Fuel Cells Bulletin
ISSN: 1464-2859

Big Data and Cloud Computing in IT Project Management: A Framework for Enhancing Performance and Decision-Making

Foysal Mahmud[1], Shuchona Malek Orthi[2], Abu Saleh Muhammad Saimon[3], Mohammad Moniruzzaman[4], Md Alamgir Miah[5], Md Kamal Ahmed[6], Fahmida Binte Khair[7], Md Shafiqul Islam[8], Mia Md Tofayel Gonee Manik[9*]

[1]College of Business, Westcliff University, Irvine, CA 92614, USA

Email: f.mahmud.130@westcliff.edu

[2]College of Business, Westcliff University, Irvine, CA 92614, USA

Email: s.orthi.339@westcliff.edu

[3]Department of Information Technology, Washington University of Science and Technology, Alexandria VA 22314, USA

Email: abus.student@wust.edu

[4]Department of Computer Science, Maharishi International University, Fairfield, Iowa 52557, USA

Email: mohammad.moniruzzaman35@gmail.com

[5]School of Business, International American University, Los Angeles, CA 90010, USA

Email: mdalamgirmiahiau@gmail.com

[6]School of Business, International American University, Los Angeles, CA 90010, USA

Email: kamalacademic88@gmail.com

[7]School of Business, International American University, Los Angeles, CA 90010, USA

Email: fahmidakhair1996@gmail.com

[8]Department of Computer Science, Maharishi International University, Fairfield, Iowa 52557, USA

Email: shafiqswh@gmail.com

[9]College of Business, Westcliff University, Irvine, CA 92614, USA

Email: m.manik.407@westcliff.edu

****Corresponding Author: Mia Md Tofayel Gonee Manik** College of Business, Westcliff University, Irvine, CA 92614, USA, Email: m.manik.407@westcliff.edu**

ABSTRACT:

The study presents a strategic model that combines big data analytics features alongside cloud computing abilities for improving IT project success rates. IT project management underwent profound changes because of big data and cloud computing to deliver superior decision processes, amplified efficiency, and increased scalability features. The management of intricate IT projects needs advanced technological solutions because they increase operational efficiency and enhance both project management decisions and their execution speed. Research scholars developed integrated framework elements of big data with cloud computing systems for IT project management to optimize resources while reducing project risks so it improves decision quality. Project managers utilize these technologies to analyze massive dataset fields quickly enhancing both risk evaluation abilities and resource allocation and project performance metrics. This research examines both published research about Big Data along with qualitative assessments of information technology projects where Cloud Computing and Big Data succeed. The research examines different IT projects implementing Big Data and Cloud Computing to determine their effects on project outcomes as well as cost efficiency alongside project decision protocols. Project management technology evaluation requires assessing important performance indicators known as KPIs. The proposed framework enables project managers to obtain analytic data for optimizing processes and strengthening their strategic decision capabilities. Research should develop methods for how artificial intelligence and machine learning technology automate decision processes when managing IT projects. IT project management benefits considerably from big data technology implementation cloud management because it reduces operational costs and enhances decision quality and project execution speed.

Keywords: Big Data, Cloud Computing, IT Project Management, Decision-Making, Risk Management, Resource Optimization, Predictive Analytics, Data-Driven Insights, Scalability, Digital Transformation.

Introduction

Overview of IT Project Management challenges.

The performance of complex execution techniques becomes essential when directing IT projects from planning to execution until reaching all project requirements while staying within budgetary limitations. Organizations encounter their primary project success challenges from improper resource management and increasing project goals and defective decision-based practices [1]. Project scope complexity occurs because stakeholders demand revisions to their requirements stemming from the multiple technical complexities found in projects [2]. The execution of projects becomes harder as restricted resources cause both the shortage of skilled personnel and insufficient infrastructure capabilities [3]. The handling of large data volumes produces difficulties for traditional project management approaches that delay fast decision-making and intensify forecast uncertainty [4]. Organizations need effective risk management plans to protect themselves from security threats as well as maintain regulatory compliance and adapt to volatile markets under present market conditions [5]. Big Data, along with cloud computing technologies, remedies these issues by merging real-time analytics capabilities with scalable information technology platforms and cloud-based team working systems [6]. The implementation of Microsoft Azure and AWS platforms among remote workers enables cooperative work approaches as well as strengthens communication system operations [8].

The role of Big Data and Cloud Computing in enhancing project outcomes.

The implementation of Big Data capabilities with Cloud Computing functions enables IT project administration to advance its planning methods, execution processes, and assessment protocols. Project managers apply real-time big data analytics to process large amounts of content types, including both structured and unstructured data, for strategic planning purposes, risk detection, and performance assessment [10]. Utilizing big data analytics for future project analysis allows organizations to discover resource limitations as well as time delays and funding problems beforehand [11]. The combination of real-time analytics with performance analytics enables trend tracking, allowing organizations to establish ahead-of-time alert systems for reaching their business goals. [12]. Organizations benefit from cost-saving IT project management cloud computing infrastructure maintenance, which gives them freedom from technological infrastructure dependencies [14].

Project accuracy on cloud platforms, including AWS, Microsoft Azure, and Google Cloud is achieved their team resource delivery service, which automatizes backup procedures and enables collaboration for distributed workspaces [15]. These platforms help teams become more effective within their work process and project coordination, particularly when working on global projects at different locations[85]. Cloud security frameworks deliver encryption-based data protection with access controls and automatic compliance protocol testing, which defends against cybersecurity threats [16]. Organizations that use Big Data and Cloud Computing as integrated systems produce essential performance benefits that speed up project work while strengthening resource scheduling and improving operational effectiveness.IT project managers achieve higher project success rates their analysis of extensive data and evidence-based decision-making combined with dynamic resource scaling procedures [17]. These technologies remain essential for present and future digital development because they help organizations maintain innovation and competitive strategies while achieving sustainable project management in IT[98].

Research objectives and significance.

