ISSN 2409-2665
Journal of Logistics, Informatics and Service Science
Vol. 11 (2024) No. 4, pp. 140-165
DOI:10.33168/JLISS.2024.0409

Enabling Construction Management Agility in China: An Empirical Study of Agile Strategies

Jiangwei Luo[1*], Mohd Wira Mohd Shafiei [1], Radzi Ismail [1], Manli Luo[2]
[1]School of Housing, Building and Planning, Universiti Sains Malaysia, Gelugor 11800, Malaysia
[2]School of Chinese Medicine, Hong Kong Baptist University, Hong Kong, China
ljw_9898@126.com (Corresponding author)

Abstract. This study analyzed the potential for applying agile management strategies to construction management in China. A survey of 350 construction professionals assessed perceptions of four agile management elements: visualization, continuous improvement, customer focus, and iterative development. PLS-SEM analysis found all four elements had significant positive impacts on construction management agility. The results also showed construction professionals view agile management positively and their perceptions play a mediating role in enabling agile management. This empirical evaluation of agile management approaches provides valuable practical insights for the construction sector in China seeking innovative strategies to meet evolving challenges. The research also makes a theoretical contribution by advancing the understanding of agile management in the understudied context of Chinese construction.

Keywords: agile management, PLS-SEM, construction management, SPSS, survey, perception.

1. Introduction

Over the past 25 years, according to the statistics of the Department of Fixed Asset Investment Statistics of the National Bureau of Statistics of China, China's construction enterprises have continued to grow bigger and stronger, the scale of assets and business scale of the construction industry has expanded rapidly, profitability has been improving, and the comprehensive strength of the industry has been significantly enhanced.In 2017, the paid-in capital of the chinese construction enterprises was RMB 3,644.2 billion yuan, which was 16 times that of 1998, with an average annual growth rate of 15.7 per cent; the total assets were 204,664 billion yuan, 17.2 times that of 1998, with an average annual growth rate of 16.2 per cent; operating income of 194,165 billion yuan, 21.1 times that of 1998, with an average annual growth rate of 17.4 percent; and corporate asset-liability ratio of 66.9 per cent; a drop of 7.2 percentage points from 74.1 percent in 1998. But chinese construction companies are finding it increasingly difficult to survive in China's highly competitive market. The competitive landscape of small and medium-sized enterprises, the introduction of new technologies and procedures, and the requirement for efficient organisational management pose challenges, and therefore the construction industry needs to be more innovative (Ribeiro and Fernandez, 2010). The projects completed in the last decade in different regions, only 39% were completed on time; 43% were completed late, over budget, or below expectations, and 18% were abandoned altogether.In 2012, many projects had 59% cost overruns and 74% time overruns (Mohammed & Jasim, 2018).The OWAIS (2022) states that major construction projects will encounter difficulties as they require constant adjustments. Accounting for contingencies is a major difficulty in the construction sector as changes are managed from start to finish (Hassasn & Khodeir, n.d.; Streule et al., 2016). Plans and projects require regular revisions during execution, which leads to cost overruns, schedule delays and low quality products (Streule et al., 2016).

Agile development methodologies are renowned for emphasizing efficiency, iterative development, and user feedback. The construction business needs more ingenuity and competition. It is also essential to include clients in every iteration (Ribeiro & Fernandes, 2010). According to Mah (2008), agile is being adopted more often in difficult and unpredictable projects. Agile increases productivity by allowing for rapid modifications and adjustments (Hassan & Khodeir, n.d.). Agile project management produces project deliverables incrementally through short iteration cycles (Mohammed, 2018). Agile Project Management (APM) seeks to continue project evaluation and adaptation through rapid stakeholder feedback (Ormeño Zender, 2021). Ormeo Zender & Garca de Soto (2021), Indicate that it promotes the organization's pragmatism.

That being said, a lot of scholarly research has been done on agile management in the construction industry. Jethva et al. (2022) looked into the suitability of agile project management for architectural design-build projects both in the design and construction stages. Using the ideas of agile project management and lean construction, Chen et al. (2007) created interface management (IM). IM manages the interactions between the many parts of a complex system to attain the best possible project performance. To that goal, Omar (2022) conducted research on BIM and agile project management to create solutions for overcoming common obstacles encountered in such undertakings. According to Kasturiwala & Rathod (2021), teams and project managers have resorted to agile project management techniques when they need to respond quickly to changes in delivery or design. Arefazar et al. (2022) advise that agile kickoffs on construction projects be scheduled to support change management. Sakikhales & Stravoravdis (2017) examine the advantages of utilizing Building Information Modelling (BIM) to apply an iterative design framework that is introduced throughout the design phase to improve building performance. Ahmed & Mohammed (2019) examined the agile quality management framework to assist construction project managers in being more adaptable. Furthermore, a framework for risk management in agile management is proposed by Ahmed & Mohammed (2019) study, which may be applied to construction projects to prevent or mitigate a variety of potential problems. Meselhy (2022) research to indicate that agility and value must be combined to create a new alliance architecture that can adapt to changes in large-scale efforts. Some academics employ agile project management to lessen the possibility of unfavorable outcomes that are frequently connected with construction projects, such as timetable slippage, cost overruns, and project cancellations. Construction delay management can be made easier with the use of agile methodologies. techniques to reduce anxiety, improve risk management, and involve clients (Paul & Rahman, 2018; Mohammed & Jasim, 2018). Mohamed & Moselhi (2019) describe how agile management can increase the probability that construction projects will be completed on schedule, flexibly, and within budget. Mohammed & Chamberlin (2020) used agile management to reduce engineering delays and better handle change. Ahmed & Altaie (2021) demonstrate how the most recent versions of Agile Project Management (APM) and Building Information Modelling (BIM) may be integrated to fight schedule slippage and growing expenses.

2. Review of Literature

2.1. Agility

Agility refers to the ability to create and respond quickly to changes, creating value in a volatile business environment (Thesing et al., 2021). Campanelli & Parreiras (2015) define agility as the ability to adapt quickly to a range of planned and unplanned changing conditions in a rapidly changing environment; to apply past knowledge in quick iterative strategies; and to create new knowledge based on this experience, demonstrating the attributes of high quality, efficiency, and ease of use. Agile has also demonstrated that it is a tactic that can handle challenging problems and swiftly adapt to shifts in the corporate environment by maintaining open lines of communication with the clientele. Agile is by nature flexible and dynamic, as stated by Maranda et al. (2022). Agile techniques, according to Campanelli & Parreiras (2015), are essentially about adhering to the values and principles outlined in the Agile Manifesto. It can swiftly produce usable products and adapt to changing needs, in contrast to more traditional methodologies.

2.2. Agile Management Fundamentals

Iterative development: "Iterative development" was first used by Moran (2015) to refer to the process of iteratively going through the different phases of the solution development life cycle to produce a tested, functional prototype in a condensed amount of time. With every iteration, the product is more refined, and the process incorporates the lessons discovered in the prior iterations. Moran (2015) coined the phrase "incremental delivery" to refer to a willingness rather than a mandate to give customers access to previously generated product artifacts. Multiple increments between the delivery of the first product and the end product are standard practice (Moran, 2015). At each stage, there is an increase in understanding and an increase in detail that can be demonstrated and delivered to the customer (Moran, 2015). More knowledge is gained and more may be demonstrated to and provided to the customer with each subsequent phase. In some approaches, the "Iteration and Increment" development process combines these two concepts into one (Moran, 2015).

