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STREAMLINING PROGRAM MANAGEMENT WITH ARTIFICIAL INTELLIGENCE: A COMPREHENSIVE SURVEY

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ABSTRACT
AI platforms now change conventional approaches while reshaping the role of program managers by creating breakthrough capabilities and demanding complex responses to manage them. A review of essential AI solutions for program management identifies ML, Computer Vision, Optimization Algorithms, NLP, and Predictive Analytics. Subsequently, the paper delves into potential benefits, which include efficiency improvement alongside precise results and predictive power capabilities. The successful integration of AI in human services demands resolution of data privacy issues as well as solutions for implementation costs and improved human-AI team dynamics and ethical standards. The research investigates three new program management positions involving AI Program Managers and Data-driven Decision Makers as well as AI Liaisons to ensure readiness for an artificial intelligence transformed world. The research paper delves into previous AI literature studying program management applications while demonstrating industrial innovations and recognizing active research gaps. AI research needs to concentrate on developing stronger algorithm decision-making methods and analyzing the ethical boundaries alongside legal ramifications, as well as studying long-term AI program management integration impacts. AI applications give organizations an opportunity, through proper exploitation, to achieve superior program management results and business results.

KEYWORDS: Program Management, Artificial Intelligence (AI), Resource Allocation, Predictive Analytics, Workflow Optimization, Automation in Program Management, Stakeholder Collaboration, Risk Management, Proactive Risk Mitigation.

1. INTRODUCTION

The rapid pace of technological advancement, coupled with the growing complexity of the global business landscape, has fundamentally altered how organizations approach program management[1]. High rates of globalization and market shifts, along with the escalating requirement for efficient execution, diminish the capabilities covered under traditional program management approaches. This is especially so when the managerial landscape consists of intricate operations of multiple connected projects and various distributed teams constantly working with an increasing amount of data. Firms need solutions for today's program management challenges that can deliver solutions within strict timelines while preserving quality [2].

AI technology, therefore, provides program management transformative opportunities manifesting from credible optimization tools [3]. Programs at a large scale are more easily addressed with the help of data driven AI tools here including and built with the help of ML, predictive analytics, advanced NLP tools combined with superior simulations that enhance companies' decision-making processes. Enterprise can leap beyond routine undertaking by systematic operational activities and terabytes information analytics coupled with real time actionable intelligence. AI-supported features improve the performance of managers in terms of resource allocation and risk mitigation in the context of their programs, as well as the timely, critical decisions which contribute to program accomplishment in the current conditions of a rapidly evolving competitive environment [4].

The use of artificial intelligence in program management enhances organizational effectiveness in operations as well as improves the speed of response [5]. AI provides solutions that are strong and predictive for being able to

foresee future occurrences and trends as well as potential risks that are addressed before emergence. Past data analysis done by artificial intelligence allows program managers to allocate resources accordingly while making accurate assessments of the necessary programs[6]. The predictive analysis assists the teams in obtaining the required resources when these are required and, more importantly, avoids project delays and optimizes budget consumption effectively. Risk assessment and, thus, risk management become more accurate through the use of AI since it provides data patterns that normal risk assessment methods cannot identify.

The use of AI tools[7], such as Virtual Assistants, chatbots, or automated systems, improves communication and coordination with the program teams through seamless, automatic and updated exchanges in real-time, helpful particularly with distributed teams. As a result, by using AI-based simulations, managers are capable of predicting future outcomes and identifying the foreseeable risks that will make it probable to construct preventive strategies for their decisions. By offering complete program development insights, this system helps organizations make decisions based on data that promotes goal achievement. AI, along with human expertise, helps organizations achieve improved results and success because it functions as a fundamental tool to navigate complicated business operations.

