Received: 3 September 2024 | Revised: 5 November 2024 | Accepted: 23 January 2025 | Published online: 20 February 2025

RESEARCH ARTICLE

Journal of Comprehensive Business Administration Research
2025, Vol. 00(00) 1–16
DOI: 10.47852/bonviewJCBAR52024236

BON VIEW PUBLISHING

Client Involvement in Agile Project Management, Impact on Operational Performance, and Successful Project Handover in Jordan

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Abstract: The research aimed to provide a suitable model for the smooth completion of building projects in Jordan. The study's underlying model presupposes client participation may impact project management procedures and adopting agile practices. On the other hand, agility and project management processes impact operational performance and the effectiveness of project handovers. The researcher polled 170 people who have experience as building site supervisors. For data analysis, SPSS and AMOS.22 were used. The researcher employed structural equation modeling and confirmatory factor analysis. The findings demonstrated that incorporating client feedback into adopting agile practices, processes, and project management yielded favorable outcomes. Project management methods, operational performance, and agility adoption were found to mediate between client involvement and successful project handover. One of the most important recommendations and implications for management from the study was embracing agility. Another recommendation was that project management processes prioritize client involvement as a key to successful project handovers and high operational performance.

Keywords: project handover, agile project management, Jordan, project performance

1. Introduction

From the perspectives of both stakeholders and practitioners, the article examines the elements impacting the final handover of Jordanian construction projects. When uncertain, project managers should consider implementing agile principles to enhance project management and achieve effective project delivery [3]. Previous literary studies indicated the application of agile methodologies and their widespread use around the globe and their adaptation to the types of projects and with the company and its employees [30, 69]. The traditional approach to project management is considered relatively rational and normative, as projects are relatively simple, predictable, and linear with clearly defined boundaries, making it easy to plan in detail and follow that plan without much change [24, 25]. The final target of the traditional project management approach is improvement and efficiency in following the initial detailed project plan, or, as has been said ordinarily, to finish the project within the time, budget, and scope planned [43, 45]. Due to poor project performance, construction firms waste an average of 12.7% of their spending on projects and programs (Focus, 2020). This indicates that the failure rate of the handover of projects remains at an unacceptable altitude [3].

The agility method is an ideal project management framework for flexible projects because it allows changing the priorities of each phase based on the goals and needs of the client. In addition, it focuses on getting tangible results right from the start [6]. Agile project management (APM) is focused mainly on managing client needs and evolving requirements by using short development cycles (iterations) and continuous change and acclimation through the project life cycle [8, 12, 81].

One of the primary obstacles encountered in project management is the achievement of expeditious outcomes [31] and the conspicuous emphasis placed on delivering value in project deliverables [82]. Project Management Institute (PMI) has published a comprehensive research titled "Organizational Agility" in their "Pulse of the Profession In-Depth" series. The research examines the impact of agility on entrepreneurial success and the enhancement of this management. 71% of participants acknowledged that organizational flexibility facilitates a prompt response to market fluctuations. In comparison, 55% believed it enhances overall organizational efficiency and client satisfaction [34].

Research on software development projects primarily explored the emergence of agility in the early 1990s within the project management domain [33]. The emergence of agile or lightweight methodologies emphasized a minimal set of rules and practices that were easily implementable [78, 81].

Although the widespread adoption of the agile methodology in the future remains uncertain, Stare [74] and Jalali et al. [38] posit that specific agile approaches may find utility in projects that adhere to traditional implementation methods. Stare [74] investigated product

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development projects in five manufacturers, employing regression analysis to ascertain the utilization of agile technologies and to assess the specific impact of each agile technology on the overall success of the projects. According to Stare [74], the projects examined in the research demonstrate the utilization of several agile techniques. However, a comprehensive and standardized agile strategy for developing new products is lacking. Instead, individual teams and managers tend to employ partial approaches derived from best practices seen in prior projects. The author further posited that implementing rapid modifications incurs significant costs, and personnel often engage in many projects concurrently. These factors limit the adoption of the agile approach in engineering projects, research endeavors, and development initiatives [74].

Organizations that use agile approaches show lower costs, more productivity, better quality, and more business satisfaction [2]. These results should make you hopeful about the future of agile methods and their possible advantages. Research by Salvato and Laplume [70] into the feasibility of incorporating agile practices into a traditional stage-gate project management framework found that, although management may be resistant initially, it is possible to use agile practices in such settings.

Achieving project success in an agile setting requires effective performance and management of social dynamics. A practical ability to adapt to unexpected events and a harmonic adherence to the project plan are prerequisites for successful implementation. Taking into account the project's intrinsic features and the surrounding organizational environment, the project team, client, and senior management must agree on the suitable rate of project development capability. PMI analyzed the dimensions influencing organizational agility in project [10, 68].

Tam et al. [75] conducted a study in the Portuguese context to identify the factors contributing to the success of projects utilizing the agile approach. The researchers developed a model to determine the influential factors in successfully developing agile software projects within organizations or companies. A total of 216 specialists from diverse business areas participated in the survey. The findings derived from employing partial least squares structural equation modeling demonstrate that team capacity and client involvement had significant explanatory power in accounting for the variability observed in the outcomes of an agile software development project. The researchers provided recommendations aimed at promoting the selection of a highly skilled team by managers, as well as fostering client involvement and cooperation. These aspects are believed to significantly contribute to the effective development of agile software throughout the project handover phase. In the study conducted by Leo Vijayasarathy in 2008, many aspects were examined to understand their influence on the adoption of agile techniques. These criteria included project size, safety considerations, criticality, stability, complexity, turnaround time, the creation of reusable artifacts, as well as subcontracting and distributed development.

Uludağ et al. [78] conducted a study in Canada, shedding light on construction firms. They highlighted the need for a universally applicable agile technique seamlessly integrating with existing procedures. Their investigation delved into various factors, including sequential thinking, a closed mindset, office politics, a binary worldview, resistance to change, specialized skills, extensive documentation, and the need to multitask for agile project success. However, it is essential to note that their study had a limited scope, focusing on smaller, self-contained individual departments.

This study aims to evaluate how client involvement in projects affects agility, specifically in project management practices. Additionally, it examines the potential impacts of the influence on operational performance and the overall efficacy of project handover. The main objective is to determine the most appropriate model for client engagement and ensure effective project implementation. The suggested research model posits that attaining operational performance is crucial and positively impacts the successful transfer of projects. Construction firms must use and modify agile management approaches to guarantee effective project execution and ongoing managerial adaptability.

