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The Future of Project Management:

Embracing artificial intelligence for enhanced efficiency, data-driven decision-making, and collaborative teamwork

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Abstract

Artificial intelligence (AI) integration into project management holds immense potential to revolutionize traditional approaches. This thesis examines AI's impact on efficiency, data-driven decision-making, and collaborative teamwork within project management. Through qualitative analysis, including semi-structured interviews with 10 participants from companies in Sweden, the study investigates AI's implications for project management practices. Key findings reveal AI's role in enhancing efficiency by automating tasks, predicting risks, and optimizing resource allocation. Moreover, AI facilitates data-driven decision-making, empowering project teams to make informed choices leading to improved project outcomes. Additionally, AI fosters collaborative teamwork through real-time communication tools and personalized learning experiences. Despite its contributions, the study acknowledges limitations, including potential lack of generalizability due to the qualitative approach and the sample size. Moreover, findings may be context-specific to Swedish companies. This study emphasizes the need of continuing to learn how AI is transforming project management in order to fully capitalize on its ability to change the sector.

Keywords: *Artificial Intelligence, Project Management, Efficiency, Data-Driven Decision-Making, Collaborative Teamwork.*

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1. Introduction

1.1 Background

The integration of AI has become a transformative force in project management practices, where productivity, flexibility, and creativity are essential. Massive data processing, pattern recognition, and autonomous decision-making capabilities of AI present a potential revolution in conventional project management techniques. Leveraging AI becomes essential for preserving competitiveness and project success as companies manage more complicated projects with shorter timeframes and budgets. Because AI can automate repetitive processes, forecast project risks, and maximize resource allocation, it is extremely important to project management. Project managers are therefore free to concentrate on value-adding and strategic decision-making. Moreover, data-driven decisions made by project teams made possible by AI-driven insights lead to more precise projections, better risk management, and better project results. Furthermore improving cooperative teamwork are real-time communication technologies, customized learning experiences, and improved platforms for engaging stakeholders.

1.2 Problem Discussion

Though AI clearly has benefits for project management, its integration and efficacy are yet unclear. Technical, financial, and organizational obstacles prevent many companies from using AI. Furthermore, not enough is known about how AI affects productivity, decision-making, and collaboration in project management procedures. These ignorances prevent AI technology from being fully adopted and thereby reduce their possible advantages. Project managers and teams also have a continuous problem because AI technologies are dynamic and need for ongoing updates and modifications. Given these potential benefits, and to maximize the value of AI, a crucial next step is to investigate successful strategies for integrating it into project management practices.

1.3 Purpose and Research Question

The aim of this thesis is to explore the future of project management by examining the role of artificial intelligence in enhancing efficiency, enabling data-driven decision-making, and fostering collaborative teamwork. This study investigates: How does the integration of artificial intelligence impact efficiency, data-driven decision-making, and collaborative teamwork in project management practices within companies? The following objectives guide this research in exploring:

- To investigate the impact of AI integration on project management efficiency.
- To explore how AI contributes to data-driven decision-making in project management.

- To examine the influence of AI on collaborative teamwork within project environments.

1.4 Delimitations

The study's qualitative design — ten participants in semi-structured interviews—may not have included all viewpoints on AI integration in project management. The focus of the research on Swedish businesses may further limit the application of the findings to other organizational or cultural contexts. Finally, given the quick advancement of AI technologies, some results could become out of date over time, calling for ongoing study in this field.

1.5 Disposition

This thesis is organised to offer a comprehensive inquiry of how artificial intelligence (AI) is integrated into project management. The backdrop of the study, the current situation, the goal and research question, and the delimitations are all covered in the introduction, which also establishes the groundwork. This lays up the context for comprehending the importance and breadth of the study. In order to begin the theoretical literature study, Chapter 2 examines the basic ideas and traits of projects and project management. It goes into great length on typical project management approaches and covers the project life cycle and its several stages. After that, the chapter turns to the idea of artificial intelligence and looks at its basic ideas and uses in relation to Industry 4.0. It looks more at how current AI technologies affect project managers' duties and obligations and examines how AI affects resource allocation and risk management. The research approach is the major topic of Chapter 3. An empirical literature survey synthesizing earlier research on AI and project management opens it. Presenting the research objectives and pointing up gaps in the existing literature, this chapter discusses the goals and significance of the study. Subsequently, the features of the sample population, the data collecting procedures (more especially, semi-structured interviews), and the data analysis procedures are thoroughly detailed together with the research design. To guarantee the rights and welfare of the participants are safeguarded, ethical issues are also thoroughly covered. Chapter 4 contains the discussions and study results. Starting with the thematic analysis of the interview results, it covers a number of topics including the participants' knowledge of AI, how AI is included into project management plans, and how AI improves data-driven decision-making and streamlines project activities. This chapter also looks at possible integration challenges, investigates which stages of project management gain the most from AI, and looks at how AI improves cooperation and teamwork in project settings. The future effects of AI on project managers and project management in general are covered, along with the most significant components of AI integration and their significance. The findings are interpreted in the term of the

body of current literature and offered practical insights in the discussion and recommendations that close this chapter.

2. Theoretical Literature Review

Theoretical literature pertinent to project management and artificial intelligence (AI) is thoroughly reviewed in this chapter. The goal of providing basic knowledge on project concepts, project management methods, and the developing field of AI technology is to lay a basis for comprehending the incorporation of AI into project management practices. The foundation of project management is provided by project concepts and life cycles. This part looks at the basic ideas of projects, their traits, and the stages of their life cycle. To accomplish project goals, processes, techniques, knowledge, and expertise must be applied. Here, we examine the fundamental ideas and traits that characterize project management as a discipline.Every stage of project execution involves distinct tasks and deliverables. Effective planning, execution, and control of projects is accomplished by the application of several methods and procedures. Application of widely used project management approaches is examined in this sub-section. Artificial intelligence refers to technology that let computers to carry out jobs that normally call for human intelligence. An introduction to AI principles and their usefullness to project management will be given here. The introduction of Industry 4.0 has significantly advanced AI applications in project management. In project management contexts, this sub-section addresses the meeting point of AI technologies and Industry 4.0 concepts. The functions and obligations of project managers are changing due to AI technologies. And the final theoretical part discusses how AI capabilities provide fresh approaches to resource allocation optimization and project risk management.

2.1 Project Concept, Characteristics and Project Life Cycle

People have participated in organized activities affecting their lives and societies from the dawn of civilization. Many times in the modern corporate environment, different activities are carried out as projects. Over time, the idea of what makes a project has changed to become its current definition. As to Lake (1997), a project is a series of activities and resources organized to achieve a certain result while accounting for constraints including time, quality, and cost and often resulting in a transformation. Companies are taking on a notably larger number of initiatives in the dynamic setting of modern society. These efforts cover not just the creation of new products or building projects but also those involving software development, marketing campaigns, process optimizations, and the launch of new services (Shenhar and Dvir, 2007).

In this sense, "project" designates a transient activity started with the goal of producing a certain good, service, or outcome. The goals of these initiatives are to enhance value, effect change, or encourage creativity. Since projects have well defined goals and deadlines that indicate when

they will start and end, their nature is mostly temporary. Projects are not the same as ongoing operational operations, which are repetitive activity aimed at the consistent production of goods or the provision of services (Kerzner, 2017). The difference between projects and continuous operational activities is this temporal aspect. In the knowledge economy, which is typified by the fact that value is mostly produced from intellectual resources rather than physical assets, the issue of project need is focussed on many basic aspects. First of all, projects are crucial elements of the process of promoting creativity and flexibility in knowledge-based businesses. By offering a structured approach, these frameworks empower teams to explore innovative ideas, develop creative solutions, and leverage the latest technologies. In today's fast-paced business environment, these factors are fundamental for achieving a sustainable competitive advantage. Projects also help businesses be able to effectively react to changing market dynamics and consumer expectations. Companies can keep growing and relevant in the face of changing industrial environments by implementing the strategic vision and introducing new goods or services through projects.

While being different from one another, projects and operations share many characteristics. Both cases have as common elements the use of organizational resources, employee involvement, and the need for exacting planning, execution, and management. It is not unusual to mistakenly classify routine tasks as different project types. Projects are completed once; operational tasks are completed regularly and constantly. To aggravate matters, finishing a project frequently leads to the creation of a completely new good or service (Gray and Larson, 2014).

The definitions of projects that are available in the scholarly literature allow us to pinpoint certain crucial elements that define the character of projects. Each project is an independent undertaking launched with the aim of achieving certain objectives, claim Cicmil et al. (2017). Over a predefined duration, projects are developed, starting at the outset and moving through several phases until they are completed. This lifecycle concept offers a methodical way to project management. This framework makes ensuring that projects move methodically through the scheduled phases. According to [Sydow & Braun, 2018] undertakings are by nature meant to be fleeting. They follow a predetermined schedule and are either successfully finished within it or abandoned if the goals are not attained or if conditions change. Projects should be directed by well stated goals that express the desired results and deliverables. These goals will provide the foundation for all planning, execution, and assessment of the project (Turner, 2009). Unquestionably, undertakings include inherent risks and uncertainties. There are often many significant unknowns and possible roadblocks when a project first starts. But as the project proceeds

and activities are completed, risks are lowered and uncertainties are progressively made clear by the application of effective project management processes (Perminova et al., 2008).

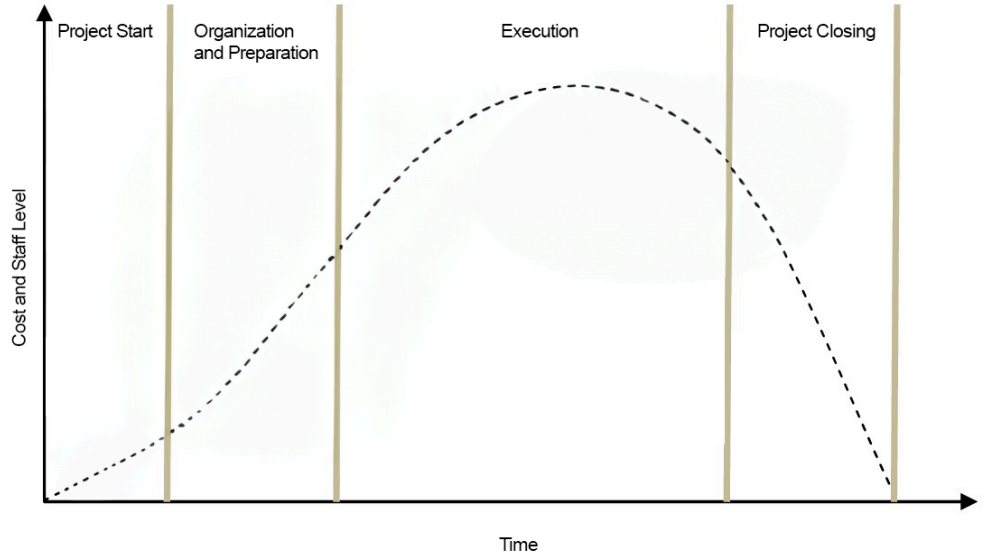
A sequenced or concurrently carried out set of related tasks makes up a project. These are interrelated actions; doing one successfully frequently depends on finishing the ones that came before it. Further adding to the intricacy of these interdependencies are resource and technology limits. Last but not least, the management and use of several resources—human capital, financial resources, materials, and equipment—is necessary for project execution (Burke, 2013). Projects are also usually completed under time limits, especially regarding cost considerations. Project success thus depends critically on efficient resource management. Moreover, initiatives have to include at least one of the following features (Gomes & Romão, 2015):

- Bringing about change; matching with strategic objectives
- Contracts help stakeholders come to an agreement; they also work well for solving big issues.
- Under the following headings can be found projects carried out by companies with the aforementioned qualities (Basu, 2016; Spychalska-Wojtkiewicz, 2018; Fitzgerald, 1998):
- Research and development (R&D) projects seeking to create new products or technologies; service projects; contract-based commercial projects; and infrastructure and construction projects
- Information systems projects; modernization and maintenance initiatives.

In order to accomplish their strategic goals, companies jointly manage operations, initiatives, programs, and sub-portfolios; this is where the name "portfolio" originates (Wideman, 2004). Projects and subprograms make up programs, which help the portfolio to align with the company's strategic goals. Within companies, organizational goals and priorities are intertwined, and portfolios relate to both programs and specific projects. The portfolio of the company ensures that the initiatives or programs are in line with the strategic plan even though they may not be directly related or interdependent (Stoshikj et al. 2014). Furthermore separating the ideas of projects and operations are certain characteristics. Projects provide a single, original good, service, or outcome; operations create duplicate goods, services, or outcomes. Projects are also transient, having a set beginning and ending date and are completed once. Operations, however, include continuous activity. Projects have little previous experience, but operations gain from that. Projects therefore are specified and certain, while operations are not. distinct projects by nature have distinct goals, timeframes, and limitations. This situation complicates the generalization of project life cycles.

Typical cost and personnel levels observed throughout the general project life cycle are shown in Figure 1.

