

Artificial Intelligence, Analytics and Agile: Transforming Project Management in the 21st Century

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Abstract: With the advent of intricate and advanced technologies, methods, and automation, several challenges have emerged that need to be addressed. Artificial Intelligent Technology, Agile and Analytics holistically improve the project management discipline through continuous improvement and consistent execution. This paper builds upon this discussion and establishes how project management is using the AI supported tools, extensive use of data analytics and the Agile approach for improvement. Technology is revolutionizing the project management, yet the role of project managers cannot be undermined since they are the primary drivers of the project and deliver value.

Keywords: Project Management, Artificial Intelligence, Data Analytics, Agile, Scrum

Though these concerns have always been at the forefront of a project manager’s duties, new developments in every field of endeavor have added to the complexity of these tasks. New technologies, automation, improved techniques, and scientific breakthroughs that occur on nearly a daily basis in most fields of study create the need for project managers to find new ways to tackle these challenges by using a combination of three strategies: artificial intelligence (AI), analytics, and Agile methodology.

I. INTRODUCTION

Artificial Intelligent technology (AI) is evolving faster than expected, Agile methodologies are being practiced by most of the organizations to manage projects and Analytics are the driving force for estimating costs and schedules. These three A’s (Artificial Intelligence, Agile, Analytics) are transforming project management practices in the 21st century. This compels us to think about if AI will replace project managers? If Analytics and AI can accomplish project estimates, track tasks and even communicate with teams, what is left for the project managers? Rest assured, there is nothing to worry about as humans are still a step ahead when it comes to managing teams. AI can help in better resource allocations, but project managers use emotional intelligence to manage the people on their teams, motivate them and keep them focused on delivering projects successfully. Scaled Agile values individuals and interactions over processes and tools and it values responding to change over following a plan. Analytics can bring deep insights into project baselines and help in budget forecasts. Analytics allow project managers to predict deviations from estimates and are extensively being used to track projects and proactively identify issues. Project managers experience many challenges while managing projects and these range from delivering on time, within budget to keeping team members motivated. Three challenges beset project managers trying to keep up with today’s projects, be they in almost any field. These challenges are: finding a more efficient way to estimate costs, correcting project performance in real time, and how to respond to changes quickly to ensure customer satisfaction.

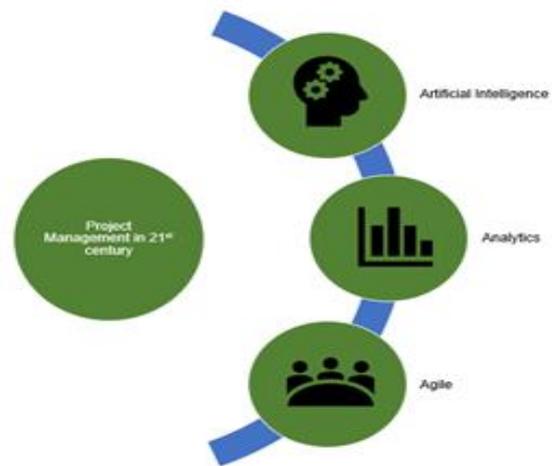


Figure 1-AI, Analytics and Agile: Transforming project Management

II. OBJECTIVE

The objective of this paper is to explore and emphasize the importance and adoption of AI, Analytics and Agile methodologies that will be disrupting the way of managing projects in 21st century. The paper discusses the challenges posed to conventional Project Management practices from AI and other disruptive technologies. It explores tools and techniques to navigate the new landscape and highlights key areas of learning for Project Managers to ensure successful delivery in this dynamic new world

III. THE CHALLENGE

With projects becoming more complex with the growth of new production technologies, automation, and a global economy, what are the most challenging issues that face project managers in the 21st century? Complexity has always been a factor in project management. New technology and a global economy, however, add more layers to the factors that impact a given project.

Manuscript received on March 07, 2022.

Revised Manuscript received on March 14, 2022.

Manuscript published on May 30, 2022.

