Evaluating the Impact of Converting to Agile on Small and Medium-Sized Enterprises (SMEs)

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Abstract

This research is written to evaluate the adoption of Agile project management in SMEs. It is an appraisal of Agile technological readiness level to know if it is always a positive result or not. Agile adoption is common in projects with high uncertainty which provides high rate of change, complexity and risk, while Tradition PM is common in projects that are well defined, reducing their complexity and risk. As Traditional PM organization face more uncertainty, they try to adapt to Agile methods to gain the benefits of Agile. For this reason, Agile has gained strong support from Small and Medium-Sized Enterprises, particularly in the healthcare, IT or software manufacturing industry, because of its flexibility and timely delivery of project product, but, there is not enough evidence to show that Agile adoption has resulted in a positive outcome in all cases. Also, there is not enough evidence of large-scale Agile adoption in non-IT industries like the Energy, Manufacturing, Aerospace, Agriculture, Construction industries etc. Hence, this work aims to provide more literature on Agile adoption in Non-IT sectors providing comparison of adoption performance across the various industries. The lessons learned is that organizations must be careful while they transition to Agile because the dual possibility of positive or negative outcome exists. The answer to the research question was answered using empirical data evidence; Agile success factors comparison against several industries was generated; A Machine Learning framework that can be used to predict Agile adoption performance in the future have been developed and need to be trained for better accuracy. Change management was also discussed, explaining how individuals cope with change. A change management framework was also developed and used to drive change within an SME organization, aligned with this research case study.

Keywords: Agile PM, Waterfall-Traditional PM, Kanban, SAFe, Scrum, SMEs, Project Success, Industry-Specific Challenges, Multi-Method Study, Healthcare, Energy, Construction, Multi-sector, HITMEA Predictive Model, Change Management, ADKAR, MoSCoW, Root Cause, Fishbone, Strategic Management.

1.0 Introduction

1.1 Background

In the current global economy, small and medium-sized enterprises are under increasing pressure to remain competitive, innovative, and responsive to the ever-changing needs of customers. The use of Traditional project management methodologies has not been able to meet these variable customer needs; therefore, it becomes imperative for them to transition to an Agile or Hybrid project management methodology in an attempt to access the benefits therein. This is because the Agile framework has four core values that meet the variability in today's business world: individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation, responding to change over following a plan (Kent Beck et al., 2025).

However, emerging literature reveals that this transition is not uniformly successful when adopted by several SMEs across different industries. For example, Taylor documents Agile's adaptability challenges in organizational contexts with rigid hierarchies, while Buresh highlights difficulties in aligning Agile with customer satisfaction in service-based SMEs (Buresh, 2008; Taylor, 2016). In contrast, Agbejule & Lehtineva reported improved cross-functional collaboration and faster decision-making in SMEs that adopted Agile after restructuring project workflows. (Agbejule & Lehtineva, 2022) . These contrasting outcomes raise questions about the general assumption that Agile adoption is inherently beneficial across all SME settings.

This study aims to bridge the gap by investigating the implementation of Agile across SMEs in multiple sectors, utilizing a literature-driven, survey-driven, and multi-method framework to help answer the research questions and objectives. Specifically, it draws on validated evidence from literature and uses a machine learning model framework to evaluate

Agile's effectiveness and determine whether its benefits outweigh its limitations in SME environments.

1.2 Research Questions

1. What is the effect of the adoption of Agile project management on SMEs? Is it always a positive move?
2. What are the success factors and barriers that influence Agile performance across several industries?
3. What model can help SMEs appraise the success or failure of Agile implementation and potential Return on Investment?
4. In terms of project outcomes on SMEs, what is the comparison between Agile and traditional project management approaches?

1.3 Theoretical Framing

This research is based on the following theory and framework:

- **Agile Suitability Frameworks**: These emphasize how organizational readiness, culture, project type, and project performance influence Agile success (Taylor, 2016).
- **Contingency Theory**: Which argues that there is no one-size-fits-all approach in project management; the effectiveness of a method depends on its fit with organizational and environmental variables (Agbejule & Lehtineva, 2022; Reams, 2023).
- **SciKit Learn**: This is a free, Pythoon-based Machine Learning framework written with programming languages like python. It can use its libraries functionalities like Matplotlib, Numpy, SciPy etc. to performing analytics on datasets, and files (ProjectPro, 2025).

1.4 Research Objectives

This study aims to:

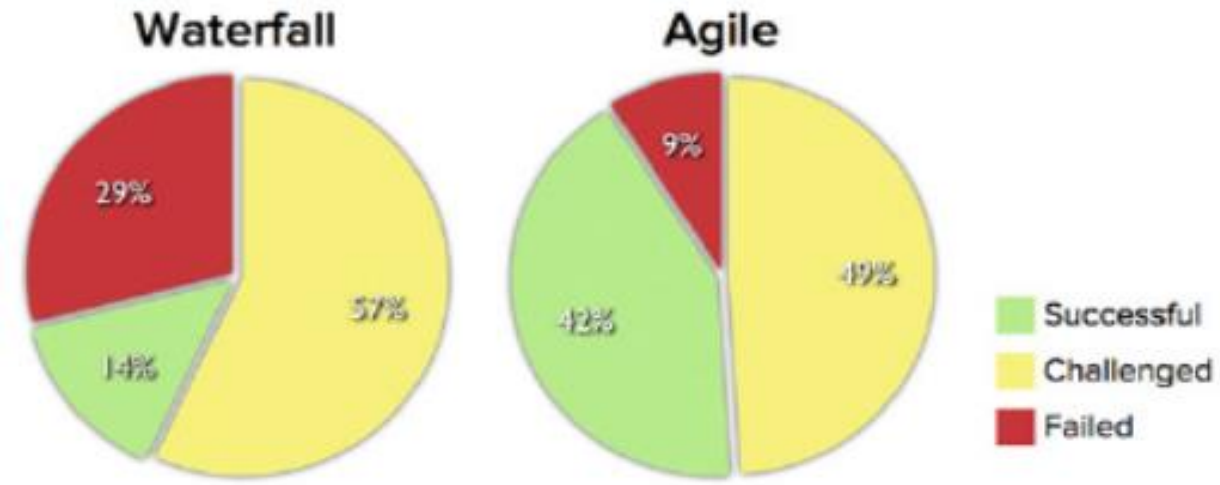
- Examine Agile's sector-specific effectiveness in SME environments.
- Identify critical enablers and inhibitors of Agile success.
- Quantify performance improvements (or regressions) using project success metrics drawn from the literature.
- Develop an evidence-based Machine Learning framework to guide SMEs considering Agile transformation (**HITMEA Model**- Healthcare, Information Technology, Telecommunication, Media & Entertainment, Energy, Agriculture, Aerospace).

1.5 Conceptual Framework & Narrative

Historically, there have been a lot of research done in the field of Agile project management and Traditional project management. However, these studies have been skewed towards Agile implementation in the Healthcare, software or IT industry alone, with some mixed results of success and failures (Totten, 2017). Organizations outside of IT, software and Healthcare are eager to transition from the traditional PM methods and embrace Agility, but would they always achieve success? This is evidenced by the research performed by the CHAOS Manifesto report of 2012 from the Standish Group that documented Agile projects are successful three times more often than non-Agile projects.

Figure 1

The CHAOS Manifesto of the Standish Group

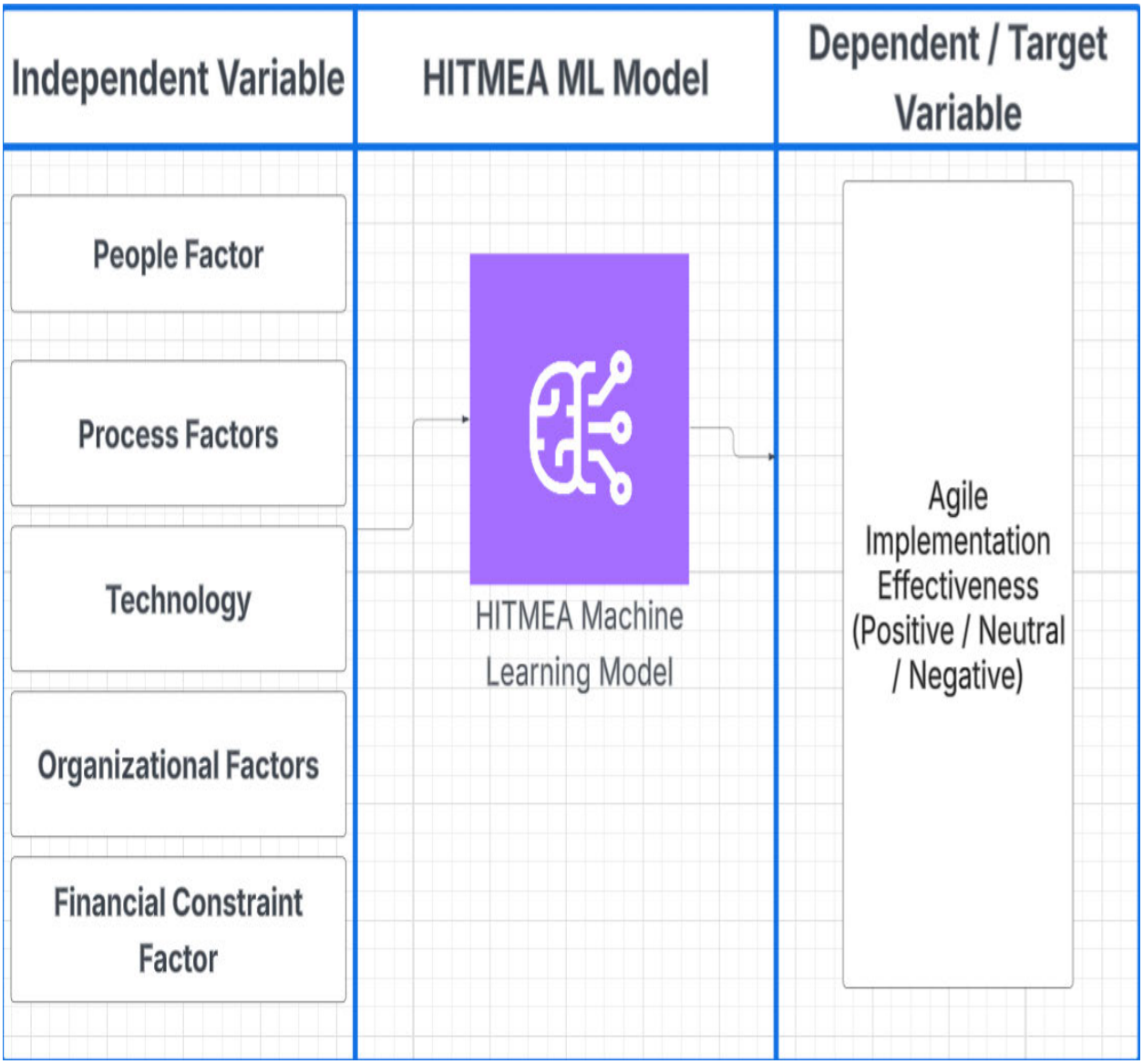


Note: The image was obtained from (Carilli, James F., 2013). The figure showed that of all the respondents interviewed, 29% revealed that while 29% of the time, projects did not meet intended success criteria, Agile performed better as only 9% of the time did it fail to meet success acceptance criteria. But this work serves as an early indicator that Agile projects are not always successful as failure occurred 9% of the time, Neutral sentiment was experienced 49% of the time, while success occurred only 42% of the time.

Furthermore, to answer the key research question, the author of this work has developed a Conceptual framework that leverages upon lessons learned from past research and the proven technology like Machine learning to perform this study. The aim is to review all previous studies on Agile and Traditional project management adoption across all industries (Healthcare, IT, Manufacturing, Energy, Aerospace, Agriculture, others etc.). This framework is called the HITMEA framework, coined in line with the industries covered. It is shown in the figure 1 below.

Figure 2

Conceptual Framework



Note: The image above was designed by the author. The model shows dependent variables needed to achieve success in Agile adoption as **People**, **Process**, **Technology**, **Organizational,** and **Financial** factors. These selected factors will be further developed after literature review in section 2 is completed, so as to generate more sub-features from literature review lessons learned. The selected independent variables for this research was obtained after the review of work done by (Chow & Cao, 2008) who used multiple regression technique for their study.

Chow & Cao identified success factors as Quality, Scope, Cost, Timing, use of rigorous Agile software and tools, and the selection of high calibre team. Similarly, (Stankovic et al., 2013) performed a study of critical success factors in agile software projects in former Yugoslavia IT companies, and determined that Project definition process, the nature of the project, Project schedule, were some of the success factors. These success factors have now been grouped into the five headings in figure 1.

People are responsible for the execution of projects, hence they are critical to Agile project execution, especially if individuals need to respond to changes from customers regarding features of project product being developed. How they behave can provide an indication on the target project outcome.

Process factors which defines the Agile methodology for the organization need to be clearly defined and understood by employees. This will ensure that the process works well for the organizations good.

Technology here refers to the tools and infrastructure that needs to be used by SMEs to achieve success in Agile project execution. A cost effective and technically adaptive tools will be best to achieve project success.

Organizational factors and Financial constraints are also key features that can help to predict a project success. Hence they are useful features for the conceptual framework and model.

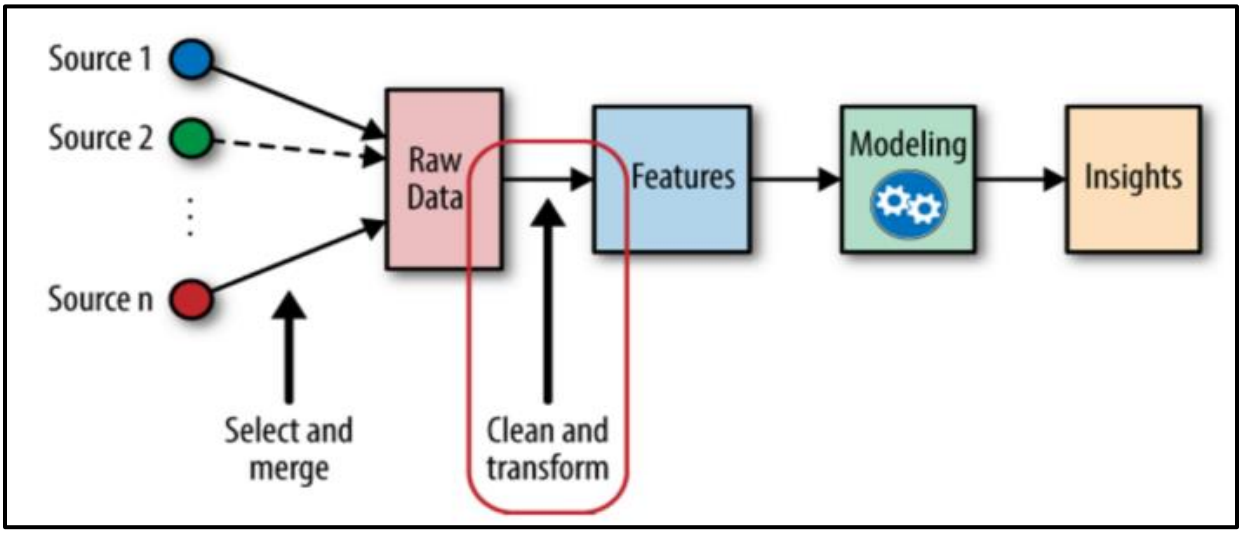
With the preliminary establishment of research framework, we can dive deep into the review of literature articles and further develop the framework. Insights on additional success factors will be determined, and this will be used to perform the Model development, training and deployment.

1.6 Method Overview

Several databases, such as Scopus, IEEE Xplore, SpringerLink, Kaggle, Google scholar, and Dimensions database were used to access the study documents. Subsequently, Zotero app was used to extract Meta data, generate automatic Bibliographic referencing and citations, and to generate *ris file*. etc. Manual review of the articles was performed as well as automatic review using the ris file to generate insights. The Covidence app was used to generate PRISMA report. Google Colab was used as a Digital Cloud computing tool for performing most of the research Modelling work, and data analysis. The figure below shows the method that will be used to generate the literature review insights:

Figure 3

Methods Overview



Note: Sources 1 (*Literature review ris file*), Source 2 (Data analysis file from Kaggle site) Source 3 (Data source from synthetic analysis) (Zheng & Casari, 2018). Raw data includes CSV files, ris files, excel files, and PDF files. After raw data is obtained, it is cleaned and transformed into useful data to allow for easy analysis. Feature engineering involves creating more relationships

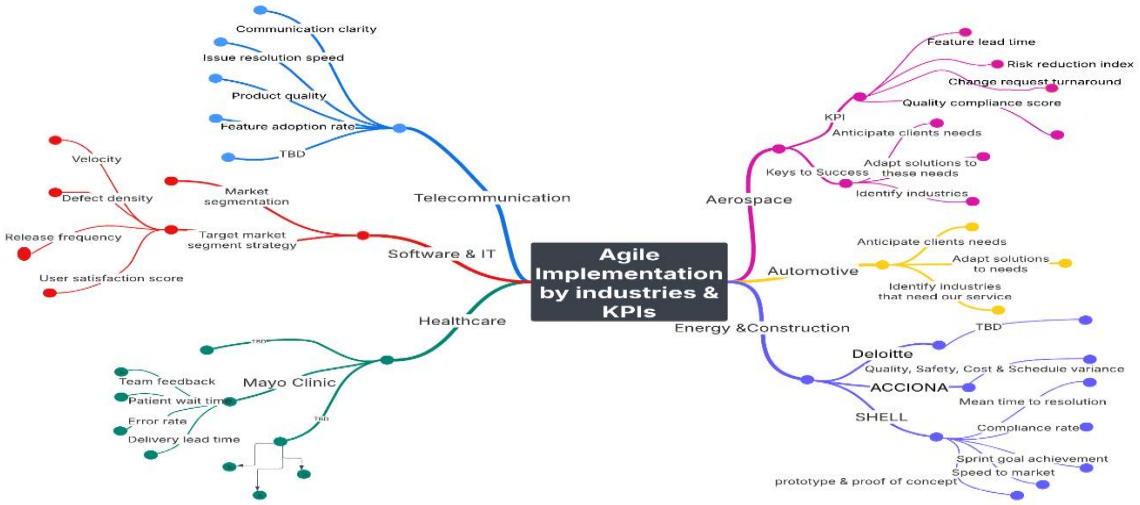
from the available variables that can help with generating new insights. Model is the algorithm that has been selected to help do this research (Random Forest, Logistic Regression, Gradient Boosting, Decision Tree).

2.0 Literature Review

The literature on Agile transformation in SMEs reveals a dynamic and evolving landscape, characterized by both widespread enthusiasm and sector-specific constraints. This review synthesizes findings from over 240 articles as shown in the Covidence report below.

Figure 4

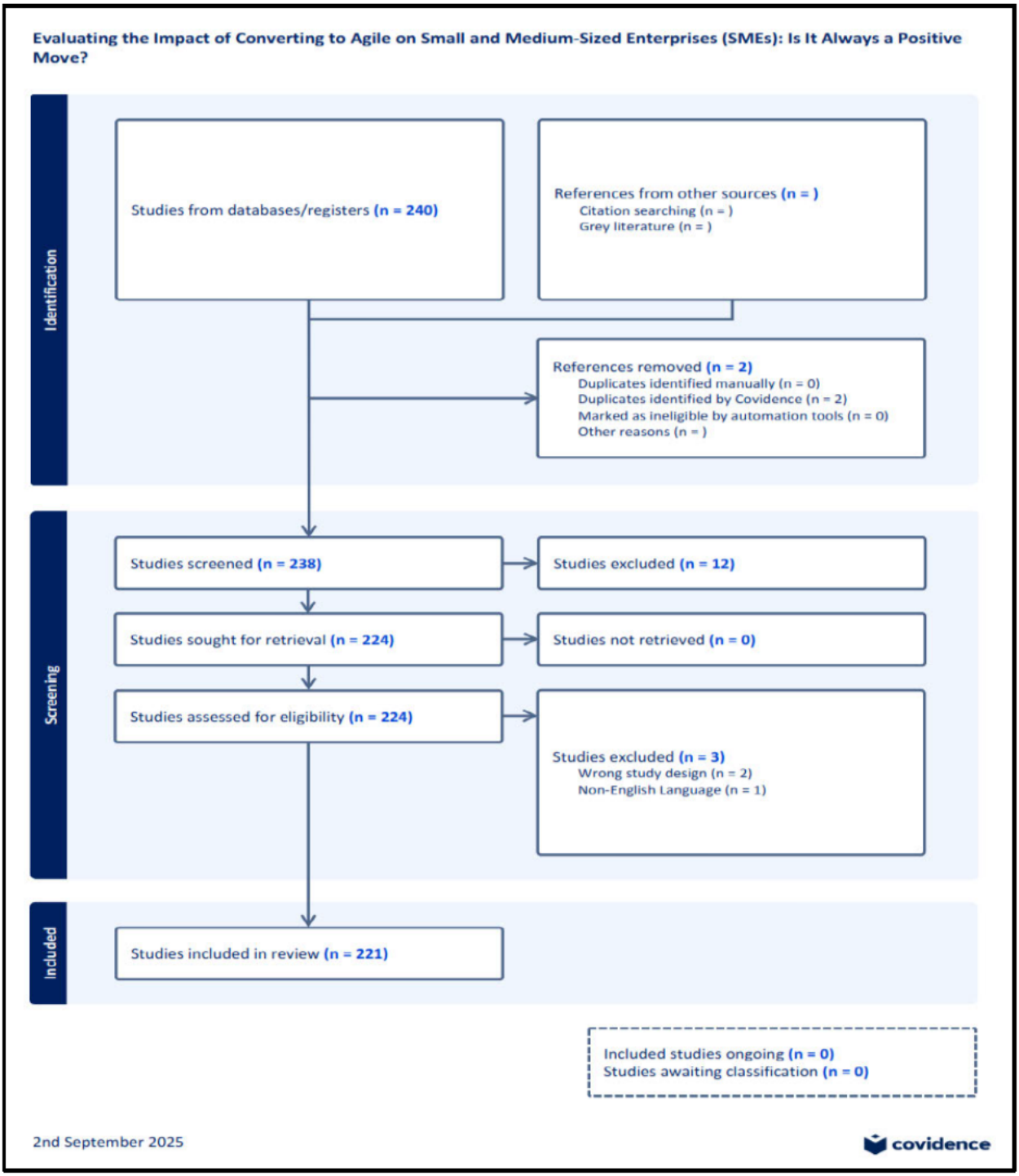
Mind map showing industry sector research strategy



Note: The mind map image above is descriptive alone but was generated by the author using Lucid Chart. This demonstrates the logic that supports the research literature review. The intention was to expand the body of knowledge by searching for KPIs and success factors across several industries. Several articles were retrieved, and reviewed across Healthcare, IT, Manufacturing, Energy, Aerospace, and other industries, as shown in the image. Also, comparative analysis insights was performed across the industries in this report.