Continuous improvement: Ellis (2016) Agile's concept of continuous improvement was first introduced in the software field and popularised and spread in other fields, and the adoption of Scrum was revolutionary - many things had to change at once: new roles were defined, new measurement systems were put in place, and teams delivered code in a fundamentally different way. But while Scrum brings great improvements, it is only the first step. After Scrum has been adopted and stabilized, teams must look for evolutionary changes that improve over time. It is a list of processes that can be adopted one or two at a time to meet improvement needs (Ellis, 2016). Agile teams may meet in activities that are not called improvement and they may not always use the term standard work for process changes (Ellis, 2016). Continuous improvement is typically Lean thinking, and Scrumban is a software development methodology that combines the characteristics of both Scrum and Kanban agile methods (Ellis, 2016). Scrumban brings value through the team's collective idea-driven evolution, where the team can choose a few key performance metrics to measure its performance: defect backlogs, on-time delivery to internal customers, customer satisfaction, and turnaround or time on task in the column. Once the performance metrics have stabilized, the team can take action to make improvements (Ellis, 2016). Agile project management (APM) relies on collaboration between all team members to deliver results, get candid feedback, and implement learning in the next iteration of the solution, one of the strengths of APM is continuous feedback and improvement (Ellis, 2016).

Visualization: Visualisation ensures that Kanban is always visible (Ellis, 2016). Kanban reveals work-in-progress and provides a simple method of limitation: when the Kanban column reaches its limit, the team cannot advance tasks into the Kanban column (Ellis, 2016). Managing the process again, which is a feature of Kanban project management, the process is intuitive - it is easy to see if the task is stalled (Ellis, 2016). Even superficial attempts at Kanban can bring value as the core of Kanban is for you to see how you are working (Ellis, 2016). One example of visual control in agile approaches that can assist a team in project organization is "hanging on the wall" planning (Hass, 2007). For example, one agile project team used multicolored decks of cards hung on the wall to represent different parts of the solution. One color represents features that have been conceived, developed, tested, and produced; the other colors represent features that have been designed, built, and tested but are not yet ready for production. As a result of the team's shared understanding of the project's status, visual control is a crucial tool for every undertaking (Hass, 2007).

Customer orientation: Denning (2016) a central feature of agile thinking is an overriding focus on delivering more and more value to customers. As the first principle of the Agile Manifesto states, "The most important thing is to delight the customer." The focus on pleasing the customer in Agile suggests an empowering mindset, with a clear trust in the talents and abilities of those doing the work, and a belief that if the company provides the right environment, values, and goals, those doing the work will often provide ongoing value and innovation to end users and customers, as well as generating revenue for the company itself (Denning, 2016). In the world of agile management, delivering value to customers is the goal of everyone in the organization (Denning,2016). In contrast, the agile mindset promotes an interactive relationship between the client, manager, and staff (Denning,2016). The average on-site customer is a team member, ready to address questions about how to use the application (Ellis, 2016). The on-site customer has extensive knowledge of the areas supported by the application (Ellis, 2016). Agile management provides a completely transparent environment where each iteration of a task is completed and the results of the work constantly receive actual feedback from the customer (Denning, 2016). Agile thinking permeates the organization where everyone is focused on how to deliver more value to the customer faster, and anyone can talk to anyone, to achieve this (Denning,2016). To this point, companies that have successfully implemented agile management report faster implementation of innovations, faster response to real customer needs, and improved customers (Denning,2016).

2.3. Perception core components (TAM model)

The Technology Acceptance Model (TAM) is a widely recognized and extensively utilized paradigm in the field of information systems. TAM's origins can be traced back to Theory of Reasoned Action (TRA) (Benbasat & Barki, 2007), which was developed from prior research in the rational action theory discipline. Benbasat and Barki (2007) state that eliciting salient concepts about people's attitudes towards certain conduct is important for the theory of reasoned action to be applied to that conduct. Perceived usefulness (PU) and perceived ease of use (PEOU), as a method of extracting significant beliefs, Davis (1986) and Davis et al. (1989) presented one of the most frequently cited papers in IS with two concepts about perceived usefulness (PU) and perceived ease of use (PEOU). "The degree to which a person believes that using a specific system will improve his or her job performance" (Davis, 1989) is the definition of perceived usefulness, as noted by several academics. Consumers are more likely to give a system a high perceived utility rating if they perceive a positive usage-performance link (Davis, 1989). On the other hand, perceived ease of use is characterized as "how simple a user thinks a system is to operate." This makes sense as the definition of "ease" is "relief from difficulty or great effort" (Davis, 1989). Users are more likely to choose the program they think is simpler to use if they are otherwise equal (Davis, 1989).

2.4. Agile Construction Management.

Agile methodologies will improve planning, efficiency, and project control and monitoring. According to Marcus et al. (2023), agile methodologies place a strong emphasis on the value of monitoring projects during their implementation, listening to stakeholder feedback, and improving team communication. Even though the majority of interviewees had no prior experience with Agile techniques, they expressed confidence in the approach's worth for project management and suggested that projects need an agile process to move from an inflexible, bureaucratic management structure to one that is a more flexible and adaptable blueprint for construction (Marques et al., 2023). According to Siddiqui et al. (2022), it is pointed out that it reduces the overtime work in the construction work, Researchers investigated two distinct building-related questions. Agile project management achieved up to an 80% cost reduction. Owen & Koskela (2006) contended that APM is beneficial at every stage of the construction process, and APM can be effectively employed to improve its reliable value delivery. Paul & Rahman (2018) state that it applies to large complex projects that are difficult to pre-specify products, and the main advantage of implementing an agile approach is increased customer engagement. Paul & Rahman (2018) noted that it is suitable for large, complex projects that are difficult to pre-specify products and that the main advantage of implementing an agile approach is increased customer engagement. Better time management and focused meetings can reduce uncertainty and improve risk management in addition to aiding in the monitoring of construction projects (Paul & Rahman, 2018). The hotel construction project manager believes that improvements can be made to improve the flexibility of the process (Marques et al., 2023).

According to Marques et al. (2023), the deployment of a project management approach is necessary to maximize its efficacy, promote transparent communication among all stakeholders, and accommodate unforeseen changes that may happen. On the one hand, agile is viewed as a significant improvement over conventional project management techniques because of its ability to increase client input on project scope requirements, enable quicker performance changes, and lower waste, costs, and time commitments throughout the execution phase. According to Siddiqui et al. (2022), agile project management is novel and enhanced. Its application can reduce project uncertainty, enhance construction timeliness, and improve customer satisfaction. In this study, we propose three research questions below.

- What variables influence agile construction management in Chinese companies?
- What is the relationship between the elements of agile management and the agilization of construction management in China?
- What is the intermediary relationship between Chinese construction practitioners' perception of agile management and the implementation of agile construction management in China?

Thus, the following is the study's hypothesis:

- H1: The implementation of agile management mode to China's construction management has a significant positive impact on construction management, and the implementation of agile construction management is beneficial
- H2: Construction management workers have significantly positive support for agile management cognition (perceived ease of use and perceived usefulness)
- H3: Construction management staff plays a significant positive intermediary role in promoting the agility of construction management, which is conducive to the agility of construction management
- H4: Agile construction management and practitioners' awareness contribute to China's construction management progress.

3.Materials and Procedures

Questionnaires were utilized in this quantitative study to evaluate the experience and knowledge of the respondents. Published research papers, articles, and journals provided the secondary data.Chinese labourers from various places engaged in building. Sharing and distributing questionnaires through online platforms such as WeChat, QQ groups, Baidu posting, etc., and screening the respondents' occupations, with non-construction management personnel eliminated. Chinese construction workers were sampled in small groups using the cluster sampling technique. 376 questionnaires were distributed in order to gain a better understanding of the applicability and viability of agile construction management in China, Remove questionnaires with missing data, anomalous data extremes, and questionnaires with response times of less than 200 seconds. 350 of those were valid and recovered. 350 samples were taken, and the rate is 93.0%. The data volume in this sample complies with smartPLS sampling guidelines.

Three key sections make up the questionnaire. The practitioners' background data, including gender, age, highest education level, position, tenure, company size, etc., is shown in the first section. The design of the scale follows the classic literature on the variable (Table 1) and some of the recently published literature, and is based on existing scales for the variable in question, which were discussed with construction managers in the industry, and discussed and revised several times with the author's PhD supervisors. The use of agile management principles, which are separated mostly into Iterative development, customer orientation, continuous improvement, and visualization are the four main components of agile management. The examination of perception's intermediary components takes place in the third section. Perceived utility and perceived ease of use—the two core tenets of TAM theory—are the primary components. Section four is using a combination of traditional construction management techniques and agile management concepts, some outcome measurements are used to assess how agile the construction management process is. Through the understanding of agile management by practitioners in the construction industry, this survey on agile construction was done to investigate the applicability of agile management practices in the field of construction engineering. Table 1 contains pertinent literature sources from which our scale questions were derived.