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Retrieval Number: 100.1/ijrte.G68770511122

DOI: 10.35940/ijrte.G6877.0511122

Journal Website: www.ijrte.org

Published By:
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For example, a political kerfuffle in a country in which a company manufactures its parts can cause a rise in prices, even scarcity. The estimate a company's sales department provided may not even cover the cost of manufacturing, in that case. On the other hand, new developments in technology can cause parts of a company's manufacturing process to become obsolete practically overnight.

Retooling the process to incorporate that technology can eat up a project's cost quickly. To deal with this century's growing complexity, project managers need an efficient way to manage three things: 1) to produce more accurate estimates, 2) to correct project performance in real time, and 3) respond to changes quickly, resulting in increased customer satisfaction.

Challenge 1: Finding a More Efficient Way to Estimate Costs

Traditional project cost management relies on finding a "baseline for the assessment of financial performance during the project," as Hendrickson and Au point out in *Cost Control, Monitoring, and Accounting*. (1) Herein, however, lies the challenge—estimating the potential problems one might encounter.

Challenges Inherent in the Estimation Process Itself

Even in a simple construction project, as Hendrickson and Au indicate, there may be up to 400 separate cost categories, when one factors in not only the materials one plans to use, but all the other costs involved, such as equipment rental or depreciation, labor, payroll preparation costs, interest on equipment or materials bought on credit, cell phone data usage if the project is out of range of wireless. Those factors

add up to a complicated web of variables. To sift through data on similar projects in the past would, of course, take a tremendous amount of time. To factor in those costs in real time in many cases with traditional methods would prove nearly impossible, since changes can occur in mere seconds, throwing off the estimate with every change.

Budgetary Concerns Further Complicate Estimates

As John Stenbeck put it in his paper, "Five keys to estimating" (2), "the absolute dread that comes from needing to provide estimates for some requirements that are, quite simply, unknown or unknowable" presents project managers with their greatest challenge. Again, those factors can change within seconds in real time. Having a reliable method to analyze all these factors in their complexity continues to stymie project managers even to this day.

A company's project manager must bring the stamp of reality to a customer's vision and that of the company's marketing department, as Stenbeck points out. The customer has a goal in mind: creating a project that falls under a certain amount. The company's marketing department, of course, wants to promise that result.

That "top-down" approach, however, rarely works. Before the marketing team promises the world on a silver platter, project managers should work "from the bottom up, first defining the requirements, then estimating the work, and finally evaluating the results." Indeed, that is the better approach. To create a more accurate bottom-up estimate, managers need a more accurate process that can deliver timely results.

