Journal of Business and Management Studies
ISSN: 2709-0876
DOI: 10.32996/jbms
Journal Homepage: www.al-kindipublisher.com/index.php/jbms

JBMS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

The Future of Enterprise Portfolio Management in the Age of Generative AI

Mudappallur Raman Venkateswaran[1]✉ Sangeetha Govindarajan[2], and Nithya Krishnan[3]
[13]Product Manager III
[2]Senior Manager, Product Management
Corresponding Author: Mudappallur Raman Venkateswaran, **E-mail**: mudappallur.venkates@walmart.com

| ABSTRACT
Starting today and due to the advent of generative AI, traditional enterprise portfolio management (EPM) is seriously disrupted, creating new opportunities for organizations to accelerate strategic alignment, optimize resource allocation, and foster innovation. This paper explores how generative AI will have the transformative power to create actionable insights and improve decision-making in EPM. Therefore, organizations can surpass traditional portfolio management's limitations and adapt to dynamic and real-time adjustments enabled by the use of predictive analytics and scenario modeling through AI-driven tools. AI's role in enhancing portfolio optimization, risk management, and project prioritization is discussed in this article, alongside challenges centered on data quality, workforce, and ethical considerations. It further explains the integration between AI and the existing enterprise system to provide a more encompassing, flexible approach to portfolio management. The paper applies generative AI in the real world through case studies from some leading organizations, which show how generative AI has been used to optimize portfolio performance, manage risks, and allocate resources efficiently. The paper ends with the vision for the future of EPM through generative AI, where generative AI powers more agile and data-driven decision-making processes. With each growing step of AI technology, it follows that businesses need to invest money to benefit from AI tools and train their staff for the transformation of AI-enhanced portfolio management.

| KEYWORDS
Enterprise Portfolio Management (EPM), Generative AI, Predictive Analytics, Resource Allocation, Risk Management.

| ARTICLE INFORMATION
ACCEPTED: 02 August 2024 **PUBLISHED:** 25 August 2024 **DOI:** 10.32996/jbms.2024.6.4.21

1. Introduction

Enterprise Portfolio Management (EPM) is an enterprise-wide strategic framework that helps organizations align their portfolios, comprising the projects across the enterprise, the programs, and the initiatives within the organization to the business objectives. It is an organized way of making investments, optimizing resources, mitigating risk, and optimizing performance. EPM differs from traditional project management, which is focused on the execution of the projects in its strong holistic view, where the initiatives are always connected to the organization's vision. EPM makes operating easier, eliminates redundancies, and ensures that all projects entail measurable benefits. However, traditional EPM methodologies tend to be static, reliant on historical data, and unable to adapt quickly to changing market conditions. Traditional EPM frameworks often lack agility when making decisions, resulting in resource distribution problems and missed opportunities. It has catalyzed the need for technologically minded, agile, predictive sensing into the portfolio management process.

Due to technology, EPM has become more agile, data-driven, and less rigid. Emerging technologies have allowed organizations to process large volumes of data, forecast trends, and optimize the distribution of resources in real-time. This transformation has been driven partly by several key innovations. Advanced data analytics empowers companies to leverage real-time data to monitor performance, determine trends, and make informed choices. Cloud computing offers solutions of scalable and easily accessible portfolio management for teams from around the globe, improving collaboration. Inefficiency is eliminated

with science, now known as artificial intelligence, and simplicity, workflow is streamlined, and predictive insights are provided for better decision-making with the help of science, so-called artificial intelligence, and automation. Our blockchain technology improves the transparency and trust in reporting by the financial and operational levels of EPM frameworks. However, this new area of progress may not be fully realized either. Typical predictive models are built upon structured data, specified rules, and previous patterns and struggle to offer flexibility and dynamism. This is when Generative AI becomes a disruptive force in EPM.

Artificial intelligence for generation (Generation AI) takes in large datasets (big data for many) and creates new content, insight, and solutions. Rather than using rules and terms of problem-solving, generative AI models use deep learning, natural language processing (NLP), and machine learning to create new patterns, forecasts, and strategies in real-time. The combination of generative AI in the EPM industry finds ways to analyze complex datasets with more vitality and powerfully find patterns that determine the best portfolio strategies. It runs through many scenarios and picks the one that will give maximum efficiency with the optimum amount of resources. Furthermore, AI-based risk management allows organizations to predict risks and suggest how to combat them. This level of automation removes the manual effort and increases accuracy; hence, it becomes easier to perform portfolio analysis on performance. Moreover, as AI-enabled tools integrate into this, portfolio management tools are beginning to be used by leading organizations to become more real-time adaptive and strategically aligned. What might seem to be a shift is more a shift towards AI-enhanced EPM as part of a broader industry transformation assisted by intelligent automation and root because analytics that make up the future of enterprise-driven decision conduction.

This article aims to understand how generative AI is changing Enterprise Portfolio Management. While organizations find their business environment becoming increasingly difficult, it has never been easier to be efficient and agile and make the right decision using AI-driven EPM tools. The purpose of this article is to illustrate a cross-section of EPM and its conventional problems, highlight how Generative AI is useful on different angles of portfolio management, discuss the application of AI in real-world EPM, highlight challenges and serious issues with AI integration, and highlight tendencies and potential development of the EPM with support of AI. This article addresses these areas and serves as a valuable resource to business leaders, project managers, and AI professionals who wish to utilize AI in EPM to make better decisions, optimize resource allocation, and enhance overall organizational agility.

The article is structured in such a way that it guarantees a structured and informative exploration of the topic. The introduction provides the background of EPM, technological transformations, and the scope of Generative AI. The following section: Understanding EPM, foundational concepts, the evolution, and traditional portfolio management challenges are examined. The Rise of Generative AI in EPM explores how Generative AI is different from standard analytics and how Generative AI is being incorporated in the EPM process. In the Key Benefits of AI in the EPM section, the analysis explains how AI helps to make wise decisions, reduce risk, and improve efficiency. Issues in AI-driven EPM cover concerns regarding data, ethical questions, and workforce adaptability. The Evaluation Methodology of AI in EPM describes the research methods used to assess the effect of AI's effect and presents the results. The Future Trends in AI and EPM part of the section predicts the emergence of portfolio management through AI. Last is Case Studies, which present the application of AI in EPM based on real-world use cases. The researchers reach the Conclusion, which summarizes key takeaways and looks into the future.

2. Understanding Enterprise Portfolio Management (EPM)

Enterprise Portfolio Management (EPM) is a technique in which an organization can manage its projects, programs, and initiatives based on higher organizational goals. With the complexity of the environments and technological advances, enterprises are bustling in such a way that calls for a balanced control on resource allocation, optimum utilization, and proper governance to achieve the highest return on investment (ROI).

Figure 1: Enterprise Portfolio Management

2.1 Definition and Core Concepts

Enterprise Portfolio Management (EPM) implies centralizing an organization's overall portfolio of projects, programs, and initiatives to maintain strategic correlation with corporate goals. EPM differs from traditional project or program management, which is concerned only with individual initiatives but looks into the big picture regarding how projects or initiatives help business success (Archer & Ghasemzadeh, 1999). One of the main focus points of EPM is to precisely optimize decision-making on higher-value initiatives, save on the usage and allocation of resources, and reduce the risks involved.

In the essence of EPM, governance frameworks, metrics measures, and risk management strategies are used to set a structured business process in making a decision (Killen, Hunt, & Kleinschmidt, 2008). Data-driven methodologies can be implemented to evaluate project feasibility or returns and dynamically adjust portfolios. As enterprises adopt digital transformation, they embrace artificial intelligence (AI) and predictive analytics to improve EPM capabilities.

