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DIFFERENCES IN BUDGET AND TIME SUCCESS BETWEEN AGILE, HYBRID, AND WATERFALL APPROACHES IN ICT-SUPPORTED SME PROJECTS

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Abstract
Information and communication technology (ICT)–supported projects within small and medium-sized enterprises (SMEs) experience disproportionately high failure rates when compared to large organizations, often due to method selection, resource constraints, and evolving project environments. Choosing an appropriate project management methodology represents a critical strategic decision that directly affects budget performance and schedule adherence—two core dimensions of the "iron triangle." This paper examines the differences in budget and time success among Agile, Hybrid, and Waterfall project management methodologies in SME ICT projects. Drawing on the principles of Success Management Theory (SMT), the study positions project success as a multi-dimensional construct shaped by stakeholder expectations and dynamic project conditions rather than by methodology alone. A comprehensive literature review is conducted to explore existing empirical and theoretical findings on methodology selection, schedule performance, cost performance, and contextual moderators such as complexity, management support, and clarity of goals. The paper employs a quantitative comparative analytic framework grounded in prior dissertation findings, extending them with additional secondary data and synthesized empirical results from peer-reviewed 2020–2024 research. Findings suggest that methodology does not independently predict budget or schedule performance in SME ICT projects. Instead, the dominant predictors of time and cost success are organizational maturity, stakeholder engagement, clarity of requirements, and adaptability to evolving conditions. Agile shows improved performance in high-uncertainty environments, Waterfall performs better in stable and regulated contexts, and Hybrid only outperforms others when organizations have the maturity to integrate its dual structures. This paper argues that the relationship between methodology and project success is conditional rather than direct. The discussion includes implications for project managers, SME leadership, policymakers, and future research.

INTRODUCTION

ICT-supported projects are central to the operational capacity, strategic growth, and competitive advantage of small and medium-sized enterprises (SMEs). These organizations increasingly rely on digital transformation initiatives, software development projects, cloud adoption, cybersecurity modernization, and business process automation. However, despite the growing necessity of ICT initiatives, SMEs continue to experience high project failure rates, often defined by cost overruns, schedule slippages, or abandonment before deployment (Gemino et al., 2021; La Paz & López, 2023). Compared to large enterprises, SMEs have smaller project teams, fewer specialized resources, tighter budgets, and less tolerance for delays—making time and budget performance critical dimensions of project success.

Project management methodologies, particularly Agile, Waterfall, and Hybrid approaches, have been identified as key determinants of how ICT projects unfold. Waterfall emphasizes upfront planning, linear sequencing, and comprehensive documentation. Agile emphasizes iterative development, adaptability, and stakeholder collaboration. Hybrid approaches blend both structures to create context-specific frameworks. Existing research shows mixed evidence regarding which methodology leads to the best time and budget outcomes. Some studies report Agile reduces schedule overruns (Khoza & Marnewick, 2020), while others find no significant differences (Lalic et al., 2022). Still others argue Hybrid outperforms both but only under specific conditions (Papadakis & Tsironis, 2020). These inconsistencies highlight the need for a deeper examination of how methodology selection influences core project outcomes in SMEs.

This study addresses a critical issue identified in recent empirical investigations: although it is often assumed that Agile methodologies outperform Waterfall and Hybrid approaches in terms of schedule adherence and cost efficiency, available evidence shows no statistically significant differences in budget or time performance across these methodologies within U.S. SME ICT projects. These findings suggest that methodological choice alone is not the primary determinant of project outcomes. Rather, organizational and contextual factors—such as the level of management support, clarity of project requirements, and the inherent complexity of the project environment—appear to exert a more meaningful influence on performance. Accordingly, a comprehensive examination of budget and schedule success across methodological approaches is essential for SMEs seeking to base their project management decisions on evidence-based insights.

This research paper extends existing inquiry by conducting a deeper analysis of the relationship between project management methodology and two fundamental dimensions of project performance: budget adherence and schedule success. The central objective is to assess whether Agile, Hybrid, or Waterfall approaches exhibit meaningful differences in their effectiveness in enabling SMEs to manage cost and time constraints in ICT-supported projects. To achieve this, the paper integrates contemporary empirical evidence, theoretical perspectives, and methodological insights drawn from literature published between 2020 and 2024, resulting in a comprehensive and substantive academic analysis.

Success Management Theory (SMT) provides the conceptual basis for this paper. SMT posits that project success is multi-dimensional and must be continuously managed, with success defined according to stakeholder expectations and evolving project conditions (Varajão et al., 2022). SMT challenges the traditional assumption that adherence to the iron triangle (time, cost, scope) alone defines success. Instead, it emphasizes stakeholder alignment, adaptability, contextual sensitivity, and ongoing management. This theoretical lens is particularly applicable to SMEs, whose constraints amplify the importance of dynamic success management.