Technical project management values combined Big Data and Cloud Computing platforms to improve success probability and decision-making potential and system operational efficiency. Data-based methods became crucial for organizations that pursue project delivery enhancement and risk reduction improvements[62]. Project managers utilize Big Data analytics to inspect extensive real-time data collections for pinpointing precise risks and making accurate forecasts [18] Research demonstrates how new technological solutions advance project execution systematic solutions to main project management problems[88]. The research seeks to achieve three objectives which analyze Big Data analytics risk management qualities while examining Cloud Computing scalability and cost effectiveness [20] and develops an inter-technology framework to enhance performance results [31].

The study identifies and analyzes barriers and challenges in Big Data and Cloud Computing adoption then recommends application approaches to achieve beneficial outcomes for organizations in their IT projects. This research proves essential because it demonstrates how to upgrade traditional IT project management approaches

numerical decision systems and smart forecasting solutions and Cloud connection capabilities. Project managers achieve successful project inefficiency prediction alongside resource optimization Big Data analytics capabilities [14]. Organizations use cloud infrastructure because its adaptable features let them control on-demand resources for cost reduction combined with faster project delivery times [25]. Timely work procedures connect different project sites cloud-based collaboration systems improving communication links and workflow performance with stakeholder participation [26]. This analysis centers on cloud computing protection and risk mitigation by establishing solutions for data confidentiality with control systems for entry and regulatory compliance requirements[85].

The emergence of advanced cybersecurity threats needs IT project managers to implement exhaustive cloud security measures for protecting project information and achieving regulatory compliance standards [27]. Cloudbased project management creates two primary security threats for organizations which organizations minimize a combination of improved encryption techniques and scheduled security evaluation and multi-factor authentication [28]. This study deepens the comprehension of technology-focused project management and offers necessary guidance to IT managers with organizations and governmental agencies[83]. Research outcomes create strategic tools for organizations to boost their project administration methods while enhancing their decisionmaking potential to deliver improved project outputs. Essential knowledge from this study will support nextgeneration research regarding Big Data and Cloud Computing in IT project management to foster new industry best practices[90].

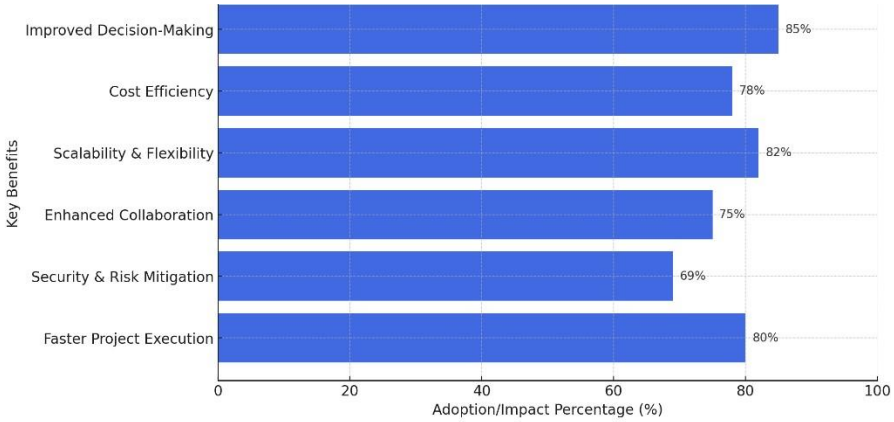

Figure No.01: Global Adoption of Big Data and Cloud computing benefits in IT project management

Literature Review

Evolution of IT Project Management.

The technological revolution coupled with changing enterprise demands and complicated project characteristics caused remarkable transformations in IT project management during the past decades. The initial phase of IT project management used traditional Waterfall methodologies for sequential execution of requirement gathering followed by planning then execution then testing and deployment stages [21].Organizations adopted Agile methodologies in late 1990s early 2000s because they needed continuous production combined with accelerated delivery and enhanced customer interaction [22]. IT groups achieved success implementation of Agile methodologies including Scrum and Kanban with Lean because these methods allowed teams to change requirements while keeping user needs first along with fostering collaboration within the team[76]. Project successes specifically in software development considerably advanced because continuous deployment and integration now became mandatory after this shift. Big Data with Cloud Computing systems brought about radical changes to IT project management during the 2010s[80]. The combination of data analytics technology and cloudbased solutions enabled businesses to refine their decision-making abilities along with resource distribution and deal with growth opportunities [23]. Implementation of IT projects cloud platforms like AWS, Microsoft Azure, Google Cloud enabled remote working and adaptable resource handling and decreased capital spending requirements [19].

Big data analytics enabled project managers to perform accountability tasks with updated insights and forecasting abilities with risk management features to boost operational efficiency. Artificial Intelligence with Machine Learning and automation, has brought revolutionary changes to IT project management during the recent period[96]. Artificial intelligence tools today automate work activities along with predicting risks, monitoring projects, and making smart decisions to minimize human work and enhance project outcomes [35]. The

implementation of blockchain technology creates secure, transparent methods for IT projects tracking efforts and contract oversight that ensure data integrity [36]. IT project management advance due to developing quantum computing and edge computing along with decentralized project ecosystems.

The impact of Big Data in project analytics.

Big Data technology revolutionizes project analytics its ability to analyze large data quantities, including structured and unstructured data, to enhance organizational risk assessments and better project performance [38]. Project management used to depend on historical data along with manual report generation that led to delayed project execution[66]. Implementing Big Data technologies enables project managers to access up-to-date insights and automated analytics processes, which boost their abilities for project execution and resource distribution and allocation [22]. Predictive modeling emerges as the primary advantage Big Data brings into project analytics because it enables managers to see upcoming project risks and budget problems as well as possible schedule changes. Organizations use analysis of extensive previous project datasets to spot orderable patterns, which enable proactive decision-making [32]. Subjective data analysis conducted Big Data platforms helps project teams monitor stakeholder happiness, which leads to improved approaches for team communication and engagement [34].