The questionnaire's goal is to ascertain whether agile management can be applied to China's construction management industry. It examines the aspects of agile management that Chinese construction practitioners view as an intermediary, based on their present understanding and the viability of implementing agile practices in various locations of China. examine the applicability of agile management to China's construction management agility.

Table 1. Questionnaire scale design

latent variable	topic	Design reference
visualization	KS1: Project teams use visual tools such as Kanban boards to track project progress KS2: In the project, there are visual ways to display work tasks, progress and problems KS3: The project has visualization tools to share project information to promote project transparency.	Zhang & Sharifi (2000); Muhammad et al (2021)
continuous improvement	GJ1: The project team conducts frequent retrospective meetings to identify issues and improve project processes GJ2: In past projects, an approach has been taken to learn from previous mistakes and apply lessons learned GJ3: The project encourages team members to actively participate in improvements and make	

	suggestions to promote the continuous improvement of agile management.	
customer orientation	DX1: The project team regularly interacts with the customer to understand their needs and expectations DX2: The project team has a mechanism to collect and analyze customer feedback to continuously improve the product or service to meet customer needs. DX3: The project puts the customer's needs at the core of the project and ensures that the project delivery is oriented to meet customer needs.	
iterative development	DD1: The project adopts an iterative development method, dividing the project into small iteration cycles and gradually delivering functions DD2: After each iteration of the project, conduct feedback and review to determine priorities and improvement points for the next iteration DD3: Projects use iterative development to more flexibly adapt to changes in the external environment and improve decision-making	
perceived ease of use	YY1: Agile management methods are easy to use and easy for construction practitioners to get started with. YY2: I find it easy and enjoyable to use agile management methods in construction projects YY3: Agile management methods feel simple to operate YY4: I feel that I can use agile management methods in construction without spending a lot of time learning. YY5: I feel confident in quickly learning and using agile management methods proficiently	Venkatesh&Davis (2000) ; Venkatesh & Davis (1996); Karahanna&Straub(1999)
perceived usefulness	YO1: Agile management brings benefits to construction projects YO2: Agile management methods have practical application value in construction projects YO3: Adopting agile management methods during the construction	Davis(1989) ;Karahanna&Straub(1999)

construction management agility	process will be more conducive to project success YO4: Agile management has application potential in various construction situations YO5: Agile management can meet my management needs in construction projects YO6: If everyone understands the benefits of agile management, it will be widely accepted by construction practitioners MJ1: Project engineering has a mechanism that allows it to flexibly reallocate resources according to actual conditions to meet the needs of the project MJ2: Members' work efficiency is high during agile construction management of project engineering MJ3: Project engineering can effectively respond to emergencies during project execution to ensure the successful delivery of the project MJ4: Project engineering can effectively respond to problems in the project and continuously improve MJ5: Project engineering can easily and quickly obtain customer market information to support project planning and decision-making.	Dove (1999) ;Overby et al(2006)

There were Likert scale questions. To indicate agreement or disagreement with the questions, five alternatives were provided. It might range from "strongly disagree," "disagree," "moderately," "agree," and finally "strongly agree." Likert scales are simpler to administer and yield more accurate results than dichotomous measures.

SPSS 25 and SmartPLS 4 were used in this study's data analysis. With SPSS, the percentage, mean, and standard deviation were computed. To ascertain variable correlations, we conducted numerous bivariate investigations. SmartPLS 4 was used to analyse the path coefficient, bootstrap coefficient, Intermediate effect test，R-squared, Variance Explained Effect Size (F-squared), collinearity statistic (VIF), and internal and external VIF values. Check the directional relationship between the variables to test the null hypothesis.

3.1. Analysis of sample statistics

The demographic analysis results of the questionnaire survey sample are displayed in Table 2. According to the figures, 99.8% of the sample survey's respondents are employed in the Chinese construction industry, fulfilling the study's objective of looking at China's average distribution.

Table 2. Basic information of investigators

	Demographic Variables	Frequency	Percentage（%）
Gender	male	192	54.9
	female	158	45.1
Age	18-25 years old	40	11.4

	26-35 years old	113	32.3
	36-45 years old	118	33.7
	45 years and over	79	22.6
Educational qualifications	High school and below	47	13.4
	College	108	30.9
	Undergraduate	161	46.0
	Master degree and above	34	9.7
Position	General staff	197	56.3
	Lower level managers	89	25.4
	middle managers	49	14.0
	top management managers	15	4.3
Company Size	Less than 50 people	91	26.0
	50-200 people	116	33.1
	200-500 people	109	31.1
	Over 500 people	34	9.7
Time in office	Within 1 year	92	26.3
	1-3 years	160	45.7
	Over 3 years	98	28.0

Table 3 displays the proportion of respondents who were aware of perception, agility in construction management, and the four agile management features. Likert scale responses ranged from 1 (strongly disagree) to 5 (strongly agree) for each question. The mean, standard deviation, and descriptive analysis for each question and item are shown in Table 3.

Table 3. Single sample statistics

	strongly disagree(%)	disagree(%)	generally(%)	agree(%)	Very much agree(%)	Mean	Std.Deviation
KS1	2.9	7.4	14.9	42.6	32.2	3.94	1.012
KS2	3.1	7.7	21.1	40.6	27.4	3.81	1.023
KS3	4.0	10.0	17.4	42.9	25.7	3.76	1.067
GJ1	2.3	7.4	16.9	42.6	30.9	3.92	0.988
GJ2	4.9	9.4	19.7	36.9	29.1	3.76	1.118
GJ3	4.9	8.9	19.7	34.6	32.0	3.8	1.128
DX1	1.7	7.4	14.6	46.6	29.7	3.95	0.946
DX2	4.6	7.1	16.6	40.0	31.7	3.87	1.08
DX3	4.3	8.0	16.3	43.4	28.0	3.83	1.059
DD1	6.0	8.3	15.7	40.0	30.0	3.8	1.136
DD2	6.3	10.6	14.3	41.1	27.7	3.73	1.158
DD3	6.9	10.0	17.1	39.1	26.9	3.69	1.169
YY1	4.6	4.6	13.1	40.3	37.4	4.01	1.05
YY2	4.6	6.3	15.4	31.1	42.6	4.01	1.116
YY3	4.6	5.7	22.3	36.0	31.4	3.84	1.075
YY4	4.3	5.4	16.3	34.9	39.1	3.99	1.077
YY5	3.1	8.6	14.6	42.0	31.7	3.91	1.041
YO1	3.7	7.4	16.6	45.4	26.9	3.84	1.022
YO2	3.4	10.3	21.1	37.4	27.7	3.76	1.074
YO3	4.3	11.1	18.3	44.6	21.7	3.68	1.065
YO4	3.4	7.7	26.0	40.6	22.3	3.71	1.008
YO5	2.9	12.9	18.9	39.7	25.7	3.73	1.07
YO6	3.1	8.3	18.6	35.4	34.6	3.9	1.067

MJ1	3.4	5.1	11.7	46.0	33.7	4.01	0.985
MJ2	3.4	6.3	14.3	43.7	32.3	3.95	1.013
MJ3	4.6	4.6	15.7	37.1	38.0	3.99	1.065
MJ4	1.7	7.1	16.3	40.9	34.0	3.98	0.972
MJ5	5.4	6.0	16.9	36.3	35.4	3.9	1.116

3.2. Reliability analysis

Table 4 presents an analysis of the survey data's dependability at each level. Every scale levelhad a Cronbach's alpha coefficient that ranged from 0.764 to 0.858（Cronbach's alpha coefficient > 0.7）. The overall scale's dependability was 0.939（Cronbach's alpha coefficient > 0.7）. The dependability of the survey questionnaire is excellent.

