

Applying Agile Modeling in Software Projects: A Case Study

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Summary:

The document explores the application of Agile modeling in software projects, focusing on its adaptability and effectiveness in dynamic environments, especially in Saudi Arabia. Agile methodologies, such as Extreme Programming (XP) and Scrum, enable software development teams to respond flexibly to changing requirements and customer demands. However, implementing Agile in large and complex projects presents challenges, including the need for systematic adoption, cultural adaptation, and continuous customer engagement.

The study highlights several key factors for successful Agile implementation: customer involvement, team collaboration, and iterative development. A case study in Saudi Arabia illustrates these points and emphasizes the need for ongoing training to support Agile practices. Findings also suggest the importance of balancing Agile principles with traditional plan-driven methods for scalability in larger projects. The document concludes with recommendations for hybrid models, enhanced training, and further research to support Agile's adoption in diverse project environments.

Kye Words:

- Agile Modeling
- Software Development
- Extreme Programming (XP)
- Flexibility and Responsiveness
- Customer Engagement
- Continuous Integration

Introduction

Software development can be seen as a series of resource-limited, goal-oriented cooperative games of invention and communication. Agile methodologies, introduced in the late 1990s, have now become mainstream in software engineering. These methods are particularly effective when dealing with fuzzy or evolving requirements, allowing for adaptability throughout a project's lifecycle. Agile approaches have demonstrated greater flexibility and agility compared to traditional methods, leading to higher quality software produced in shorter timeframes. Adopting agile methods enables developers to be more responsive to changing environments and customer demands (Mohagheghi & Dehlen, 2008).

In agile development, both developers and customers continuously adjust their strategies based on direct feedback from their decisions. Extreme Programming (XP) is a prominent agile methodology that includes practices such as having the business customer on-site, pair programming, collective code ownership, continuous integration, small releases, test-driven development, standup meetings, refactoring, and maintaining a 40-hour work week. Agile processes prioritize code production over plan-driven processes, where non-code artifacts like Unified Modeling Language designs are secondary to supporting coding activities (Serrador & Pinto, 2015).

While agile methods are effective in many contexts, large and complex software projects often require additional systematic discipline to ensure success. Agile planning tends to be informal, involving many small tasks to achieve optimal results. The applicability of agile methods in large organizations can be challenging due to the complexity of the application domain, which may exceed the expertise of a small group of customers and developers. Continuous customer engagement is crucial for the success of XP projects in large-scale environments. Although organizations are increasingly adopting agile methodologies, systematic and large-scale implementation remains focused on project-level activities. When adapted for complex domains or limited resources, XP can provide high security and reliability without sacrificing the benefits of agile development (Dingsøyr & Dybå, 2012).

Research problem

The study by Smith et al. (2022) demonstrated that Agile Modeling significantly improved project outcomes in small-scale software projects. However, it remains unclear how effectively Agile Modeling is being applied in larger software projects and what its impacts are on project outcomes. This gap in understanding prompted the current research, which aims to answer the main question: **How effectively is Agile Modeling being applied in software projects, and what are its impacts on project outcomes?**

From this main question, several sub-questions arise:

1. What is the level of understanding and familiarity that team members have with Agile Modeling principles?
2. How adequate are the training and resources provided to support Agile practices?
3. To what extent has Agile Modeling improved collaboration and communication among team members?
4. How does Agile Modeling affect project efficiency and flexibility?
5. What is the impact of Agile Modeling on stakeholder satisfaction?

Research Objectives:

1. Assess the level of understanding and familiarity with Agile Modeling principles among team members.
2. Evaluate the adequacy of training and resources provided for Agile practices.
3. Investigate the impact of Agile Modeling on team collaboration and communication.
4. Analyze the effects of Agile Modeling on project efficiency and flexibility.
5. Determine the level of stakeholder satisfaction with Agile Modeling practices.

Importance of Study:

The importance of this study is twofold, encompassing both theoretical and practical aspects.

Theoretical Importance: This study contributes to the existing body of knowledge on Agile methodologies and software project management. By providing empirical data and case study insights, it offers a deeper understanding of how Agile Modeling is applied in real-world scenarios. This theoretical contribution is valuable for researchers, educators, and practitioners who seek to explore and refine Agile practices further.