2.2 The Evolution of Portfolio Management

Portfolio management has come a long way in the last few decades, with changing views on business strategy, technology, and risk management. While it is true that portfolio management refers to selecting portfolio items and optimizing stock and asset combinations, this practice was originally limited to financial investments. As time went by, organizations rediscovered that the principles of portfolio management could also be applied to project and program management, resulting in the evolution of modern EPM methodologies (Mbiru, 2020).

Organizations started to streamline decision-making as structured frameworks, such as the Portfolio Management Standard by the Project Management Institute (PMI), became adopted throughout the late 20th century. This new approach involved the shift from the purely financial framework towards the strategic and operational approach, which consequently necessitated the integration of governance models, risk assessment methods, and performance tracking systems.

A digital transformation era, cloud computing, and AI-based insights have led EPM to go from a rigid to a modern EPM that leverages data and is adaptive (Nyati, 2018). With machine learning algorithms and big data analytics, businesses now use machine learning to predict their projects' success rates, optimize resource allocation, and visualize portfolio decisions in line with market trends (Cooper et al., 2001).

2.3 Key Components of EPM

Unique concepts such as Effective Enterprise Portfolio are effective because they contain numerous interdependent components that enable organizational efficiency and 'strategic' success.

Strategic Alignment

Strategic alignment means that all projects and initiatives contribute to an organization's long-term business objectives. Beyond the financial returns, projects need to be evaluated regarding their strategic value, competitive positioning, and customer impact (Meskendahl, 2010). By evaluating clear goals and performance indicators, enterprises can guarantee that their portfolios are in accordance with the current market requirements and corporate goals.

Governance

In EPM, governance frameworks determine who does what with what and in what order. Good governance structures improve transparency, mandate compliance with regulatory requirements, and automate the portfolio valuation process (Müller, Martinsuo & Blomquist, 2008). Governance, accountability reports, and performance metrics are also important in keeping a check.

Performance Optimization

Performance optimization involves continuous monitoring and improvement in the portfolio's efficiency. The organization quantifies project success using KPIs such as ROI, Net Present Value (NPV), and time to market. Advanced EPM systems embrace predictive analytics to identify bottlenecks and deviations and recommend corrective actions (Cooper et al., 2001).

Risk Management

Risk management in EPM involves realizing, evaluating, and controlling uncertainties that might affect the project's success. All risks in enterprise portfolios are financial risks, compliance issues related to regulation, market fluctuations, and technological disruptions (Killen et al., 2008). Organizations use scenario planning and risk simulation models to create proactive mitigation strategies.

Figure 2: Elements of Enterprise Project Management

2.4 Traditional Challenges in EPM

EPM is not without challenges, making it difficult to be effective.

Lack of Real-time Insights

The biggest limitation of traditional EPM is that it relies on stale data and stale reporting mechanisms. Today, many organizations still depend on manual processes or stand-alone tools that do not give a real-time view of portfolio performance (Müller et al., 2008). Insights on markets' trends and growing risks are not provided, so decision-makers cannot change their strategy.

Resource Constraints

Despite the development of portfolio management methods, the resource allocation problem continues to be a major challenge in portfolio management since many enterprises need to manage several high-priority projects concurrently. Due to reliance on past performance data, traditional EPM methods will not reflect current resource availability or project demand (Meskendahl, 2010). This leads organizations to overcommit resources to less impactful projects without cost value and to overlook important projects.

Inefficient Decision-Making

EPM decision-making inefficiencies result from fragmented data sources, lack of shared evaluation criteria, and resistance to implementing new technologies. However, many organizations are faced with aligning executive decisions with project-level insights, thus resulting in misaligned investments and poor portfolio performance (Archer & Ghasemzadeh, 1999). Providing a promising data-driven solution in the form of integration from AI and advanced analytics enhances portfolio adaptability and decision delivery with the trigger of action at the right time.

Enterprise Portfolio Management (EPM) ensures business strategies match project delivery, provide governance, and enhance performance. EPM went from traditional financial management principles to AI-driven strategic oversight of the enterprise's portfolios. However, real-time insights, resource constraints, and inefficient decision-making remain to make it ineffective (Bansal, 2022). Using digital tools, advanced analytics, and governance frameworks, organizations can use their portfolio decisions to achieve long-term business goals better.

3. The Rise of Generative AI in Enterprise Portfolio Management (EPM)

With the generative artificial intelligence (AI) rollout, the Enterprise Portfolio Management (EPM) experience is undergoing a fundamental shift. Advanced machine learning models powered by generative AI enable organizations to optimize resource allocation, improve decision-making, and automate complex portfolio strategies. Generative AI is becoming a disruptive force for businesses trying to get flexibility and efficiency in managing their portfolios.

3.1 What is Generative AI?

Generative AI means that artificial intelligence systems can create new data, insights, and patterns by learning from existing datasets. It differs from traditional rule-based AI that follows fixed logic; generative AI can independently generate text, imagery, simulations, and predictive models. The so-called models in this thesis use deep learning architectures like Generative Adversarial Networks (GANs) or Transformers to generate novel content (Goodfellow et al., 2014).

In EPM, generative AI refers to analyzing huge amounts of structured and unstructured data to find patterns, seek risks, and suggest the best portfolio strategies. Unlike conventional predictive analytics, generative AI can run multiple future scenarios so corporations can proactively pivot their portfolios. It helps organizations foresee market fluctuations, resource constraints, or inefficiencies in their operations before they occur.

3.2 How Generative AI Differs from Traditional AI

There are traditional AI systems in enterprise management that automate repetitive tasks, boost data processing, and support decision-making based on predefined rules. Most of these systems are based on supervised learning models where the AI learns to identify patterns using labeled datasets and make predictions (Russell & Norvig, 2016). Traditional AI is good at structured problem-solving but cannot be creative in new insights beyond historical data.

Figure 3: Generative AI in Investment-A Roadmap to Financial Success

Generative AI, on the other hand, uses deep neural networks capable of producing entirely new outputs based only on observed knowledge. Such capability enables creative problem-solving, scenario planning, and autonomous decision support. Within the realm of EPM, generative AI can generate alternative investment models, simulate alternative risk scenarios, and dynamically optimize the strategy of project prioritization. These models leverage reinforcement learning to improve by continuously testing and evaluating various portfolio strategies (Silver et al., 2017). In addition, generative AI is more interpretable than traditional AI models since generative AI explains the rationale behind its recommendations. It is critical to have this level of transparency for enterprise executives who need justifications for portfolio decisions in industries such as finance, healthcare, and government sectors dominated by the need for compliance.

3.3 The Role of Large Language Models (LLMs) in EPM

Generative AI applications in EPM rely heavily on the advancements of large language models (LLMs), such as GPT-3 and BERT. LLMs process natural language data, and organizations can derive insights from unstructured data such as project reports, financial statements, and stakeholder communications (Brown et al., 2020). These models enable an understanding of the context and sentiment in which geopolitical uploads occur and extract these from the underlying geopolitical data, key decision-making indicators, streamlined reporting processes, and improved risk analysis.

Sending sentiment analysis on organizational communications is one of the main contributions of LLMs to EPM. AI-based models evaluate employee feedback, market sentiment, and stakeholder feedback and assess the project's viability and possible risks (Some, 2023). Moreover, LLMs enable automated knowledge management that makes the insights gained within historical projects available and actionable by portfolio managers.

LLMs recommend real-time predictive analytics based on the synthetic data combined from multiple functional areas. For instance, they can review procurement contracts, vendor contracts, and regulatory filings to find compliance risks or to propose cost-saving measures. The integrated reporting system allows organizations to make an informed portfolio decision through a comprehensive data analysis instead of depending on fragmented reporting.