The four critical areas:

1. **Academic Contribution** — It clarifies the uncertain relationship between methodology and project performance in SMEs, addressing gaps in the literature.
2. **Practical Guidance for Project Managers** — It helps practitioners select methodologies based on project context rather than generic assumptions.
3. **Support for SME Leadership** — It highlights decision factors for resource allocation, capacity building, and risk mitigation.

4. **Policy Implications** — It informs government and industry bodies seeking to increase SME competitiveness through improved ICT project outcomes.

Budget performance and schedule attainment remain two of the most widely used indicators of ICT project success, especially within small and medium-sized enterprises (SMEs) that operate with limited resources and minimal tolerance for delays or cost overruns (Ciric et al., 2021; Sithambaram et al., 2021). The selection of a project management methodology—including Agile, Waterfall, or Hybrid frameworks—represents one of the earliest and most consequential decisions that project managers make. Because methodologies shape planning rigor, adaptability, communication patterns, and risk responsiveness, they are often assumed to directly affect cost and time outcomes (Gemino et al., 2021; La Paz & López, 2023). However, the academic research is mixed, and the dissertation results suggest that no significant differences exist in budget or time success across methodologies within U.S. SME ICT projects.

This literature review synthesizes current knowledge related to methodology selection, the iron triangle of project success, and empirical findings comparing methodologies' effects on schedule and cost performance. The review is organized into six major sections: (a) Theoretical Framework; (b) Characteristics of Agile, Waterfall, and Hybrid Approaches; (c) Success Factors Related to Budget and Schedule; (d) Comparative Performance Across Methodologies; (e) SME-Specific Challenges; and (f) Synthesis and Knowledge Gaps. Together, these sections establish the conceptual and empirical foundation for examining whether Agile, Hybrid, or Waterfall methodologies materially influence budget and time performance in ICT-supported SME projects.

Success Management Theory (SMT) provides the primary theoretical framework for this paper. SMT argues that project success is not static or limited to the traditional iron triangle of cost, time, and scope, but is instead a dynamic construct shaped by stakeholder perspectives, environmental conditions, project complexity, and the evolving nature of requirements (Varajão et al., 2022). In contrast with traditional project management theories that emphasize compliance with predetermined constraints, SMT conceptualizes success as a negotiated and adaptive outcome that unfolds over time.

From an SMT lens, the selection of Agile, Waterfall, or Hybrid methodologies is not itself determinative of project success. Instead, success depends on how well the methodology supports stakeholder needs, accommodates change, and aligns with the project environment. SMT emphasizes three pillars: (a) continuous definition of success; (b) continuous management of success; and (c) continuous protection of success (Takagi & Varajão, 2020). These principles challenge the assumption that methodology selection alone can guarantee improvements in cost or schedule performance.

Budget and schedule success are central components of traditional project success definitions because they provide measurable and objective indicators of performance. However, SMT suggests that cost and time performance must be interpreted within broader contextual and stakeholder expectations. For example:

- Some stakeholders may prioritize rapid delivery over strict budget adherence.
- Others may value stability and predictability, aligning better with Waterfall's structured planning.
- Agile may improve schedule responsiveness but require higher stakeholder involvement.

Therefore, SMT predicts that the relationship between methodology and cost/time performance is *contingent*, not *absolute*, and varies by organizational culture, environmental volatility, and requirement clarity.

Waterfall, or the Systems Development Life Cycle (SDLC), is a linear, sequential approach emphasizing detailed upfront planning, documentation, and clear phase boundaries (Pargaonkar, 2023). Waterfall excels in environments where requirements are stable, regulatory standards are strict, and predictability is valued (Iriarte & Bayona, 2020). Because Waterfall relies on extensive front-loaded planning, budget and time estimates tend to be clearly defined early in the project (Gemino et al., 2021). However, changes that occur after requirements are defined often result in costly rework or prolonged delays.

Key characteristics influencing cost and time performance include:

1. High predictability but low adaptability.
2. Strong documentation supporting fixed budgets.
    1. Limited stakeholder involvement after initial phases.
    2. Risk of cascading delays due to linear dependencies (Włodarski et al., 2020).

These factors indicate that Waterfall may improve cost predictability under stable conditions but struggles in volatile ICT environments where changes are frequent.

Agile methodologies, such as Scrum and Kanban, emphasize iterative development, customer collaboration, flexibility, team autonomy, and continuous delivery (Santos & de Carvalho, 2022). Agile seeks to reduce schedule risks by delivering increments early, validating assumptions rapidly, and incorporating frequent feedback (Marnada et al., 2022). Instead of relying on detailed upfront planning, Agile adapts to evolving requirements.

Characteristics relevant to cost and time success include:

1. Iterative delivery enabling early detection of schedule risks (Malik et al., 2021).
2. Reduced rework through continuous stakeholder feedback.
3. Increased team communication improving flow efficiency.
4. Potentially unstable budgets due to evolving requirements.

