

## The Role of Agile Leadership in The Timely Delivery of Projects in The Chinese Construction Industry

Jiangwei Luo<sup>1\*</sup>, Mohd Wira Mohd Shafiei<sup>1</sup>, Radzi Ismail<sup>1</sup>, Manli Luo<sup>2</sup>, Weibo Song<sup>3</sup>

<sup>1</sup>School of Housing, Building and Planning, Universiti Sains Malaysia, Gelugor 11800, Malaysia

<sup>2</sup>School of Chinese Medicine, Hong Kong Baptist University, Hong Kong, China

<sup>3</sup>China Construction (South Pacific) Development Co Pte Ltd, China

*ljw\_9898@126.com (Corresponding author)*

**Abstract:** This empirical research examines the role of agile management strategies guided by effective leadership towards timely project delivery in the Chinese construction sector. Survey data from 738 construction professionals assessed five agile methods including iterative development, flow of visual information and customer orientation combined with adaptive leadership styles. PLS-SEM modeling demonstrates these agile techniques and leadership decision-making have significant positive influence on prompt project completion. The findings contribute insights on targeted agile transformations customized for the Chinese industry to drive efficiency, quality and stakeholder satisfaction amidst volatility.

**Keywords:** Agile management, leadership, project delivery, SPSS, PLS-SEM, construction management

## **1.Introduction**

In 2022, according to the "Statistical Analysis of Construction Industry Development in 2022" released by the China Construction Industry Association, Chinese construction industry companies achieved profits of 836.9 billion yuan, a decrease of 10.181 billion yuan or 1.20% from the previous year; the growth rate was 1.47% lower than the previous year. percentage points. The construction industry's output value profit margin (the ratio of total profit to total output value) has reached its highest value of 3.63% since 2014 and has shown an overall downward trend. In 2022, the construction industry output value profit margin was 2.68%, 0.21 percentage points lower than the previous year. It has declined for six consecutive years and has been below 3% for two consecutive years. China's construction sector is currently searching for efficient project delivery methods as a result of the industry downturn. Because both the necessity for quicker construction project completion and the forces of a competitive market have grown (Han, 2013). However, data indicates that cost overruns and schedule delays affect 80% of development projects. In construction, schedule delays are frequent and recurrent, which invariably results in rework, cost overruns, and legal claims (Han, 2013; Soeharto, 2001). Delays can happen in more unanticipated ways as projects get more complicated (Han, 2013).

Because building projects are characterized by uncertainty, there will always be more erratic delays (Han, 2013). According to Lalu et al. (2019), construction projects must be finished as budgeted, on time, and schedule. However, the amount of potential delays that may be anticipated and budgeted for at project inception is limited (Han, 2013). Schedule delays are normal, but they frequently result in significant losses as well, including problems with cost, quality, and safety (Han, 2013). According to Han (2013), projects should incorporate flexibility to reduce the likelihood of unanticipated delays and timetable delays. More significantly, Han (2013) notes that this adaptable technique improves overall project performance in addition to helping with scheduling.

According to Han (2013), agile management is an integrated strategy that applies agile enablers throughout the project life cycle to help projects thrive in a fluid environment. It is derived from agile theories in other technical fields. The adaptability of the system is investigated with the ultimate goal of minimizing delays while coping with delays induced by complicated construction changes, as agility and related theories continue to emerge in the construction area (Han, 2013). According to Toor and Ofori (2008), the construction sector requires a new approach to project leadership. According to Lloyd-Walker & Walker (2011), teams formed to complete distinct but frequently related projects are handling an increasing amount of work nowadays. This is the reason we support the need for new leadership philosophies for all project leaders, not just those in the construction sector (Lloyd-Walker & Walker, 2011). This new approach will produce projects that not only meet the traditional Iron Triangle success criteria of meeting deadlines and budgets while maintaining quality standards but will also foster knowledge retention and sharing (Lloyd-Walker & Walker, 2011). Agile leaders are those who can define, disseminate, and uphold the organizational vision while guiding the team and consistently influencing its behavior; this is known as "agile leadership" (Parker et al., 2015). Agile leadership is defined by Parker et al. (2015) as a leader's capacity to: sense urgency and direction; work hard up front and set expectations and norms; share responsibility and mutual accountability; recognize problems and make decisions effectively; foster commitment and trust among members; balance the needs of the group and the individual; maintain cohesion without stifling individuality; face differences and handle conflicts; handle minority opinions; and use effective communication techniques. We can conclude that an organization will have greater agility capabilities if its leaders can use their forward-looking strategic vision to make the best decisions at the right time and use their initiative, awareness, and plans to achieve the best goals and plans (Facurrunnisa et al., 2020). Agile leadership enables consistent strategy implementation through the application of contemporary scientific methodologies appropriate for working in a context full of ambiguity and uncertainty (Factorunnisa et al., 2020). According to Akkaya (2020), in the quickly evolving world of today, leaders must maintain their agility to outperform their subordinates. In an increasingly globalized environment, agile executives prioritize teamwork and

communication to stay competitive (Akkaya & Üstgörül, 2020).

Nonetheless, according to Fachrunnisa et al. (2020), leadership agility refers to the ability to influence others and bring about changes. Since always, one of the most important abilities for modern managers to possess is agility (Factorrunnisa et al., 2020). Agile leaders can provide the frameworks, tactics, and procedures needed to make the shift to organizational agility go successfully. Agile leadership must be prioritized to generate a significant degree of agility to respond to the current competitive and unstable environment (Attar & Abdul -Kareem, 2020). Agile managers can help large organizations succeed if they have strong speed and flexibility skills (Buhler, 2010). According to Crawford (2007), a project's ability to succeed is directly tied to the project manager's skill set, and the project manager's skill set plays a role in the project's successful completion. Agile leadership's capacity to direct the group and consistently affect team dynamics is evident (Facrunnisa et al., 2020). To increase organizational performance and be prepared to take on the difficulties of the modern world, teams should always add value for consumers by having a variety of talents, flexibility, and speed (Facurrunnisa et al., 2020).

Although the concept of agile management has been the subject of numerous academic studies, more research is needed on how to develop agile leadership that is more project-aligned by examining agile leadership in an agile management environment based on project deliverables. Therefore, the authors aim to learn more about this challenging topic, which drives the study and analysis of these structures. The survey of Agile leadership will contribute to the technical iteration of Agile management in various project management (administration) fields and try new management models and the extension of project management theory. This research gap may be necessary for both those involved in project management and those involved at the leadership level, as different types of leadership and management decision-making styles affect different project outcomes such as project efficiency, quality, schedule, performance, etc. This study aimed to analyze the relationship between leadership, agile management strategy, and timely project delivery, explore advances in agile project management technology, and combine leadership characteristics to achieve a theory supplement of agile leadership and agile leadership program practices. This study will continue by addressing the following research questions:

**Q1:** Analyze the causal relationship between the given constructs: the impact between leadership and project completion, whether agile management affects project delivery, and whether leadership is conducive to project agility.

**Q2:** Does agile management fully or partially mediate leadership and project delivery?

## **2.Literature Review, Hypothesis Formulation and Research Framework**

### **2.1. Agile Leaders**

In a 1991 Lehigh University Ighco Institute report outlining the steps American companies can take to become manufacturing leaders once more, Nagel and Dove (1991) introduced the idea of agility. The ability to react to novel risks and unforeseen obstacles in the business environment is what Sharifi and Zhang (1999) define as agility. They call it the capacity to benefit from the gains of change in this process. Additionally, they stress two components to the agile concept: seizing opportunities presented by change and adapting to it appropriately. The dictionary defines "agile" as the capacity to respond swiftly, adaptable, and intelligently (McKenz, i.e., & Aitken, 2012). Additionally, Tahmasebifard (2017) noted that agility is quickly evolving into a strategic instrument for success and resolving the issue of controlling the influence of a complex and dynamic environment within an organization.

According to ÖNALAN et al. (2022), organizations that undergo agile transformation can benefit from various factors, including enhanced technical skills, a collaborative and empathetic work environment, increased employee emotional flexibility with leadership support, and the formation of proactive understanding. The crucial aspect to consider in this situation is the significance of the leader's function in establishing this kind of organizational atmosphere (Özdemir & Çetin, 2019). Examining

organizational structures and management techniques for agility is common. Parker and associates (2015) Those who set the bar high and serve as examples for others are considered leaders. Leaders must view each member of the organization as an individual and try to figure out what drives them to perform their duties. In addition, he needs to treat everyone with respect and cultivate solid business ties. In order to achieve stability and consistency in a constantly changing world, leaders must possess the agility to thrive in diverse and dispersed institutions (McKenzie & Aitken, 2012).

Consequently, agile leaders must be flexible, inventive, visionary, prepared to take chances, fast to make the right decisions, attentive to their surroundings, and productive, according to Prasongko and Adianto (2019). According to Akkaya (2020), agile leaders are those who can recognize the demands of their organization both internally and externally and adjust to shifting surroundings and technologies in order to meet those needs. Fernandez (2006) also emphasized the need for prompt and flexible responses to emergencies brought on by environmental changes, and she defined agile leadership as the capacity to act swiftly in the face of sudden changes. Agile leaders can think creatively and strategically to align their organization with its internal and external environments, as noted by ÖNALAN et al. (2022). Agile leaders can bring out the best in people, use their feedback to make the necessary organizational changes, and use change's opportunities while limiting its harmful effects (ÖNALAN et al., 2022). Businesses that use agile leaders to integrate agility into their operations are better equipped to adapt to change rapidly and provide stakeholders with higher business value (ÖNALAN et al., 2022). Organizations can attain agility with fewer resources and more quickly detect changes in the business environment if their executives possess agile leadership (Attar & Abdulkateem, 2020). One may argue that the word "agile leadership" has always been novel, evolving, and relevant (Katainen, 2020). ÖNALAN et al. (2022) added that agile leadership is a skill that is becoming more and more necessary for executive teams as well as for entire businesses since change and complexity now impact managers at all organizational levels.

