & 0.24 & 0.41 & 0.24 & 0 \\ 0.146 & 0.361 & 0.52 & 0 & 0 \end{bmatrix}$$

According to the index weight summary of the H market informatization management process evaluation shown in Table 3-4, the relevant fuzzy relationship matrix of .T.I.T. infrastructure construction is calculated according to the above formula. First, calculate the basic .T.I.T. configuration and informatization budget support of the .T.I.T. infrastructure management process, and then calculate the fuzzy relationship matrix of the first level evaluation indicators of .T.I.T. infrastructure construction according to the calculation results. The calculation process is as follows:

The eigenvector of the basic it configuration (M1) evaluation pointer fuzzy matrix relationship is calculated as follows:

M1 = W1×P1

$$= (0.19110.1517\ 0.2185\ 0.2764\ 0.1623)x \begin{bmatrix} 0.05 & 0.125 & 0.25 & 0.375 & 0.2 \\ 0.1 & 0.425 & 0.225 & 0.175 & 0.075 \\ 0.55 & 0.175 & 0.2 & 0.075 & 0.012 \\ 0.53 & 0.225 & 0.125 & 0.011 & 0.01 \\ 0.075 & 0.55 & 0.375 & 0 & 0 \end{bmatrix}$$

=（0.1717 0.3711 0.1217 0.1382 0.1913）

The eigenvector of the fuzzy matrix relationship of the informatization budget support (M2) evaluation index is calculated as follows:

M2 = W2×P2

$$= (0.4377\ 0.5623) \times \begin{bmatrix} 0.11 & 0.24 & 0.41 & 0.24 & 0 \\ 0.146 & 0.361 & 0.52 & 0 & 0 \end{bmatrix}$$

= (0.2655 0.2320 0.2322 0.1347 0.1356)

The eigenvector of the .T.I.T. basic implementation management process evaluation index judgment matrix is calculated as follows:

Mx1 = Wx1×PX1

$$= (0.4348\ 0.5652)x \begin{bmatrix} 0.1717 & 0.3711 & 0.1217 & 0.1382 & 0.1913 \\ 0.2655 & 0.2320 & 0.2322 & 0.1347 & 0.1356 \end{bmatrix}$$

= (0.1505 0.1447 0.2541 0.1935 0.2571)

The characteristic vectors of fuzzy matrix relations of evaluation indicators at all levels, such as the application effect (MX2), talent construction management process (MX3), organizational management process capability (MX4), and security operation guarantee (mx5) of the optimization evaluation system for H market

informatization management process, are calculated in turn. The results are as follows:

Mx2 = (0.1258 0.2147 0.3074 0.1768 0.1793)

Mx3 = (0.1317 0.222 0.2682 0.2142 0.1637)

Mx4 = (0.1179 0.1108 0.3601 0.1588 0.2525)

Mx5 = (0.1272 0.1356 0.1636 0.2232 0.2505)

According to the calculation result matrix of the first level evaluation index of the evaluation system, draw the impact curve of each evaluation index in the evaluation process of H company, and calculated the maturity of each evaluation value according to the result matrix of each evaluation index, so as to obtain the overall process implementation of H company, as shown in Figure 3-1:

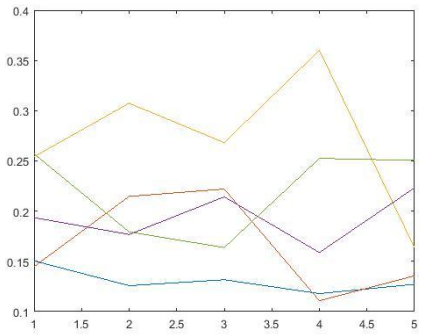

Figure 3-1

According to the eigenvector of the fuzzy matrix relationship of the primary indicators calculated by the above matrix and the weight results of the primary evaluation indicators in table 3-4, the eigenvector of the overall fuzzy matrix relationship of the H market informatization management process is calculated as follows:

Mx = Wx × Px

= (0.1463 0.2927 0.2195 0.1464 0.1951)

$$\times \begin{bmatrix} 0.1505 & 0.1447 & 0.2541 & 0.1935 & 0.2571 \\ 0.1258 & 0.2147 & 0.3074 & 0.1768 & 0.1793 \\ 0.1317 & 0.222 & 0.2682 & 0.2142 & 0.1637 \\ 0.1179 & 0.1108 & 0.3601 & 0.1588 & 0.2525 \\ 0.1272 & 0.1356 & 0.1636 & 0.2232 & 0.2505 \end{bmatrix}$$

=(0.1567 0.1452 0.2635 0.2663 0.1684)

According to the above calculation results, the maximum value of the eigenvector of the overall fuzzy matrix relationship in the H market informatization management process is 0.2663. According to the principle of maximum membership of the fuzzy matrix relationship, the preliminary judgment level of the H market informatization management process capability is the defined level.