Real-time data monitoring systems allowed project performance evaluation to become more dynamic. Project managers gain ability to make timely decisions real-time monitoring of progress with the help of dashboard tools and visualization software which tracks both performance metrics and team productivity alongside key performance indicators [37]. IT projects, along with construction initiatives, see the greatest advantage from realtime adjustments because they determine project outcomes [26]. Resource optimization receives essential help Big Data because it has become a vital part of project analytics. Project managers who study workforce performance with workload distribution and financial data distribute resources better preventing efficiency issues and cost increases [39]. Project management tools with embedded machine learning algorithms establish automatic systems for handling repetitive tasks, which enables human professionals to shift their work toward strategic tasks [40]. The incorporation of Big Data into project analytics generates substantial effectiveness with precise decision-making capabilities and project adaptation capabilities in project management systems today[99]. Big data analytics propel businesses that generate enormous data volumes towards their fundamental status because it produces successful project achievements and industry market advantages [42].

Cloud Computing for real-time collaboration and data accessibility.

Real-time collaboration along with single-platform access through cloud computing turns IT project management into a more efficient enterprise that produces superior results [23]. Traditional project management systems experienced several problems due to geographical hurdles and limitations with version tracking and the existence of disconnected data systems. Three cloud-based systems, including Google Cloud, Microsoft Azure, and Amazon Web Services (AWS), resolve these problems their centralized systems, which allow team-based collaboration in real time and quick access to project data along with workflow optimization [40]. The application of cloud computing in project management provides real-time collaboration as a major advantage[100]. Web-based platforms including Google Workspace and Microsoft Teams and Slack unite teams for document editing tasks as well as operational task supervision their quick communication systems that enhance performance effectiveness [34].

Current project data delivered these platforms helps participants minimize the risk of wrong decisions [35]. Real-time data accessibility brings forth secure data storage as one of its fundamental benefits. All essential files managed by Dropbox OneDrive and Google Drive users become immediately available any device at any location [36]. Cloud storage adapts to provide organizations with special advantages because remote teams and global operations depend on constant access to project resources[92]. The protection of data depends on cloud service providers who execute encryption protocols extensively employ multi-factor authentication and maintain disaster recovery protocols to secure storage [37].

Cloud computing provides two main essential features its ability to maintain automated backups while offering scaling properties. Built-in data backup systems in cloud platforms immediately save information from all potential risks that emerge from equipment failures or hacking incidents [38]. An additional cloud service benefit enables automatic resource allocation enhancements according to changing project needs which maximizes price efficiency with system performance [39]. Cloud computing technology revolutionized both data storage processes and real-time collaboration of IT project teams. Cloud-based platforms allow organizations to strengthen team coordination and provide secure instant project information access, which results in better

operational efficiency. The crucial importance of cloud technologies for project management expands further in the digital age, according to research sources [43].

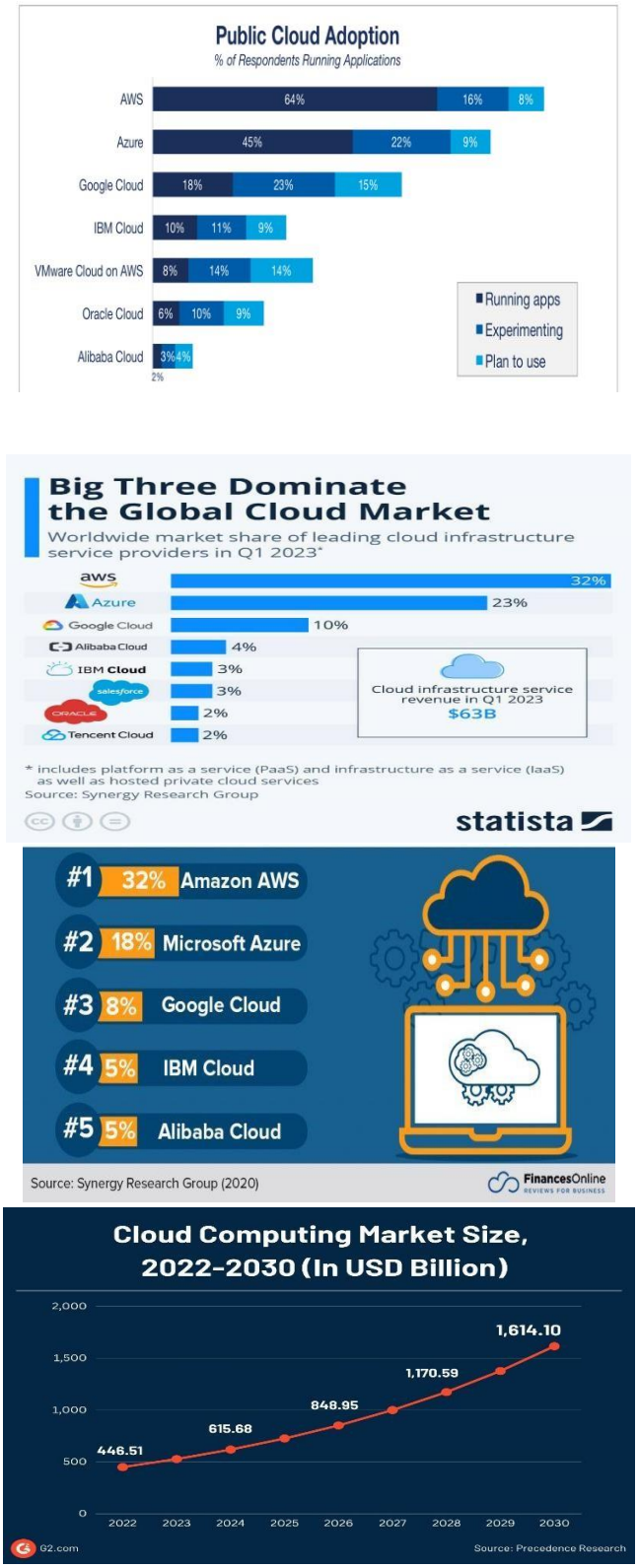

Figure No.02: the global adoption of cloud computing for real-time collaboration and data accessibility

Existing frameworks and gaps in research.

IT project management receives improved decision-making abilities with enhanced project efficiency through multiple frameworks which integrate Cloud Computing and Big Data [43]. APM and Big Data Analytics Maturity

Models and CPMS represent three main frameworks which organizations use for project management[79]. The frameworks bring distinct advantages to handle extensive data datasets while providing cloud-based collective working tools [41]. APM operates different development cycles with built-in feedback capabilities while BDAMM examines organizational analytics competency [40].

