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Relationship Determinants between AI Technology Adoption Behavior and Performance of Software Enterprises

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Abstract

With the continuous progress of science and technology, the arrival of artificial intelligence subverts the traditional industries. Enterprises urgently need to carry out technological innovation to reduce costs. The introduction of artificial intelligence technology can reduce workload and improve development efficiency for software enterprises. Reduce operating costs. This paper takes the software enterprise as the research object, takes the artificial intelligence as the independent variable and the software development cost as the dependent variable. The hypothesis is proposed through the four intermediate variables of development efficiency, management innovation, product quality, labor force and the degree of introduction of artificial intelligence. A total of 332 valid questionnaires were collected by using electronic questionnaires. The sample data are analyzed by Smartpls 3.0 software, and the data are analyzed by Algorithm, Bootstrapping, cross multiplication, structural equation and other methods. The results show that AI has a significant positive impact on software development cost, a significant positive impact on product quality, a significant positive impact on labor force, a significant positive impact on development efficiency, a significant positive impact on management innovation, and a significant positive impact on software development cost. Labor has a significant positive impact on software development costs. Development efficiency has a significant positive impact on software development cost. Management innovation has a significant positive impact on software development cost. Product quality plays an intermediary role between the introduction of artificial intelligence and the cost of software development. Development efficiency also plays an intermediary role between the introduction of artificial intelligence and the cost of software development. From the research, we know that the introduction of AI can enrich the theories of process reengineering, process optimization and management decision-making, and can also find the factors that affect output performance from the perspective of technological innovation to provide reference for future research.

Keywords: Artificial Intelligence, Technological Innovation, Cost Management, Performance Management

JEL Classification Code: C12, M15, O15, O32

1. Introduction

Artificial intelligence (Artificial Intelligence, referred to as AI) is a comprehensive discipline, including computational science, management, psychology, mathematics and statistics. Its greatest feature is that it can simulate, extend and expand human behavior. This technology has developed rapidly since it came out in 1956. It combines with all fields of production and life and affects the cost of various industries to a great extent. In recent years, the emergence of AI technology, especially the data-led machine learning technology, has completely changed the performance of enterprises. This paper starts from the development of AI technology and the characteristics of management performance. This paper focuses on the factors that affect the performance of enterprises with the introduction of AI. Whether AI can reduce costs for software companies, what aspects does AI reduce costs, and what

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kind of innovation AI brings to enterprises, and so on. This paper analyzes what new innovations there are in process reengineering, process optimization and process decision-making with the introduction of AI. Therefore, it is of practical value and practical significance to study the role that AI should play in the performance of software enterprises and AI for management innovation.

2.Literature Review

Bo Sui et al (2021) think that AI, as a technological innovation, can optimize the labor force structure of enterprises, and then promote the innovation level of enterprises. Jin Chen (2021) Scholars believe that AI will become an important engine to promote the development of high-quality economy. However, the current AI field is mainly affected by technological development and capital-driven.