Figure 5

Prisma Report from Covidence

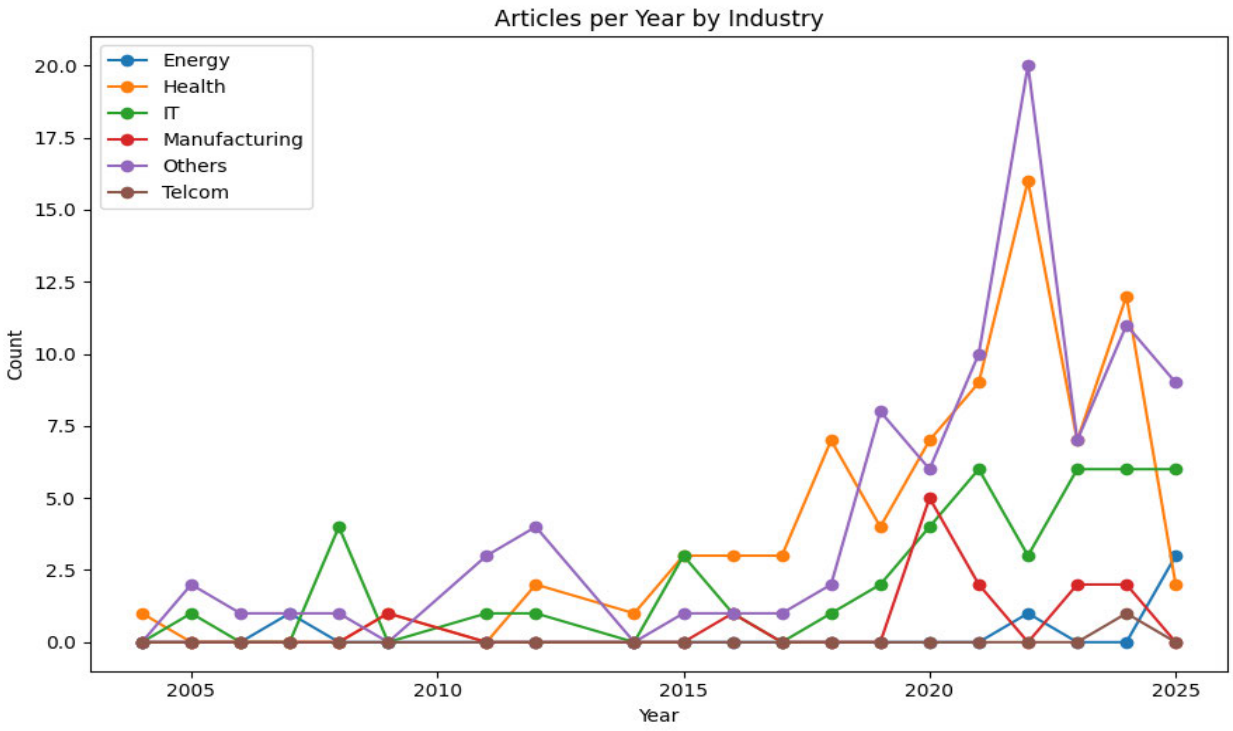


Note: The above image was generated by the author. About 240 articles where used for this research. These articles, in the form of PDF files, were downloaded from several databases (Web of Science, Scopus, Kaggle, Google Scholor, and Dimensions database). Afterwards, they were uploaded unto Zotero app for easy reference and review of the articles. Subsequently, an ris file was extracted using Zotero app. The extracted ris file was eventually uploaded unto Covidence app for use in generating the Covidence report.

2.1 Agile Adoption Success Factors

Figure 6

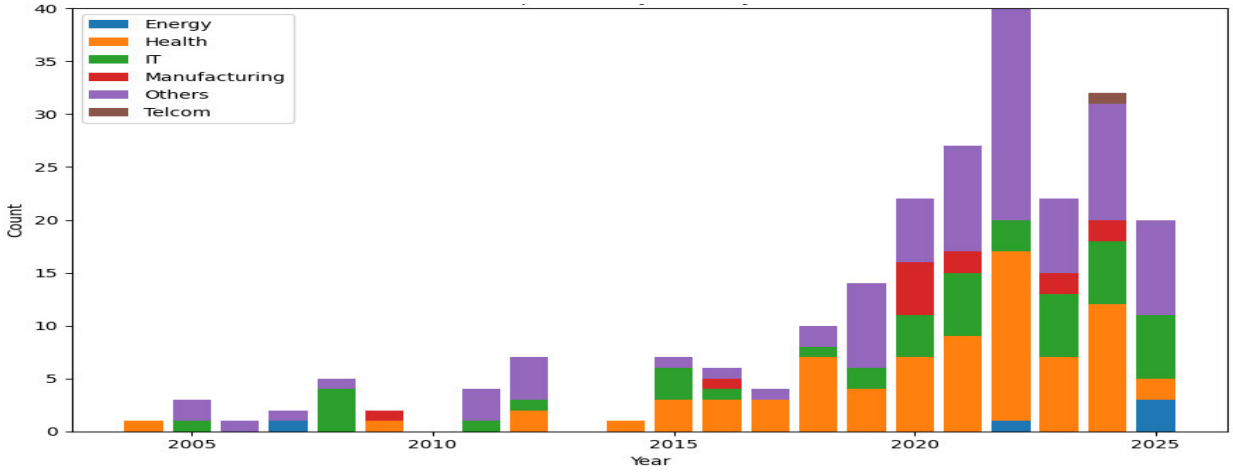
Articles per year by Industry



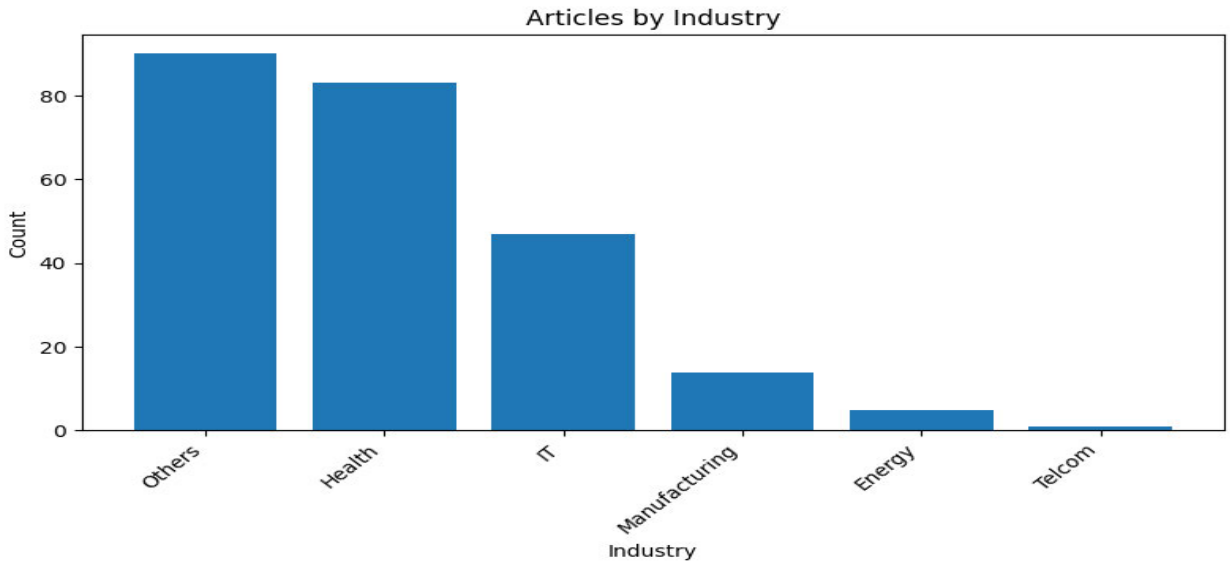
Note: The image above shows the time trend single line drawing of the literature reviewed. The spike from 2020 to 2025 indicates that the research focused on the most resent articles.

Figure 7

Articles per year by industry



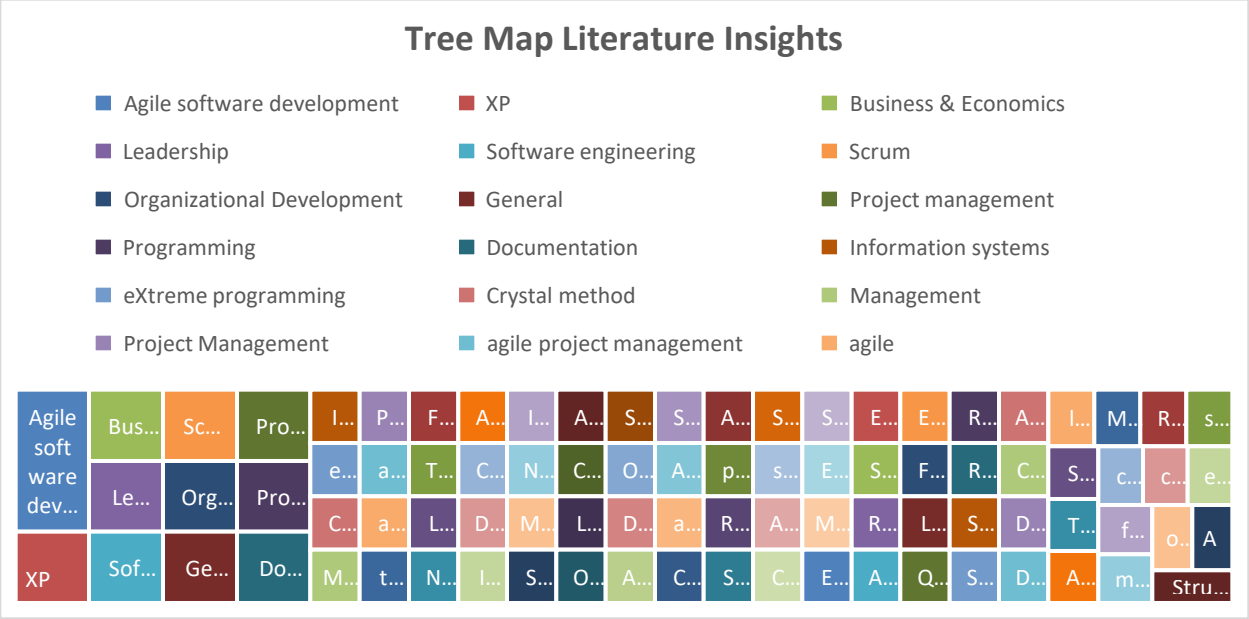
Note: The image above was generated by the author and shows database used in this research. The image shows that most of the articles reviewed were recent and relevant. A lot of the articles were in the Health (Orange, IT and combined b0x of Others industries)



Note: The image above is a vertical Bar Chart that summarizes the articles used by industry research. This was generated by uploading the ris file of the literature articles unto Colab notebook and then running python codes to generate thematic insights. The **Others** column includes

industries like Aerospace and defense, Automotive, General multi-sector, Construction, Agriculture etc., but they were grouped together to allow for good visualization. This means, most of the research documents where from Health, IT, Manufacturing, Energy, Telecom and Others industries. The aim was to expand Agile research studies beyond Healthcare, Software and IT industries alone, as has always been the case historically.

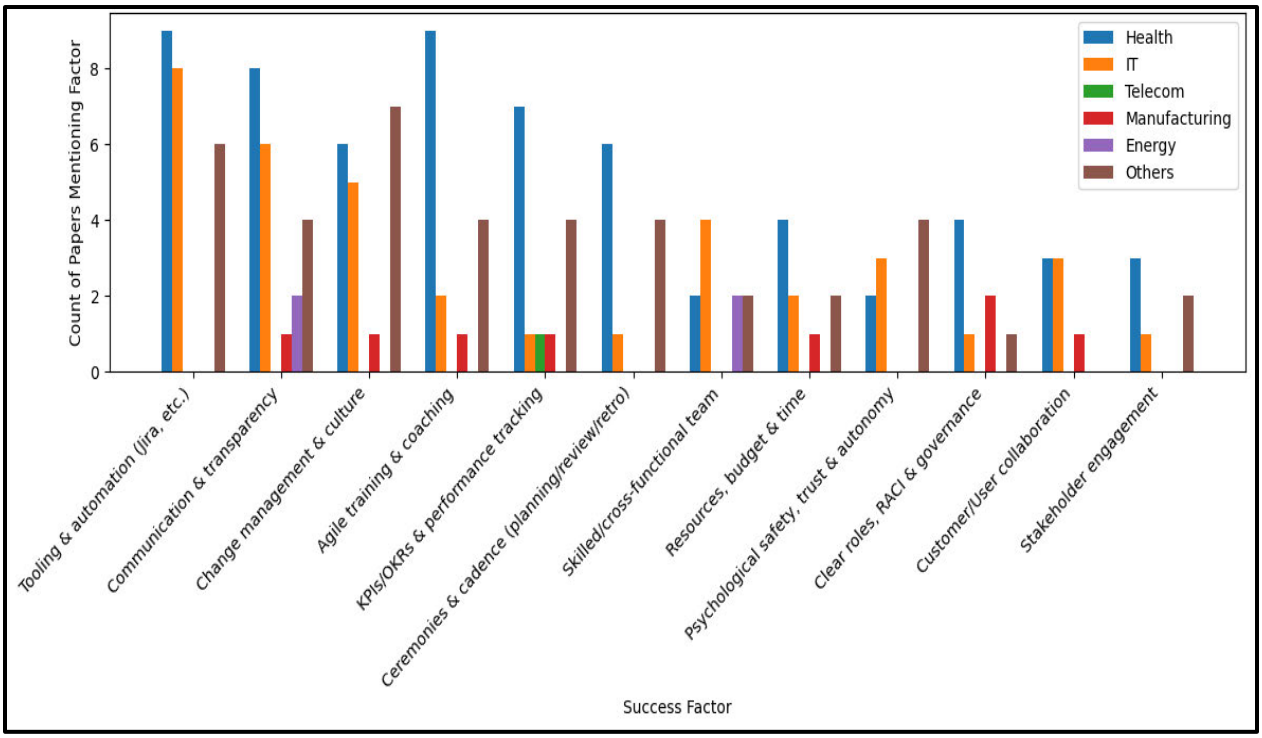
Figure 8



Note: The image above is the Tree map that summarizes the key words from the articles used for this research. This was generated by uploading the ris file of the literature unto Colab notebook and then running python codes to generate thematic insights. There are a rich source of project management mentions and documentations. This adds confidence to our literature source.

Figure 9

Top 12 Success Factors Across Several Industries



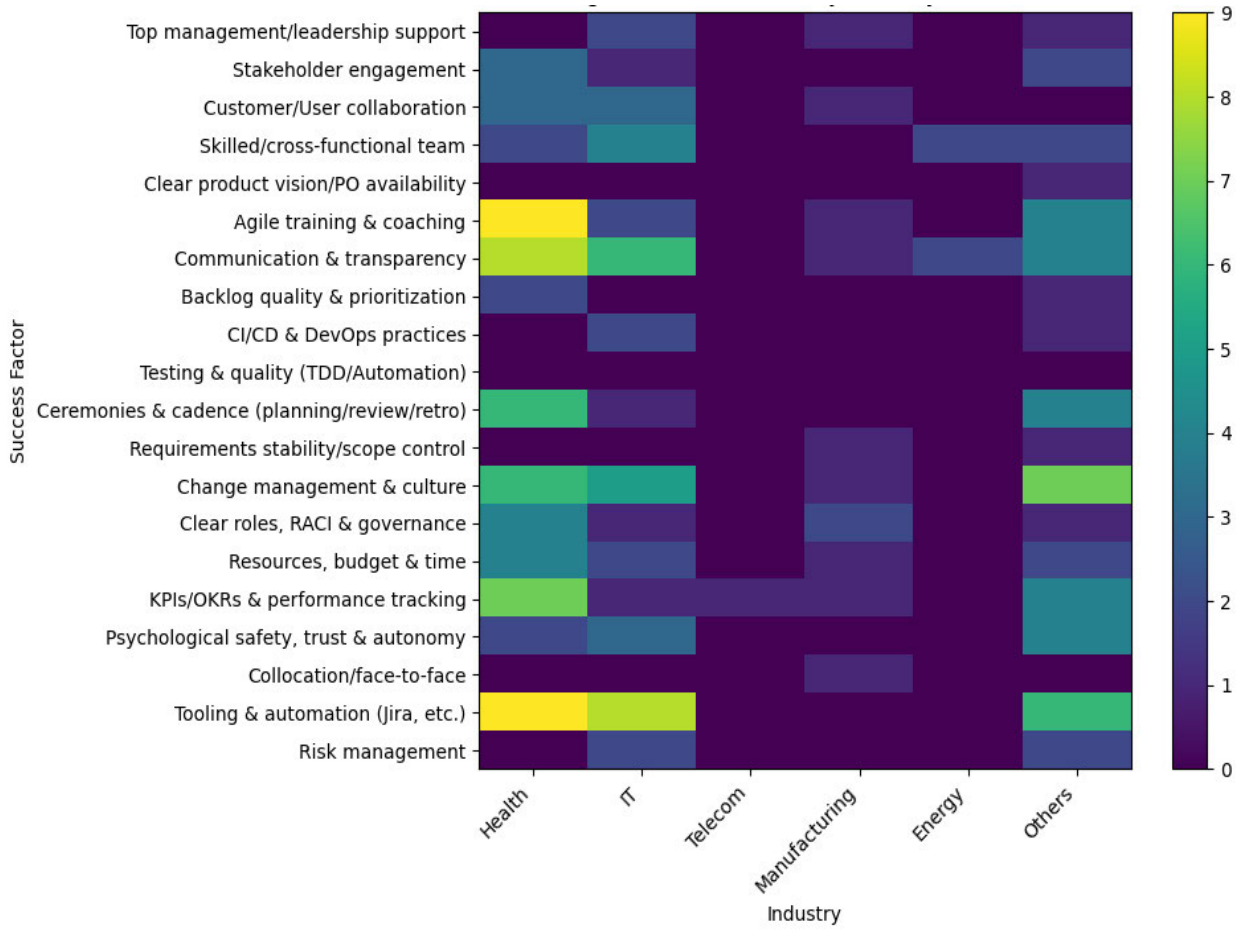
Note: The image above shows the top 12 success factors across several industries that have adopted Agile project management in one way or another. The insight was generated by using ris file and running python code on Colab Notebook. The prompts used was to generate python code that scans through the research documents ris file, classifies each paper into **Health, IT, Telecom, Manufacturing, Energy, Others** (with Others split into **Aerospace & Defense, Automotive, Construction, Agriculture, General multi-sector**), detects **Agile success-factor mentions** (counted **at most once per paper**), builds comparison tables, and generates downloadable **Excel/CSV + PNG** visualizations.

The top twelve success factors that must be managed by organizations to achieve success in their Agile adoption projects are as follows: Using effective Tooling and Communication, Effective communication and Transparency, good Change management & Culture, performing Agile training and coaching, tracking organization KPIs and objectives and key results (OKRs),

Ceremonies and Candence, skilled team, Resource, budget and time, RACI, customer collaboration, and Stakeholder engagement. Healthcare and IT (Blue and Orange bars) continue to show strong performance. Also, there doesn't seem to be a lot of Agile adoption in non-IT industry by the virtue of little literature that exist.

Figure 10

Agile Success Factors by Industry



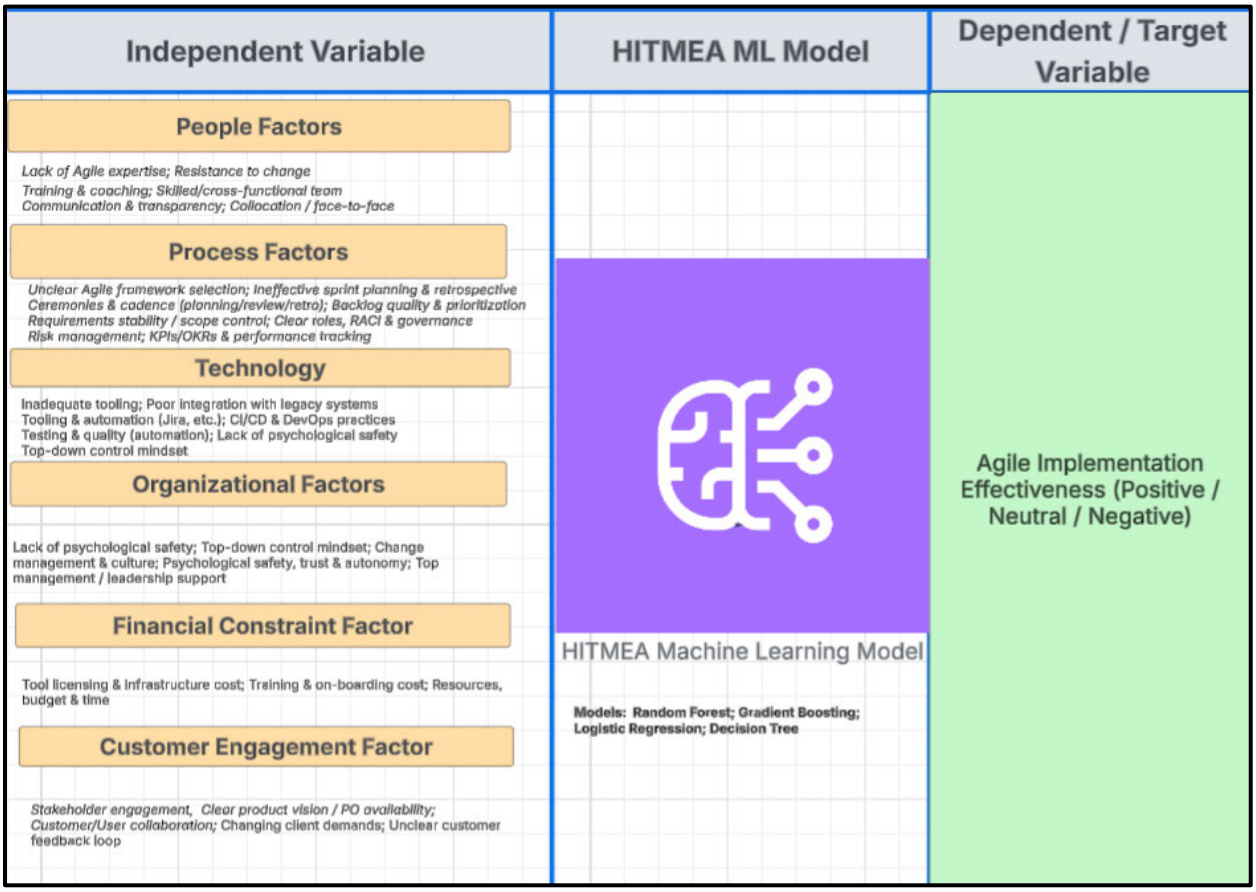
Note: The above image shows more success factors generated from literature review. This chart compares Agile success factors against other industries. Organization can use this chart to guide their decision making, to achieve business growth and success. Yellow is the highest target, and

the health care industry can benefit from increasing their participation in Agile training and coaching, as well as improving the availability of tools for the team.