## 2.2. Components of Agile Management

**Iterative incremental development:** "Iterative development," coined by Moran (2015), is the method of iteratively going through several phases of the solution development life cycle to produce a workable prototype that has been tested quickly. Small iterative cycles for development and implementation enable quick experimentation and feedback, as well as real-time strategy adjustments based on experiment outcomes (Beerbaum, 2023). The phrase "incremental delivery" was first used by Moran (2015) to describe a willingness on the part of the vendor to provide consumers with access to previously developed product artifacts, as opposed to the right. It is customary to make multiple adjustments between the initial delivery of a product and its final version (Moran, 2015). Understanding grows at each level, and the client can be given demonstrations and details (Moran, 2015). After every step, we can show our clients and give them further information. Some methods combine These two ideas into one "iterative and incremental" development process (Moran, 2015).

Visualization and information flow necessitate honest and open communication inside the company. This makes it easier to ensure everyone is pursuing the same objectives and is aware of the related strategy and status updates (Beerbaum, 2023). The Kanban board is always visible, thanks to visualization (Ellis, 2016). Teams cannot advance tasks on a Kanban board once they reach their limit, but they indicate work in progress and offer a straightforward method of limiting it (Ellis, 2016). Once more, this process may be managed using Kanban project management; it is simple to identify if a task is stagnating and is intuitive (Ellis, 2016). Since the fundamental purpose of Kanban is to let you observe how you operate, even flimsy attempts at it might be beneficial (Ellis, 2016). A "hanging on the wall" plan is an example of visual control in agile approaches that can support teams in a project organization (Hass, 2007).

**Continuous improvement:** It is an ongoing process of development and learning. This implies that the plan is never "finished" but is continuously improved and modified in response to input and outcomes (Beerbaum, 2023). Ellis (2016) After being first presented in the software industry, agile and

continuous improvement gained popularity and expanded to other industries, and Scrum's acceptance was revolutionary. Scrum is an excellent starting point but not the end game. Once Scrum is embraced and established, teams must search for incremental improvements. To address the need for improvement, a few of these procedures can be implemented one at a time (Ellis, 2016). Agile Project Management (APM) is a team effort that depends on everyone working together to provide outcomes, get direct feedback, and facilitate learning for the next iteration of the solution. Continuous feedback and development are among APM's advantages (Ellis, 2016).

**Customer Orientation:** Creating value for consumers is the main objective of an agile strategy. This necessitates thoroughly comprehending the client's requirements and preferences and a readiness to modify methods when necessary (Beerbaum, 2023). Denning's (2016) Agile thinking is characterized by its primary focus on providing consumers with ever-increasing value. "The most important thing is to please the customer," reads the Agile Manifesto's first principle. When an Agile team prioritizes customer satisfaction, it shows that they have an empowered mindset, a strong belief in the talent and capabilities of the work, and the understanding that, given the proper environment, values, and objectives, the people working there will usually continue to innovate and add value for customers and end users while also bringing in money for the business (Denning, 2016). According to Denning (2016), the objective of agile management is for all members of the organization to give value to customers.

**Teamwork:** Agile techniques necessitate cooperation across several organizational roles. This entails assembling people with various specialties and abilities to collaborate on a project to achieve a shared objective (Beerbaum, 2023). Conversely, an agile attitude encourages communication and collaboration among managers, staff, and clients (Denning, 2016). Team members who are ready to answer inquiries about utilizing the application are live customers in the field (Ellis, 2016).

Agile approaches are beneficial in unclear and changing situations, as these conditions may make traditional long-term planning less successful. Organizations may better manage change and generate value for consumers by utilizing flexibility, experimentation, and iterative adaptation (Beerbaum, 2023).

### 2.3. Leadership and project delivery relationship

Project management efficacy determines the project's outcome, and leadership is crucial to project success (Raziq et al., 2018). According to Clarke (2009: 192), leadership abilities are viewed as soft skills rather than a component of project management. Ogunlana (2008) asserts that effective leadership is crucial in completing projects, mainly when collaborating with individuals or teams. Munns & Bjeirmi (1996), who claimed that the leader's agile management and project delivery relationship have a significant role in the success or failure of project delivery, corroborate this claim. Azman et al. (2020) believe a leader should have various skills, dispositions, and styles. A competent team led by a competent leader yields excellent outcomes (Azman, 2020). If a leader needs more leadership abilities, even with managerial expertise, the project is likely to yield subpar outcomes or, in the worst case, fail (Azman, 2020). According to Boshomane and Naidoo (2022), confident leaders are more comfortable with a people-centered approach to project completion than a production-centered one. Leadership styles differ, but in order to be effective, a person must possess specific traits. To attain optimal production, diverse personalities within the team and the type of project being handled determine the varied abilities and work styles needed (Lategan & Fore, 2015). In agreement, Lategan and Fore (2015) note that leadership is a unique skill needed in different circumstances compared to other skills. Lategan and Fore (2015) emphasized that specific leadership traits and styles are thought to be essential for accomplishing projects. According to Rossiter (2004), for any organization to be effective, its leaders must be creative, considerate, courteous, sensitive, and willing to go above and beyond what is required of them. Therefore, to support the organization's performance in finishing projects on time, leaders must comprehend and identify dependent components of the organizational environment before making decisions (Boshomane & Naidoo, 2022). According to Westland (2006), a project is considered successful when it is completed within the allotted time and budget while maintaining a specific level

of work quality, client happiness, and personnel satisfaction. Given this, we put forth the following theory.

**H1:** Leadership has a positive impact on timely project delivery.

#### **2.4. Relationship between leadership and agile management**

Leaders have to deal with various circumstances, particularly those that are novel, shifting, and unclear (Kumar et al., 2022). Project leadership needs to change to meet the evolving demands of the twenty-first century to stay relevant (Lloyd-Walker & Walker, 2011). Organizations need to be able to react swiftly and manage all uncertainties as markets get more complex, turbulent, and uncertain (Kumar et al., 2022). Joiner and Josephs (2007) define leadership agility as the capacity to lead successfully in highly complex and fast-changing environments. Traditional management is frequently viewed as needing to be faster in these markets, and agile leadership promotes granting teams the power and autonomy to make decisions independently (Kumar et al., 2022). Agile leaders can handle every scenario that arises under a framework for sustainable action and are flexible enough to modify their behavior to fit the circumstances (Uyun, 2019). According to McKenzie and Aitken (2012), for leaders to perceive and comprehend impending organizational changes, they must first comprehend the changes already occurring. According to ÖNALAN et al. (2022), leaders must exhibit empathy to help staff members remember their identity and the organization's objectives during the transition. Developing a learning culture within the company is the responsibility of agile leaders. They should encourage improved team and employee communication, collaboration, and ongoing learning in their day-to-day work (ÖNALAN et al., 2022).

People's objectives and tasks can become unclear in unstable circumstances. Thus, an adaptable leader with emotional intelligence is needed (ÖNALAN et al., 2022). Performance has to be a topic of discussion in agile leaders' everyday work and conversations (ÖNALAN et al., 2022). Apart from following these routines to attain optimal performance, (ÖNALAN et al., 2022) contend that agile executives should consistently monitor and assess all systems and procedures within the organization. Agile leaders should converse with team members one-on-one and be personable to facilitate comprehension, adaptability, and efficiency on the part of the workforce. They must give their staff constructive criticism if they want to succeed (ÖNALAN et al., 2022). To put it concisely, agile leaders have three primary responsibilities: ensuring the organization is agile, continuously striving for organizational excellence through continuous improvement, and guaranteeing customer delight (ÖNALAN et al., 2022). Agile leadership also necessitates a grasp of creativity and the ability to identify solutions in the face of constant change, pressure, and crises (ÖNALAN et al., 2022). According to ÖNALAN et al. (2022), agile leadership necessitates continuous learning from experience and feedback-giving. According to ÖNALAN et al. (2022), agile leaders are individuals who do not think twice about helping others grow, including being able to motivate and uplift those under their direction. The guiding principles of agile leadership, according to Parker et al. (2015), are as follows:

- the ability to minimize planning based on assumptions of unpredictability
- the ability to view the organization as a flexible and adaptable system of smart people
- the ability to determine the limits of external control to protect order
- the ability to view team members as talented and valuable stakeholders
- the ability to view the team's collective capabilities as a mechanism for problem-solving
- the ability to support adaptation to constant change

The capacity to fulfill requirements and oversee outcomes. In this instance, we presume:

**H2:** Leadership has a positive impact on the adoption of project agile management.

#### **2.5. Relationship between agile management and project delivery**

The essence of agile project management is the need for an adaptable development approach that enables companies to create products that meet customers and add value to the company while completing project delivery with customers (Sowaidan, 2016). Some authors argue that traditional

project management techniques focused only on meeting technical needs and project planning while pursuing cost, time, quality, and success criteria are considered ineffective (Bourne et al., 2000; Walton & Dawson, 2001). Agile project management technology is well supported by the research of Serrador and Pinto (2015) and Gemino et al. (2020), who found that project agility can significantly increase stakeholders' success, as well as successful project delivery and reduce project operational time. While frequent changes in demand can negatively impact project success, agile methods are more likely to be successful and complete delivery than conventional methods when the rate of demand change is high. This is because agile methods are designed to deal with frequently changing requirements and specifications. The agile approach is based on several fundamental principles, including close customer collaboration and user interaction (Cric Lalic et al., 2022). These customer-oriented working modes significantly improve the project's operability, reduce the project's error rate, and reduce the project delivery cost. According to Ahimbisibwe et al. (2015), iterative delivery helps guide projects through uncertainty, reducing ambiguity while improving quality based on customer feedback. The agile approach is based on several fundamental principles, including close customer collaboration and user interaction (Cric Lalic et al., 2022). According to Shenhar and Dvir (2007), projects with more significant technical uncertainty may require a more formal approach to demonstrate better planning and control, as well as larger budgets and longer project duration. Agile project management techniques are created to reduce project costs and overall project variability while addressing changes and uncertainties in project delivery requirements (Cockburn & Highsmith, 2001). Therefore, we infer that the agile project management model aligns with the market demand of the new era, which can improve project delivery, improve quality, reduce time, better meet customers' needs, obtain better market support, and make project products more competitive. Given this, we propose the following research hypotheses and conceptual framework (Figure 1).

