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**Research Article**

# Machine Learning Model's Analysis The Success Factors Of Agile Project Management To Determine Project Success Rates

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**ABSTRACT**

Agile software development refers to a method or strategy for supervising and completing software projects, emphasizing flexibility, collaboration, and incremental progress. This stands in opposition to the conventional Waterfall model, which follows a step-by-step and linear procedure. The Agile methodology is especially suitable for endeavors in which requirements might change over time and where incorporating customer input and adjustments are of the utmost importance.

Based on the data collected through the Google Form survey, we are attempting to give precise prediction of project success ratio based on the opinions of 100 Project Management Professionals on 10 parameters using machine learning algorithms.

**Keywords:** Agile Project Management, Machine Learning, Linear Regression, Logistic Regression, Decision Trees, Random Forests, Support Vector Machines, Machine Learning Model, Agile Project Management.

## INTRODUCTION

While numerous project management methods and approaches are available to choose from for a new project, the current success ratio overwhelmingly favors Agile methodologies. Therefore, we are analyzing the data related to Agile approaches. We are proceeding with a practical study and analyzing primary data gathered from experienced Agile project managers.

We are considering 10 major factors that could affect project management. While there are many other factors, their relevance depends on a project-specific basis. We have selected these 10 common factors, which are applicable to most projects. This study will provide a clearer understanding for adjusting and optimizing project management efforts.

Given the multitude of factors that require analysis and subsequent selection by the project owner, in cases where client requirements are inadequately defined or subject to frequent changes, soliciting client feedback on a daily or alternate-day basis becomes crucial. In such scenarios, Agile methodology is the optimal solution.

Machine learning models comprise algorithms or mathematical structures that undergo training using data to generate predictions, classifications, or decisions, all without the need for explicit programming for each individual task. They constitute a fundamental part of machine learning and are employed to solve a wide range of problems. Among those, we have selected 5 models to predict the success ratio.

## PROBLEM DEFINITION

Analyzing the success factors of the Agile methodology in project management using machine learning is a novel endeavor. In this analysis, we are considering various related factors, including requirements, time, manpower, cost, and resources.

Accurate estimation during the planning phase is foundational for predicting the success of Agile software projects. The inherent dissimilarity between Agile methodologies and traditional approaches renders conventional techniques inadequate for precisely forecasting success in Agile software projects. This inaccuracy can result in both time and cost overruns.

Intelligent techniques are needed for success prediction in agile software projects to achieve better results. To address these challenges, an innovative model is proposed. This model harnesses the power of Linear Regression, Logistic Regression, Decision Trees, Random Forests, and Support Vector Machines to enhance success prediction.

## RELATED WORK

1. zIn 2022, Dr. Rupali Pravinkumar Pawar and Dr. Kirti Nilesh Mahajan [1] from Pune, India, conducted a small study to comprehend agile and traditional prince2 method success factors. For the same understanding, they used both the survey and the interview as primary data, as well as a book and articles as secondary data. The total number of respondents for the primary data was 42, ranging in age from less than three years to more than twelve years. There were a total of 12 factors examined for each, and they all came from product- and service-based businesses.

2. Fazal Qudus Khan, Saim Rasheed (2020) [2] significantly compared the Rapid Application Development (RAD) and Agile methods to develop the projects over the IT project management. They have conducted the Quantitative and Qualitative research for the same and have analyzed it through Comparison, case study and by using the Sprints. but they have chosen the student to complete their research work, so there are Biased data. T-test. F-test and Anova tests can be performed to have quality statistical analysis to evaluate the hypothesis. The sample size was too small for this research.

3. Abdallah Lalmi, Gabriela Fernandes and their team (2021) [3] have compared traditional, agile and lean methodologies. They have used qualitative methods and have tried to develop the hybrid model from these three methods. Tried to reduce the manpower usage, shortening project schedules, reducing costs, eliminating waste and increasing project satisfaction and optimizing results. Their theory was based on the short project not suitable for the larger and bigger team. So, there is a lot of work that needs to be done.

4. Michael Pace (2019) [4] has tried to find out the discrepancy between the project management methodology and project success. He tried to conclude the result through qualitative research to get the exact relationship between the Project management methodology and the chance for the success of the project. He did not used the survey methods, so his result was based on his comparison which is lack of reality. Such inductive inquiry emphasizes the efficient age of hypothesis by means of escalated interviews and topical examination of any arising designs.

5. Peyman Badakhshan, Kieran Conboy and his team [2019] [5] had deep analysis about the use of scrum's key or potential positive influence use in other collaborative management and coordination in research processes like in the education department and other science departments to reach their goal. They did surveys in various universities and did their research via one to one interview and through online activities too.