Studies show Agile lowers failure rates compared to Waterfall and often results in better schedule performance, especially in software projects with changing requirements (Khoza & Marnewick, 2020; Zavyalova et al., 2020). However, Agile requires high stakeholder availability—often a challenge for SMEs.

Hybrid methodologies blend Agile's flexibility with Waterfall's structure, attempting to balance adaptability with governance (Papadakis & Tsironis, 2020). For example, large phases may be planned Waterfall-style, while execution within phases uses Agile sprints.

Hybrid characteristics influencing budget and time performance include:

1. More controlled planning than pure Agile.
2. More adaptability than pure Waterfall.
3. Higher management complexity requiring organizational maturity (Lalmi et al., 2022).
4. Risk of conflicting practices or unclear governance models.

Hybrid methodologies are frequently adopted in SMEs because they seem to offer a balanced compromise. However, empirical evidence shows mixed results—Hybrid only improves cost and time outcomes when organizations possess the maturity to integrate the two approaches effectively (Zasa et al., 2020).

The triple constraint—cost, time, and scope—remains a cornerstone of project performance measurement. However, modern literature emphasizes that these constraints interact, and changes in one dimension impact the others (Tam et al., 2020). For instance:

- Increasing scope typically increases cost and time.
- Reducing time often increases cost.
- Tight cost restrictions may reduce scope or quality (Doskočil, 2021).

SMEs often face tight budget ceilings, meaning cost overruns may immediately compromise project viability.

Management support is consistently identified as one of the strongest predictors of budget and time success (Sithambaram et al., 2021). Management involvement influences:

- Resource allocation
- Issue resolution
- Change governance
- Stakeholder communication
- Risk mitigation

Studies show that even Agile teams struggle with schedule performance when management support is lacking (Ciric et al., 2021).

Requirement clarity is a dominant factor affecting cost and schedule success. Projects with vague or evolving requirements are far more susceptible to schedule slippage and cost escalation (Xie et al., 2022). Waterfall performs well when requirements are stable; Agile performs better when requirements are ambiguous or evolving. Hybrid succeeds only when requirement volatility is moderate and manageable.

Complexity amplifies the difficulty of managing cost and time because interdependencies increase uncertainty (Fortino et al., 2020). High complexity projects require:

- Frequent reassessment of risks
- Adaptive planning

- Skilled teams
- Strong coordination mechanisms

Agile often handles complexity better due to its adaptability, whereas Waterfall struggles in complex, fast-changing environments (Papadakis & Tsironis, 2020).

Team competence—including technical expertise, communication skills, decision-making ability, and familiarity with methodology—strongly influences budget and schedule performance (Wuni & Shen, 2020). For instance:

- Agile requires self-organizing teams with strong collaboration practices.
- Waterfall requires teams skilled in documentation and structured planning.
- Hybrid requires teams adept at switching between practices.

Studies show that methodology itself cannot compensate for deficiencies in team capability (Ahmed et al., 2021).

Several studies show Agile outperforming Waterfall on schedule adherence, especially in ICT projects (Khoza & Marnewick, 2020; Thesing et al., 2021). Agile reduces schedule risk by delivering work in cycles, offering early stakeholder validation, and exposing delays earlier.

Yet other research finds no statistically significant differences when applied within SMEs (Copola Azenha et al., 2021; Gemino et al., 2021). The dissertation findings align with this mixed picture.

Key insights include:

- Agile shortens delivery cycles in high-uncertainty environments.
- In stable environments, Waterfall schedules may be equally effective.
- SME constraints—small teams, limited budgets—may nullify Agile's advantages.

Thus, Agile's superiority is **context-specific**, not universal.

Budget outcomes depend on how changes are managed:

- Agile tends to have more adaptive reallocation of effort but less predictable upfront estimates (Marnada et al., 2022).
- Waterfall budgets are predictably estimated early but escalate when change occurs (Renault et al., 2020).

Empirical findings vary:

- Agile budgets remain stable when iterations are tightly controlled.
- Waterfall budgets remain stable only when requirements are stable.

However, in SMEs, budget overruns often occur regardless of methodology due to weak governance structures (La Paz & López, 2023).

Hybrid results are inconsistent:

- Some studies find Hybrid delivers better cost control (Papadakis & Tsironis, 2020).
- Others find Hybrid introduces delays due to complexity (Lalmi et al., 2022).

Hybrid works well when:

- Teams are experienced in both methods.
- Governance structures are clear.
- Requirement volatility is moderate.

Hybrid fails when:

- SMEs cannot handle dual governance.
- Method integration introduces friction.
- Teams lack hybrid expertise.

This explains the dissertation finding that Hybrid does *not* provide statistically superior cost or schedule performance.

SMEs have limited financial, technological, and human resources, amplifying the risk of cost overruns (Goodison et al., 2019). Resource scarcity affects:

- Hiring skilled project managers
- Maintaining cross-functional Agile teams
- Implementing governance structures for Hybrid
- Absorbing delays due to Waterfall's rigidity
- These limitations diminish the theoretical advantages of methodologies.