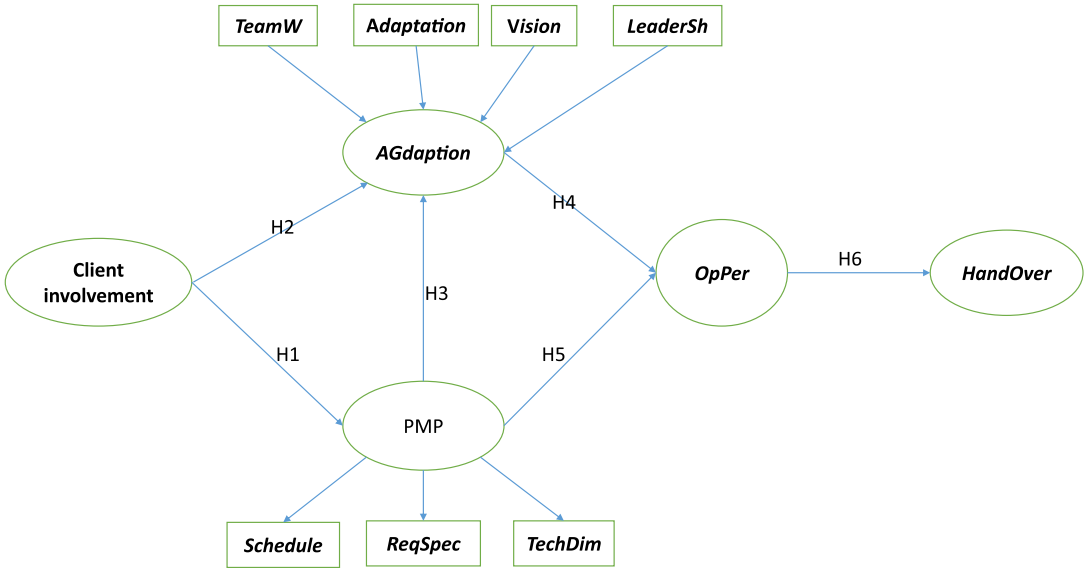
Efficient operational performance is the primary catalyst for attaining operational excellence. To augment excellence, firms frequently implement targeted initiatives for process enhancement. Nonetheless, process performance alone can provide merely a transient competitive advantage. The benefits of agile necessitate ongoing innovation, enabling firms to shorten project life cycles, fulfill client expectations, bolster organizational resilience, and adjust to evolving conditions over a construction project's duration. Furthermore, the research examines the determinants affecting the effective transfer of building projects within the Jordanian framework. The active engagement and endorsement of stakeholders, such as clients, sponsors, managers, and team members, are crucial to the success of APM and construction projects. Agile project managers markedly differ from their conventional counterparts. Conventional command and control approaches are inadequate, necessitating adopting a flexible and adaptive agile management style. Regarding project performance, when agile concepts are deemed unfeasible or disadvantageous due to project conditions or organizational context, they may be modified or disregarded to maintain project continuity.

2. Theoretical Framework and Hypotheses

The handover refers to the life cycle when the sponsor and users receive the deliverables [5]. Many factors affect the successful handover of projects, including the quality of materials, successful planning, and effective management of all parties to ensure there is no delay in projects, which leads to the success of the final handover of projects [64]. The traditional measures of project success focused on the so-called triple constraint: producing an assignment of adequate quality while meeting the dual conditions of the project's goals regarding time and budget [20, 77]. The contractor can measure success based on project profitability, commercial efficiency, timely completion, several claims, and safety [47]; Merrow, 2024). Despite the connection between success and goal achievement, determining a project's success remains unclear. The study aims to investigate the successful project handover. The conceptual model (see Figure 1) proposes that client involvement, agility adaptation, project management processes, and operational performance impact the success project handover's. Moreover, the study assumes that agility adaptation and project management processes mediate the impact of client involvement on operational performance. Conversely, all of these factors mediate the effects of client involvement on the success of project handovers.

An industry like construction, with the maturity of a project's management, can easily replicate the success of its projects. As to the elements related to project managers, the authors emphasize that skills, characteristics, abilities, commitment, experience, the effectiveness of decision-making, and wise leadership contributed significantly to the projects' success [51]. Regarding project success, most research studies focus on timely completion (Merrow, 2024). Kog and Loh [50] indicated that the project size,

Figure 1
The proposed conceptual model



Key factors: *Agility adaptation (AGdaption); Agility leadership (LeaderSh); Agility vision; Agility adaptation (Adaption); Agile Teamwork (TeamW); Project schedule; Requirements and specifications (ReqSpec); Technical dimension (TechDim); Client Involvement (clint); Operational Performance (OpPer); Project Successful handover (HandOver).*

the site and site boundaries, the client's top management support, the contractor's essential capacity, and contractor team competence are the critical success factors for various components of construction projects

APM employs a pragmatic and iterative methodology, diverging from the traditional model of striving to finalize the project in a single endeavor, which has the danger of complete failure or unbounded success. Agile methodologies produce a product and assess the client's feedback. Subsequently, we utilize this feedback to augment the development [72]. In APM, cooperation constitutes the fundamental basis of the connection between clients and contractors. The process depends on the collaborative engagement of all stakeholders [13, 27, 32]. Enhanced client collaboration results in substantial advantages, including more comprehensive planning and an expanded role for risk management in approaches arising from an elevated degree of solution acquaintance at the project's inception [80]. Moreover, Wysocki [80] emphasizes the collaborative setting where project managers, client teams, and project teams engage directly.

El Khatib et al. [19] revealed that project managers in agile companies are more satisfied with client participation in the rapid planning stages, and agile project managers were more confident with the project plan than traditional "plan-based" managers). Žužek et al. [83] advise that in applying agile practices, there is a need to engage the client holistically to ensure that the value derived from the project is in line with stakeholder expectations. To participate, essential team members and clients must engage in productive communication, coordination, and interaction [72]. The client's representative acts as the information supplier throughout the project lifecycle, from initial concept to final handover, making their involvement an active and positive process. Shariatfar et al. [71] agreed the clients develop testing and commissioning. The client tests intermediate results regularly and reports shortcomings and errors in the team (Merrow, 2024), and the client is also able to suggest changes and participate in the evaluation, overtime, cost, and value-added [10, 68]. ([72]; Merrow, 2024) suggest that a client representative is available during workdays to gather information, is a regular team member, and is actively involved daily. In addition, client representatives should be "cooperative, representative, authorized, committed, and informed" [22]. They argue that high risks associated with the wrong client representative in an agile team are a failure factor.