Table 4. Questionnaire reliability analysis

latent variable	Observed variables	Alpha coefficient
visualization	KS1-KS3	0.776
continuous improvement	GJ1-GJ3	0.764
customer orientation	DX1-DX3	0.778
iterative development	DD1-DD3	0.838
perceived ease of use	YY1-YY3	0.865
perceived usefulness	YO1-YO3	0.863
agile construction management	MJ1-MJ3	0.858
total variable	KS1-KS3, GJ1-GJ3, DX1-DX3, DD1-DD3, YY1-YY3, YO1-YO3, MJ1-MJ3	0.939

3.3. Validity analysis and Data analysis

Based on Kaiser-Meyer-Olkin values（KMO） and Bartlett's test of sphericity were used to analyse the data. The sample data is appropriate for exploratory factor analysis (EFA) since the P value is 0.000 (P<0.001), passing the Bartle sphericity test, and the KMO value is 0.939, higher than 0.70.

Table 5. KMO and Bartlett's Test

KMO		0.939
Bartlett's Test of Sphericity	Approx. Chi-Square	4806.709
	df	378
	Significance	0.000

Passed the KMO and Bartlett's Test,then the data were subjected to an exploratory factor analysis using the principal component analysis approach. As can be seen in Table 6, the findings indicated that seven common factors accounted for 67.2% of the whole questionnaire, exceeding the required 60% and satisfying the criteria of exploratory factor analysis,then the factor dimensions are obtained by rotating the matrix,through the above data measurement, it shows that the reliability and validity are good.

Table 6. Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.680	38.141	38.141	10.680	38.141	38.141	3.850	13.751	13.751
2	1.972	7.043	45.184	1.972	7.043	45.184	3.194	11.406	25.156
3	1.541	5.503	50.687	1.541	5.503	50.687	2.889	10.316	35.473
4	1.317	4.705	55.392	1.317	4.705	55.392	2.362	8.434	43.907

5	1.205	4.304	59.696	1.205	4.304	59.696	2.240	8.000	51.907
6	1.090	3.894	63.590	1.090	3.894	63.590	2.177	7.774	59.681
7	1.013	3.619	67.209	1.013	3.619	67.209	2.108	7.528	67.209
8	.652	2.330	69.539						
9	.607	2.169	71.708						
10	.585	2.090	73.797						
11	.568	2.030	75.827						
12	.547	1.954	77.782						
13	.541	1.931	79.713						
14	.522	1.865	81.578						
15	.480	1.716	83.294						
16	.468	1.670	84.964						
17	.457	1.631	86.595						
18	.441	1.576	88.171						
19	.422	1.508	89.679						
20	.404	1.443	91.122						
21	.399	1.424	92.546						
22	.358	1.279	93.825						
23	.342	1.221	95.046						
24	.322	1.148	96.194						
25	.312	1.116	97.310						
26	.270	.963	98.273						
27	.253	.904	99.177						
28	.230	.823	100.000						

Extraction Method: Principal Component Analysis.

Table 7. Rotated component matrix

	Component						
	1	2	3	4	5	6	7
YO3	.730						
YO4	.723						
YO5	.722						
YO2	.709						
YO6	.682						
YO1	.671						
YY3		.779					
YY4		.717					
YY1		.702					
YY5		.669					
YY2		.652					
MJ4			.718				
MJ1			.692				
MJ2			.605				

MJ5			.582				
MJ3			.556				
DD3				.817			
DD2				.777			
DD1				.748			
DX2					.801		
DX1					.755		
DX3					.718		
KS2						.782	
KS3						.757	
KS1						.682	
GJ2							.764
GJ3							.745
GJ1							.712

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

According to the rotation component matrix, we can judge the factor attribution of the various problems, KS 1, KS 2 and KS 3 belong to factor 1, Its factor load is greater than 0.6, Name it as visualization according to its title content; GJ 1, GJ 2 and GJ 3 belong to factor 2, Its factor load is greater than 0.7, Name it continuous improvement according to its title content; DX1, DX2, DX3 and other 3 topics belong to factor 3, Its factor load is greater than 0.7, Named it as customer orientation according to its title content; Three topics, including DD1, DD2, and DD3, belong to factor 4, Its factor load is greater than 0.7, It is named as iterative development according to its title content; YY1, YY2, YY3, YY4, YY5 and other 5 titles belong to factor 5, Its factor load is greater than 0.6, According to the content of the title, it is named as perceived ease of use; YO 1, YO2, YO 3, YO 4, YO 5 and YO 6 belong to factor 6, Its factor load is greater than 0.6, It is named as perceived usefulness according to its title content; MJ 1, MJ 2, MJ 3, MJ 4, and MJ 5,5 titles belong to factor 7, Its factor load is greater than 0.6, According to its title content will be named as the construction management Agility.

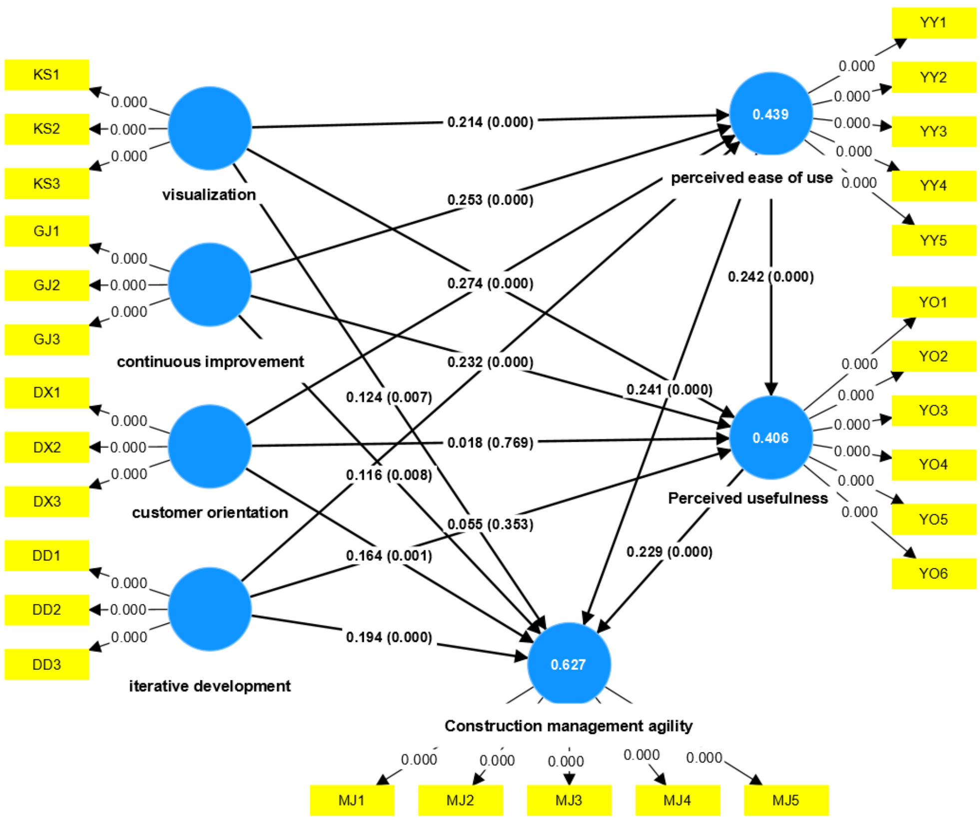

Fig.1: PLS Algorithm Analysis Results Graph (Path coefficient & P-value)