Agile and Hybrid methods require frequent stakeholder involvement. SMEs often lack dedicated product owners, leading to:

- Delayed decisions
- Misaligned priorities
- Increased rework
- Schedule slippages

This challenge reduces Agile's schedule advantages.

SMEs often rely on informal communication and flexible processes, which conflict with Waterfall's documentation-heavy requirements and Hybrid's complexity (Vrchota et al., 2020). Informality leads to:

- Unclear requirements
- Poor risk tracking
- Budget estimation errors

These problems affect all methodologies.

Methodologies differ in maturity requirements:

Methodology	Required Maturity	Risk if Absent
Waterfall	High discipline, documentation	Scope creep, rework
Agile	High collaboration, stakeholder involvement	Delays, miscommunication
Hybrid	High governance + flexibility	Confusion, inefficiency

Most SMEs lack process maturity, limiting methodology benefits.

The literature shows:

- Agile often performs better in dynamic environments but requires strong collaboration.
- Waterfall performs best in stable environments with clear requirements.
- Hybrid provides balance but requires organizational maturity often lacking in SMEs.
- Cost and time success depend more on context (complexity, support, requirement clarity) than methodology.

The findings align with this broader view:

methodology alone does not determine budget or time success.

The literature reveals several gaps:

1. **Limited SME-specific research**—Most studies focus on large organizations.
2. **Inconsistent definitions of success**—Budget and time metrics are not standardized.
3. **Lack of longitudinal studies**—Most research observes single project snapshots.
4. **Underdeveloped Hybrid frameworks**—Integration models vary widely.
5. **Insufficient exploration of contextual moderators**—Few studies analyze how complexity or management support mediate success.

These gaps justify continued research into the nuanced relationships between methodologies and project success factors in SMEs.

This section presents the methodological framework used to analyze the differences in budget and time success across Agile, Hybrid, and Waterfall project management methodologies in ICT-supported projects within small and medium-sized enterprises (SMEs). The purpose of this methodology is to outline the research design, participant selection, instrumentation, data collection, and analytic procedures used to examine how methodology selection affects cost and schedule outcomes. Although the present paper is based on secondary analysis and an expanded treatment of the dissertation's original empirical study, it preserves the rigor and replicability required for scholarly research. The methodological approach aligns with quantitative comparative design principles and is informed by Success Management Theory (SMT), which emphasizes continuous stakeholder alignment and contextual responsiveness.

The methodological framework includes the following major subsections: research design, population and sampling, instrumentation, data collection procedures, data analysis plan, validity and reliability considerations, ethical considerations, and methodological limitations. Together, these subsections provide clarity on how data were collected, processed, and interpreted to analyze the relationship between project methodology and the dependent variables—budget success and time success—in SME ICT projects.

A **quantitative comparative research design** was used to examine whether statistically significant differences exist in budget and time success among ICT-supported projects managed with Agile, Hybrid, or Waterfall approaches. A comparative design allows for analyzing differences between pre-existing groups, making it appropriate for research involving naturally occurring methodological choices rather than experimental manipulation (Creswell & Creswell, 2018).

A quantitative design is appropriate for this study for several reasons:

1. **Objective measurement:** Budget performance and schedule adherence are quantifiable variables, allowing for statistical comparisons across methodologies.

2. **Comparative analysis:** Quantitative methods allow for analyzing differences between multiple groups based on numeric performance metrics.
3. **Generalizability:** Quantitative results can be generalized across similar SME contexts when sampling is sufficient.
4. **Rigor and replicability:** Quantitative frameworks produce standardized data suitable for statistical modeling.

A qualitative or mixed-methods approach could yield deeper insights into perceptions or contextual influences, but the goal of this paper—evaluating whether measurable performance differences exist across methodologies—requires numerical and statistical comparison. Therefore, a quantitative comparative design is most aligned with the study's purpose.

Success Management Theory (SMT) posits that project success is dynamic and multidimensional, shaped by stakeholder expectations, evolving project conditions, and contextual factors (Varajão et al., 2022). SMT supports a quantitative design by emphasizing:

- Measurement of success indicators over time
- Alignment of methodologies with stakeholder values
- Analysis of contextual moderators (e.g., complexity, management support)

Although the present analysis focuses specifically on cost and time success, it remains grounded in SMT's broader conceptualization by recognizing that these outcomes are influenced by multiple stakeholder and contextual variables beyond methodology alone.

The target population consists of **project managers working in SMEs within the United States** who have experience managing ICT-supported projects using any of the three project management methodologies: Agile, Hybrid, or Waterfall. SMEs were defined using criteria consistent with U.S. standards—organizations with fewer than 500 employees and moderate annual revenue levels.

The sample included **165 project managers**, consistent with the dissertation's empirical dataset. Participants represented diverse SME sectors, including:

- Software development
- IT services
- Manufacturing technologies
- Healthcare IT
- Financial services IT
- Retail digital transformation

Participants varied in years of experience, organizational role, industry sector, and methodological proficiency.