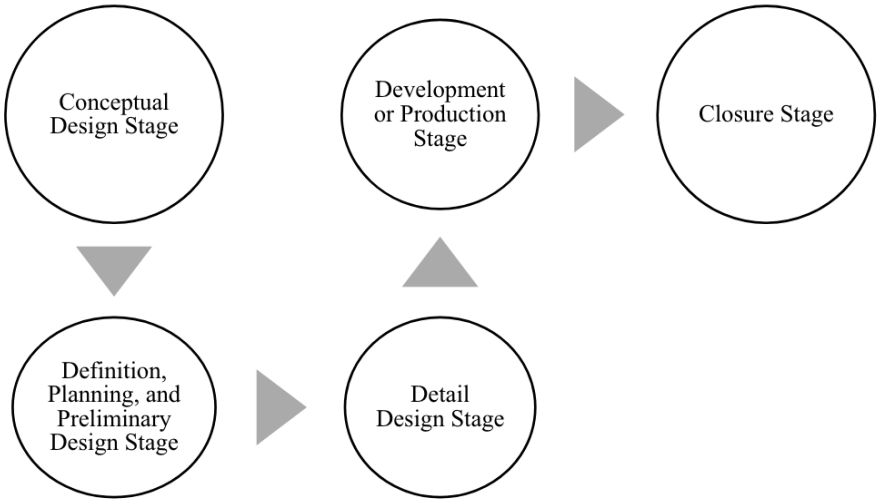
Figure 1. Typical Cost and Personnel Levels



Source: Janes & Succi, (2012)

As seen from the change impact charts depending on the project life cycle and project duration, the risk and uncertainty in projects exhibit a decreasing trend throughout the project's life cycle. The maturation of the project in its later stages, accompanied by the necessary decision-making and transition to other phases in agreement, reduces uncertainties throughout the life cycle. Additionally, while product features defined at the begining of the project do not significantly affect the project cost, it is observed that changes that may be requested towards the end of the life cycle can have serious impacts on costs. The stages depicted in the following figure generally occur in many projects within the project life cycle.

Figure 2. Stages of project design



Source: Kerzner (1989)

The conceptual design stage is the initial phase where a need for a product or service arises. Feasibility studies are conducted based on the requirements specified in the project definition documents. Following a feasibility study, a thorough evaluation is conducted to decide if the project should move forward. For projects that are decided to continue, concepts are developed through detailed feasibility studies analyzing technical, economic, social, and institutional feasibility (Kerzner,1989). The definition, planning, and preliminary design stage are where the organizational structures of projects are established, definitions are made for problem-solving, and activities are determined. During this stage, business models related to the project, implementation strategies, performance reporting processes, goals, quality control and assurance systems, and communication channels are developed. The detail design stage generally exists in projects, although it is combined with the development stage in some projects. Comprehensive planning is done during this phase. The plan includes the following activities (Kerzner,1989):

- Product and process design
- Final performance requirements
- Detailed breakdown of work
- Scheduling
- Documentation of cost and resource management
- Detailed contingency plans for high-risk activities
- Budgets
- Expected sources of funding

Before proceeding to the stage of development or production, it is necessary to prepare thorough plans that cover the entirety of the project and contain an adequate amount of in-depth

information. The quality and amount of depth of the plans that are developed at this stage are strongly tied to the success of the initiatives that are being undertaken. Additionally, the limits and challenges that are encountered during the detailed design stage provide for improved visibility of details, which eventually enables projects to move more healthily in subsequent stages through changes (Kerzner, 1989). The phase of the project known as the development or production stage is the period in which the anticipated product or service of the project is built within the framework of the plans that were made. Consequently, it is the stage of the life cycle that necessitates the greatest amount of time, labor, and effort overall. Evaluations are made at this stage regarding the extent to which the time, money, and performance goals that were specified in the project plans have been reached. In addition to conducting tests to determine whether the product fulfills the intended requirements and gaining the relevant approvals, evaluations are also made evaluating the extent to which the project has been completed. The necessity for well-designed control mechanisms has developed as a result of the fact that the stage of producing the product or service in accordance with the expectations of the customer comprises major performance-influencing factors of the project. This is because the stage contains activities that compare the planned plans with the present situation. According to Kerzner (1989), one of the most significant duties that project teams are responsible for is satisfying this demand.

Through the expertise of the project manager, the lessons learned from previous successes and failures, and the support from top management, the closing stage emerges as one of the most critical variables that leads to the success of projects. In this context, projects that have been finished and have fulfilled all of the requirements should be closed. The closure stage plays a critical role in building a knowledge base for future projects. This stage focuses on capturing both successful solutions implemented throughout the project and valuable lessons learned from any challenges encountered. All project information is also archived in databases to serve as a future reference point. Additionally, the closure stage is responsible for documenting the challenges that were encountered during the process of project execution. The experiences that are collected should be documented soon after specific milestones in order to reduce the likelihood that participants in long-term projects would forget the data. Additionally, chances to benefit from this data should be provided in other initiatives (Kerzner, 1989).

2.2 Project Management Concept and Characteristics

The Industrial Revolution, which occurred in Europe in the latter half of the 18th century, was responsible for the increase in complexity of work life as well as the dramatic changes that took place. Adam Smith, a Scottish philosopher and economist, made a significant contribution to the

field of economics by writing "The Wealth of Nations" in 1776. In this work, he highlighted the concept of division of labor and tackled significant economic difficulties. The year 1911 marked the publication of Frederick W. Taylor's book titled "The Principles of Scientific Management." Taylor suggests that the best way to carry out a task should be identified, that scientific methods should be utilized, that scientific approaches should be utilized in the recruitment process, that workers should be provided with opportunities for self-improvement, that workers should be assisted in achieving their goals, and that the tasks of management and workers should be separated. In the United States, Frederick W. Taylor (1856-1915), the pioneer of scientific management, focused on finding solutions to management problems at the workshop level. On the other hand, Henri Fayol (1841-1925), a French engineer, sought to find solutions to management problems from the top down (Vashisht & Vashisht, 2023). "Harmonogram" was a technique that was invented by Polish engineer Karol Adamiecki (1866-1933) in the year 1896. The purpose of this approach was to ensure that industrial activities were carried out in a harmonic manner (Debicki, 2015). (1903) is the year that saw the publication of this method that was invented by Adamiecki (the vertical bar graph) (Morris et al., 2013). Through the years that followed, a significant number of individuals continued to demonstrate an interest in the scientific process. Henry Gantt was one of them, and he was known for paying particular attention to the psyche of workers and their morale in the production process. In 1917, Gantt developed the Gantt chart, which was a tool that made the process of scheduling projects significantly simpler. During World War I, this chart was utilized in the construction of battleships, and it has preserved a significant amount of its original formatting to this day. It was necessary for firms to modify their organizational structures in order to accommodate the increased complexity of work life that occurred during World War II (Rosso & Randolph, 2001). The Program Evaluation and Review Technique (PERT) and the Critical Path Method (CPM) are two examples of some of the project management software applications designed to support. According to Agyei (2015), these methodologies provide project managers with vital support by calculating the longest path toward completion of a project as well as the shortest manner of completion.

PERT, CPM, Work Breakdown Structure, and Earned Value are some of the tools that have helped elevate project management to the forefront of attention for a considerable amount of time. On the other hand, integration concerning a particular objective was of greater significance than these. It was Schriever's opinion that this integration ought to have been carried out over the entirety of the project life cycle. Capabilities possessed by humans were also significant. High-level leadership, collaborative effort, and task performance were the primary focuses of Schriever, Raborn, and Philips at the time. Thamhain and Wilemon (1977) found that the Apollo was the

location of numerous investigations on the subject of teamwork and individual talents. In 1969, the Project Management Institute (PMI) was created, and in 1972, the International Project Management Association (IPMA) was established (Weaver, 2007). throughout addition, a great number of associations for project management had already been created throughout Europe prior to this. At that time, the focus of project management was on the difficulties that were associated with the project objectives as well as the tools and procedures that were utilized (Morris et al., 2013).

"A project is a temporary effort that aims to create something unique, such as a product, service, or outcome," the Project Management Institute (PMI) PMBOK defines. The beginning and the end of any endeavor are distinct. According to Abd Elhameed (2018), projects are instruments that organizations use to achieve the strategic goals they have set for themselves. In order to accomplish a particular goal, the purpose of a project is to move the organization from one state to another in order to accomplish the goal. On the other side, programs are sets of projects that are brought together and managed jointly. By coordinating several projects, which is more efficient than handling each one separately, they hope to improve the situation and bring about positive results. Furthermore, certain projects that are included in a program have the potential to generate benefits for the organization even before the program itself is ultimately completed. The organization and prioritization of resources across projects is another area that might benefit from program management.

Project management is the process of implementing knowledge, abilities, instruments, and processes to project activities in order to meet project requirements. Project management exists to add value to the job that is finished, claims Schwalbe (2009). According to Anantatmula (2020), project management is a process that involves combining management, economics, finance, decision sciences, and accounting among other academic disciplines. It adopts a systems approach to the goal of merging various fields. As seen by Soderlund and Geraldi (2012), project management may also be defined as the adept and knowledgeable application of different techniques and tools to meet the expectations of everyone involved. Apart from the traditional planning strategies, they emphasize that modern project management integrates approaches like optimization theory and quantitative research. Esteves et al. (2020) have noted that a project that is not well planned from the start may cause serious issues for the business later on. Many companies use project management techniques that are inappropriate for managing complex projects. Braglia and Frosolini (2014) further note that most companies are unaware of the advantages of using more contemporary project management techniques.

Project management has changed throughout time. Agile project management is the technique used to today's projects in contrast to the one known as traditional project management. Nevertheless, project management techniques are really used to manage projects according to the particular requirements of the businesses carrying them out (Špundak, 2014). In this regard, especially in our day, the evolution of information technology has caused a change from conventional to agile project management. Known by other names, such as predictive, classical, waterfall, or cascade project management, traditional project management takes a methodical approach to fully satisfy stakeholders' wants and expectations as well as project requirements (Morris, 2023). Leading the project team through structure and reporting is equally as important to project management as applying knowledge, abilities, tools, and strategies for project activities. Conventional project management executes its plans using the Plan, Do, Check, and Act cycle. Projects are supposed to be completed on schedule, under budget, and with the intended scope (Srivannaboon, 2009). The triple constraint is represented in conventional project management by the Project Constraints Triangle, sometimes called the iron triangle or devil's triangle. This tackles the problems of striking a balance between scope, time, and cost to guarantee that jobs are finished successfully (Nieto-Rodriguez, 2021). It emphasizes that budget, deadlines, and scope are the primary restrictions on a project and that these are also its key constraints. The triangle also implies that modifications in one or both of the other requirements are necessary when one changes in order to preserve quality. A project might be finished more quickly, for instance, by cutting back on scope or raising the budget (Nieto-Rodriguez, 2021).

2.3 Phases of Project Management

In the traditional method, projects go through five process groups: initiation, planning, execution, monitoring and control, and closing (Bryson, 2018). Defining the project correctly and systematically is of great importance for a successful project management process. The initiation phase of the project can be defined as the processes carried out to define the project or phase of an existing project by obtaining approval to start a new project or a new phase. The initiation process group of the project essentially aims for two situations: To clearly define project objectives and To organize all necessary resources within these objectives (Cheung, 2010). Since the decisions made in this initial phase have a much greater impact on time and costs than the decisions made in subsequent stages, managers need to be very careful when making decisions in this first step of the project. Additionally, practices such as developing the project initiation document and identifying project stakeholders are carried out in this phase. The limited completion times of projects and the

fact that project personnel generally also serve in their functional departments necessitate a detailed planning phase.

As a result of the fact that projects frequently exceed their intended deadlines and budgets (Fabricius and Buttgen, 2015), careful planning is very important for achieving success. The plans must to be specific, with actions that are well-defined and responsibilities that are given. In order to prevent large time and expense overruns in the future, it is necessary to devote a sufficient amount of time and resources to project planning. It is important to conduct all of the relevant analyses during the planning phase, which involves identifying the path or paths to pursue depending on the project objectives. The techniques and tactics that will be used to finish the project or phase are also outlined during this stage. During the planning phase, the project management plan and its sub-plans, which include plans for the scope, schedule, cost, quality, human resources, communication, risk, procurement, and management of stakeholders, are developed. Initial steps include defining the scope of the project, collecting requirements, and establishing the work breakdown structure. The activities and the relationships between them are identified, and estimates are made for the durations of the activities and the resources that are required. During this phase, the timetable is produced, cost estimates and budgets are established, risks are identified, and quantitative and qualitative risk analysis are carried out. The final step is to plan responses to potential threats.