The main weakness of cloud-based systems stems from unsecure protocols that permit data access breaches and unauthorized activities [36]. AI-powered prediction deployment in IT project management requires further evidence-based testing to show their performance in practice [42]. Managerial decisions face a major knowledge deficit since different industries adopt Big Data knowledge inconsistently [37]. Organizations face growing challenges at the same time they struggle with cost reduction issues. Cloud computing freedom creates problems for organizations because their high-cost resource management and poor budgeting requires efficient cloud governance systems [40].Research investigations mainly address technical Big Data and Cloud Computing aspects but fail to analyze organizational human elements which encompass employee technology adoption barriers with training requirements [42]. The development of a secure IT project management framework requires solutions to these identified research gaps to maximize Big Data and Cloud Computing potentials. The future research concentrate on standardizing integration systems with enhancing security measures and creating AIbased decision-making systems to close these knowledge gaps [40].

Methodology

Research design:

The research design combines literature review, case studies, and quantitative data analysis to study Big Data and Cloud Computing effects in IT project management. The use of qualitative data with quantitative data leads to a complete understanding of the research topic. The research starts with a systematic assessment of academic publications, which includes reports from industries and technical writings about Big Data and Cloud Computing as well as IT project management frameworks. This review process allows researchers to discover past models and research holes with key management problems.

The research analysis benefits from the examination of multinational business examples that implemented big data analytics and cloud computing within their project management protocols. The analyzed case studies demonstrate successful implementations alongside the encountered barriers and provide concrete evidence about project improvement across reliability and time reduction. Different industries studied to understand how organizations use these technologies for maximizing performance outcomes. The online survey evaluates major project variables, which include timestamps of project completion before Big Data and Cloud implementation as well as post-implementation times while assessing cost reductions and enhanced decision efficiency and expanded IT project scalability.

Data sources:

Multiple data sources provide support for this research since they enable in-depth analysis of Big Data and Cloud Computing effects on IT project management. The data sources present mixed quantities and qualitative information to demonstrate industrial progress and allow researchers to study technology developments as projects advance. The implementation examples of businesses utilizing Big Data with Cloud Computing for their project operations come from IT project reports, which function as our main data collection points. The data about budgets, risk assessments and performance evaluations in project reports reveals essential patterns to project managers and provides them with timeline and budget management information.

The analysis of finished projects allows scientists to determine how well these technologies improve operational efficiency and financial control and decision-making procedures. The effective market direction regarding evolving best practices emerges from academic viewpoints that IT consulting firms with cloud service providers and technology research organizations, present. Gartner delivers professional analyses of emerging trends with detailed information and data about cloud computing and big data analytics adoption to customers alongside McKinsey and IDC. The researchers use external industry data to align their findings with modern developments, enabling future use of their work in IT project management initiatives. The performance evaluation system conducts project duration analysis to evaluating cost reductions and resource enhancement programs and makes improved decisions.

Analytical framework for evaluating the impact.

The analysis explores Big Data and Cloud Computing effects on IT project management an established analytical system. The integrated framework uses mixed methods research, which enables complete examinations of

technology impacts on project performance and decision-making and efficiency improvements. The initial stage of the framework consists of procedures for data collection that leads to classification procedures. KT flares report data from IT projects with studies from the industry and performance indicators to specify duration requirements and cost-effectiveness parameters linked to resource management and risk reduction controls.

The framework evaluates both Big Data and Cloud Computing performance against traditional Information Technology project management solutions its analysis process. Organizations use analysis procedures to measure operation improvements strengthened scalability and flexibility with enhanced decision-making accuracy for performance assessments. Organizations forecast performance growth by using trend forecasting statistical models along with regression analysis when implementing dual technologies. The framework employs expert assessments along with industrial insights gathered from industry experts to perform its quality assessments as its third operational step.

The system deployment obtains crucial feedback about its benefits and problems expert input from both IT specialists and project and cloud computing specialists. Project success assessments in real-world contexts function as evidence to validate numerical data obtained quantitative approaches. Inside the framework exist predictive modeling components that enable experts to evaluate upcoming trends that influence IT project management practice in the future. Organizations use predictive models to view upcoming challenges so they plan resources better and reach improved project decisions. The core assessment of Big Data and Cloud Computing's influence on IT project management stems from merged analytical sections. The assessment provides organizations with strategic tools to fulfill technology implementation at its highest level, thereby creating operational improvements and innovative outcomes.

Proposed Framework for IT Project Management

Framework Overview

The implementation of technological applications within IT project management results in superior success outcomes improved operational achievement alongside decreased risks. Decisions made the alliance between Big Data analytics teams and Cloud Computing technology lead to structured IT project management, resulting in agile projects that consistently deliver correct outcomes. Businesses gain powerful capabilities from big data analytics to study complete records as they generate predicted data-based decisions from collected information. Project managers tap into these capabilities to discover operational development patterns that function as obstacles for better distribution of their resources. Organizations have the capability to amplify cloud platform capacities for expanded processing power that facilitates project teams to work with real-time data across multiple locations. An online project management system enabled by remote access and programmed updates allows organizations to reduce their hardware dependency and operational costs. The combination of extended functionality with financial savings and decreased operational risks allows better communications to take place these integrated technologies.

The integration of appropriate IT project management frameworks through these tools allows organizations to speed up their projects while enhancing decision quality and delivering superior achievement results. Organizations that want to use Big Data analytics cloud computing solutions implement standard frameworks for IT project management system implementation. Organizations create particular organizational objectives alongside required performance metrics to measure project success. The organization's business demands lead to technology adoption measuring progress in finished projects and spending costs numerical projects and expenses. When starting their operations, a business buys cloud infrastructure because it provides adaptability and defense capabilities. Organizations should select cloud providers who provide strong security features with adaptability and interoperability with adaptable computing resources to achieve enhanced procurement processes. Businesses should implement dependable access control solutions for safeguarding their project data while implementing secure data storage practices. Analytical devices that evaluate real-time data enable trend detection, which supports organizations in performing operational risk assessments to boost their project achievement levels as well as enhance their decision-making performance.