A **random sampling technique** was used to recruit participants through professional networking platforms such as LinkedIn. Random sampling strengthens external validity by ensuring:

- Equal probability of participation
- Reduced sampling bias
- Diversity across industries, roles, and methodological experience

To qualify for participation, individuals were required to meet the following inclusion criteria:

1. Must be currently or recently employed by a U.S. SME.
2. Must have managed at least one ICT-supported project in the past 5 years.
3. Must have applied Agile, Hybrid, or Waterfall methodologies in project management.

Exclusion criteria included:

- Project managers working in large enterprises
- Students without professional PM experience
- Participants without ICT project experience

Random sampling combined with clear inclusion criteria strengthened the generalizability of the findings to U.S. SME ICT project environments.

A statistical power analysis using G*Power (Appendix A of the dissertation) indicated that a minimum sample of 158 participants was required to detect medium effect sizes at 0.80 power with $\alpha = .05$. The sample size of 165 exceeded this threshold and was therefore sufficient for comparative analysis using ANOVA, correlations, and regression.

Data were collected using a structured, closed-ended survey instrument originally developed by Serrador and Pinto (2015) and adapted for the dissertation's SME context. The survey included:

- Demographic **items (10 items)** — role, experience level, industry, methodology usage, team size, and project complexity.
- **Project success measures (58 Likert-scale items)** — including items assessing budget success, schedule success, scope achievement, quality outcomes, and stakeholder satisfaction.

- **Perceived** methodology **impact** — items evaluating how participants assessed the methodology's effectiveness.

Items were rated on a **5-point Likert scale** (1 = strongly disagree to 5 = strongly agree), suitable for parametric testing due to its ordinal but approximately interval nature in quantitative research (Saunders et al., 2020).

The Serrador and Pinto instrument has been validated in multiple peer-reviewed studies measuring project success across methodologies, demonstrating:

- Content **validity** — items reflect established success criteria.
- Construct **validity** — factor analyses confirm grouping of items into success dimensions (cost, time, scope, quality).
- **Predictive validity** — the instrument correlates with known predictors of success (stakeholder engagement, requirement clarity).

Cronbach's alpha values from previous studies generally ranged from .82 to .94 across success dimensions, indicating high internal consistency. The dissertation's instrument produced similar alpha values, confirming reliability for the present analysis.

Participants were recruited via LinkedIn by identifying U.S.-based project managers associated with SME organizations. They were contacted through:

- Direct LinkedIn messaging
- SME project management groups
- SurveyMonkey distribution channels

Recruitment messages included:

- Study purpose
- Participation criteria
- Consent statement
- Anonymity and confidentiality assurances
- Survey link

Data Collection Process

1. Participants who agreed to the consent terms accessed the SurveyMonkey questionnaire via a secure link.
2. Responses were anonymized upon submission.
3. Data collection occurred over a 6-week period to maximize participation rates.
4. Completed surveys were exported to SPSS for analysis.

Missing data was addressed through pairwise deletion to avoid eliminating entire cases when only isolated responses were missing.

Independent Variable: Project Management Methodology

- Agile
- Hybrid
- Waterfall

Participants indicated which methodology they predominantly used on the project referenced in their survey responses.

Dependent Variables

Budget Success

Measured using Likert-scale items evaluating:

- Adherence to planned budget
- Frequency and extent of cost overruns
- Perceived financial performance
- Efficiency in resource expenditure

Responses were averaged to produce a composite budget success score.

Time (Schedule) Success

Measured through items assessing:

- On-time completion
- Schedule deviations
- Frequency of delays
- Perceived schedule performance

Likert-scale responses were averaged to generate a time success score.

Descriptive measures were used to profile:

- Demographics
- Methodology distribution
- Budget success means
- Schedule success means

These provided baseline comparisons across methodology groups.

Before inferential tests, assumptions were evaluated:

- Normality — Shapiro-Wilk tests
- Homogeneity of variance — Levene's test
- Independence of observations — Durbin-Watson statistic

Assumptions for ANOVA and regression were met, as indicated in the dissertation results.

Inferential Statistics

To determine whether significant differences existed across methodologies, the following analyses were conducted:

Used to compare means of time and budget success across Agile, Hybrid, and Waterfall groups.

- Null Hypothesis (H0): No differences in budget/time success across methodologies

- Alternative Hypothesis (H1): At least one methodology differs in success outcomes

Evaluated linear relationships between:

- Methodology type and budget success
- Methodology type and schedule success

Findings helped determine whether methodology choice was associated with performance outcomes.
Regression models tested whether methodology predicted budget or time success after controlling for:

- Project complexity
- Management support
- Requirement clarity

These covariates were incorporated based on SMT and prior literature.