All of the operations that are carried out in order to finish the activities that are outlined in the project plan in order to fulfill the requirements of the project are referred to as the execution and implementation phase of the project. In the event that the project plans are approved, the phase of implementation for the activities that have been identified for the project will commence. It is time to put the project plan that was prepared into action. At the end of this phase, the project product is delivered, which brings an end to the activities that comprise this phase. These activities include delivering the product or service that was created for the project. executing actions such as directing and managing project operations, creating quality assurance, forming, developing, and managing the project team, managing communication, executing procurements, and ensuring stakeholder participation are all practices that are carried out during the execution phase of the project. It is possible to describe the monitoring and control phase of the project as the collection of all the procedures that are required to monitor the progress status and performance, organize, identify areas in which modifications to the plan are required, and proceed with the implementation of the indicated adjustments. The purpose of monitoring and control is not to assign blame or impose punishment; rather, it is to keep track of progress and make certain that appropriate measures are

done in a timely manner in the event that there are areas that require improvement. Discrepancies between the actual progress of the project and the progress that was intended for the project are found and measured during the monitoring and control phase of the project.

Processes such as monitoring and controlling project work, conducting integrated change control, approving and controlling scope, controlling schedule and costs, quality control, communication and risk control, and controlling procurements and stakeholder engagement are activities that are carried out during the monitoring and control phase of the project. The closure phase of the project denotes all of the operations that are carried out in order to finish all of the activities associated with the project. When it comes to the phases of project management, the closing phase is one of the stages that is most frequently neglected. It is now possible for the project to go on to the closing phase if it has been accepted by the authorities and it has been decided that there will be no extra activities found as a result of the controls. During the process of finishing the project, it is also verified if the project has been finished in accordance with the requirements (Zulch, 2014).

2.4 Project Management Techniques

One of the most common approaches used in planning is the graph-based (bar or bar diagram) method developed by Henry Gantt in 1915. The Gantt chart is created by specifying the planned and actual durations of the project stages, along with start and finish times, along a timeline (Kumar, 2005). The steps (activities) of the planned work are represented by horizontal bars of proportional length. The sequence of activities is arranged from top to bottom, and the timeline flows from left to right. Henry Gantt referred to this technique as the "Daily Balance Schedule," thus emphasizing the ease of measuring progress against the plan, which is the fundamental advantage of the chart (Wilson, 2003). The Critical Path Method (CPM) was developed in 1957 by Mr. Walker, an employee of the DuPont company, for scheduling maintenance downtime in chemical factories (Hyatt & Weaver, 2006). Essentially, this method consists of the following steps (Aliyu, 2012):

- Defining the project, breaking down work packages into activities,
- Identifying relationships between activities, determining activity dependencies, and sequencing activities,
- Creating a network diagram that describes the relationship between activities,
- Estimating time and cost for each activity,
- Determining the longest path (critical path) through the network for project completion.

Obtaining start and finish times for each activity is the first step in CPM. Determining the start and finish times of activities due to dependencies between activities requires special calculations. As a result of these calculations, activities are divided into critical and non-critical, with critical activities being those that, if delayed on their start date, would cause a delay in the completion date of the entire project. On the other hand, for a non-critical task, the time between the earliest start and latest finish dates calculated in the project is greater than the actual duration of the task. In other words, a non-critical task has slack or float time. Activities on the critical path have zero slack time, whereas activities not on the critical path have float time. By calculating the start and finish times of activities, critical activities on the critical path and activities that can be delayed without extending the project completion time (having float) are identified.

Two years earlier, in 1958, the United States Navy employed the Program Evaluation and Review Technique (PERT) for the first time to develop the Polaris missile intended for submarines (Ezell, 1968). It was thus made clear how important PERT is for time management and control. To plan how to use current resources and budget to finish a planned project on schedule, utilize the PERT approach (Ba'Its et al., 2020). This approach enables the detection of hazards, bottlenecks, and program deviations. While in the Critical Path Method the durations of activities are known with certainty, in actual practice it might not be feasible to know them with certainty. The idea of probabilistic time so emerges when it is unknown for sure how long actions will take. Probabilistic critical paths are those that come from the assumption that durations of activities that are unknown with certainty are a probability distribution, as was the case when the original PERT approach was created (Bagshaw, 201). Moreover, it is not practical to inquire of a person or organization about the probability distribution of completion times for certain tasks; instead, three distinct timings are established for every action (Agyei, 2015):

• Most optimistic time: Describes the fastest time, under ideal circumstances, that the task will be finished.

• The longest time the activity will take to finish when everything goes wrong is known as the most pessimistic time.

• Most likely moment: It is the moment to finish the task under anticipated circumstances, according to previous experiences.

Every activity in the PERT approach has a beta distribution as its probability distribution; the average of these three predicted times is used to calculate the duration of the activity.

The literature on project team performance and motivation emphasizes the temporal changes in teams. Teams are typically quite driven and eager at first. They collaborate effectively and are thrilled about the objectives of the project. Conflicts could arise, though, as the initiative continues. Teams can get into these disputes because members have different priorities, viewpoints, or methods of operation. The fascinating thing is that, with proper management, these disagreements can really strengthen the team and enhance the project's result. Improved teamwork results from constructive conflict management. Conflicts bring individuals together to discuss honestly, listen to one another, and work out solutions. Project managers should so be aware of this. They have to make the atmosphere encouraging, resolve disputes, and improve communication in teams. In this way, teams can leverage their differences to produce more original and fruitful work.

Projects are clearly transient undertakings with stated limits to accomplish particular goals. The way project management techniques have developed mirrors the ever-changing character of contemporary corporate environments, where projects include anything from new product development to improved services. Over the course of a project, the phases of the project management process are planning, execution, monitoring, and control. Every stage is essential to project success and calls for close attention to detail and efficient stakeholder communication. Additionally covered are useful tools for planning, scheduling, and resource allocation in project management: the Gantt chart, Critical Path Method (CPM), and Program Evaluation and Review Technique (PERT). Through the identification of important routes, resource optimization, and risk management, these methods help to achieve project success.

2.5 Artificial Intelligence Concept

Artificial intelligence, or AI for short, is being used more and more as technology digitizes and automation in production becomes more common. This has highlighted the need of nations giving this innovation first priority and funding. An AI has several definitions. Artificial intelligence, or AI, as defined by Acemoglu and Restrepo (2020), is the research and creation of intelligent machines composed of algorithms and software that can identify, understand, and react to their environment. The Oxford English Dictionary defines AI systems as computer systems' theory and development for tasks requiring human intelligence. AI systems are those that, under computer or other computer-controlled control, can perform particular actions and behaviors in a way that is similar to that of sentient beings. AI is not a particular technology, but rather a set of procedures that include data analysis and technologies, apps, and software that enhance the intelligence of already-existing procedures (Boucher, 2020). Computer systems that are able to see, reason, and

occasionally learn and act in reaction to what they see and their goals are referred to as "artificial intelligence" (AI). Sometimes AI even has similarities to human thought processes.

One could consider artificial intelligence as a digital industrial revolution. Similar issues are raised by the development of artificial intelligence technologies, just as the Industrial Revolution introduced automation into human existence: Did production rise at this time? What kind of impacts did social welfare have at this historical era? Could you maybe describe the course that social and economic inequality followed? One can also raise comparable concerns about the integration of artificial intelligence technology into daily life. Due to the fact that artificial intelligence technology is not a single, straightforward technology, it is possible that clear answers to these issues will not be instantly forthcoming. This is due to the fact that it is intrinsically unpredictable due to its complexity and its dependence on a variety of technological disciplines. Through the use of data analysis and the ability to forecast future processes, artificial intelligence technology is able to provide useful feedback in the interpretation of the subject it works on. It is possible that the significance of this technical innovation may become obvious in decision-making processes that are based on the interpretation of data, such as selecting production methods and marketing tactics, as well as mapping consumer habits in the years to come. If artificial intelligence technology is seen in this manner, with an emphasis on its application across the economy, it has the potential to make tasks more efficient, faster, and better. Self-driving automobiles, human speech and translation, and supply chain management that is more efficient are some of the current applications of artificial intelligence. According to Meltzer (2019), artificial intelligence technology is dependent on machine learning, which is a technique that use complex algorithms and enormous amounts of data in order to generate increasingly accurate predictions about the future.

When it comes to artificial intelligence technology, algorithms can be implemented in a variety of ways, such as a component of a production process or as a product for the end user. In light of the fact that it has the capacity to profoundly affect the way in which societies live and work, it is essential to acknowledge that technical change brought about by this system happens without fail. In point of fact, artificial intelligence technology has already been encountered by humans as a part of this process of development. Computers are capable of thinking in lieu of humans, responding to voice commands, and, despite the fact that they do not have genuine feelings, they are able to modify their behavior in accordance with the circumstances in which they find themselves. As an illustration, intelligent assistants like as Siri are able to carry out a variety of tasks for users and deliver responses that convey a certain attitude in response to questions that are posed. Everything in a Tesla vehicle is connected to everything else, and any information that is

learned by one can be shared with the rest of the fleet. According to Szczepanski (2019), AI is also capable of matching costs and vehicles when an Uber ride is requested. AI technology has the ability to create a digital footprint for an individual by mapping the past activity of a social media user. This is accomplished through the utilization of certain algorithms. The logical organization of the websites that a user often visits, the identification of the areas of interest that they have, and the development of recommendations that are thought to be appealing to the user are all made possible as a result of this.

Artificial intelligence (AI) technology advancements do not necessarily have to be completely distinct, external, or independent from automation and machine learning advances. This is due to a number of different situations. The key reason for this is because the majority of the new activities that are generated with AI use automation as their foundation. Automation has resulted in the creation of new job categories for businesses that incorporate artificial intelligence into their manufacturing processes. A consequence of the automation that is required in order to make the transition to production methods that need a significant amount of capital is the interrelated nature of production processes. Machine learning is the driving force behind artificial intelligence technology. "Out-of-sample" experiments are used in the field of machine learning to determine how accurately a model in a dataset can predict fresh data. According to Agrawal et al. (2019), the major foundation for the advancement of artificial intelligence technology is the ongoing development of deep machine learning techniques. These approaches make use of the complexity and function of the human brain as a model for computer design. Through the process of machine learning, computer programs are able to acquire knowledge, enhance their skills, and even increase their performance by moving forward into the following future.

In its broadest sense, machine learning is a collection of methods that allow computers to create data-based models and automate programming through the systematic discovery of statistically meaningful patterns in existing data (Bhavsar et al., 2017). Machine learning is a type of AI that achieves accurate inference based on prediction methods without being explicitly programmed in software applications. Its algorithms aim to predict new output values using past data inputs (Bakshi & Bakshi, 2018). Machine learning focuses on developing computer programs that can access data and use it to learn on their own (Mitchell, 2006). Learning can be thought of as a process that begins with searching for sample patterns in data, then continues with observing or processing data, such as direct experience or instructions, based on collected examples to make better decisions in the future. The primary goal here is to enable computers to learn automatically without external assistance like human intervention and adjust their actions accordingly (Das &

Behera, 2017). Machine learning is a way to create AI, and it is one of the main driving forces behind the use of machine learning in organizations. There may be uncertainties in understanding the relationship between AI and machine learning. Generally, while AI aims to replicate some aspects of human perception or decision-making (Jarrahi, 2018), machine learning is used to improve or automate almost any task, not just those related to human cognition (Holzinger, 2016).

The notion to enable machines to think dates back to the early 1900s. One of the biggest developments of the past century is regarded to be the development of robots that resemble humans not only in appearance and physical traits but also in cognitive aspects. In 1945 Vannevar Bush put forth the ground-breaking concept of a "system that amplifies human knowledge and understanding". Yet Alan Turing questioned, "Can a machine think?" In his well-known imitative game from 1950, Turing put out a challenge to see if a machine could behave intelligently like a human (Petropoulos, 2018).

Dependency among sectors that facilitate steps from manufacture to distribution of a product is growing as technology progresses. Technology advancement makes industries with more AI utilization more appealing, which may boost productivity, particularly in non-labor-intensive manufacturing. Automation and robotics are not just for the industrial industry; they are predicted to be employed in many other industries as well and to keep growing. Generally speaking, supply chains, robots, automation, voice and recognition technologies, and sales automation are among the service industries where AI can be invested. Depending on the degree of development and governance systems of the nations, investments are seen as both public and private. The emphasis areas of the businesses may determine the kind of investments made. The domains in which technology will be used will eventually expand as long as investments in AI technology rise. Applications in the domains of design, health, and education might lead to job chances for fresh graduates. Particularly, individualized education programs and specialized instruction are thought to benefit students with particular learning challenges as well as other students without any issues (Kolb, 2014). Particularly throughout the pandemic, this has been somewhat experienced. Programs for training and teaching have been carried out remotely in several nations in an effort to stop the pandemic. The assumption that technical developments will be even more important in the future has emerged as a result of the deployment of this system to reduce the damage caused by the epidemic. This is so that it may be quite expensive to offer education and training services to more than a small percentage of pupils using the technology that is already available. In this situation, artificial intelligence applications can specialize the educational system and increase the number of positions available to education experts who will design and carry out customized education

programs. In the health and geriatric care sectors, similar expectations are also evident. Markets and national budget planning policies are significantly influenced by technological innovation, the development of the internet, shifting consumer demands and behaviors, economic developments resulting from manufacturers' ongoing pursuit of maximum profit, and financial crises. Apart from the recent political, military, and economic problems on a worldwide scale, infectious disease outbreaks can compel humanity to take various safety measures everywhere.