**H3:** Agile management has a positive impact on timely project delivery.

As shown in Figure 1, the conceptual framework of this study is based on the general environment of the application of agile management in project leadership, and the relationship between leadership and project success and timely delivery. Assume a main hypothesis and 5 sub-hypotheses on the connection discussed above:

**H 4:** Leadership has a positive impact on timely project delivery through the mediation of agile management elements.

**H 4a:** Leadership has a positive impact on timely project delivery through the mediation of iterative and incremental development elements

**H 4b:** Leadership has a positive impact on timely project delivery through the mediation of continuous improvement elements

**H 4c:** Leadership has a positive impact on timely project delivery through the mediation of customer orientation factors

**H 4d:** Leadership has a positive impact on timely project delivery through the mediation of visual information flow elements

**H 4e:** Leadership has a positive impact on timely project delivery through the mediation of teamwork elements

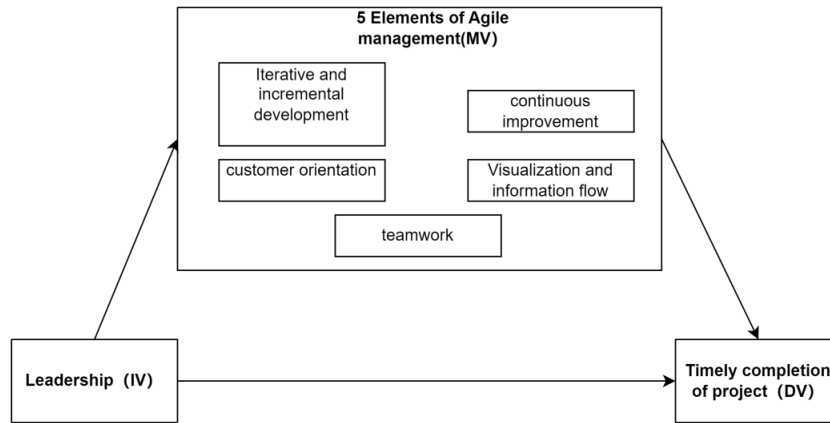


Fig.1: The conceptual framework of variables.

### 3. Research Methodology

#### 3.1. Sample and data collection

The questionnaire targeted engineering project practitioners living and working across China as survey participants. This study used a survey method to collect feedback from the engineering project industry. These people come from different regions, socioeconomic backgrounds, and cultures in China. Therefore, although the interviewees were from one country, they had different backgrounds. Data are mainly collected from participants such as WeChat groups and QQ groups for professional construction management practitioners on the Internet and the Xiaohongshu Questionnaire online community for related construction practitioners. In order to obtain more realistic and accurate data and relevant research results, In order to better understand the applicability and feasibility of agile leadership in China and the necessity and advantages of agile leadership, 863 participants from all over China were collected to fill out the questionnaire; after estimating missing values, 738 samples were obtained after eliminating outliers and other samples, and the rate is 85.5%. This sample size fully meets the PLS—sample statistical requirements for SEM.

The demographic analysis results of the questionnaire survey sample are displayed in Table 1. 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 1. Basic information of investigators

	Demographic Variables	Frequency	Percentage (%)
Gender	male	352	47.7%
	female	386	52.3%
Age	18-25 years old	123	16.7%
	26-35 years old	321	43.5%
	36-45 years old	227	30.8%
	45 years and over	67	9.1%
Educational qualifications	High school and below	174	23.6%
	College	270	36.6%
	Undergraduate	269	36.4%
	Master degree and above	25	3.4%
Position	General staff	606	82.1%
	Lower level managers	77	10.4%
	middle managers	38	5.1%

	top management managers	17	2.3%
Company Size	Less than 50 people	324	43.9%
	50-200 people	285	38.6%
	200-500 people	75	10.2%
	Over 500 people	54	7.3%
Time in office	Within 1 year	183	24.8%
	1-3 years	349	47.3%
	Over 3 years	206	27.9%

Table 2 displays the proportion of respondents who were aware of leadership, agile managements, and the project delivery on time. 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 2.

Table 2. Single sample statistics

Code	strongly disagree(%)	disagree(%)	generally(%)	agree(%)	Very much agree(%)	Mean	Std. Deviation
LD1	4.7	8	19.8	37	30.5	3.8	1.101
LD2	4.5	6.4	15.2	39.3	34.7	3.93	1.074
LD3	4.9	6.6	19.1	34.3	35.1	3.88	1.111
LD4	4.5	4.2	14.5	33.7	43.1	4.07	1.069
LD5	3.5	5.4	14.1	36.2	40.8	4.05	1.04
DD1	7.6	11.2	17.1	38.9	25.2	3.63	1.191
DD2	5	9.1	19.1	38.6	28.2	3.76	1.109
DD3	5.7	10.3	22	33.1	29	3.69	1.158
DD4	4.5	7.5	16	37.9	34.1	3.9	1.092
DD5	4.7	8.9	19.2	34.7	32.4	3.81	1.125
DX1	3.8	8.4	17.8	37	33.1	3.87	1.082
DX2	3.3	6	17.3	39.8	33.6	3.95	1.019
DX3	4.9	6.4	16.3	40.4	32.1	3.88	1.08
DX4	3	4.5	15.3	36.3	40.9	4.08	1.002
DX5	3.3	6.1	15.7	36.4	38.5	4.01	1.039
KS1	8.1	12.2	17.3	38.6	23.7	3.58	1.205
KS2	7.9	9.9	18.2	35.1	29	3.67	1.213
KS3	6.4	10.2	15.2	37.7	30.6	3.76	1.176
GJ1	5.6	12.1	20.3	38.6	23.4	3.62	1.131
GJ2	4.7	7.9	24.1	36.4	26.8	3.73	1.085
GJ3	3.8	7.5	20.7	39.2	28.9	3.82	1.051
GJ4	3.7	7	15.7	36.4	37.1	3.96	1.068
XZ1	6.9	11.8	24.1	33.6	23.6	3.55	1.171
XZ2	6.8	10	17.9	37.8	27.5	3.69	1.171
XZ3	5	10.8	18.6	39.3	26.3	3.71	1.118
XZ4	4.1	9.2	17.2	37.5	32	3.84	1.097
XM1	4.5	6.1	17.3	38.9	33.2	3.9	1.069
XM2	5.3	5	15.9	36.3	37.5	3.96	1.1
XM3	3.8	6.4	15.2	35.5	35.5	4	1.068
XM4	1.9	6.5	14.2	39.6	37.8	4.05	0.975
XM5	3.4	7.3	14.2	40.8	34.3	3.95	1.04
XM6	4.1	4.3	13.4	35.4	42.8	4.09	1.047

## 3.2. Measures

### 3.2.1. Questionnaire design and reliability analysis

The study was based primarily on the raw data collected through a comprehensive questionnaire using a Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). In order to facilitate statistical data, leadership is referred to as LD, timely completion project is called XM, and the five elements of agile management are collectively called MJ, where iterative, incremental development is DD, continuous improvement (CX), customer orientation (DX), visual information flow (KS), and teamwork is XZ. The literature sources are shown in Table Table 1. According to the background of this study, based on the design of the relevant literature, we exchanged views with the doctoral supervisors of the relevant project managers and the authors. We adjusted the questionnaire several times to make the questionnaire targeted. The scale has been discussed and modified repeatedly, with good internal consistency. Therefore, we consider it suitable to study three aspects: Leadership (LD), Agile Management Elements (MJ), and timely Project Delivery (XM), as shown in Table 1.

Moreover, related questionnaire questions are attached after the references. The questionnaire consists of three key components. Background data for the practitioners, including gender, age, maximum educational level, position, tenure, and company size, are found in Part I. The scale design follows the classic literature on this variable and some recently published literature. It is based on the existing scale of the variable with discussions with construction managers within the industry and several discussions and revisions with the authors' doctoral tutors. The second part is the agile management intermediary component, which is mainly divided into iterative development, customer-oriented, continuous improvement, team collaboration, and visual information flow, which are the five main components of agile management. Lead the timely delivery of the project in the third part of the project measures. To explore the applicability and prospects of agile leadership practices in construction engineering through understanding leadership and agile management in the project.

The questionnaire aimed to determine the relationship between agile leadership and the timely delivery of construction projects in China while exploring the advantages of agile leadership and its role. Based on the understanding of Chinese construction industry practitioners and managers and implementing the realistic feasibility and advantage of agile leadership construction, examines the combination of leadership and the main elements of agile management to discuss agile leadership in project delivery, examines the potential of agile management in China construction industry management leadership.