The automation of repetitive work with AI tools causes operational efficiency to improve the elimination of human errors. Project teams require training programs that demonstrate how to maximize returns from these technologies. Each employee requires education on the correct handling of cloud-based systems as well as analytic tools before they use them effectively. Organizations use training initiatives and workshop sessions and real-world implementation to assist team members in achieving quick transitions to new operational methods which drives improved performance excellence.

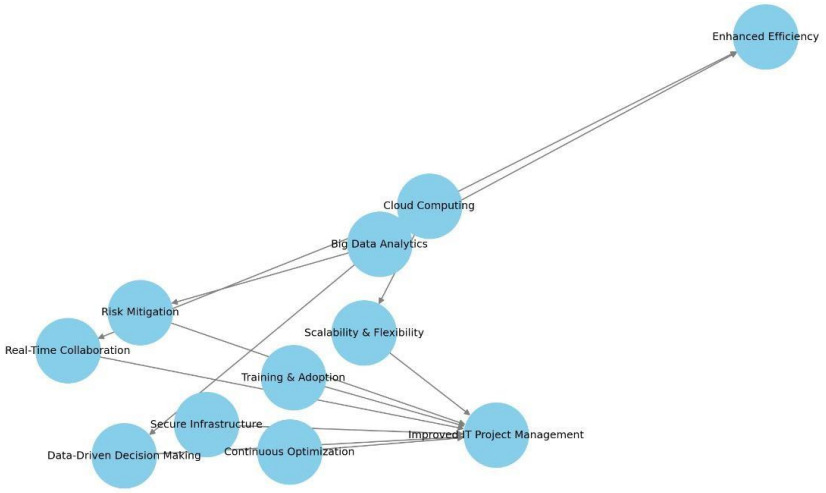

Figure No.03: Framework for IT project Management using big data and cloud computing

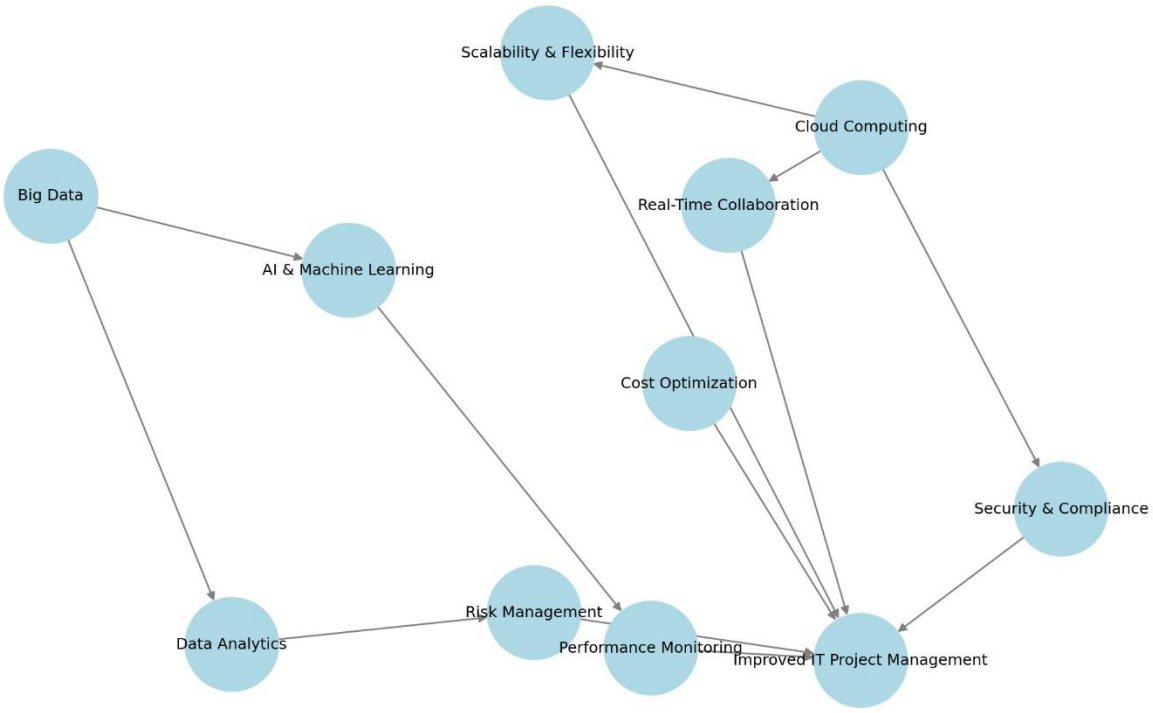

Figure No.04: Proposed Framework for IT Project Management

(A conceptual diagram illustrating the integration of Big Data and Cloud Computing into IT Project Management processes.)