3.4.2 Overall capability level evaluation results and capability evaluation grade

According to the index weights determined step by step by the FAHP method mentioned above, through the quantitative calculation of the fuzzy relationship feature vector corresponding to the index weights at all levels and the evaluation indicators at all levels, the overall capability evaluation feature vector of the H market informatization management process is obtained. In order to calculate the overall capability evaluation results of the H market, according to the score range (n) corresponding to the five capability levels of the automotive business informatization management process based on the CMMI model, the score range is defined as shown in table 3-7:

Table 3-7 Ability Level score range based on automobile business information management process

Capability level	Score range
Level 1 capability level	0 ～20
Level II capability level	20~40
Level III capability level	40~60
Level IV capability level	60~80
Level 5 capability level	80~100

The score matrix is expressed as n= (20406080100).
Finally, to calculate the overall evaluation level (LX) of the H market informatization management process, the feature vector of the overall capability level of the H market informatization management process calculated above is calculated with the capability level score.

H. The overall evaluation results of the market informatization management process are as follows:

Lx = MxxN
= (20 40 60 80 100) × (0.1567 0.1452 0.2635 0.2663 0.1684)
= 62.90

According to the calculation, the overall score of the H market informatization management process is the defined level.
To further verify the capability level evaluation results of each level-1 evaluation index, the same calculation method as the overall evaluation level results is used to calculate the evaluation results of the level-1 evaluation index respectively, and the corresponding capability level evaluation results of the indicators at all levels are as follows:
The calculation result of the .T.I.T. infrastructure management process (L1) is:

L1 = Mx1xN
= (20 40 60 80 100) × (0.1505 0.1447 0.2541 0.1935 0.2571)
= 65.23

The calculation result of the business informatization application management process effect (L2) is:

L2 = Mx2xN
= (20 40 60 80 100) × (0.1258 0.2147 0.3074 0.1768 0.1793)
= 61.62

The calculation result of the talent construction management process (L3) is:

L3 = Mx3xN
= (20 40 60 80 100) × (0.1317 0.222 0.2682 0.2142 0.1637)
= 61.11

The calculation result of the organization management process strategy (L4) is:

L4 = Mx4xN
= (20 40 60 80 100) × (0.1179 0.1108 0.3601 0.1588 0.2525)
= 66.35

The calculation result of safety operation guarantee management process indicator (L5) is:

L5 = Mx5xN
= (20 40 60 80 100) × (0.1272 0.1356 0.1636 0.2232 0.2505)
= 60.69

From the analysis of the evaluation calculation results of each level I evaluation index, although there are some differences in the evaluation indexes of the H market informatization management process, the evaluation results of each level have reached the defined level. Therefore, the defined level is taken as the overall evaluation level of the H market informatization management process.

3.5 Real-time evaluation system of the H market enterprise informatization

According to the evaluation and analysis results of the business information management process of the H market, it is proved that the informatization implementation in the H market has a relatively mature ability. For the H market, in the era of great development and wide application of information technology, making full use of advanced .T.I.T. technology to realize the upgrading and transformation of traditional industries and sustainability in informatization will certainly bring benefits to the enterprise. Under the background of the rapid development of the domestic automobile circulation industry, real-time informatization monitoring in the H market business management has become an important way to improve an enterprise's performance.

3.5.1 Evaluation summary of H market informatization management

First, the implementation of .T.I.T. infrastructure meets the needs, and the investment and effect of the informatization budget are apparent. The H market has a high proportion of it basic implementation index scores for business informatization implementation: on the one hand, it is reflected in the forward-looking planning and cognition of enterprise management decision-makers on business informatization construction. The construction of business informatization has been carried out very early, and the investment and application in business support software system provide a basic guarantee for the development of business; On the other hand, The H market decision-makers have a reasonable capital budget planning for business informatization construction, which accounts for a high proportion of budget capital investment for informatization construction, and the budget investment related to business informatization is reasonable and efficient. At the same time, it meets the

actual needs of the development of business informatization management process optimization.