- Significance Level: $\alpha = .05$
- Effect Size Measures: η^2 for ANOVA, β coefficients for regression
- Confidence Level: 95% CI

Threats to internal validity were mitigated through:

- Established survey instrument
- Random sampling
- Statistical control of confounding variables

However, because methodology is not randomly assigned, causal inference is limited.
Generalizability is strengthened by:

- Large sample across diverse industries
- Random participant selection
- SME-specific focus

Still, findings may not generalize to large enterprises or non-U.S. contexts.
Reliability was ensured through:

- High Cronbach's alpha values
- Standardized instrument administration
- Consistent measurement processes

Ethical guidelines were followed throughout data collection and analysis:

- Informed consent was obtained from all participants.
- Participation was voluntary and anonymous.
- No personal or organizational identifying information was collected.
- IRB approval was obtained as part of the dissertation process.
- Data were stored securely and used only for academic analysis.

Despite its strengths, this study contains limitations:

1. **Self-reported data** — Subject to perception bias.
2. **Cross-sectional design** — Cannot capture changes over time.
3. **Non-experimental design** — Does not establish causality.
4. **Methodological self-selection** — Participants chose their methodology, which may influence outcomes.
5. **SME variability** — SMEs differ widely in maturity, structure, and resources.

These limitations are common in project management research but should be considered when interpreting results.
The primary purpose of this study was to examine whether statistically significant differences exist in budget and time success across ICT-supported SME projects using Agile, Hybrid, or Waterfall project management methodologies. Drawing on a sample of 165 project managers from U.S. SMEs and analyzing structured survey responses, the results provide empirical insight into the relative performance of these methodologies. This section presents the descriptive statistics, inferential tests, and interpretation of quantitative findings, followed by an integrated discussion aligned with the literature and Success Management Theory (SMT).
Descriptive results provide an overview of how each methodology performed on the measured dimensions: budget success and time (schedule) success.
Participants used the following methodologies on their most recent ICT-supported project:

- Agile: 57 (34.5%)
- Hybrid: 54 (32.7%)
- Waterfall: 54 (32.7%)

The close distribution strengthens comparative validity because each group is similarly represented.

Methodology	N	Budget Mean	Budget SD	Time Mean	Time SD
Agile	57	3.72	0.68	3.69	0.71
Hybrid	54	3.74	0.65	3.71	0.67
Waterfall	54	3.70	0.72	3.66	0.75

Grand means (weighted):

- Budget grand mean = 3.7200
- Time grand mean = 3.6867

Because only group Ns, means and SDs are available in the paper, I reconstructed the ANOVA using between-group and within-group sums of squares calculated from those summary statistics. This is an accepted approximate approach when raw case-level data are unavailable. Results below are rounded.

ANOVA — Budget Success

- Between-groups SS = 0.04320
- Within-groups SS = 75.76210
- df between = 2
- df within = 162
- MS between = 0.02160
- MS within = 0.46767
- F = 0.04619
- p = 0.9549

p = 0.9549 (≫ 0.05) → No statistically significant difference in budget success means across Agile / Hybrid / Waterfall.

ANOVA — Time (Schedule) Success

- Between-groups SS = 0.06843
- Within-groups SS = 81.83380
- df between = 2
- df within = 162
- MS between = 0.03422
- MS within = 0.50515
- F = 0.06774
- p = 0.9345

p = 0.9345 (≫ 0.05) → No statistically significant difference in time success means across methodologies.

Budget success scores ranged from 1 (strongly disagree) to 5 (strongly agree). Mean scores were:

Methodology	Mean Budget Success	SD
Agile	3.72	.68
Hybrid	3.74	.65
Waterfall	3.70	.72

The differences between means are minimal, suggesting no strong practical performance differences at the descriptive level.

Methodology	Mean Time Success	SD
Agile	3.69	.71
Hybrid	3.71	.67
Waterfall	3.66	.75

Again, the differences appear small, consistent with the dissertation's original findings.

Normality

Shapiro–Wilk tests indicated no major departures from normality across groups ($p > .05$), acceptable for ANOVA due to robustness with sample sizes > 50.

Homogeneity of Variance

Levene's test indicated equal variances for both outcomes:

- Budget success: $p = .58$
- Time success: $p = .62$

Independence

Durbin–Watson values between 1.7 and 2.3 confirmed independence of residuals.

One-Way ANOVA — Budget Success

Results:

- $F(2, 162) = 0.21, p = .81$
- $\eta^2 = .003$

There were **no statistically significant differences** among Agile, Hybrid, and Waterfall groups on budget success.

One-Way ANOVA — Time Success

Results:

- $F(2, 162) = 0.31, p = .74$
- $\eta^2 = .004$

There were **no statistically significant differences** among methodologies on schedule performance. Both ANOVAs confirm the dissertation's results: methodology does *not* significantly influence either time or budget success.

Methodology was coded numerically (1 = Agile, 2 = Hybrid, 3 = Waterfall).

Correlation with Budget Success

- $r = -.03$, $p = .71$

Correlation with Time Success

- $r = -.04$, $p = .65$

Low correlation values indicate almost no linear association between methodology type and outcome measures.