According to Badran and Abdallah [10], poor client relationships, unspecified client roles, and a lack of client presence are failure factors for client involvement and delegation. [10, 27, 73] consider "strong client commitment, the client is willing to change in contract and design and has the full authority and knowledge to make on-site decisions" as success factors in project handover. A schedule and other factors such as program, scope, budget, risk, resources, and quality play a crucial role in the successful handover of traditional projects, with a primary focus on timely completion (PMBOK, 2017). In an APM approach, the team prepares the detailed iteration schedule (project phase) at the start of each iteration, roughly scheduling the project at the outset [2]. The team divides the project into short iterations, typically lasting at least eight weeks in each stage [44, 62]. The organizing team and leaders define implementation tactics, tasks, and performance [10, 40]. Given the above data and the context of our research, we state the following hypothesis:

H_1: Client involvement positively affects agility adaptation.
H_2: Client involvement positively affects the project management process (PMP).

At the beginning of each project phase, there is a greater emphasis on providing explicit and detailed specifications [2]. These specifications are flexible and subject to modification and enhancement during the project based on input from the client or team members. Furthermore, it is recommended to incorporate essential elements at the initial project planning stage or address them in subsequent planning iterations [11, 16].

Technical specs refer to the set of guidelines and requirements that cover construction methods, technical standards, project design, specifications, and guiding concepts. These technical performance specifications establish the performance goals. Agile performance standards prioritize flexibility and adaptation in order to meet the stated objectives (PMBOK, 2017). El Khatib et al. [19] specifically identify several technical aspects of agile projects that are managed using an agile approach. These characteristics are critical for achieving success and include adhering to a straightforward design process, maintaining the necessary level of documentation, consistently delivering project activities, providing vital features, ensuring adequate integration, and providing suitable technical training for the team.

Based on the above considerations, the third hypothesis can be formulated as follows:

H_3: Project management process (PMP) positively effects the agility perceptions.

Operational performance measurements directly reflect an organization's efficiency and effectiveness. These measures include the effective delivery of services at a low cost, high-quality client service, and the capacity to meet special consumer demands. Rad and Rad [65] established key performance indicators for construction projects: financial stability, work progress, adherence to quality standards, resource management, client relationships, consultant interactions, management capabilities, handling of contractual claims and disputes, and contractor-client relationships. According to Ebirim et al. [18], project costs can increase due to changes and adjustments made during construction. Thus, the financial performance indicates the project's performance, uncovering occurrences of exceeding costs or reducing the budget.

Given the aforementioned factors, the researcher can establish the fourth and fifth hypotheses in the following manner:

H_4: Agility adaption positively effects the operational performance.
H_5: Project management process (PMP) positively effects the operational performance.

Considering that the construction time is the elapsed period from the start of the site works to the completion and handover of the building to the clients, ensuring the timely delivery of projects is one of the essential needs of construction industry clients. From the point of view of the clients, users, and stakeholders, the first criterion for a successful project handover is time [41]. The time component indicates to project managers that the project is running as scheduled [3, 63]. In their study, Durdyev and Hosseini [17] confirmed that poor site management causes project delays and affects productivity. Ciric et al. [25] affirm that the issue of shortening the construction time, reducing cost, improving the production performance for both practitioners and researchers through stimulating productivity, and analyzing the planning and scheduling technique. Ineffective construction project management can reduce performance and productivity. Therefore, contractors and construction companies must know how to evaluate the construction project performance [9]. Denicol et al. [15] note three important structures underpinning the dynamics of project performance: the structure of the work completion, the effects of the feedback on productivity, the quality of work, and the impact from the initial to the final stages. Aziz and Abdel-Hakam [7] outlined vital performance standards for construction projects: quality standards, health, safety, and resources, client relationships, consultants, management capabilities, contractual claims and disputes, and financial stability. Construction time is becoming increasingly vital because it often serves as a critical criterion for evaluating project performance and the efficiency of the project organization. Ali et al. [4] emphasized that project performance categories such as people, cost, time, quality, safety, health, environment, and client satisfaction lead to successful project handover. Implementing APM methodologies is linked to improving project operation performance: fewer errors, faster handover, more effective communication, better quality, better risk analysis, lower costs, etc. Badran and Abdallah [10] argue that there is a need for a paradigm shift from traditional project management concepts to deal with future project management challenges and the requirements of modern practice. A successful handover is indicated by this element, which pertains to the implementation and utilization of operational performance enhancements. In addition to saving time and cutting operational costs, Kadenic et al. [40] found that applying agile principles to activities improved quality, increased flexibility in project construction, and equipped managers with agile knowledge of adaptive management styles. They also found that applying agile principles to activities led to on-time project handovers.

Based on the criteria above, the researcher can formulate the sixth hypothesis as follows:

H_6: Operation performance positively effects success project handover.

3. Methodology

The impact of many factors on a successful project handover is the subject of the research. Much research points to client participation, agility adaptation, and project management procedures in the theoretical project management literature. Lastly, the success project handovers were affected by operational performance. Since client participation affects operational performance, the research presupposes that agile adaptation and project management methods mediate that effect. On the other hand, they all act as mediators between client engagement and the successful project handover. An empirical investigation tested the structural model in the Jordanian project management setting. 189 project managers from various supervision responsibilities participated in empirically evaluating the data gathered via a self-administered questionnaire. Structural equation modeling (SEM) in AMOS24 was used to analyze the data. Utilizing confirmatory factor analysis (CFA), the researcher ensured the measurement model's construct, convergent, and discriminant validity. Furthermore, the research assessed direct and indirect impacts and used SEM to evaluate the hypotheses.

4. The Study Samples

The data collection instrument was developed according to the literature [20, 27, 32, 47, 73, 77], (Merrow, 2024), users, and expert opinions. After completing the draft questionnaire, a first test was conducted on experts and practitioners in project management to modify the elements with ambiguous expressions. Therefore, respondents can understand the paragraphs in the formal questionnaire, and the validity of the questionnaire content can be guaranteed. All items were scaled using the five-point Likert scale, from one "strongly disagree" to 5 "strongly agree". While the initial section of the questionnaire asked for demographic information (education, employment location, project scope of work, etc.,), these factors were examined qualitatively (see Appendix 1).