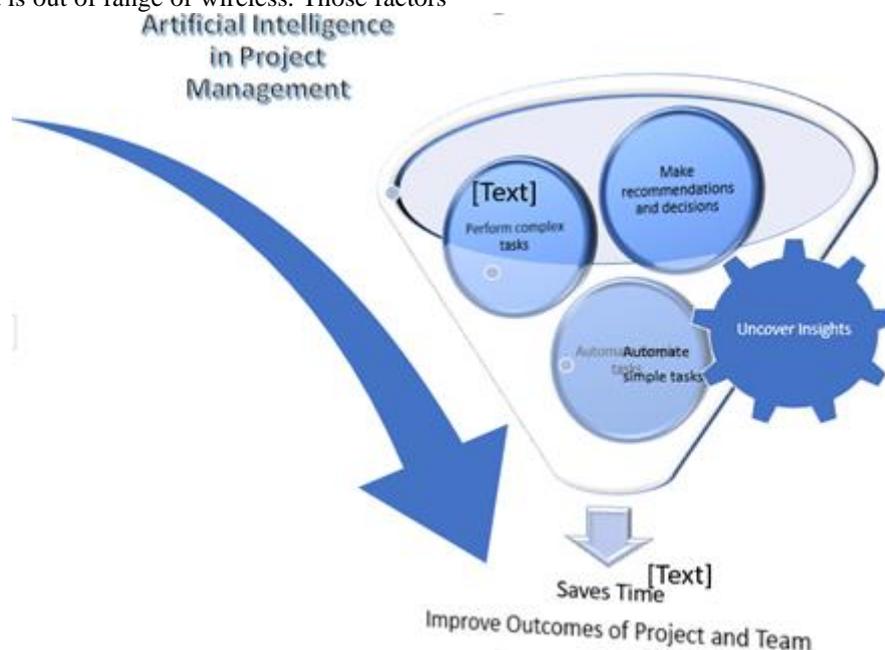


Figure 2- Artificial Intelligence for Project Management

Challenge 2: Correcting Project Performance in Real Time

Once the estimate comes in, the work begins. How can a project manager see potential problems and correct them before precious time and money flows down the drain? If there were only a method to detect underperforming aspects of a project in real time, a project manager could analyze those problems, come up with a solution, and get the project

back on track. As Helena Bachar points out in her *Clarizen.com blog post* (3), what was once a "fairly informal process" is now a requirement—a risk management plan. Her checklist includes the following best practices:

- Begin the process early, with a predefined plan for identifying and monitoring risks as the project proceeds.
- Identify possible risks and assign team members to detect and report those issues
- Prioritize risks, using the likelihood of occurrence and the impact each will have on the project as criteria
- Maintain communication on both ends, with the project teams, with company executives, and with the end customer.

The crucial factors here are to identify and prioritize each possible risk, detect those areas quickly, and adjust the process to correct the project’s course. The ideal solution, therefore, would be to have a strategy to identify underperforming areas in real time, make the correction, and re-evaluate the solution in real time.

Challenge 3: How to Respond to Changes Quickly

If a project manager can identify underperforming aspects of a project in real time, how can he or she respond to those changes in a way that ensures the end customer’s satisfaction? Chuck Millhollan (4) puts it well in the title to his paper, “Scope change control: control your projects or your projects will control you!” According to Millhollan, four factors affect a project manager’s effectiveness in managing changes. They are as follows:

- Inadequate project requirements
- “Scope creep”—a project exceeding its original boundaries
- Poor structure and methods
- Little or no control over change

Even when a manager has the strategies in place to tackle project requirements and structure, scope change can occur even in the best-laid plans.” Estimating potential costs and requirements and the ability to effect change in real time can be of little use if the scope changes—and if the manager has little control over the change.

What project managers need to address scope change, then, is a strategy that can handle these changes

efficiently, quickly, and with the full blessing of the end client. Such a strategy should empower teams to make decisions about changes on the fly and 1) either get the client’s approval to make those changes or 2) find another way to make the project work in a way that satisfies the client. It would appear, then, that a solution to these challenges must involve more than one strategy. Fortunately, thanks to new developments in technology and management methods, there is a combination of strategies that can produce the best possible outcome. Trends and Transformation in Project Management How can project managers produce this outcome, given their need to analyze new concepts and information to produce more accurate estimates, correct project performance in real time, and respond to changes quickly, resulting in increased customer satisfaction? By leveraging three state-of-the-art project management strategies, namely, AI (artificial intelligence), Analytics, and Agile, project managers can keep their company on the leading edge of its industry.