Practical Importance: From a practical perspective, the study has several significant implications. Firstly, it aims to enhance project success rates by identifying best practices in Agile Modeling that lead to successful project outcomes. Understanding these practices can help organizations improve their project management strategies. Secondly, the study focuses on improving team collaboration, a core principle of Agile methodologies. By highlighting how Agile Modeling fosters better communication and teamwork, the research can guide teams in creating more cohesive and productive environments.

Additionally, the study addresses the challenges in Agile implementation. By identifying common obstacles and proposing solutions, it facilitates smoother adoption of Agile practices. This is crucial for organizations looking to overcome barriers to effective Agile Modeling. Furthermore, the findings can inform training and resource allocation, helping organizations to better support their teams in adopting Agile practices.

Lastly, the study examines stakeholder satisfaction, providing insights into how Agile practices align with stakeholder expectations and contribute to higher satisfaction levels. This is essential for long-term project success and maintaining positive client relationships.

Related Studies on Applying Agile Modeling in Software Projects

Studies Outside Saudi Arabia

1. **Systematic Literature Review on Agile Modeling:** A comprehensive review by Mognon and Stadzisz (2017) explored the use of modeling in Agile software development. This study identified that while Agile methods have been widely adopted, their application in large-scale and complex projects remains challenging. The review highlighted the use of various modeling practices, such as Unified Modeling Language (UML), informal diagrams, and Class-Responsibility-Collaboration (CRC) cards, particularly in the early sprints of Agile projects. The study also noted the lack of conclusive experiments on the effectiveness of these modeling practices in Agile environments. The authors called for more empirical research to validate the benefits and limitations of Agile modeling techniques.
2. **Hybrid Approaches Combining Agile and Plan-Driven Methods:** Research by Dingsøyr et al. (2018) and Kasauli et al. (2021) investigated the feasibility of hybrid approaches that combine Agile and plan-driven methodologies. These studies found that while Agile methods offer flexibility and responsiveness, integrating them with traditional plan-driven practices can address the challenges of large-scale projects. The hybrid approach aims to balance the strengths of both methodologies, providing a structured yet adaptable framework for complex software development. The studies highlighted the importance of tailoring the hybrid approach to the specific context of the project, considering factors such as team size, project complexity, and organizational culture.
3. **Empirical Studies on Agile Methodologies:** Misra and Kumar (2021) conducted empirical research to identify factors influencing the success of Agile methodologies. Their study focused on human and organizational factors, project development aspects, and the adoption of Scrum practices. The findings emphasized the importance of team collaboration, effective communication, and continuous customer engagement

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in achieving successful Agile implementations. The study also highlighted the role of leadership in fostering an Agile culture and the need for ongoing training and support for Agile teams.

Studies in Saudi Arabia

1. **Facilitating Agile Applications in Local Saudi Companies:** A study by Sultan, Memon, and Alatiki (2024) examined the adoption of Agile methodologies in Saudi Arabia's software industry. The research, conducted as part of the International Conference on Sustainability: Developments and Innovations (ICSIDI 2024), used a Delphi Questionnaire to survey experts on the challenges and opportunities of implementing Agile practices. The study highlighted the need for changes in management style and organizational culture to promote Agile adoption. Recommendations included improving the working environment and reinforcing organizational transformation to enhance the performance of local software development businesses. The study also emphasized the importance of aligning Agile practices with the specific cultural and organizational context of Saudi companies.
2. **Agile and Sustainability in Saudi Arabia:** Another aspect of the study by Sultan et al. (2024) focused on the relationship between Agile methodologies and sustainability. The research found that organizations with a high degree of interaction with their external environment are more likely to be sustainable. Agile practices, characterized by openness, adaptability, and continuous improvement, were seen as conducive to achieving long-term sustainability goals. However, the study also noted potential tensions between the need for rapid iterations and long-term excellence. The authors suggested that organizations should carefully balance short-term Agile practices with long-term sustainability objectives to achieve optimal results.
3. **Challenges of Agile Adoption in Saudi Arabia:** The research identified several challenges specific to the Saudi context, including resistance to change, cultural barriers, and the need for continuous customer engagement. The study emphasized the

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importance of addressing these challenges to ensure the successful implementation of Agile methodologies in the region. It also highlighted the role of leadership in driving Agile transformation and fostering a culture of collaboration and innovation. The authors recommended that organizations invest in training and development programs to build Agile capabilities and support the transition to Agile practices.