Upon completion of the literature articles, and generated insights have now been used to update the Framework model as shown in figure 10.

Figure 11

Updated Framework Model



Note: The image above shows an updated Research Framework after the completion of literature review. Here, further sub-factors have been embedded into the framework, as a result of the insights obtained after thematic analysis of the research articles. The factors in the figure 7 as well as other established factors, will be used as input parameters that will predict Agile adoption success or failure (Agile Implementation).

2.2 Theoretical Foundations and Agile Principles

The Agile methodologies emerged from the Agile Manifesto, which emphasizes promoting customer collaboration, iterative development, and responsiveness to change. It was more common in the IT industry. However, since the emergence of frameworks such as Lean, Kanban, Scrum, SAFe, and XP, other non-IT organization are trying to harness the benefits of Agile even in their own Waterfall type of organization. In some situations, they have had to combine the benefits of Agile and Waterfall to for an Hybrid methodology (Dingsoyr et al., 2022; Kent Beck et al., 2025; UniversityOfMinnesota, 2022).

Agile has 12 main principles that help small and medium-sized businesses work more effectively. These include faster delivery of work, more motivated teams, better customer focus, and the ability to adjust plans or budgets more easily. Still, using Agile isn't always simple. It often means that leaders must change how they manage, teams need to work together differently, and the company's processes need to improve.

2.3 How Agile affects SMEs – Key Themes from literature review

The Agile methodology has transformed the way organizations operate, shifting away from traditional methods. SMEs often experience improvements in their delivery speed, flexibility, and team collaboration, but these improvements do not happen automatically immediately after Agile adoption. Success, however, depends on several key factors, as will be revealed in subsequent sections of this report, and are referred to as key success metrics.

There are some emerging patterns which include:

- **High alignment between Agile and IT and software-intensive SMEs** (e.g., Spotify, Omega Software, Redgate) (Do Khoi, 2024).

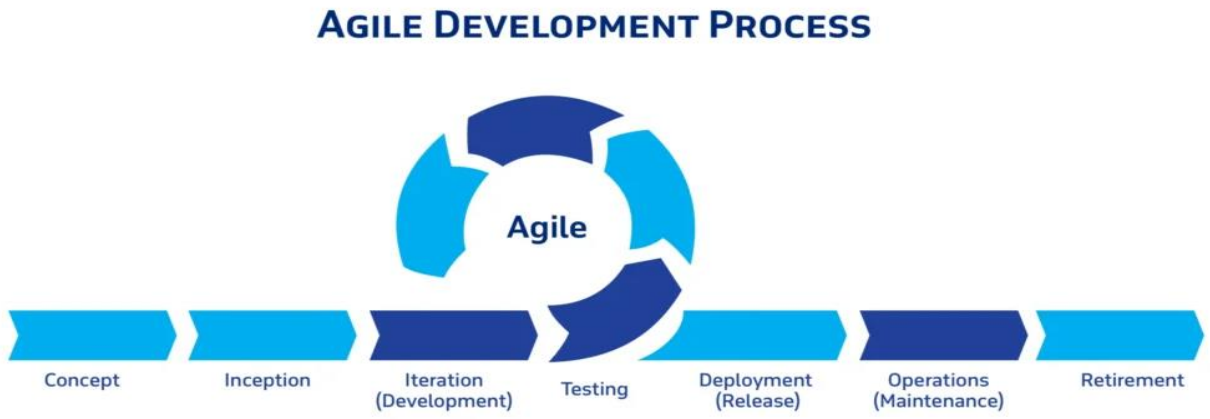
- **Mixed results in sectors with legacy governance or safety constraints** (e.g., healthcare, aerospace, construction).
- **Favorable outcomes when Agile is hybridized with traditional PM methods** (e.g., Toyota, NASA case studies using Lean + Scrum, Agile-Waterfall Hybrid, etc.) (Do Khoi, 2024).

2.4 Agile Development Process

The image below summarizes the Agile development process. This process, if correctly deployed, can lead to great success to establishments. Several factors will contribute to its adoption success or failure.

Figure 12

Agile Development Process



Note: The Image above was retrieved from (Laila Meraj, 2024). The image illustrates the Agile development process, beginning with the concept phase and concluding with the retirement phase. This process is very integral to achieving success in Agile adoption. Every employee in the organization should understand the Conceptualization, Inception, Iteration, Testing, Deployment, Operations and Retirement phases, and what their role is in the overall big picture.

2.4.1 Agile Methodology

The following summarizes the key Agile methodology that helps achieve success if implemented by SMEs: Start with small steps; involve all team members in the process; Give priority to flexibility; Focus on creating value; be simpler; Assess steps taken; Encourage an organizational culture focused on continuous development (saba-khergiani, 2023) (UniversityOfMinnesota, 2022) (Dingsoyr et al., 2022).

2.4.2 Types of Agile Methodology

The following are the types of Agile methodology that may be adopted for implementation by SMEs:

2.4.2. 1 Lean

Muda: Eradicate waste. Remove anything that is not adding value to the customer.

Mura: Eliminate variations. Remove overhead variances and standardize processes.

Muri: Remove overload. Anything above 60%–70% capacity actually slows work down.

2.4.2.2 eXtreme Programming.

This software development methodology shares many similarities with Scrum, particularly with its emphasis on communication and responsiveness.

2.4.2.3 Kanban.

Kanban shares similarities with both **Lean** and **Scrum**. This project management methodology emphasizes efficiency (like Lean) and collaboration (like Scrum). Kanban is much less prescriptive in its approach, allowing for greater flexibility and rate of return on deliverables.

2.3.3 Agile versus Traditional

Table 1

Agile versus Traditional : Triple Contraints Comparaison

Constraint (KPIs)	Traditional (Waterfall)	Agile (Scrum/Kanban/etc.)
Scope	**Fixed** — Defined upfront in detail.	**Flexible** — Evolving requirements; prioritized backlog.
Time	**Flexible** — Schedule may change to meet scope.	**Fixed** — Iterations/sprints are time-boxed (e.g., 2 weeks).
Cost	**Flexible** — Cost can increase to meet scope.	**Fixed or semi-fixed** — Teams operate within set budgets.

Note: Organizations that decide to adopt Agile must understand these constraints to ensure it suits its organization's strategic goals and objective.

The driving force behind Kanban Methodology is to release work both faster and of higher quality continually.

2.5 Barriers and Root Causes of Agile Challenges in SMEs

The figure **14** (Fishbone Diagram) categorizes these challenges into six root causes: People, Process, Technology, Culture, Financial Constraints, and Customer Engagement

2..5.1 Root Causes of Agile Implementation Barriers

Figure **14** (Fishbone Diagram, created by the author) illustrates six major root causes influencing Agile outcomes:

Table 2

Root Cause of Agile PM Transition Failures

Root Cause	Challenge Example
People	Lack of Agile expertise, role confusion, resistance to change
Process	Misaligned framework choice, poor sprint retrospectives
Technology	Legacy systems, inadequate tools (Jira, Trello), lack of CI/CD integration

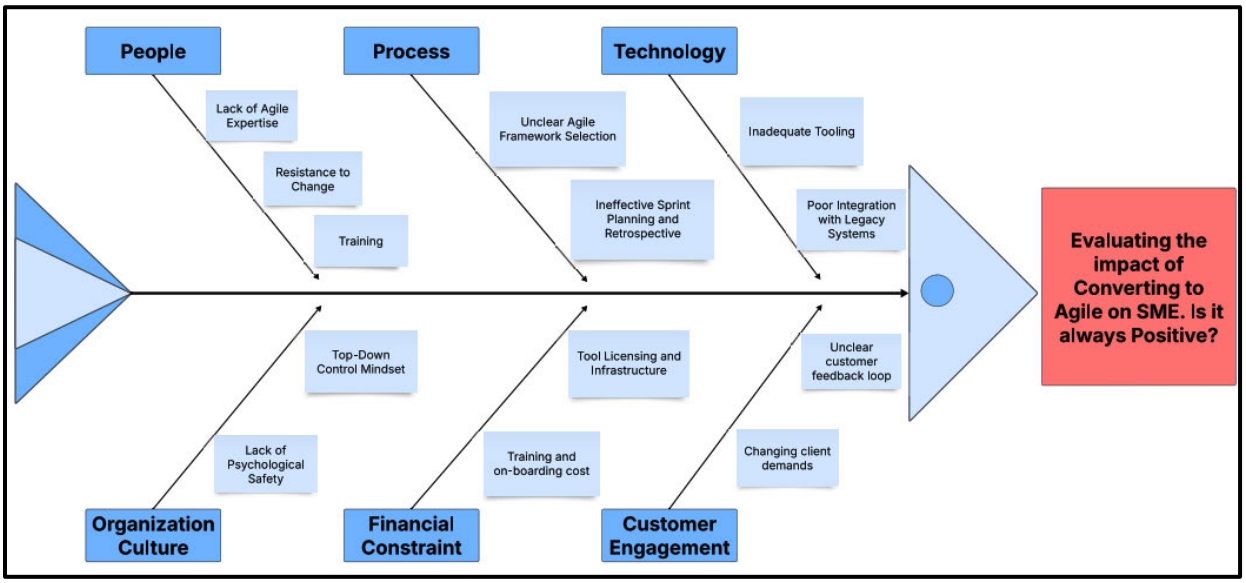
Culture	Top-down hierarchy, lack of psychological safety
Financial Constraints	Training costs, tool licensing, infrastructure limitations
Customer Engagement	Weak feedback loops, misunderstanding of Agile delivery models

Note: Sources:; (Chodipilli, 2022) (Troise et al., 2022) (Mishra et al., 2021)

Root Cause Analysis / Fishbone Diagram

Figure 13

Fishbone Diagram Showing the Root cause diagram evaluating the challenges of Converting to Agile on SMEs



Note: The Image above was generated using Lucid Chart by the author.

This Fishbone (Ishikawa) Diagram identifies **six key root cause categories** that influence whether the Agile transition leads to positive or negative outcomes for SMEs (Meraj, 2024) (Mishra et al., 2021). The root cause includes People (customer engagement), Process (project complexity), Technology (need for technological integration), Organizational culture, and Financial constraints (cost overruns, delays) (Chow & Cao, 2008).

People factor can affect Agile project adoption, because individuals are responsible for project execution. If they lack expertise in Agile project management, they will need to be

trained so that they can help the project achieve success. Also, people are usually resistant to change, which is the main ingredient of successful Agile implementation. Hence, there should be a good change management system in SMEs to help overcome the challenge of employees being resistant to changes that is needed to help the business achieve its strategic objective (AWSAmazonRDS, 2025) (Amazon Web Services, 2023) (AWSBilling&Cost, 2025) (AWSElasticBeanstalk, 2025).

Customer engagement is at the heart of Agile implementation success. Organizations must establish a good stakeholder management register and use it to categorize stakeholders in the order of the Power and Influence upon the organization. The stakeholder register will document what level attention should be given to all stakeholders, for example, weekly communication to a client. This strategy will ensure that customers and other key stakeholders are properly informed on project activities, allowing them to proffer useful feedback early in the project life cycle.

Process such as the Agile Framework need to be well defined and established in the organization. The process will establish clear guidance for project implantation that follows Agile methods such as Backlog planning, Sprint planning, Retrospectives etc. SMEs must continually improve their process for improvement and efficiency.

Technology includes the technical tools that is available in the organization to support Agile implementation. Organizations need to improve on their tools so as to remain efficient and competitive in project delivery. Some of the tools could be the use of software's like Jira for software development, Asana for collaborative task management Trello for its Kanban visualization style etc. These tools should have the capability to work with Heritage existing systems allowing for easy transitioning.

Organizational culture affects Agile implementation success. A good culture that supports Agile implementation is one that supports open communication, empowerment of employees through self organizing team, customer focus, transparency, and psychological safety etc. Organizations implementing Agile should improve upon these factors in order to see positive results.

Cost is also another factor that must be managed to help organization achieve success in Agile adoption. These costs could include training cost, and infrastructure costs. The organizations can now leverage on AWS cloud computing services and benefit from lower costs provided from AWS leveraging on economies of scale. Other cloud computing service providers like Azure can also be leverage upon to reduce physical on-premises setup. These could computing organizations allows SMES to scale up or scale down their licensing and computing tools needs, and they pay only for services used. Also, Organizations can reduce training costs by using the concept of "Train the trainer", whereby few individuals within the organization are trained by external third-party contractor, and after the training, the trained employee trains others within the organization. This will drive down cost tremendously, especially for SMEs.

2.6 Change Management in Agile Transition

Many organizations struggle with change management within their organization. This is because traditional methods of making changes don't easily allow for adjustments to be made as needed. This is particularly true for larger organizations that are trying to transition from Traditional to Agile because they will require more coordination to achieve success. Agile performance appraisals have shown that change management in Agile is typically very successful in small teams, as Agile was initially designed for small software teams. However, transitioning Agile into medium-sized and larger teams usually introduces more challenges. The ability to handle inter-team coordination, interface with other organizational units, and manage stakeholders

is critical to success. Furthermore, employees and individuals in general are always resistant to change at the beginning, but when they are convinced that the benefits outweigh the risks, they then begin to accept change. Agile methods have been both criticized and advocated for, and various literature research has shown that accommodating change may be a factor in both success and failure (Dikert et al., 2016) (Boehm & Turner, 2005) (Chow & Cao, 2008) (Dybå & Dingsøyr, 2008) (Fry & Greene, 2007) (Koehnemann & Coats, 2009).

Table 3

ADKAR × Change Management Activities — Matrix (v2)

Change management activities	**A**	**D**	**K**	**A**	**R**
Communications	●				
Sponsorship	●				●
Coaching		●	●	●	●
Resistance management		●		●	
Training			●	●	

Note: Legend: A = Awareness, D = Desire, K = Knowledge, A = Ability, R = Reinforcement.

(Hiatt, 2006). For a change to happen in an individual within an organization, Communication must happen first and that leads to **A**wareness by the individual. The change must be communicated. Also, most changes come in the form of a project that must be authorized by a project sponsor. Also, the employee must Desire change or accept the change before it can happen. Furthermore, Knowledge is required for change to happen within an organization, hence, Training are required to drive change within an organization. The employee **A**bility increases after they are trained, making them skilled and competent to implement change. Finally, **R**einforcement focuses on continuous improvement by the entire organization.

2.6.1 Reasons for change management in Agile

The key reason why organizations undergo change is due to influence from within and external to the organization. The factors include: Demand for faster delivery to customers; Change in requirements as stakeholders may require an update to the features in the produced deliverable or minimum viable product; The need for an upgrade to an existing Heritage system may require organizations to undertake new projects that will build and deliver new systems, which will in turn lead to new operational and maintenance procedures for operating and managing the new system; Coordinate medium to large, multi-team programs because at scale, organizations move to Agile to synchronize many teams and interface better with non-dev functions (Koutsikouri et al., 2020)

2.6.2 How employees cope with change in Agile

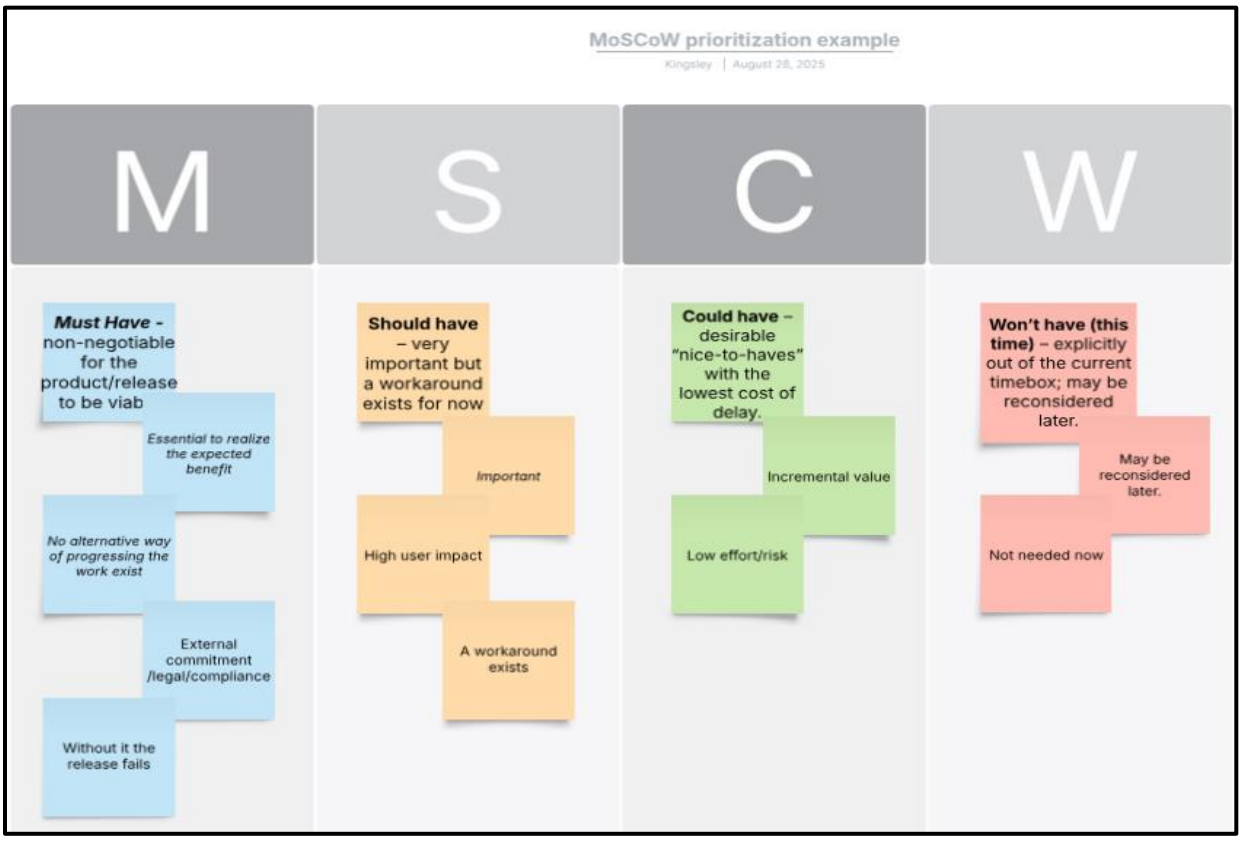
Employees cope with change by changing their behavior as follows: They try to make sense of the new system; They practice with peers to understand the new system; They eventually let go of the old legacy system and embrace the new system.

2.6.3 MoSCoW for Change Prioritization and Management

This Model helps organizations to prioritize their project tasks that drives organizations strategic change.

Figure 14

Summary of the MoSCoW Technique_ Supports change management Prioritization of Product backlog and Sprint backlog



Note: The image was generated by the author using Lucidspark and review of the work by (Franklin, 2021). It prioritizes project tasks and activities into Must Have, Should Have, Could Have, and Wont Have with the Must Haves as top priority tasks and the wont have as least priority tasks (Laila Meraj, 2024).

2.6.4 The ADKAR Model for Change Management in Agile Project Management

This Model ensures that Individual or employees overcomes barriers to change and achieves adoption for introduced change.

Figure 15

ADKAR model for Agile Change Management

Note: The image above was created by the author using Lucidchart, and it demonstrates change management in Agile project management (K. N. Tang, 2019) (Paramitha & Suroso, 2020).

It represents the essential element of change for a single individual. This model can also be used for a group of individuals within an organization as a coaching tool to support employees through an organizational change process. It guides change management activities, such as communication, sponsorship, coaching, and training, and helps diagnose non-performing changes by conducting an ADKAR assessment. Each component of the ADKAR model plays a part in ensuring the successful implementation of change within an organization. For example, if **A**wareness and **D**esire are low among the employees of an organization implementing an Agile transition, there will be a high likelihood of project failure. Similarly, in the absence of **K**nowledge and **A**bility, there is a significant tendency to experience lower utilization of new processes or systems, leading to the failure of the project product or low productivity within the organization. In the absence of Reinforcement, individuals will most likely forget the new process and revert to old ways, thereby negating all the benefits of the latest changes introduced in the organization. (Hiatt, 2006).

2.7 Summarized Agile Project Success Metrics vs. Industry

Success was evaluated using both traditional KPIs (time, cost, scope) and Agile-specific performance indicators. Below is a cross-sector mapping of the most frequently cited Agile success metrics:

Table 4

Agile Project Success Metrics by Industry: Critical Enablers and Inhibitors of Agile Success.