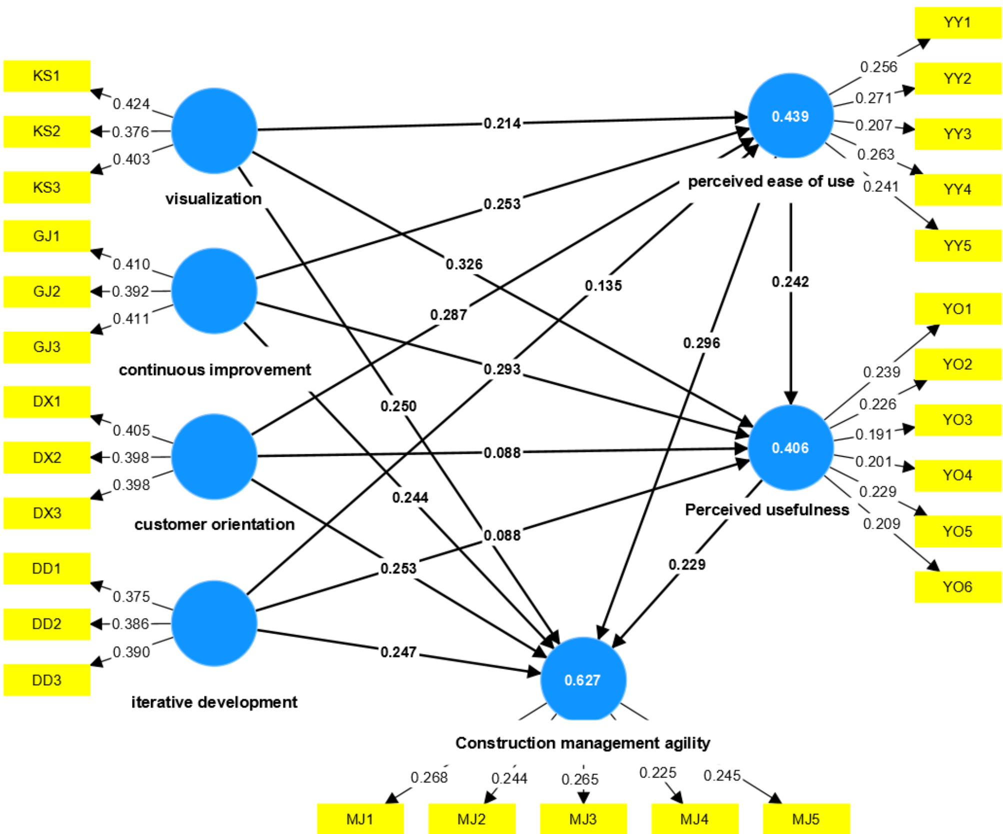

Fig.2: PLS Algorithm Analysis Results Graph (total effect size)

Figure 1 shows the results of the least squares path algorithm for seven variables in the study: 1) visualization 2) continuous improvement 3) customer orientation 4) iterative development 5) perceived ease of use 6) perceived usefulness 7) construction management agility.

The above model aims to show that these 7 variables are interrelated in order to achieve the objectives of this study, namely:

- explore the factors that determine the agility of construction industry management in China;
- explore the correlation between agile management factors and construction management agility;
- explore the mediating role of construction practitioners' cognition of agile management in the process of construction management agility

The bivariate study of variable indicators is shown in Table 9, This variable has 12 indications. The p-values of most indicators differ considerably ($p<0.05$). A monotonically connected agile management variable indicator is statistically significant for this investigation. The correlation coefficients of each indicator are positive and moderately linear.

The bivariate study of variable indicators is shown in Table 10, This variable has 11 indications. P-values are significant in most measurements. The perceptual element indicators are monotonically connected, which is statistically significant for this investigation. Each indicator is positively correlated and moderately linear.

Bivariate investigations of variable indicators are shown in Table 11, This variable has 5 indications. Most measures indicate substantial p-value differences. This study shows monotonically connected and statistically significant construction management agility element factor results. Each indicator has a moderate, positive correlation coefficient.

Table 8. Path coefficients

	construction management agility	perceived usefulness	perceived ease of use	continuous improvement	customer orientation	iterative development
construction management agility						
perceived usefulness	0.229					
perceived ease of use	0.241	0.242				
continuous improvement	0.116	0.232	0.253			
customer orientation	0.164	0.018	0.287			
iterative development	0.194	0.055	0.135			
visualization	0.124	0.274	0.214			

Figure 2 shows that the path coefficients from the four agile management elements (visualization, continuous improvement, customer orientation, iterative development) to construction management agility are 0.250, 0.244, 0.253and 0.247, respectively, at Cohen (1988) statistical standards. The path weights are 0.250, 0.244, 0.253, and 0.247, showing that visualization, continuous improvement, customer focus, and iterative development moderately improve construction management agility.

From Figure 2, a medium-sized effect is defined by Cohen (1988) statistical threshold of more than 0.25. From Figure 1 and Figure 2, In the path from Agile Management 4 elements (visualization, continuous improvement, customer orientation, iterative development) to perceived ease of use, the effect values were 0.214,0.253,0.287, and 0.135(P-value <0.05), indicating that only iterative development had a weak impact on perceived ease of use, while the other three showed moderate effects.

Visualization, continuous improvement, customer orientation, and iterative development affect perceived usefulness by 0.326, 0.293, 0.088, and 0.088, respectively. Continuous improvement and visualization have moderate influence on construction management agility (P-value < 0.05) Since both the P-values of iterative development and customer orientation (see Figure 1) were greater than 0.05, there was no statistical significance. Perceived ease of use has a medium effect on perceived usefulness (0.242). Additionally, the path coefficients from perceived ease of use and perceived usefulness to construction management agility are 0.241 and 0.229（see Table 8）and all of P-value of them are lower than 0.05(see Figure 1), indicating that these factors moderately or above positively affect agility.

Table 9. Correlations between measurement indicators of agile management elements

Correlations													
		KS1	KS2	KS3	GJ1	GJ2	GJ3	DD1	DD2	DD3	DX1	DX2	DX3
KS1	Pearson Correlation	1	.521**	.509**	.267**	.251**	.276**	.430**	.319**	.285**	.287**	.244**	.284**
	Sig. (2-tailed)		0	0	0	0	0	0	0	0	0	0	0
KS2	Pearson Correlation	.521**	1	.579**	.252**	.229**	.256**	.392**	.348**	.271**	.278**	.246**	.314**
	Sig. (2-tailed)	0		0	0	0	0	0	0	0	0	0	0
KS3	Pearson Correlation	.509**	.579**	1	.233**	.241**	.277**	.362**	.343**	.286**	.199**	.235**	.309**
	Sig. (2-tailed)	0	0		0	0	0	0	0	0	0	0	0
GJ1	Pearson Correlation	.267**	.252**	.233**	1	.481**	.526**	.254**	.280**	.227**	.253**	.305**	.247**
	Sig. (2-tailed)	0	0	0		0	0	0	0	0	0	0	0
GJ2	Pearson Correlation	.251**	.229**	.241**	.481**	1	.553**	.221**	.322**	.244**	.198**	.314**	.260**
	Sig. (2-tailed)	0	0	0	0		0	0	0	0	0	0	0
GJ3	Pearson Correlation	.276**	.256**	.277**	.526**	.553**	1	.337**	.393**	.357**	.203**	.240**	.295**
	Sig. (2-tailed)	0	0	0	0	0		0	0	0	0	0	0
DD1	Pearson Correlation	.430**	.392**	.362**	.254**	.221**	.337**	1	.651**	.613**	.332**	.345**	.369**
	Sig. (2-tailed)	0	0	0	0	0	0		0	0	0	0	0
DD2	Pearson Correlation	.319**	.348**	.343**	.280**	.322**	.393**	.651**	1	.633**	.276**	.355**	.313**
	Sig. (2-tailed)	0	0	0	0	0	0	0		0	0	0	0
DD3	Pearson Correlation	.285**	.271**	.286**	.227**	.244**	.357**	.613**	.633**	1	.292**	.227**	.235**
	Sig. (2-tailed)	0	0	0	0	0	0	0	0		0	0	0
DX1	Pearson Correlation	.287**	.278**	.199**	.253**	.198**	.203**	.332**	.276**	.292**	1	.588**	.504**
	Sig. (2-tailed)	0	0	0	0	0	0	0	0	0		0	0
DX2	Pearson Correlation	.244**	.246**	.235**	.305**	.314**	.240**	.345**	.355**	.227**	.588**	1	.532**
	Sig. (2-tailed)	0	0	0	0	0	0	0	0	0	0		0
DX3	Pearson Correlation	.284**	.314**	.309**	.247**	.260**	.295**	.369**	.313**	.235**	.504**	.532**	1
	Sig. (2-tailed)	0	0	0	0	0	0	0	0	0	0	0	