6. Elvir M. Akhmetshin, Petr Yu. Romanov and his team did a study in 2019 [6] for The methodologies and theoretical methods have been used for the innovation project management in enterprise. They have used the PMBoK for their study which is suitable for the target audience. They have used 9 sections including (Integration, scope, time, cost, quality, human resource, communication, risk and procure-management). Which leads to better use of the PMBoK instead of the traditional way.

7. In 2020 Mohsin Malik a , Shagufta Sarwar and his team [7] examine psychological empowerment in agile performance and practices. They did the survey on what the best practices are available to get the good performance of delivering the project via using agile. through explanatory mechanism they were able to find-out the best relationship between the agile practices and its performance on delivering the project smoothly.

8. Milos Jovanovic, Antoni-Lluis Mesquid and his team in 2020 [8] did a systematic analysis for factors and issues in agile adoption and transition. They analyze the development factors of agile which could be challenges for practitioners. They have analyzed 27 primary surveyed data and their factors at different levels. They had evaluated the approaches which were varying institute wise as their project seemed to have different different requirements.

9. Nikhil Govil, Mayank Saurakhia and his team in 2020 [9] did the study in behavior analysis of adopting the agile methodology and DevOps culture in eCommerce websites. They have explored the use of DevOps in agile as both do have the iterative phases to implement in project management. They have explored its benefits as well as their implementation methods which could be used to deliver it in an efficient way.

10. Magne Jørgensen [2019] [10] he had a quantitative approach to get the relationship among the successful software development, agile practices and in project size. He has visited 3 seminars and have collected 196 responses from their respondent in Norway, His findings is showing that agile project management leads to successfully project delivery beside the traditional methods, he have consider some of basic factors to analyze the data which could extend to get the precise result.

11. Project Portfolio Management (PPM) is crucial for company growth, facilitating strategic planning across various scenarios. PPM aims to efficiently manage resources for successful project execution and organizational objectives achievement. With vast data generated daily in PPM, there's a need for models to process and interpret it, where Machine Learning emerges as a key enabler for automated pattern recognition and trend analysis. This paper reviews Machine Learning implementation proposals and critical success factors for Project Management, identifying 7 ML methods and 18 critical success factors for PPM from 122 articles reviewed.

12. Governments worldwide increasingly rely on private participation projects and foreign ownership for technology and capital access in infrastructure. Predicting the success of these projects is crucial for decision-making. A multidimensional study using heterogeneous classifiers on real-world World Bank data across sectors (Energy, Telecommunication, Transport, Water Sewerage) reveals sector and region-specific predictability, with Telecommunication projects in Sub-Saharan Africa showing the highest success rates

13. This study addresses the challenge of accurately predicting software project outcomes by deploying a novel multi-regression model, achieving an impressive accuracy of nearly 98.3%. Additionally, the research introduces a recommendation system for optimal team design matrix, leveraging project statistics, client history, and human resource capabilities to enhance software project management efficiency and mitigate the risk of failures.

14. Lean Six Sigma (LSS) integrates Lean and Six Sigma methods to achieve a capability level of 3.4 defects per million opportunities, enhancing business efficiency and customer satisfaction. Despite its widespread adoption, many struggle to realize expected benefits. Research into causal mechanisms linking LSS enablers to outcomes is limited, highlighting the need for comprehensive study. Utilizing Natural Language Processing (NLP) and cross-domain knowledge, a novel method aims to develop a concise model elucidating how LSS elements drive quality, customer satisfaction, and business performance.

15. The expansion of information technology (IT) has led to numerous IT projects, yet their success rates remain low, with about 1 in 3 projects failing. Researchers have explored predictive techniques, but no models focus on predicting success pre-initiation. This study introduces a new set of variables tailored to IT projects, validated through expert interviews and surveys, providing a foundation for developing a prediction model based on project metrics before project initiation, offering a roadmap for future research in this area.

## APPROACHED MACHINE LEARNING MODELS

Utilizing the data gathered from the Google Form survey, our aim is to employ machine learning algorithms in order to provide an accurate forecast of project success ratios. This forecast will be derived from the input of 200 Project Management Professionals and will rely on assessments across 10 distinct parameters.

## SUPERVISED MACHINE LEARNING: CLASSIFICATION:

1. LDA is a method that detects the linear combination of characteristics that best distinguishes different classes in data.

2. Random forests use groups of decisions to classify data by aggregating predictions from multiple trees.

3. Decision trees make decisions based on the values of features to classify examples, dividing feature space into regions.

4. Logistic regression models the probability of a binary outcome using a logistic function, making it suitable for binary classification tasks.

5. Naive Bayes assumes independence among features and calculates the probability of an example belonging to a class using Bayes' theorem.