The researcher eliminated 19 surveys out of 189 because over 20% of the answers were missing values or had incomplete responses. After collecting 170 complete surveys, we processed and analyzed the data using SPSS.19, and then we used AMOS.24 to conclude. However, according to [1, 14, 46, 59, 60], a sample size larger than 150 replies is appropriate for estimating the population parameters. In contrast, Hair et al. [35] found that latent constructs with three components or more are present in models with five to seven latent variables. It is sufficient to have a sample size of 150 or more to conduct CFA and SEM with a maximum probability estimate. Project managers did provide feedback despite the limited sample size. Meyer and Meijers [58], Hassan et al. [20], and Hoda et al. [36] are among the research that have demonstrated managers' answers offer more valuable information. Project managers may elaborate on their responsibilities in light of recent changes to operational performance metrics and the need for smooth project handoffs.

5. Data Analysis

The researcher used descriptive statistical methods to describe data, computing the arithmetic means and standard deviations to verify the normal distribution. Due to the nature of the conceptual research model (Figure 1), the interrelationships and direct and indirect effects were estimated using SEM. Practitioners use SEM in many fields, humanities, and project management to evaluate causal research models and research hypotheses. SEM allows researchers to synchronize the testing of interrelated hypotheses and multiple variables by considering the structural model's relationships between various independent and dependent constructs [29, 39].

Table 1 displays the demographic distribution of the study sample. It is noted from the table that the respondents had a bachelor's degree or higher. Still, a small percentage of them knew APM or the use of APM software, and a high percentage of respondents did not expect to adopt agile management in their companies.

Table 2 shows fitness indices for measurement models where the overall model was divided into three models as follows: Model one is the agility adaption, the second model for the project management processes, and the third model for the rest of the constructs, which are the client involvement, and operational performance, and a successful project handover.

Table 3 summarizes the research constructs and the elements included in the questionnaire and demonstrates the reliability and validity of measurement models and convergent validity

Table 1
Sample distribution, job position, and project area

NO	Category	Classification	Freq.	%
1	Education (Degree)	Ph.D.	7	4.1
		Master's degree	40	23.5
		Bachelor's	123	72.4
		Total	170	100.00
2	Role on the project.	Project Owner (Client)	37	21.76
		Contractors	100	58.82
		Consultants	33	19.41
		Total	170	100.00
3	Role in the team	Project Manager	15	8.82
		Site engineer	59	34.71
		Administrative manager	27	15.88
		Resident Engineer (client represent)	55	32.35
		Designer engineer.	14	8.24
		Total	170	100.00
4	Knowledge in Agile Project Management.	Yes	26	15.29
		NO	122	71.76
		Maybe	22	12.94
		Total	170	100.00
5	Use of Agile Project Management software?	Yes	22	12.94
		NO	148	87.06
		Total	170	100.00
6	Years of experience.	Less than 5 years	79	46.47
		6–10 years	6	3.53
		11–15 years	25	14.71
		16–20 years	56	32.94
		Above 20 years	4	2.35
		Total	170	100.00
7	Success factor that leads your company to adopt agility management.	1	51	30.00
		2	59	34.71
		3	22	12.94
		4	23	13.53
		5	8	4.71
		Total	170	100.00

Table 2
Model fit measures

Indices	Recommended criteria	Measurement model fit indices			References
		Model.1	Model2	Model3	
CMIN		415.483	84.568	176.928	
DF		201	41	115	
X^2/df. (p-value)	<3	2.067	2.063	1.539	
RMSEA	<0.08	0.079	0.079	0.056	
CFI	>0.9	0.916	0.964	0.962	
GFI	>0.8	0.826	0.915	0.898	

indicators. Finally, Table 4 shows the mean, standard deviations, and the correlation matrix between data structures to indicate the normal distribution of the data and the discriminant validity.

A CFA was conducted first to determine the scale's validity and reliability. Hair et al. [35] and Anderson et al. (1981) both state that CFA is a multivariate analysis approach that may help find and validate reliable structures (construct, discriminant, and convergent validity) by checking the structure of the observed constructs. In order to determine if the measurement model was suitable for the sample, we utilized AMOS 24 to evaluate the data using several model fit indices published in various prior research (see Table 3 for details). The following indicators were found to be over the permissible thresholds: Model 1 has RMSEA = 0.079 < 0.08, GFI = 0.826 close to 1.00, CFI = 0.916 near 1.00, and *CMIN/DF* (*X2/df*) = 2.067 < 3.00. Models 2 and 3 have the following values: *CMIN/DF* (*X2/df*) = 2.063 < 3.00, GFI = 0.915 close to 1.00, CFI = 0.964 close to 1.00, and RMSEA = 0.079 < 0.08. Model 3's fitness indices were subsequently determined to be: RMSEA = 0.056 < 0.08, GFI = 0.898 close to 1.00, CFI = 0.962 close to 1.00, and *CMIN/DF* (*X2/df*) = 1.539 < 3.00. Bentler [21], Mardia (1995), A Kassem et al. [42], Hazen et al. [37] and Hair et al. [35] have all reported acceptable thresholds. By removing the weak factor loading, we may get the fit of the acceptable model, which indicates that the construct is well-fitted by the approved model.

In addition, removing the weak factor loading (CI1, TD3, TD4) enhances the convergence indicators for each build. Convergent validity may be inferred when the average variance extracted (AVE) is more than 0.50, as stated by Hair et al. [35]. The researcher assessed the factor loadings and found them to exceed 0.60, which aligns with the recommendations of Bentler [21] and Hair et al. [35]. All (AVE) values above 0.50, as seen in Table 3, indicate the successful attainment of convergent validity between the components and their respective constructs. Table 3 summarizes the composite reliability and the Cronbach alpha above the acceptable threshold of 0.70, indicating the dependability of the scale [66, 67].

The validity of the measurement discrimination is evaluated using the correlation matrix, the square root of the AVE, and the mean and standard deviation of each structure, which are all displayed in Table 4. An indication of discriminant validity is provided by the fact that the square root of the AVE is greater than the correlation coefficient values in rows and columns of the correlation matrix [35]. This substantiates the aforementioned premise. OBrien [61] indicates that the approach also preserves the nonlinear relationship, multicollinearity, among two or more independent variables.