Table 3. Questionnaire design and reliability analysis

Variable	Question number	Alpha coefficient (a)	Literature source
Leadership (LD)	LD-LD5	0.861	Yousef (2022)
	DD1-DD5	0.869	Chia et al((2022);
Agile Management (MJ)	DX1-DX5	0.847	Muhammad ( 2021 );
	KS1-KS3	0.848	Jain & Suman
	GJ1-GJ4	0.819	( 2016 ); Al Maamzi &
	XZ1-XZ4	0.844	Tawfik ( 2022 )
Project delivery on time (XM)	XM1-XM6	0.875	Muhammad ( 2021 );
			Fransisca et al (2023)
Total variable	LD-LD5, LD-LD5, DX1-DX5, KS1- KS3, GJ1-GJ4, XZ1-XZ4, XM1- XM6	0.952	

Table 3 also presents an analysis of the survey data's dependability at each level. Every scale level had a Cronbach's alpha coefficient that ranged from 0.819 to 0.875 (Cronbach's alpha coefficient >

0.7) . The overall scale's dependability was 0.952 (Cronbach's alpha coefficient > 0.7) . The dependability of the survey questionnaire is excellent.

**3.2.2. Validity analysis and Variable dimension 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 0.966, higher than 0.70.

Table 4. KMO and Bartlett's Test

KMO		0.966
Bartlett's Test of Sphericity	Approx. Chi-Square	12363.156
	df	496
	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 5, the findings indicated that seven common factors accounted for 65.9% 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 5. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.986	40.581	40.581	12.986	40.581	40.581	3.519	10.998	10.998
2	1.644	5.138	45.718	1.644	5.138	45.718	3.342	10.443	21.441
3	1.588	4.964	50.682	1.588	4.964	50.682	3.304	10.324	31.766
4	1.466	4.580	55.262	1.466	4.580	55.262	2.937	9.177	40.943
5	1.394	4.355	59.617	1.394	4.355	59.617	2.894	9.043	49.986
6	1.121	3.505	63.122	1.121	3.505	63.122	2.769	8.653	58.639
7	.905	2.829	65.951	.905	2.829	65.951	2.340	7.312	65.951
8	.639	1.998	67.948						
9	.573	1.791	69.739						
10	.563	1.759	71.498						
11	.548	1.711	73.210						
12	.536	1.675	74.885						
13	.504	1.576	76.461						
14	.493	1.539	78.001						
15	.484	1.513	79.513						
16	.470	1.467	80.980						
17	.463	1.447	82.427						
18	.451	1.409	83.836						
19	.444	1.388	85.224						
20	.430	1.345	86.568						
21	.426	1.333	87.901						
22	.408	1.275	89.176						
23	.400	1.249	90.426						
24	.377	1.178	91.604						
25	.370	1.156	92.759						
26	.362	1.130	93.889						
27	.355	1.110	94.999						
28	.343	1.071	96.070						
29	.336	1.051	97.121						
30	.323	1.009	98.130						
31	.308	.963	99.092						
32	.290	.908	100.000						

Extraction Method: Principal Component Analysis.

Table 6. Rotated component matrix

	Component						
	1	2	3	4	5	6	7
DD5	.739						
DD2	.733						
DD1	.721						
DD4	.718						
DD3	.700						
DX3		.715					
DX2		.708					
DX4		.706					
DX5		.681					
DX1		.679					
LD1			.721				
LD3			.717				
LD2			.699				
LD5			.663				
LD4			.657				
XM4				.648			
XM2				.638			
XM3				.633			
XM5				.537			
XM6				.528			
XM1				.519			
XZ1					.777		
XZ2					.746		
XZ4					.728		
XZ3					.702		
GJ2						.737	
GJ1						.733	
GJ3						.702	
GJ4						.682	
KS3							.795
KS1							.771
KS2							.769

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

According to the rotation component matrix (see Table 6), Can judge the factor attribution of various problems, LD 1, LD2, LD3, LD4, LD5 belong to factor 1, Its factor load is more significant than 0.6, Named leadership according to the title content; Five themes, DD1, DD2, DD3, DD4, and DD5, belong to factor 2, Factor load is more significant than 0.7, named as iterative development according to the title content; Five themes, including DX1, DX2, DX3, DX4, and DX5, belong to factor 3, Factor load is more significant than 0.6, According to the title content as a customer orientation; GJ 1, GJ 2, GJ 3, and GJ 4 belong to factor 4, Factor factor load is more significant than 0.6, Continuous improvement according to the title content naming; KS 1, KS 2, and KS 3 belong to factor 5, Factor load is more significant than 0.6, According to the title content, Called the visual information flow; The four themes of XZ 1, XZ 2, XZ 3, and XZ 4 belong to factor 6, Factor load is more significant than 0.7, named as teamwork according to the title content; XM 1, XM 2, XM 3, XM 4, XM 5, and XM 6,6 titles belong to factor 7, Its factor load is more significant than 0.5, According to the title content named for the project completed in time.

Pearson correlation analysis was selected to examine leadership, agile management core five elements, and timely project delivery (see Table 7) with the following results:

Table 7. Correlation among leadership, agile managements &amp; timely project delivery

		KS	DD	GJ	DX	XZ	LD	XM
KS	Pearson Correlation	1	.475**	.475**	.460**	.494**	.453**	.588**
	Sig. (2-tailed)		0	0	0	0	0	0
DD	Pearson Correlation	.475**	1	.483**	.536**	.492**	.541**	.652**
	Sig. (2-tailed)	0		0	0	0	0	0
GJ	Pearson Correlation	.475**	.483**	1	.501**	.444**	.549**	.643**
	Sig. (2-tailed)	0	0		0	0	0	0
DX	Pearson Correlation	.460**	.536**	.501**	1	.460**	.567**	.663**
	Sig. (2-tailed)	0	0	0		0	0	0
XZ	Pearson Correlation	.494**	.492**	.444**	.460**	1	.546**	.595**
	Sig. (2-tailed)	0	0	0	0		0	0
LD	Pearson Correlation	.453**	.541**	.549**	.567**	.546**	1	.683**
	Sig. (2-tailed)	0	0	0	0	0		0
XM	Pearson Correlation	.588**	.652**	.643**	.663**	.595**	.683**	1
	Sig. (2-tailed)	0	0	0	0	0	0	

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

Bivariate studies measuring the variables between the dimensions are listed in Table X. This table has 7 indicators. Most metrics indicate that the p-values are significantly different from each other ( $P < 0.05$ ). This indicates that the results of the measured dimensions and variables are monotonically correlated and are statistically significant for this study. In terms of correlation coefficient (r value), all dimensional variables showed moderate and positive correlation.

### 3.3. Data

#### 3.3.1. Use of statistical analysis

Smart-PLS 4 performs statistical analysis to study the model. It was deemed appropriate due to some of the following reasons: (1) for predicting the model and variance levels; (2) the research prototype is complex; (3) understanding the interaction of various constructs as new elements in the study.

Table 8. Evaluation of the measurement model with reliability and validity test of factors (N = 738 ).

	CR	Factor Loading	AVE	VIF
LD	0.863		0.644	
LD1		0.793		1.834
LD2		0.785		1.787
LD3		0.794		1.841
LD4		0.816		1.928
LD5		0.823		1.966
DD	0.870		0.657	
DD1		0.813		1.966
DD2		0.814		1.963
DD3		0.784		1.780
DD4		0.814		1.964
DD5		0.826		2.057
DX	0.849		0.621	
DX1		0.776		1.697
DX2		0.776		1.716
DX3		0.802		1.841
DX4		0.819		1.926
DX5		0.768		1.676
GJ	0.824		0.649	
GJ1		0.784		1.649
GJ2		0.796		1.683
GJ3		0.808		1.699
GJ4		0.834		1.802
KS	0.849		0.767	
KS1		0.885		2.105
KS2		0.875		2.053
KS3		0.867		2.002
XZ	0.849		0.682	
XZ1		0.793		1.778
XZ2		0.849		2.018
XZ3		0.822		1.844
XZ4		0.838		1.915
XM	0.875		0.615	
XM1		0.781		1.818
XM2		0.799		1.957
XM3		0.806		2.012
XM4		0.762		1.768
XM5		0.769		1.769
XM6		0.788		1.867

## 4. Data Analysis and Results

### 4.1. Measures

In the measurement model, all loading item values are more significant than 0.7. Because the significance is less than 0.05 (see Figure 2), this indicates convergent validity at the item level shown in Table 3. Composite reliability considers Cronbach's alpha value greater than 0.70(see Table 3), hence reliability. At the construct level, the AVE values of the items exceeded 0.50, which shows discriminant

validity between constructs. According to Table 2, all VIF values are lower than 3.5, indicating that collinearity does not affect the results of the structural model (Diamantopoulos & Sigauw, 2006; Mittal et al., 2023).

#### 4.2. Evaluation of structural model

This study demonstrates the coefficient of determination ( $R^2$ ) of structural model measurements and path coefficients, SmartPLS 4 uses a bootstrapping method with 10,000 responses as the original sample ( $n = 738$ ) for t values and standard errors (Hair et al., 2013). The path coefficients and sizes are shown in the structural model ( see Figure 3 ), and Figure 3 shows the path relationships between the variables. The endogenous variables in Figure 3 show coefficients of determination ( $R^2$ ) higher than 20% level and therefore acceptable in this study.