A. Structure of paper
This paper is structured as follows: Overview of AI Program Management present in Section I. Section II provide the Overview of AI Technologies Relevant to Program Management and their applications in program management. Discusses the new roles and opportunities created by AI adoption present in Section III. Section IV discusses the Challenges in Integrating AI in Program Management. Reviews existing research and studies on AI applications shown in Section V. Summarizes the findings and discusses the limitations of AI in program management in Section VII.

2. OVERVIEW OF PROGRAM MANAGEMENT

Program management refers to the process of overseeing a project or program with the objective of ensuring that its completion contributes to the achievement of the company's long-term objectives [8]. This approach entails coordinating the efforts of several related projects. Several projects are being completed under one roof as a result of this collaborative effort. Since there will be numerous projects involved in the process of launching a new brand, it may be argued that this is an example of a program. This program will include the launch of a website, an application, and tangible branding materials like business cards, packaging, marketing, and more if it's a clothesline. These are all stand-alone projects that entail many teams to accomplish various goals in order to fulfill the primary strategic purpose of establishing the apparel brand. Although distinct from one another, the deliverables are interdependent and critical to the program's success as a whole. Managing a program entail coordinating the efforts of multiple teams working on separate but related initiatives. This means that the program manager and all of the project managers will be coordinating their efforts to finish each project on schedule and to the best of their abilities.

A. The fundamental goals of program management
The purpose of programs is to improve the administration of individual projects in order to generate value. Their value is in the improved project management that bring, but these tools cannot guarantee the completion of certain project goals [9]. Program management's primary objectives fall into two broad categories:
- Efficiency and effectiveness goals: Management considerations that a good project manager should have, even when working on similar projects independently. It is thought that by addressing these specific areas of management in an integrated manner, overall management effectiveness and efficiency can be enhanced.
- Business focus goals: Interaction between projects and the larger organization's needs, objectives, drives, and culture.

B. Project Management Industry Statistics
Project management expertise is in high demand, so it's important to know where things stand in the field [10]. Here are a few important statistics to consider (project-management-statistics):
- By 2027, the world's economy will crave 87.7 million project management roles, according the Project Management Institute. Since this is the case, more doors will open for those working in project management.

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- 71% of firms worldwide report integrating agile methodology to varied degrees, indicating its growing popularity [11]. More adaptable and iterative methods of project management are becoming the norm, and this change mirrors that trend.
- As 91% of teams utilize virtual solutions for project management, data reveals that remote project management is here to stay. As time goes on, this fad is expected to become more prevalent.
- The most recent "Pulse of the Profession" study from the Project Management Institute states that top-performing firms are able to finish 90% of their projects within the specified time, money, and scope. This highlights the significance of well-managed projects for achieving success.
- Concerning the financial side, delays or going over budget affect 78% of projects. The importance of improved planning, risk management, and foresight in controlling costs is underscored by this.
- For 46% of firms, proper project planning is a major concern. Successful project execution is built upon solid planning, which is why this component is of utmost importance.

According to these project management statistics, learning and development are still crucial for project managers who wish to succeed. Project managers can equip themselves to meet industry demands and contribute to their organization's success by keeping themselves updated on the latest technologies and trends.

C.Program Management Lifecycle
Formulation, organization, deployment, evaluation, and dissolution are the five primary phases that make up the program management lifecycle [12]. They will go into more depth about them below:

- Talking about the program's expectations and outlining all the goals that need to be achieved with the stakeholders happens during the formulation process.
- Developing a comprehensive plan outlining the program's timetable, deliverables, and resources is what the Organization stage is all about [13]. The dual process develops through multiple cycles concurrently with Stage 1 because of shifting requirements needs.
- The "Deployment" phase concludes the project timeline because program and project managers work together to achieve timely execution." Every deliverable requires work within the deployment stage. Agile programs employ periodic deployment periods spanning two to three weeks.
- The fourth step named Appraisal stage brings together all stakeholders to review modified processes prior to moving forward. The moment of assessment and authorization has arrived.
- Project dissolution occurs when all termination processes complete during the program lifecycle's final stage. This is also where the program's monitoring mechanisms are established.