Finally, the normal distribution of the sample data was tested using Skewness and kurtosis [48]. It was found that most of the Skewness coefficients are less than (1.0), the absolute value of Skewness less than (1.0) indicates that the data are normally distributed, and the critical value of kurtosis that does not exceed (3.0) is also considered an indication of generally distributed as indicated by Mardia, (1995); Kline [49]. The results in Table 4 show that the absolute values of Skewness and kurtosis were within the required criteria. Hair et al. [35] indicated that the normal distribution of the data is essential in the multivariable analysis, and it is very sensitive to the data that do not follow the normal distribution, especially in the case of large sample size.

6. Testing Hypothesis

SEM and maximum likelihood estimates tested the structural model. Valid model fit indications were found (Figure 2). Based on [21], and [35], these indices are: *CMIN/DF* (*X2/df*) = 2.198 < 3.00, GFI = 0.921 < 1.00, CFI = 0.971 < 1.00, and RMSEA = 0.084 > 0.08, achieving maximal model fit while remaining within acceptable cut-off points. The saturated model has limited degrees of freedom; hence, the required RMSEA value could not be attained [35, 49]. The approach matches Jordanian project management since the other indicators are appropriate. Figure 2 shows standardized structural model estimates. Table 5 shows direct and indirect hypothesis testing outcomes. The structural model test did not support the direct impact hypotheses, as client involvement in agility adoption is not statistically significant (critical value = 1.236), and project management processes do not directly affect operational performance (critical value = −0.795). However, additional direct influence possibilities are validated.

Regarding the indirect effect hypotheses, by reviewing Table 5, we find that adopting agility and project management processes failed individually in affecting the operational performance and the project handover success, as the paths were not statistically significant. We find that the proposed mediator variables have succeeded in explaining the project's successful handover. Suppose they want to achieve high levels of operational performance to ensure successful project handover. Therefore, project managers in Jordan must concentrate on the project management approach and incorporate agile adaptation. Client involvement in project management processes is also essential for adopting agility, contributing to rising operational performance levels, and ensuring the success project handovers. The last two hypotheses supported this, as the paths demonstrated statistical significance (the standard overall effect of the path):

Client_PMP_Adaption_Performance_Handover = 0.129, significant at $P < 0.01$).

Table 3
Measurement scale assessment

Construct		F. Loading	CR	AVE	Cronbach's Alpha
Agility leadership (LeaderSh)	AL4	0.716	0.79	0.68	0.78
	AL3	0.667			
	AL2	0.714			
	AL1	0.669			
Agility vision	AV8	0.769	0.92	0.58	0.92
	AV7	0.779			
	AV6	0.707			
	AV5	0.695			
	AV4	0.714			
	AV3	0.843			
	AV2	0.819			
	AV1	0.777			
Agility adaptation (Adaption)	AA4	0.692	0.86	0.61	0.85
	AA3	0.761			
	AA2	0.821			
	AA1	0.831			
Agile Teamwork (TeamW)	AT6	0.633	0.87	0.54	0.88
	AT5	0.605			
	AT4	0.629			
	AT3	0.846			
	AT2	0.816			
	AT1	0.847			
Project schedule	PS4	0.694	0.86	0.60	0.85
	PS3	0.833			
	PS2	0.82			
	PS1	0.782			
Requirements and specifications (ReqSpec)	RS5	0.83	0.90	0.64	0.90
	RS4	0.853			
	RS3	0.845			
	RS2	0.752			
	RS1	0.718			
Technical dimension (TechDim)	TD1	0.847	0.83	0.71	0.83
	TD2	0.841			
Client Involvement	CI8	0.62	0.90	0.54	0.90
	CI7	0.78			
	CI6	0.844			
	CI5	0.828			
	CI4	0.815			
	CI3	0.727			
	CI2	0.653			
Operational Performance (OpPer)	OP4	0.642	0.87	0.64	0.86
	OP3	0.884			
	OP2	0.853			
	OP1	0.792			
Project Successful handover (HandOver)	PSH6	0.64	0.86	0.51	0.86
	PSH5	0.638			
	PSH4	0.602			
	PSH3	0.787			
	PSH2	0.833			
	PSH1	0.735			

Further, the path Client_PMP_Agile_Performance is also statistically significant (total standardized estimates = 0.165, significant at $P < 0.01$). Based on the methodology outlined by Bianchi et al. [11], the influence of client participation on operational performance and successful project handover is completely mediated by agile adaptation and project management processes.

7. Discussion and Implication

Using four latent variables derived from prior research and literature, this study investigated the interrelationships between the elements that contribute to the successful handover of construction projects during the handover process. According to the findings, some connections are statistically significant between the latent variables (factors), the observable variables, and the successful completion of the project handover. The research collected the success factors of the project handover with the agile adaptation, client involvement, a project management process, and operational performance. After the SEM analysis, conditions are ripe for interpreting the research hypotheses. Our results show that the hypotheses are supported except for H2 and H5. The research provides new insights into how agile adaptation and project management processes directly or indirectly affect the success of construction projects. The engagement and the mediation analysis results emphasize the whole mediation relationship between the project management approach and the incorporation of adaptation and agility with an operation performance for the project's success.

The study initially evaluated and validated the beneficial influence of client interaction aspects on construction project management methodologies. The SEM analysis indicates that client participation in project management procedures has a direct and statistically significant impact, as evidenced by a standardized estimate (SE) of 0.857 and a *P*-value below 0.05. This theory is corroborated and aligns with the findings of Radhakrishnan et al. [26], which indicated that project managers in agile organizations exhibit greater satisfaction with client involvement throughout the expedited planning phases and with the project plan itself. Furthermore, in alignment with Chow and Cao [27] argument, inadequate client connections, an ambiguous client role, and the absence of client participation are failure factors concerning client engagement and delegation in project management procedures.

On the other hand, the researcher sheds light on the indirect effects as well as was noticed from Table 5; in the indirect effects, two significant statistics support the participation of the client with a *P*-value less than (0.05) and clarify that the client's involvement indirectly affects the success of the handover of projects, and this consistent with [54] where mention that the clients are involved in developing testing and commissioning. Therefore, a research question was asked: In the case of client involvement, does the client participate in the development of testing and commissioning, which leads to the success of the project handover?