Xiaobo qu (2019) believes that the new technological revolution represented by robots and AI has brought tremendous and profound changes to the labor market, as well as the impact and trend of the new technological revolution on employment demand and work tasks.Baohua Li (2018) studies the direct impact of technological innovation on cost management by changing the product structure and cost composition of enterprises. In order to solve the changes of product structure and cost composition, cost management innovation or method innovation should be carried out. Mingyi Chen et al (2020) believe that technological progress is the key reason for promoting economic growth and improving human living standards, and whether the emergence of AI new technology can completely replace labor has been debated in various industries. Yongjie Cheng et al (2020) believes that traditional industries are empowered by AI, and technological innovation is most directly affected by the impact on human employment. Zhongquan Liu (2019) believes that technological innovation is an important influencing factor of cost management innovation. There is an economic relationship between technological innovation and cost management, and technological innovation has an impact on enterprise management behavior. Yanmei Hou (2021) believes that the scientific and effective cost management model improves the competitiveness of the company in the industry, helps enterprises to capture the market, promotes the stable and sustainable operation of the company, and realizes the importance of cost management of enterprise value. Li Sun (2020) thinks that only by analyzing the problems encountered in the implementation of enterprise cost management and formulating effective measures to solve the problems of cost management, can the efficiency of cost management be improved. Wuli Tu (2011) thinks that in an enterprise organization, performance management, as an important part of human resource management, has a strategic important position. scientific performance management system plays a role in continuously promoting employee and organizational performance improvement and employee ability development in the whole process of human resource management, and it is a driver for organizations to continuously create value. Zhenbang Fang (2010) believes that the development of organizational performance management is based on the formulation of performance plans. only by ensuring the detailed and effective performance plan can any organization ensure the smooth implementation of other aspects of performance management. Feng Li (2019) thinks that organizational performance management is very important for the development of enterprises. In organizational performance management, various influencing factors should be comprehensively considered, and the organizational performance management plan should be planned scientifically and reasonably according to the actual situation of the enterprise. to improve the level of enterprise performance management, so as to ensure the stable development of enterprises in the fierce market competition. Ming Feng et al (2017) believes that through the establishment and improvement of performance management mechanism, organizational performance management has changed from qualitative objectives in the past, lack of performance evaluation and performance feedback to quantitative indicators, timely performance evaluation and feedback, and achieved certain results in organizational performance management. Yaqiong Ren (2020) thinks that cost management has become the key and difficulty of enterprise internal management. From the aspects of project budget management, project process control, human resource management and project cost accounting model, we seek effective and positive countermeasures from project budget management, project process control, human resource management and project cost accounting mode. in order to provide better project cost management and useful ideas for enterprises. Zhihui Yao (2019) thinks that software enterprises need to do a good job in the cost management of software research and development in order to improve their economic benefits and core market competitiveness, and to promote the healthy and sustainable development of software enterprises. the cost management system needs to be constantly summarized and improved in the process of implementation, which is a process of continuous improvement.

3. Research method & Statistical Design

3.1 Research methods

3.1.1 Literature analysis

Through China knowledge net, library and foreign database, this study combs, summarizes and compares the theoretical research achievements of AI, software enterprise, cost management theory, labor-saving principle theory, technological innovation theory, enterprise efficiency management, process reengineering, process optimization and management decision-making in China and other countries, so as to understand the cutting-edge theoretical research and progress related to this research as much as possible. Based on this, the theoretical framework and research hypotheses of the thesis are put forward.

3.1.2 Questionnaire survey method

This paper mainly takes software enterprises as the research object. The questionnaires were distributed randomly through QQ technical discussion group, AI technical discussion QQ group, technical exchange WeChat group, internal WeChat group of software companies, etc. a total of 435 questionnaires were received. after excluding invalid questionnaires, there were 332 valid questionnaires, and the recovery rate of effective questionnaires was 97.39%. After the reliability analysis of the data received, the research questionnaire used included 7 scales with a total of 30 questions, and the data of the recovered questionnaire were analyzed.

3.1.3 Empirical analysis

Empirical analysis is to test the theoretical research hypotheses proposed in this paper through the collected sample data. That is, according to the research needs of the paper to collect sample data, the use of statistical analysis methods for processing and analysis, in order to test the various measurement scales in the paper, so as to verify the theoretical research hypotheses proposed in the paper. After the questionnaire is collected, the data are sorted out, the descriptive analysis of the data and the reliability and validity of the data are analyzed, and the collected data are statistically analyzed by Smartpls 3.0 statistical analysis software to test the hypotheses of this study. And the results of statistical analysis are further analyzed and discussed.

3.2 Statistical design

3.2.1 Questionnaire design

The questionnaire survey method used in this study, the design of the questionnaire is carried out on the basis of the maturity scale that has been studied by predecessors, at the same time, according to the specific scenes involved in the process, appropriately modify and add part of their own design. Six scales including artificial intelligence scale, artificial intelligence introduction scale, development efficiency scale, labor force scale, product quality scale, management innovation scale and software development cost scale are designed.