Investments in technology are increasing in many fields of work. These investments are mainly based on digital technological developments. Capital movements and cash flows in countries are supported by technological innovations through venture capital funds, business angels, and non-banking financial institutions (such as microfinance institutions, mobile operator ventures, SMEs). Additionally, companies have begun to focus on the mobile commerce market, which enables them to conduct their sales online. Through AI technology, similar products to those previously purchased by customers or searched for in search engines can be recommended. This can result in directing customer consumption habits. AI technology brings innovations not only to companies but also to governments and policymakers, necessitating the creation of some regulations. Especially in terms of legal disputes that may arise, rules of Social Media Law may need to be established to prevent them. The need for various ethical and moral rules based on ethical and moral norms in social media, considered as a form of socialization in digital environments, can be interpreted as a result of evolving and changing human behaviors. It may take some time for social rules to be accepted by everyone. Such situations suggest that technology can also affect the field of law, as it does in other sciences, and therefore, work in the field of law is necessary to adapt to developments.

The Industrial Revolution, starting in England and spreading worldwide, changed the world's economic and social balance. The most influential sector in the revolution, which brought innovations with it, was the automobile sector, which was one of the sectors most in need of mechanization. There was not an immediate increase in the general wage level during those times. After investments in human capital increased labor skills and decisions were made to enable mass education, an increase in worker wages was observed. With the increase in these skills, people became employees of large producers who enabled production on a larger scale, rather than individual producers. After these developments, factories employing multiple workers emerged, and production could be realized through the combination of labor and capital at different stages. With the Industrial Revolution, people began to live in collective housing, large buildings, or complexes,

directing their lifestyle from villages to cities so they could work simultaneously in factories or production lines. This led to changes in their cultural lifestyles.

In many spheres, including healthcare, the economy, and education, AI technology can benefit humanity. Considering the enormous economic potential of AI systems, it is imperative to state that many industries and enterprises will already benefit from its advantages. For instance, a lot of companies use speech recognition and response systems like Siri, Alexa, and Cortana. Though it is possible to argue that voice systems are increasing unemployment, they can also help to lower unemployment by increasing the need for qualified workers brought about by corporate technology investments. Jobs in fields like information processing can be created for skilled workers by voice recognition technologies. Conversely, unemployment can eventually decline as production rises and new economic sectors are developed. Analytics and CRM systems have been linked with machine learning algorithms to find out how to better service clients. Websites have chatbots integrated in to give users quick service (Velu, 2021). AI techniques in the transportation industry help to design transportation networks and manage traffic flows in addition to supporting the development of autonomous cars (Stone et al., 2016).

Artificial intelligence technology in education can result in the adoption of novel instructional strategies. They might help new services that back individualized learning environments like distance education to emerge. Algorithms that facilitate rapid knowledge retrieval and logical deductions about the intelligence and abilities of people can make education more success-oriented. Thus, one can assess pupils by going beyond subjective assessments. Artificial intelligence in healthcare services offers tools to assist medical professionals during the phases of diagnosis, detection, and decision-making. By means of these services, it is possible to guarantee early diagnosis of illnesses and to deploy robotic systems in surgeries to reduce the possibility of mortality. Patients can also use chatbots and online virtual health assistants to discover their medical records, make appointments, comprehend the billing procedure, and do other administrative tasks.

AI-provided data analytics in development and humanitarian aid can assess humanitarian aid scenarios and help accomplish sustainable development goals (Vacarelu, 2018). It might help in making wise choices in various instances regarding the growth of developing nations. This can make efficient use of financial and time resources possible. Financial advice can be given and historical investment data can be gathered by desktop programs. Every stage of production is made easier to operate by the efficient reporting generated by computer systems in industries. It helps companies to reach two very important goals: profit maximization and cost minimization. AI may assist in the design of new services, enhance corporate processes, and evaluate huge volumes of

data among other fields. All these beneficial outcomes are probably going to help nations both at home and abroad achieve social harmony as well as economic progress, development, and wealth. All things considered, the advantages of AI technology are higher production and marketing, the development of objective decision-making skills, and higher productivity.

2.6 Industry 4.0 in Project Management: AI applications

Methods of artificial intelligence are being used in project management procedures more and more. A survey of the literature shows that artificial intelligence technologies are applied in project management processes for project risk assessment, time and cost optimization, integration with Enterprise Resource Planning (ERP) systems, process and method improvement in project management, and application of artificial intelligence techniques. Uncertainty in project management procedures results from mistakes made in cost estimation and risk detection in construction projects. In this work, fuzzy logic methods based on expert opinions were applied to identify uncertainty in project cost, duration, contracts, and document arrangement. Since it immediately impacts the time and cost of software projects, accurate risk assessment is crucial. A survey of the literature is presented in this work with an emphasis on creating machine learning methods for software project risk assessment. Although machine learning finds extensive application in project management, the review shows that it is more effective in lowering project errors to evaluate project risks using machine learning. Among other conclusions include the possibility of using machine learning algorithms to efficiently lower the risk of project failure and improve software development performance (Mahdi et al., 2020). In a related work, risk management, project success, and human perception were investigated using machine learning applied to text mining on articles and Twitter data. The assessment came to the conclusion of a strong correlation between the pertinent parameters (Papadaki et al., 2019).

For companies to lower direct and indirect expenses, accidents, and unpredictably high damage risks, equipment failures must be predicted in advance. With machine learning algorithms based on maintenance records of identified equipment, Kohli suggested an equipment dependability model that categorizes equipment failures (Kohli, 2018). Applications of artificial intelligence methods have been made to knowledge management and software project management procedures to facilitate the management of complicated decision-making scenarios and big projects. Using genetic algorithms to project data kept in a software database, Li et al. (2002) enhanced time-cost optimization. This helped decision-makers, particularly in project management of large-scale initiatives, to examine difficult circumstances. In another work, sentiment analysis was done using the K Nearest Neighbor - KNN machine learning supervised learning method on data gathered from

MS Project program websites, offering insights into cost, time management, user support, and interface usability (Baro et al., 2019). Learning the organization's past allocation techniques, the machine learning-supported model in the study concentrated on human resources and offered suggestions for time, cost, and quality improvements (Kieling et al., 2019). To assist project managers in making decisions, a study on 12 years of cost data using a linear regression model based on machine learning techniques sought to forecast future costs of construction projects (Arage and Dharwadkar, 2017).

Predescu et al. (2019) report on a study where artificial neural network algorithms were used to complete the project management activity arrangement within time constraints. The study offered project managers and decision-making in project management procedures support as well. Regression analysis models were examined in order to enhance project cost estimate and guarantee timely completion of projects. The study contrasted machine learning-based algorithms for planning software projects and precisely anticipating labor requirements. Generally speaking, machine learning and artificial intelligence contribute well to the optimization of software applications, management systems, operational models, and technological infrastructure-based organizational processes. In this sense, machine learning enhanced Enterprise Resource Planning (ERP) software provides major benefits to businesses in the domains of Problem Source Analysis, Customized Insights and Predictive Analytics, Production Capacity, Product Quality, and Optimization procedures. It takes monitoring technology developments and incorporating them into company operations to stay up to date with the changes in corporate governance that have brought about the current competitive environment among firms. ERP (enterprise resource planning) systems are useful to companies operating e-commerce, e-business, and e-government processes. ERP systems are integrated systems in which all kinds of information owned by businesses are stored in databases and continuously processed in electronic media.

This is achieved by means of ongoing observation with artificial intelligence-based methods. Several technologically oriented businesses are already beginning to feel the impact of the use of artificial intelligence and machine learning. They are changing the way that company executives and lower-level managers oversee and run the company. The practical insights provided by machine learning and artificial intelligence enable companies to identify and seize many opportunities that they were previously unaware of, as well as make better informed decisions. When it comes to corporate management, an enterprise resource planning (ERP) system that is armed with artificial intelligence and machine learning is a powerful instrument that can bring advantages in spotting

challenges pertaining Both automated daily chores and sophisticated forecasting are feasible with the application of "Smart" system intelligence (Biezepol, 2020).

A literature review on leadership perception in the relevant subject was carried out as part of a study that emphasized the fact that construction projects serve as the foundation for construction management. Additionally, using genetic algorithms derived from artificial intelligence methods, feature selection was carried out on components that were obtained from the review that was carried out. In the context of Project Portfolio Management (PPM), which seeks to plan successful projects and manage all available resources in order to achieve strategic goals for the growth of the company, a literature review was carried out in order to compile and examine recommendations for implementing critical success factors in order to improve project management. During the course of the literature research, Marchinares and Aguilar-Alonso (2020) made recommendations for the actual implementation of essential success elements. These recommendations were based on the utilization rates of machine learning algorithms. As a result of shifting requirements and the development of new technologies, the modern environment for project management is continuously undergoing the process of evolution. Ong and Uddin had a conversation about the current state of data science and artificial intelligence in the project management industry, with a particular emphasis on the potential applications and uses that could be developed in the future within this framework. They noted that artificial intelligence in project management attempts to simplify project processes and boost efficiency, with diverse applications aimed at modernizing existing industry standard procedures. This is in response to the fact that technological applications are becoming increasingly complex. According to Ong and Uddin's research from 2020, they also brought attention to the fact that the growth of technology would enable the emergence of a variety of data scientist professions in the future, and that these technology-supported roles will eventually replace traditional ones. The model that Pena and his team developed, which was based on machine learning, contributed to the improvement of the processes involved in the execution of projects. The proposed model was incorporated into the project management tool, which led to an increase in the accuracy of the results obtained during the process of project evaluation as well as an improvement in the efficiency of decision-making throughout the process of project management (Pena, 2019).

An analysis of the application of machine learning techniques in project management processes stresses the importance of using third-party software and the thorough analysis of machine learning-supported project management techniques to transform conventional project management techniques. Furthermore, it highlights the need of project managers being aware of artificial intelligence-supported project management procedures in order to adjust to changing

circumstances and stay ahead of the competition (Wang, 2019). Ruchi and Srinath put up a platform that integrates machine learning ideas with big data in project management procedures. The created architecture has as its benefit the efficient digitization of project-related data, all phases of project management, and different transaction log formats both inside and outside of the pertinent organization. Although the study highlights that standard project management tools are autonomous software concentrating on various project management aspects, the created platform was shown to close the coordination gap between various project development stakeholders (Ruchi and Srinath, 2018).

Decision support for planning and process improvement in software projects has been provided by a thorough analysis of machine learning algorithms on failures in earlier software projects. With well-known learning models and suggested solutions, software project faults have been predicted (Tian et al., 2019). An artificial intelligence-supported new communication and engagement framework for energy projects has been developed in a study concentrating on the social acceptance of energy projects and contributing to artificial intelligence applications in energy systems. With the approach employed in the study, project managers in energy projects can create virtual communication and engagement tools powered by artificial intelligence to incorporate citizens, stakeholders, and authorized project managers who are impacting energy projects in the system (Buah et al., 2020). Emphasizing the importance of machine learning in project management, several enhancements have been suggested to enhance project-related workflows and develop smart process systems by using contemporary technologies in the global environment, such as task assignment to project teams, task completion speed, and task completion time prediction (ManikReddy and Iyer, 2018).

Feature transformation, feature selection, and parameter tuning strategies have been evaluated using project data in a work to improve the accuracy rates of machine learning algorithms by optimizing features and parameters. The study provides an inventive method to automate meetings held to plan important procedures, with the goal of improving relevant operations, and highlights the need of optimizing various algorithms to raise accuracy rates. An automated system that uses machine learning algorithms and is linked with mobile systems has been suggested to identify user preferences and produce significant outcomes to reduce the length of the negotiation process cycles (Fordyce and Tyler, 2000). In order to forecast the performance of individual projects, Sabahi and Parast presented a machine learning method based on measures of several facets of people's entrepreneurial orientation and attitudes. Machine learning algorithms have been evaluated to offer insights into the use of new technologies in data science and machine learning in

operations management and project management research, so enhancing the link between the entrepreneurial abilities of project team members and project performance (Sabahi and Parast, 2020).

Project success prediction has been achieved by modeling attributes found in software projects and project-related phrases as vectors trained with machine learning classification algorithms and based on ranking scores. Results on the current model have been significant (Illahi et al., 2021). Analyzing the literature research reveals that applications with artificial intelligence support are being created especially for various business sectors involved in the project management process. On the adopted model, the evaluation is done in teams after the integration of project management and ERP technologies under one roof and the definition of the project's anticipated results as evaluation criteria on the system. Differentiating the study is this procedure, which entails presenting the right project team to the project manager taking into account previous experiences before the project begins to predict the successful completion of the project. The web-based, dynamic and scalable architecture of the software created within the model allows it to be used to many project kinds and provide machine learning results to end users.