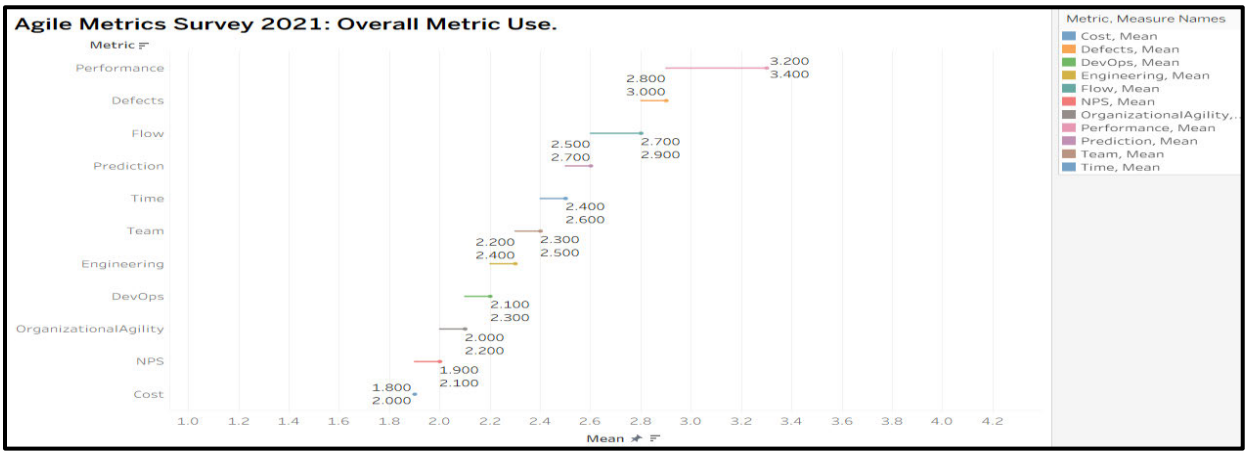
Industry	Most Reported Success Metrics
Software/IT	Delivery speed, team collaboration, customer satisfaction, iteration frequency
Healthcare	Cross-team collaboration, iterative feedback, regulatory adaptability
Energy	Time-to-market, waste reduction, cost efficiency, sustainability metrics
Construction	On-time delivery, stakeholder alignment, risk management
Telecom	Communication clarity, issue resolution speed, product quality
Retail	Inventory turnover, forecast accuracy, lead time reduction
Finance	Customer satisfaction, sprint predictability, compliance readiness
	Mission adaptability, safety adherence, milestone control
Agriculture	Innovation rate, deployment time, field test accuracy
Media & Entertainment	Creative autonomy, release frequency, user retention

Note: Source of metrics, as shown in the table, was auto-generated from Python code and Colab notebook thematic analysis of over 240 literature review articles (Do Khoi, 2024) (Troise et al., 2022) (Chow & Cao, 2008) (Mc Donnell et al., 2024) (Mohr & Bourne, 2004) (Mukhi et al., 2023) (Robu et al., 2020) (Salmani et al., 2022) (T. Tang et al., 2018) (Thiyagarajan et al., 2024) (Wilson et al., 2018) (Brunet et al., 2021) (Wilson et al., 2018) (Dube et al., 2020) (Dubuc et al., 2021) (Amin Hakim, 2019) (Mukhi et al., 2023) (Liu et al., 2022) (Marelli et al., 2024) (Desai et al., 2024) (Improta et al., 2020) (Alotaibi & Almudhi, 2023) (Boustani et al., 2019) (Md Kazi Sahab

Uddin et al., 2024) (Majd & Majd, 2023) (Kokol, 2022) (Tanniru et al., 2021) (Ahmad & Wasim, 2023) (Pool, E. T., et al., 2019)

Figure 16

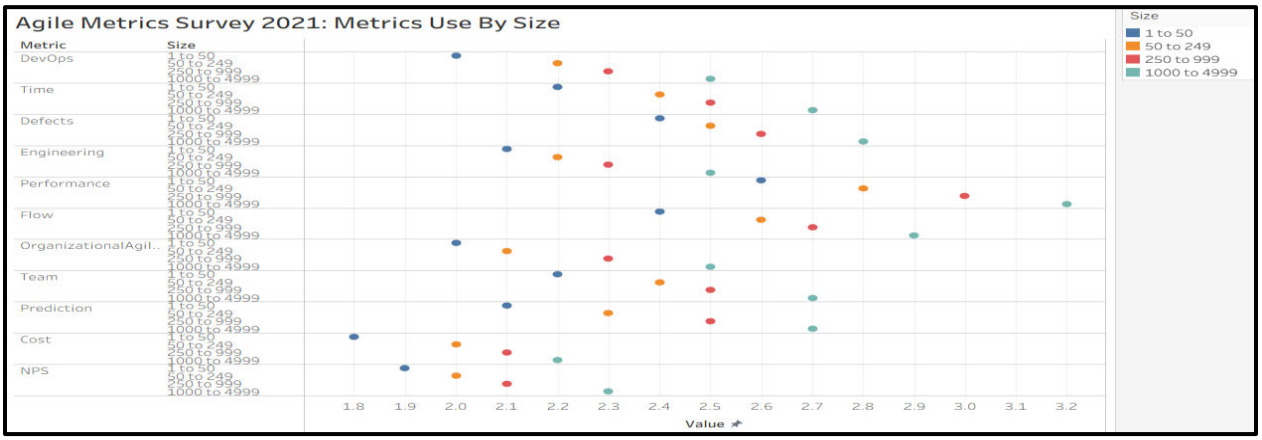
Agile Metric Survey 2021: Overall Metric Use



Note: The chart above was created by the author using literature survey dataset from Agile metric survey 2021 accessed from (Wolpers, 2021). This image provides additional metrics that can influence project success following Agile adoption. The key factors here are Cost, Defects, Time, Team, Organizational Agility, DevOps etc.

Figure 17

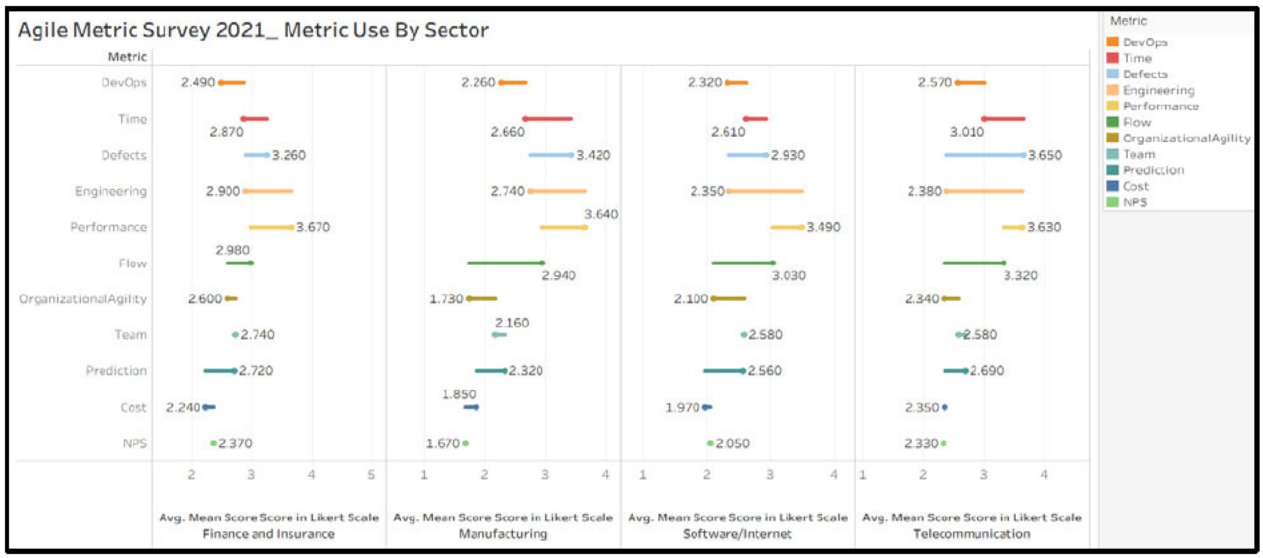
Metric use by size



Note: The chart above was created by the author using literature survey dataset from Agile metric survey 2021 accessed from (Wolpers, 2021). The left-hand side shows additional metric that drive organizations performance. The company size provides insights for SMEs, whose key metrics for success includes minimizing defects in manufacturing, Time or duration management, cost management, Team work etc.

Figure 18

Agile Metric Survey 2021_ Metric Use By Sector



Note: The chart above was created by the author using literature survey dataset from Agile metric survey 2021 accessed from (Wolpers, 2021)

Table 5

Key Performance Indicators metrics across several industries (General)_ critical enablers and inhibitors of Agile success.

Industry	**Summarized KPIs & Mentions from Literature Review**		
General :	Return on investment (ROI)	Reduce project cost	Adaptation,
(Health, IT,	Time-to-Market	Better managed	Integration,
Manufacturing,	Productivity	teams	Completion,

Media & Entertainment, Energy, Aerospace, Agriculture)	Stakeholder Satisfaction Risk Mitigation Velocity Self-organized teams Communication Team flexibility Team expertise eam experience Customer involvement Change management process Increase productivity Improved project visibility Agile oriented management process. Accelerate project/product delivery Enhanced ability to manage changing priorities Enhanced project/product quality Enhanced delivery predictability Enhanced client relationship Better focus on client	Improved team morale Customer and team integration Delivery frequency Customer validation Decision time Project plan updating time Implementation Information Quality Cost Collaboration Innovation Strategies Performance Education Adoption Value Agility implication Impact Applications	Sustainability Organizational Culture, Strategy, Satisfaction, Availability, Expectations Delivery speed, Sprint Velocity Throughput Minimum viable product (MVP) DevOps Defects, Employee Engagement Operational Performance Flow Organizational Agility Team Prediction

	Reduce project risk	Productivity	Net Promoter Score (NPS)

Note: The summarized list in the table was extracted from over 200 literature reviewed articles across several industries (Benjamin & Potts, 2018) (Gawdyda et al., 2023) (Giordanengo et al., 2018) (Holden et al., 2021) (Louis Babineau & Lily Lessard, 2015) (Bartlett et al., 2023) (Brunet et al., 2021) (Dotsenko et al., 2023) (Dudgeon et al., 2012) (Duffy et al., 2022) (Goodison Rav et al., 2019) (Amin Hakim, 2019) (Hardy et al., 2024) (Ho et al., 2012) (Khan et al., 2024) (Lakhani et al., 2020) (Lavoie-Tremblay et al., 2017) (Loudon, 2012) (Nagle Lynn M., 2016) (Copola Azenha et al., 2021) (Nyman & Öörni, 2023) (Žužek et al., 2020) (Jalali Sohi et al., 2021) (Sassa et al., 2023) (Timinger et al., 2024) (Marnewick & Marnewick, 2023) (Bogumił, 2020) (Ciric et al., 2019) (Famoti et al., 2025) (Do Khoi, 2024)

2.8 Gaps in Literature and Research Contribution

Key gaps identified includes the following:

- Lack of unified KPI frameworks for non-software industries adopting Agile
- Limited studies on Agile's failure in SMEs especially in non-IT industries
- No recognized SME specific Agile readiness model integrating size, industry, culture, maturity, and can predict success or failure of Agile adoption

This study has addressed the identified gaps by generating a comprehensive list of KPIs that can be used to predict Agile adoption evaluation across several industries. Additionally, this research yielded further findings on Agile performance appraisal across multidisciplinary sectors. Change management has been explained and shown to have a significant impact on an organization's ability to drive organizational change and successful Agile adoption. Finally, the research developed the HITMEA Framework of Agile Prediction, utilizing four predictive models that leverage the principles of Decision Tree, Logistic Regression, Random Forest, and Gradient

Boosting Machine Learning Models for predicting Agile Adoption. The **HITMEA Framework** is a heuristic for evaluating the suitability of Agile methodologies in the Healthcare, IT, Telecom, Media, Energy, Agriculture, and Aerospace industries.

3.0 Methodology

3.1 Research Design

This study will build upon the framework defined in section 1.5 and examines the effects of organizations' transition to agile from traditional project management methodology and performs a review and appraisal of the transition outcomes. Several industries were considered for this review, including the following key industry sectors: technology, finance, healthcare, retail, manufacturing, construction, energy, education, government, and automotive. In this research, machine learning classification algorithms were employed to train models, which were subsequently evaluated and utilized to predict project outcomes and identify patterns in the effectiveness of agile methodologies across various industrial contexts.

The experimental design uses machine learning models to analyze project data and classify success patterns, treating industry sector, agile methodology implementation, and various project characteristics as predictor variables. The classification target represents project success outcomes.

3.2 Two-Phase Data Analysis Approach

A two-phase approach was implemented because the data available for this kind of research project is not readily available. First, data was collected from Kaggle, but it may not be as significant as what would be needed in a viable project. Secondly, data was also generated with Python to simulate real-life data, which comprises several KPIs that have more influence on determining if agile methodology is effective for an organization's project or not.

3.2.1 Phase 1: Real-World Industry Dataset

The first phase utilized an industry project dataset obtained from Kaggle, which contained information about projects from multiple sectors. This dataset included variables such as agile effectiveness, risk mitigation, management satisfaction, supply chain improvement, time

efficiency, and cost savings. The data represented real-world scenarios across various industries where agile methodology had been implemented.

Variable Descriptions

The summary of the dataset variables can be seen in the table below

Dataset Variables and Descriptions

Table 6

Phase 1 Data Analysis_ Variables Description Table

Variable	Description	Range/Unique Values
1. Agile effectiveness	Measures how well Agile methodologies enhance project management processes.	2 to 5
2. Risk mitigation	Captures the effectiveness of Agile in identifying and reducing risks throughout the project lifecycle.	2 to 5
3. Management satisfaction	Represents how satisfied management is with the outcomes of Agile-implemented projects.	2 to 5
4. Supply chain improvement	Evaluates the impact of Agile practices on optimizing supply chain processes.	2 to 5
5. Time efficiency	Measures improvements in time management within Agile projects.	2 to 5
6. Cost savings	Quantifies the percentage of cost savings achieved due to Agile methodologies.	10 to 48
7. Project Success	0 = Failure/ underperformance while 1 = Success meeting or exceeding objectives.	0, 1

Note: The ranges in the table were chosen using a Likert scale of 1 to 5 for variables Agile effectiveness, Risk mitigation, management satisfaction, supply chain, & Time efficiency. Project success target label was arbitrarily defined as 0 for failure and 1 for success.

Initial analysis revealed inconsistencies in the data. These issues hindered the ability to build reliable classification models that could accurately predict project success based on the implementation of agile methodology.

3.2.2 Phase 2: Synthetic Industry Dataset Creation

Dataset Overview

A synthetic dataset was created to represent industry projects with controlled characteristics. This synthetic data was designed to capture the key variables that influence project success across different industry sectors while maintaining realistic relationships between agile methodology implementation and project outcomes. Refer to success factors from literature review in chapter 2 for details as per figure 3, 4, 13 and 14 respectively. The Agile Effectiveness dataset contains 1,000 observations across 19 predictor variables and 1 target variable.

- Sample Size: 1,000 observations
- Features: 19 predictor variables
- Target Variable: Agile effectiveness

Column Descriptions and Unique Values

Table 7

Phase 2 Analysis_ Variables Description and Categories Table

Variable Name	Scale / Range / Categories	Description
1. Industry	Healthcare, Technology, Manufacturing, Energy, Education, Automotive, Construction, Finance, Retail, Government.	The industrial sector in which the organization operates
2. Firm Size	1 = Small (1–50); 2 = Medium (51–200); 3 = Large (201–1000); 4 = Enterprise (1000+)	Organizational size category.
3. Agile Adoption Stage	Scale 1–10	Current maturity of agile implementation.

	Variable Name	Scale / Range / Categories	Description
4.	Team Size	Continuous (5–25)	Number of people in the agile team.
5.	Leadership Support	Scale 1–10	Level of management commitment and support.
6.	Team Experience	Scale 1–10	Collective agile experience of the team.
7.	Training Quality	Scale 1–10	Quality of agile training provided.
8.	Tools Integration	Scale 1–10	Level of agile tool sophistication and integration.
9.	Customer Involvement	Scale 1–10	Degree of customer engagement.
10.	Communication Frequency	Scale 1–10	Intensity of team/stakeholder communication.
11.	Change Management	Scale 1–10	The organization's ability to manage change.
12.	Sprint Completion	Percentage (40–100%)	This is the rate of sprint goals completed.
13.	Stakeholder Satisfaction	Scale 1–10	This is a measure of how satisfied stakeholders and end-users of the project's product feel.
14.	Technical Debt Level	Scale 1–10	Accumulated technical debt in the codebase.
15.	Project Duration	Percentage (70–130%)	Actual duration vs planned duration.
16.	Budget Adherence	Percentage (80–140%)	Actual cost vs planned budget.
17.	Velocity Consistency	Percentage (50–100%)	Consistency of team velocity across sprints.
18.	Quality Metrics Score	Scale 1–10	Composite of code quality metrics.
19.	Risk Management Score	Scale 1–10	Effectiveness of project risk management.
20.	Retrospective Frequency	Meetings /month (1–8)	Number of retrospectives per month.

A summary of the column descriptions is shown in the table below.

Table 8

Phase 2 Analysis_ Target Variable Effectiveness Label

Category	Description	Example Characteristics	Distribution (%)	Frequency (n)
Positive	Strong Agile performance, successful implementation.	High sprint completion, intense stakeholder satisfaction, adequate leadership support, and experienced teams.	61.6	610
Neutral	Mixed outcomes, moderate success with room for improvement.	Moderate completion rates, balanced stakeholder responses, and some challenges alongside successes.	25.6	256
Negative	Poor Agile performance with significant barriers.	Low completion rates, stakeholder dissatisfaction, and structural and cultural resistance to Agile.	12.8	128

Data Validation Process:

After creating the synthetic dataset, it was reviewed by project representatives in Nigeria with experience in Project management and business analytics experience. They examined the data structure, industry-specific characteristics, and relationships between project outcomes. They confirmed that the synthetic data accurately reflected realistic industry project scenarios and contained appropriate representations of how agile methodology typically impacts projects across different sectors. This validation ensured that, although artificially generated, the dataset maintained practical relevance and could serve as a reliable foundation for analyzing the effects of agile methodologies in industry contexts. There is, however, a need to conduct additional surveys to validate the synthetic datasets further and develop an improved model with higher accuracy, lower bias, and lower variance.

3.3 Machine Learning Classification Framework for Project Success Assessment

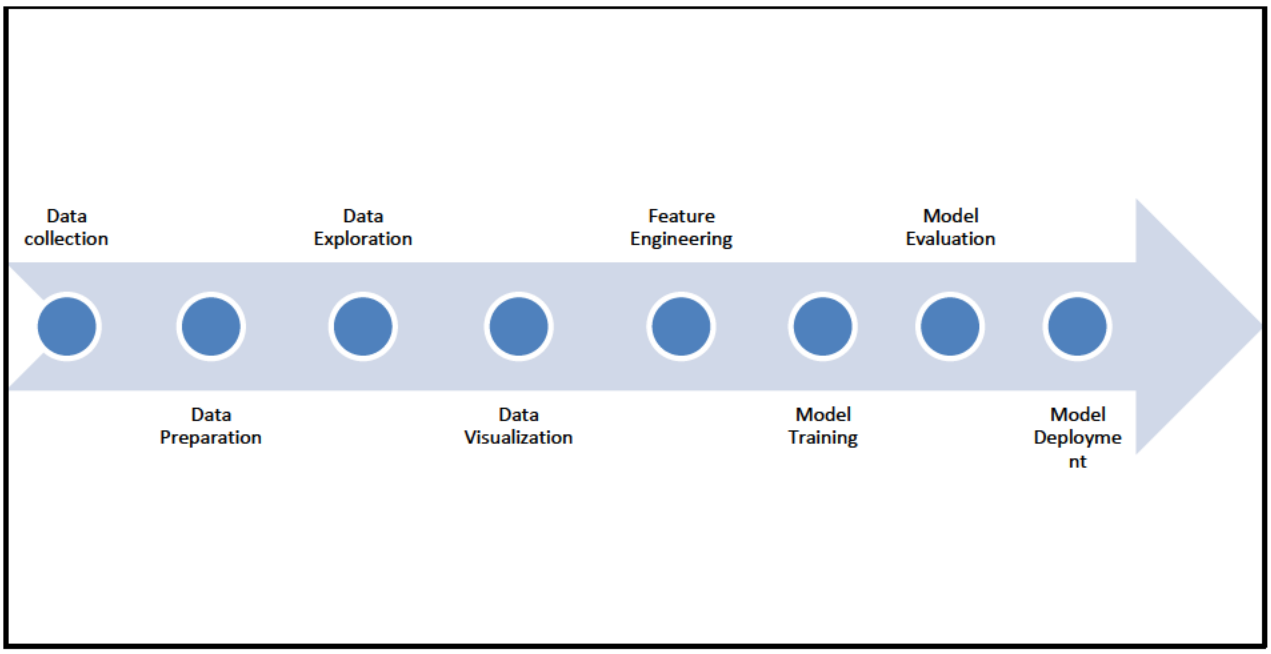
This project management research deployed a data science Machine learning classification framework to help achieve a structured process for predicting project research questions. The classification problem was structured to predict project success outcomes based on the industry sector, the implementation of agile methodologies, and other project characteristics. This approach enabled the identification of patterns in how agile methodology performs across different industry contexts and under various project conditions.

The HITMEA machine learning pipeline is aligned with global best practices in Machine learning principles and body of knowledge. The methodology progressed through five key phases, namely: Data collection, data preparation, data cleaning, feature engineering and visualization, and model development.

Firstly, the Data Collection phase formed the research foundation of the analytical part of this research, where the dataset containing project outcomes across multiple industries with varying agile implementation approaches was sourced from survey websites. Secondly, the data preparation phase involved the initial exploration and understanding of variable distributions, data types, and structural characteristics of the dataset. Thirdly, the data cleaning phase addressed missing values, outliers, and issues related to data quality. Fourthly, the Feature Engineering phase helped create new dependent variables to gain better insights from the data. In contrast, the Visualization phase encompassed exploratory data analysis, correlation assessment, and feature transformation to optimize predictive capabilities. Finally, Model Development involved algorithm selection, training, validation, and performance evaluation to identify the most effective classification approach (Hapke & Nelson, 2020).