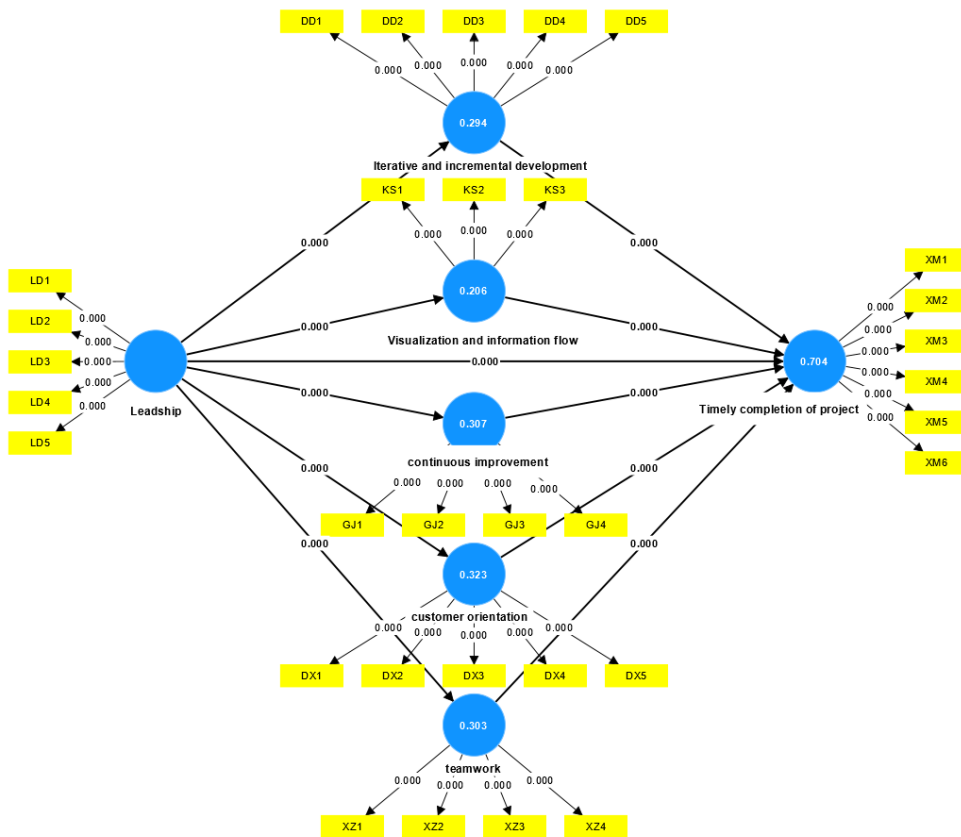


Fig.2: Measurement Model Statistics (P-Value)

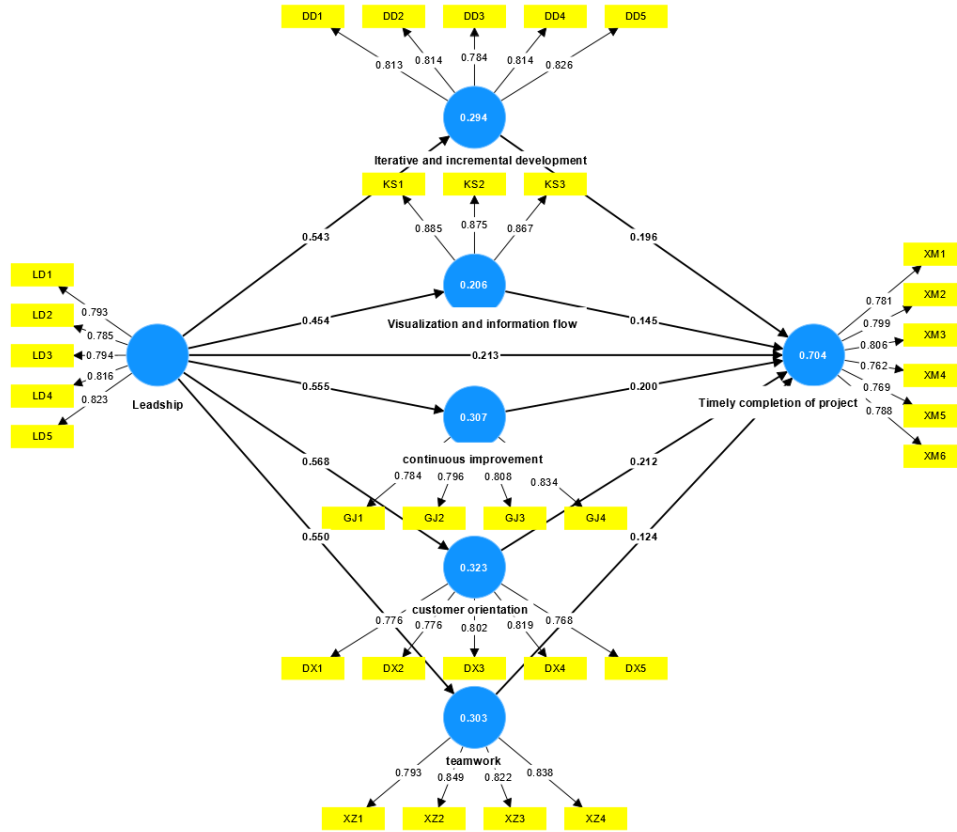


Fig. 3: Measurement Model Statistics (Path coefficient & R<sup>2</sup>)

Figure 3 shows the partial least squares algorithm model, and Table 9 summarizes the results for r-squared. The adjusted r square value is better than the r square value because it is determined based on the correlation variables of the model and grows regardless of the correlation of the variables. Furthermore, the r-square number shows the degree to which the input variable explains the maximum change in the output variable. Leadership and Agile Management Key 5 factors explained 70.1% of the timely delivery of items in this study with an r-squared value of 0.701. The r square value of the adjusted agile management five elements is DD (0.294), KS (0.206), GJ(0.307), DX(0.323), XZ(0.303), showed that the leadership factor explained the agile management five element iterative development 29.4%, Visual information flow 20.6%, Continuous improvement of 30.7%, Customer-oriented, 32.3%, A 30.3% change in team collaboration, Because the R square values in Table 9 are all greater than 20%, So all the R square values meet the basic standard, And the adjusted R party for timely project delivery is 0.701, So, according to general rule of thumb is that the R<sup>2</sup> values are 0.25, 0.50, and 0.75, respectively, which are weak, medium, and firm (Hair et al.,2011), The Leadership and Agile Management 5 elements have a good explanation for timely project delivery, Can explain 70.1% of the changes in timely project delivery.

Table 9. Summary of R-Squared Results

	R-square	R-square adjusted
DD	0.294	0.294
XM	0.704	0.701
KS	0.206	0.205
GJ	0.307	0.307
DX	0.323	0.322
XZ	0.303	0.302

To ensure that the assessments of the components created in this study are not closely related, discriminant validity (DV) was used. Therefore, the DV coefficient should be much lower than the convergent validity coefficient. Discriminant validity assesses the significance of the connections between the components of a study. When comparing one structure to another, it utilizes the square root of the AVE for that particular structure. This work used two different techniques to evaluate the DV of the constructs, as shown by the correlation coefficients in Table 10. Afterward, the AVE values and component-squared connections of all constructs for each factor were assessed (Fornell & Larcker, 1981). The AVE value of each factor supports DV.

Table 10. Discriminant validity analysis from CFA.

	DD	LD	XM	KS	GJ	DX	XZ
DD	<b>0.81</b>						
LD	0.543	<b>0.802</b>					
XM	0.652	0.685	<b>0.784</b>				
KS	0.475	0.454	0.589	<b>0.876</b>			
GJ	0.483	0.555	0.645	0.476	<b>0.806</b>		
DX	0.536	0.568	0.664	0.459	0.506	<b>0.788</b>	
XZ	0.493	0.55	0.599	0.497	0.45	0.464	<b>0.826</b>

As shown by the total effect of Table 11 and Figure 2, Among them, the every effects of agile management on timely delivery of the project are about 0.2, And the P-values were all less than 0.05, Moreover, the total effect of Agile Management total elements (MJ) on timely project delivery is 0.675, according to general rule of thumb is that the R 2 values are 0.25, 0.50, and 0.75, respectively, which are weak, medium, and firm (Hair et al.,2011), Represents that the overall effect of Agile Management 5 elements on timely project delivery is a significant positive effect, Where continuous improvement (0.2), customer orientation (0.212), iterative development (0.196) have a slightly more significant impact on timely project delivery than visual information flow (0.145) and team collaboration (0.124), Show that continuous improvement, customer orientation, iterative development may more directly affect the time delivery of a project in agile management, While the visual information flow and teamwork may have less impact on timely project delivery than other elements, Not one that works directly on project delivery. However, the total effect of Agile Management total elements (MJ) on timely project delivery is 0.675, indicating that agile management overall has a substantial and significant positive effect on timely project delivery. At the same time, the total effect value of leadership on the five elements of agile management is in the range of 0.5, and the P value is less than 0.05, which indicates that leadership has a moderately significant positive impact on the five elements of agile management, which will profoundly affect the implementation of agile management. At the same time, the total effect of leadership on the timely delivery of the project is 0.685, and the P-value is less than 0.05, so strong leadership affects the timely delivery of the project, which also shows that there is a strong correlation between agile management elements, leadership and timely delivery of projects.