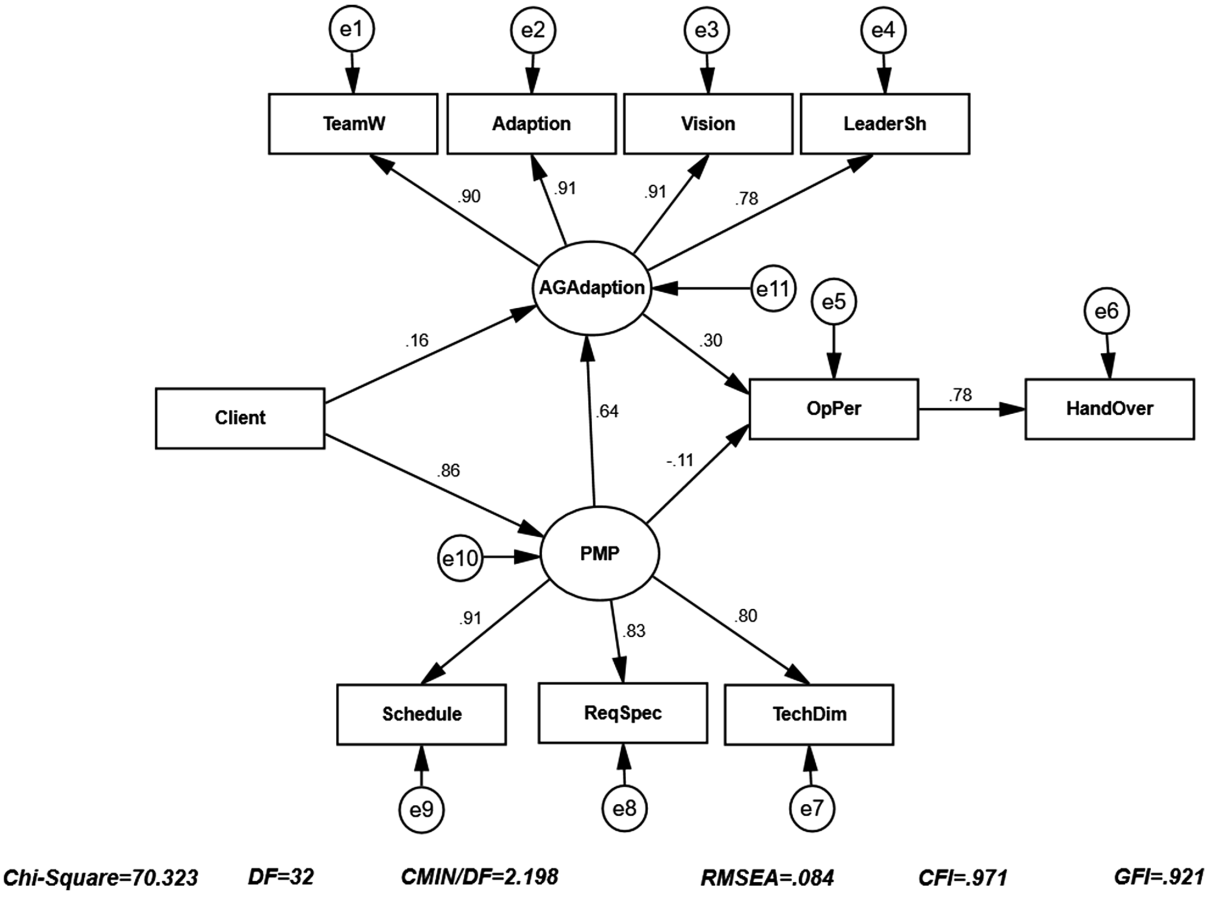
The second hypothesis (H2), regarding the impact of client participation on agile adoption, is unsupported, as seen in Table 5, where the *P*-value is (0.216), and the SE is low at (0.156). It also aligns with the observations made by Boehm and Turner [22] in their study, whereby they contend that the significant risk posed by erroneous client representatives inside project management teams contributes to project failure. Wysocki [80] noted that more client participation results in substantial variations, including enhanced planning specifics and a more prominent emphasis on risk management, influenced by the degree of acquaintance with solutions at the project's inception.

As the third variable, the project management procedures (PMP) substantially affect agile adaption, demonstrated by a P-value below 0.001 and a SE of 0.857. The result corroborates the hypothesis and is consistent with Chow and Cao [27] findings, emphasizing the significance of technical factors in projects utilizing an agile management methodology. Critical success aspects encompass efficient design oversight, comprehensive documentation, reliable execution of project tasks, demonstration

Table 4
Descriptive statistics and correlation

	Descriptive statistics				Correlations and SQRT (AVE)									
Construct	Mean	Std. Deviation	Skewness	Kurtosis	1	2	3	4	5	6	7	8	9	10
Leadership	3.9	0.682	−0.833	2.838	**0.693**									
Vision	3.8	0.711	−0.782	1.177	0.546	**0.762**								
Adaption	3.8	0.782	−0.800	0.962	0.695	0.446	**0.781**							
TeamW	3.9	0.699	−0.590	0.504	0.500	0.495	0.411	**0.735**						
Schedule	3.9	0.742	−0.546	0.475	0.532	0.588	0.652	0.667	**0.775**					
ReqSpec	4.1	0.709	−0.682	2.423	0.454	0.537	0.588	0.632	0.742	**0.800**				
TechDim	3.9	0.817	−0.740	0.876	0.513	0.512	0.549	0.637	0.757	0.520	**0.843**			
OpPer	3.8	0.771	−0.597	0.269	0.134	0.261	0.177	0.153	0.071	0.158	0.065	**0.735**		
HandOver	3.9	0.650	−0.669	1.107	0.159	0.256	0.250	0.220	0.147	0.160	0.145	0.483	**0.800**	
Client	4.2	0.654	−0.455	2.526	0.496	0.598	0.631	0.709	0.560	0.763	0.662	0.160	0.185	**0.714**

Figure 2
The structural model



Key factors: *Agility adaptation (AGdaption); Agility leadership (LeaderSh); Agility vision; Agility adaptation (Adaption); Agile Teamwork (TeamW); Project schedule; Requirements and specifications (ReqSpec); Technical dimension (TechDim); Client Involvement (Client); Operational Performance (OpPer); Project Successful handover (HandOver).*

of vital attributes, effective integration, and suitable technical training for the team. The project schedule is contingent upon the same factors. The study agreed with Brandon [23] that complexity is mainly determined at the project's outset, growing increasingly intricate only at the start of each phase, consistent with the APM approach. Walter [57] asserts that requirements and specifications can be altered and finished during the project, shaped by the suggestions of the client or team members.