3.2.2 Sample selection

It is determined that the number of valid samples in the survey is 332. In view of the particularity of the software industry, this questionnaire survey adopts the survey methods of quota sampling and snowball sampling. Considering that the software profession is an important influencing factor, a questionnaire was distributed to the respondents who were engaged in the software industry. Finally, the comprehensive use of Excel table, SmartPLS to input, statistics and analysis of the collected data.

3.2.4 Questionnaire distribution

This questionnaire uses an electronic questionnaire. After modifying the relevant questionnaire through the questionnaire star, it spreads in some QQ groups, WeChat groups and enterprise WeChat groups engaged in the software industry through the QR code of the questionnaire. At the same time, it also carries out secondary dissemination with the help of some netizens.

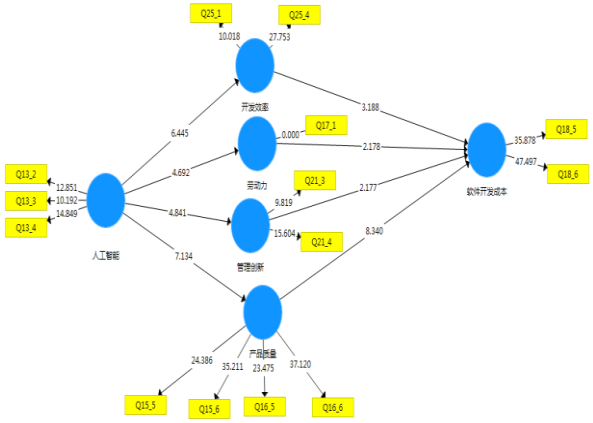
3.2.5 Descriptive analysis

The questionnaire of this study contains 7 latent variables, and 30 items of the scale are analyzed by mathematical statistics. This survey questionnaire is all in the form of electronic questionnaires, because the research objects of this paper are people engaged in the software industry, so the subjects should first engage in the software industry, including big data and AI. The electronic questionnaire is mainly produced through the questionnaire Star platform and has been distributed since September 10, 2020. A total of 435 questionnaires have been received, excluding those that take less than 60 seconds to answer questions, and some of them have not been completed completely and the answers have not changed. 332 valid questionnaires were collected, and the recovery rate of valid questionnaires was 97.39%. Then import the corresponding data into the Smartpls 3.0 statistical software and analyze the reliability and validity.

4.Data Analysis

4.1 Research model

Figure 1: Theoretical model of the impact of artificial intelligence on the output performance of software companies



4.2 Put forward a hypothesis

Table 1: A list of theoretical hypotheses in this study

serial number	Hypothetical number	Hypothetical content
1	H1	The introduction of AI helps to reduce the cost of software development.
2	H2	The introduction of AI helps to improve the efficiency of development.
3	H3	Development efficiency helps to reduce the cost of software development.
4	H4	Development efficiency plays an intermediary role between the introduction of AI and the cost of software development.
5	H5	The introduction of AI is beneficial to the improvement of product quality.
6	H6	Product quality helps to reduce the cost of software development.
7	H7	Product quality plays an intermediary role between the introduction of AI and the cost of software development.
8	H8	The introduction of AI helps to reduce the labor force.
9	H9	Labor helps to reduce the cost of software development.
10	H10	Labor plays an intermediary role between the introduction of AI and the cost of software development.
11	H11	The introduction of AI is beneficial to management innovation.
12	H12	Management innovation helps to reduce the cost of software development.
13	H13	Management innovation acts as an intermediary between the introduction of AI and the cost of software development.
14	H14	The degree of introduction of AI plays a positive role in regulating the development efficiency and software development cost.
15	H14a	The degree of introduction of AI plays a positive role in regulating the relationship between management innovation and software development cost.
16	Hl4b	The degree of introduction of AI plays a positive role in adjusting between product quality and software development cost.
17	H14c	The degree of introduction of AI plays a positive role in adjusting between labor force and software development cost.