Table 11. Summary of total effects

	DD	XM	KS	GJ	DX	XZ	MJ
DD		0.196					
KS		0.145					
GJ		0.2					
DX		0.212					
XZ		0.124					
MJ		0.675					
LD	0.543	0.685	0.454	0.555	0.568	0.55	0.701

Beta and P value results are shown in Figure 5; the direct relationship between leadership and project delivery indicates that leadership has a positive impact on the response to the timely delivery of

projects ( $\beta = 0.213$ ,  $t$  stats = 22.854,  $p$ -value = 0.000), leadership The direct relationship between capabilities and agile management elements shows that leadership has a positive impact on the response to agile management elements ( $\beta = 0.701$ ,  $t$  stats = 25.447,  $p$ -value = 0.000), and the relationship between the five elements of agile management and timely project delivery The direct relationship indicates that the Agile 5 elements have a positive impact on the response to timely project delivery ( $\beta = 0.675$ ,  $t$  stats = 6.656,  $p$ -value = 0.000). There is also an indirect relationship between leadership and timely project delivery, mediated through the five elements of Agile management. Relationship ( $\beta = 0.473$ ,  $t$  stats = 15.454,  $p$ -value = 0.000); among them, iterative incremental development ( $\beta = 0.106$ ,  $t$  stats = 6.357), continuous improvement ( $\beta = 0.111$ ,  $t$  stats = 6.442 ), Customer orientation ( $\beta = 0.121$ ,  $t$  stats = 6.321), visual information flow ( $\beta = 0.066$ ,  $t$  stats = 4.429 ) and team collaboration ( $\beta = 0.068$ ,  $t$  stats = 4.215) are equally crucial for leadership and project timeliness There is also a moderating indirect relationship between delivery. Therefore, the  $P$  values are all less than 0.05, and the  $t$  values are all greater than 1.96, so all values are very significant. The results support the hypotheses of H1, H2, H3, H4, and the five sub-hypotheses of H4 (see Table 12).

Table 12. Hypothesis results.

Hypothesis	Relationship	$\beta$	t-value	p-value	Result
H1	LD->XM	0.213	22.854	0.000	supported
H2	LD->MJ	0.701	25.447	0.000	supported
H3	MJ->XM	0.675	6.656	0.000	supported
H4	LD->MJ->XM	0.473	15.454	0.000	supported
H4a	LD->DD->XM	0.106	6.357	0.000	supported
H4b	LD->GJ->XM	0.111	6.442	0.000	supported
H 4c	LD->DX->XM	0.121	6.321	0.000	supported
H4d	LD->KS->XM	0.066	4.429	0.000	supported
H4e	LD->XZ->XM	0.068	4.215	0.000	supported

When calculating the significance of the mediation effect, the non-parametric bootstrapping method was used (Hair et al., 2012; Hair et al., 2013). There is an indirect mediating effect between leadership, the five elements of agile management, and timely project delivery, as shown in Table 6. Through the absorption effect, the study has a significant indirect effect on the construct; therefore, it rationalizes the mediating necessity effect (Hair et al., 2013). The VAF result of leadership from the five elements of agile management to timely project delivery is close to 70 % (  $P < 0.05$  ), and the correlation path coefficients are all positive (see Figure 3), as shown in Table 13. Therefore, the core five elements of agile management significantly and positively mediate the relationship between leadership and project delivery.

Table 13. Partial mediation test

Mediating effects	Indirect effects	Total effects	VAF	T est results	P
LD->MJ->XM	0.473	0.685	69%	Partial mediation	0.000
LD->DD->XM	0.106	0.685	15.5%	Partial mediation	0.000
LD->GJ->XM	0.111	0.685	16.2%	Partial mediation	0.000
LD->DX->XM	0.121	0.685	17.7%	Partial mediation	0.000
LD->KS->XM	0.066	0.685	9.7%	Partial mediation	0.000
LD->XZ->XM	0.068	0.685	9.9%	Partial mediation	0.000

Cohen's  $f^2$  measures effect size (Cohen, 1988). Henseler et al. (2015) believe that the indicator effect size range is as follows: 0.02 (weak effect), 0.15 (medium effect) and 0.35 (strong effect). According to Table 14, leadership (LD) explains that the project delivery (XM) Degree ( $f^2 = 0.077$ ) is not substantial in the presence of the mediating variable agile management and only plays a specific explanation and influence. There is a substantial effect on the explanation of the five elements of agile management (MJ) and project delivery (XM) ( $f^2 = 0.779$ ), indicating that the five elements of agile management (MJ) can well explain or affect the timely delivery of projects (XM). For the five elements of agile management (MJ), leadership (LD) has a solid explanation and influence ( $f^2 = 0.964$ ), indicating that leadership plays a decisive role in controlling or involving the agile management process and explains that Agile management is accurate in predicting the direction of timely delivery of projects. Leadership is accurate in predicting the direction of agile management.

Table 14. Summary of F-Squared Results

	MJ	XM	LD
MJ		0.779	
LD	0.964	0.077	

Based on  $f^2$  results, the impact of leadership on agile management ( $f^2 = 0.964$ ): This shows that the effect of leadership on promoting agile management is potent. Leadership may directly promote the implementation or development of agile management in different ways.

The impact of agile management on timely delivery of projects ( $f^2 = 0.779$ ): Agile management has a high explanatory power on timely delivery of projects, which means that adopting agile management methods may significantly affect the timely delivery performance of projects. Agile management is about flexibility, rapid feedback, and teamwork, which may directly contribute to project completion on time. Direct effect of leadership on timely project delivery ( $f^2 = 0.077$ ): The  $f^2$  value of the direct effect is relatively low, which may mean that the impact of leadership itself on timely project delivery is not a primary or direct factor. This does not mean that leadership has no impact on project delivery but suggests that it may be realized more through influencing agile management.

These results imply that leadership may indirectly influence timely project delivery by promoting agile management. Agile management may act as an essential intermediary, translating leadership influence into effectiveness in project execution and delivery.

## 5. Discussion and Findings

### 5.1. Discussion on Hypothesis results

Data statistics and analysis ensure that all assumptions in this article are established and accurate. Based on Henseler et al. (2015), the indicated effect size range is 0.02 (weak effect), 0.15 (medium effect), and 0.35 (strong effect). According to the P value of the relevant path in Table 5 and the total effect of the independent variables on the dependent variable shown in Table 6, it can be seen that the impact of leadership on timely project delivery is solid and positive (Total effect  $s = 0.685$ ,  $P < 0.05$ ,  $t > 1.96$ ), indicating that leadership is almost one of the most critical factors in determining whether a project can be delivered on time.

Regarding the relationship between leadership and the five major elements of agile management, according to the P value (0.000), regression coefficient ( $\beta = 0.701$ ), and t value ( $t > 1.96$ ) of the correlation path from leadership to the total elements of agile management in Table 5, leadership can be obtained. It is also an essential factor that determines whether agile management can be implemented smoothly. It also significantly positively affects agile management. At the same time, regarding the relationship between agile management and project delivery, according to the relevant path P value (0.000), regression coefficient ( $\beta = 0.675$ ), and t value ( $t > 1.96$ ) from leadership to the total elements of agile management in Table 5, it can be seen that agile management is also. It has a significant positive and robust effect on timely project delivery, indicating that agile management is an essential factor in

promoting the smooth development and delivery of projects.

Regarding the relationship between leadership and timely project delivery under the intermediary role of agile management, in the agile management intermediary environment, according to Table 5, the P value (0.000), regression coefficient ( $\beta = 0.473$ ), and t of the relevant path from leadership to timely project delivery value ( $t > 1.96$ ), and according to the agile intermediary effect test in Table 6, the VAF is equal to 69%. The VAF is close to 80%, indicating that agile management has played a substantial intermediary with the addition of an agile management intermediary between leadership and project delivery. At the same time, the regression coefficient ( $\beta = 0.473$ ) indicates that agile management is a positive mediator affecting leadership and project delivery.

According to the analysis data of the five sub-hypotheses of agile management in Table 5, it can be seen that the t values of iterative, incremental development, continuous improvement, customer orientation, team collaboration, and visual information flow are all greater than 1.96, and the P values are all less than 0.05. According to their regression coefficients, iterative, incremental development ( $\beta = 0.106$ ), customer orientation ( $\beta = 0.121$ ), continuous improvement ( $\beta = 0.111$ ) and team collaboration ( $\beta = 0.068$ ), visual information flow ( $\beta = 0.066$ ) It can be seen that the positive mediating effect of iterative, incremental development, customer orientation, and continuous improvement on leadership and timely project delivery is twice that of team collaboration and visual information flow. According to the principle of mediating effect, it is the critical element of leadership through mediating variables in agile management. Indirectly affects the dependent variable project delivery, so it can be concluded that the indirect effect of leadership on iterative, incremental development, customer orientation, and continuous improvement has a more significant effect on project delivery than on visual information flow and team collaboration and is more efficient.

## 5.2. Theoretical implications

First, This study enriches the findings of previous studies, These findings link agile management core strategies to leadership and program delivery, Exploring the current theory about the lack of agile management leadership in China, Developed and explored the underlying framework for agile leadership in China, On the issue of project delivery, Provided the agility basis and guidance for leadership, about the mediating role of agile management, Performed a detailed analysis and elaboration, Through the author's empirical exploration and analysis, Demonstrate that the core 5 elements of agile management play a more than medium mediation impact on leadership in project delivery, This also emphasizes that the practical exploration and theoretical exploration and supplement of agile leadership are necessary, Iterative agile development, continuous improvement, customer orientation in the direct role of agile leadership than teamwork, visual information flow in the agile leadership framework is more prominent, it shows the agile leadership practice in the field of Chinese leadership research investigation of authenticity and rigor, the real emphasizes the agility strategy has different significant influence on project delivery, different strength, emphasize the core strategy of agile leadership in China project implementation is entirely feasible and practical.