** Correlation is significant at the 0.01 level (2-tailed).

Table 10. Correlations among perceptual factor items

Correlations												
		YY1	YY2	YY3	YY4	YY5	YO1	YO2	YO3	YO4	YO5	YO6
YY1	Pearson Correlation	1	.613**	.545**	.661**	.502**	.376**	.349**	.294**	.275**	.366**	.329**
	Sig. (2-tailed)		0	0	0	0	0	0	0	0	0	0
YY2	Pearson Correlation	.613**	1	.527**	.629**	.516**	.406**	.353**	.306**	.303**	.381**	.294**
	Sig. (2-tailed)	0		0	0	0	0	0	0	0	0	0
YY3	Pearson Correlation	.545**	.527**	1	.538**	.535**	.269**	.299**	.324**	.266**	.283**	.286**
	Sig. (2-tailed)	0	0		0	0	0	0	0	0	0	0
YY4	Pearson Correlation	.661**	.629**	.538**	1	.549**	.355**	.357**	.280**	.293**	.363**	.316**
	Sig. (2-tailed)	0	0	0		0	0	0	0	0	0	0
YY5	Pearson Correlation	.502**	.516**	.535**	.549**	1	.339**	.362**	.332**	.274**	.368**	.283**
	Sig. (2-tailed)	0	0	0	0		0	0	0	0	0	0
YO1	Pearson Correlation	.376**	.406**	.269**	.355**	.339**	1	.508**	.504**	.534**	.550**	.480**
	Sig. (2-tailed)	0	0	0	0	0		0	0	0	0	0
YO2	Pearson Correlation	.349**	.353**	.299**	.357**	.362**	.508**	1	.496**	.508**	.565**	.539**
	Sig. (2-tailed)	0	0	0	0	0	0		0	0	0	0
YO3	Pearson Correlation	.294**	.306**	.324**	.280**	.332**	.504**	.496**	1	.495**	.512**	.471**
	Sig. (2-tailed)	0	0	0	0	0	0	0		0	0	0
YO4	Pearson Correlation	.275**	.303**	.266**	.293**	.274**	.534**	.508**	.495**	1	.546**	.457**
	Sig. (2-tailed)	0	0	0	0	0	0	0	0		0	0
YO5	Pearson Correlation	.366**	.381**	.283**	.363**	.368**	.550**	.565**	.512**	.546**	1	.523**
	Sig. (2-tailed)	0	0	0	0	0	0	0	0	0		0
YO6	Pearson Correlation	.329**	.294**	.286**	.316**	.283**	.480**	.539**	.471**	.457**	.523**	1
	Sig. (2-tailed)	0	0	0	0	0	0	0	0	0	0	

** Correlation is significant at the 0.01 level (2-tailed).

Table 11. Correlation among construction management agility projects

Correlations						
		MJ1	MJ2	MJ3	MJ4	MJ5
MJ1	Pearson Correlation	1	.603**	.601**	.601**	.559**
	Sig. (2-tailed)		0	0	0	0
MJ2	Pearson Correlation	.603**	1	.568**	.485**	.493**
	Sig. (2-tailed)	0		0	0	0
MJ3	Pearson Correlation	.601**	.568**	1	.528**	.542**
	Sig. (2-tailed)	0	0		0	0
MJ4	Pearson Correlation	.601**	.485**	.528**	1	.516**
	Sig. (2-tailed)	0	0	0		0
MJ5	Pearson Correlation	.559**	.493**	.542**	.516**	1
	Sig. (2-tailed)	0	0	0	0	

** Correlation is significant at the 0.01 level (2-tailed).

Table 12 shows the T values and path P-values in this study. in which the relationship between the four elements of agile and perceived ease of use and the four elements of agile management and agility in construction management are significant ($p < 0.05$, $t > 1.96$), and among the agile management elements, the relationship between visualization, continuous improvement and perceived usefulness is significant ($p < 0.05$, $t > 1.96$). At the same time, the relationship between the two elements of perception and the agility of construction management is also significant. ($p < 0.05$, $t > 1.96$), where the relationship from perceived ease of use to perceived usefulness is also significant. However, the relationship between iterative development among agile management elements, customer orientation and perceived usefulness shows an insignificant correlation ($p> 0.05$, $t<1.96$), which is not statistically significant.

Table 12. Summary of Boostrapping Results

	Original sample(O)	Sample mean(M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Perceived usefulness -> Construction management agility	0.229	0.227	0.053	4.31	0
Continuous improvement -> Construction management agility	0.116	0.117	0.044	2.662	0.008
Continuous improvement -> Perceived usefulness	0.232	0.232	0.055	4.194	0
Continuous improvement -> Perceived ease of use	0.253	0.25	0.061	4.122	0
Customer orientation -> Construction management agility	0.164	0.161	0.049	3.353	0.001
Customer orientation -> Perceived usefulness	0.018	0.018	0.062	0.294	0.769
Customer orientation -> Perceived ease of use	0.287	0.29	0.063	4.535	0
Iterative development -> Construction management agility	0.194	0.195	0.047	4.104	0
Iterative development -> Perceived usefulness	0.055	0.058	0.059	0.93	0.353
Iterative development -> Perceived ease of use	0.135	0.133	0.054	2.48	0.013
Perceived ease of use -> Construction management agility	0.241	0.242	0.06	4.022	0
Perceived ease of use -> Perceived usefulness	0.242	0.239	0.068	3.578	0
Visualization -> Construction management agility	0.124	0.125	0.046	2.689	0.007
Visualization -> Perceived usefulness	0.274	0.276	0.06	4.557	0
Visualization -> Perceived ease of use	0.214	0.215	0.056	3.829	0

Note: P-Value less than 0.05 is a significant effect

Table 13. Intermediate effect test

Mediating effects	Indirect effects	Total effects	VAF	Test results	P
4 elements of Agility -> Agility in Construction Management (Perceived Ease of Use Mediation)	0.645	0.739	87.3%	Partial mediation	0.000

4 elements of Agility -> Agility in Construction Management (Perceived Usefulness Mediation)	0.581	0.739	78.7%	Partial mediation	0.000

The variance explained in Table 13 can be calculated using the corresponding formula VAF = (mediation effect + direct effect) / total effect, i. e. based on the path coefficients in Figure 1 and Table 8. The variance of perceived ease and perceived usefulness was 87.3% and 78.7%, respectively, corresponding to a p-value less than 0.05. Since the VAF of perception 2 elements is about 80%, perceived ease of use and perceived usefulness significantly explain the relationship between independent and dependent variables, so the two elements of perception highly mediate the relationship between agility 4 elements and agility.

Table 14. Summary of R-Squared Results

	R-square	R-square adjusted
Construction management agility	0.627	0.62
Perceived usefulness	0.406	0.398
Perceived ease of use	0.439	0.432

Figure 1 and Figure 2 show the partial least squares algorithm model, and Table 14 summarizes R-squared results. The adjusted R-squared value is better than the R-squared value since it is determined based on the model's relevant variables and grows regardless of variable relevance. Additionally, the R-squared number shows how much the input variables explain the maximum variation in the output variables. The four agile management elements and the two perception factors explained 62% of construction management agility in this study, according to the R-squared value of 0.62. The adjusted R-squared values of perceived ease of use and perceived usefulness were 0.398 and 0.432, respectively, indicating that the Agile 4 factors explain 39.8% of the variation in perceived ease of use and 43.2% of the variation in perceived usefulness.