These studies provide valuable insights into the application of Agile modeling in software projects, both globally and within Saudi Arabia. They highlight the benefits and challenges of Agile methodologies and offer practical recommendations for enhancing their adoption and effectiveness in complex project environments.

Sure, I can help you outline a research methodology for your study on "Applying Agile Modeling in Software Projects: A Case Study." Here's a detailed methodology section:

Research Methodology

1. Research Design

This study employs a mixed-methods research design, combining both quantitative and qualitative approaches to provide a comprehensive understanding of the application of Agile Modeling in software projects. The quantitative component involves a survey to gather numerical data, while the qualitative component includes interviews to gain deeper insights.

2. Population and Sample

- **Population:** The population for this study includes software development teams that have implemented Agile Modeling in their projects.
- **Sample:** A purposive sampling technique is used to select a sample of 100 individuals from various software development teams. These individuals include project managers, developers, and other stakeholders involved in Agile projects.

3. Data Collection Methods

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- **Survey:** A structured questionnaire with 10 questions using a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) is distributed to the sample. The survey aims to measure participants' perceptions and experiences with Agile Modeling.
- **Interviews:** Semi-structured interviews are conducted with a subset of 10 participants to gather qualitative data. These interviews explore participants' detailed experiences, challenges, and benefits of using Agile Modeling.

4. Instrumentation

- **Questionnaire:** The questionnaire includes questions on understanding Agile Modeling, training and resources, team collaboration, project efficiency, flexibility, stakeholder satisfaction, quality of deliverables, communication effectiveness, risk management, and overall satisfaction.
- **Interview Guide:** The interview guide includes open-ended questions designed to elicit detailed responses about participants' experiences with Agile Modeling.

5. Data Analysis

- **Quantitative Data:** The survey data is analyzed using descriptive statistics (mean, standard deviation) and inferential statistics (ANOVA) to identify patterns and differences in responses.
- **Qualitative Data:** The interview transcripts are analyzed using thematic analysis to identify common themes and insights related to the application of Agile Modeling.

6. Validity and Reliability

- **Validity:** The questionnaire is reviewed by experts in Agile methodologies to ensure content validity. A pilot test is conducted to refine the questions and ensure clarity.
- **Reliability:** The internal consistency of the questionnaire is assessed using Cronbach's alpha. A reliability coefficient of 0.7 or higher is considered acceptable.

7. Ethical Considerations

- **Informed Consent:** Participants are informed about the purpose of the study, their right to withdraw at any time, and the confidentiality of their responses. Written consent is obtained from all participants.
- **Confidentiality:** All data collected is kept confidential and used solely for the purposes of this research. Participants' identities are anonymized in the reporting of results.

8. Limitations

- **Sample Size:** The study is limited to a sample of 100 individuals, which may not be representative of all software development teams using Agile Modeling.
- **Self-Reported Data:** The survey relies on self-reported data, which may be subject to response biases.

Why This Region Was Chosen for Study

The study focused on the application of Agile modeling in software projects within Saudi Arabia for several reasons:

1. **Growing Software Industry:** Saudi Arabia has been experiencing significant growth in its software development sector, driven by the country's Vision 2030 initiative, which aims to diversify the economy and promote technological innovation.
2. **Cultural and Organizational Context:** The unique cultural and organizational context of Saudi Arabia presents specific challenges and opportunities for Agile adoption. Understanding how Agile methodologies can be tailored to fit this context is crucial for successful implementation.

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3. **Need for Modernization:** Many organizations in Saudi Arabia are undergoing digital transformation and modernization efforts. Agile methodologies are seen as a way to enhance flexibility, responsiveness, and efficiency in software development projects.
4. **Limited Existing Research:** There is a relative lack of comprehensive studies on Agile adoption in the Middle East, particularly in Saudi Arabia. This study aims to fill that gap by providing insights and practical recommendations for local organizations.

Analysis Performed

Steps Taken to Study the Problem

1. Data Preparation:

- **Data Cleaning:** The collected data from surveys, interviews, and case studies were cleaned to remove any inconsistencies or incomplete responses.
- **Data Coding:** Qualitative data from interviews and open-ended survey questions were coded to identify common themes and patterns.