At this point, it is necessary to study agile leadership in China, and the theory that emphasizes agile leadership in China also needs to be further supplemented. So, at the same time, the agile management and project delivery, and leadership and project delivery, the author through data sorting and literature review, found that agile management and project delivery, and leadership and project delivery based on data analysis, agile management on project delivery is innovative, mobility conforms to the market in the new period, and sustainability and has been in different countries supply chain research project delivery to play an important role. The field also showed an urgent need for related theory supplements. Leadership and project delivery, which many scholars have extensively studied, emphasize the importance of leadership theory in project delivery and the importance of leadership as a critical determinant and position in the practice of project delivery.

## 6. Conclusion

This study explores the current delays in construction project management. Through literature reading and summary, the author attempts to introduce the agile management model into China's current project leadership model and combines the core five elements of agile management with leadership. Optimize the current leadership strategy model and build a basic framework for agile leadership in project management. We have conducted an empirical investigation on leadership agility and timely project delivery and evaluated project management practitioners' assessment of project leadership and timely project delivery under leadership agility. The author also analyzed the empirical data and concluded with Relevant argument results.

According to the analysis of empirical data in this article, leadership positively correlates with the five core elements of agile management (iterative, incremental development, visual information flow, continuous improvement, team collaboration, and customer orientation). The P values are all less than 0.05, indicating that leadership is positive. It significantly impacts agile management because the core that controls the entire project management is the leader. The leader's quick response and strategic flexibility play an essential role in project implementation success. Suppose leaders can make the best decisions at the best time with a forward-looking strategic vision and can use their initiative, awareness, and plans to achieve the best goals and plans. In that case, an organization will also have more excellent agile capabilities ( Sanatigar et al., 2017 ). It was also found that agile management significantly positively affects project delivery because the core elements of agile management address concepts based on the changing market and external project environment, such as iterative, incremental development, and continuous improvement. Although iterative, incremental development, and continuous improvement appear to waste time, their core elements are to adhere to customer orientation, try their best to welcome changes, and meet customer requirements. Therefore, through our data analysis, iterative, incremental development, and the three significant elements of continuous improvement and customer orientation, we can see that they are directly and positively related to intermediary leadership and the timely delivery of projects.

Visual information flow, team collaboration, etc., also positively impact the timely delivery of projects. These visual information flows make the work process and project progress transparent, clarify the scope of employees' responsibilities, and encourage employees' enthusiasm. It improves the project's information sharing, fluency, and productivity. Team collaboration further promotes the efficiency of project delivery. Team collaboration in agile management makes work more focused. At the same time, team collaboration establishes an autonomous collaboration community and daily stand-up meetings to share project progress and tomorrow's plans. Improve work efficiency, thereby increasing the speed of project delivery. Based on the mediating relationship between agile management elements, timely project delivery, and leadership, agile leadership needs to focus on guiding and motivating iterative and incremental development in an agile environment. This means that leaders need to focus on the iterative and incremental development of projects to promote rapid iteration and effective delivery of projects—the role of leadership in controlling continuous improvement and customer orientation. Leaders must ensure the team is focused on customer needs while providing support and guidance for continuous improvement to ensure continued project optimization and customer satisfaction. In an agile environment, leadership requires moderate information flow management and team collaboration. This means leaders must provide support and resources for information flow and collaboration without being overly involved, allowing teams to work autonomously and ensure a smooth flow of information. You can clearly understand the key areas and specific responsibilities that agile leadership needs to focus on in an agile management environment to ensure timely project delivery and efficient team operation. At the same time, agile leadership must adapt to employee empowerment activities and enhance the organization's ability to thrive in unpredictable work scenarios ( Hayward, 2021). A team under agile leadership should have more cooperation, teamwork, positive feedback, high motivation, and a less hierarchical structure ( Akkaya & Üstgörül, 2020 ).

The research establishes agile iterations matched with the construction expertise of leaders in facilitating information flows, raising collaboration, and aligning client needs, which are pivotal for project timelines. By validating these synergies in the Chinese backdrop, tailored recommendations are shaped for construction heads seeking responsive structuring without compromising industry regulations or constraints. The multi-dimensional scale development and modeling approach advances methodologies for analyzing leadership-driven agile transitions. As the following steps, the framework can be tested across organizational scales and project varieties to generalize findings. Regulatory reforms could also be examined to spur innovation adoption. Although this paper has limitations in geographical boundaries and other aspects, it provides data-driven insights based on quantitative assessment from the perspective of management practitioners, filling the research gap in China's construction management agility leadership. This paper lays a foundation for future research, and it is hoped that further research can be conducted through in-depth case studies, field investigations, comparative analysis, and other research methods—longitudinal tracking and revealing the application and promotion of agile leadership.

## Acknowledgments

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

- Attar, M., & Abdul-Kareem, A. (2020). The role of agile leadership in organizational agility. In *Agile business leadership methods for industry 4.0* (pp. 171-191). Emerald Publishing Limited.
- Azman, MHN, Mohamed, A., & Odzaly, EE (2020, March). A Theoretical Study on Project Delivery and Leadership Style. In *Proceedings of the 3rd International Conference on Networking, Information Systems & Security* (pp. 1-8) .
- Akkaya, B. and Üstgörül, S. (2020) “Leadership Styles and Female Managers in Perspective of Agile Leadership”, *Agile Business Leadership Methods for Industry 4.0*, 121-137. doi:10.1108/978-1-80043-380-920201008
- Akkaya, B. (2020) “Review of Leadership Styles in Perspective of Dynamic Capabilities: An Empirical Research on Managers in Manufacturing Firms”, *Yönetim Bilimleri Dergisi*, 18(36): 389-407. <https://doi.org/10.35408/comuybd.681427>
- Ahimbisibwe, A., Cavana, R. and Daellenbach, U. (2015), “A contingency fit model of critical success factors for software development projects: a comparison of agile and traditional plan-based methodologies”, *Journal of Enterprise Information Management*, Vol. 28 No. 1, pp. 7-33.
- Al Maamzi, JJ, & Tawfik, T. (2022). The effectiveness of agile management on traditional projects within public organizations. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1218, No. 1, p. 012037). IOP Publishing.
- Akkaya, B., & Üstgörül, S. (2020). Sustainability of SMEs and health sector in a dynamic capabilities perspective. In *Challenges and opportunities for SMEs in Industry 4.0* (pp. 43-64). IGI Global.
- Breakspear, S. (2017). Embracing Agile Leadership for Learning: how leaders can create impact despite growing complexity. *Australian Educational Leader*, 39(3), 68-71.
- Beerbaum, DO (2023). *Agile Strategy—Achieving Sustainable Advantage*. Available at SSRN .

Bourne, M., Mills, J., Wilcox, M., Neely, A. and Platts, K. (2000), "Designing, implementing and updating performance measurement systems", *International Journal of Operations and Production Management*, Vol. 20 No. 7, pp. 754-771, doi: 10.1108/01443570010330739.

Boshomane, LJ, & Naidoo, DS (2022). Leadership Factors Influencing Successful Project Delivery: The Case of A South African Civil Engineering Company. In *Proceedings of the International Conference on Industrial Engineering and Operations Management*. <https://api.semanticscholar.org/CorpusID> (Vol. 260948954).

Buhler, P. (2010). The Agile Manager. *Supervision*, 71(12),18–20.

Crawford, LW (2007). Developing the project management competence of individuals. In JR Turner (Ed.), *Gower handbook of project management* (4th ed., p. 678–694). Aldershot, UK: Gower Publishing.

Clarke, P. (2009). Leadership, beyond project management. *Journal of Industrial and Commercial Thinking*, 41(4), 187-194.

Ciric Lalic, D., Lalic, B., Delić, M., Gracanin, D., & Stefanovic, D. (2022). How project management approach impact project success? From traditional to agile. *International Journal of Managing Projects in Business* , 15(3), 494-521.

Cockburn, A. and Highsmith, J. (2001), "Agile software development: the people factor", *Computer*, Vol. 34 No. 11, pp. 131-133.

Ciric Lalic, D., Lalic, B., Delić, M., Gracanin, D., & Stefanovic, D. (2022). How project management approach impact project success? From traditional to agile. *International Journal of Managing Projects in Business* , 15(3), 494-521.

Chia, FC, Tung, YH, & Yong, FYY (2022, November). Examining the Agile Project Management Practices in the Malaysian Construction Industry. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1101, No. 4, p. 042041). IOP Publishing.

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

Diamantopoulos, A., & Siguaw, JA (2006). Formative versus reflective indicators in measure organizational development: a comparison and empirical illustration. *British Journal of Management*, 17(4), 263–282.

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

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

Fernandez, JA (2006) "The Agile Leader: Conditions for Succeeding in China", *Advances in Global Leadership*, 4: 255-275. doi:10.1016/S1535-1203(06)04017-2

Fachrunnisa, O., Adhiatma, A., Lukman, N., & Ab Majid, MN (2020). Towards SMEs' digital transformation: The role of agile leadership and strategic flexibility. *Journal of Small Business Strategy*, 30(3), 65-85.

Fransisca, D., Raharjo, T., Hardian, B., & Suhanto, A. (2023, March). Success factors for agile adoption in one of the ministries in Indonesia. In *AIP Conference Proceedings* (Vol. 2508, No. 1). AIP Publishing.

Gemino, A., Reich, BH and Serrador, PM (2020), "Agile, traditional, and hybrid approaches to project success: is hybrid a poor second choice", *Project Management Journal*, Vol. 52 No. 2, pp. 161-175.