Figure 19

The Machine Learning Pipeline_ Research Methodology Process Flow Chart



Note: The Machine learning pipeline follows the structure as specified by (Sharma, 2022) (Ivan Belcic & Cole Stryker, 2025) (Hapke & Nelson, 2020). Here, data is collected from existing historical performance of organizations who have transitioned from Traditional project management to Agile project management. These datas are prepared and cleaned to remove outliers, missing values and errors, before performing data exploration, visualization and additional feature generation. About 80% of historical datas are usually used to train the model while 20% is used to evaluate and test the model. Errors from data training (Bias) is compared with errors from model testing (variance) and the final model is deployed for large scale usage once the Model accuracy is of very good accuracy. Accuracy here is simply the ratio of correct predictions by the model to the total observations (Kimberly, 2021)

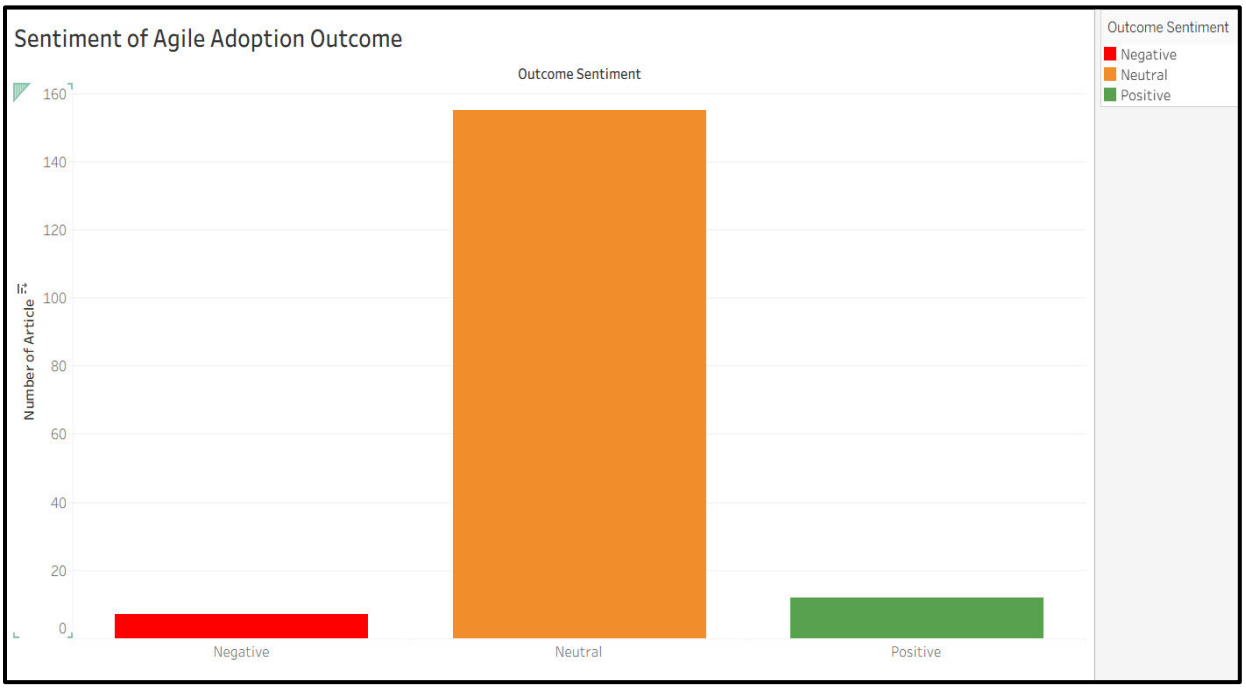
4.0 Data Analysis and Results (Expected Potential Outcomes)

This section presents all the key data analysis visualizations from the literature review's thematic analysis, Phase 1 data analysis, and Phase 2 data analysis. This section provides a foundation to understand the various data insights and to allow for comparison of all data.

4.1 Literature review Insights

Figure 20

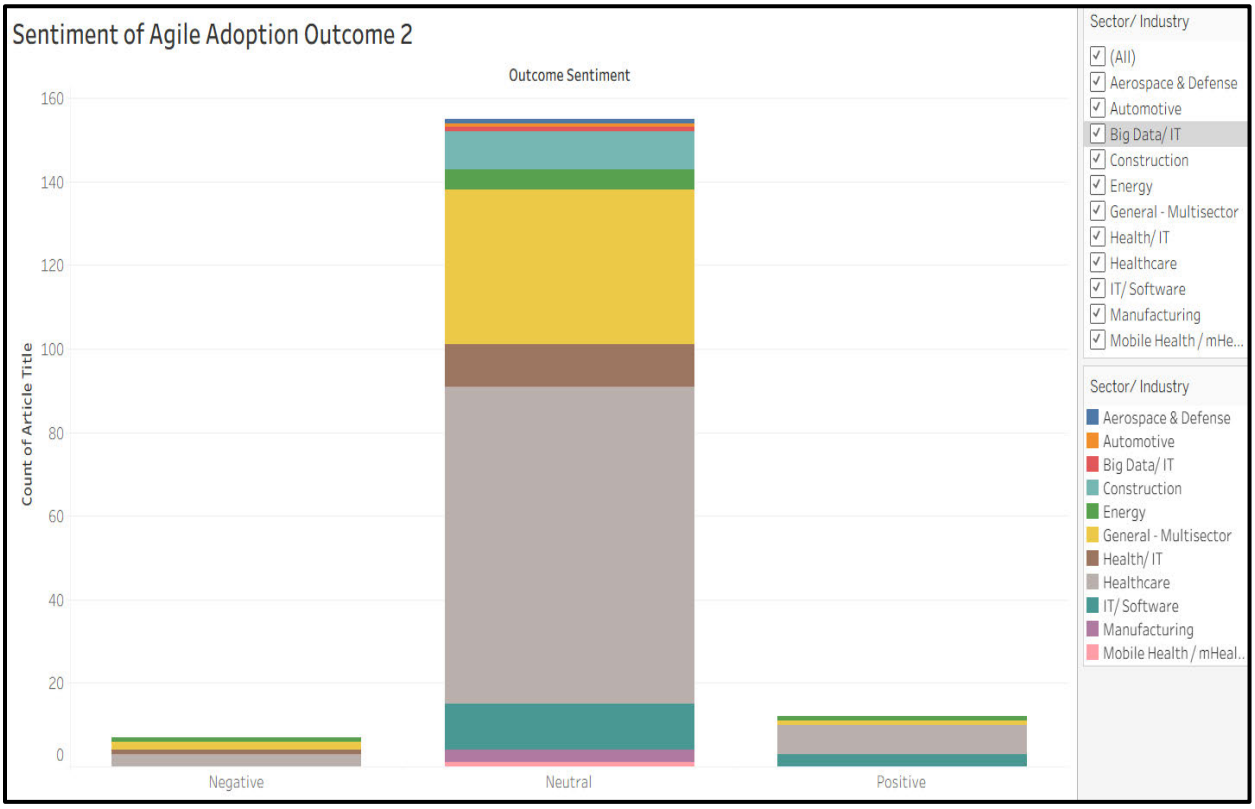
Literature Sentiment Analysis 1_ Sentiment of Agile Adoption Outcome versus Number of Articles reviewed



Note: The image above was generated by the author using Tableau publishing and downloaded sentiment analysis after python programming on Google Colab Notebook, automating the review process of over 200 Article. From the image, most of the articles reviewed show a neutral sentiment (orange bar), which means that Agile adoption is not always positive. Here, the positive sentiment (Green bar) is slightly above the negative sentiment (red bar). Since this sentiment was obtained from the literature review, there is a need to compare this result against other analysis, before coming to a conclusion.

Figure 21

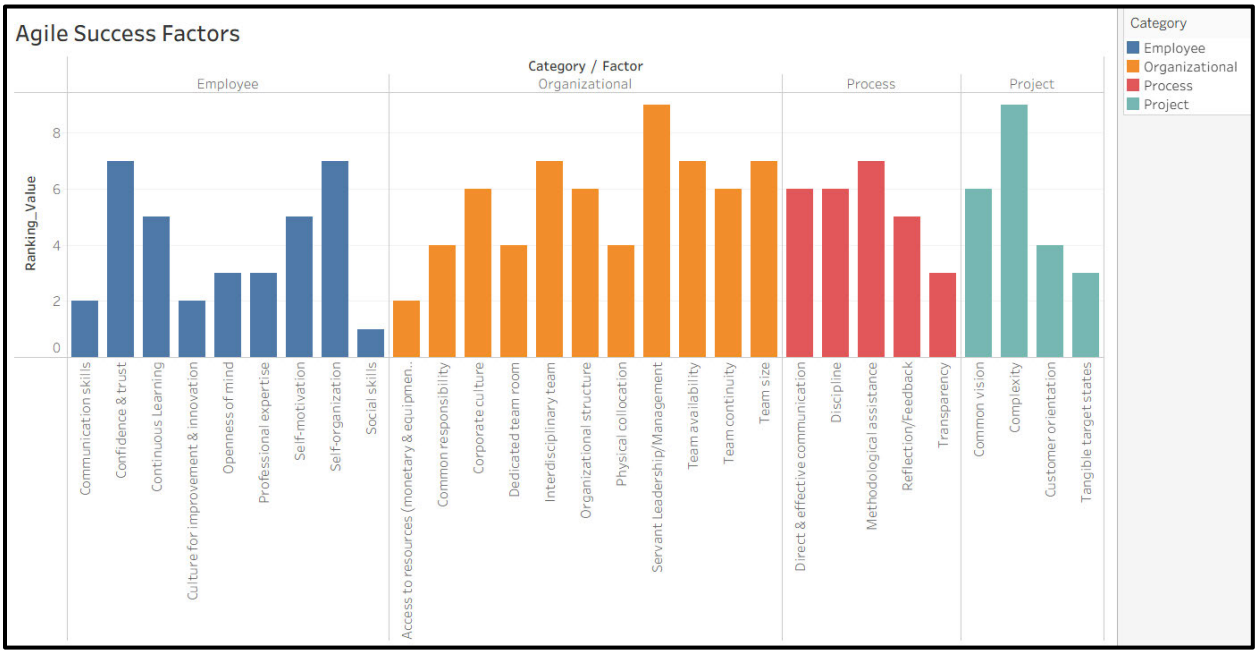
Literature Sentiment Analysis 2_ Sentiment of Agile Adoption Outcome & Sectorial Articles reviewed



Note: The image above was generated by the author using Tableau publishing and downloaded sentiment analysis file after python programming on Google Colab Notebook, automating the review process of 240 Article. This image shows that indeed several organizations now adopt Agile management. It also shows how these industries view the adoption of Agile project management. From the image, most neutral sentiment drivers stem from insights obtained from Mobile Health/, Manufacturing, Healthcare, IT/ Software, and General multi-sector industries, which show a widespread distribution.

Figure 22

Agile Success Factors by Category drivers

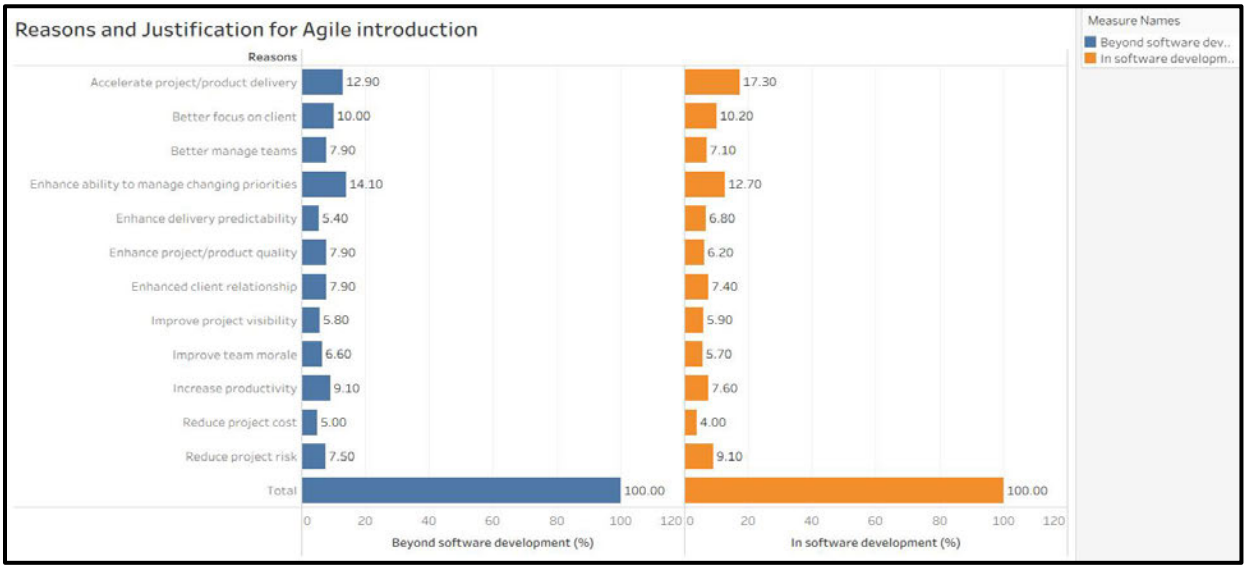


Note: The image above was generated by the author using Tableau tool and survey data from (Ciric et al., 2019) (Ciric Lalic et al., 2022). From the visualization, Employees factors sentiment is that the key driver to success in Agile implementation is building confidence and trust within teams, building a self-organizing and motivating team, encouraging a continuous learning organization, hiring individuals with good professional experience, encouraging good communication among teams etc. Also, from Organizational factor sentiment, Servant leadership management style, team size, building inter-disciplinary team, ensuring high team members availability to support project work, fostering good corporate culture and ensuring good team continuity are some of the key drivers of Agile adoption performance. Similarly, from the Process factor sentiment, promoting direct and effective communication, discipline in following process requirements, Methodological assistance, and creating a feedback loop organization are key drivers to Agile adoption success. Finally, from the Project factor sentiment, success drivers

depend on project complexity, establishing a well understood common vision of the project and organization, and customer orientation are among the drivers to Agile adoption success.

Figure 23

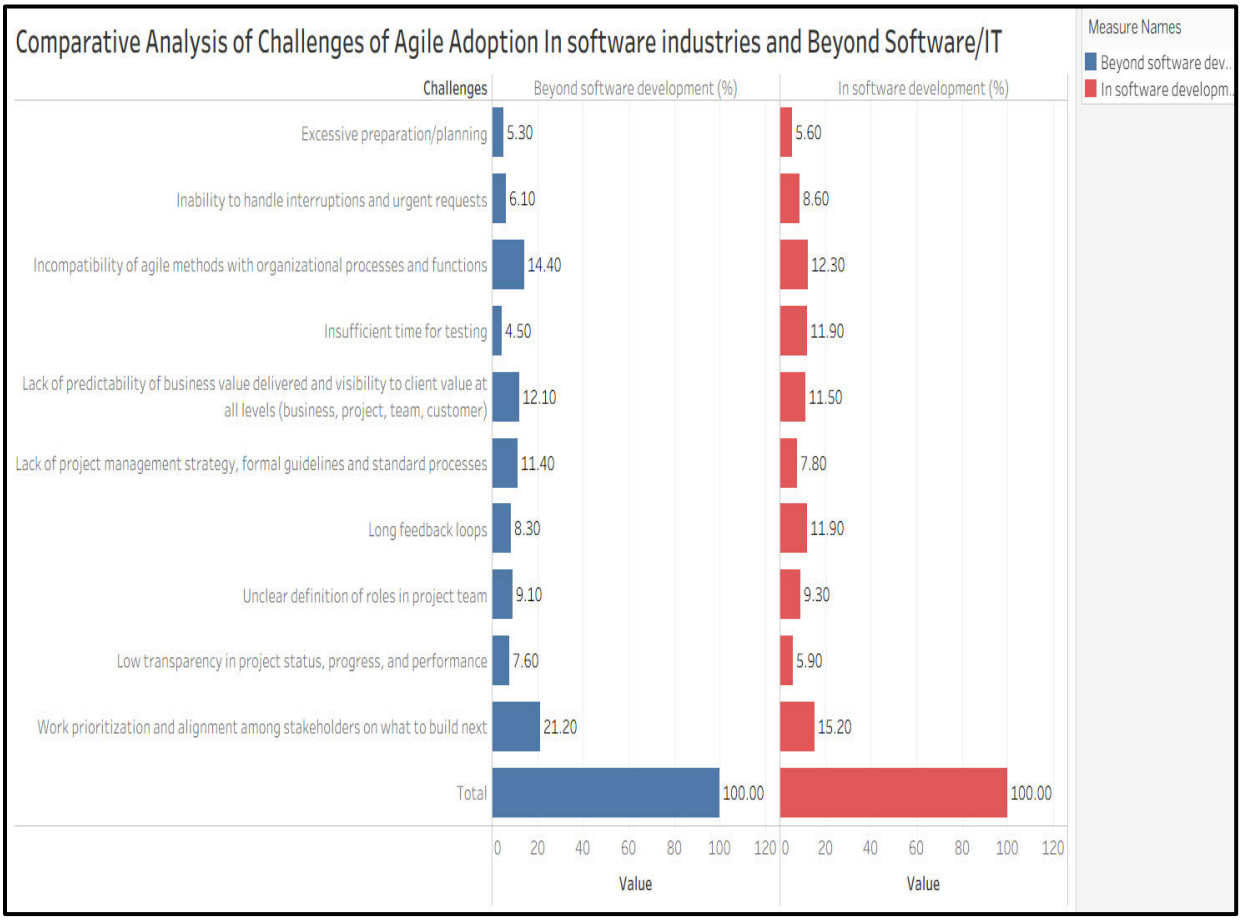
Reasons and Justification for Agile introduction



Note: The image above was generated by the author using Tableau tool and survey data from (Ciric et al., 2019) (Ciric Lalic et al., 2022). From the visualization, the survey was conducted for individuals in Software development industries and for individuals in other non-software development industries (Beyond software development). The reasons and justification for Agile introduction in software development industries are primarily to Accelerate project and product delivery, enhance the ability to manage priorities, achieve better focus on client needs, and to reduce project risk among others. Similarly, for non-software development industries, the Agile adoption justification is primarily to Accelerate project and product delivery, enhance the ability to manage priorities, achieve better focus on client needs, increase productivity, enhance project/ product quality, better manage teams, and enhance client relationships.

Figure 24

Challenges of Agile Adoption



Note: The image above was generated by the author using Tableau tool and survey data from (Ciric et al., 2019) (Ciric Lalic et al., 2022). From the visualization, the survey was conducted for individuals in Software development industries and for individuals in other non-software development industries (Beyond software development). The image shows the challenges of Agile adoption in both software development industry and non-software development industries. Both segments of industries confirm that the primary challenge is work prioritization and alignment among stakeholders on what to build next. This means that there is a need for organization to establish clarity on project scope details upfront even though Agile allows for incremental development. Furthermore, the incompatibility of Agile methods with organizational

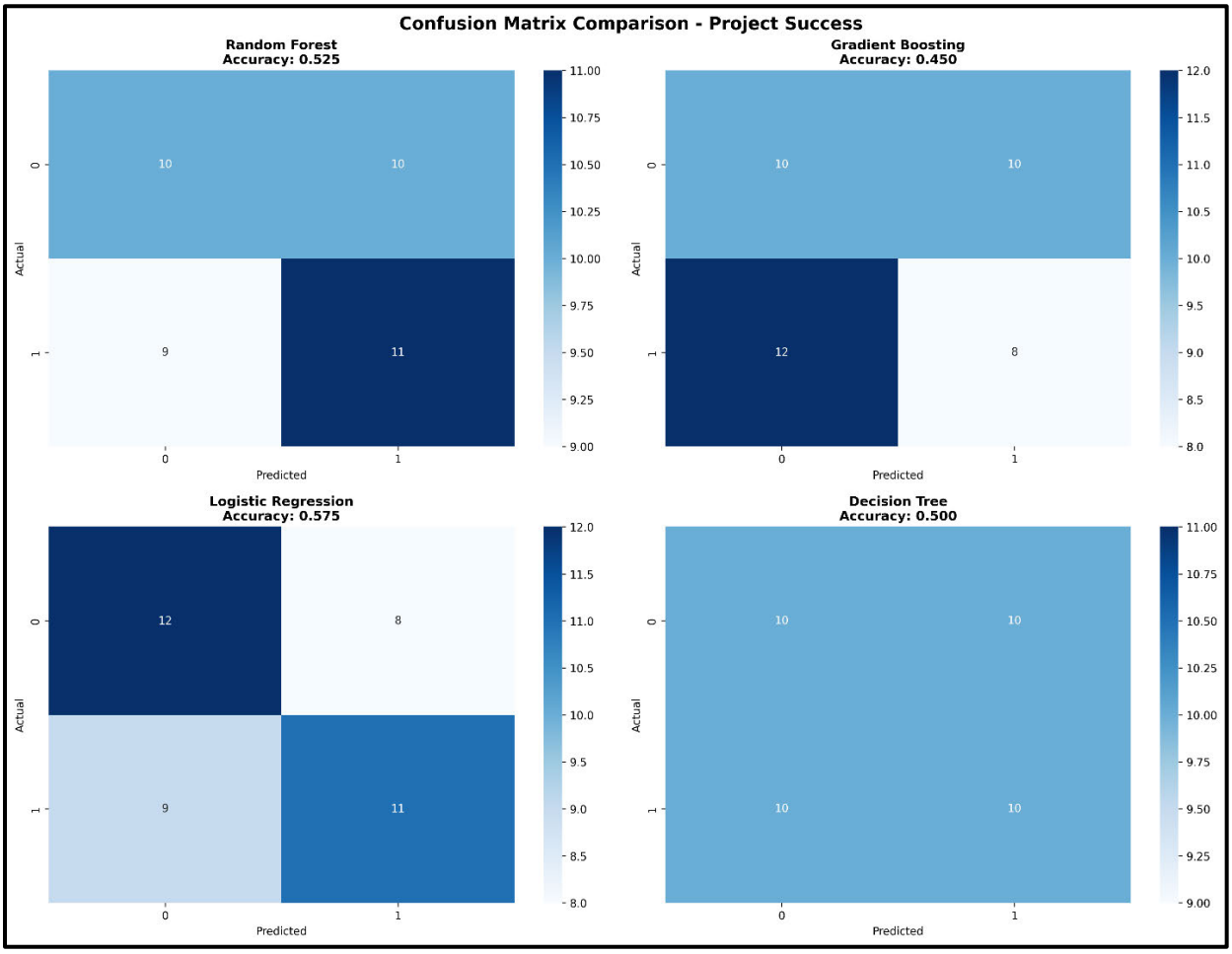
processes and function is a key indicator to Agile failures in both segments. Also, the lack of predictability of business value delivered at all levels (Business, Customer, Project, and Team) is a challenge common to both segments. However, the care some challenges that are higher in software industries that are not necessary a challenge in other industries such as Insufficient time for testing, which is a common challenge in software industries but not a key challenge in other non-software industries.

4.2 Phase 1 Analysis and Insights from Survey Dataset (Kaggle)

A review was performed on Agile survey dataset, which contained records of 200 Agile software development projects. It included various performance metrics related to Agile methodologies, measuring their effectiveness in project success, risk mitigation, time efficiency, and cost savings. Several insights were obtained, as shown in the figures below.