3. OVERVIEW OF AI TECHNOLOGIES RELEVANT TO PROGRAM MANAGEMENT

A growing number of program management methods are using artificial intelligence (AI) technology. These technologies have many useful uses and can greatly improve the oversight and management of complicated projects and initiatives [14]. This part provides the understanding of AI technologies relevant to program management and evaluates actual AI applications concerning program planning and risks, allocation of resources and decision-making, as well as prospects of improving precision and speed and the ability to predict the future. The term AI refers to multiple computer technologies that let systems replicate human intellectual processes. Some of the key AI technologies relevant to program management include:
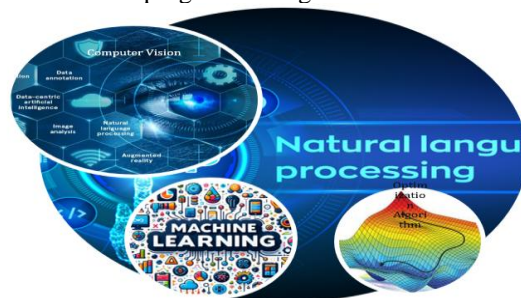

Fig. 1.   AI Technologies Relevant for Program Management

A.Machine Learning (ML)

Data-driven computers automatically acquire knowledge from input data which enables them to make predictions and judgments without program-oriented specifications. Program managers can utilize various ML methods to optimize operations, conduct predictions, and create classifications, among other capabilities. Supervised and unsupervised learning, together with reinforcement learning, represent the major methods.

B. Computer Vision
Computers can now read and evaluate visual data from photos or movies thanks to computer vision technologies [15]. By applying computer vision methods, including object detection alongside pattern recognition and image recognition, managers can track project development while ensuring quality assurance.

C. Optimization Algorithms
Within boundaries, optimization algorithms enable computers to identify the best possible solution for problems. Program management benefits from optimization algorithms that optimize resource allocation scheduling and portfolio management to achieve maximum efficiency while reducing costs.

D. Natural Language Processing (NLP)
Through NLP methods computers acquire the ability to analyze translate and construct new customized language forms. Text mining algorithms combined with sentiment analysis technology and chatbot systems are key NLP applications to enhance program management.

E. Predictive Analytics
Through predictive analytics techniques, computers study historical patterns of data to make predictions about upcoming events [16]. Through program management, predictive analytics enables risk management while forecasting demand and predicting project performance to enhance planning and decision-making processes.

F. Benefits of AI Adoption in Program Management
There are a number of possible advantages to using AI in program management, such as:
- Increased Efficiency: Artificial intelligence tools lead to automated fundamental processes which improve operational flows that enable program managers to pursue strategic initiatives.
- Improved Accuracy: The analysis of large databases, pattern identification and prediction work better with AI algorithms, which boost both decision quality and reduce errors.
- Enhanced Predictive Capabilities: With the help of the AI-based predictive analytics program managers are able to see what kind of problems they might face in the future, as well as the existing and potentially emerging opportunities in terms of market opportunities and variations.
- Optimized Resource Utilization: Cost reduction happens by way of Planning, Development Scheduling, Portfolio Management, and Resource Allocation through the AI algorithms [17].

AI technology presents a plethora of benefits to program managers concerning planning and risk management and resources' allocation and decisions-making systems. Program managers increase productivity thus deliver accuracy in addition to the predictive ability through the use of an AI based system and this leads to success in accomplishing organizational goals. The full integration of AI to needs a solution to the problems touched on by data sensitivity, ethical and quality of data.