Second, the optimization of the business informatization management process has achieved remarkable results, and the standardization degree and quality of the automotive business are continuously improving. Mature automobile business processes are the basis of business information construction. The H market integrates all the businesses in the circulation fields such as automobile evaluation and detection, auction transaction, settlement, insurance, transfer of ownership, and licensing, which greatly improves the speed and efficiency of automobile business processing and saves a lot of time and cost for operators and consumers, While achieving remarkable social benefits for the orderly circulation of automobiles, it also brings good economic benefits to the market. At the same time, the H market began to take the business informatization management process as the top priority of business informatization development, put forward higher requirements for the application effect and mature development of business informatization, reducing the business cost of the H market and improving the application level and effect of informatization while continuously optimizing the implementation and improvement.

Third, relevant business departments and business personnel have the ability to understand the business and skillfully operate the informatization software system. While carrying out business informatization, the business department of the H market pays attention to the accurate understanding of business and the rationality of business process so as to make the business informatization efficient and adaptable to the environment. H market effectively learns the business knowledge and ability of business personnel, improves the business personnel's strong professional ability and business informatization communication ability, and can skillfully operate the business systems related to the business and process sorting and application. It also improves the business informatization management process for the business personnel.

Fourth, establish and improve the institutional construction of various market systems and norms. H. market decision makers attach great importance to the compliance, rationality, practicality, standardization, and security of business informatization. As a state-owned holding enterprise, in order to avoid illegal business and business informatization implementation, the H market decision-making managers regard outsourcing management and outsourcing effect as important influencing factors for business informatization implementation. At the same time, improve the strategic decision-making level and ability of business informatization implementation, and promote the implementation of business informatization and the continuous improvement of implementation ability from the height of market management decision.

Fifth, strengthen the operational security measures for the implementation of business informatization. Strengthen the operation guarantee response mechanism of business informatization software system, and improve the emergency response ability and professional processing ability of informatization implementation personnel. Improve the security level of business informatization, put forward specific and feasible schemes and solutions in the implementation process of business informatization in terms of security strategies, security operation measures, and data security of business informatization, provide security guarantee for improving and optimizing the implementation and capacity of business informatization, and ensure the safety of business operation in the H Market. At the same time, the ability of data backup and data recovery has been improved and strengthened in informatization operation management.

3.5.2 Problems in the informatization capability of the H market

Through the evaluation of the H market business informatization management process, it is not difficult to find that the H market has deficiencies in the following five aspects:

First, some automotive businesses' subsystem and process integration need to be standardized. In the process of business informatization construction in the H market for many years, the integration degree of each business is low, the process is relatively independent, and the synergy between businesses needs to be integrated and integrated. The integration of business processes and collaboration with the business need to be further standardized. There are data integration and standardization problems, such as redundancy in business data.

Second, the H market business informatization management process optimization budget investment proportion has a prominent advantage in the height of organizational strategy. The budget investment proportion ensures the improvement of business informatization management process optimization. The analysis results show that the ability of business information personnel in the H market in terms of business knowledge and specialty is slightly insufficient, and the allocation of capital investment required for the training of business knowledge and specialty needs to be improved. On the other hand, giving full play to the core role of the business system corresponding to business informatization in the process of business development is also a major problem faced by the H market.

Third, in terms of the application effect of the business informatization management process, it is also necessary to further improve the informatization management process and business integrated decision support. The evaluation results show that the comprehensive score of the application effect of the business informatization management process in the H market is 61.62. As the business informatization management

process pays more attention to the improvement of the internal informatization processing capacity, the internal transformation of much external or third-party business informatization highly related to the business needs to be further optimized.

Fourth, according to the evaluation results of talent construction management process indicators, the H market informatization management process lacks professional talents and related professional training. There is a certain degree of deviation in the budget investment in the talent construction and management process, which affects the professional ability of informatization employees to deal with emergencies in the informatization management process.