4.3. Analysis of reliability and validity

4.3.1 Reliability analysis

Table 2: Analysis of the reliability and validity of each scale

Factor	Measuring item	Standard load	Cronbach's Alpha	Composite Reliability	AVE
AI	Q13_2	0.705	0.61	0.747	0.51
	Q13_3	0.658			
	Q13_4	0.748			
Development efficiency	Q25_1	0.651	0.64	0.751	0.606
	Q25_4	0.888			
labour force	Q17_1	1.000	1.000	1.000	1.000
Management innovation	Q21_3	0.720	0.66	0.752	0.604
	Q21_4	0.831			
Product quality	Q15_5	0.756	0.786	0.862	0.609
	Q15_6	0.796			
	Q16_5	0.753			
	Q16_6	0.815			
Software development cost	Q18_5	0.841	0.623	0.841	0.726
	Q18_6	0.863			

According to the data in the table, after calculating the standard load of all the measured items, the Cronbcah, a value of each variable、AVE Value (Average Variance Extracted) and CR (Composite Reliability). The reliability and aggregate validity of the scale were checked. The calculation results are shown in Table 2. The standard load of each measurement item is more than 0.6, and the Cronbcah' a value of each variable is also more than 0.5, indicating that the measurement model has good reliability. And all the variables AVE are higher than 0.5 and CR are greater than 0.6, indicating that the measurement model has a good aggregate validity network.

4.3.2 Discriminant validity test

Table 3: Comparison between the square root of each variable AVE and the corresponding correlation coefficient

	artificial intelligence	Product quality	labour force	Development efficiency	Management innovation	Software development cost
AI	0.705					
Product quality	0.349	0.781				
labour force	0.253	0.223	1.000			
Development efficiency	0.334	0.478	0.294	0.779		
Management innovation	0.255	0.336	0.196	0.272	0.777	
Software development cost	0.261	0.588	0.260	0.437	0.327	0.852

As can be seen from the above table, there are mainly three methods to test the discriminant validity in Smartpls3.0 analysis. The first is the comparison method between AVE and correlation coefficient, in which the AVE of each construct is greater than the square of the structure correlation coefficient. (Fornell and Larcker, 1981).The second kind is Standardized factor loading > Cross loading ; The third kind is between construtions.HTMT<0.85.In order to verify the discriminant validity, the first method is AVE and correlation coefficient comparison method. The results show that the discriminant validity of the model can meet the requirements.

4.4 Model hypothesis test

4.4.1 Model hypothesis test

Table 4: Path analysis coefficient

Path	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
AI-> product quality	0.349	0.352	0.049	7.164	0
AI -> labor force	0.253	0.255	0.054	4.666	0
AI -> development efficiency	0.334	0.338	0.051	6.558	0
AI -> Management Innovation	0.255	0.26	0.052	4.943	0
Product quality->software development cost	0.451	0.452	0.054	8.41	0
Labor force-> software development cost	0.089	0.089	0.042	2.133	0.033
Development efficiency-> Software development cost	0.164	0.164	0.052	3.179	0.001
Management Innovation-> Software Development cost	0.113	0.115	0.051	2.207	0.027

Table 5: Results of path analysis and hypothesis testing

Research hypothe-sis	Path	Path coefficient	T value	P value	Test result
H5	AI-> product quality	0.349	6.975***	0.000	True
H8	AI-> labor force	0.253	4.615***	0.000	True
H2	AI-> development efficiency	0.334	6.373***	0.000	True
H11	AI-> Management Innovation	0.255	4.895***	0.000	True
H6	Product quality-> software development cost	0.451	8.305***	0.000	True
H9	Labor force-> software development cost	0.089	2.157*	0.031	True
H3	Development efficiency-> Software development cost	0.164	3.199**	0.001	True
H12	Management Innovation-> Software Development cost	0.113	2.209*	0.027	True

Note : * *p-value*< 0.05; ** *p-value*< 0.01; *** *p-value*< 0.005

From the results in Table 4 and Table 5, we can see that artificial intelligence has a positive impact on product quality. The results of the model show that artificial intelligence has a significant positive impact on product quality. The introduction of artificial intelligence is beneficial to improve product quality. Artificial intelligence has a positive impact on the labor force. Artificial intelligence has a positive impact on development efficiency. Artificial intelligence has a positive impact on management innovation. Product quality has a positive impact on software development cost. First of all, labor has a positive impact on software development costs. Development efficiency has a positive impact on software development cost. Management innovation has a positive impact on software development costs. It shows that management innovation is beneficial to reduce the cost of software development. Finally, it is deduced that the introduction of artificial intelligence has a significant positive effect on reducing the cost of software development, that is to say, the introduction of artificial intelligence has a positive effect on reducing the cost of software development.