4. OPPORTUNITIES FOR PROGRAM MANAGERS
Automation of intelligence technology brings new challenges and opportunities as well as new responsibilities and exposures in the program for the managers. This section discusses how such adoption helps program managers by showing opportunities in light of shifting professional demands and AI platforms and continuous workforce development initiatives for career enhancement in the prospectively AI-driven program management environment. Program management benefits from AI adoption through new roles for program managers so they could improve efficiency along with effectiveness and develop innovations based on AI technologies. Some of the new roles and opportunities include:
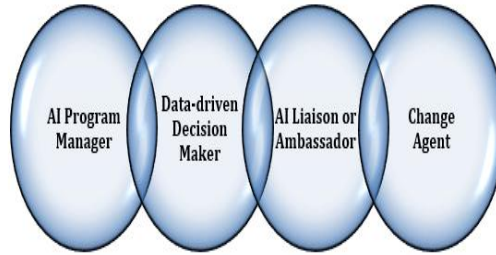
Fig. 2.   Roles and opportunities

A.AI Program Manager:
These technologies, therefore, reach the best development implementation and optimization under competent leadership of artificial intelligence-managed projects. AI platforms and tools integration into program management systems require effective collaboration between AI program managers with data scientists in collaboration with AI engineers, and other parties interested in the development.

B.Data-driven Decision Maker:
Using AI, program administrators get to enhance performance as well as identify opportunities where data solutions are produced. Intelligential can improve forecasting procedures as well as risks and resources and develop strategic programs to ensure program success.

C.AI Liaison or Ambassador:
Program managers act as mediators and liaisons between business units to communicate with development teams for stakeholders' reference and readjustments between the team developers. In its capacity it can match AI technical expertise with business requirements to ensure program needs are met by AI solutions.

D.Change Agent:
Specifically, it implies that program managers should promote AI at the cultural level as well as support stakeholders in achieving mindset change and organizational AI readiness for transformation. These program managers should create AI education programs that foster innovation skills and enhance awareness on AI all across the organization.

5.   CHALLENGES IN INTEGRATING AI IN PROGRAM MANAGEMENT

The integration of AI systems in program management is challenging and has several barriers that must be overcome for organizations to realize proper deployment. These challenges can be grouped into technical, organizational and human factors, as shown in Figure 3 below.
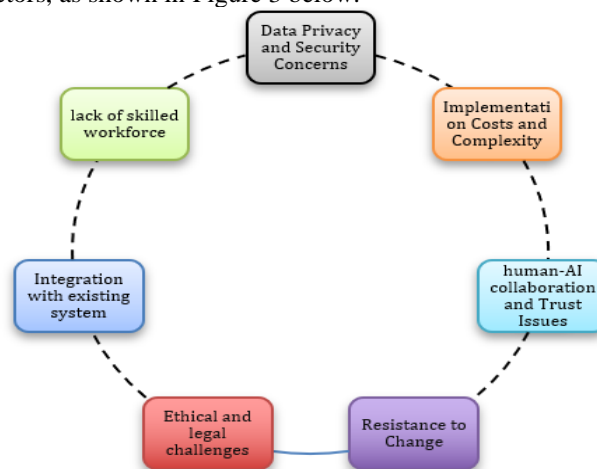

Fig. 3.   Types of challenges of program management

A.Data Privacy and Security Concerns

The use of AI faces its biggest obstacle in handling of sensitive information. These include but are not limited to project specifications, plans and documents, financial information, and personnel and stakeholders' information. Hence, security and protection remain a top priority for GDPR, two of the most important layers are security protocols for data protection and system trust management.

B.Implementation Costs and Complexity
Those using the AI system for developing and implementing investment and maintenance experience intensively demanding costs. A great deal of funds is required by many organizations for their initial implementation of AI into program management systems; this includes hardware and software, as well as the cost of incorporating specialized personnel. The nature of these systems presents implementation challenges for the organizations in question that often lack technological know-how and infrastructural support.

C.Human-AI Collaboration and Trust Issues
shows that workers are perceptive in adopting AI tools because they fear job replacement or a lack of concrete knowledge about AI. There must be confidence from the workers that AI systems increase their efficiency in what they do rather than systems that mimic human work.