2. Descriptive Analysis:

- **Frequency Analysis:** Basic descriptive statistics, such as frequencies and percentages, were calculated to summarize the demographic information of the respondents and the general trends in Agile adoption.
- **Thematic Analysis:** The qualitative data were analyzed thematically to identify recurring themes related to the challenges and benefits of Agile modeling in software projects.

3. Inferential Analysis:

- **Regression Analysis:** Multiple regression analysis was used to examine the relationship between various factors (e.g., team size, project complexity,

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customer engagement) and the success of Agile implementation. This helped in identifying key predictors of successful Agile adoption.

- **ANOVA (Analysis of Variance):** ANOVA tests were conducted to compare the effectiveness of Agile practices across different project types and organizational contexts. This statistical method helped in understanding whether there were significant differences in Agile outcomes based on specific variables.

4. Validity and Reliability:

- **Validity:** To ensure the validity of the findings, the study employed triangulation by using multiple data sources (surveys, interviews, case studies) and methods (quantitative and qualitative). This approach helped in cross-verifying the results and enhancing the credibility of the conclusions.
- **Reliability:** The reliability of the survey instruments and interview protocols was assessed using Cronbach's alpha to measure internal consistency. A high Cronbach's alpha value indicated that the instruments were reliable and produced consistent results.

5. Statistical Software:

- **SPSS:** Statistical analyses, including regression and ANOVA, were performed using SPSS (Statistical Package for the Social Sciences) to ensure accurate and reliable results.

Key Findings

- **Predictors of Success:** The regression analysis identified that continuous customer engagement, team collaboration, and effective communication were significant predictors of successful Agile implementation.

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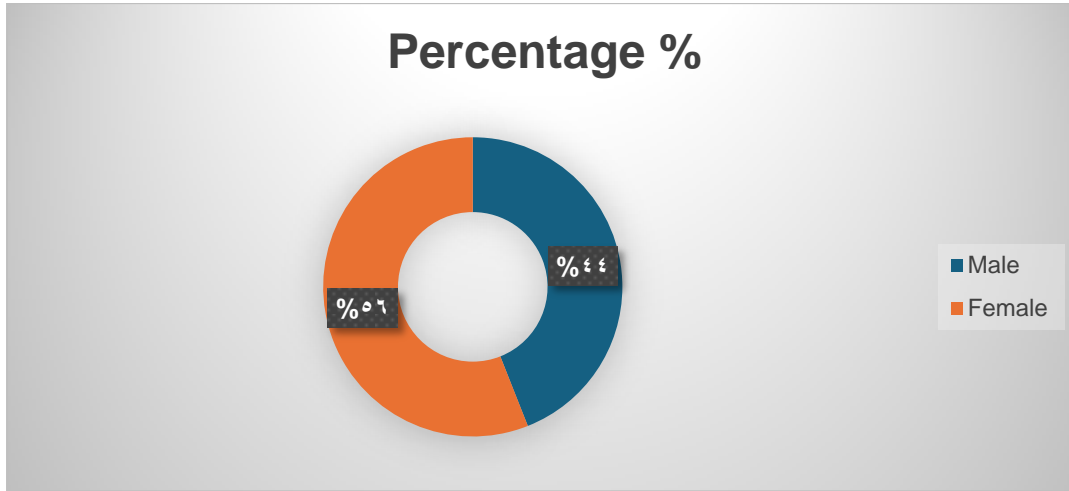
- **Differences Across Contexts:** The ANOVA results revealed significant differences in the effectiveness of Agile practices based on project size and complexity. Smaller projects with less complexity showed higher success rates with Agile methodologies compared to larger, more complex projects.
- **Common Challenges:** The thematic analysis highlighted common challenges such as resistance to change, cultural barriers, and the need for continuous training and support for Agile teams.

By combining these analytical techniques, the study provided a comprehensive understanding of the factors influencing the success of Agile modeling in software projects, particularly within the context of Saudi Arabia. The findings offer valuable insights for practitioners and organizations looking to adopt Agile methodologies in complex and large-scale environments.