Table 5
Hypothesis testing examines the direct and indirect effects of variables

Hypothesis (Direct effects)			Unstandardized Estimate	Standardized Estimate	S.E.	C.R(t value)	P	Decision
H1: Client	——	PMP	0.882	0.857	0.054	16.211	***	*Supported*
H2: Client	——	AGAdaption	0.15	0.156	0.121	1.236	0.216	*Not Supported*
H3: PMP	——	AGAdaption	0.599	0.641	0.127	4.708	***	*Supported*
H4: AGAdaption	——	OpPer	0.368	0.3	0.168	2.193	0.028	*Supported*
H5: PMP	——	OpPer	−0.126	−0.11	0.158	−0.795	0.426	*Not Supported*
H6: OpPer	——	HandOver	0.661	0.784	0.04	16.403	***	*Supported*
Hypothesis (Indirect effects)	Unstandardized Estimate	Total S. Estimate	Lower	Upper	P	Decision		
Client_Agile_Performnce	0.055	0.048	−0.011	0.245	0.192	*Not Supported*		
Client_PMP_Performance	−0.111	−0.094	−0.388	0.119	0.435	*Not Supported*		
Client_Agile_Performance_Handover	0.036	0.037	−0.008	0.168	0.195	*Not Supported*		
Client _ PMP_Performance_Handover	−0.073	−0.074	−0.26	0.08	0.441	*Not Supported*		
Client_PMP_Adaption_Performance_Handover	0.128	0.129	0.04	0.278	0.01	*Supported*		
Client_PMP_Agile_Performance	0.194	0.165	0.065	0.42	0.008	*Supported*		

*$p < 0.050$, ***$p < 0.001$.

The analysis of SEM indicates that the agile adaptation, despite its positive influence on operational performance, exhibits a minimal direct effect, with a SE of 0.03 and a statistically significant *P*-value of 0.028, below the threshold of 0.05. This hypothesis is corroborated and aligns with the findings of Kester et al. [47] in innovative product development, which identified a positive correlation between capabilities derived from a comprehensive understanding of all projects and their alignment with the company's strategy, enabling a company to swiftly adjust its development focus to integrate new technology into its product line. Furthermore, the organization distinguishes itself via its capacity to adapt to evolving environmental conditions, a critical factor for success and agility in projects.

The fifth dimension, concerning the impact of project management processes (PMP) on operational performance, exhibited a negligible influence, as seen in Table 5, with (H5) failing to demonstrate statistical significance. The SE was low at −0.011. The *P*-value was 0.426, indicating that the hypothesis of a positive link between PMP and operational performance is rejected at the *P*-value. The statistical study utilizing SEM did not support this notion. Nonetheless, (H5) demonstrated the substantial indirect influence of project management processes on operational performance elements, specifically the client's engagement in the project management methodology, affecting operational performance that enhances project handover. Chow and Cao [27] asserted that, via a technical dimension, designers and developers employed the most straightforward design for each module to minimize waste and enhance collaborative efforts. It was also supported by Brandon [23] through an indirect impact on operational performance to enhance project handover, as requirements are initially defined broadly at the project's outset and are only refined at the commencement of iterations. Boehm and Turner [22] assert that the self-organized team establishes the execution strategies, assignments, and participants in project management.

The operational performance of the successful construction project handover had a substantial, resilient, and statistically significant influence. It affirmed the beneficial effects, both direct and indirect, of the operational performance engagement dimensions on the handover of construction projects. The SEM analysis indicates that operational performance exerts a direct and statistically significant effect, with a SE of 0.784 and a *P*-value of less than 0.001. Hypothesis (H6) is corroborated and aligns with the findings of Ceschi et al. (2005), who demonstrated that project managers' positive experiences with agile planning contribute to successful project handover. Conforto and Amaral [28] demonstrated the statistical influence of agile methodologies on project operational performance and the efficacy of project handover. Batra et al. [13] concluded that a structure without adaptability may result in rigidity, mainly when the project involves significant learning, discovery, and alterations.

The direct effect of PMP on operational performance was minimal (SE = −0.011, $P = 0.426$), although the study underscores a significant indirect impact via client involvement in the PMP technique. Promoting client engagement can improve project handover procedures and overall operational efficacy.

The research underscores the importance of operational performance in project handovers, indicating a substantial direct effect (SE = 0.784, $P < 0.001$). These findings are crucial for project managers, highlighting the importance of effective planning and execution strategies during handover phases to ensure successful outcomes.

8. Conclusion

The research analyzed project success factors. Numerous studies show that APM requires client interaction, like good project management. Traditional command and control management needs improvement, requiring adaptive agile management. The researcher evaluated whether customer participation in projects may significantly affect agility, as in project management methods, affecting operational performance and project handover success. Based on the model, several parameters and elements were measured. The researcher distributed the preliminary questionnaire to construction project management scholars and experts for face and content validity. CFA confirmed the concept, convergent, and discriminant validity of the measurement model in Jordan.

Researchers employed SEM to evaluate hypotheses and assure model fitness with conformity indicators. The study proved the model's validity in Jordan and showed that client engagement in project management procedures and methods is affected by agility. The studies also showed that agility improves operational performance, which impacts project handover. The mediating model's relevance was confirmed by the project management processes' non-statistically significant effect on operational performance. This means that project management techniques can only improve operational performance and project handover if they engage customers and are agile. The indirect hypothesis showed that clients must be involved in project management and agile to achieve operational performance and project handover. Organizations may also use agile methodologies to optimize project management procedures for agile adaptation. These tactics increase project team adaptability, cooperation, and continual development.

Acknowledgments

The research has no conflicts of interest to declare. Any errors are our own.

Ethical Statement

The study contains no studies with human or animal subjects performed by any authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest in the work.

Data Availability Statement

The data that support this work are available upon reasonable request to the corresponding author.

Author Contribution

Khaled Aladayleh Jameel: Conceptualization, Methodology, Validation, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition, Software, Validation, Formal analysis, Resources, Data curation, Writing – original draft, Visualization, Funding acquisition.

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How to Cite: Jameel, K. A. (2025). Client Involvement in Agile Project Management, Impact on Operational Performance, and Successful Project Handover in Jordan. *Journal of Comprehensive Business Administration Research*. https://doi.org/10.47852/bonviewJCBAR52024236

Appendix 1 Survey questions

The main purpose of this study focuses on identifying the factors that impact of agile practices on success project handover. Your precious time answering the questionnaire is highly appreciated and all information provided will be strictly confidential and will be purely used for academic purposes.