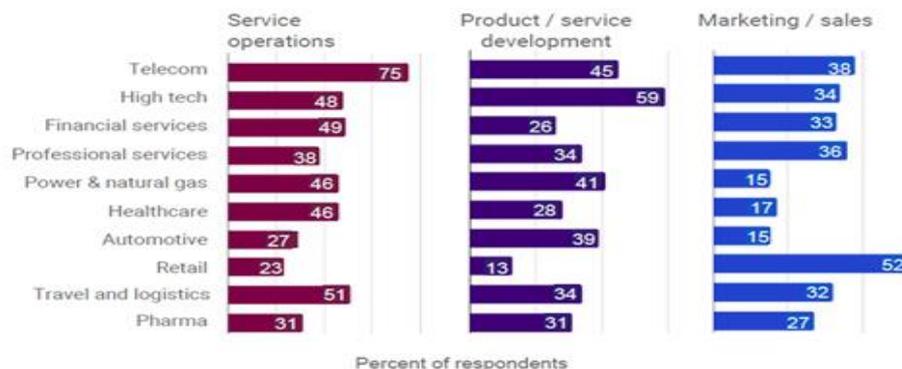
AI: Technology for Tomorrow’s Tasks

Today’s project managers must have a grasp of cutting-edge technologies to tackle all the challenges with which each new project presents. Even though they’ve handled a wide variety of IT projects in the past, says technical project manager Audrius Zujus (5), future projects will likely involve machine learning and artificial intelligence (AI). In fact, he argues, it is no more an option, but rather “essential for technical project managers to have a healthy relationship with these concepts.”

More Accurate Estimates

Since studies project AI to produce 2.3 million jobs and \$2.9 trillion in revenue, it will be important for companies to integrate AI into their project management tools, says Zujus.

AI adoption by industry and function (2018)
Source: McKinsey & Company



Note: The size of each bar is relative to the industries within each function; Telecom: N = 77; High tech: N = 215; Financial services: N = 306; Professional services: N = 221; Electric power and natural gas: N = 54; Healthcare systems and services: N = 67; Automotive and assembly: N = 120; Retail: N = 46; Travel, transport, and logistics: N = 55; Pharma and medical products: N = 65.

Figure 3- AI adoption by Industry and Function (Source: McKinsey & Company)

Its value, he says, lies in its ability to categorize new data about previous data it has analyzed. Its internal algorithms (operating instructions) analyze previous features of an object or idea that help it classify objects or ideas it will receive in the future. One can see where this would be beneficial for business applications, specifically for providing estimates. As Zujus points out, humans aren't great "at dealing with large volumes of data." AI algorithms, however, are. After an AI algorithm analyzes a large number of data from previous estimates in a given category, for example, building a mobile application for a business, it can better predict an estimate for what it would cost another business to build itself a mobile application with different requirements, factoring each requirement into the equation from a wide range of previous data sources. With humans, larger the data to analyze, the longer it takes. However, with AI, more the data that they can crunch, the more accurate and faster will be the estimate. That may indeed be the reason more and more industries have adopted it as an essential strategy for success. AI can control for predictable human fallibility, while also enabling project managers to be even better at their jobs. Consider the following tasks carried out daily by project managers:

Human vs. Machine Project Management		
	Traditional Project Manager	Robot Project Manager
Staff Evaluation	Long project planning cycles involving budgeting and recruiting	Automated skill matching, candidate vetting, and team making
Work Assignment	Planning tools, long team meetings, strategic business alignment, and time-consuming one-on-one meetings	Automated availability detection, tasks assigned as needed
Performance Monitoring	Qualitative and quantitative data for providing 360° feedback	Automated monitoring
Sanction Underperformers	Performance management plans and dismissal	Errors and automated warnings
Worker Grievances, Personal Issues, and Workplace Nuance	Issue identification, work with team member and HR on resolving issues	Errors and automated warnings


The Smart Way to Find Business Software

Figure 4- Project Management: Human vs Machine (Source: Capterra)

Although, there are not many project management tools with AI yet certain exceptions exist. Such as Chatbots. They are great examples of artificial intelligence in project management software. For example, Cisco Spark and Redbooth teamed up with the Api.ai platform to create a messaging bot that asked team members things such as, "What's happening today?", "Show me what my team is working on," and "What's urgent?"

Stratejos provides a similar function for Agile software development teams as a Slack integration. Similar Siri-like tools will be more frequently used in upcoming years.

There are a few heavier project management software platforms with AI functionality. For example:

ZiveBox: A "digital workforce" tool with a healthy number of PM features, ZiveBox uses AI to determine how long a task *should* take, to examine the productivity of each team member, and to sort through enterprise-level communication databases.

Rescoper: The project management software automatically alters the "view" of each user so that it's tailored for their specific permissions settings, automatically schedules tasks based on workload and task duration, and provides alerts if the system "thinks" your project is going to run into budgeting or scheduling trouble.