Figure 25

Phase 1 Data Analysis Approach _ Confusion Matrix of Agile Adoption Success Prediction using four Predictive Models

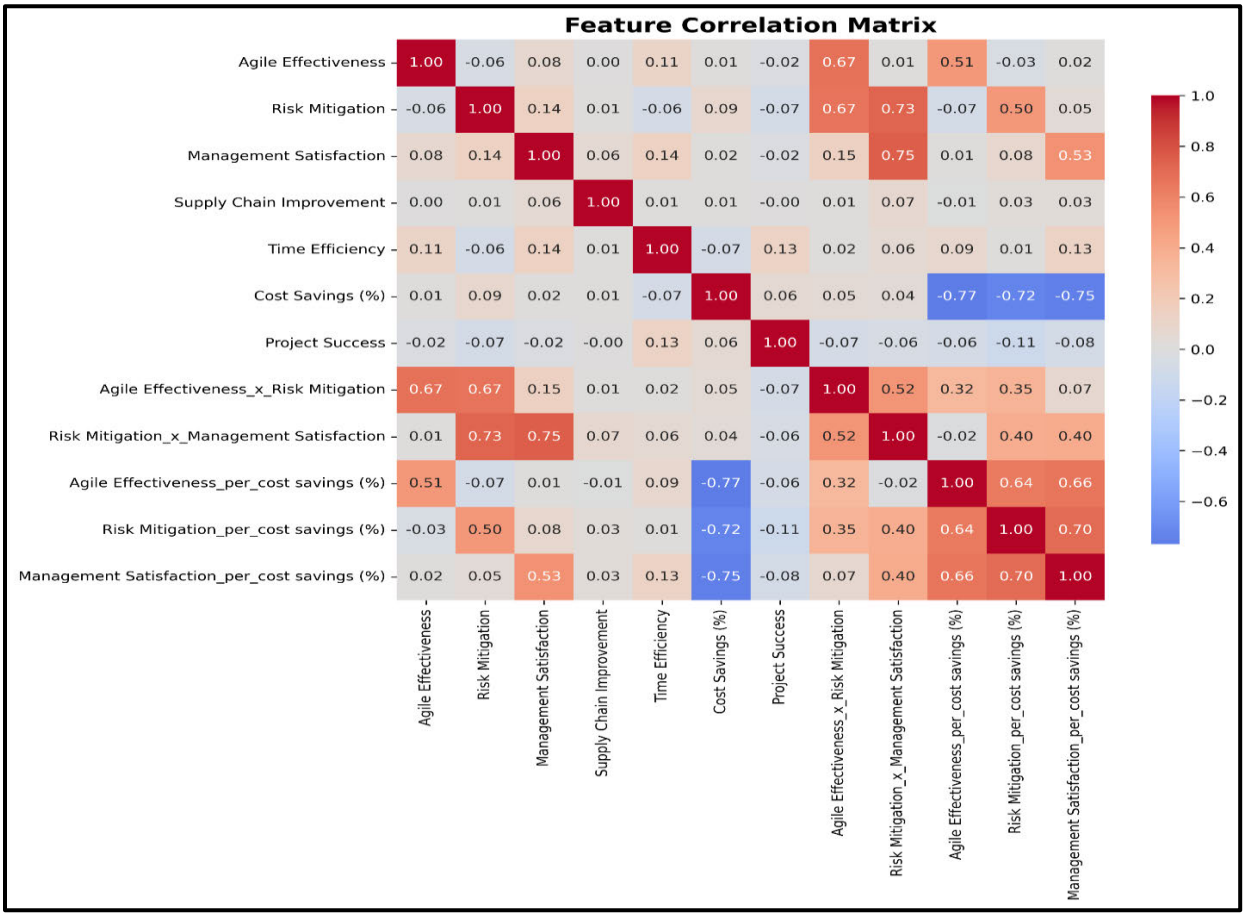


Note: Confusion Matrix was generated by the author using python code on Colab Notebook and dataset from Kaggle (digro k, 2025). The confusion matrix is a table layout of different outcomes of the prediction that summarizes the performance of the classification model. It compares model predictions versus actual outcome of events. The outcome can be **True Positive (TP)**, **True Negative (TN)**, **False Positive (FP)** and **False Negative (FN)** using a two-by-two matrix, as shown in the figure 25 above. In this analysis, the Random Forest model has an accuracy of 0.525, the Gradient Boosting Model has an accuracy of 0.450, the Logistic Regression Model has an accuracy of 0.575, and the Decision Tree Model has an accuracy of 0.50. The most accurate

predictive model here was the **Logistic Regression Model.** Its **TP** was 11 which meant that the model predicted Agile adoption as **Positive 11 times,** and it was actually correct. Also, its **TN** was 12 which meant that the model predicted Agile adoption as **Negative 12 times,** and it was correct in its prediction. Now, the model's inaccuracy stems from the fact that it had some wrong predictions. For example, its FP was 8 (the predicted Agile adoption as positive 8 times but it was wrong as the actual outcome was Negative), while its FN was 9 (the predicted Agile adoption as Negative 9 times but it was wrong as the actual outcome was Positive). If the model was 100% accurate, it would have predicted True Positive as (**TP+FN= 11+9= 20**) and it would have predicted True Negative as (**TN+ FP= 12+8=20**), which would mean Agile adoption prediction sentiment is 50% - 50% (20 vs 20), a neutral sentiment! But as per the model, we have (12 vs 11) with Negative slightly edging it.

Figure 26

Phase 1 Data Analysis Approach: Feature Correlation Matrix from Agile Adoption Survey Data Analysis

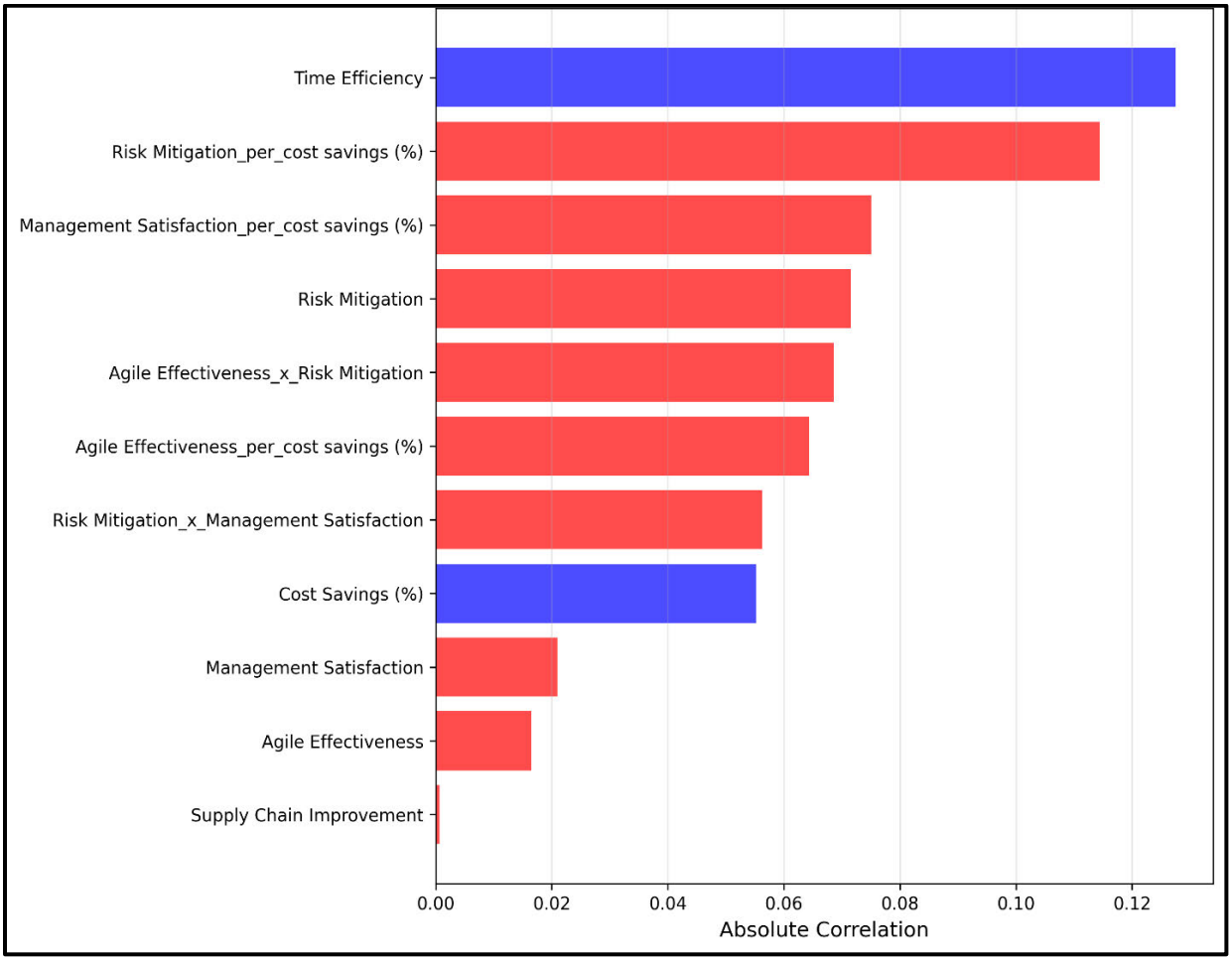


Note: The image above was generated by the author using python code on Colab Notebook and it shows the Heat Map feature correlation from Agile survey data on Kaggle database (digro k, 2025). The blue tab shows negative correlation while the red tab shows positive correlation. The correlation heatmap is descriptive and was used to visualize which features move together linearly (red = positive, blue = negative), not to infer causation. In this chart of figure 27, we can see (1) the three "per-cost savings" features are highly correlated with one another (multicollinearity) (SixSigmaProSMART, 2023), (2) Cost Savings and Time Efficiency are strongly negatively correlated (a trade-off), and (3) Project Success has only weak–moderate links to any single feature, so success likely depends on combinations such as the interaction

Agile × Risk rather than one metric alone. What this tells is that no single feature can be used to determine if Agile adoption can lead to success or failure in an SME, but that there is a need to model combinations of metrics over single metrics, reduce or regularize the redundant "per-cost" predictors, and note that higher "benefit per cost" intensity may align with lower success in this sample (the negative correlations), meaning cost-efficient gains matter.

Figure 27

Phase 1 Data Analysis Approach: Feature Correlation with Project Success

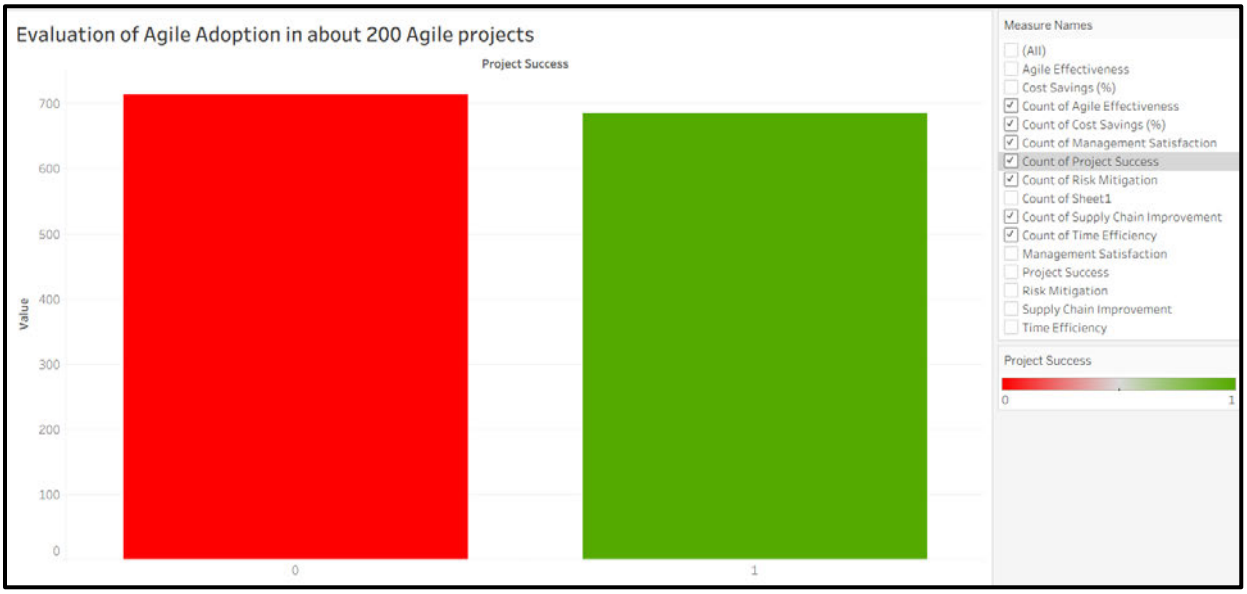


Note: The image above was generated by the author using python code on Colab Notebook and it shows the feature correlation with Project success for Agile survey data on Kaggle database (digro k, 2025). The horizontal bar chart shows Absolute correlation values. The red bars

represent negative correlation while the blue bars represent positive correlation. From the visualization, we can see that Time *Efficiency* is the strongest positive correlate with Project Success while *Cost Savings (%)* is a smaller positive. Similarly, we can see that most others including the "per-cost savings" features and interaction terms (e.g., *Agile effectiveness* × *Risk mitigation*, *Risk mitigation* × *Mgmt Satisfaction*) lean **negative**. What this tells is that no single feature can be used to determine if Agile adoption can lead to success or failure in an SME. However, organisation must carefully scale these metrics to suit their size and manage carefully. The negative sentiments can be improved upon if the organizations in the survey work on improving Risk Management, Management and stakeholder alignment, and Agile Effective (achieving desired project outcomes like increased productivity, improved customer satisfaction, faster delivery, better project product quality etc.). The organizations should also continue to maintain Time efficiency and Cost control to improve the probability of achieving project success.

Figure 28

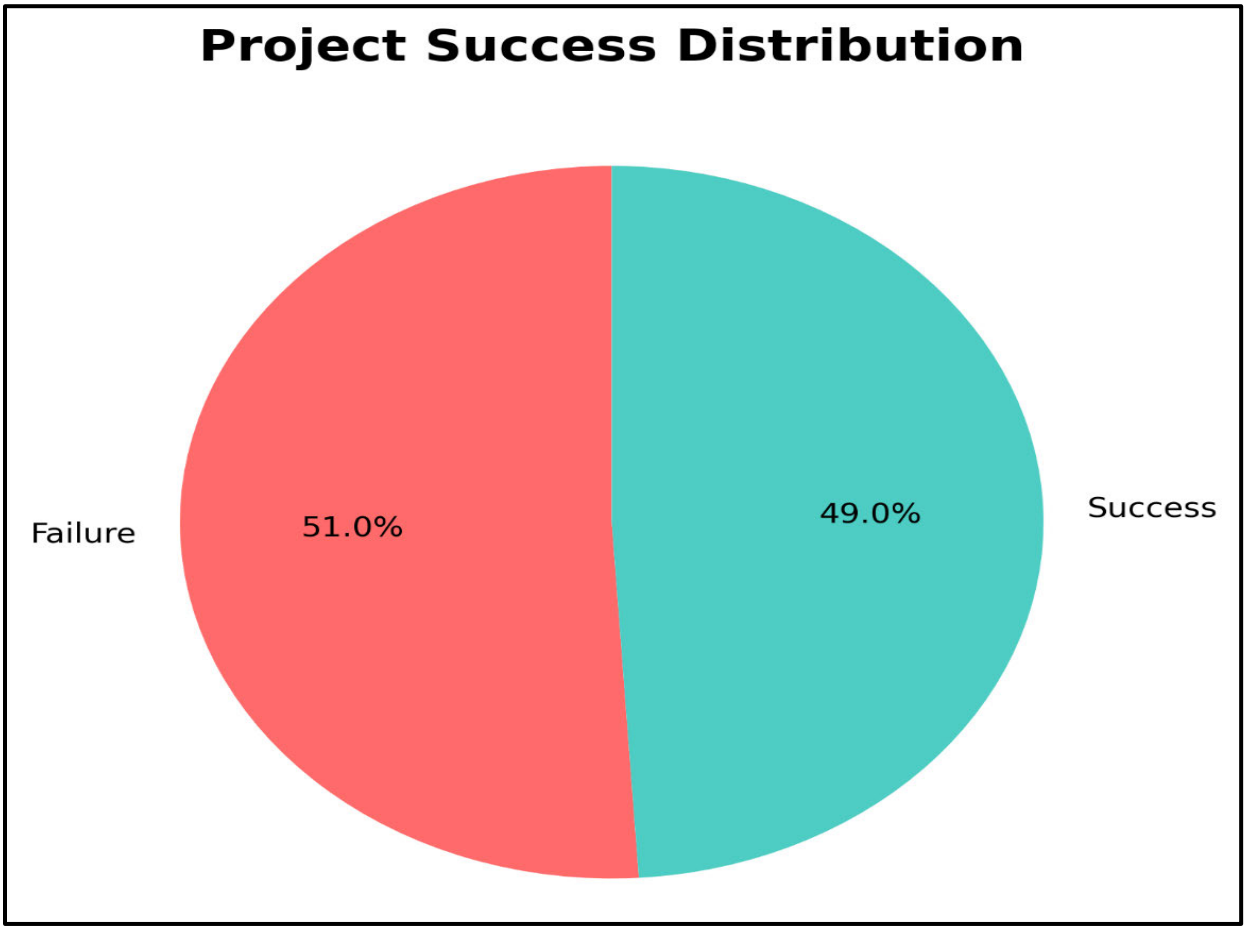
Phase 1 Data Analysis Approach: Evaluation of Agile Adoption_ Assessment of 200 Agile projects



Note: The image was generated by the author using Tableau and Agile survey downloaded from Kaggle website (digro k, 2025). A review of approximately 200 Agile project sentiments reveals a nearly neutral sentiment. Project Success (binary: 0 = Failure, 1 = Success) (digro k, 2025). This is the dependent variable, representing whether the project was considered successful or not. This sentiment was achieved by aggregating all sentiments across several performance metrics, including Agile Effectiveness, Cost Savings, Management Satisfaction, Risk Mitigation, Supply Chain Improvement, and Time Efficiency. This confirms that Agile adoption does not necessarily translate to project success, as there is a good blend of project success and Failure stories from respondents.

Figure 29

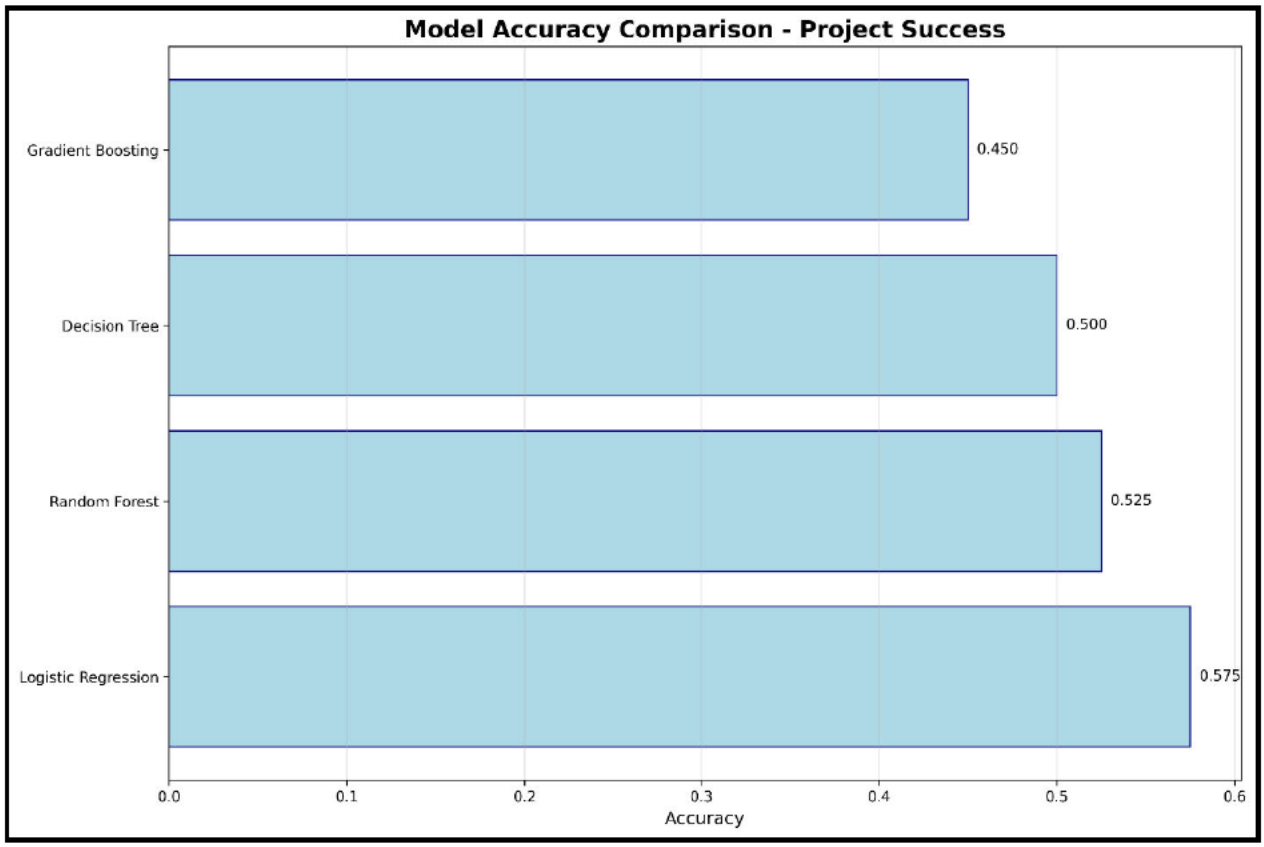
Phase 1 Data Analysis Approach: Pie Chart of Agile Adoption Evaluation Sentiment



Note: The image above was generated by the author using Python code on Colab Notebook and a dataset from Agile survey data downloaded from Kaggle website (digro k, 2025). The data analysis reveals a near-neutral sentiment, with 'Failure' edging it out at 51%, while the success rate is 49%. This confirms that Agile adoption does not necessarily translate to project success, because there is no positive correlation among all the listed success factors. This further explains that there is usually trade-offs that organizations must make to achieve business objectives. For example, a project that is going behind schedule may need to expend more resources inorder to recover on the schedule, and this would cost more.

Figure 30

Phase 1 Data Analysis Approach: HITMEA Predictive Model_ Comparison of Models by Accuracy or Bias



Note: The HITMEA Predictive Model of Agile Adoption generated by the author and shows the accuracy of the prediction model used (digro k, 2025).