3.4 The Adoption of AI-Driven Portfolio Management in Enterprises

As organizations start to grasp the power of generative AI in EPM, we are now seeing the adoption of generative AI picking up speed. Leading enterprises in various sectors like finance, manufacturing, and technology have integrated AI-driven tools to make portfolio governance and resource management more efficient. 50% of organizations that had implemented AI-driven decision support systems said they saw improved portfolio performance with an increase in return on investment (ROI) and reduced costs of operations (Sanchez, 2020).

One of the major factors driving AI adoption around EPM is enabling risks in complex project portfolios. AI-powered models calculate interdependencies between projects, predict possible bottlenecks, and suggest other activity schemes. This proactive approach allows them to allocate resources dynamically, delivering the optimal project outcomes while disrupting the processes as little as possible.

AI EPM systems also boost real-time collaboration across dispersed groups. Cloud-based AI platforms allow data from various sources to integrate to fuse the disparate data scattered in the cloud, giving stakeholders the ability to see up-to-date portfolio insights and align strategic priorities (Jay, 2023). AI is used to create AI-driven dashboards so that executives can use data to make more accurate data-driven decisions and better keep tabs on what is happening in their portfolios and who is accountable for what.

3.5 Real-World Examples of AI in Portfolio Management

Several organizations have successfully deployed generative AI in EPM to innovate and improve operational efficiency. For instance, Siemens uses AI-powered decision support systems to optimize its global project portfolio. Using machine learning algorithms, Siemens can find high-impact projects, allocate resources in the commercial environment in real time, and automate risk assessment. JPMorgan Chase is another notable case of companies integrating generative AI models into their financial portfolio management systems. These models determine the investment risks based on market trends, customer sentiment, and economic indicators and suggest an asset allocation strategy. The firm automates portfolio rebalancing, thereby increasing its decision-making power in investment by reducing the force mechanism.

Figure 4: Benefits of AI in Portfolio Management

Google employs AI-driven project management tools to streamline innovation workflows in the technology sector. The success rate for a project is forecasted using historical project data and employee productivity metrics, and optimal resource allocation is recommended using AI models (Wamba-Taguimdje et al., 2020). Google has been able to speed up product development cycles while maintaining the strategic alignment of its global portfolio. The real-life implementations, though, were thoughts based around the generative AI of generating and creating a model, which demonstrates just how well the EPM field can be changed with the generative AI. Within the enterprises, its AI practices will continue to be further fine-tuned so as to integrate advanced machine learning techniques across its portfolio management practice to increase efficiencies, accuracy, and agility.

4. Key Benefits of Generative AI in Enterprise Portfolio Management (EPM)

Generative AI is a technology that has become a sea star in the enterprise portfolio management space. The procedure of portfolio management, such as an organization, can be optimized with the help of the power of predictive analytics, real-time data processing, and machine learning, together known as generative AI (Dahal, 2023). The main advantages of the generative AI application to EPM are discussed in this paper. It shows how its use will increase decision-making skills, resource allocation, project prioritization, and better use of portfolios.

4.1 Enhanced Decision-Making

Among all the advantages of integrating generative AI into EPM, the most compelling one, its ability to add to decision-making processes is one of the most compelling. Most portfolio management still relies on static models and historical facts, which do not reflect the level of complexity and dynamics in modern business environments. However, unlike generative AI, it enables real-time data analysis, scenario-based simulations, and automated insights for decision-makers to navigate uncertainty and optimize strategies.

Real-time Data Analysis

Generative AI models can take in massive waves of data from different sources, such as market trends, customer behaviors, project performance, and financial indicators. Real-time analysis of this data allows AI systems to spot risks, opportunities, and patterns emerging that are not identifiable through traditional methods (Tien, 2017). The advantage of this is that executives can react quickly to changes in the business environment and can make timely decisions based on informed information, thereby improving strategic alignment and reducing the risk of overlooking important information.

AI-driven Simulations for Risk Mitigation

AI-powered simulations play many roles in predicting the outcomes of a variety of portfolio strategies. The simulations account for many factors and circumstances that could disrupt, enabling an organization to predict risks and create mitigation plans before doing anything. For example, generative AI can create multiple market conditions or economic scenarios so that companies can anticipate changes in demand, supply chain problems, or regulatory changes. This degree of foresight enables organizations to make decisions that decrease the chances of losses while increasing their portfolio's resilience.

Automated Insights for Executives

What executives can get from generative AI are also actionable, automated insights that provide a small lift to free up manual data interpretation efforts. Instead of digging through intricate reports and waiting for human analysts to report back, decision-makers can rely on AI-generated recommendations specific to their objectives (Shirkhorshidi et al., 2023). The insights are accompanied by data visualizations, making it easy for leaders to quickly grasp the implications of different strategies, thereby lending themselves to fast decision-making.

4.2 Dynamic Resource Allocation

This game changer for organizations managing a complex portfolio and demonstrating how generative AI enables generative AI to optimize resource allocation in dynamic real-time. In a fast-paced environment, traditional resource allocation methods usually require past performance data and static forecasts and are no longer practical. With AI-powered tools, an organization can increase the utilization of resources, tackle market fluctuation, and/ or try to model different resource allocation scenarios to get the best results possible.

Scenario-based Modeling

Generative AI is best at performing scenario-based modeling to generate simulations based on different assumptions regarding the market, project requirements, and available resources. For instance, an AI model may be used to simulate how assigning resources to one project from another can impact market demand or business directives. With such flexibility, organizations can test the Planner's impact on another basket strategy without impacting monthly portfolio returns.

Optimizing Resource Utilization

AI continuously monitors real-time data and gives insights to organize resource utilization, which makes organizations more efficient in the use of resources. As an example, generative AI can monitor specific projects' progress and suggest reallocating resources as an answer to existing requirements to avoid wasting them and never using them (Rane, 2023). It is a level of optimization that reduces operational inefficiencies and allows organizations to achieve better outcomes with less or the same resources.

Adapting to Market Conditions

Another advantage of AI in resource allocation is that it can adjust to changes in the market. Generative AI can include economic shifts, competitive pressure, and even regulatory changes in its models (Gill, 2018). By analyzing these variables further, the AI system can tirelessly flaunt real-time advice for a portfolio strategy and resource allocation so that the corporations remain agile and can curveball in response to the changing market dynamics.

4.3 Project Prioritization and Optimization

Generative AI has not only helped improve project prioritization and optimization in an enterprise but has also simplified the process. The reason is that it is usually the case that an organization controls many different projects that may be more or less important, may afford higher or lower financial returns, or may be more or less strategically aligned. Therefore, selecting the projects that should be attended to first is a difficult problem. It can assist in identifying the most relevant project with respect to

the organizational goals and making up a list of the projects to be prioritized, taking into account given parameters (Costantino et al., 2015).

Figure 5: Project Prioritization Matrix

Multi-criteria Analysis

The advanced AI system can also undertake sophisticated multi-criteria analysis, including the project's financial returns, available resources, market trends, project interdependencies, and more, for priority decisions for the project. Humans will miss out on the patterns and correlations in the big datasets that AI can greatly benefit from so AI can make more informed decisions. This approach identifies key projects that can maximize overall portfolio value and fit the organization's strategic objectives (Gandomi & Haider, 2015).

AI-based Portfolio Configuration

Additionally, generative AI can select the right mixture of projects to set a strategic portfolio for an organization's target. AI is capable of studying the interdependencies between projects and modifying the portfolio to start the right projects first (Bansal, 2015). It is a useful capability in the complex portfolios of organizations with competing initiatives that are aligned with the investments to the long-term growth and sustainability goals.

4.4 Predictive and Prescriptive Analytics

Generative AI is very strong at predictive and prescriptive analytics and it brings a powerful toolkit to predicting future performance of the portfolio or what action needs to be taken. These become critical for organizations to control the risks and improve on investments and align their portfolio with its respective organizational objectives.