Fifth, the H market has insufficient capabilities in informatization operation security and data security. The operation safety of software systems related to business informatization in the H market is an important factor in ensuring the high-quality operation of business informatization. However, the H market does not reflect a comprehensive operation safety management system from the perspective of evaluation results. In terms of operation guarantee and safety precautions, only data backup is used to protect data information. At the same time, The ability to recover lost data still needs to be improved.

Finally, from the analysis of the evaluation results of organizational strategic management ability, the H market has deficiencies in strategic organizational management, organizational culture, and strategic coordination ability in the process of informatization management. The H market does not pay enough attention to the importance of corporate culture in the process of informatization management, resulting in the collaboration between businesses becoming a short board to improve the process of informatization management. On the other hand, the evaluation of the informatization management process capability of the H market has a short starting time, and there is a lack of experience in the formulation and coordination of the overall development strategy and informatization strategy of the organization, which restricts the efficient and sustainable development of the business informatization management process.

3.6 Optimization measures for the business informatization management in the H market

By evaluating the business informatization management process of the H market, this paper summarizes the valuable experience of the H market in the implementation of business informatization and also exposes the areas that need continuous optimization and improvement in the implementation of business informatization.

In view of this, the good experience needs to be continuously adhered to and developed. For the deficiencies, optimization measures are proposed to improve and optimize the business informatization implementation process in the future so as to realize the continuous optimization of the business informatization management process of the H market and improve the operation efficiency of the H market from the strategic level. In order to take targeted and effective measures to optimize in the future, the following five optimization measures are proposed:

First, it is necessary to improve the integration and unity of business subsystems and optimize the investment and allocation of the business informatization budget after the H market has been implementing business informatization for many years. The focus of the informatization budget was paid to the construction of business informatization. However, no, a special fund has been invested in improving the informatization capability in the business management process.Therefore, in terms of optimizing the allocation of the informatization budget, the proportion of the budget in improving the ability of the business informatization management process has to be raised

Second, improve the efficiency of organizational decision-making management and the ability and level of informatization management process. To build an applicable and personalized comprehensive business integration system construction project, The H market needs to reduce the impact on decision-making efficiency, obtain more timely and accurate information and reduce business operation risks in terms of standardizing and standardizing the business, weakening the redundancy of internal business information collection and weak business integration ability, Improve the efficiency of management decision-making, strengthen the executive power of management, and form effective support for the H market decision-making.

Third, improve the professional ability of talents, increase investment in the process of talent construction and management, and provide more professional training plans. The H market pays more attention to informatization infrastructure in the informatization process, while the construction of talent construction management process, business ability, and professional ability in the process of informatization management need to be strengthened and improved. It is necessary to increase the training opportunities and effects of relevant personnel through the combination of internal and external training methods, improve the management process of informatization talent construction, and improve the ability level of the H market business informatization management process.

Fourth, we will improve security systems and rules and strengthen information security. The H market needs to the capacity building of network information security and put forward specific and feasible

optimization measures for the current lack of security awareness, inadequate measures, and weak security management rules and regulations and operation management to guarantee business informatization management process.

Finally, create an excellent corporate culture and regulatory environment, and improve strategic management, decision-making, and coordination capabilities. To ensure the rationality and effectiveness of various systems in the H market, it is necessary to strengthen the corporate culture, improve the ideological understanding and implementation level of internal business informatization management process evaluation, and support the sustainable development of the enterprise.

IV. Summary

This study takes the H market as a study to discuss the evaluation system of the business informatization management process based on the CMMI model. The assessment of the business informatization management process of the H market is mainly based on the constructed evaluation system. The evaluation questionnaire is constructed to investigate the informatization regarding the personnel in the management and sales department, personnel in the informatization implementation department, merchants, customers, and other personnel related to business informatization in the H market. The FAHP method is applied in analyzing the data obtained to explore the comprehensive performance of business informatization in the H market. The evaluation results were analyzed, the experience and deficiencies of H market business informatization were summarized, and optimization measures were proposed.. It provides feasible optimization measures for the implementation of follow-up business informatization in the H market and the direction for evaluating and continuously optimizing the business informatization management process in the H market.

Funding and/or Conflicts of interests/Competing interests

The data underlying the results presented in the study are available within the manuscript.I declare that my article had no funding and conflicts of interests,no competing interests during the whole research and preparing the work for submission.

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