4.4.2 Intermediary effect test

Table 6: Path analysis coefficient

Path	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
AI-> product quality-> software development cost	0.157	0.16	0.03	5.164	0
AI-> labor force-> software development cost	0.023	0.023	0.012	1.867	0.062
AI-> development efficiency-> software development cost	0.055	0.056	0.02	2.747	0.006
AI-> Management Innovation-> Software Development cost	0.029	0.03	0.015	1.939	0.053

Table 7: Mediation effect and hypothesis test results

Research hypothesis	Path	Path coefficient	T Value	P value	Test result
H7	AI-> product quality-> software development cost	0.157	5.018***	0.000	True
H10	AI-> labor force-> software development cost	0.023	1.868	0.062	False
H4	AI-> development efficiency-> software development cost	0.055	2.718**	0.007	True
H13	AI-> Management Innovation-> Software Development cost	0.029	1.867	0.062	False

Note : * p-value< 0.05; ** p-value< 0.01; *** p-value< 0.005

From the intermediary variables reflected in tables 6 and 7, we can see that product quality has a positive impact on the introduction of AI and software development costs. It shows that product quality plays an intermediary role between the introduction of AI and software development cost. Development efficiency has a positive impact on the introduction of AI and software development costs. It shows that development efficiency plays an intermediary role between the introduction of AI and software development cost. The labor force has no direct influence between the introduction of AI and the cost of software development. It represents that the labor force does not play an intermediary role between the introduction of AI and the cost of software development. It shows that the labor force does not play an intermediary role in the middle. Management innovation has no direct impact on the introduction of AI and the cost of software development. It means that management innovation does not play an intermediary role between the introduction of AI and the cost of software development. It shows that management innovation does not play an intermediary role in the middle.

4.4.3 Regulatory effect test

Table 8: Mediation effect and hypothesis test results

Path	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
The introduction of AI to regulate product quality-> software development cost	0.032	0.046	0.054	0.588	0.556
The introduction of AI to regulate the labor force-> the cost of software development	0.016	0.004	0.041	0.392	0.695
Introduction of AI to regulate development efficiency-> software development cost	-0.027	-0.017	0.051	0.525	0.6
Introduction of AI to regulate management innovation-> software development cost	0.014	0.018	0.06	0.227	0.82

Table 9: Regulation effect and hypothesis test results

Research hypothesis	Path	Path coefficient	T Value	P value	Test result
Hl4b	The introduction of AI to regulate product quality-> software development cost	0.032	0.588	0.556	False
H14c	The introduction of AI to regulate the labor force-> the cost of software development	0.016	0.392	0.695	False
H14	Introduction of AI to regulate development efficiency-> software development cost	0.027	0.525	0.600	False
H14a	Introduction of AI to regulate management innovation-> software development cost	0.014	0.227	0.820	False

From the results in Table 8 and Table 9, we can see that the degree of introduction of AI has no direct impact on product quality and software development cost, and does not play a positive role in regulation. Therefore, it is assumed that H7 is not valid. The degree of introduction of AI has no direct impact on the development efficiency and software development cost, and does not play a positive role in regulation. Therefore, it is assumed that H14 is not valid. The degree of introduction of AI has no direct impact on the labor force and software development costs, and does not play a positive role in regulation. Therefore, it is assumed that H14c is not valid. The degree of introduction of AI has no direct impact on management innovation and software development costs, and does not play a positive role in regulation. Therefore, it is assumed that H14a is not valid.