AI Forecasting for Financial Returns

Using generative AI, historical project data and external market conditions can be analyzed and used to predict the performance of different portfolio strategies. AI allows organizations to make investment decisions based on what data is forecasted to drive revenue streams, cost structure, and return on investment (ROI) for different areas of investment. Consequently, executives make do without too much analysis and select the most profitable option from among several scenarios for their portfolio.

Identifying and Preventing Bottlenecks

Predictive models can also use AI tools to predict when a problem in a portfolio may mature into a critical problem. By analyzing the project timelines, resource constraints, and external variables, AI systems can help identify potential delays or resource constraints that might affect the progress of the project (Yaseen et al., 2020). Proactive means organizations are capable of taking corrective action prior to such problems escalating. In the long run, portfolio performance is better, and projects are delivered on time and within budget.

4.5 Automation and Efficiency Gains

Generative AI provides huge automation and efficiency gains in enterprise portfolio management. AI automates routine tasks and frees human resources to do work that adds more value to the organization, thereby enhancing effectiveness and productivity.

Reducing Manual Effort in Data Processing

The automation of the collection, processing, and analysis of vast amounts of data allows for significant lessening of the manual effort necessary to execute traditional portfolio management processes. This automation decreases the time for decision-making and data updates consistently; hence, the data is always accurate and remains updated in real-time, which can offer a holistic view of how the portfolio performs (Huang et al., 2018).

Improving Portfolio Visibility

AI tools save plenty of time with their ability to consolidate data from different sources and present it as a lean-to interpret and compile into a unified dashboard (Sainio, (2023). These dashboards help executives view key performance indicators, keep track of project progress, and evaluate the overall plan of attack. This greater visibility enables more informed decision-making, faster responses to emerging problems, and better project-to-organizational goal alignment.

5. Challenges and Considerations in AI-driven EPM

However, generating options and mix possibilities in Enterprise Portfolio Management (EPM) with generative AI present their own set of problems and concerns that must be dealt with to make the project successful. These problems include data quality worries, ethical concerns, workforce adaptation, and cybersecurity risks.

5.1 Data Quality and Accessibility

Data availability and quality are probably one of the biggest challenges when making AI take the reigns from hardware and become part of the EPM end-to-end process (Bansal, 2023). Because generative AI models need a lot of data to produce insights and predictions, they adapt to their environments. However, we know that the effectiveness of these AI models depends on how good the data they were trained on is. Poor data quality can be incomplete, outdated, or bad, severely weakening the accuracy and reliability of the AI outputs.

Figure 6: Importance of Data Quality

Importance of Data Governance

These issues would be addressed through data governance. A firm needs to create a strong framework for data management to assert that the data is dependable enough and ascertainable. Among effective data governance practices are setting up clear guidelines on who owns the data, ensuring data and information are validated and cleaned in place, and monitoring data integrity continuously (Abraham et al., 2019). Doing so will help organizations enhance the accuracy and reliability of AI-generated insights so that informed decisions can emerge.

Ensuring Accuracy in AI Insights

Aside from being accurate, how AI produces insights is also dependent on how accurately the data represents real-world cases and the organization's goals. To ensure the AI system outputs are confirmed and adjusted as necessary, it is important to keep the feedback loops between the machine and human experts running all the time. For instance, AI algorithms can suggest a resource allocation plan that requires human consent to evaluate such plans about the business's strategic objectives. To improve decision-making powered by AI, accuracy in AI insights has also become a source of more trust in AI-driven systems inside companies.

5.2 Ethical and Regulatory Compliance

With organizations increasingly using AI to make decisions in portfolio management, ethical and regulatory compliance concerns are rising. Yet the use of AI-generated insights can present a host of questions around transparency, accountability, and fairness.

Transparency and Accountability

Ensuring transparency in AI decision-making processes is one of the most pressing ethical challenges in its current use. However, many AI models based around deep learning are similarly ''black boxes'', making it hard for users to know how decisions are arrived at (Binns, 2018). Lack of transparency can result in mistrust in intelligent systems, especially in critical areas such as financial forecasting and risk management. Companies should adopt XAI frameworks that lend interpretability and understanding to the decision-making process to recover from this. By taking this approach, stakeholders can understand why AI should generate insights, which is imperative when it comes to accountability.

Adhering to Data Protection Laws

COMPLIANCE with evolving data protection rules like the General Data Protection Regulation (GDPR) is required for EPM package applications. A rule of this law governs how data is collected, processed, and stored, and there are incredibly strict limits on the usage of personal and sensitive information (Hoofnagle et al., 2019). Therefore, organizations must do their part to ensure that their AI models adhere to these rules by applying data anonymization, encryption, and consent management procedures to ensure the data involved is deemed sensitive enough to adhere to these rules and conform to others, like the OneCounterData Privacy Act. Complying with data protection laws is necessary to avoid legal consequences and loss of reputation.

5.3 Workforce Adaptation and AI Skill Gaps

In addition, adopting generative AI in EPM is accompanied by challenges arising from changes in workforce adaptation. Wherever AI tools are deployed, they enhance human decision-making abilities, but only if they are paired with a workforce that knows how to use them well. There might be innumerable employees with the skills necessary to interact with AI systems, but this may be a barrier to adoption.

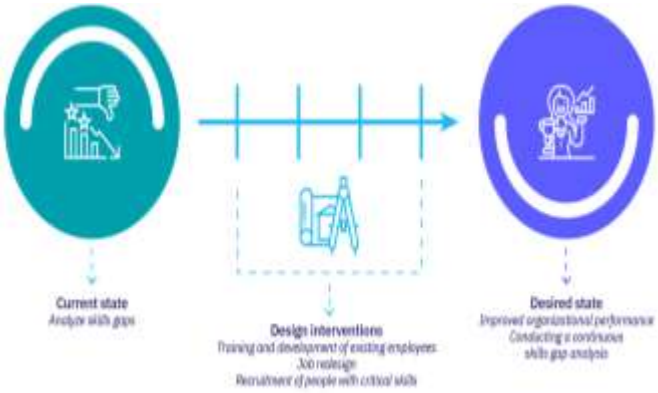

Figure 7: Skills Gap Analysis

The Need for Upskilling Employees

A solution to this problem is to invest in reskilling and upskilling at least their employees. AI is related to data analysis and ethical use of AI among the competencies that should be achieved from training programs. Organizations also need to maintain a culture of continuous learning to assist employees in learning about current developments in AI and the most effective procedures (Brynjolfsson & McAfee, 2017). Upskilling employees is a way companies can leverage the most from AI tools and incorporate human expertise in AI-based processes.

Human-AI Collaboration

Instead of viewing AI as a replacement for humans just as decision makers, AI is better viewed as a tool to enable collaboration with human decision-makers. Human judgment is still needed to parse the insights generated from complex data analysis and make strategic decisions based on them. Human AI collaboration is effective if the AI system's strength and human

expertise are both utilized to produce the best results. This collaboration brings benefits such as improved decision-making and assistance for employees in adopting these AI tools without resistance.

5.4 Security Risks and AI Bias

Like any other system, AI integration into any EPM system poses new security risks and the possibility of bias in AI. These risks must be carefully managed.

Cybersecurity Concerns

Like any other digital system, AI-driven EPM tools are also prone to cybersecurity threats. AI models could be misconfigured or hacked to arrive at the wrong insights or interfere with portfolio management decisions (Sinha et al., 2023). For this reason, organizations must have strict cybersecurity guardrails such as secure data storage, encryption, access control, etc. Meanwhile, regular security audits and stress testing on AI systems should be done to find and eliminate vulnerabilities.