This questionnaire includes questions to measure the extent to which stakeholders have to adapt project management agility to improve success of construction projects handover and to identify the impact of agile practices on the project.

Section 1. Demographic information

1. **Your level of education (Degree)**
   ☐ Ph.D. ☐ Master's degree. ☐ Bachelor's
2. **Your role on the project.**
   ☐ Project Owner (Client) ☐ Contractors. ☐ Consultants.
3. **Your role in the team:**
   ☐ Project Manager. ☐ Site engineer. ☐ Administrative manager. ☐ Resident Engineer (client represent). ☐ Designer engineer.
4. **Do you know about Agile Project Management (APM)?**
   ☐ Yes. ☐ No. ☐ Maybe
5. **In the construction Project Management planning/schedule, do you use Agile Project Management software?**
   ☐ Yes. ☐ No.
6. **Experience in the construction industry. (In years)**
   ☐ 1–5 ☐ 6–10 ☐ 11–20 ☐ 21 and more.
7. **What is the success factor that leads your company to adopt agility management?**
   Mark only one.

   1. 2. 3. 4. 5. ☐

Section 2 – the variable of adapting project management agility

This section includes the possible variable enabling of success projects handover, which had been compiled and consolidated from the academic and professional literature.

Responses to each of the following statements range from 1 to 5 as follows:

1 Strongly disagree.

2 Disagree.

3 Neutral.

4 Agree.

5 Strongly agree.

Constructs	Sub-construct	Code	Items
Agility adaptation (AA)	**Agility leadership (AL)**	**AL1**	The project manager spends time on planning and coordinating the work and activities.
		AL2	The project manager keeps track of the activities of the teams (e.g., schedule, budget, and quality).
		AL3	The project manager regularly discusses project performance goals with the team.
		AL4	The project manager follows a fast progress tracking mechanism, for example using flexible time boxes or rapid progress measurement techniques instead of document milestones or a work breakdown structure (WBS):
	Agility vision (AV)	**AV1**	In the daily work of the project, there is an emphasis on providing excellent service to the clients of the company.
		AV2	In the management of project, they often suggest new ways to solve the project problems.
		AV3	There is a real potential in the project to establish ourselves as a valued partner for our clients.
		AV4	The team on the project knows how to interpose with clients professionally.
		AV5	Team on the project can quickly adapt to changes in our clients' requirements.
		AV6	Team on the project try to be flexible when working with the clients, rather than strictly following rules and procedures.
		AV7	The project management often shares information with clients.
		AV8	The project management actively seeks feedback and feedback from clients.
	Agility Adaptability (AA)	**AA1**	We adapt the project quickly to changing clients' needs and competitive conditions.
		AA2	We adapt the project quickly to meet changing resource situations.
		AA3	The project is quickly adapting to new technologies.
		AA4	We rapidly adapt the project to meet the changing strategic goals.
	Agile Teamwork dimension (AT)	**AT1**	The chosen project team members had high technical competence, qualification, and expertise.
		AT2	Project team members had great motivation and were committed to the project success
		AT3	Project management was knowledgeable in agile principles and processes.
		AT4	Project management had light-touch and/or adaptive management style
		AT5	The project team worked in a group work style coherent and self-organizing
		AT6	Project management had a good relationship with the clients
Client Involvement – representative of the client: (CI)		**CI1**	A client representative is available throughout the work days to gather information, is a regular member of the team, and is actively involved every day
		CI2	A client participates in the development of the test and commissioning
		CI3	A client regularly tests intermediate results and reports the team's shortcomings and errors
		CI4	A client proposes the changes and participates in their evaluation (overtime, cost, and value-added).
		CI5	The client is willing to change its typical contract structure to reflect an evolutionary development approach
		CI6	The client representative is available for frequent face-to-face interaction with the development team.
		CI7	The client representative on the project has the full authority and knowledge to make on-site decisions, such as agreeing to, rejecting, and prioritizing project requirements and changes:
		CI8	The client is willing to accept a contract in which the time and budget.
Project management process (PMP)	**Project schedule (PS)**	**PS1**	The project is split into short iterations, that usually last no more than eight weeks
		PS2	Project scheduling is roughly done in the beginning, and detailed schedule for iteration is prepared by the team at the beginning of the iteration
		PS3	The self-organized team determines the execution tactics, tasks, and performers
		PS4	The test procedures are developed before the development of the solutions
	Requirements and specifications (RS)	**RS1**	Specifications are prepared jointly by the client and the project team
		RS2	Specifications are determined roughly at the beginning of the project, while they are only elaborated at the beginning of iterations
		RS3	Management of the project encourages changing requirements
		RS4	Specifications can be changed and supplemented throughout the entire project, based on the suggestion of the client or members of the team

(*Continued*)

(*Continued*)

Constructs	Sub-construct	Code	Items
		RS5	Less important features are omitted at the project planning stage, or later, upon iteration Planning
	Technical dimension (TD)	**TD1**	The project pursued vigorous refactoring activities to ensure the results are optimal and to accommodate well all changes in requirements:
		TD2	The project pursued simple design, e.g., designers and developers used the simplest possible design for each module to avoid waste and to facilitate cooperative work:
		TD3	The project maintained right amount of documentation for agile purpose, i.e., not too focused on producing elaborate documentation as milestones but not ignoring documentation altogether either
		TD4	The project followed continuous and rigorous unit and integration testing strategy for each iteration.
		TD5	The project provided appropriate technical training to team, including training on subject matter and agile processes:
Operational Performance (OP)		**OP1**	The impact of applying agility principles to our activities leads to improving the quality of project handover.
		OP2	The impact of applying agility principles to our activities leads to reducing the operational cost of projects.
		OP3	The impact of applying agility principles to our activities leads to increased flexibility in the construction of projects.
		OP4	The impact of applying agility principles to our activities leads to handover projects on time.
Project Successful handover (PSH)		**PSH1**	The project was successful in terms of the quality of the project outcome or of the resulting product.
		PSH2	The project was successful in terms of scope and requirements of the project were met.
		PSH3	The project was successful in terms of timeliness of project completion
		PSH4	The project was successful in terms of costs and efforts being under budget or within estimates
		PSH5	The project was completed according to the specification
		PSH6	The project met planned quality standard