5. Results and Discussion

Table 10: hypothesis test results

Research hypothesis	Test results
H1: The introduction of AI has a positive impact on reducing the cost of software development.	True
H2: The introduction of AI has a positive impact on improving development efficiency.	True
H3: Development efficiency has a positive impact on reducing software development costs.	True
H4: Development efficiency acts as an intermediary between the introduction of AI and the cost of software development.	True
H5: The introduction of AI has a positive effect on improving product quality.	True
H6: Product quality has a positive impact on reducing software development costs.	True
H7: Product quality acts as an intermediary between the introduction of AI and the cost of software development.	True
H8: The introduction of AI is beneficial to reduce the labor force and has a positive impact.	True
H9: The labor force has a positive impact on reducing the cost of software development.	True
H10: Labor plays an intermediary role between the introduction of AI and the cost of software development.	False
H11: The introduction of AI has a positive impact on management innovation.	True
H12: Management innovation has a positive impact on reducing software development costs.	True
H13: Management innovation acts as an intermediary between the introduction of AI and the cost of software development.	False

Research hypothesis	Test results
H14: The degree of introduction of AI plays a positive role in adjusting between development efficiency and software development cost.	False
H14a: The degree of introduction of AI plays a positive role in regulating the relationship between management innovation and software development cost.	False
Hl4b: The degree of introduction of AI plays a positive role in adjusting between product quality and software development cost.	False
H14c: The degree of introduction of AI plays a positive role in adjusting between labor force and software development cost.	False

For Results,AI has a significant positive impact on software development costs. The introduction of AI technology can promote business process reengineering, optimize business processes, and make management decisions using AI technology, thus improving production efficiency and reducing enterprise costs.AI has a significant positive impact on product quality, and the emergence of artificial intelligence technology can replace human beings to do more work, especially repetitive and complex work.AI has a significant positive impact on the labor force and a significant positive impact on development efficiency. The introduction of artificial intelligence to rebuild the original process will inevitably reduce the labor force in all aspects of work at the same time. It can take the place of human beings to engage in more complex tasks of the labor force, and it can continuously perform frequent, large-scale and computerized tasks without rest.AI has a significant positive impact on management innovation, which is mainly reflected in process reengineering, business process optimization, management decision-making and so on.AI has a significant positive impact on the cost of software development, the introduction of artificial intelligence technology as technological innovation, technological innovation to promote the number of new products, so as to improve the performance of technological innovation.

The labor force has a significant positive impact on the cost of software development, and the introduction of artificial intelligence will change the situation of the labor force, because the input of artificial intelligence labor force will further improve labor productivity. Development efficiency has a significant positive impact on software development cost. Artificial intelligence frees the labor force from repetitive labor, and enterprises can use cheap capital to replace labor.Management innovation has a significant positive impact on software development cost. It can carry out workflow transformation, business process optimization and intelligent decision-making from many aspects of the enterprise, and it is the most direct way to reduce the development cost.Product quality plays an intermediary role between the introduction of artificial intelligence and the cost of software development. The introduction of artificial intelligence, as a new technology, can reduce the defect rate of products by making use of the characteristics of artificial intelligence, that is to say, the introduction of artificial intelligence will improve product quality, and the improvement of product quality will inevitably reduce the development cost. therefore, product quality plays an intermediary effect here.

Development efficiency also plays an intermediary role between the introduction of artificial intelligence and the cost of software development. Artificial intelligence can reduce the workload of repetitive work, and it can also carry out 24-hour work without the limitation of working hours. It has strong physical strength and continuous tolerance, and can work in strict accordance with technical requirements and work rules, and there is no phenomenon of laziness.

To sum up the above research results, the main theoretical contribution of this paper is that artificial intelligence technology is a new IT technology, so its academic research results are very few in the field of management research, especially on the impact on enterprises or organizations. In particular, there is an in-depth study on technological innovation theory, process reengineering theory, process optimization theory, management decision-making theory and so on. Based on the perspective of enterprise performance, this paper studies the relationship between artificial intelligence technology adoption behavior and software enterprise output performance, which enriches the theoretical research of artificial intelligence in the field of management.

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