Addressing AI Bias in Decision-Making

AI bias continues to be a major challenge despite AI perpetuating the existing biases that have already been established in the data that is being used to train the AI. Regarding EPM, AI bias might lead to decisions being made suboptimally, focusing on the preference of those data patterns over another. Therefore, organizations must rely on fairness-aware algorithms that actively identify and eradicate bias. Apart from this, it is only fair that organizations regularly audit their AI systems for fairness and ensure representation in their datasets, which feeds into their AI models (Ferrara, 2023). These steps will strengthen the organizations' ability to care for their AI tools so they do not make biased and unfair decisions.

6. Methodology for Evaluating AI in EPM

A structured methodology to assess the application of generative AI in Enterprise Portfolio Management (EPM) as it relates to the effectiveness, efficiency, and impact of AI tools on portfolio strategies. Literature review and case studies, as mentioned earlier, are the elements of this methodology being part of a research method for data collection and analysis via AI tools, where evaluation criteria of the accuracy, cost benefit analysis and calculation of AI based ROI and the challenges of exploring its practicality in EPM are included.

6.1 Research Approach

The first step in AI evaluation in EPM is to cover a vast amount of literature that describes how AI can be applied to portfolio management. This literature review thus creates a foundation for understanding the use of AI tools in EPM processes and how they are specifically used in the generative AI area. These papers are reviewed for their academic journal articles, conference papers, and industry reports that reveal their opinions on the possibilities and limitations of AI in portfolio management. Recently, studies have explored business practices of how AI technologies are implemented in business decision-making by highlighting present practices, methods, and challenges of the issue.

The case studies from industry leaders who have deployed AI-based EPM systems are combined to form a literature review. In these case studies, we apply rubrics toward the real-world adoption of AI tools, offering examples of the AI being used in practice. There are lessons to be learned from how various organizations employ generative AI technology for the portfolio management of their products and processes and how generative AI technology can be scaled up and leveraged more effectively in other industries (Ooi et al., 2023). Some of these include using AI in project prioritization at large tech companies and the use of AI in portfolio optimization of financial institutions.

6.2 Data Collection and Analysis

The reporting of data collection for the evaluation of AI in EPM assesses the main tools that AI has been used by organizations globally. The tools are AI-based, using software and platforms with the power of AI (artificial intelligence), such as machine learning algorithms, natural language processing, and predictive analytics. Tools used to optimize portfolio management functions like resource allocation, project prioritization, and risk analysis include IBM Watson, Google Cloud AI, and Microsoft Azure AI. These tools need to be evaluated in as much detail as possible to know what functionalities these tools will provide for the process, as well as how they will be integrated into the current EPM framework.

Figure 8: An Overview of Enterprise Performance Management (EPM)

Data is collected on the performance of the relevant AI tool. It is essential to characterize performance metrics to evaluate how effective these tools are in enhancing the decision processes, resource allocation decisions, and project success (Chan et al., 2004). The success rate of the project, time to market, and return on investment (ROI) are these factors. This data can be found by researchers from enterprise reports, from AI tool documentation, and from interviewing industry professionals about EPM. The tangible benefits and drawbacks of the efforts to control a company's portfolio based on the use of these tools are discussed from the perspective of performance indicators.

Qualitative data about portfolio managers' experience using AI tools, as well as other stakeholders, comes from surveys and interviews with the portfolio managers. These help fill out the picture of the practical realities and successes in using AI in EPM with additional qualitative insights that support a complete picture of the quantitative performance metrics.

6.3 Key Evaluation Criteria

Several key criteria on which basic evaluation of AI for EPM can be done to ensure the tools are effective in a real-world context. The accuracy of AI insights is the first and most important criterion. Specifically, AI models, especially when machine learning-based, are created to learn insights from large amounts of data. Nevertheless, for the insights to serve as the basis for portfolio decision-making, they must be reliable and accurate. It takes accuracy and the comparison of AI-driven predictions (which could be project success rates or financial forecasts) to actual results. Researchers highlight the need to ensure data quality and AI model training are considered when powering insights.

A critical evaluation criterion pertaining to the cost-benefit analysis of AI-driven tools is another important parameter. Implementing AI in EPM can require a high upfront investment in software, training, and even data infrastructure. However, this is not really a cost since the cost is short-term and will be outweighed by the long-term benefits of adopting AI, which are increased efficiency, optimized resource allocation, and better decision-making. Therefore, when investing in AI systems, organizations must first think about the entire ROI of such systems. In the process, the total cost of ownership is calculated, and savings and value given by the portfolio management outcomes are compared.

These are no less important than the first three of these elements when it comes to the evaluation methodology, but especially for the later AI-driven ROI calculation. With ROI calculations, we can also look at how much financial benefit AI brings to portfolio management by saving costs, investing in better portfolio performance, or being more competitive in the market (Bartram et al., 2020). Through the use of AI models that predict the outcome of resource utilization and project success, organizations are then able to calculate real-time ROI in order to adjust portfolio strategies as required. Many studies have shown that AI tools can help financial performance by accurately predicting project outputs and finding the optimal portfolio configurations.

6.4 Challenges in Researching AI for EPM

There are a couple of issues when applying AI in EPM research. Data limitations are one of the major problems. For AI to generate accurate insights, it needs access to incredibly high-quality, comprehensive data from many different sources. Still, most organizations are plagued by fragmented, inconsistent, or incomplete data that hampers accurate prediction and ineffective AI models. This second reason is that, even if the labor problem is removed, AI algorithms are very dependent on the quality of the data they process, which means that poor data governance can have a severe negative effect on the effectiveness of AI in portfolio management.

The rapid advancements in AI technology are another major challenge to finding AI suitable for use in an EPM application. New algorithms, models, and tools are often added to the AI field, and the AI field evolves fast. This makes research quickly become

outdated as newer AI solutions are developed and deployed (Dwivedi et al., 2021). These advancements make it very hard to produce modern research methodologies and tools to keep up with these advancements and produce long-term studies on the impact of AI. Furthermore, the nature of technological advancement means it is not easy to foresee the path that AI will take in portfolio management, which introduces an element of uncertainty to the research.

7. Future Trends in AI-driven EPM

Today, the integration of advanced AI technology is increasingly shaping the future of Enterprise Portfolio Management (EPM). Businesses are looking for ways to improve efficiency and optimize resources to navigate the complexities of the dynamic market. At this time, AI-driven innovations are becoming the ultimate solution.

7.1 Integrated AI Ecosystems

This is among the most prevalent future trends of EPM that involve incorporating AI into existing enterprise ecosystems like Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) systems. These platforms are now easy to interface with AI-driven tools that give up-to-the-minute insights, automate many routine processes, and allow intelligent decision-making. The more organizations use these AI integration capabilities, the more data between departments will intersect—finance, sales, human resources, and operations—so that portfolio management decisions will reflect the needs of an entire enterprise.

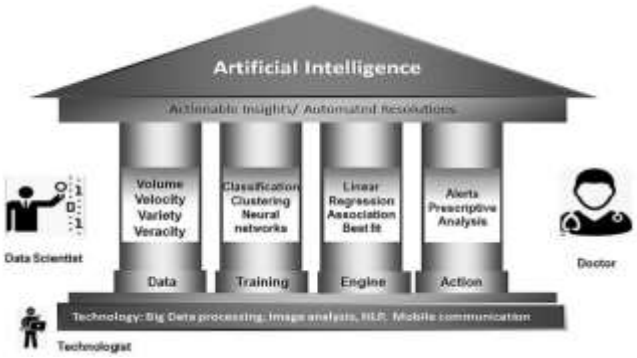

Figure 9: Pillars of AI ecosystem

For example, the combination of AI and ERP systems can move dynamically project allocations in response to changes in the availability of resources, decisions about financial conditions, or a changing market (Yathiraju, 2022). By integrating with EPM, EPM professionals can move portfolios more fluidly than the data points allow. Similarly, the integration of AI in these CRM systems ensures that all data about the client is fed to the decision process or, rather, enables live access to information concerning customer satisfaction, market needs, and other risks involved with ongoing projects. It is implied that there is a trend towards more flexible, data-driven portfolio management that allows organizations to respond quickly to internal and external changes.