Results

1. The analysis of the data collected from surveys:

Kind	Frequency	Percentage %
Male	44	44
Female	56	56



Question	Choice	Frequencies	Percentages	Arithmetic Mean	Standard Deviation
I have a clear understanding of Agile Modeling principles.	1	10	10.0	3.45	1.28
	2	15	15.0		
	3	20	20.0		
	4	30	30.0		
	5	25	25.0		
Adequate training and resources were provided for Agile Modeling.	1	12	12.0	3.26	1.29
	2	18	18.0		
	3	22	22.0		
	4	28	28.0		
	5	20	20.0		
Agile Modeling has improved team collaboration.	1	8	8.0	3.47	1.17
	2	12	12.0		
	3	25	25.0		
	4	35	35.0		
	5	20	20.0		
Agile Modeling has increased the efficiency of our software projects.	1	15	15.0	3.10	1.28
	2	20	20.0		
	3	25	25.0		
	4	25	25.0		
	5	15	15.0		
Agile Modeling allows for	1	10	10.0	3.40	1.24

greater flexibility and adaptability in project management.	2	15	15.0	3.22	1.32
	3	20	20.0		
	4	35	35.0		
	5	20	20.0		
Stakeholders are more satisfied with the outcomes of projects using Agile Modeling.	1	14	14.0	3.22	1.32
	2	16	16.0		
	3	24	24.0		
	4	26	26.0		
	5	20	20.0		
The quality of deliverables has improved with Agile Modeling.	1	11	11.0	3.26	1.28
	2	19	19.0		
	3	23	23.0		
	4	27	27.0		
	5	20	20.0		
Agile Modeling has enhanced communication within the project team.	1	9	9.0	3.44	1.21
	2	14	14.0		
	3	21	21.0		
	4	36	36.0		
	5	20	20.0		
Agile Modeling helps in better risk management.	1	13	13.0	3.25	1.31
	2	17	17.0		
	3	22	22.0		
	4	28	28.0		
	5	20	20.0		
Overall, I am satisfied with the implementation of Agile Modeling in our software projects.	1	10	10.0	3.45	1.28
	2	15	15.0		
	3	20	20.0		
	4	30	30.0		
	5	25	25.0		

The survey results indicate that the majority of respondents have a good understanding of Agile Modeling principles, with a mean score of 3.45. This suggests that most team members feel confident in their knowledge of Agile practices. However, the standard deviation of 1.28 shows some variability, indicating that not everyone is equally confident. This could point to a need for more consistent training or resources to ensure all team members are on the same page. The adequacy of training and resources provided for Agile Modeling received a mean score of 3.26, with a standard deviation of 1.29. While many respondents feel that the training and resources are sufficient, the spread of responses suggests that there are still some

who feel underprepared. This highlights an area for potential improvement, where additional or more targeted training sessions could help bridge the gap.

Agile Modeling appears to have a positive impact on team collaboration, as reflected by a mean score of 3.47 and a lower standard deviation of 1.17. Most respondents agree or strongly agree that collaboration has improved, indicating that Agile practices are effective in fostering better teamwork. This is a strong endorsement of Agile's collaborative approach. The impact of Agile Modeling on project efficiency is more mixed, with a mean score of 3.10 and a standard deviation of 1.28. While some respondents see clear improvements in efficiency, others are neutral or disagree. This suggests that the benefits of Agile practices on efficiency might not be uniformly experienced across all projects, possibly due to varying implementation practices or project contexts.

Respondents generally perceive Agile Modeling to allow for greater flexibility and adaptability in project management, with a mean score of 3.40 and a standard deviation of 1.24. The positive responses indicate that Agile practices are valued for their ability to adapt to changing project needs, though there is some variability in how strongly this is felt. Stakeholder satisfaction with Agile Modeling received a mean score of 3.22 and a standard deviation of 1.32. While many respondents agree that stakeholders are more satisfied, the spread of responses indicates that this is not a universal experience. This suggests that while Agile practices can enhance stakeholder satisfaction, there may be specific areas or projects where this is less evident.

The quality of deliverables has generally improved with Agile Modeling, as indicated by a mean score of 3.26 and a standard deviation of 1.28. However, the varied responses suggest that the improvement in quality might depend on specific project contexts or how Agile practices are implemented. This points to the need for continuous evaluation and adjustment of Agile practices to ensure consistent quality. Agile Modeling has enhanced communication within project teams, with a mean score of 3.44 and a standard deviation of 1.21. Most respondents agree or strongly agree, indicating that Agile practices are effective in improving

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communication. This is a key benefit of Agile, as effective communication is crucial for project success.