D.Lack of Skilled Workforce
For standing organizations, problems arise when it comes to identifying or training adequate numbers of staff who have the specific knowledge that is required in order to manage AI-driven systems. The absence of the proper skills hinders the implementation schedule of AI systems, although their reliability is reduced.

E.Resistance to Change
Employees, as well as other organizational stakeholders, also often resist change from their previous methods of program management and are slow to adopt new forms enabled by AI. AI processes are generally regarded as innovative when they introduce systems that have interfered with conventional manual techniques that build on historical practices. AI's successful integration requires organizations to manage employees' resistance while developing organizational climates that accept AI as an enrichment tool rather than a threatening automation tool.

F.Integration with Existing Systems
AI tools need 100% integration with the current program management software programs and support structures. It is seen that organizations are capable of meeting challenges when they try to implement AI solutions on older system architectures. It means that AI systems require full compatibility with other tools on the market to function without interruptions and let information flow as it should between various applications.

G.Ethical and Legal Challenges
The use of AI decision-making systems continues to present concerns for transparency with justice concerns and accountability principles. In vitally important spheres such as, for example, healthcare or finance the legal issue arises as to who should bear the consequences of decisions made by AI agents. For responsible AI system utilization, organizations need to solve existing legal and moral concerns.

The resolution of these challenges demands organized training programs as well as infrastructure development together with stakeholder partnerships and honest implementation of AI systems. Organizations achieving an overcoming of these hurdles will maximize AI potential within program management to guarantee enhanced accuracy in decision making performance and operational improvement.

6. LITERATURE OF REVIEW
This section provides some previous research on program management with artificial intelligence methods and techniques that are listed in below:

This study, Kathuria, Duggal and Lande (2024) organize the scholarly inputs on automated processes so far to define what its strengths, approach and problems for HRM and to provide a sophisticated view of what has been recognized, and what needs to be recognized, and future directions of study to shape a global HRM research program. More study on the function of AI-assisted apps in HRM activities and patterns of interaction in big multinational businesses disseminating such technologies is required [18].

This study, Yuhua et al. (2021) takes stock of where things stand and where conventional methods of managing security chip production programs fall short, then suggests a new way of handling chip issue programs and builds a framework for oversight using web services. This study proposes a program management approach and system for chip manufacturing that streamlines the program management process and increases the system's operational efficiency[19].

The study, Dubey et al. (2023) adopts an interpretive perspective and a deductive approach. Data collection, AI algorithm implementation, integration into the system, and infrastructure issues are all included in the technical setup. Accuracy, sensitivity, quickness of processing, and scalability are examples of performance measures, and the influence on patients and healthcare providers is highlighted by user viewpoints and experiences. Informed permission, data security, and legal compliance are all included in the ethical considerations. The results highlight the potential advantages of data-driven medical services, but they also highlight how crucial ethical precautions and user acceptance are. Upcoming studies ought to concentrate on improving algorithms, protecting privacy, and evaluating long-term effects [20]

This study, Teubner (2018) utilization of IT to facilitate organizational transformation has been on the rise in both for-profit and non-profit sectors and is now reaching a fever pitch with the term "Digital Transformation" being tossed around. Therefore, it should come as no surprise that practitioners are looking for advice on how to handle this kind of change. Although this requirement has been met by professional organizations through the release of Program Management (PgM) best practice standards, their actual usefulness in managing programs, especially IT initiatives, remains unclear. The field of information technology PgM is quite new to academic study. This prompted us to look into the difficulties encountered by managers in five IT programs that ran into issues. They found a number of management problems and shortcomings, such as not having an architectural overview, having trouble handling changes to the project's scope, stakeholders' interests, cultural diversity within the company, not having enough internal PgM competencies, and unclear management roles and duties [21].