ClickUp: ClickUp is comparatively new tool. While still in beta, its algorithms can already:

- Predict the best team member for a task and assign those tasks to them
- Automatically tag users in comments based on relevancy contexts
- Visualize notifications and updates
- Predict deadlines that won't be met
- Correct task time estimates
- Make corrections
- Update tools in timely manner
- Input data correctly



Figure 5- AI tools need Human inputs

Analytics: The Key to Better Project Performance

With AI, one can indeed come up with more accurate estimates and predictions for a given project. But what about the project’s performance? Traditionally, project management firm Mavenlink argues that the (6) project managers only had the capability to collect data, and “checking tasks off as they’re completed...” With today’s data analytics, though, says Mavenlink, project managers can see how a particular project is performing through dashboards that display all the crucial parameters that define success or failure.

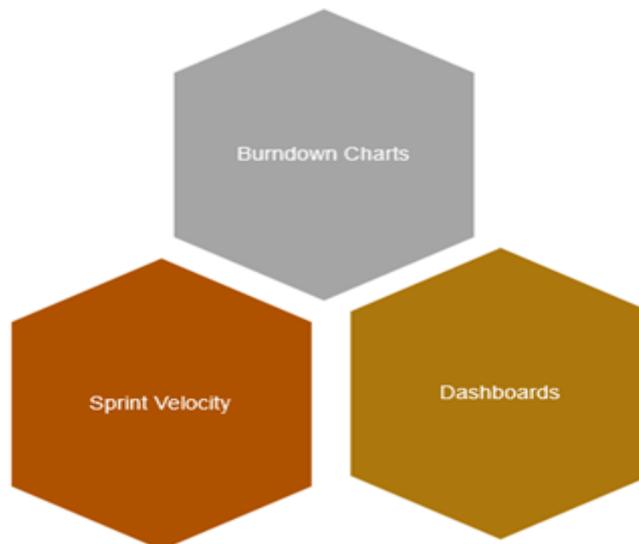


Figure 6- Analytics for Agile

Analytics provide insight on baselines of the project and hence help to manage them better. This insight and analysis can be used in project tracking and understanding specific patterns, trends and deviations from projected estimates leading to strategic decision making for project success.

Real-Time Analysis, Real-Time Corrections

Catching underperforming categories early, project managers can analyze the data within the category to see exactly what is causing the poor performance. This, in turn, gives the manager a chance to correct the problem in real time.

Having this capability gives project managers who have access to a powerful data analysis program, therefore allows them to assess options, detect problems they might not have foreseen, as Mavenlink puts it, “with real-time flexibility that can help avert disaster.”

The common methods of statistical data analysis techniques for projects are:

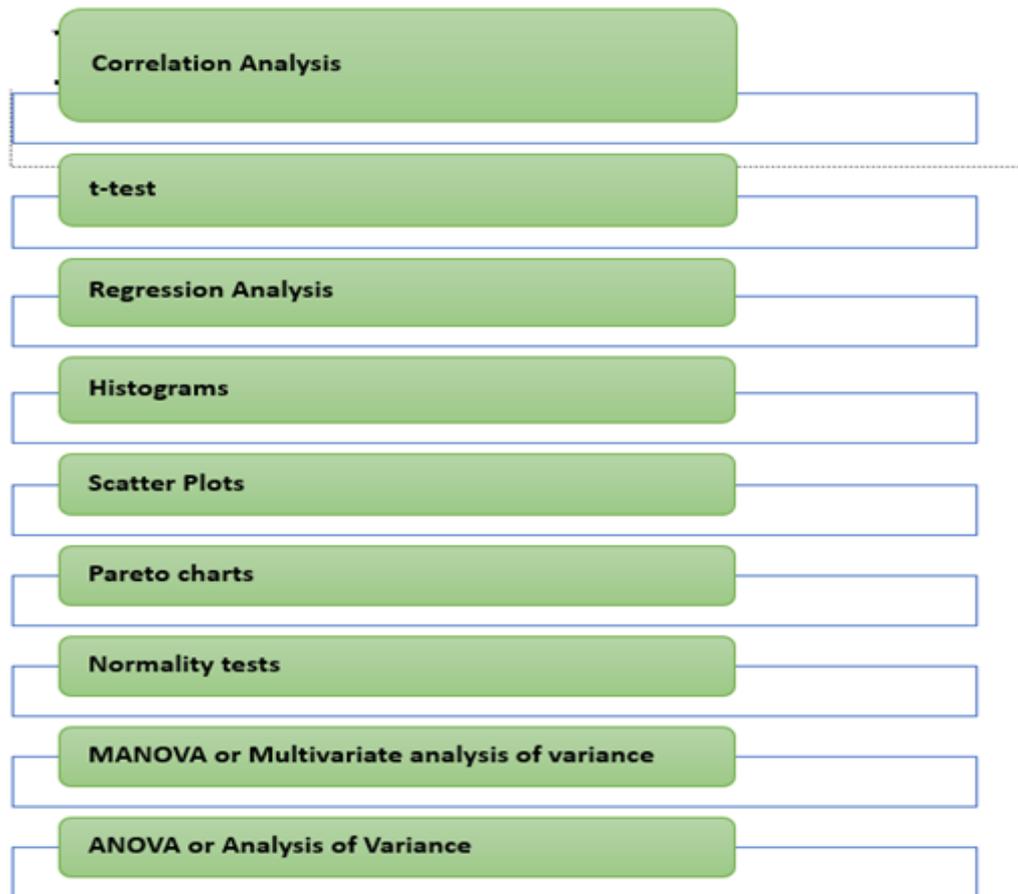


Figure 7- Data Analysis Techniques

They are explained as follows:

- **Correlation Analysis:** Correlation analysis shows how one variable relates to another. For instance, it shows whether piece rates lead to better productivity.
- **Regression Analysis:** Regression analysis is a quantitative prediction of the difference in values of one variable from that of another variable.
- **t-test:** t-test is a basic test to determine whether two groups of data are statistically different. For instance, use the t-test to determine the similarity of time sheet data from two different projects.
- **ANOVA or Analysis of Variance:** ANOVA makes use of simultaneous comparisons and determines whether a significant relation exists between variables.
- **ANCOVA or Analysis of covariance:** ANCOVA is a merger of ANOVA and regression analysis, to model a linear relationship between one continuous quantitative variable and one or more qualitative variable.
- **MANOVA or Multivariate analysis of variance:** MANOVA is a generalized form of ANOVA, used to make simultaneous comparisons and determines the existence of a significant relationship between two or more dependent variables.
- **Normality tests:** normality tests find determine the extent to which a random variable is distributed normally.
- **Scatter Plots:** Scatter plots are 3D visualizations that facilitate a representation of multivariate data in four dimensions.
- **Histograms:** Histograms are diagrams consisting of rectangles, with the area of each rectangle proportionate to the frequency of a variable, and the width of the rectangle equal to the class interval.
- **Pareto charts:** Pareto charts are a combination of bar and line graphs, to display values of one variable in descending order as bars, and cumulative values of all variables in a category, left to right, as a line graph.

Agile: Quick Responses, Customer Satisfaction

Although AI and analytics use algorithms and analysis to predict and detect, Agile puts the human factor back into the equation. Specifically, Agile methodology, as Hygger’s Pavel Kukhnavets puts it (7), “emphasizes individuals and interactions over processes and tools.”

Agile values:



Figure 8- Agile Principles (Source: Agile manifesto)

The 12 Agile principles (abridged) as per Aagilemanifesto (2001) are enlisted below:

1. Satisfy the customer through early and continuous delivery of valuable software,
2. The best requirements and designs emerge from self-directed teams,
3. Welcome changing requirements and use change for a competitive advantage,
4. Deliver working software as frequently as possible,
5. Customers and developers must work together daily throughout the project,
6. Trust people, and give them the leadership, environment, and support they need,
7. Convey information to and within the team using face-to-face conversation,
8. Working software is the primary measure of progress,
9. Sponsors, developers, and users should be able to maintain a constant pace,
10. Continuous attention to technical excellence and good design enhances agility,
11. Simplicity (the art of maximizing the amount of work not done) is essential, and
12. At regular intervals, the team reflects on what and how to do better and adjusts.