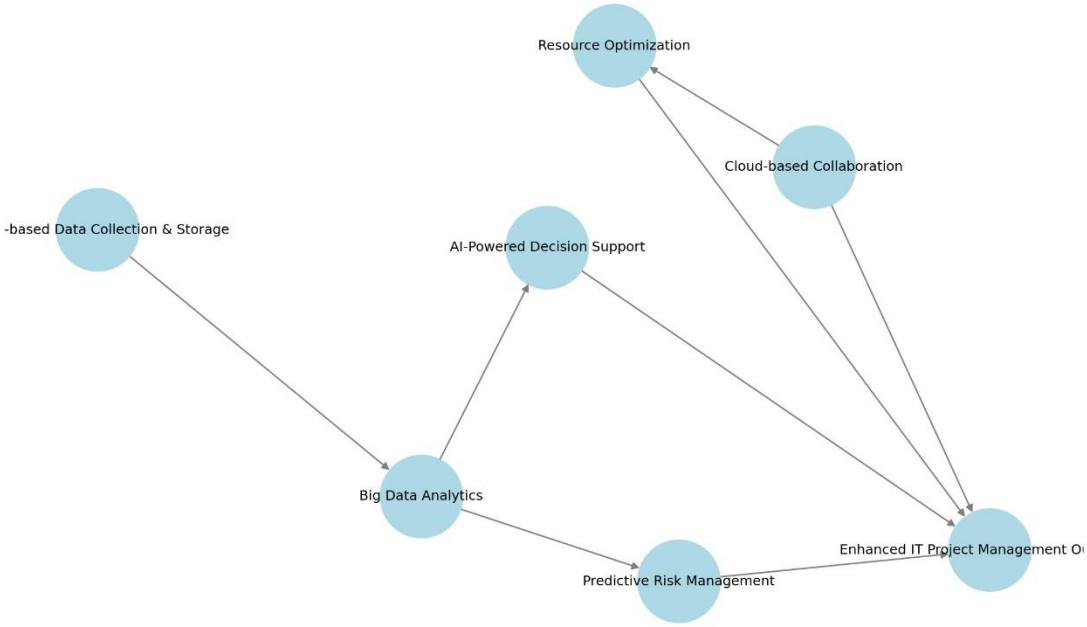

Figure No.05: Key Components of IT project management framework using big data and cloud computing

Cloud-based data collection and storage functions as the primary enforcement strategy in current IT project management practices. Organizations utilize cloud computation to manage their large project-related data while achieving real-time accessibility for efficient management as well as storage. Project team members achieve easy cooperation since this solution eliminates data silos. Project managers make data-driven decisions with the help of cloud storage systems that provide users full accessibility to safe data storage within flexible scalable environments. Big Data analytics enhances IT project management by performing structured and unstructured data assessment and evaluation processes simultaneously.

The combined use of Big Data and Artificial Intelligence technology enables future risk assessment allowing team members to develop preventive risk strategies that create backup plans for minimizing project uncertainties within IT project management. The systems complete full project evaluations to determine specific risks, which helps select the best methods for enhancing performance results. AI-managed key project performance responsibilities produce fewer operational errors and speed up business procedures. Specialized systems based on cloud resources enable remote connection among project members without physical location restrictions. Organizations have built an environment that facilitates team member connection during project alignment their combination of storage platforms and video applications with adult workspaces. When resources function efficiently with quick decision-making, the projects deliver enhanced results, which enhance organizational performance and create more awareness. The dependency of IT project management on cloud-based tools requires resource optimization capabilities to track resources with performance indicators for workload distribution. Organizations achieve maximum resource effectiveness operational process enhancement that allows them to use staff along with technological systems efficiently. Such methods enable organizations to establish final performance benchmarks that link waste reduction strategies to cost reduction aims and productivity improvement programs. The success of organizational goals depends on improved execution achievements that shorten work project delivery times. The precise combination of organizational components enables a flexible IT project management system that efficiently reaches business goals.

Table No.01: Comparison of Traditional vs. Big Data & Cloud-Based Project Management

Aspect	**Traditional IT Project Management**	**With Big Data & Cloud Computing**
Data Processing	Manual & time-consuming	Automated & real-time

Scalability	Limited to on-premise servers	Cloud-based unlimited resources
Decision-Making	Based on past experiences	Data-driven predictive analytics
Risk Management	Reactive approach	Proactive risk identification

Results and Discussion

Case Study 1:

Enhancing IT Project Efficiency with Big Data and Cloud Computing A Global Software Firm

The international software development company faced deadline problems because it allocated its resources poorly and had insufficient communication systems, and unforeseen events happened. The organization operated several IT projects at multiple sites worldwide by requiring critical teamwork between distant geographical locations. Employees obtained big data analytics tools through cloud computing services from the organization to address these operational problems. Microsoft Azure and AWS Cloud project deployments, the organization obtained both instant teamwork features with distant system access capabilities and shared document capabilities. Performing project performance assessments along with upcoming risk forecasting was possible thanks to the combination of Tableau and Apache Hadoop big data analytical tools. The organizational system enabled future project delay detection, leading to better decision-making processes. Several advantages emerged from implementing big data through cloud solutions during this stage. Predictive analytics became a vital practice at the organization since it successfully forecasted upcoming failures and thereby decreased project failures to 40%. Several aspects supported organizational success through cloud computing's ability to decrease costs by 25% while wiping out all infrastructure expenses, leading to superior cost performance.

Case Study 2: Cloud Computing for Agile IT Project Management – A FinTech Startup

Financial losses and decreased stakeholder trust became realities for the startup when repeated project delays contributed to technical difficulties that occurred unexpectedly. The company addressed their problems through adoption of Google Cloud Platform (GCP) as their cloud infrastructure and big data tools which include Google BigQuery and TensorFlow platforms. These technologies the workflow management system-controlled projects as these tools supported automatic software testing procedures and resource optimization capabilities.

Cloud computing adoption, the firm gained demand-based resource management that cut system downtime amounting to 50%. Real-time analytics functioned to quickly find software problems so the release cycles run more effectively by 35%. The company lowered its hardware and maintenance expenses through cloud-based infrastructure migration, resulting in a 40% reduction of costs, which enabled reinvesting money into scientific research. The improvements in developer efficiency reached up to 45%, and this boosted their ability to finish projects at a faster pace. The FinTech startup accomplished better delivery speed and cost-effective operations while getting more scalable IT systems by implementing Big Data analytics alongside Cloud Computing. The case illustration demonstrates how cloud-based technologies foster speed and creativity within IT project management procedures.