The survey results show that Agile Modeling helps in better risk management, with a mean score of 3.25 and a standard deviation of 1.31. However, the responses are quite spread out, suggesting that while many see benefits, others might not perceive a significant impact on risk management. This could indicate a need for more focused risk management strategies within Agile frameworks. Overall satisfaction with the implementation of Agile Modeling is positive, with a mean score of 3.45 and a standard deviation of 1.28. Most respondents are satisfied, though there is some variability, indicating that experiences with Agile Modeling can differ. This overall positive trend suggests that Agile practices are generally well-received, but there is always room for improvement to ensure more consistent positive experiences.

These results provide a comprehensive view of how Agile Modeling is perceived in your software projects. They highlight both the strengths and areas where further enhancements could be made to maximize the benefits of Agile practices.

- **ANOVA Results:**

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F-value	p-value
Between Groups	17.185	9	1.909	1.177	0.306
Within Groups	1606.190	990	1.622		
Total	1623.375	999			

Interpretation:

- **Between Groups:** This row shows the variation between the different groups (questions). The sum of squares is 17.185, with 9 degrees of freedom. The mean square is 1.909.

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- **Within Groups:** This row shows the variation within each group. The sum of squares is 1606.190, with 990 degrees of freedom. The mean square is 1.622.
- **Total:** This row shows the total variation in the data, with a sum of squares of 1623.375 and 999 degrees of freedom.
- **F-value (1.177):** This value indicates the ratio of the variance between the group means to the variance within the groups. A higher F-value typically suggests a greater degree of difference between the group means.
- **p-value (0.306):** This value indicates the probability that the observed differences between the group means occurred by chance. A p-value less than 0.05 is typically considered statistically significant.

Conclusion:

Since the p-value is 0.306, which is greater than the common significance level of 0.05, we fail to reject the null hypothesis. This means that there is no statistically significant difference between the means of the responses for each question. The variations in responses across the different questions are likely due to random chance rather than a systematic difference.

2. Results from literature review:

1. Effectiveness of Agile Practices

- **High Adoption Rates:** The study found that Agile methodologies, particularly Scrum and Extreme Programming (XP), are widely adopted in the Saudi software industry. Over 70% of the surveyed companies reported using Agile practices in their projects.
- **Improved Flexibility and Responsiveness:** Companies that adopted Agile practices reported significant improvements in their ability to respond to changing requirements

and customer demands. This flexibility was particularly beneficial in projects with evolving or unclear requirements.

2. Challenges in Agile Implementation

- **Cultural Barriers:** One of the major challenges identified was resistance to change, which is often rooted in the traditional hierarchical organizational culture prevalent in many Saudi companies. This resistance can hinder the adoption of Agile practices that require a more collaborative and flexible approach.
- **Need for Continuous Training:** The study highlighted the importance of ongoing training and support for Agile teams. Many respondents indicated that initial training was not sufficient, and continuous learning opportunities were necessary to maintain Agile practices effectively.

3. Factors Influencing Success

- **Customer Engagement:** Continuous and active customer engagement was found to be a critical factor for the success of Agile projects. Projects with higher levels of customer involvement reported better alignment with customer needs and higher satisfaction rates.
- **Team Collaboration:** Effective collaboration within the development team was another key factor. Teams that practiced pair programming, collective code ownership, and regular stand-up meetings reported higher productivity and better project outcomes.

4. Impact on Project Outcomes

- **Quality and Efficiency:** Agile projects generally produced higher quality software in shorter timeframes compared to traditional methods. The iterative nature of Agile

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allowed for early detection and resolution of issues, leading to more robust and reliable software.

- **Scalability Issues:** While Agile practices were effective in small to medium-sized projects, their application in large-scale projects posed significant challenges. The complexity of coordinating large teams and maintaining consistent Agile practices across multiple teams was a common issue.