2.7 The existing AI technologies that influence the responsibilities of project managers

Whatever their particular application or degree of implementation, AI applications can be divided into seven different patterns. These patterns are Hyper Personalization, Autonomous Systems, Predictive Analytics and Decision Support, Human-Computer Interaction, Pattern Recognition, Anomaly Detection, and Goal-Oriented Systems (Walch, 2019). Initially, the Project Management Body of Knowledge (PMBOK) had parallels with autonomous systems, pattern recognition, and anomaly detection. All seven patterns, save for pattern anomalies and recognition systems, can interact with each other during the planning stage. Involvement in decision support and predictive analytics as well as human engagement is part of the execution phase. Phases of monitoring and control use different AI capabilities, hyper-personalization not included. Autonomous systems and human-computer interaction are finally included in the last stage. Applications for AI tools in various management processes include chatbots, deep learning, and natural language processing (NLP). A chatbot, for example, might help with meeting scheduling, group coordination, action item extraction from meetings for assignments with deadlines, reminders and follow-ups, and stakeholder record keeping by recording meeting information.

Using data from components to forecast which ones might not meet quality standards, deep learning is a useful tool for improving quality management. In a same vein, Natural Language

Processing (NLP) guarantees precise and efficient communication by bridging the gap between human and computer comprehension. By comprehending and answering to their language, NLP also helps in discovering pertinent material, which raises output quality and lowers the expenses related to repetitive operations. Deeper insights into possible results provided by AI improve the precision of decision-making. Through data correlations and trends, the system removes superfluous information so managers may concentrate on important insights. For instance, companies in the financial industry are ranging in their degree of integration of AI into their long-term plans, which calls for a reevaluation of their main goals, strengths, and areas for development.

Companies are urged more and more to consult with corporate management experts. Such a company, for example, is McKinsey's QuantumBlack, which provides improved project planning reliability by automated scheduling based on programmed logic and principles (Mohamed, 201). Furthermore, in case of unanticipated events, automatic monitoring of activity status and progress guarantees prompt notifications to project managers. Reputable project management software businesses are coming up with creative solutions as a result of AI integration into project management, especially through machine learning (Dam et al., 2019). One well-known vendor, Atlassian, offers a Jira plugin that finds and fixes small issues, freeing up project managers from the planning and prioritizing work and allowing knowledgeable team members to concentrate on more important duties. Early AI in project management, according to Atlassian, will be specialized assistants focused on particular project or team management chores such knowledge management, budgeting, sprint management, and estimate. The biggest benefits are seen in situations marked by ambiguity and complexity when the combined powers of AI and human intelligence are used Website: Atlassian

Accenture observed the interactions between people and machines at numerous other businesses. They discovered that businesses who combine AI with human learning benefit substantially more from their AI initiatives. They so devised the MELDS scheme. Five key concepts are presented in it for combining AI and humans: adopting the correct attitude, attempting new things, defining and managing goals in a leadership role, and understanding the value of data in AI strategies. Posing the correct perspective is seeing AI and people cooperating favorably. Trying new things refers to trying with several AI applications and taking lessons from them. Being in control and ensuring AI is assisting the business in achieving its goals is what it means to lead the way in goal setting and AI management. Acknowledging the value of data in AI strategies is knowing that high-quality data improves AI performance. Wauters and his group concentrated on

leveraging the clever computer trick known as k-Nearest Neighbours to improve earned value management (EVM) and estimate project durations. They sought to improve project management and planning for businesses (Accenture, 2018).

In project management in particular, AI technologies present a viable way to tackle optimisation problems. These tools are ready to simplify processes and guarantee that projects go smoothly and effectively. To avoid pointless chores, reduce the likelihood of reworks and conflicts, reduce delays, and improve overall project coordination, such optimization efforts are essential. A new method in the framework of EVM, the application of Nearest Neighbor analysis has the potential to completely transform the assessment and management of project performance. Using AI to find patterns and trends in project data, this method improves forecasting and decision-making accuracy. The capacity to identify and resolve any problems early on is one of the main advantages of including AI techniques like Nearest Neighbor into project management. Project managers should take proactive steps to course-correct by recognizing departures from anticipated project results, reducing interruptions and maximising resource use (Chen & Shah, 2018).

Adopting optimization techniques led by AI can also result in notable increases in operational effectiveness. Project teams can more successfully distribute resources, expedite processes, and eventually complete projects on schedule and under budget by automating repetitive operations and using predictive analytics. A paradigm change in project management techniques is represented by the Nearest Neighbor methodology being included into the EVM framework. Project management procedures should become more accurate, stable, and perform overall better thanks to this hybrid AI strategy, which will help companies more effectively accomplish their strategic goals. A novel method made possible by AI, process mining seeks to find important insights within intricate procedural frameworks. Monitoring of important processes, anomaly prediction, hidden bottleneck discovery, and collaborative pattern extraction are made easier with this approach. It basically provides a thorough knowledge of how procedures work, which enables businesses to improve productivity and streamline operations.

Apart from process mining, other optimization algorithms are strong instruments for creating workable strategies that combine time, money, and quality factors in the ideal ratio. During later phases of a project, these algorithms are essential in reducing the necessity for costly corrections. Organizations may prevent possible problems and guarantee more seamless project execution by using sophisticated computational methods. Moreover, a number of instruments designed to assist project managers in the field of agile project management have been established by the integration

of AI technology. Utilising AI, these tools improve decision-making procedures, promote collaboration, and maximise resource distribution. Project managers may efficiently negotiate the ever-changing terrain of agile projects, encouraging flexibility and promoting success, by using predictive modeling and real-time data analytics.

Teams cannot be assembled, projects cannot be assigned to certain resources, and deadlines cannot be effectively managed without these tools. Consider "Stratejos," which links with Slack to simplify Agile software team communication. Then there's "ZiveBox," which uses communication databases at the enterprise level to schedule task delivery and evaluate each team member's productivity (Gupta, 202). "Clickup" helps to choose the best team member for a certain assignment and promotes communication by tagging users in pertinent comments, therefore guaranteeing that deadlines are reached (Botha & Van Greunen, 2023). Data entry, project planning, and other routine chores that frequently annoy project managers have answers in AI. Artificial intelligence frees up important time and resources so project managers may concentrate on strategic decision-making and problem-solving.

2.8 The Influence of AI on Managing Project Risks and Allocating Resources

As the aforementioned research indicate, risk management is the area where AI is most likely to make major progress. Even the sharpest human viewers may not be able to spot correlations in data. AI can. Consider its ability, for example, to help project managers find insightful information and practical solutions on risk assessment and reduction. Among the many tasks that make up risk management are identification, analysis, planning, monitoring, control, and communication. In this area, AI can be very important in obtaining parametric data. To forecast exact timeframes for next projects, it can, for instance, examine past project schedules. To learn from data inputs, identify interdependencies, evaluate the likelihood of failure, and assess risk magnitude from both qualitative and quantitative perspectives, a number of AI technologies have been developed, including neural networks, fuzzy logic, and machine learning (Odejide & Edunjobi, 2021).

AI provides the ability to monitor, examine, and predict possible hazards in various teams and work settings under uncertainty, so solving issues with quality, cost, efficiency, and protection. Applications of it have mostly concentrated on risk assessment, prioritizing, and identification. In addition, AI-based risk analysis offers practical information that enable project managers to proactively handle potential hazards and put positive solutions in place. Process automation, changes to staffing levels, and careful project monitoring are some of these steps to guarantee that deadlines and budgets are met (Brundage et al., 2018). Leaders in the healthcare industry are essential to advancing healthcare continuously by using the most recent data science breakthroughs.

This is using advanced data processing methods to get important conclusions from the large and complex datasets that are gathered inside health systems. For instance, machine learning algorithms can be used to estimate, given professional opinion and lessons from previous projects, how long and what resources project activities will take. Machine learning applications can include continuous patient monitoring and data analysis. Leading companies in this initiative are LifeMeshAI, which uses probabilistic modeling to help public health experts by using machine learning for population-level data analysis. Proactive strategies in illness prevention and management are made possible by this method. Moreover, by automating decision-making processes, decision management systems are completely changing workflow methods. In the meanwhile, by identifying patterns in the data being processed, knowledge-based systems improve human decision-making abilities and enable more effective and knowledgeable decision-making procedures. Healthcare leaders may bring about revolutionary improvements that enhance patient outcomes and maximize healthcare delivery by integrating these cutting-edge technology (Mohamed, 201).

3. Research Methodology

This chapter dives into the methodological framework employed to investigate the impact of AI on project management. It outlines the research design, data collection methods, analysis strategy, and ethical considerations undertaken throughout the research process.

3.1. Empirical Literature Review

An investigation on the potential of artificial intelligence (AI) in project management (PM) automation is conducted by Auth et al. (2019), with a particular emphasis on the role that AI plays in changing PM processes. The authors analyze the existing uses of automated project management (APM) as well as its potential for the future. They also address the development of APM and its link with artificial intelligence. However, they note that actual implementations still fall short of ambitious expectations, despite the fact that they are positive about the capabilities of artificial intelligence. However, rapid development suggests that there will be promising breakthroughs in the near future. This article by Wang (2019) investigates the use of artificial intelligence technology in project management and argues for its use in order to improve both efficiency and competitiveness. In the course of his discussion of several artificial intelligence technologies, such as machine learning, Wang proposes that Machine Learning-based Project Management (MLPM) emerges as the most suitable alternative. The purpose of this strategy is to utilize the capabilities of artificial intelligence to expedite project processes and to advocate its incorporation into traditional project management approaches in order to achieve better results. Dam et al. (2019) present a framework that may be utilized to enhance agile project management (PM) by utilizing artificial intelligence technologyThe authors emphasize the potential of AI to transform project management, especially agile methodologies. They envision AI automating tasks, providing data-driven insights for estimating timelines and predicting risks, and offering actionable recommendations. This highlights their recognition of AI's ability to fundamentally change how projects are managed. Their methodology incorporates artificial intelligence into a variety of agile project management features, with the goal of increasing both productivity and the percentage of successful projects.

An investigation of the revolutionary potential of artificial intelligence in project management is conducted by Odejide and Edunjobi (2024), with a special emphasis on decision-making and risk management. They highlight the capability of artificial intelligence to evaluate enormous volumes of data in order to improve decision-making processes and reduce risks associated with projects. At the same time as they acknowledge issues such as data bias, they underline the role that artificial intelligence plays in changing project management techniques, thereby opening the way for more

effective and efficient project outcomes. In their study, Shoushtari et al. (2024) investigate the ways in which AI is influencing the procedures involved in project management (PM). In project management, they highlight the potential of artificial intelligence to automate processes, provide insights prompted by data, and improve decision-making. They envision the future involvement of artificial intelligence in personalized project management approaches and real-time monitoring, despite the fact that they acknowledge problems such as data quality and ethical constraints. Shamim (2024) investigates the incorporation of artificial intelligence into project management methods, highlighting the role that AI plays in improving both efficiency and decision-making procedures. In the course of examining the advantages and disadvantages of implementing AI in project management, the author demonstrates the importance of having experience in AI algorithms and data science in order to ensure a successful implementation. Following the conclusion of the research, some future directions for efficiently utilizing AI in project management are suggested. The authors Tarawneh and others (2024). Examine the application of AI technology, specifically Deep Neural Network (DNN) models, in project management for the purpose of predicting success and optimizing resources. They provide evidence that artificial intelligence has the ability to enhance the accuracy of project planning and to facilitate real-time monitoring. Their study demonstrates the significance that artificial intelligence plays in revolutionizing project management procedures and improving project outcomes, despite the fact that regular training is required.

3.2. Research Aim and Significance

An investigation into the incorporation of AI into project management (PM) techniques is the purpose of this thesis. More specifically, the investigation will concentrate on the ways in which AI has the potential to boost productivity, facilitate data-driven decision-making, and encourage collaborative teamwork. Due to the fact that businesses are becoming increasingly reliant on project management strategies in order to accomplish their goals, it is of the utmost importance to have a comprehensive understanding of the possible impact that artificial intelligence could have in the present business environment. In order to provide a knowledge of how artificial intelligence technology may influence project management practices in the future, the purpose of this thesis is to convey this understanding. The significance of this thesis lies in the fact that it is able to anticipate future developments in project management and the likelihood that artificial intelligence would bring about transformation. Because of the rapid pace at which artificial intelligence is developing, it is absolutely necessary to have a solid understanding of the implications that it has for project management. The utilization of AI algorithms and technology enables project managers to automate

processes that are repetitive, streamline procedures, and distribute resources in a more efficient manner, ultimately leading to an increase in production and efficiency. In addition, artificial intelligence enables project managers to make decisions that are founded on facts by utilizing vast quantities of project data and metrics that are updated in real time. Through the utilization of advanced data analysis and predictive modeling, AI systems are able to recognize patterns, foresee outcomes, and provide recommendations regarding the most effective courses of action. The ability to do so helps project managers to make decisions that are well-informed, which ultimately leads to the successful completion of the project under consideration. Collaboration technologies that are powered by artificial intelligence make it easier for members of a project team to share information, coordinate their efforts, and communicate with one another. AI inspires collaboration, which ultimately leads to increased production, inventiveness, and problem-solving skills among team members. This ultimately adds to the successful completion of a project.