The study, Miterev, Engwall and Jerbrant (2016) proves that while talking about program management competencies, programs should not be seen as a single, generic entity. Not only that, but the results show that program content is a major variable in understanding the dynamics of program management. Appointment choices, employee evaluations, and organizational development should all benefit from the conceptual framework proposed in this research, which integrates program types with competency profiles for program management [22].

In this article, Gilmour and Lewis (2006) evaluate the effectiveness of senior executive program managers compared to political appointees subject to Senate confirmation using the management grades from the Bush administration. They break down the administration's management grade system and show how it might shed light on comparing different levels of management. They present evidence from 234 government projects to support the idea that programs led by senior executives are superior to those run by appointees. Across the board, they find that initiatives run by political appointees perform worse in terms of management quality. Political appointees' rightful role in federal program administration should be evaluated in a systematic assessment, they conclude [23].

Table I presents an overview of studies examining the use of AI in program management across various industries. It highlights the need for further research in specific areas such as AI's role in human resource management, particularly within multinational companies, and the development of AI-based systems to streamline production processes in manufacturing sectors. Additionally, challenges in managing IT programs during digital transformation are discussed, with a call for refining best practices and frameworks. Further exploration into the role of program content in understanding program management dynamics and the effectiveness of different leadership structures is also suggested.

TABLE I. SUMMARY OF RESEARCH ON AI APPLICATIONS IN PROGRAM MANAGEMENT

Authors	Key Focus	Objectives	Challenges	Future Directions

Kathuria, Duggal, and Lande(2024)	AI-assisted applications in HRM	To organize scholarly inputs on automated HRM processes and define strengths, problems, and future study directions	Limited research on AI's role in HRM activities and interaction patterns in multinational businesses	More study needed on the function of AI in HRM and its integration into multinational businesses.
Yuhua et al. (2021)	AI in chip production program management	To propose an AI-driven management approach and develop a Webservice-based management system for chip production	Traditional program management methods for chip production are inefficient and cumbersome.	Refinement of AI-based management systems for chip production and extension to other industries.
Dubey et al. (2023)	AI in healthcare services	To explore AI's impact on healthcare services, focusing on data-driven decision-making and ethical concerns	Issues with data security, user acceptance, and legal compliance, as well as algorithmic accuracy	Future studies should improve algorithms, ensure privacy, and assess the long-term effects of AI in healthcare.
Teubner (2018)	IT program management during digital transformation	To analyze challenges faced in managing IT programs during digital transformation	Scope changes, stakeholder interests, lack of internal competencies, and unclear management responsibilities	Further research needed on best practices for IT program management and the value of professional standards.
Miterev, Engwall, and Jerbrant (2016)	Program management competences	To create a framework combining program types and management competencies for better	Lack of framework to understand program management dynamics based on program content	Future research should apply the framework to staff assessments, organizational development,

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		organizational development		and appointment decisions.
Gilmour and Lewis (2006)	Senior executives vs. political appointees in program management	To examine the impact of management by senior executives versus political appointees	Political appointee-led programs tend to score lower in management areas, leading to suboptimal results	Future studies should assess the proper role of political appointees in federal program management and explore improvement strategies.

7. CONCLUSION AND FUTURE WORK

Program managers can greatly benefit from optimizing resource allocation and risk management, among other areas of project monitoring, by incorporating AI into their work. The broad use of AI is impeded by a number of obstacles, such as worries about data privacy, expensive implementation costs, and resistance to change. Despite these challenges, AI technologies provide great promise for optimizing program performance, risk forecasting, and resource allocation, making them indispensable tools for contemporary program managers. The limitations of current AI systems, particularly regarding ethical issues, human-AI collaboration, and the need for specialized expertise, point to areas that require further attention. Complying with data protection standards while integrating AI with older systems is also a complicated challenge. Improving AI algorithms for more efficiency, transparency, and accuracy should be the emphasis of future research. Moreover, strategies to upskill the workforce and foster a culture of AI readiness should be developed to ensure successful implementation and long-term benefits in program management across various industries.

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