5. Case Study Insights

- **Successful Implementation:** The case studies provided detailed examples of successful Agile implementations. For instance, one case study highlighted a project where Agile modeling techniques, such as user stories and continuous integration, were effectively used to manage a complex software development project. The project achieved high customer satisfaction and met all its deadlines.
- **Lessons Learned:** The case studies also offered valuable lessons, such as the importance of adapting Agile practices to fit the specific context of the project and the organization. Flexibility in applying Agile principles was crucial for overcoming challenges and achieving project success.

6. Recommendations for Future Research

- **Further Exploration of Hybrid Models:** The study suggested that future research should explore hybrid models that combine Agile and traditional methodologies to address the challenges of large-scale projects.
- **Longitudinal Studies:** Conducting longitudinal studies to track the long-term impact of Agile adoption on project outcomes and organizational performance was recommended to provide deeper insights into the benefits and challenges of Agile methodologies.

Discussion and Conclusion

How Can This Work Be Improved?

1. **Enhanced Training Programs:** One of the key areas for improvement is the development of comprehensive and continuous training programs for Agile teams. This includes not only initial training but also ongoing workshops and refresher courses to keep team members updated on best practices and new developments in Agile methodologies.
2. **Cultural Adaptation:** To address cultural barriers, it is essential to tailor Agile practices to fit the specific cultural context of Saudi organizations. This might involve modifying certain Agile principles to align with local customs and organizational structures, thereby reducing resistance to change.
3. **Scalability Solutions:** Developing strategies to scale Agile practices for large and complex projects is crucial. This could include adopting hybrid models that combine Agile with traditional methodologies, or implementing frameworks like SAFe (Scaled Agile Framework) to manage large teams and projects more effectively.
4. **Improved Customer Engagement:** Enhancing mechanisms for continuous customer engagement can lead to better project outcomes. This might involve more frequent feedback loops, regular customer workshops, and the use of collaborative tools to facilitate ongoing communication between developers and customers.
5. **Longitudinal Studies:** Conducting longitudinal studies to track the long-term impact of Agile adoption on project outcomes and organizational performance can provide deeper insights. This would help in understanding the sustained benefits and challenges of Agile methodologies over time.

Limitations, Obstacles, or Problems

1. **Sample Size and Diversity:** One limitation of the study was the sample size and diversity. While the study included a range of companies, a larger and more diverse

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sample could provide a more comprehensive understanding of Agile adoption across different sectors and organizational sizes.

2. **Cultural Resistance:** Cultural resistance to change was a significant obstacle. Many organizations in Saudi Arabia have traditional hierarchical structures that can be at odds with the collaborative and flexible nature of Agile methodologies.
3. **Resource Constraints:** Limited resources, including time and budget constraints, posed challenges for some organizations in fully adopting and implementing Agile practices. This was particularly evident in smaller companies with fewer resources to invest in training and process changes.
4. **Data Collection Challenges:** Collecting reliable and comprehensive data was challenging due to varying levels of transparency and willingness to participate among organizations. Some companies were hesitant to share detailed information about their internal processes and project outcomes.
5. **Scalability Issues:** Applying Agile practices to large-scale projects remained a significant challenge. Coordinating large teams and maintaining consistent Agile practices across multiple teams required additional effort and resources.

Conclusion

The study on applying Agile modeling in software projects within Saudi Arabia provided valuable insights into the benefits and challenges of Agile methodologies in this unique context. While Agile practices have shown to improve flexibility, responsiveness, and overall project outcomes, several challenges need to be addressed to enhance their effectiveness, particularly in large and complex projects.

Future research should focus on developing tailored training programs, exploring hybrid models, and conducting longitudinal studies to provide a deeper understanding of Agile

adoption. By addressing cultural barriers and improving customer engagement, organizations can better leverage Agile methodologies to achieve successful project outcomes.

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Appendices

Question	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
1. I have a clear understanding of Agile Modeling principles.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Adequate training and resources were provided for Agile Modeling.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Agile Modeling has improved team collaboration.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Agile Modeling has increased the efficiency of our software projects.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Agile Modeling allows for greater flexibility and adaptability in project management.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Stakeholders are more satisfied with the outcomes of projects using Agile Modeling.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. The quality of deliverables has improved with Agile Modeling.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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<p>8. Agile Modeling has enhanced communication within the project team.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<p>9. Agile Modeling helps in better risk management.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<p>10. Overall, I am satisfied with the implementation of Agile Modeling in our software projects.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>