7.2 Autonomous Portfolio Management

The second big change brought about by AI is autonomous portfolio management. With the improvement in machine learning algorithms and predictive analytics, future AI systems may be programmed to manage portfolios autonomously (Bansal, 2023). Using these systems would enable continuous monitoring of project status, responsive project strategies in real-time, and optimal project portfolio configurations without human intervention.

The AI can analyze enormous variables, such as project performance data, prevailing market conditions, and financial metrics, to decide resource allocation, project prioritization, and risk management. With AI capable of automatically making adjustments such as these, it could free human managers from a lot of their time and effort, allowing them to focus on higher-level strategy and innovation instead (Haleem et al., 2022). Additionally, autonomous systems can neutralize human bias and error in portfolio decisions that otherwise would be based on human biases and errors, which will streamline the whole process and make it more transparent and reliable.

7.3 Collaborative AI in EPM

The increasing number of connected businesses means collaborative AI will play a bigger role in EPM. AI-driven tools will enable better cross-collaboration among teams, departments, and external stakeholders, so portfolio decisions should be aligned with the organizational objective. AI systems can, therefore, synthesize various departments' inputs into a unified strategy that includes the overall view of the organization in its intelligence.

Consider, for example, AI-powered platforms that support project managers, resource planners, and financial analysts in getting real-time updates and recommendations from all around the organization with data. They will be able to better determine courses of action, minimize conflicts, and work towards one group to achieve strategic goals. Moreover, AI will play a potentially more important role in helping AI support virtual teamwork, even across global teams, as AI technology grows.

7.4 AI-driven Innovation in Business Strategy

AI is also expected to spark business strategy innovation by helping organizations better sense and respond to market trends. Generative AI enables organizations to analyze huge quantities of market data, consumer behavior trends, and competitive intelligence to develop and refine their strategic initiatives (Nyati, 2018). Furthermore, these AI systems can predict the emergence of a new trend, locate a new business possibility, or make suggestions for it that can maximize the potential for growth.

Figure 10: AI Strategy for Business

For instance, it can predict shifts in market sentiment based on the kind of social media patterns, news reports, and consumer feedback. These insights allow organizations to adjust their portfolios in light of such market disruptions, leaving them proactive and competitive in the face of market disruptions (Day, 2011). In addition, by allowing businesses to run "what if" scenarios that AI can model, they will know the consequences of various strategic decisions and which path might be most favorable for them in an uncertain environment.

7.5 Regulatory Evolution and AI Governance

As AI takes an increasingly central role in EPM, there will be growing requirements for robust regulations governing the ethical, legal, and regulatory issues related to using AI in decision-making. With more and more of the work done by AI systems in portfolio management, accountability is what matters. For AI to be truly adopted in EPM, it will be important to ensure transparency, fairness, and compliance with data protection regulations.

The space of AI is still coming to terms with its regulatory landscape. Government and industry bodies are striving to bring standards to combat AI biases, the privacy of the data, and the ethical ramifications of the development of such fully autonomous decision-makers (Nassar & Kamal, 2021). However, as AI starts to be adopted in portfolio management actions by organizations, those adopting AI in their portfolio management will have to be ahead of these regulatory changes by bringing in strong AI governance practices. It is about agreeing on clear data collection protocols that explain AI models and creating systems for monitoring and auditing AI decision-making.

8. Case Studies: AI in Action in EPM

From optical illusory patterns to interior grids, announcements of an AI program being worked on for portfolio performance and risk management have increased as artificial intelligence (AI) continues to gain popularity in the Enterprise Portfolio Management field (EPM).

8.1 Case Study 1: AI-powered Portfolio Optimization in a Fortune 500 Company

One of the Fortune 500 companies in the financial sector has been able to integrate AI data-driven tools for portfolio optimization. However, managing many projects across old business units without applying traditional portfolio optimization methods caused some challenges for this company. The company utilized machine learning algorithms first to develop a system that utilizes historical performance data, market trends, and strategic goals to assist with real-time recommendations on what the portfolio should be changed.

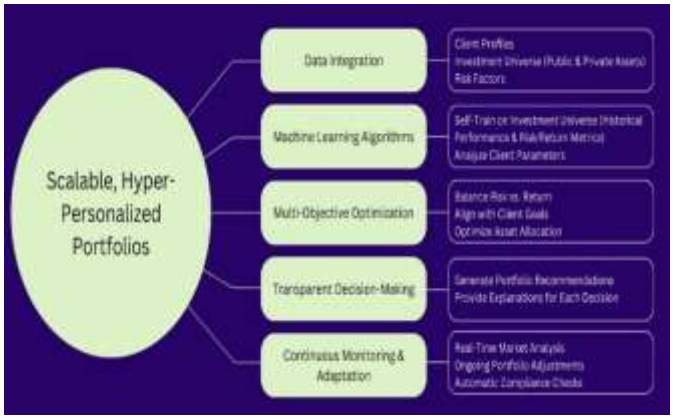

Figure 11: AI-Driven Portfolio Optimization

In this kind of company, the AI system they have implemented follows reinforcement learning techniques to keep changing the portfolio so that the resources are directed to the projects that have the highest chance of succeeding (Antonopoulos et al., 2010). This means the AI system can predict the financial returns of a project by considering variables like market conditions, stakeholder feedback, and external economic factors. Therefore, the corporation has acquired the ability to optimize its portfolio, align projects and corporate goals, and improve its financial performance. The addition of generative AI has also allowed the company to dynamically prioritize projects without waste and allocate resources according to real-time data instead of static past performance measures.

8.2 Case Study 2: Generative AI for Risk Management in a Global Enterprise

A global manufacturing enterprise also used generative AI to improve risk management processes. However, due to a large portfolio of projects around the world, the company had difficulty finding and overcoming risks in its operations. Using AI-based risk management tools, the company was able to simulate different scenarios and hues of the risks in the project portfolio.

In analyzing historical data to learn about past risks, such as supply chain disruptions, regulatory changes, and geopolitical factors, we applied generative AI models, particularly deep learning algorithms. It also gave prescriptive recommendations for mitigating these risks by recommending what to do, such as reallocating resources or adjusting a project timeline. The proactive risk management approach has helped the company avoid substantial financial loss and made projects close to acceptable risk tolerance levels (Steinberg, 2011). Additionally, due to improvements in the AI system's ability to process massive amounts of data in real time, the company's agility has been enhanced when faced with unexpected demands.

8.3 Case Study 3: Predictive Analytics for Resource Allocation in Tech Firms

One of the leading technology firms in Silicon Valley implemented predictive analytics into its EPM processes to optimize resource allocations. The company faced the issue of effectively managing its workforce and resources spread across multiple software development projects (Kumar, 2019). Common resource management techniques did not give accurate forecasts, so there were always surpluses and shortages of resources.

This way, the company was using predictive analytics to analyze a number of factors, including project timelines, employee availability, and skill sets, to forecast resource requirements more precisely. Then, the AI system predicts needed resources based on known project complexity and timescales and variables outside of the project, such as the availability of talent in the external market and competitor activity (Raharjo & Santoso, 2022). In particular, this predictive approach assisted the company in optimally allocating its workforce with the right skills on the right projects in the right way.

Figure 12: Benefits of Predictive Analytics

As a result, this AI-driven solution cut resource underutilization by 20% and cut 15% off the time to project delivery. The company also aligned its resource allocation with strategic goals, hence reducing the operational cost and increasing the success rate of its projects. Through better forecasting of needs, the firm was able to prevent many costly delays and stay competitive in the fast-paced tech industry.