Table 9

Phase 1 Data Analysis _ Model Prediction Accuracy

HITMEA Model	Accuracy	Precision	Recall	F1_Score
Logistic Regression	0.575	0.5789	0.55	0.5641
Random Forest	0.525	0.5238	0.55	0.5365
Decision Tree	0.5	0.5	0.5	0.5
Gradient Boosting	0.45	0.4444	0.4	0.4210

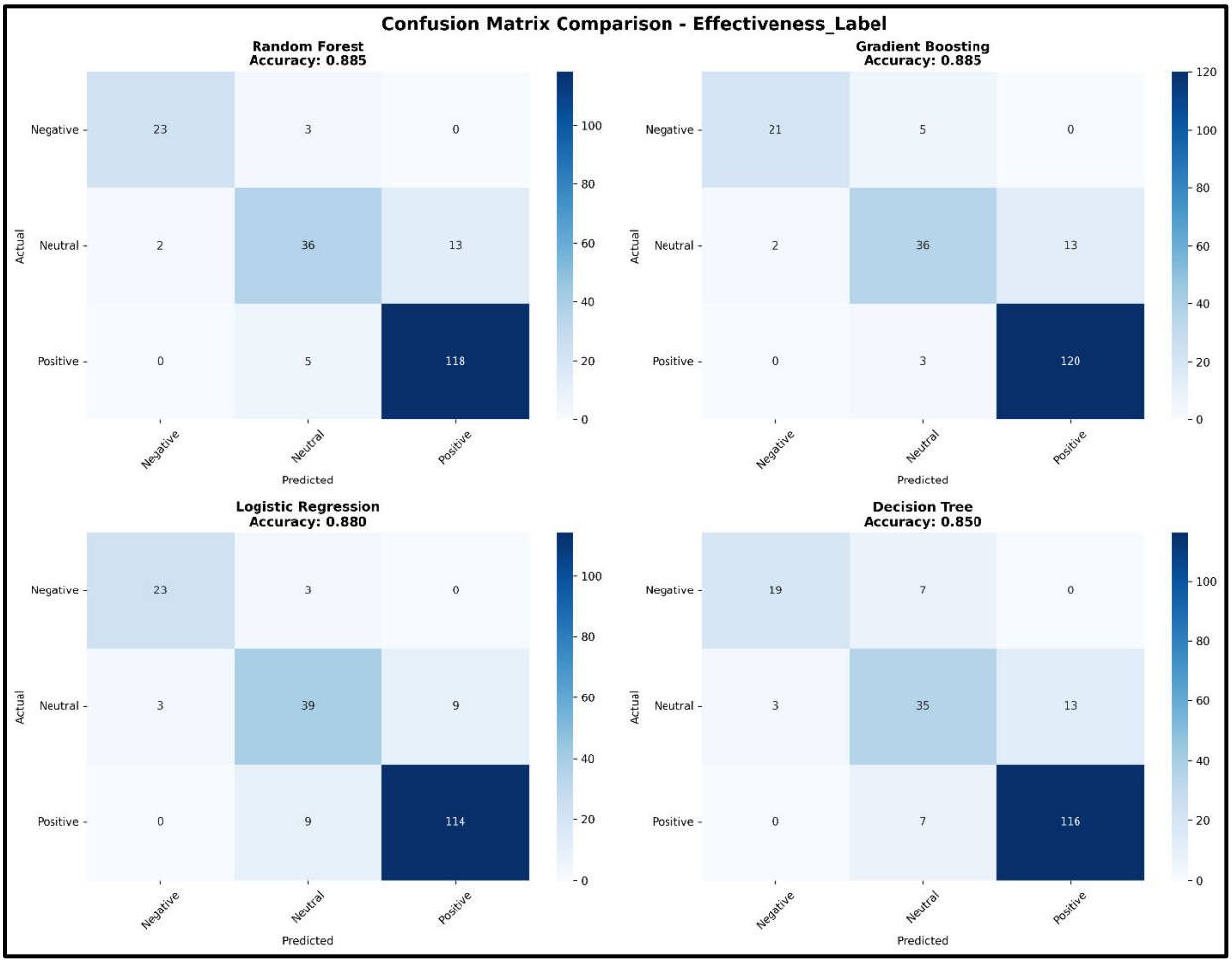
Note: The author generated the table above by using python code on Colab Notebook.

4.3 Phase 2 Analysis and Insights from Synthetic Dataset

To achieve better model training, a synthetic dataset was generated using Python to simulate real-life data. This data was validated by sharing it with experienced project professionals.

Figure 31

Phase 2 Data Analysis Approach _ Confusion Matrix of Agile Adoption Success Prediction using four Predictive Models

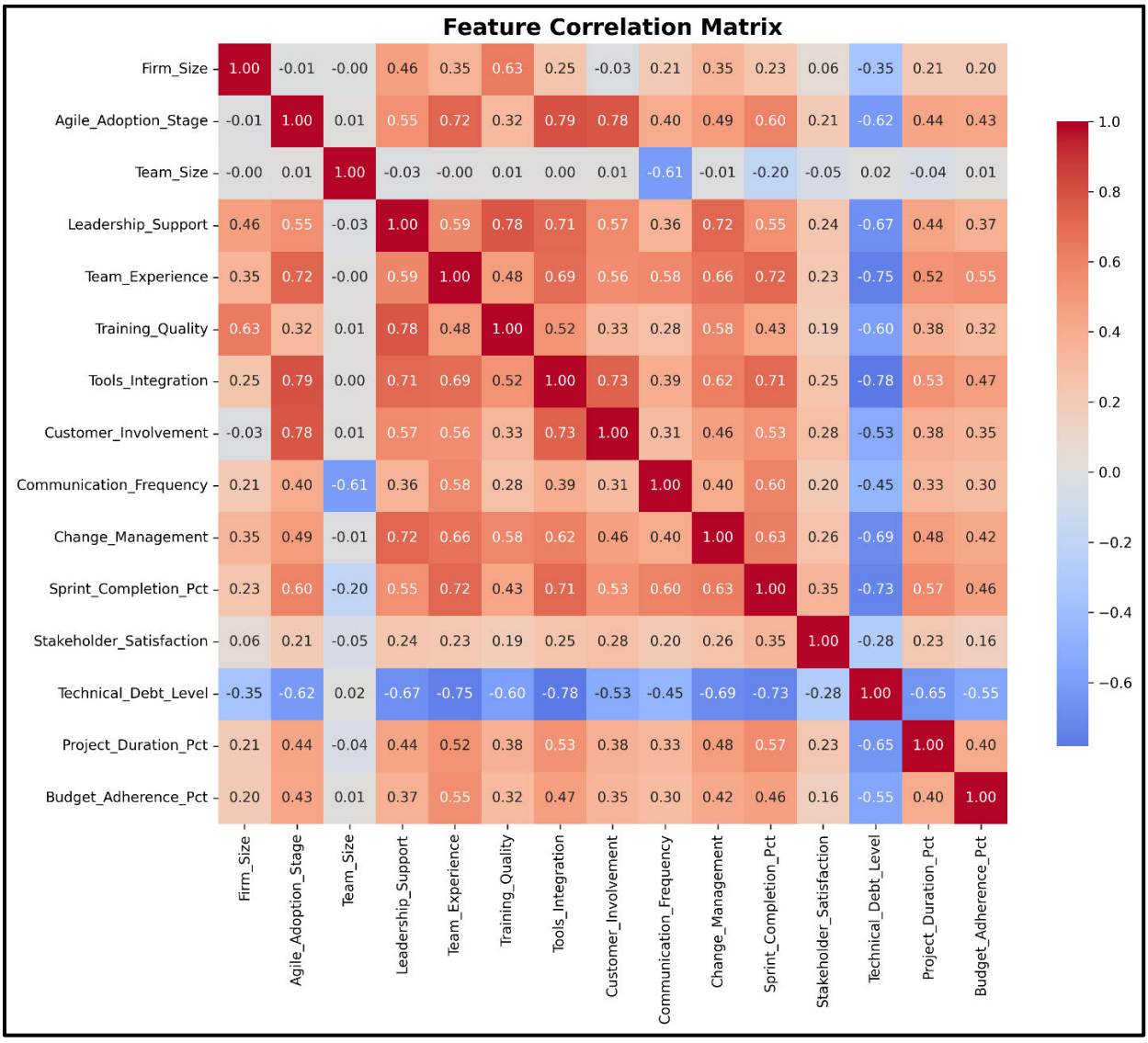


Note: The Confusion Matrix was generated using Python code on Colab Notebook for the Training Model. The model with the best accuracy here is the Random Forest (0.885) and Gradient Boosting (0.885). The Logistic Regression model is also very good, with an accuracy of 0.880. Examining the Models, for example, we can see that the Model predicted both positive

and negative outcomes for Agile adoption; however, the ratio of favorable outcomes was greater than the pessimistic outcome predictions. This confirms the need to use larger, cleaner datasets to train machine learning models, such as the HITMEA model, to ensure more accurate forecasts for future test datasets.

Figure 32

Phase 2 Data Analysis Approach: Heat Map showing the Feature Correlation Matrix from Agile Adoption Survey Data Analysis



Note: The image above was generated by the author using Python code in a Colab Notebook, displaying the correlation between the Heat Map feature and synthetic data for Model training. The key performance indicators were obtained from the work of (Chow & Cao, 2008), and the literature review insight in section 2 of this report. These KPIs were determined after collecting empirical information and conducting statistical analysis of approximately 109 data points from Agile projects across a diverse group of organizations of various sizes, industries, and geographic locations.

Figure 33

Feature Correlation with Effectiveness Label

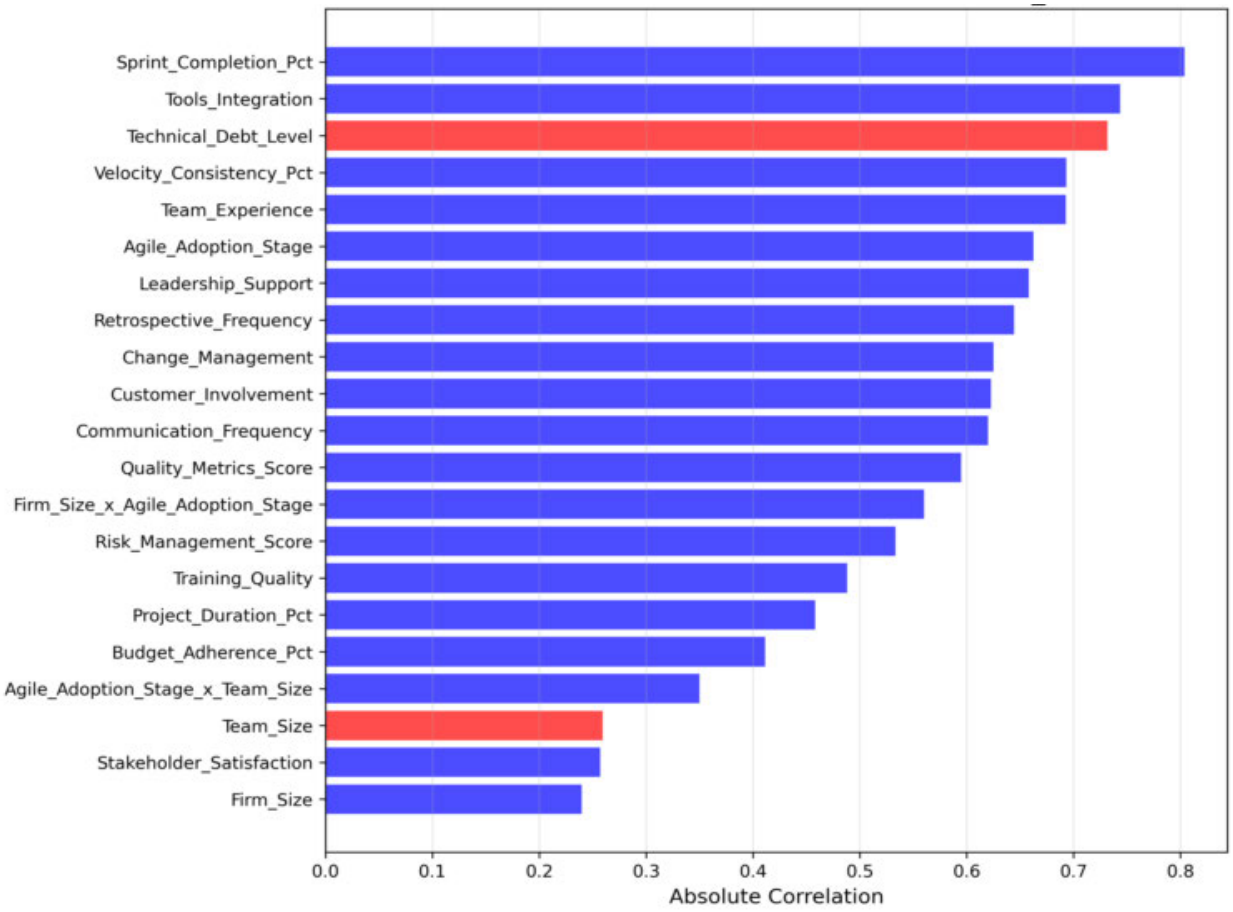


Figure 34

Effectiveness Label Distribution

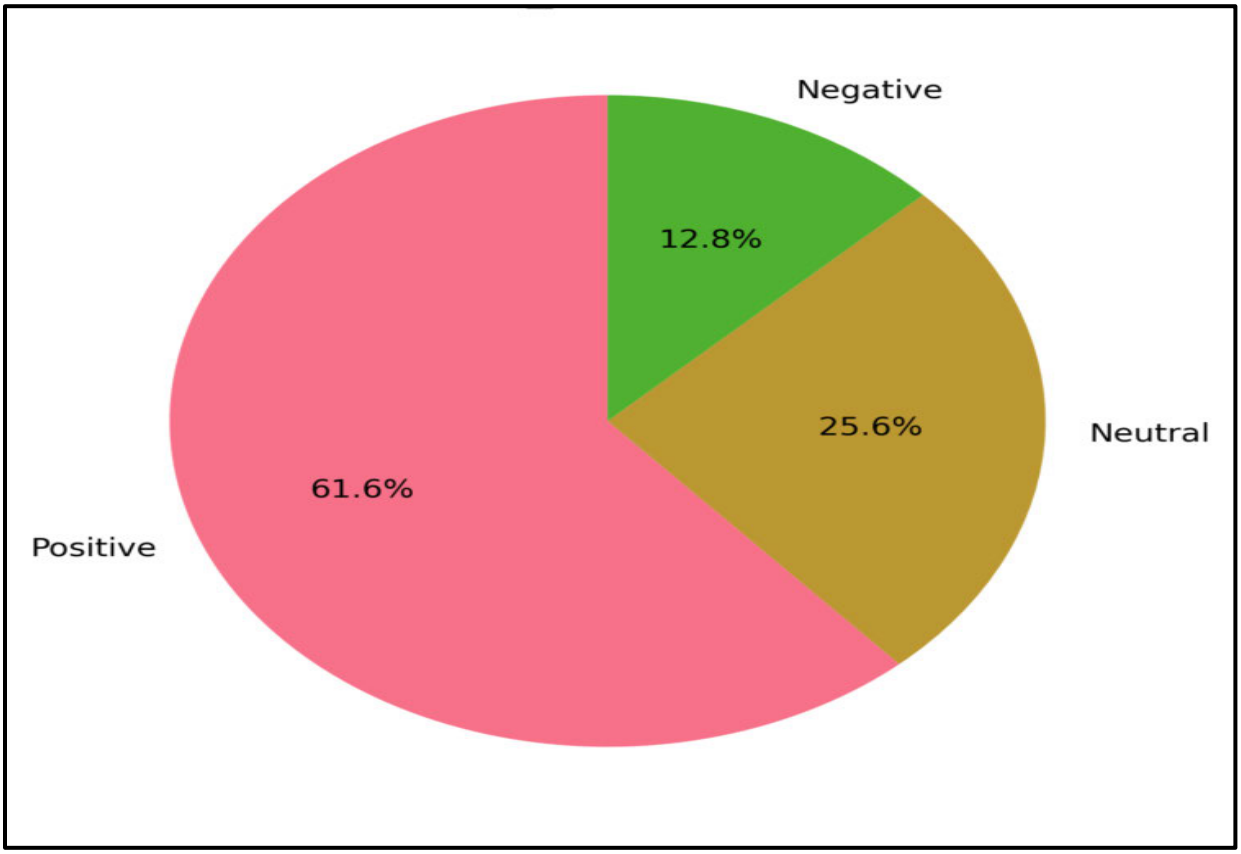


Figure 35

Phase 2 Data Analysis Approach: HITMEA Predictive Model_ Comparison of Models by Accuracy or Bias

Note: The HITMEA Predictive Model of Agile Adoption. The image above was generated by the author using python code on Colab Notebook. The bar shows the accuracy of the models

Table 10

Phase 2 Data Analysis _ Model Prediction Accuracy

Model	Accuracy	Precision	Recall	F1_Score
Random Forest	0.885	0.8822	0.885	0.8819
Gradient Boosting	0.885	0.8823	0.885	0.8813
Logistic Regression	0.88	0.88	0.88	0.88
Decision Tree	0.85	0.8474	0.85	0.8476

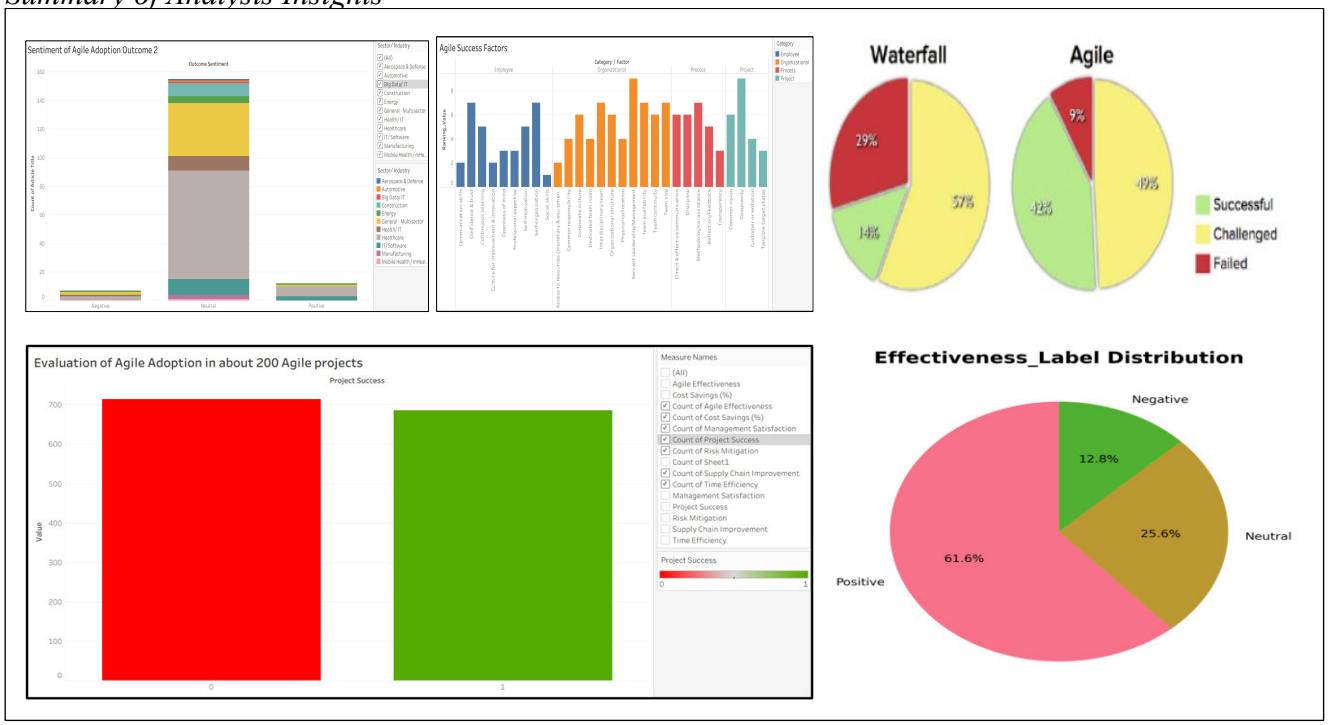
Note: The author generated the table above by using Python code on Colab Notebook. From the table, it can be seen that although the Model Random Forest and Gradient Boosting had the same accuracy value (0.885), the F1 score was, however, better for Random Forest, hence its ranking as the best model at this stage. The other three models (Gradient Boosting, Logistic Regression, and Decision Tree) are all performing well in terms of prediction using the test datasets.

5.0 Discussion

This section summarizes the results findings from the literature review and Data Analysis

Figure 36

Summary of Analysis Insights



5.1 What the results mean.

Upon review of the existing literatures, and the performance of two Quantitative analysis, several visualizations were generated as shown in figure 36 above, and they provided the following insights and summary:

1. It was difficult to access Agile adoption appraisal across several industries from previous literature research. This gap has now been solved now by this research work.
2. Prior to this research, there was no model or app that existed for Agile prediction in the past. However, this research work has closed the gap through the development of the HITMEA app that provides capability to predict outcomes across several industry sectors.
3. To solve the challenges faced by SMEs regarding the increasing pressure to stay competitive, innovative, and responsive to customer needs, SME should use Strategic Management to Analyze their existing strategies, formulate strategies, Implement strategies, and use strategic control tool to reinforce performance.
4. Strategy analysis involves setting clear organizational Mission, Vision, and strategic object. It should also involve SMEs performing Internal environment analysis (using SWOT analysis tool), performing external environment analysis (using PESTLE analysis tool), and using the Porters five forces model of industry competition to manage threats. Enhancing the awareness of the external environment can be achieved by SMEs if the perform regular environmental scanning, environmental monitoring, and competitive intelligence checks and use the findings to perform forecasts.
5. From the model deployment and testing findings, SMEs should monitor metrics like Size, Sprint velocity, Sprint completion pct as key indicators. They should also

monitor factors such as People, Process, Technology, Organization, Financial and Customer engagement using tools like SWOT, PESTLE, Porters five forces model

6. Agile adoption is common in projects with high uncertainty which provides high rate of change, complexity and risk, while Tradition PM is common in projects that are well defined, reducing their complexity and risk
7. It has become clear that Agile is not always beneficial for SMEs. Outcomes depend on the industry, culture, team maturity, project scale, and the method's implementation. Also from figure 9, several features like Tooling and automation (using JIRA tool etc.), Communication and transparency, Change management and culture, Agile training and coaching, KPIs/ OKRs and performance tracking, Resources, budget, time, Customer/ user collaboration, all drive success of Agile adoption across several industries.