3.3. Identification of Research Gaps and Research Questions

It seems from a literature study that there are major research gaps in the field of AI integration into project management (PM), especially in the domains of collaborative teamwork and data-driven decision-making. Although research now in publication highlights the ability of AI to automate work, offer insights, and improve PM process efficiency, more targeted research is required to determine how AI may particularly help data-driven decision-making and foster cooperative teamwork within project teams. Examining AI's revolutionary potential in project management, Odejide & Edunjobi (2024) and Shoushtari et al. (2024) concentrated especially on risk management and decision-making. In their investigation of how AI might be included into PM procedures, Shamim (2024) and Tarawneh et al. (2024) highlighted how AI might improve productivity and decision-making. In 2019, Dam and colleagues put forth a framework to help agile project management by using AI technology. Wang (2019) promoted using AI technology in project management to increase productivity and competitiveness. None of the research looked particularly at how AI might facilitate cooperative teamwork and data-driven decision-making in project teams. Though it was noted that AI has the ability to automate jobs and increase productivity, these fields have not received enough dedicated research.

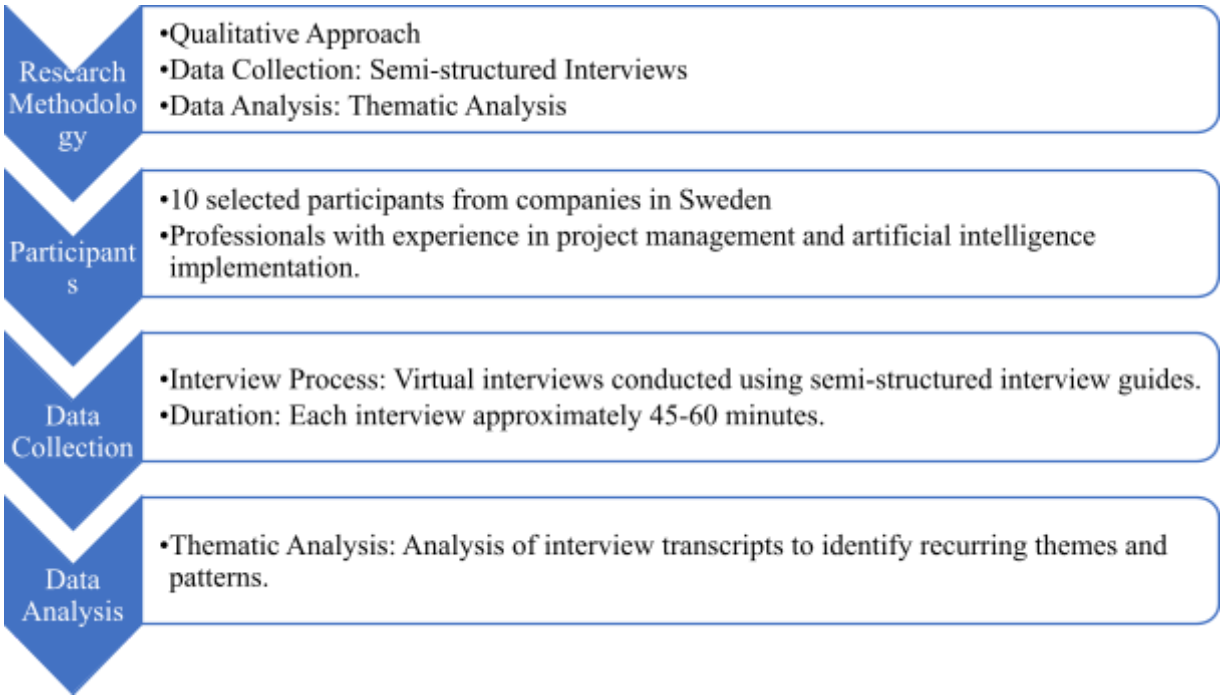
- How can AI improve decision-making in projects by using data effectively and ensuring its accuracy?
- What challenges hinder AI adoption for teamwork in projects, and how can we overcome them for better collaboration?

- How can AI tools be integrated into project management to enhance teamwork, communication, and overall project success?

3.4. Research Design

In this study, qualitative research method was utilized. Qualitative research method is defined as an approach where the researcher collects qualitative data to understand research problems and draws conclusions using the advantages of qualitative integration. In the research, the interview technique based on qualitative research methods was used. With the framework of responses to open-ended questions, the aim was to accurately understand participants' thoughts, expectations, and perception levels regarding the subject. Based on the interviews with participants, the aim was to examine the expectations, perception levels, and the relationship between perceived and actual usage of artificial intelligence in project management.

Figure 1. Research Design



3.5. Research Sample

The research sample consists of professionals from various consulting firms with diverse backgrounds and experience levels in project management. Here are the details of participants given in the table below.

Table 1. Sample of the study

N	Participant code	Age	Gender	Experience	Role	Company
1	P1	30-35	Man	8	Project Manager	Implement Consulting Group
2	P2	25-30	Woman	6	Project Manager	Chief Consulting AB
3	P3	35-40	Man	14	Project Manager	Revelopment Consulting AB
4	P4	30-35	Man	12	Senior Manager	Fortos Consulting AB
5	P5	45-50	Man	24	Project Manager	Sigma Consulting AB
6	P6	25-30	Woman	9	Manager	EY Consulting
7	P7	45-5	Man	15	Project Manager	Anbratt Consulting AB
8	P8	35-40	Woman	17	Project Manager	ALFRED Consulting
9	P9	35-40	Woman	11	Senior Consultanta	Deloitte
10	P10	30-35	Woman	12	Project manager	NIRAS International Consulting

3.6. Data collection method

For this study, semi-structured interviews were selected as the data collecting technique. While there is opportunity for the interviewer to probe further questions depending on the participant's answers, semi-structured interviews have a set of predefined questions. Deep and flexible exploration of participants' perspectives and experiences is made possible by this approach. Because they allow us to collect comprehensive qualitative information on participants' viewpoints and experiences with the incorporation of AI into project management, semi-structured interviews are thought appropriate for this study. We hope to obtain important insights into participants' knowledge of AI, its importance in the modern world, and their views on its use in project management techniques by having open-ended discussions with them. Moreover, semi-structured interviews give the chance to discuss a broad spectrum of subjects about the possible advantages, difficulties, and future ramifications of artificial intelligence in project management. We can go more into particular topics of interest, such the influence of AI on data-driven decision-making, teamwork, and the changing function of project managers, by asking and having debates.

Carefully thought out interview questions are meant to elicit thorough answers from participants. There is a broad spectrum of AI and its application to project management covered in the interview questions. They start by inquiring as to participants' knowledge of artificial

intelligence and its relevance today. Then, giving participants the chance to provide examples from real life, they probe participants' opinions on using AI into project management techniques and whether they have seen AI simplifying project chores. Furthermore included in the questions are the possible challenges in incorporating AI into project management procedures as well as how AI might support data-driven decisions. Inquiries are also made of participants regarding the project management stage that would gain the most from AI integration and how AI might help project teams distribute resources. Moreover, the interview questions ask about instances of how AI may improve cooperation and teamwork in projects and how participants see AI changing the job of project managers in the future. They also invite participants to forecast how AI will develop in project management and what effects it would have on the wider business world. The questions lastly invite participants to elaborate on their answers, give instances, and make their positions clear. Interviewees are given the chance to provide comments on anything they believe was missed during the process.

3.7. Data analysis methods

Thematic analysis will be employed for data analysis. Finding recurring themes or patterns in the interview responses is the goal of thematic analysis. In order to familiarize ourselves with the data, the interview transcripts will first be thoroughly examined. Then, important concepts, ideas, or recurrent subjects will be recognized and given the designation "theme." To enable a more thorough comprehension of the participants' viewpoints on artificial intelligence (AI) in project management, these issues will be arranged into a logical framework. In order to find patterns and relationships in the data, each theme will be investigated in light of the research questions. This study benefits greatly from the flexible approach that thematic analysis offers in examining complex qualitative data. It makes it possible for researchers to methodically examine various points of view and derive significant conclusions from the comments provided by participants.

3.8. Ethical Considerations

Several ethical issues were thoroughly addressed in the course of carrying out this study to guarantee the rights and welfare of every participant. Above all, before the interview started, informed permission was taken from every participant. As a result, they knew exactly why the study was being done, what participating would require, and any possible advantages or disadvantages. All through the research process, confidentiality was also upheld. As such, any personal data supplied by participants was kept completely private and only available to the study's author. It was promised to participants that any reports or publications coming out of the study would keep their answers anonymous. Furthermore, there were no repercussions for individuals who choose to leave

the research at anytime. They received knowledge of this right both before and during the interview. Steps were also done to guarantee safe storage and protection against unwanted access of the gathered data.

4. Research Findings and Discussions

This chapter analyzes key themes identified through interviews conducted during the research. Thematic analysis, a method for uncovering recurring patterns in qualitative data, is used to gain valuable insights into participants' perceptions and experiences with AI integration in project management. By drawing connections to existing research, this chapter sheds light on the transformative power of AI in project management, offering valuable insights for both researchers and practitioners. This chapter also contains discussions and recommendations that analyze the findings and propose actions based on the research.

4.1. Interview findings: Thematic analysis

Current section covers thematic analysis of interview findings in order to assess the patrerns and themes emerged in interview.

4.1.1 Understanding of Artificial Intelligence

Theme 1: Machine Intelligence

Across the interviews, participants see AI as the process of giving robots the ability to think and develop on their own, much like human intelligence. The view expressed by Participant 1 is that "artificial intelligence, simply put, is like giving machines a brain to think and learn." This description points to a conception of artificial intelligence (AI) as giving computers cognitive capacities, hence closing the gap between artificial and human intelligence. Such an impression illustrates the revolutionary possibilities of artificial intelligence in allowing robots to carry out activities like problem-solving and decision-making that are customarily connected to human intellect.

Theme 2: Automation and Efficiency

Participants stress how artificial intelligence can automate tasks, quickly process a lot of data, and find insights that are difficult for humans to understand. Participant 2 expresses this point of view, "It is important because it helps us automate tasks, process a large amount of data quickly, and find insights that we might miss." This categorization emphasizes how artificial intelligence may simplify operations, reduce the need for human labor, and expedite decision-making processes, all of which eventually raise operational efficiency in a range of fields.

Theme 3: Industry Transformation

Participants also demonstrate how AI is transforming sectors, including better decision-making, trend forecasting, and customized experiences. The ability of AI to completely transform conventional business models and operational paradigms is emphasized from this angle. As participant 3 puts it, "It's a big deal today because it can transform industries and make things run better." Artificial intelligence is revolutionizing our lives with everything from trend prediction to customized recommendations." Such expressions emphasize how AI stimulates creativity, increasing corporate competitiveness and promoting customer-focused strategies.

4.1.2. Incorporating AI into Project Management Strategies

Theme 1: Efficiency Enhancement in Planning and Execution

Participants generally have a positive attitude toward the introduction of artificial intelligence into project management approaches, particularly during the phases of planning and execution. Their perspective is that artificial intelligence is a tool that may improve operational efficiency by streamlining procedures such as scheduling, resource allocation, and labor assignment. In order to illustrate this, Participant 1 suggests, "Integrating AI into project management strategies as an opportunity to streamline tasks like scheduling and resource allocation during the planning phase." The emphasis is placed on this viewpoint. The capacity of artificial intelligence to improve project processes, boost planning precision, and speed up task completion is the primary emphasis of this subject. All of these capabilities have the potential to contribute to improved project outcomes.

Theme 2: Real-time Data Analysis for Monitoring and Controlling

The use of artificial intelligence for real-time data analysis throughout the project management phases of monitoring and controlling was another issue raised by participants. All of the participants acknowledge that artificial intelligence has the ability to assess project data, recognize dangers, and promote fast decision-making. This viewpoint is articulated by Participant 3, who says, "Artificial intelligence could offer real-time data analysis, which would assist us in identifying risks early on and making adjustments in a timely manner to ensure that projects remain on track." When it comes to improving project oversight, enabling proactive risk management, and developing adaptive project control systems, this theme demonstrates the role that artificial intelligence plays.

Theme 3: Predictive Analytics for Performance Optimization

Participants also recognize that predictive analytics driven by artificial intelligence (AI) has the ability to maximize project performance at different stages. They want AI to be able to predict problems, make best use of available resources, and improve teamwork. As for Participant 8, he says, "AI could provide predictive analytics for risk assessment and enhance collaboration among

team members." This theme demonstrates how AI may improve decision-making, reduce project risks, and promote agile project management techniques, all of which contribute to project success.

Themes that run through participants' views of using AI into project management techniques are improving planning and execution efficiency, monitoring and controlling using real-time data analysis, and performance optimization with predictive analytics. These topics demonstrate how AI may completely change project management techniques and enable businesses to execute projects with more effectiveness, flexibility, and success.

4.1.3. AI Streamlining Project Tasks

Theme 1: Efficiency Enhancement in Planning and Execution

Specifically throughout the phases of planning and execution, participants mention instances in which artificial intelligence has helped to expedite project management responsibilities. They place an emphasis on the role that robots driven by artificial intelligence play in automating tasks such as scheduling, resource allocation, and risk analysis, which ultimately results in increased operational efficiency. As an illustration, Participant 1 describes the implementation of an artificial intelligence-driven scheduling tool that modified project deadlines according to the availability of resources, hence enhancing resource allocation and reducing conflicts when possible. The subject demonstrates that artificial intelligence has the capability to increase planning accuracy, optimize project workflows, and reduce the amount of manual labor required, which eventually leads to a smoother execution of projects.