8.4 Lessons Learned from AI Adoption in EPM

These are a few key lessons from the abovementioned case studies about adopting AI for enterprise portfolio management. By delivering data-driven insights to improve decisions, AI systems have also been proven effective in optimizing portfolio performance (Bansal, 2022). In all three case studies, the implementation of machine learning and the use of predictive analytics made adjustments in the portfolio more dynamic and more informed, leading to better strategic alignment and better financial outcomes.

Data quality and governance importance were also shown when AI was integrated. In all instances, the actionable insights that the AI could provide relied significantly on high-quality, accurate data. Organizations need to invest in robust data management practices to make AI tools in EPM effective (Kiran, 2017). While there is promise in AI to help with resource allocation and risk management, the human element cannot be overlooked. Adoption of AI, however, is not just based on the latest technology. It also needs employees who will work collaboratively with the AI. The case studies exhibit that AI should not be considered a tool that replaces humans but rather a complementary tool to augment human decision-making.

9. Conclusion

Generative AI integration into Enterprise Portfolio Management (EPM) is fuelling a transformation that ensures the field faces up to managing and optimizing portfolios for organizations. This paper examines the capabilities generated by AI for optimizing decision-making, resource allocation, risk management, and innovation for organizations. These advancements are a giant leap forward, breaking the limitations of conventional portfolio management techniques that frequently cannot cope with the speed of change in the surroundings. There is no line between generative AI's role in EPM and its effects on real-time decision-making, predictive analytics, and resource optimization. Machine learning algorithms used in AI-driven tools enable executives to leverage these applications to rapidly receive the insights vital for making quick decisions from vast amounts of data. It allows organizations to suitably realign the portfolios to strategic targets, making the best possible use of resources and optimizing return on investment. For instance, generative AI's capacity to run massive simulations and predictive models provides worthwhile foresight to face risk before things get out of hand.

In several critical areas, Generative AI is immediately apparent as the primary benefit of Generative AI in EPM. The most significant advantage is that AI systems can analyze large amounts of data and deliver actionable insights that otherwise would be overwhelmingly difficult to derive with the help of humans. Simulation with AI allows organizations to evaluate many portfolio scenarios, optimize the use of resources, and incrementally roll in projects that align with their business goals. Generative AI's dynamic resource allocation capabilities help organizations stay responsive to changing market conditions and avoid resource wastage while high-priority projects get attention. Automating routine tasks and data analysis reduces the workload of manual tasks in portfolio management, which enables human resources to be devoted to strategic planning and innovation. It helps to enhance the overall efficiency of Portfolio Management Systems, boosting and maintaining higher organizational agility. Predictive and prescriptive analytics forecast future outcomes and provide prescriptive recommendations to mitigate risks and capitalize on new opportunities.

All this, however, has its barriers when integrating generative AI into EPM. AI depends heavily on accurate, complete data to give accurate results, and these are its most pressing concerns: data quality and accessibility. Organizations need robust data

governance frameworks to combat bias, ensuring that the data that goes into AI models is reliable and useful. Also, AI use in EPM has to be carefully managed in terms of ethical and regulatory implications. Building trust in AI-driven decisions means ensuring transparency and accountability and that it follows data protection regulations. Another challenge is for the workforce to adapt to new AI technologies. While AI is part of the picture and enhances human decision-making, it has to collaborate with adequately trained employees to work alongside the AI system. Therefore, organizations need to upskill their workforce to leverage AI tools effectively, and human expertise should still be included in decision-making. The progress on the AI side influences the future of EPM. When applied creatively, Generative AI presents a unique opportunity to transform the portfolio management process from allocation to resource allocation, risk control, and portfolio alignment. While AI in EPM does hold the potential to unlock its full power, organizations will only use AI as a tool to the extent it handles such challenges as data governance, workforce adaptation, and ethical considerations. With the advent of AI technologies, organizations need to be flexible and ready to update their EPM strategies to keep up with the most recent technologies to leverage the added benefits provided. This means that enterprises will be better equipped to manage their portfolio and bet on a future in which AI pervades almost every aspect of their business.

Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.
Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers.

References

[1] Abraham, R., Schneider, J., & Vom Brocke, J. (2019). Data governance: A conceptual framework, structured review, and research agenda. *International journal of information management*, *49*, 424-438.

[2] Antonopoulos, I., Robu, V., Couraud, B., Kirli, D., Norbu, S., Kiprakis, A., ... & Wattam, S. (2020). Artificial intelligence and machine learning approaches to energy demand-side response: A systematic review. *Renewable and Sustainable Energy Reviews*, *130*, 109899.

[3] Archer, N. P., & Ghasemzadeh, F. (1999). *An integrated framework for project portfolio selection*. International Journal of Project Management, 17(4), 207-216. https://www.academia.edu/download/45804682/63.pdf

[4] Bansal, A. (2015). Energy conservation in mobile ad hoc networks using energy-efficient scheme and magnetic resonance. Journal of Networking, 3(Special Issue), 15. https://doi.org/10.11648/j.net.s.2015030301.15

[5] Bansal, A. (2020). System to redact personal identified entities (PII) in unstructured data. International Journal of Advanced Research in Engineering and Technology, 11(6), 133. https://doi.org/10.34218/IJARET.11.6.133

[6] Bansal, A. (2022). Deployment strategies to make AI/ML accessible and reproducible. Journal of Artificial Intelligence and Cloud Computing, 1(E179). https://doi.org/10.47363/JAICC/2022(1)E179

[7] Bansal, A. (2022). Revolutionizing call centers through ASR and advanced speech analytics. Journal of Artificial Intelligence and Cloud Computing, 1(E178). https://doi.org/10.47363/JAICC/2022(1)E178

[8] Bansal, A. (2023). Identifying hallucination in retrieval-augmented generation. International Journal of Advanced Research in Engineering and Technology, 14(7), Article 007. Retrieved from https://iaeme.com/MasterAdmin/Journal_uploads/IJARET/VOLUME_14_ISSUE_7/IJARET_14_07_007.pdf

[9] Bansal, A. (2023). Optimizing RAG with hybrid search and contextual chunking. Journal of Emerging Applications in Science and Technology, 5(E114). https://doi.org/10.47363/JEAST/2023(5)E114

[10] Bartram, S. M., Branke, J., & Motahari, M. (2020). *Artificial intelligence in asset management*. CFA Institute Research Foundation.

[11] Brown, T., Mann, B., Ryder, N., Subbiah, M., Kaplan, J., Dhariwal, P., & Amodei, D. (2020). Language models are few-shot learners. *Advances in Neural Information Processing Systems, 33*, 1877-1901. https://proceedings.neurips.cc/paper_files/paper/2020/file/1457c0d6bfcb4967418bfb8ac142f64a-Paper.pdf

[12] Brynjolfsson, E., & McAfee, A. (2017). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W. W. Norton & Company. http://www.as.utexas.edu/astronomy/education/fall15/wheeler/secure/ExponentialGrowth.pdf

[13] Chan, A. P., & Chan, A. P. (2004). Key performance indicators for measuring construction success. *Benchmarking: an international journal*, *11*(2), 203-221.

[14] Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (2001). *Portfolio management for new product development: Results of an industry practices study*. R&D Management, 31(4), 361-380. https://www.academia.edu/download/32323293/wp_13.pdf

[15] Costantino, F., Di Gravio, G., & Nonino, F. (2015). Project selection in project portfolio management: An artificial neural network model based on critical success factors. *International Journal of Project Management*, *33*(8), 1744-1754.

[16] Dahal, S. B. (2023). Utilizing Generative AI for Real-Time financial market analysis opportunities and challenges. *Advances in Intelligent Information Systems*, *8*(4), 1-11.