5.2 Research Question 1 — Effect of Agile adoption on SMEs.

According to the Kaggle dataset (Phase 1), the sentiment is almost neutral, with failures at 51% and successes at 49%. This shows Agile adoption does not automatically lead to success. Several factors could be responsible could lead to the failure sentiment as shown in figure 8, Figure 12 figure 15, 16 and 17. Also, the Model performance in Phase 1 was modest (best accuracy = 0.575 with Logistic Regression), reinforcing that outcomes are mixed in practice. Furthermore, from the visualization of figure 26, we can see that Time *Efficiency* is the strongest positive correlate with Project Success while *Cost Savings (%)* is a smaller positive.

5.3 Research Question 2 — Success factors and barriers.

Several factors have been identified in figure 8, and figure 12. as key enablers to achieving success in Agile transitioning by organizations. Benefits reported across SMEs include flexibility, faster feedback, customer alignment, increased team engagement, improved

predictability, and shorter time-to-market. These are real and valuable when the environment fits Agile. However, common barriers are also evident, including weak prioritization, a mismatch between the framework process and Agile, unclear roles, a lack of Agile skills, culture and hierarchy issues, Agile tool selection poor customer engagement, and budget limitations. The fishbone diagram in Figure 14 categorizes them into six main areas: People, Process, Technology, Culture, Finance, and Customer Engagement.

5.4 Research Question 3 — A predictive model SMEs can use.

This research has developed the HITMEA Frame work and models for use, as per figure 1 and figure 10. In Phase 1, using a real-world dataset, the models, which is an algorithm in python, captured patterns with low to moderate accuracy (0.45–0.575), which mirrors the noisy, mixed outcomes commonly seen in practice. In Phase 2, the synthetic dataset's accuracy improved (0.85–0.885) across multiple algorithms, indicating that the signal is learnable when the data are rich. This confirms the need to gather larger, cleaner, sector-tagged datasets for more accurate predictions by the Model. This Model has the capacity to help organizations make sound business predictions and decisions that will have positive outcome and massive return on investment.

5.5 Research Question 4 — Agile vs Traditional in outcomes.

The summarised insights from Table 2, and Table 3 of this report have shown that Agile can outperform Traditional in terms of adaptability, collaboration, and delivery speed when the context is suitable (e.g., high uncertainty, engaged stakeholders). However, in rigid or highly regulated settings without strong change management, Traditional or Hybrid Approaches often perform better. This analysis is a qualitative one

5.6 Role of change management.

Change management is crucial in driving organizational change. Organizations that are highly adaptable to change will most likely achieve success in Agile adoption. On the contrary, organizations that do not adapt well to change would struggle to achieve success despite transitioning from Traditional to Agile management. Change Management models, such as the HITMEA, should be used to improve the behavior of individuals and employees, thereby increasing the likelihood of Success in SMEs that transition from Traditional to Agile management.

5.6.1 Executive Summary

I developed a personal change management framework, HITMEA—**H**ypothesize, **I**nstrument, **T**est, **M**easure, **E**xtend, and **A**nchor—to improve Agile adoption outcomes in small and medium-sized enterprises (SMEs). I grounded the framework on my empirical insights (heat maps, feature correlations, and model results) and on established change and Agile literature (Hiatt, 2006). From my results, logistic regression performed best with ~0.575 accuracy, and project success distribution was near 49% success vs. 51% failure. The strongest drivers of success in my exploratory analysis were **Time Efficiency**, **Risk Mitigation**, **Management Satisfaction per cost savings**, and overall **Cost Savings**. My Objectives and Key Risks target cycle time, risk practices, leadership alignment, and cost-value ratios, while the HITMEA steps provide a practical path to execute, learn, and institutionalize improvements.

5.6.2 HITMEA Industry Lens: How I Tailor the Playbook

Industry	High-Impact Practices	Metric I Watch
Health	Risk-based testing, compliance-by-design, cross-	Cycle time to release; defects in clinical scenarios.

	functional reviews with clinicians.	
IT/Software	CI/CD, trunk-based development, automated testing; strong backlog hygiene.	Deployment frequency; lead time; change fail rate.
Manufacturing	Kanban with WIP caps, supplier collaboration, and on-style escalation.	Throughput; first-pass yield; downtime MTTR.
Energy	Permit/HSSE integrated into flow, risk pre-mortems for high-stakes work.	Risk burndown; schedule adherence; incident rate.
Aerospace	Model-based systems engineering, rigorous change control, verification early.	Nonconformance trends; verification pass rate.
Agriculture	Iterative trials, farmer feedback loops, simple mobile data capture.	Time-to-validate; adoption rate; cost per outcome.

5.6.3 90-Day Roadmap to Execute HITMEA

Days 0–15 (**Hypothesize & Instrument**): This involves setting up a plan to drive the change. I will baseline flow, risk, and satisfaction; set definitions; configure dashboards; and agree on pilot scope with sponsors.

Days 16–45 (**Test & Measure**): At this stage, I will try and test the plan. I will run two iterations with tight feedback, remove blockers daily, and hold weekly learning reviews.

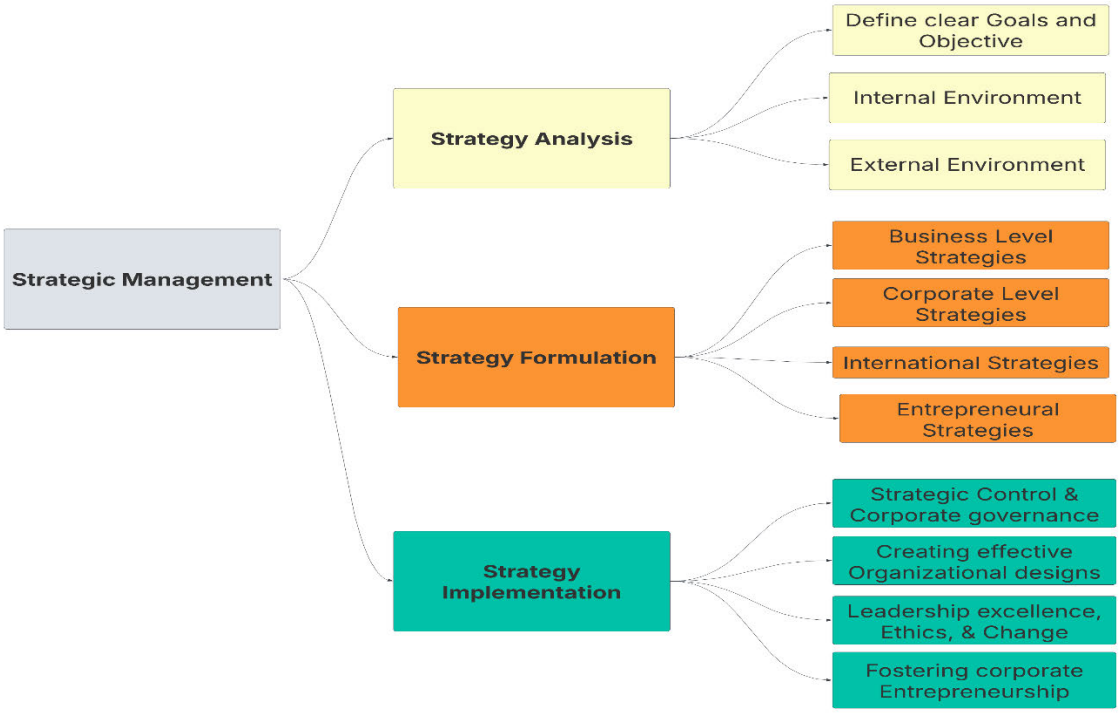
Days 46–75 (**Extend**): I scale proven practices to 2–3 additional teams, refine playbooks, and align incentives.

Days 76–90 (**Anchor**): I formalize governance, update policies, and close the loop with leadership on outcomes vs. Objectives and key results OKRs.

5.6.4 Strategic Management as a Tool for Change management

Figure 37

Strategic Management as a tool for driving organizational Change and Agile success

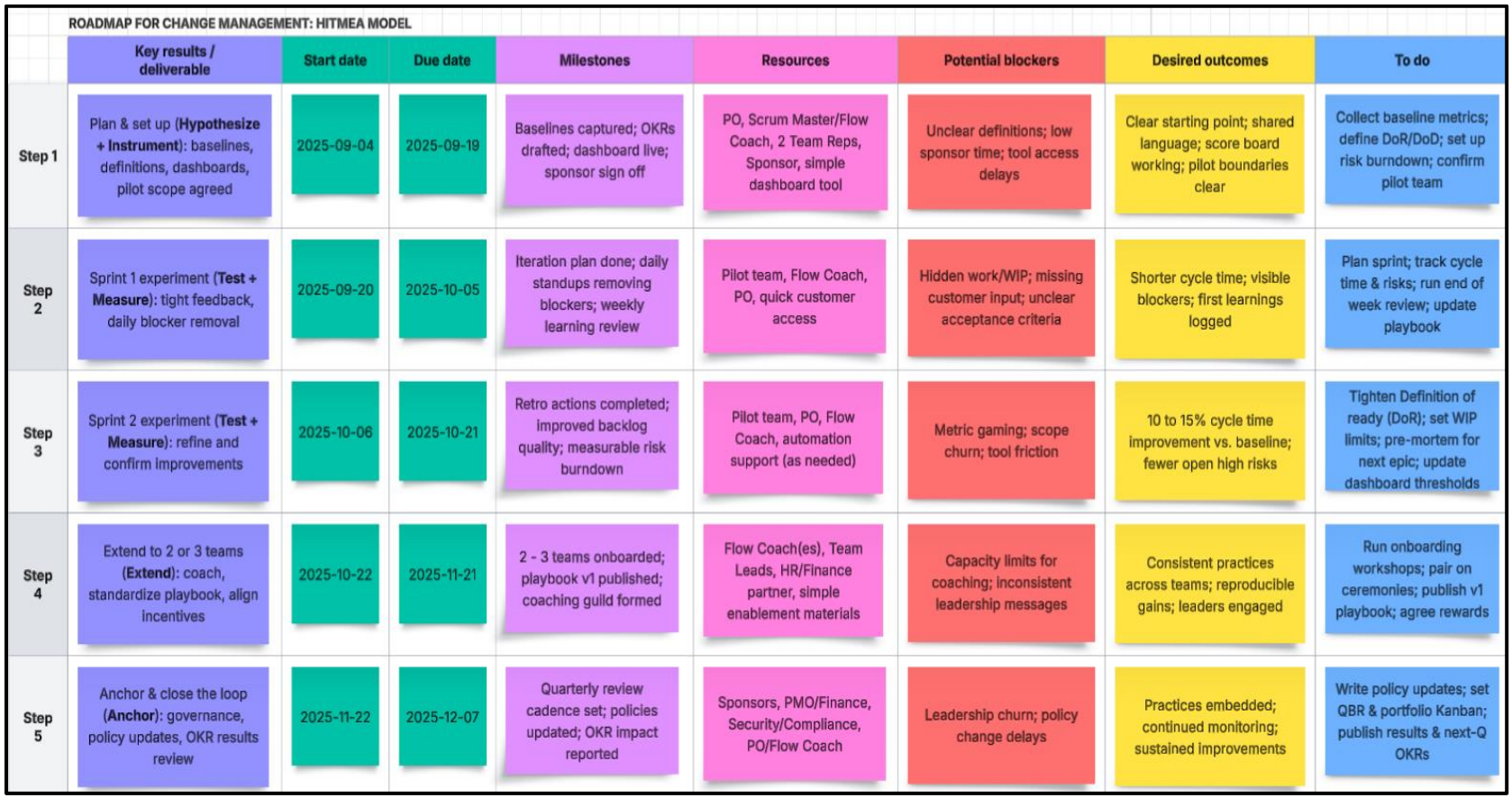


Note: SMEs should use the tool above to drive organizational change and success. They should regularly perform Strategy Analysis, Strategy formulation, and Strategy implementation. Strategy analysis helps SMEs to validate if they are where they intend to be (Vision, Mision and strategic objective). This also involves conducting internal environment analysis using tool like SWOT analysis, and conducting external environment analysis using tool like PESTLE analysis. These analysis will expose success factors that need to be managed by the organization.

Subsequently, Strategy formulation is done to provide solutions that help organizations meet their strategic goals. Furthermore, Strategy implementation is done to execute the formulated strategies while allowing for a feedback loop that validates if executed projects meets organization's strategic objective.

Figure 38

Roadmap for Change Management



ROADMAP FOR CHANGE MANAGEMENT: HITMEA MODEL

	Key results / deliverable	Start date	Due date	Milestones	Resources	Potential blockers	Desired outcomes	To do
Step 1	Plan & set up (**Hypothesize + Instrument**): baselines, definitions, dashboards, pilot scope agreed	2025-09-04	2025-09-19	Baselines captured; OKRs drafted; dashboard live; sponsor sign off	PO, Scrum Master/Flow Coach, 2 Team Reps, Sponsor, simple dashboard tool	Unclear definitions; low sponsor time; tool access delays	Clear starting point; shared language; score board working; pilot boundaries clear	Collect baseline metrics; define DoR/DoD; set up risk burndown; confirm pilot team
Step 2	Sprint 1 experiment (**Test + Measure**): tight feedback, daily blocker removal	2025-09-20	2025-10-05	Iteration plan done; daily standups removing blockers; weekly learning review	Pilot team, Flow Coach, PO, quick customer access	Hidden work/WIP; missing customer input; unclear acceptance criteria	Shorter cycle time; visible blockers; first learnings logged	Plan sprint; track cycle time & risks; run end of week review; update playbook
Step 3	Sprint 2 experiment (**Test + Measure**): refine and confirm improvements	2025-10-06	2025-10-21	Retro actions completed; improved backlog quality; measurable risk burndown	Pilot team, PO, Flow Coach, automation support (as needed)	Metric gaming; scope churn; tool friction	10 to 15% cycle time improvement vs. baseline; fewer open high risks	Tighten Definition of ready (DoR); set WIP limits; pre-mortem for next epic; update dashboard thresholds
Step 4	Extend to 2 or 3 teams (**Extend**): coach, standardize playbook, align incentives	2025-10-22	2025-11-21	2 - 3 teams onboarded; playbook v1 published; coaching guild formed	Flow Coach(es), Team Leads, HR/Finance partner, simple enablement materials	Capacity limits for coaching; inconsistent leadership messages	Consistent practices across teams; reproducible gains; leaders engaged	Run onboarding workshops; pair on ceremonies; publish v1 playbook; agree rewards
Step 5	Anchor & close the loop (**Anchor**): governance, policy updates, OKR results review	2025-11-22	2025-12-07	Quarterly review cadence set; policies updated; OKR impact reported	Sponsors, PMO/Finance, Security/Compliance, PO/Flow Coach	Leadership churn; policy change delays	Practices embedded; continued monitoring; sustained improvements	Write policy updates; set QBR & portfolio Kanban; publish results & next-Q OKRs

5.6.4 Governance & Roles (RACI)

Executive Sponsor *(Accountable):*

Secures sponsorship and decision rights.

Product Owner (Responsible):

Prioritize by value and validate outcomes with customers.'

Scrum Master/Flow Coach (Responsible):

Enable teams, remove impediments, and maintain metrics.

Team (Responsible):

Deliver increments, improve continuously, and keep WIP healthy.

Finance/PMO (Consulted):

Track value and cost-of-delay; adapt funding to flow.

Security/Compliance (Consulted):

Build quality in early.

Customers/Users (Informed/Consulted):

Provide feedback each iteration.

5.7 Implications for SMEs.

Do not "go Agile" by default. First check readiness indicators like leadership support, skills, tools, customer access, and then choose the right tool such as Scrum, Kanban, Lean, SAFe, or Hybrid to fit your size and context. Also, start small, prove value, and scale carefully; large structures and hierarchy raise risk. In addition, track a focused KPI set (delivery speed, stakeholder satisfaction, predictability, quality) and tie it to business goals, not just activity, as per the report literature KPI maps. Finally, use the HITMEA model to **screen** projects/units for fit and risk; expect better predictions as more high-quality, sector-labeled data are collected.

6.0 Limitations of this Study

This research acknowledges several key constraints that affect the scope and interpretation of findings:

6.1 Data Quality and Representation:

The Kaggle dataset may not fully represent all SME industry contexts or geographic regions, which could potentially limit its generalizability across diverse organizational environments. Additionally, the synthetic dataset cannot capture all real-world scenarios.

6.2 Industry Variation:

The implementation of Agile methodology varies significantly across industries. Different organizations may interpret and execute agile practices differently. Hence, what works positively for one organization may not necessarily work for another; however, the models presented in this report will significantly bridge this variability.

6.3 More Surveys needed in Non-IT and Non-Software industry

Due to time constraint for this research, there was not enough survey carried out to establish Agile adoption success in non-IT industries like the Energy and Construction industries. This research will benefit from conducting more surveys to obtain real life insights.

6.4 Validation and Testing

There is a need for more real-world testing and performance evaluation to assess the accuracy, effectiveness, and efficiency of this model in solving real-world problems.

6.5 Deployment

The HITMEA model, is not yet deployed large scale to the industries for testing and performance review. Deployment needs to be done to further appraise the predictive capabilities of the Model.

7.0 Recommendation

To resolve the limitations experienced while executing this project, the following are recommended to improve upon this work:

- Data Quality representation should be improved upon by conducting surveys across several industries such as Energy (Oil and Gas and Renewable Energy), Construction, Manufacturing, Aerospace and Agricultural industries.
- The Industry Variation challenge, which makes different organizations interpret and execute agile practices differently, can be resolved by ensuring that the new HITMEA model is adopted industry wide. This model will significantly bridge this variability gap as it has features that can help to track and predict performance across several industries.
- To improve upon validation and testing of the HITMEA model, organizations should use change management to drive organizational change. Awareness of the model should be shared with SMEs using communication tools and sponsorship of business leaders. The desire of employees to accept this HITMEA model can be achieved through Coaching and Resistance management. Also, the Knowledge of employees needed to adopt this model can be improved upon through coaching. Furthermore, the ability of employees to deploy this model can be improved through coaching, resistance management, and training. Finally, a feedback loop should be used to reinforce learnings from the use of this predictive app.
- Future researchers should do more work to improve upon the HITMEA Machine Learning Model for predicting and appraising the adoption of Agile project management. An open-source website and database with a large number of historical datasets on Agile implementation results can help in training the HITMEA ML Model to achieve greater capability in predicting Agile performance sentiments.

8.0 Conclusion

In summary, this research has shown that the transition of SME organizations from Traditional project management to Agile project management is not uniformly successful when adopted by several SMEs across different industries. This is because the traditional project management methods often fail to meet the increasing demands for SMEs to remain competitive, innovative, and customer friendly. Hence, it is important that Agile, which offers flexibility, adaptability and improved customer collaboration, be adopted to achieve success in SMEs. Also, project success metrics have evolved from simple, quantifiable KPIs of Time, Scope, and Cost to a multidimensional construct that has a long-term perspective, directly relating to effectiveness and organizational impact. This includes achieving an organization's strategic management goals, objective, vision, and mission. The root cause factors of People, Process, Technology, Culture, Finance, and Customer Engagement also have a significant impact on success. However, organizations can develop their own success factors by conducting 5 Why workshops, Run a fishbone, and perform SWOT analysis for internal environment assessment, and PESTLE analysis for external environment assessment.

Furthermore, outcomes depend on the industry, culture, team maturity, project scale, and the implementation of methods. Agile can be a decisive advantage for SMEs, but only when it aligns with the work and the organization is prepared for change. Additionally, Agile can be challenging for organizations as they grow from small to medium size. Therefore, it is recommended that organizations transitioning to Agile should consider starting small and gradually scaling up their organization size to avoid the challenges of Agile in large organizations. They should also consider using a Hybrid methodology that combines the benefits of both Agile and Traditional to deal with Agile implementation in Medium to large organizations. They should use the ADKAR change management models to support the people side of change and improve organizational behaviour that drives change adoption. The new

HITMEA model is a proof of concept that Agile prediction can now be performed by a newly developed HITMEA app, and it can serve as an indicator tool for organizations across several industries to assess their Agile implementation performance.

Finally, to further close the gap in literature for Agile adoption in Non-IT and Non-Software industries, this research will benefit from more survey across industries like Energy (Oil and gas, Renewable), and Construction (Fabrication and Civil) as these industries are known to practice predominantly Traditional / Waterfall project management. The study will unravel how they have changed their existing project management framework to integrate the Agile concept. It will also be a further appraisal of Agile adoption in Non-IT and Non-software industry, with resulting datasets serving as input to training the HITMEA predictive model.

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Appendix 1 Demo of HITMEA Predictive Model

Discussion _ Deployment_ HITMEA Model Demo for Agile PM Predictions

What: A Machine Learning Model developed for Agile Project Management Effectiveness Prediction.

Why: It provides more effective prediction capabilities

How: Leverages proven Machine learning principles for prediction of Target

HITMEA-MODEL DEMONSTRATION

Step 1: Click the link to access the Agile Prediction app
Step 2: Select a Dataset for review
Step 3: Select the best performing predicting Model for your selected Dataset in step 2 above
Step 4: Select different values for each features. Also select industry for sectorial predictions
Step 5: Click the predict button and see the visualization result (Positive, Negative or Neutral outcome)

Dataset 1 Observation

- **Risk Mitigation Per-cost savings**: Increasing this value may lead to negative outcome sometimes as not all risk mitigation results in overall good for the business. Sometimes, it may be beneficial to let the risk event occur.
- **Agile effectiveness per cost saving**: Increasing this value increased positive adoption outcome
- **Time Efficiency**: Increasing time efficiency numbers showed improvement in Agile adoption rate
- **Cost Savings %**: Increasing this feature may not result in an improvement in Agile adoption success rate

Dataset 2 Observation

- **Project duration Pct**: Increasing this feature increased the neutral to negative adoption outcome
- **Budget Adherence Pct**: Increasing this feature increased the neutral to negative adoption outcome
- **Communication**: Increasing this feature increased Positive adoption outcome
- **Sprint Completion Pct**: Reducing this value negatively affected Agile adoption success
- **Sprint Velocity**: Reducing this value negatively affected Agile adoption success
- **Technical debt**: Increasing this feature reduced Agile success possibility