Table 15. Summary Of F-Squared Results

	construction management agility	perceived usefulness	perceived ease of use	4 elements of Agile management
construction management agility				
perceived usefulness	0.078			
perceived ease of use	0.084	0.054		
4 elements of Agile management	0.267	0.17	0.752	

Table 15 shows that the four agile management elements have a high degree of explanation of perceived availability (0.752) and a moderate degree of perceived usefulness (0.17), while perceived availability does not explain perceived usefulness to a significant extent (0.054). These four agility factors have a moderate interpretation of construction management agility (0.267), whereas, perceived ease of use and perceived usefulness explained weakly construction management agility respectively （0.084 & 0.078）.

Table 16. Summary of inner VIF value results

	construction management agility	Perceived usefulness	perceived ease of use	continuous improvement	customer orientation	iterative development	visualization

construction management agility			
perceived usefulness	1.684		
perceived ease of use	1.88	1.781	
continuous improvement	1.523	1.432	1.318
customer orientation	1.487	1.486	1.34
iterative development	1.513	1.508	1.475
visualization	1.603	1.476	1.395

Table 17. Summary of outer VIF value results

code	KS1	KS2	KS3	GJ1	GJ2	GJ3	DD1	DD2	DD3	
VIF	1.506	1.679	1.652	1.49	1.552	1.649	1.965	2.049	1.891	
code	DX1	DX2	DX3	YO1	YO2	YO3	YO4	YO5	YO6	
VIF	1.658	1.725	1.511	1.784	1.843	1.663	1.749	1.949	1.675	
code	YY1	YY2	YY3	YY4	YY5	MJ1	MJ2	MJ3	MJ4	MJ5
VIF	2.13	2	1.736	2.247	1.687	2.211	1.81	1.92	1.771	1.711

This study's internal and exterior Variable Inflation Factor（VIF） values are in Tables 16 and Table 17，No external VIF values are above 10, and all VIFs are below 5, showing no multicollinearity in the data (Wiengarten et al., 2011; Valliant, DL, & Valliant, R. 2012; George & Mallery, 2019). So this threshold is reasonable.

4. Result

Through the analysis, H1: the implementation of agile management model to Chinese construction management is significantly positively affecting construction management, the It is established that the implementation of Agile in construction management is favorable because the total effect from the Agile management elements in Figure 2 to the construction management sensitization in China and the results of the bootstrapping method in Table 12 show that the implementation of Agile in construction management is beneficial. The coefficients of the path from agile management elements to construction management agilization in China in Figure 1 and the results of the bootstrapping method in Table 12 show that t The t-value and P-value ($t>1.96$, $P<0.05$) of the path from the elements of agile management to the agilization of construction management are statistically significant. The coefficients of the paths from the 4 elements of agile management to construction management agilization are in the range of 0.25, so it shows that agile management significantly and positively affects construction management agilization. Agile management has a significant positive impact on construction management agility, so it is established that it is favorable to implement agility in construction management, and at the same time, it shows that agile management is the key factor that affects the agility of China's construction management. At the same time, it shows that the four key factors of agile management are the key factors affecting the agility of construction management in China.

For H2: Construction management staff's perception of agile management (perceived ease of use and perceived usefulness) is holding significantly positively supported,As shown in the partial least squares algorithm model in Figure 2 above and the t-values and p-values of the paths in Table 12, the effect sizes of the four elements of Agile Management to Perceived Ease of Use are basically in the range of 2.5 except for the effect sizes of Iterative Development which are small. The effect values of the 4 elements of agile management to perceived ease of use are basically in the range of 2.5, except for the effect value of iterative development, which is small, and their t-values and P-values are in accordance with the standard (t>1.96, P<0.05). For Perceived Usefulness, the effect value of the Agile Management 4 elements to Perceived Usefulness (see Figure 2) shows that the effect values for Visualization and Continuous Improvement are in the 0.3 range. values are in the range of 0.3, indicating that these two elements positively influence the perceived usefulness element, while customer orientation and iterative development are in the range of 0.088, according to the t-value and p-value table in Table 12, customer orientation and iterative development are not statistically significant in terms of perceived usefulness. This is not statistically significant, but it does not affect our ability to determine the influence of most of the factors, and it also indicates that construction management staff are not aware of the four elements of agile management. However, this does not affect our ability to determine the impact of most of the factors, and indicates that there is a significant positive relationship between the perception of the construction management staff on the four elements of Agile management and that the staff has a positive attitude towards Agile management. the staff has a positive attitude towards Agile Management.

For H3: The perception of construction management personnel is an important positive intermediary factor of construction management agility. As seen from Table Table 13, perceived ease of use and perceived usefulness are partial mediating variables, with VAF values all about 80%, indicating strong interpretation of variation in the process of constructing management agility，Moreover, the mediation effect values were 0.645 and 0.581（P<0.05） respectively, which is a high mediation effect strength, indicating that the 2 perceived core elements have a good positive role in promoting the agility of construction management. In Figure 1, the mediation effect of agile management elements is positive and the relevant path P value is less than 0.05. Therefore, meeting the statistical criteria for significant effects, construction managers' perceptions are significant positive mediating effects of the role in favor of flexibility in construction management. so the perceived factor of construction management personnel is the important and positive mediation of construction management agility.

For H4: The application of the 4 elements of Agile Management and the perception of Agile Management by practitioners with intermediary roles are beneficial to the development of construction management agility in China is established, according to the conclusions of H1, H2 and H3, according to H1, the 4 elements of Agile Management have a significant positive impact on construction management agility, and the 4 elements of Agile Management have a significant positive impact on construction management agility. Meanwhile, H2 shows that practitioners' perceptions of agile management are positive, and according to H3, it can be concluded that construction practitioners' perceptions of agility in terms of perceived ease of use and perceived usefulness have played a large role in mediating the promotion of agility，So agile management and practitioners' agile awareness contribute to China's agile construction management progress.

5. Conclusion

This study provided an empirical assessment of agile management approaches for construction management in China, evaluating practitioner perceptions of core agile elements and their impacts on construction agility. Visualization, continuous improvement, iterative development, and customer orientation boost agile construction management adoption, according to this study. Agile management in construction benefits construction management because It increases project flexibility, construction worker enthusiasm, job efficiency, and emergency response, allowing the project to be completed faster and successfully. After agile construction management, the project Focusing on difficulties has improved, the project can be continuously enhanced, external environment information can be collected faster, market information can be captured better, and plans and decisions can be made faster. Our research also found that Chinese construction practitioners support agile management, understand its technical methods, and believe it can actively improve China's construction management. Construction management may be agile. They consider the two key agile management technological qualities of visualization and continuous improvement to have significant application prospects, but they don't think much about continuous customer orientation and iteration. Thus, frequent customer connection listening to client suggestions, and iterative development have minimal influence. This also reveals that Chinese construction workers perceive iterative development and customer orientation differently. For construction workers, though, Continuous improvement, client orientation, and visualization are easy-to-use and feasible agile principles and technology, in their perspective. They acknowledge that iterative development is difficult to learn and apply. Yes, iterative development is mostly employed in several software industries in China and less in engineering, So they may not deeply realize the advantages of iterative development, and at the same time, it can be obtained that agile management in the direction of construction in China, for the perception of the construction personnel, they think it works. At the same time, our quantitative study found that construction practitioners' perception and awareness of agile management played a good intermediary role in promoting construction management agility in China. Therefore, to promote construction management agility in China, agile management training for construction practitioners is also particularly important, so that employees can have a comprehensive and objective perception of agility, and so that agility can be better integrated into the local construction management.

The results of this mediated study show the significant positive impact of four key agile factors. This improves the theoretical and practical knowledge of agile management strategies specific to the Chinese construction industry. Despite the limitations of this paper on geographical boundaries, but this quantitative assessment of the practitioner perspective provides data-driven insights, to make up the research gap in the agility of construction management in China, the findings of this paper set the stage for future research, and it is hoped that subsequent studies will longitudinally track and uncover the impact of agile management through in-depth case studies, comparative analyses, and other research methods.