[17] Day, G. S. (2011). Closing the marketing capabilities gap. *Journal of marketing*, *75*(4), 183-195.

[18] Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., ... & Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International journal of information management*, *57*, 101994.

[19] Ferrara, E. (2023). Fairness and bias in artificial intelligence: A brief survey of sources, impacts, and mitigation strategies. *Sci*, *6*(1), 3.

[20] Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International Journal of Information Management, 35*(2), 137-144. https://www.sciencedirect.com/science/article/pii/S0268401214001066

[21] Gill, A. (2018). Developing a real-time electronic funds transfer system for credit unions. International Journal of Advanced Research in Engineering and Technology (IJARET), 9(1), 162-184. Retrieved from https://iaeme.com/Home/issue/IJARET?Volume=9&Issue=1

[22] Goodfellow, I., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A., & Bengio, Y. (2014). Generative adversarial networks. *Advances in Neural Information Processing Systems, 27*, 2672-2680. https://dl.acm.org/doi/pdf/10.1145/3422622

[23] Haleem, A., Javaid, M., Qadri, M. A., Singh, R. P., & Suman, R. (2022). Artificial intelligence (AI) applications for marketing: A literature-based study. *International Journal of Intelligent Networks*, *3*, 119-132.

[24] Hoofnagle, C. J., Van Der Sloot, B., & Borgesius, F. Z. (2019). The European Union general data protection regulation: what it is and what it means. *Information & Communications Technology Law*, *28*(1), 65-98.

[25] Jay, R. (2023). *Enterprise AI in the Cloud: A Practical Guide to Deploying End-to-end Machine Learning and ChatGPT Solutions*. John Wiley & Sons.

[26] Killen, C. P., Hunt, R. A., & Kleinschmidt, E. J. (2008). *Project portfolio management for product innovation*. International Journal of Quality & Reliability Management, 25(1), 24-38. https://opus.lib.uts.edu.au/bitstream/10453/10093/1/2008003301.pdf

[27] Kiran, S. (2017). *Effectiveness of Real-time Business Intelligence on Enterprise Performance Management: a Systematic Literature Review* (Master's thesis).

[28] Kumar, A. (2019). The convergence of predictive analytics in driving business intelligence and enhancing DevOps efficiency. International Journal of Computational Engineering and Management, 6(6), 118-142. Retrieved from https://ijcem.in/wp-content/uploads/THE-CONVERGENCE-OF-PREDICTIVE-ANALYTICS-IN-DRIVING-BUSINESS-INTELLIGENCE-AND-ENHANCING-DEVOPS-EFFICIENCY.pdf

[29] Mbiru, J. (2020). *Developing an entrepreneurial project management model for social enterprise organisations* (Doctoral dissertation, University Of Tasmania). https://figshare.utas.edu.au/articles/thesis/Developing_an_entrepreneurial_project_management_model_for_social_enterprise_organisations/23250239/1/files/40974149.pdf

[30] Meskendahl, S. (2010). *The influence of business strategy on project portfolio management and its success—A conceptual framework*. International Journal of Project Management, 28(8), 807-817. http://modir3-3.ir/article-english/article309.pdf

[31] Müller, R., Martinsuo, M., & Blomquist, T. (2008). *Project portfolio control and portfolio management performance in different contexts*. Project Management Journal, 39(3), 28-42. https://www.researchgate.net/profile/Tomas-Blomquist/publication/227738621_Project_Portfolio_Control_and_Portfolio_Management_Performance_in_Different_Contexts/links/5a9fa62545851543e634a45e/Project-Portfolio-Control-and-Portfolio-Management-Performance-in-Different-Contexts.pdf

[32] Nassar, A., & Kamal, M. (2021). Ethical dilemmas in AI-powered decision-making: a deep dive into big data-driven ethical considerations. *International Journal of Responsible Artificial Intelligence*, *11*(8), 1-11.

[33] Nyati, S. (2018). Revolutionizing LTL carrier operations: A comprehensive analysis of an algorithm-driven pickup and delivery dispatching solution. International Journal of Science and Research (IJSR), 7(2), 1659-1666. Retrieved from https://www.ijsr.net/getabstract.php?paperid=SR24203183637

[34] Nyati, S. (2018). Transforming telematics in fleet management: Innovations in asset tracking, efficiency, and communication. International Journal of Science and Research (IJSR), 7(10), 1804-1810. Retrieved from https://www.ijsr.net/getabstract.php?paperid=SR24203184230

[35] Ooi, K. B., Tan, G. W. H., Al-Emran, M., Al-Sharafi, M. A., Capatina, A., Chakraborty, A., ... & Wong, L. W. (2023). The potential of generative artificial intelligence across disciplines: Perspectives and future directions. *Journal of Computer Information Systems*, 1-32.

[36] Raharjo, B., & Santoso, J. T. (2022). AI For Effective Project Resources Management. *Elkom: Jurnal Elektronika dan Komputer*, *15*(2), 465-492.

[37] Rane, N. (2023). Role of ChatGPT and similar generative artificial intelligence (AI) in construction industry. *Available at SSRN 4598258*.

[38] Russell, S., & Norvig, P. (2016). *Artificial intelligence: A modern approach* (3rd ed.). Pearson. https://thuvienso.hoasen.edu.vn/bitstream/handle/123456789/8967/Contents.pdf?sequence=3

[39] Sainio, K. (2023). *Generative Artificial Intelligence Assisting in Agile Project Pain Points* (Doctoral dissertation, Master's Thesis, Faculty of Management and Business, Tampere University, Finland).

[40] Sanchez, O. (2020). *The Role of Artificial Intelligence in Investment Decision Making: A Study of Senior Management Perceptions within Private Equity and Venture Capital Firms* (Doctoral dissertation, Dublin, National College of Ireland).

[41] Shirkhorshidi, R., Norazman, N., Rosli, M. B., Arriffin, M., & Karbasian, M. (2023, May). How to Comply Ai Generated Data with Wells Hse Performance Procedures and Requirement in Practice. In *SPE/IADC Middle East Drilling Technology Conference and Exhibition* (p. D011S006R002). SPE.

[42] Silver, D., Schrittwieser, J., Simonyan, K., Antonoglou, I., Huang, A., Guez, A., ... & Hassabis, D. (2017). Mastering the game of Go without human knowledge. *Nature, 550*(7676), 354-359.

[43] Sinha, A. R., Singla, K., & Victor, T. M. M. (2023). Artificial intelligence and machine learning for cybersecurity applications and challenges. *Risk Detection and Cyber Security for the Success of Contemporary Computing*, 109-146.

[44] Some, L. (2023). Automated decision-making in project management. https://www.diva-portal.org/smash/get/diva2:1811458/FULLTEXT01.pdf

[45] Steinberg, R. M. (2011). *Governance, risk management, and compliance: It can't happen to us--avoiding corporate disaster while driving success*. John Wiley & Sons.

[46] Tien, J. M. (2017). Internet of things, real-time decision making, and artificial intelligence. *Annals of Data Science*, *4*, 149-178.

[47] Wamba-Taguimdje, S. L., Wamba, S. F., Kamdjoug, J. R. K., & Wanko, C. E. T. (2020). Influence of artificial intelligence (AI) on firm performance: the business value of AI-based transformation projects. *Business process management journal*, *26*(7), 1893-1924.

[48] Yaseen, Z. M., Ali, Z. H., Salih, S. Q., & Al-Ansari, N. (2020). Prediction of risk delay in construction projects using a hybrid artificial intelligence model. *Sustainability*, *12*(4), 1514.

[49] Yathiraju, N. (2022). Investigating the use of an artificial intelligence model in an ERP cloud-based system. *International Journal of Electrical, Electronics and Computers*, *7*(2), 1-26.