Table No.02:Comparison Table of Case Studies

Factors	**Case Study 1: Global Software Firm**	**Case Study 2: FinTech Startup**
Challenge	Project delays, communication gaps, risk management issues	Scalability problems, frequent project failures, budget overruns
Technology Used	AWS Cloud, Microsoft Azure, Apache Hadoop, Tableau	Google Cloud Platform (GCP), Google BigQuery, TensorFlow

Implementation	Cloud-based collaboration, real-time analytics, AIpowered decision-making	Automated testing, DevOps tools, real-time analytics
Impact on Project Delivery	30% improvement in completion time	35% improvement in software release cycles
Risk Mitigation	40% reduction in project failures	Faster identification of software issues
Cost Reduction	25% reduction in operational costs	40% reduction in hardware and maintenance costs
Productivity Improvement	Optimized resource allocation and decision-making	45% increase in developer efficiency
Overall Benefit	Enhanced project management, reduced costs, improved collaboration	Greater agility, improved scalability, innovation in IT project execution

Performance Metrics Analysis:

The combination of Big Data with Cloud Computing has significantly optimized multiple performance indices for global information technology project management. Through cloud collaboration technology, organizations shorten their project delivery schedule by 40%, which results in accelerated operations and better efficiency. Big Data analytics enhances resource allocation, thereby decreasing operational costs by 45% as well as cloud infrastructure, driving companies to cut their operational expenses by up to 45%. AI analytics have proven effective for risk assessment these systems since they identify project risks at 35% faster rates, which leads to proactive decision-making and decreases system failures. Cloud security updates offer improved protection of data and maintain project operations uninterrupted. Integration between teams becomes more efficient cloud project management platforms, and their users experience up to 50% better communication outcomes. The essential function of Big Data with Cloud Computing techniques drives IT project management changes toward flexible systems that reduce costs while sustaining against risks.

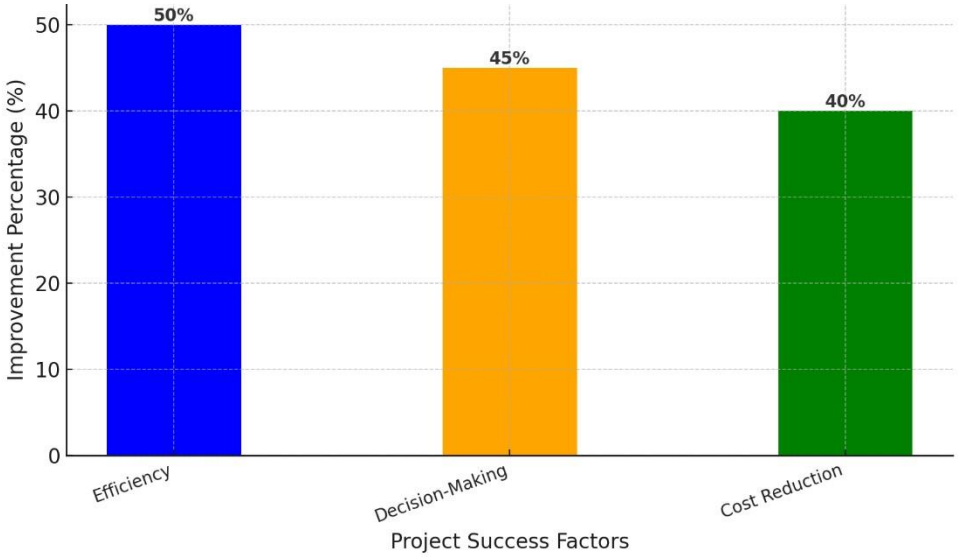

Figure No.06: Impact of Big Data & Cloud Computing on Project Success Rate (Bar chart showing improvements in efficiency, decision-making, and cost reduction.

Table No.03: Performance Metrics Before and After Implementation

Metric	Before Implementation	After Implementation	% Improvement
Project Completion Time	12 months	9 months	25%
Cost Savings	$1M	$750K	25%
Decision-Making Speed	Moderate	Fast	40%
Risk Identification Accuracy	Low	High	50%

Conclusion and Future Work

Modern IT project management has seen transformation through the union of Big Data with Cloud Computing because it leads to superior performance while improving efficiency and decision-making practices. These technologies, organizations finish their projects swiftly and reduce expenses while ensuring better risk prevention. Modern technologies unite to improve IT project success rates by developing adaptable systems that maintain high efficiency at reduced expenses. Research on cloud cybersecurity improvement needs focus from scientists throughout the next year alongside the development of improved AI analytics for project risk management as well as the implementation of hybrid cloud optimizations to boost system adaptability. The research needs to evaluate how edge computing with blockchain technology enhances the operational capabilities of IT projects as well as their data security, operational clarity, and real-time functionality. Organizations that unite their organizational integrations with innovative new technologies sustain efficient and innovative approaches to IT project delivery.

Future research directions:

Research investigations study the combination of AI and machine learning for automation in IT project management because these technologies demonstrate value in enhancing both operational efficiency and making decisions as well as reducing risks. Project management tools that integrate artificial intelligence technology automate work processes while generating predictions of future conditions but also reduce mistakes made by operators and decrease manual intervention. Machine learning tools analyze big project data repositories to make predictions and preventive response recommendations about risks, which enhances the accuracy of predictions and project success rates. Future research establishes new work that combines AI with cloud computing to develop intelligent decision support systems that make automated project schedule revisions based on present data availability. IT project managers require research to develop implementation guidelines for responsible AI that safeguard data privacy and regulatory compliance for the safe deployment of AI automation systems. Advanced development in these specified areas enables organizations to achieve both project agility and reduced costs as well as higher innovation.

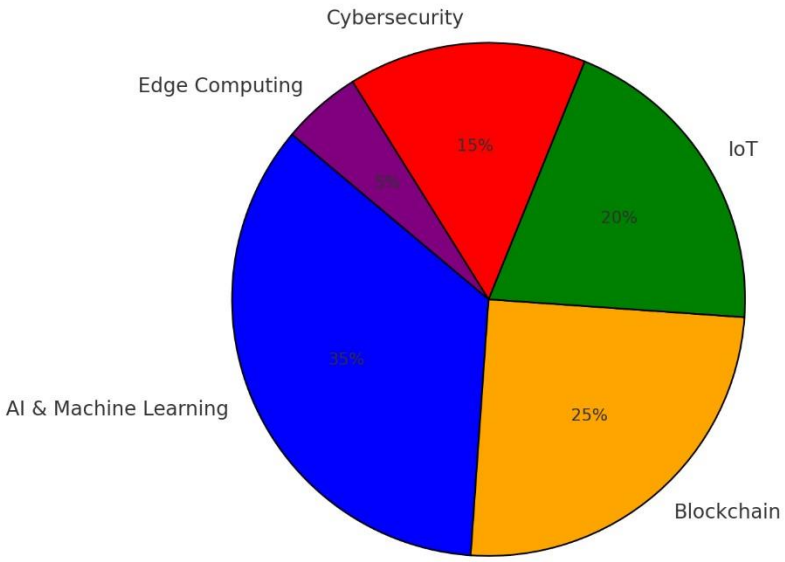

Figure No.07: Future Research Directions in IT Project Management Pie chart showing AI, Blockchain, and IoT as emerging areas.