Theme 2: Proactive Risk Management and Monitoring

The primary focus of this theme is on the role that artificial intelligence plays in the proactive management and monitoring of risks that occur throughout the execution of a project. Examples of predictive analytics solutions that are powered by artificial intelligence and have the ability to identify potential hazards and delays are provided by the participants. With the help of these technologies, teams are able to take preventative measures and make certain that projects continue to go as planned. Participant 6 makes a reference to the employment of artificial intelligence algorithms for the aim of studying data from previous projects, recognizing potential risks, and devising preventative measures in advance. Within the context of this topic, it is proved that artificial intelligence can play a part in enhancing project oversight, facilitating rapid decision-making, and preventing interruptions and delays in project completion.

Theme 3: Automation and Optimization of Communication

The participants emphasize how AI may automate communication procedures and maximize resource distribution in project control. They give instances such chatbots driven by AI for communicating with stakeholders and project management software driven by AI for tracking performance and progress. Participant 4 says, for example, that teams can concentrate on key activities and increase efficiency by automating stakeholder engagement with AI-powered chatbots. This theme demonstrates how AI can improve project efficiency generally, facilitate communication, and foster teamwork.

4.1.4. AI-Assisted Data-Driven Decision-Making in Project Management

Theme 1: Predictive Analytics for Risk Assessment

The need of AI in offering predictive analytics for risk assessment is emphasized by the participants, who help project managers foresee possible obstacles and efficiently distribute resources. AI powered tools, such machine learning models and anomaly detection algorithms, make it easier to spot anomalies in project data and more accurately project future results. Participant 4 for example discusses using AI to identify anomalies in order to proactively reduce risks, and Participant 10 emphasizes the application of predictive models to project results. The ability of AI to improve decision-making by offering useful information for resource allocation and risk management is demonstrated by this theme.

Theme 2: Insights Extraction from Complex Data

tools driven by artificial intelligence, such as natural language processing and data clustering algorithms, are highlighted by the participants. These tools scan project documentation and segment data in order to uncover patterns and preferences. As an illustration, Participant 2 talks the utilization of natural language processing in order to extract meaningful information from project documentation, whereas Participant 6 highlights the utilization of clustering methods in order to segment project data in order to implement targeted strategies. This subject demonstrates the role that artificial intelligence plays in reducing large data sets and providing project managers with clear and actionable insights.

Theme 3: Personalized Recommendations for Optimization

AI applications look for patterns and abnormalities in past project data. The programs next offer customized suggestions for improving the project in compliance with particular standards based on the results of this study. For example, the third participant talks about using recommendation systems to provide customized recommendations for project optimization, and the seventh talks about using prescriptive analytics to provide practical guidance. In particular, this theme shows how

AI can be used to support decision-making by offering special solutions that solve certain project aims and objectives.

The information offered by the participants shows that artificial intelligence can make data-driven project management decisions possible. This is achieved by means of risk assessment using predictive analytics, complicated data insights extraction, and optimization recommendation modification. Artificial intelligence (AI) is revolutionizing decision-making and enabling project managers to successfully optimize project outcomes, reduce risks, and make wise decisions. These topics show how artificial intelligence is bringing decision-making up to date.

4.1.5. Potential Obstacles in Integrating AI into Project Management Processes

Theme 1: Resistance and Fear of Job Displacement

Underscoring that AI seeks to enhance rather than to replace human abilities is essential to addressing this issue. First participant emphasizes the need of overcoming this anxiety and preserving stakeholder trust by highlighting the ability of AI to increase productivity without taking the place of human labor. The need of controlling organizational change and encouraging team members to embrace AI technologies is demonstrated by this theme.

Theme 2: Lack of Understanding and Familiarity with AI Technologies

The need of offering enough training and assistance to close this knowledge gap and promote acceptance of AI tools is emphasized by the participants. The need of addressing worries regarding algorithm openness and prejudice in AI-driven decision-making is emphasized by Participant 2. This theme demonstrates the need of communication and education to encourage project management teams to comprehend and embrace AI technologies.

Theme 3: Cultural Barriers and Organizational Inertia

It will take creating an innovative and lifelong learning culture inside companies to overcome this challenge. To get the support of project stakeholders, Participant 7 stresses the need of welcoming innovation and resolving doubts about the accuracy of insights produced by AI. The need of leadership and change management techniques in encouraging the adoption of AI technologies and advancing organizational transformation is demonstrated by this theme.

Participants list possible roadblocks to include in the integration of AI into project management procedures, such as organizational inertia, cultural impediments, and a fear of losing one's job. To encourage acceptance of AI technology and their successful integration into project management

processes, these challenges must be addressed through efficient communication, education, and change management techniques.

4.1.6. Project Management Phases Benefiting Most from AI Integration

Theme 1: Planning Phase Optimization

Participants point out that project management stands to benefit most from AI integration during the planning stage. Big dataset and historical project data analysis capabilities of AI offer insightful information for project planning, including resource allocation, budget projection, and risk assessment. First participant stresses the need of using AI in the planning phase to provide more realistic project plans and make better judgments. The function of AI in improving project planning accuracy and laying the groundwork for good project results is demonstrated in this theme.

Theme 2: Execution Phase Efficiency

The help AI provides with work scheduling, progress monitoring, and performance monitoring expedites project execution procedures. The ability of AI to automate repetitive operations and offer real-time data, which allow project managers to spot possible bottlenecks and make prompt adjustments, is emphasized by Participant 2. This subject demonstrates how AI helps to guarantee project success and increase project execution efficiency.

Theme 3: Monitoring and Control Phase Enhancement

Tools driven by artificial intelligence track project performance indicators on a continual basis, spot plan deviations, and foresee any problems or dangers. Participant 3 highlights the proactive way that AI helps project managers to quickly take corrective action and reduce interruptions, therefore keeping projects on schedule to meet their goals. The function of AI in improving project monitoring and control procedures to reduce risks and keep projects on track with objectives is demonstrated in this theme. The capacities of AI to simplify procedures, offer insightful information, and support proactive decision-making help to enhance project results at all phases of project management.

4.1.7. Enhancing Collaboration and Teamwork in Projects with AI

Theme 1: Automated Task Management and Communication

Participants stress how project management systems driven by artificial intelligence can improve cooperation and teamwork. These sites automate deadline notifications, task updates, and conversation starters with chatbots or virtual assistants. Participant 1 emphasizes how this encourages openness and closes communication gaps, therefore creating a more unified work

atmosphere. The contribution of artificial intelligence to project teamwork and communication process simplification is demonstrated in this area.

Theme 2: Personalized Support and Skill Development

AI systems examine personal work habits, preferences, and performance indicators to provide customized recommendations for raising output and teamwork. The way this customized strategy facilitates teamwork and the successful accomplishment of project goals is emphasized by Participant 6. Within project teams, AI is shown to support ongoing learning, skill growth, and creativity in this theme.

Theme 3: Proactive Conflict Resolution and Communication Enhancement

Participants draw attention to how AI might foresee and resolve disputes or communication breakdowns before they happen. Project managers can take proactive preventive action by having AI algorithms examine project communication patterns for indications of miscommunication or team stress. The way that this proactive strategy encourages better cooperation and teamwork inside project teams is emphasized by participant 8. In order to increase teamwork, this subject highlights the part AI plays in encouraging proactive dispute settlement and improving communication efficacy.

4.1.8. Envisioning AI's Impact on Project Managers and Project Management

Theme 1: Evolution of Project Manager Roles

Participants believe artificial intelligence will change project management and cause them to concentrate on strategic leadership rather than conventional task management. Project managers should be able to make fast and efficient data-driven decisions thanks to the predicted valuable insights provided by AI. Participant 6 sees project managers using AI technologies to improve teamwork, maximize project results, and more skillfully handle uncertainty. The possibility of AI to reshape project management as strategic leaders who use AI technology to propel project success is highlighted by this theme.

Theme 2: Automation and Efficiency Improvement

Participants expect artificial intelligence to simplify project management chores so that project managers can concentrate more on strategic decision-making than on administrative work. Because AI can optimize timetables, resource allocation, and general project efficiency, participant 2 thinks it will completely transform project management. This theme illustrates how automation and efficiency enhancement made possible by AI can improve project management procedures.

Theme 3: Adaptation and Skill Development

With AI predicted to change project management into a more dynamic and flexible process, project managers will need to learn data analysis, AI application, and cross-functional cooperation. Participant 8 emphasizes that in order to fully use AI technology, one must embrace new skills and embrace AI technologies. The need of ongoing education and skill improvement for project managers to succeed in an AI-driven project management environment is demonstrated by this theme.

4.1.9. Identifying the Most Impactful Factors of AI Integration

Theme 1: AI's Role in Different Phases of Project Management

The participants pointed up different stages of project management when AI integration might make the most difference. The planning stage (P1) was highlighted by some, the execution (P2), monitoring and controlling (P3), closing (P4), risk management (P5), communication and cooperation (P6), decision-making (P7, P10), resource management (P8), and stakeholder management (P9) by still others. Reflecting the many possible uses of AI across all project stages, each participant gave examples of how AI might improve particular project management phases.

Theme 2: Strategic Importance of AI Integration

The strategic value of integrating AI into project management was underlined by participants. They emphasized how AI may be used to streamline project procedures, boost decision-making, reduce risks, and foster teamwork. Participants talked about, for instance, how AI-powered solutions may foresee hazards, automate tedious chores, and customize communication plans to the preferences of stakeholders. This theme demonstrates the ability of AI to stimulate strategic value and creativity in project management procedures.

Theme 3: Customization and Tailored Solutions

The possibility of artificial intelligence-driven technology to evaluate project data and offer customized advice based on the needs and difficulties of a certain project was discussed by participants. AI can successfully handle particular problems that come up in project management because of its capacity to provide specialized solutions that are tailored to a project's requirements. Among these difficulties can be improving communication, seeing possible hazards, or allocating resources as best they can.

The participants determined, for the purpose of this summary, which phases and aspects of project management AI may most significantly affect. The elements that comprise these ideas include

strategic relevance, customization, and solutions that are adapted to the individual needs and difficulties of a certain project. The participant experiences clarified the ground-breaking possibilities of artificial intelligence in project management techniques. These examples show how AI-powered solutions may speed up project processes, enhance decision-making, lower risks, and promote open communication.

4.1.10. Uncovering Additional Important Aspects of AI Integration

Theme 1: Fostering a Culture of Innovation

The need of promoting an innovative culture inside project teams was emphasized by the participants. They underlined that embracing AI need to go beyond just putting tools into place and include fostering an atmosphere where team members feel free to experiment with novel concepts and strategies. Team members are encouraged by this innovative culture to see chances to use AI to enhance project results, which eventually propels ongoing development and innovation inside the company (P1).

Theme 2: Ethical Implications of AI Integration

A further important topic is the moral ramifications of using AI into project management. Aware of worries about algorithm bias, data privacy, and possible effects on employment positions, participants underlined the need of making sure AI functions morally and transparently. Through early resolution of these ethical issues, businesses may foster stakeholder confidence and guarantee ethical application of AI in project management (P2).

Theme 3: Ongoing Learning and Development

The requirement of continuing education and development in the framework of AI integration was emphasized by the participants. They underlined how quickly AI technologies are developing and how important it is to stay up to date on new developments and best practices. Project teams should optimize the advantages of AI integration and maintain their competitiveness in today's dynamic business climate by giving ongoing learning through training programs, workshops, or certifications focused on AI and its applications in project management top priority (P3).

Theme 4: Change Management in AI Integration

The part change management plays in AI integration projects was demonstrated by the participants. They underlined that workflows, job responsibilities, and corporate culture may all be significantly altered by putting AI-driven tools and processes into use. The smooth adoption and least amount of stakeholder resistance depend on effective change management techniques. Through employee

involvement in the change process, resolution of their issues, and provision of sufficient assistance and training, companies can more successfully make the switch to AI-powered project management (P4).

Theme 5: Impact of AI on Project Risk Management

Participants emphasized how AI might affect project risk management. They talked about how AI technologies present fresh chances for recognizing, evaluating, and reducing project risks, but they also pointed out drawbacks and difficulties, such algorithmic biases and how to evaluate insights produced by AI. Ensuring that AI integration projects succeed requires investigating how AI might improve risk management procedures while tackling these issues (P5).

These themes highlight further significant facets of artificial intelligence integration in project management, such as promoting an innovative culture, tackling ethical issues, giving continuous learning and development top priority, putting change management plans into action, and improving project risk management procedures by means of AI use. Every element helps AI integration programs inside companies succeed generally and remain sustainable.

4.2. Discussions and Recommendations

An understanding of how artificial intelligence is perceived and applied in project management was gained through the interviews, which provided useful insights. Participants view artificial intelligence as a technology that has the potential to teach robots to think and learn on their own, much like humans. They are of the opinion that artificial intelligence has the potential to disrupt several businesses by automating jobs, processing data, and providing insights that people would overlook.