Acknowledgements

I sincerely thank all reviewers and my supervisors for their valuable and professional insights and suggestions and my friend’s assistance. It is thanks to their professional knowledge and selfless dedication that our work quality has been greatly improved. We sincerely appreciate and respect their efforts and contributions.

References

Ahmed, M. N., & Mohammed, S. R. (2019). Developing a risk management framework in construction project based on agile management approach. Civil Engineering Journal, 5(3), 608-615.

Ahmed, G. A., & Altaie, M. R. (2021). Investigation the opportunity of BIM with agile management approach in Iraqi construction projects. In E3S Web of Conferences (Vol. 318, p. 02001). EDP Sciences.

Arefazar, Y., Nazari, A., Hafezi, M. R., & Maghool, S. A. H. (2022). Prioritizing agile project management strategies as a change management tool in construction projects. International Journal of Construction Management, 22(4), 678-689.

Benbasat, I., & Barki, H. (2007). Quo vadis TAM?. Journal of the association for information systems, 8(4), 7.

Campanelli, A. S., & Parreiras, F. S. (2015). Agile methods tailoring–A systematic literature review. Journal of Systems and Software, 110, 85-100.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates.

Chen, Q., Reichard, G., & Beliveau, Y. (2007). Interface management-a facilitator of lean construction and agile project management. International Group for Lean Construction, 1(1), 57-66.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly, (9), 319-339.

Davis, F.D. (1986). A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results. MIT Sloan School of Management, Cambridge, MA.

Denning, S. (2016). How to make the whole organization "Agile". Strategy & Leadership, 44(4), 10-17.

Dove, R. (1999). Knowledge management, response ability, and the agile enterprise. Journal of knowledge management, 3(1), 18-35.

Ellis, G. F. R. (2016). Agile Project Management: Scrum, eXtreme Programming, and Scrumban. Project Management in Product Development. Butterworth-Heinemann, 4(3).

Gasik, S. (2016). Project Management Development Practice and Perspectives. In 5th International Scientific Conference on Project Management in the Baltic Countries in the University of Latvia, April (pp. 14-15).thods, 39, 175-191.

George, D., & Mallery, P. (2019). IBM SPSS Statistics 26 Step by Step: A Simple Guide and Reference. Routledge.

Hass, K. B. (2007). The blending of traditional and agile project management

Hassan, E. N. E., & Khodeir, L. Impact of Agile Management on the Optimization of Change in Construction Projects: A Literature Review.

Jethva, S. S., & Skibniewski, M. J. (2022). Agile project management for design-build construction projects: A case study. Int. J. Appl. Sci. Eng, 19, 1-11.

Kasturiwale, A., & Rathod, K. (2021). Agile project management in construction industry. International Journal of Research in Engineering and Science (IJRES) ISSN, 9(6), 9-11.

Karahanna, E., & Straub, D. W. (1999). The psychological origins of perceived usefulness and ease-of-use. Information & management, 35(4), 237-250.

Mah, M. (2008). Measuring agile in the Enterprise. In Proceedings of the Agile Conference, Canada: Toronto.

Marnada, P., Raharjo, T., Hardian, B., & Prasetyo, A. (2022). Agile project management challenge in handling scope and change: A systematic literature review. Procedia Computer Science, 197, 290-300.

Martin, A. (2023). Introduction to an agile framework for the management of technology transfer projects. Procedia Computer Science, 219, 1963-1968.

Marques, J. A. L., dos Reis Morais, J. J. B., Alves, J., & Gonçalves, M. (2023). EFFECTIVENESS ANALYSIS OF WATERFALL AND AGILE PROJECT MANAGEMENT METHODOLOGIES–A CASE STUDY FROM MACAU'S CONSTRUCTION INDUSTRY. Revista Gestão em Análise, 12(1), 23-38.

Meselhy, M. S. (2022). BUNDLING THE FRAMEWORK FOR ALLYING THE VALUE ENGINEERING AND AGILE MANAGEMENT. Fayoum University Journal of Engineering, 5(2), 52-62.

Moran, A. (2015). Managing Agile: Strategy, Implementation, Organisation and People. Managing Agile. Cham: Springer International Publishing.

Mohammed, S. R., & Jasim, A. J. (2018). Using agile construction management principles for reducing delay in Iraqi construction industry. Association of Arab Universities Journal of Engineering Sciences, 25(5), 151-170.

Mohamed, B., & Moselhi, O. (2019, June). A framework for utilization of agile management in construction management. In CSCE 2019 Conference.

Mohammed, K. N., & Chambrelin, K. S. (2020). An analytical approach in usage of agile methodologies in construction industries–A case study. Materials Today: Proceedings, 33, 475-479.

Muhammad, U., Nazir, T., Muhammad, N., Maqsoom, A., Nawab, S., Fatima, S. T., ... & Butt, F. S. (2021). Impact of agile management on project performance: Evidence from IT sector of Pakistan. Plos one, 16(4), e0249311.

Ormeño Zender, Y., & García de Soto, B. (2021). Use of Scrum in the rehabilitation of a commercial building in Peru. Construction Innovation, 21(2), 145-163.

Omar, N. (2022). Enhancing agile application in construction projects using BIM (Doctoral dissertation, Heriot-Watt University).

Overby, E., Bharadwaj, A., & Sambamurthy, V. (2006). Enterprise agility and the enabling role of information technology. European journal of information systems, 15, 120-131.

Owen, R. B., & Koskela, L. (2006). Agility in construction. In The Proceedings of 20th IPMA World Congress on Project Management (pp. 1-4). International Project Management Association.

OWAIS, Z. (2022). AGILE PROJECT MANAGEMENT AS A CHANGE MANAGEMENT TOOL IN DYNAMIC CONSTRUCTION PROJECTS, A NECESSITY TO COOP WITH PROJECTS'INCREASING COMPLEXITY AND UNCERTAINTY. Scientific Papers of Silesian University of Technology. Organization & Management/Zeszyty Naukowe Politechniki Slaskiej. Seria Organizacji i Zarzadzanie, (160).

Paul, A. J., & Rahman, S. K. (2018). Study on Agile Management in Construction Project Using Scrumban Methodology. Int. Res. J. Eng. Technol, 774, 774-777.

Ribeiro, F. L., & Fernandes, M. T. (2010). Exploring agile methods in construction small and medium enterprises: a case study. Journal of Enterprise Information Management, 23(2), 161-180.

Sakikhales, M. H., & Stravoravdis, S. (2017). Using agile project management and BIM for improved building performance. Building information modelling, building performance, design and smart construction, 65-78.

Siddiqui, M. A. R., Kamran, S. M., & Memon, A. A. (2022). Application of Agile Project Management Approach in Construction Projects: An Experimental Research.

Strausser, G. (2015). Agile Project Management Concepts Applied to Construction and Other Non-IT Fields. Paper presented at PMI® Global Congress 2015—North America, Orlando, FL.

Stare, A. (2014). Agile project management in product development projects. Procedia-Social and Behavioral Sciences, 119, 295-304.

Streule, T., Miserini, N., Bartlomé, O., Klippel, M., & De Soto, B. G. (2016). Implementation of scrum in the construction industry. Procedia engineering, 164, 269-276.

Thesing, T., Feldmann, C., & Burchardt, M. (2021). Agile versus waterfall project management: decision model for selecting the appropriate approach to a project. Procedia Computer Science, 181, 746-756.

Valliant, D. L., & Valliant, R. (2012). Variance inflation factors in the analysis of complex survey data.pdf.

Venkatesh, V., & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. Management Science, 46(2), 186-204.

Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. Decision sciences, 27(3), 451-481.

Wiengarten, F., Fynes, B., Humphreys, P., Chavez, R. C., & McKittrick, A. (2011). Assessing the value creation process of e-business along the supply chain. Supply Chain Management: An International Journal.

Hassan, E. N. E., & Khodeir, L. Impact of Agile Management on the Optimization of Change in Construction Projects: A Literature Review.

Zhang, Z., & Sharifi, H. (2000). A methodology for achieving agility in manufacturing organizations. International Journal of Operations & Production Management, 20(4), 496-513.