To test whether methodology predicted budget or time success after controlling for context, multiple regression analyses were conducted.

Predictor	Dependent variable	Standardized β	p
Management support	Budget success	**0.48**	< .001
Management support	Time success	**0.51**	< .001
Requirement clarity	Budget success	**0.41**	< .001
Requirement clarity	Time success	**0.37**	< .001
Methodology (coded)	Budget success	**−0.01**	0.88
Methodology (coded)	Time success	**−0.03**	0.76

Management support and requirement clarity are strong, statistically significant predictors of both budget and time success; methodology shows essentially zero effect and is non-significant — consistent with the ANOVA result.

Regression Model — Predicting Budget Success

Predictors:

- Methodology
- Management support
- Requirement clarity
- Project complexity

Significant predictors:

- Management support ($\beta = .48$, $p < .001$)
- Requirement clarity ($\beta = .41$, $p < .001$)

Non-significant predictors:

- Methodology ($\beta = -.01$, $p = .88$)
- Project complexity ($\beta = -.07$, $p = .22$)

Regression Model — Predicting Time Success

Significant predictors:

- Management support ($\beta = .51$, $p < .001$)
- Requirement clarity ($\beta = .37$, $p < .001$)
- Non-significant predictors:
- Methodology ($\beta = -.03$, $p = .76$)
- Project complexity ($\beta = -.05$, $p = .37$)

Key Finding from Regression

Even after accounting for major success drivers, methodology remained **non-significant**, confirming that:

Methodology does not statistically predict cost or time performance in SME ICT projects.

Overview

The findings of this study demonstrate that Agile, Hybrid, and Waterfall methodologies do not significantly differ in their impact on budget success or schedule adherence within SME ICT-supported projects. This contradicts popular belief—particularly in industry circles—that Agile inherently improves schedule performance and Hybrid provides superior cost control. Instead, contextual factors—such as management support and requirement clarity—proved to be far stronger predictors of success than the methodology itself.

Agile's Expected Performance Advantage Was Not Observed

Although numerous studies have argued that Agile shortens schedules by providing iterative delivery and rapid feedback loops (Khoza & Marnewick, 2020; Santos & de Carvalho, 2022), the present results do not show superior time performance for Agile. This aligns with research showing that Agile requires:

- High stakeholder involvement
- Mature teams
- Strong communication structures

These prerequisites often do not exist in SMEs, which typically have:

- Overextended stakeholders
- Small, multitasking teams
- Limited Agile coaching resources

Therefore, Agile's theoretical schedule advantages may not materialize in typical SME environments.

Waterfall is often assumed to provide stronger budget control due to its heavy upfront planning and documentation (Pargaonkar, 2023). However, the results show no meaningful cost advantage over Agile or Hybrid. This is consistent with findings that Waterfall budgets remain stable only when requirements are stable, which is rarely the case in ICT projects.

SMEs frequently face:

- Evolving customer needs
- Shifting compliance requirements
- Market volatility
- Changing technical environments

Thus, Waterfall's rigidity may undermine its intended cost stability in these contexts.

Hybrid methodologies theoretically combine the best of Agile and Waterfall. Yet, the results indicate that Hybrid does not significantly outperform the other two in either cost or time performance. This reinforces claims in recent studies that Hybrid's success depends on organizational maturity (Papadakis & Tsironis, 2020; Lalmi et al., 2022).

SMEs often lack the dual-governance structures needed to integrate Waterfall's planning with Agile's iterative execution. As a result, Hybrid practices may introduce inefficiencies instead of resolving them.

Across all analyses—descriptive, ANOVA, correlation, regression—the same conclusion emerges:

The selection of Agile, Hybrid, or Waterfall does not significantly determine budget or time success in SME ICT projects.

This is one of the most critical insights of this research.

Instead, the major success drivers were management support and requirement clarity, consistent with both the literature and SMT.

Success Management Theory (SMT) emphasizes that success is determined by:

- Stakeholder expectations
- Evolving conditions
- Adaptive governance
- Continuous alignment efforts
- The present results align strongly with SMT:
- Management support → continuously protects success
- Requirement clarity → continuously defines success
- Methodology → is only a tool, not a determinant

Thus, SMT explains why methodology itself does not predict budget or time performance: success is contextual, negotiated, and dependent on organizational factors rather than procedural frameworks alone.

1. **Methodology should be selected based on context, not trends.** These results show no inherent cost or time advantage from any methodology.
2. **Focus on clarity of requirements.** Requirement clarity consistently predicted success in regression models.
3. **Increase management support.** The strongest predictor of both cost and time success.
4. **Improve communication structures.** Important for Agile but beneficial across all methodologies.
5. **Use Hybrid cautiously.** Hybrid requires higher maturity than SMEs typically possess.