- Hair Jr., JF, Hult, GTM, Ringle, C., & Sarstedt, M. (2013). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. SAGE Publications.
- Hair, JF, Sarstedt, M., Ringle, CM, & Mena, JA (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science*, 40, 414–433 .
- Hair, JF, Ringle, CM, & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing theory and Practice*, 19(2), 139-152.
- Henseler, J., Ringle, CM, & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the academy of marketing science*, 43, 115-135.
- Hayward, S. (2021). *The Agile Leader: How to Create an Agile Business in the Digital Age*. London, UK: Kogan Page Publishers.
- Han, F. (2013). Defining and evaluating agile construction management for reducing time delays in construction.
- Hass, KB (2007). The blending of traditional and agile project management. *PM world today* , 9 (5), 1-8.
- Joiner, B., & Josephs, S. (2007). Developing agile leaders. *Industrial and commercial training*, 39(1), 35-42.
- Jain, R., & Suman, U. (2016). Effectiveness of agile practices in global software development. *International Journal of Grid and Distributed Computing*, 9(10), 231-248.
- Katainen, A. (2020). Innovation implementation in agile organization: The challenges and solutions from the perspective of middle managers (Master's thesis, Itä-Suomen yliopisto).
- Kumar, R., Singh, K., & Jain, SK (2022). Assessment of Agile manufacturing impact on business performance of Indian manufacturing industry: A PLS-SEM approach. *Sustainable Manufacturing and Service Economics*, 1, 100001.
- Lloyd-Walker, B., & Walker, D. (2011). Authentic leadership for 21st century project delivery. *International Journal of Project Management*, 29(4), 383-395.
- Lategan, T., & Fore, S. (2015) . The impact of leadership styles on project success: case of a telecommunications company. *Journal of Governance and Regulation*.
- Lalu, M., Tiong, I., & Shidqul, AM (2019). Application of fast track method to accelerate project implementation time in the hospital construction. *International Journal of Scientific Engineering and Science*, 3(11), 49-53.
- Lloyd-Walker, B., & Walker, D. (2015, April). Collaborative project procurement arrangements. Project Management Institute.
- McKenzie, J., & Aitken, P. (2012). Learning to lead the knowledgeable organization: Developing leadership agility. *Strategic HR Review*, 11(6), 329-334.
- Munns AK, & Bjeirmi BF, (1996). The role of project management in achieving project success.
- Mittal, A., Gupta, P., Kumar, V., Antony, J., Cudney, EA, & Furterer, S. (2023). TQM practices and their impact on organizational performance: the case of India's Deming-award industries . *Total Quality Management & Business Excellence*, 34(11), 1410–1437.

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

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

Nagel, R. & Dove, R. (1991). "21st Century Manufacturing Enterprise Strategy: An Industry," Led View of Agile Manufacturing, Vol. I and II, Iacocca Institute, Lehigh University.

ÖNALAN, GO, YILDIRAN, C., & ÖNALAN, O. (2022). THE MEDIATING ROLE OF MANAGEMENT INNOVATION IN THE IMPACT OF AGILE LEADERSHIP ON FIRM PERFORMANCE. *Journal of Management and Economics Research*, 20(2), 205-230.

ÖZDEMİR, N., & ÇETİN, M. (2019). Çevik liderlik ölçeğinin geliştirilmesine yönelik güvenilirlik ve geçerlilik çalışması: Eğitim örgütleri üzerine bir uygulama. *R&S-Research Studies Anatolia Journal*, 2(7), 31 2-332.

Ogunlana, S., (2008). Performance and leadership outcome correlates of leadership styles and subordinate commitment' *Engineering Construction and Architectural Management*, Vol. 15, no. 2, pp. 7-99

Prasongko, A., & Adiando, T. (2019). The Role of the Agile Leadership Model as a Competitive Advantage for the Future Leader in the Era of Globalization and Industrial Revolution 4.0. *Jurnal Pertahanan: Media Informasi Tentang Kajian & Strategi Pertahanan yang Mengedepankan Identity, Nasionalism & Integrity*, 5(3), 126-133.

Parker, DW, Holesgrove, M., & Pathak, R. (2015). Improving productivity with self-organized teams and agile leadership. *International Journal of Productivity and Performance Management*, 64(1), 112–128. <https://doi.org/http://dx.doi.org/10.1108/MRR-09-2015-0216>

Raziq, MM, Borini, FM, Malik, OF, Ahmad, M., & Shabaz, M. (2018). Leadership styles, goal clarity, and project success: Evidence from project-based organizations in Pakistan. *Leadership & Organization Development Journal*, 39(2), 309-323.

Rossiter, D. (2004). *Leadership Skills*. New York: Ferguson.

Sowaidan, A. (2016). The impact of agile project management on the effective delivery of innovative products (Doctoral dissertation, The British University in Dubai (BUiD)).

Serrador, P. and Pinto, JK (2015), "Does Agile work? - A quantitative analysis of agile project success", *International Journal of Project Management*, Elsevier APM and IPMA., Vol. 33 No. 5, pp. 1040-1051, doi: 10.1016/j.ijproman.2015.01.006.

Shenhar, AJ and Dvir, D. (2007), *Reinventing Project Management: the Diamond Approach to Successful Growth and Innovation*, Harvard Business School Press, Boston, Massachusetts.

Soeharto. (2001). *Project Management From Conceptual To Operational*. Jakarta: Erlangga.

Şahin, S., & Alp, F. (2020). Agile leadership model in health care: Organizational and individual antecedents and outcomes. In *Agile Business Leadership Methods for Industry 4.0* (pp. 47-68). Emerald Publishing Limited.

Sharifi, H., & Zhang, Z. (1999). A methodology for achieving agility in manufacturing organizations: An introduction. *International journal of production economics*, 62(1-2), 7-22.

Sanatigar, H., Peikani, MH, & Gholamzadeh, D. (2017). Identifying organizational agility and leadership dimensions using Delphi technique and factor analysis: An investigating among public sector

pension funds (PSPFs) in Iran. *International Journal of Public Leadership*, 13(4), 276 - 294. <https://doi.org/10.1108/ijpl-01-2017-0005>

Toor, S.-u.-R., & Ofori, G. (2008). Leadership for future construction industry agenda for authentic leadership. *International Journal of Project Management*, 26(6), 620–630.

Tahmasebifard , H., Zangoueinezhad, A. and Jafari, P. (2017) “The Role of Entrepreneurial Orientation in Achieving Agility Capability”, *Journal of Applied Economics and Business Research*, 7(2): 137–156.

Uyun, Q. (2019) “Leadership Agility, the Influence on the Organizational Learning and Organizational Innovation and How to Reduce Imitation Orientation”, *International Journal for Quality Research*, 13(2).

Westland, J. (2007). *The project management life cycle: A complete step-by-step methodology for initiating planning executing and closing the project*. Kogan Page Publishers.

Walton, EJ and Dawson, S. (2001), “Managers' perceptions of criteria of organizational effectiveness”, *Journal of Management Studies*, Vol. 38 No. 2, pp. 173-200, doi: 10.1111/1467-6486.00233.

Westland, J. (2006). *The Project Management Life Cycle: A Complete Step-By-Step Methodology for Initiating, Planning, Executing & Closing a Project Successfully*.

Yousef, YA (2022). Investigating the Role of Critical Success Factors in Achieving the Success of Agile Projects in the Gaza Strip. *Journal of computing and information technology*, 30(2), 117-137.

## Appendix: Questionnaire

### Agile management elements(MV)

#### Visualization and information flow

1. The project regularly creates and maintains a project visualization dashboard to display project progress and information.
2. Projects use information boards and visualization tools to display employee tasks, progress, work processes, and issues.
3. Projects use visual tools to share project information and improve project transparency.

#### Iterative and incremental development :

4. The team will conduct regular reviews and evaluations of short-term goals to check progress
5. During each iteration, the team will adjust and optimize requirements and product functions.
6. The project team will collect feedback regularly to continuously improve the delivery quality and efficiency of each iteration.
7. The project will break down the requirements into small parts and discuss them in detail with the team
8. The project emphasizes meeting customer needs through step-by-step, continuous delivery

#### Continuous improvement:

9. Projects encourage employees to bring innovative ideas to projects and improve them
10. Projects always encourage analysis of actual versus planned results
11. Project adjusts plan and team performance based on review results
12. Project collects feedback and adjusts based on feedback

#### Customer orientation:

13. Customer needs will be prioritized so the team knows how to start the project
14. The project required a comprehensive review of key aspects to ensure client expectations were met
15. Always involve the client from the start of the project
16. Project encourages input and feedback from team members and customers
17. Projects will be encouraged to define the project with clear customer needs or business vision through strategy meetings

#### Teamwork :

18. The project encourages teams to brainstorm, collaborate and innovate
19. The project focuses on how the team interacts internally and externally
20. The project will establish an autonomous collaborative community to share responsibilities
21. The project encourages daily stand-up meetings to share project progress and tomorrow's plans

#### Leadership(IV)

1. The project leader effectively communicates the project's vision and goals.
2. Project leaders can effectively delegate tasks and responsibilities.
3. Project leaders understand agile methods and practices.
4. Project leader effectively balances the needs of multiple stakeholders
5. Project leaders are able to make timely and effective decisions.

#### Timely project completion elements(DV)

1. This project was completed on schedule
2. The job was completed on time and on budget.
3. Successfully complete project scope adjustments within the stipulated timeframe
4. The quality of project deliverables meets client expectations.
5. The client was pleased with the overall outcome of the project
6. The client was pleased with the level of engagement and communication on the project.