They believe that artificial intelligence has the potential to dramatically increase efficiency in project management, particularly in the areas of planning and execution. Artificial intelligence has the ability to optimize workflows and shorten the time it takes to make decisions by automating functions such as scheduling and resource allocation. Additionally, it is able to evaluate data at real-time for the project in order to identify hazards and make adjustments in a timely manner, hence improving project oversight and control. According to the participants, artificial intelligence has the potential to improve communication and teamwork inside project teams. Tools that are powered by artificial intelligence have the ability to automate communication procedures, provide individualized help, and even foresee problems and find solutions before they emerge. The environment of the team becomes more unified and productive as a result of this. Integration of artificial intelligence into project management, on the other hand, is not without its obstacle. As

potential impediments, participants perceive reluctance to change, a lack of knowledge, and cultural barriers as being among the most significant. To overcome these obstacles and assure the successful adoption of artificial intelligence, it is necessary to implement strategies for effective communication, education, and change management.

The research that was carried out by Auth et al. (2019), Wang (2019), and Dam et al. (2019) collectively makes a contribution to the continuing discussion over the potential incorporation of artificial intelligence methodology into project management (PM) methodologies. An investigation into the ways in which artificial intelligence has the potential to transform project management methods is presented in the article written by Auth et al. (2019). The development of automated project management (APM) and its connection to artificial intelligence is the primary emphasis of the authors. In spite of the fact that they acknowledge the potentially fruitful applications of artificial intelligence, they highlight the fact that real implementations have not yet completely matched expectations, which indicates that there is room for progress. On the other hand, Wang (2019) advocates for the use of AI into project management in order to boost both efficiency and competitiveness. Wang advocates for a method known as Machine Learning-based Project Management (MLPM), which he considers to be an important and efficient approach.

This strategy makes use of artificial intelligence technology, such as machine learning, in order to speed up the processes involved in the project and improve the results. This is in line with the results that were reached about the fundamental issues of the thesis, particularly with regard to the role that artificial intelligence plays in enhancing efficiency and predictive analytics for the purpose of performance optimization. Dam et al. (2019) describe a system that is specifically built to support agile project management (PM) through the incorporation of artificial intelligence. This system was developed by Dam themselves. Within the scope of agile methodologies, they realize artificial intelligence's capacity to automate procedures, provide analytics for estimation and risk prediction, and offer recommendations that may be put into action for an organization. According to the findings of the thesis, which also emphasize the potential of artificial intelligence to improve efficiency, ease real-time data analysis, and encourage proactive risk management in project execution, this is compatible with the findings. The thesis also emphasizes the capacity of intelligence to enhance efficiency.

The literature highlights the promise of artificial intelligence in project management, but it also recognizes the obstacles and gaps in implementation that now exist. As a result of the fact that it is probable that the practical applications of artificial intelligence in project management might not live up to the lofty expectations that have been established, Auth et al. (2019) propose that there is a

need for continued research. In a manner that is analogous, the thesis delves into the potential obstacles that may be encountered when striving to include artificial intelligence into the processes of project management. One of these challenges is a lack of awareness regarding artificial intelligence technologies, as well as a resistance to change. The literature and the thesis, on the other hand, underline the revolutionary potential of artificial intelligence in terms of speeding project workflows, enhancing decision-making processes, and increasing communication within project teams.

The main conclusions of the thesis are supported by the research about the potential of artificial intelligence in project management conducted by Auth et al. (2019), Wang (2019), and Dam et al. (2019). All of these elements considered together show how cruicial AI is to boosting efficiency, promoting data-driven decision-making, and achieving project results. Conversely, they acknowledge the need of carrying out more research and offering answers to the deployment-related problems.

An other thing to think about is that the studies done by Odejide and Edunjobi (2024), Shoushtari et al. (2024), Shamim (2024), and Tarawneh et al. (2024) all add to the ongoing conversation about how AI might be included into project management (PM) approaches. As noted by Odejide and Edunjobi (2024), artificial intelligence has the ability to greatly enhance risk management and decision-making in the context of project management. Shoushtari et al. (2024) also emphasize how artificial intelligence can enhance project management decision-making processes, automate jobs, and produce insights driven by data. These are the same talents as those mentioned in the paragraph before. These results further emphasize how artificial intelligence helps to enhance decision-making, simplify project tasks, and provide real-time data analysis for the goal of project operations monitoring and regulation. The topic analysis of the thesis, which also emphasizes the part artificial intelligence plays in these domains, is consistent with these results. Shamim (2024) researches how artificial intelligence is being included into project management processes. He emphasises how AI might improve decision-making and efficiency. The results of Shamim's study are presented in this paper. These results support the conclusions drawn in the thesis, especially with reference to the ability of artificial intelligence to enhance planning accuracy, streamline project procedures, and promote agile project management techniques, in that order. Moreover, Shamim (2024) stresses that using AI effectively requires knowledge of data science and artificial intelligence algorithms.

Tarawneh and colleagues (2024) examine how artificial intelligence technologies are used, more particularly Deep Neural Network (DNN) models, in project management (PM) for resource

optimization and success prediction. The results of their investigation demonstrate how artificial intelligence may help with real-time monitoring and enhance project planning accuracy. The results of the thesis about the application of AI in predictive analytics for performance optimization and real-time data analysis for project monitoring and control activities are consistent with these results. Although the thesis and literature taken together emphasize the ground-breaking possibilities of artificial intelligence in project management, they also recognize the challenges that still need to be overcome and the need for knowledge of AI technologies to effectively apply AI. Many difficulties are mentioned in the thesis and the literature. These difficulties include the need for continuous training, ethical issues, data bias, and quality of the data. However, every source stresses that artificial intelligence, through automation, data-driven insights, and real-time monitoring, has the ability to transform project management processes, enhance decision-making, and raise project outcomes.

Furthermore, a number of significant insights into the understanding of artificial intelligence (AI), its integration into project management (PM) strategies, its impact on the phases of project management, as well as the potential benefits and drawbacks of using AI are revealed by the thematic study of the interview findings. These conclusions, which coincide with and supplement the literature, meet the literature that was discussed in the investigations carried out by Odejide and Edunjobi (2024), Shoushtari et al. (2024), Shamim (2024), and Tarawneh et al. (2024). Above all, the results and the body of research highlight the ground-breaking possibilities of artificial intelligence in project administration. This promise is shown by the fact that AI helps to enhance decision-making procedures, streamline project processes, and produce better outcomes. The ability of AI to provide machines cognitive abilities and streamline processes is emphasized by themes like Machine Intelligence, Automation and Efficiency. These themes are consistent with the literature's emphasis on AI's capacity to automate procedures, provide insights based on data, and enhance project management decision-making.

The benefits of including AI into project management activities are agreed upon by both the literature and the results. Ideas like improving planning and execution efficiency; using real-time data analysis for monitoring and control; and using predictive analytics to optimize performance Through real-time data analysis and predictive analytics, I would like to establish a connection with the lectures that have been published in the literature about the possibilities of artificial intelligence to enhance operational efficiency, enable proactive risk management, and maximize project performance. Themes including resistance and fear of job displacement, ignorance and familiarity with AI technologies, cultural barriers and organizational inertia, and stakeholder acceptance are

reflections of concerns expressed in the literature regarding knowledge gaps, organizational resistance to the adoption of artificial intelligence. Furthermore, the need of encouraging cooperation and teamwork in artificial intelligence projects is acknowledged by the thesis and the literature. Themes like Automated Task Management and Communication, Personalized Support and Skill Development, Proactive Conflict Resolution and Communication Enhancement mirror the literature's discussions on the potential of artificial intelligence to improve collaboration and teamwork in project management. These themes emphasize the part AI plays in improving teamwork, encouraging individualized assistance, and enabling proactive communication in project teams. The results also estimate how artificial intelligence would affect project managers and project management in general. These results predict shifts in the functions of project managers, job automation, and the need for flexibility and skill development. A number of themes—"Fostering a Culture of Innovation," "Ethical Implications of AI Integration," "Ongoing Learning and Development," "Change Management in AI Integration," and "Impact of AI on Project Risk Management"—highlight the more general organizational and ethical issues related to the use of artificial intelligence in project management. These issues resound with the focus that the literature places on handling ethical issues, encouraging continuous learning and development, and successfully leading organizational change.Based on interviews, here are eight proposals for incorporating artificial intelligence into project management::

1. Project teams should be educated about the capabilities and advantages of artificial intelligence to foster acceptance and comprehension. Raising knowledge of artificial intelligence.

2. Provide comprehensive training courses so that team members and project managers may learn the abilities required to use AI tools effectively.

3. Regulations and guidelines must be established to ensure that artificial intelligence is applied morally and openly. Among the ethical issues are algorithm bias and data privacy.

4. The fourth stage aims to foster an innovative culture in project teams, therefore fostering creativity. This will encourage the project to be improved continuously and the study of AI-driven solutions.

5. Creating efficient change management plans is essential to negotiating the organizational changes brought about by the integration of AI. These plans need to get past resistance and promote stakeholder buy-in.

6. To increase teamwork and simplify communication, artificial intelligence-powered collaboration solutions should be used, regardless of the project members' location or time zone.

7. Improved project planning, risk management, and resource allocation will result from data-driven decision-making supported by AI-driven analytics and predictive models. This is the final and seventh stage in improving decision-making.

8. In order to optimize efficiency and effectiveness, you should always assess how the use of AI affects the project's results and the dynamics of the team.

5. Conclusion

This chapter concludes the exploration of AI integration in project management. The concluding section acknowledges the limitations of this study while also proposing avenues for future research. This emphasizes the valuable contribution AI can make to project success, based on the research findings and their implications.

5.1 Answering the Research Questions

Artificial intelligence integration into project management greatly improves productivity, data-driven decision-making, and cooperative teamwork. Project managers may concentrate on strategic operations when AI automates mundane chores like scheduling and resource allocation. Through real-time data analysis and predictive analytics, which raise planning accuracy and execution efficiency, it simplifies project chores. AI provides sophisticated analytical features for data-driven decision-making that let project managers to forecast possible risks, maximize resource use, and extract insightful information from huge datasets. This improves project performance generally by resulting in more timely and well-informed decisions. By use of automated task management tools and individualized support, AI promotes improved communication and coordination among team members, therefore enhancing overall project results. To completely enjoy these advantages, though, issues like aversion to change and ignorance of AI technologies need to be resolved.

5.2 Implications and Contributions

5.2.1 Practical Implications

Major practical ramifications arise from using artificial intelligence in project management. Resource allocation, risk management, planning and scheduling, and many other project management chores can be automated and optimized with artificial intelligence technologies. Concurrently, this increases output and lowers the likelihood of human mistake. With the assistance of artificial intelligence technology, which offer them real-time insights and predictive analytics, project managers may reduce risk and make proactive decisions. Eventually, this leads to more alignment with corporate objectives and better project performance. Customized support systems and artificially intelligent communication tools also improve cooperation and coordination, which strengthens and unifies the workplace.

5.2.2 Theoretical Implications

These results have theoretical implications that go much beyond a deeper understanding of how artificial intelligence is changing project management techniques. Artificial Intelligence is a paradigm change in project management that emphasizes predictive analytics and data-driven decision-making. This change requires a review of conventional project management theories and frameworks to take into account the potential and constraints of artificial intelligence technologies. The paper also emphasizes the need of doing more investigation into the moral ramifications of artificial intelligence in project management. The creation of reliable and moral AI systems in this area depends on both algorithmic biases and worries about data privacy.

5.3 Limitations of Study and Recommendations for Future Research

Several restrictions of this study should be taken into account. The study mostly uses semi-structured interview qualitative data, which may not adequately represent the spectrum of opinions and experiences on AI integration in project management. Additionally, there is a small sample size, therefore not all industries or organizational settings may benefit from the conclusions. To confirm and build upon these results, future study should use mixed-method approaches and bigger, more varied populations. Long-term effects of AI integration on project management methods and results should also be investigated in more research. Research into the moral and social ramifications of AI is desperately needed, especially with regard to algorithmic biases, data privacy, and employment displacement. In order to overcome opposition and promote the usage of artificial intelligence technology in project management, research should also concentrate on creating efficient change management techniques. Future study in these domains can offer more thorough understanding and useful recommendations for using AI to improve project management procedures.

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Appendix A

Interview Questions

1. What is your understanding of artificial intelligence and why is it important today?

2. How do you feel about incorporating AI into project management strategies?

3. Have you witnessed AI streamlining project tasks? Could you provide an instance?

4. In what ways can AI assist in data-driven decision-making for project management?

5. What potential obstacles do you foresee in integrating AI into project management processes?

6. Which stage of project management stands to gain the most from AI integration?

7. Could you offer examples of how AI could enhance collaboration and teamwork in projects?

8. How do you envision AI impacting the role of project managers and project managemen in the future?

9. Which of the factors you mentioned are most important? Why? Can you elaborate? Can you give an example?

10. In your opinion, is there anything that I have not asked you about, but you think is important?