## PARAMETERS WE USED TO ANALYZE THE RATIO SUCCESS

1. How would you rate the support and involvement of upper management in the agile process?

2. How would you rate the level of resources allocated to the agile process in your organization?

3. How well-defined are the project goals and requirements?

4. How frequently are project progress and status reviewed?

5. How well is the team managing changes in requirements or scope?

6. How well is the team adapting to changes in technology or tools?

7. How well is the team managing risks and issues?

8. How would you rate the communication and collaboration among team members in your agile project?

9. How would you rate the level of trust among team members in your agile project?

10. How would you rate the level of empowerment given to team members in your agile?

**Data Collection:** We conducted a comprehensive data collection effort, gathering primary data on success factors directly from 100 Project/Product Managers employed at reputed IT companies that utilize Agile methodologies. This data was meticulously collected via a Google Form survey, ensuring diversity. By tapping into the firsthand

experiences and perspectives of these practitioners, we gained valuable insights into the key factors contributing to the success of Agile projects within the IT sector.

## METHODOLOGY: MACHINE LEARNING ALGORITHM

In our methodology, we gathered primary data from 100 Project/Product Managers at respected IT firms using Agile methods, facilitating quantitative analysis. Employing Supervised Machine Learning, specifically a Classification model, we implemented algorithms like Linear Differential Analysis (LDA), Random Forest, Decision Tree, Logistic Regression, and Naive Bayes. Additionally, we developed a custom algorithm tailored for the Classification model within Supervised Machine Learning to enhance our analytical approach.

## CUSTOM CLASSIFICATION ALGORITHM:

The creation of a custom model for predicting project success rate based on agile project management factors involves designing a neural network tailored to the specific requirements. By adopting TensorFlow, a robust framework for machine learning, one can implement this model efficiently.

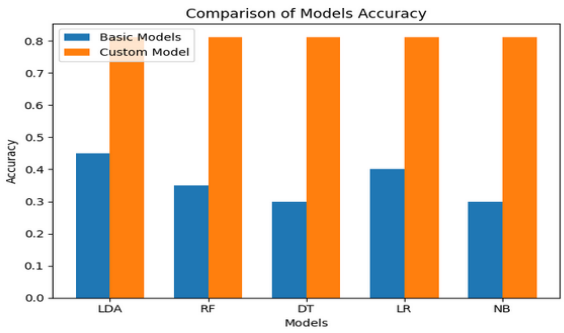
Through defining a custom model class inheriting from tf.keras.Model and incorporating fully connected layers with batch normalization and dropout, alongside a sigmoid activation function in the output layer, the model can effectively predict success rates bounded between 0 and 1.

Furthermore, the process encompasses instantiation, optimization, loss function definition, and compilation, culminating in the fitting of the model to training data. To optimize performance, adjustments in hyperparameters, model architecture, and preprocessing steps are vital, ensuring alignment with the nuances of the problem and characteristics of the data. Ultimately, this approach enables the creation of a robust predictive tool tailored to agile project management contexts.

**Basic/Custom Model's MSE and R2 Comparison:**

| Model | MSE train | R2 train | MSE test | R2 test |
|---|---|---|---|---|
| LDA | 89.473684 | -0.111159 | 90.0 | 0.108911 |
| Random Forests | 30.263158 | 0.624167 | 90.0 | 0.108911 |
| Decision Trees | 34.210526 | 0.575145 | 85.0 | 0.158416 |
| LogisticRegression | 80.263158 | 0.003225 | 110.0 | -0.089109 |
| Naive Bayes | 113.157895 | -0.405289 | 190.0 | -0.881188 |
| Custom Model | 6.806793 | -8.353243 | 6.700104 | -6.533767 |

**Comparison of Model Accuracy:**




## RESULT AND DISCUSSION:

In our analysis, we have examined 10 significant factors, and the data indicates that Agile methodologies have become indispensable for projects where requirements evolve over time. This underscores the adaptability and flexibility of Agile in accommodating dynamic project needs. The iterative nature of Agile practices aligns well with the shifting demands of modern project environments, enabling teams to respond promptly and effectively to changing requirements. This finding emphasizes the importance of embracing Agile principles to ensure project success in today's dynamic business landscape.

The evaluation of Mean Squared Error (MSE) and R-squared (R2), alongside accuracy comparisons, demonstrates the superiority of custom machine learning models over basic counterparts. Custom models exhibit higher precision, as evidenced by superior accuracy rates and MSE/R2 results. This highlights the effectiveness of utilizing tailored machine learning approaches to project management data. Leveraging custom models enables organizations to gain more accurate insights into project dynamics, enhancing decision-making and improving project outcomes.

## CONCLUSION:

In conclusion, our study highlights the critical role of Agile methodologies in projects characterized by evolving requirements. The superior performance of custom machine learning models underscores their effectiveness in analyzing project success factors. By leveraging Agile principles and tailored machine learning approaches, organizations can enhance their adaptability and decision-making capabilities, ultimately leading to improved project outcomes in dynamic environments. Embracing Agile and advanced analytics techniques represents a strategic imperative for organizations seeking to thrive in today's rapidly changing business landscape

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