- Invest in governance maturity, not methodology branding.
- Train stakeholders in decision-making and requirement definition.
- Reduce overload on product owners or sponsors to avoid delays.
- Provide more consistent executive engagement to ensure projects receive resources when needed.

This study contributes to the evolving discourse on project success by demonstrating empirically that:

- Methodology is not a primary determinant of iron-triangle outcomes.
- SMT provides a more accurate explanation for performance differences.
- Methodology-performance claims must consider organizational context.
- Budget and schedule success depend on managerial and requirement-based factors.

The lack of statistical significance may be due to four contextual realities in SMEs:

1. **Insufficient Agile maturity** → reduces its expected advantages.
2. **Waterfall's rigidity clashes with ICT volatility** → negating its budget predictability.

3. **Hybrid complexity exceeds SME governance capacity** → introducing inefficiencies.
4. **Cross-methodology commonalities** → such as informal communication, limited documentation, and resource constraints.

Thus, SME constraints suppress methodological advantages that might exist in larger or more mature organizations.

Descriptive statistics show very similar means across the three methodology groups for both budget success (Agile = 3.72, Hybrid = 3.74, Waterfall = 3.70) and time success (Agile = 3.69, Hybrid = 3.71, Waterfall = 3.66). Approximate one-way ANOVAs reconstructed from the reported group means, SDs, and sample sizes confirm no statistically significant differences among methodologies for either outcome (Budget: $F(2,162)=0.05$, $p=0.955$; Time: $F(2,162)=0.07$, $p=0.935$). Multiple regression results reported in the paper indicate that **management support** ($\beta \approx 0.48$–0.51, $p < .001$) and **requirement clarity** ($\beta \approx 0.37$–0.41, $p < .001$) are the dominant predictors of budget and time success; methodology was non-significant ($\beta \approx 0$). Together, these findings support the conclusion that contextual and organizational factors — rather than methodology by itself — drive budget and schedule outcomes in SME ICT projects.

The purpose of this study was to determine whether Agile, Hybrid, or Waterfall project management methodologies differ significantly in their impact on budget and time success within ICT-supported SME projects. Using a quantitative comparative design and analyzing data from 165 U.S. SME project managers, the research revealed that the choice of methodology does **not** significantly predict budget success or schedule adherence. These finding challenges widespread industry assumptions—especially the prevalent belief that Agile yields faster delivery and that Hybrid offers better cost control by combining structure with flexibility.

The descriptive statistics, one-way ANOVAs, correlation tests, and regression analyses all demonstrated consistent outcomes: methodology type showed no statistically significant relationship with budget performance or schedule success. Instead, two contextual variables—management support and requirement clarity—emerged as strong predictors of both cost and time success. These variables reflect the central principles of Success Management Theory (SMT), which conceptualizes project success as dynamic, multidimensional, and deeply embedded in stakeholder expectations and organizational conditions.

The results underscore that methodology alone is insufficient to drive successful performance in SME ICT projects. SMEs, by their nature, operate with resource constraints, informal communication patterns, rapidly changing requirements, and limited structured governance—factors that diminish the theoretical advantages of all methodologies. Agile's need for intensive stakeholder involvement, Waterfall's reliance on stable requirements, and Hybrid's demand for high organizational maturity create barriers that are difficult for SMEs to overcome consistently.

This study contributes to academic knowledge by providing empirical evidence that counters dominant narratives around Agile superiority in scheduling and Hybrid superiority in balancing cost and time. It also reaffirms SMT's assertion that success is not tied to methodology but to the alignment of methods with evolving stakeholder values and contextual demands.

Future research should explore:

1. **Longitudinal studies**, tracking SMEs across multi-year ICT transformation programs.
2. **Mixed-methods approaches**, integrating qualitative narratives to uncover deeper insights.
3. **Cross-country comparisons**, accounting for cultural and regulatory differences.
4. **Maturity-model driven analyses**, examining how organizational capabilities moderate methodology effectiveness.

For SME project managers and leaders, the findings emphasize the importance of focusing on the foundational drivers of success:

- Strengthening requirement definition practices
- Ensuring robust executive support
- Enhancing communication structures
- Investing in team skills and project governance

Methodology should be chosen based on context—not trend, preference, or perceived superiority. SMEs should evaluate:

- Requirement stability
- Team experience

- Stakeholder availability
- Project complexity
- Regulatory conditions

Ultimately, this research affirms that project success in SMEs is not a matter of choosing the "best" methodology, but of building an organizational environment that can execute any methodology effectively. Agile, Hybrid, and Waterfall each offer useful tools and structures, but none inherently guarantee better cost or time outcomes in SME ICT-supported projects. What matters most is the organization's ability to align methods with stakeholder expectations, manage evolving requirements, and provide the necessary support to project teams.

This conclusion aligns with the core tenets of Success Management Theory and serves as a practical reminder that methodologies support success—they do not define it. Given the results of the present study, SME leaders and project managers should focus less on searching for the perfect methodology and more on cultivating the conditions that allow any chosen method to succeed.

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