Though AI and analytics can find areas of underperformance and predict several possible solutions, an Agile team uses collaboration and incremental improvements in short time bursts to produce needed changes in a project in much less time than traditional project development.

Collaboration, Creative Freedom Produce Measurable Results

This flexible process allows teams to evolve the product through incremental improvements, responding to changes with solutions gleaned from each previous prototype. In Agile methodology, teams troubleshoot in collaboration with both the end customer and each other, helping speed the process forward with customer satisfaction and superior performance the ultimate goals.

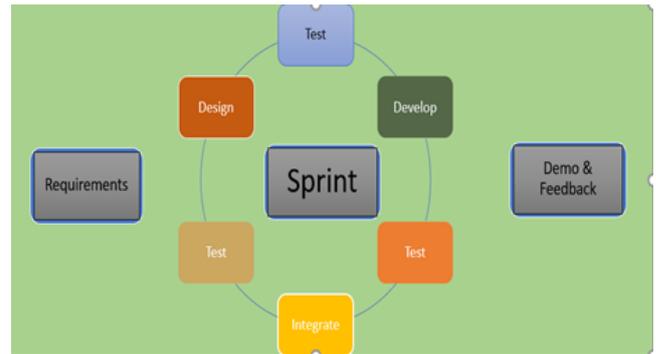


Figure 9 – Agile Project Management

With Agile project management, teams prioritize the most important challenges to solve, streamlining the process by reducing minor considerations. Feedback is quick, without the layers of bureaucracy inherent in traditional process management. Most importantly, as Kukhnavets points out, “Agile empowers team members to work creatively and effectively.” This strengths-based approach, therefore, prioritizes a creative approach to finding solutions in the 21st century (Figure 3). Combined with the testing capacity of AI and the problem-detection capability of analytics, Agile provides the third ingredient in more effective product management. Combined with AI and advanced analytics, Agile’s human factor provides the needed spark to power effective project management (Figure 4). When an organization uses all these tools: AI, analytics, and Agile, it will no doubt see its performance rise well above its competitors, provided it uses each tool in its proper context (Figure 5).

IV. CONCLUSION

As projects in all fields of endeavor become more complex, thanks to new technologies and more efficient production processes, the need for project management that can better project accurate estimates, correct underperforming areas of the project rapidly and efficiently, and respond to changes quickly in a way that increases the client’s satisfaction has never been greater. When project managers and their employers adopt these three strategies: AI, analysis, and Agile, they are more likely to achieve optimum efficiency in all aspects of a project’s completion. When efficient project management also results in client satisfaction, that is the ultimate measure of project management success.

Transforming Project Management

	Artificial Intelligence	Agile	Analytics
1	Project Management AI tools can automate tasks, provide insights and even communicate with the team.	Agile focuses on customer collaboration and allows to adapt to client's needs throughout the development process.	Dashboards are integral part of Project Management.
2	Artificial Intelligence helps in risk analysis and strategic decision making.	Focus on business value. Fast product releases and faster ROI.	Focus on project performance based upon data.
3	AI and machine learning to predict outcomes of projects using existing data and predict estimates and completion rate of project teams.	Transparency and increased project control by regular sprint meetings.	Reporting and analytics help to track waterfall as well as Agile projects.

Figure 10- 3As Transforming Project Management

Artificial Intelligence and Analytics can be leveraged for decision making on resource allocations, cost, and schedule estimates as well as lessons learned trends from previous projects. On the other hand, Agile practices can be customized in various ways to ensure optimization of resources, lean project management and enhances customer/business engagement. PMI has a framework for Agile projects - Disciplined Agile, that offers choice in your way of working and will certainly positively impact the future of managing projects and delivering value. AI, Agile and Analytics are transforming project management practices & tools and future of these technologies and methodologies will certainly disrupt the way of managing projects.

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