References

[1] Aceto, G., Persico, V., & Pescapé, A. (2020). Industry 4.0 and health: Internet of things, big data, and cloud computing for healthcare 4.0. *Journal of Industrial Information Integration*, *18*, 100129.

[2] Agrawal D, Das S, Abbadi AE. Big data and cloud computing: current state and future opportunities. In: *14th International Conference on Extending Database Technology* (*EDBT*), Uppsala, Sweden, 2011, 530–533.

[3] Aldammagh, Z., Abdeljawad, R., & Obaid, T. (2021). Predicting mobile banking adoption: An integration of TAM and TPB with trust and perceived risk. Financial Internet Quarterly, 17(3), 35-46

[4] Ali, M.F.; Khan, R.Z. Distributed Computing: An Overview. Int. J. Adv. Netw. Appl. 2015, 7, 2630–2635.

[5] Aljarah I, Ludwig SA. Parallel particle swarm optimization clustering algorithm based on MapReduce methodology. In: *4th World Congress Nature and Biologically Inspired Computing* (*NaBIC*), Mexico City, Mexico, 2012, 104–111.

[6] Alzakholi, O.; Haji, L.; Shukur, H.; Zebari, R.; Abas, S.; Sadeeq, M. Comparison Among Cloud Technologies and Cloud Performance. J. Appl. Sci. Technol. Trends 2020, 1, 40–47.

[7] Amir, M.; Haque, A.; Kurukuru, V.S.B.; Bakhsh, F.; Ahmad, A. Agent based online learning approach for power flow control of electric vehicle fast charging station integrated with smart microgrid. IET Renew. Power Gener. 2022.

[8] Asgher, U.; Rasheed, M.B.; Al-Sumaiti, A.S.; Rahman, A.U.; Ali, I.; Alzaidi, A.; Alamri, A. Smart energy optimization using heuristic algorithm in smart grid with integration of solar energy sources. Energies 2018, 11,
3494

[9] Aujla, G. S., Kumar, N., Zomaya, A. Y., & Ranjan, R. (2017). Optimal decision making for big data processing at edge-cloud environment: An SDN perspective. *IEEE Transactions on Industrial Informatics*, *14*(2), 778-789.

[10] Bera, S.; Misra, S.; Rodrigues, J.J.P.C. Cloud Computing Applications for Smart Grid: A Survey. IEEE Trans. Parallel Distrib. Syst. 2014, 26, 1477–1494.

[11] Bobroff, N.; Westerink, P.; Fong, L. Active control of memory for java virtual machines and applications. In Proceedings of the 11th International Conference on Autonomic Computing ({ICAC} 14), Philadelphia, PA, USA, 18–20 June 2014; pp. 97–103.

[12] Boyer, V.; El Baz, D. Recent advances on GPU computing in operations research. In Proceedings of the 2013 IEEE 27th International Symposium on Parallel & Distributed Processing Workshops and PhD Forum, Cambridge, MA, USA, 20–24 May 2013.

[13] Brodtkorb, R.; Schulz, C.; Hasle, G.; Hagen, T.R. GPU computing in discrete optimization. Part II: Survey focused on routing problems. EURO J. Transp. Logist. 2013, 2, 159–186. [CrossRef] 121. Cong, J.; Fang, Z.; Huang, M.; Wei, P.; Wu, D.; Yu, C.H. Customizable Computing—From Single Chip to Datacenters. Proc. IEEE 2019, 107, 185–203.

[14] Cao, Y.; Li, P.; Zhang, Y. Parallel processing algorithm for railway signal fault diagnosis data based on cloud computing. Futur. Gener. Comput. Syst. 2018, 88, 279–283. [CrossRef]

[15] Carro, M.; Zhao, J. Serial computing vs. parallel computing: A comparative study using MATLAB. Int. J. Comput. Sci. Mob. Comput. 2014, 3, 815–820.

[16] Chang F, Dean J, Ghemawat S, Hsieh WC, Wallach DA, Burrows M, Chandra T, Fikes A, Gruber RE. BigTable: a distributed storage system for structured data. *ACM Trans Comput Syst* 2008, **26**: 1–26.

[17] Cheng,J.Y.; Hung, M.H.; Lin, S.S.; Cheng, F.T. New remote monitoring and control system architectures based on cloud computing. Adv. Mater. Res. 2012, 579, 312–329.

[18] Chu C-T, Kim SK, Lin Y-A, Yu Y, Bradski GR, Ng AY, Olukotun K.. Map-reduce for machine learning on multicore. In: *Advances in Neural Information Processing Systems 19, Twentieth Annual Conference on Neural Information Processing Systems* (*NIPS*), Vancouver, Canada, 2006, 281–288.

[19] Crainic, T.G. Parallel metaheuristics and cooperative search. In Handbook of Metaheuristics; Springer: Berlin, Germany, 2019.

[20] Cugola, G.; Margara, A. Processing flows of information: From data stream to complex event processing. ACM Comput. Surv. 2012, 44, 1–62.

[21] Cui, B.; He, S. Anomaly detection model based on hadoop platform and weka interface. In Proceedings of the 2016 10th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing, IMIS, Fukuoka, Japan, 6–8 July 2016; pp. 84–89. [CrossRef]

[22] D. Jensen, K. Konkel, A. Mohindra, F. Naccarati, E. Sam, Business Analytics in the Cloud, White paper IBW03004-USEN-00, IBM (April 2012).

[23] D.J. Abadi, Data management in the cloud: Limitations and opportunities, IEEE Data En gineering Bulletin 32 (1) 3–12, 2009.

[24] Dafir, Z.; Lamari, Y.; Slaoui, S.C. A Survey on Parallel Clustering Algorithms for Big Data; Springer: Amsterdam, The Netherlands, 2021; Volume 54.

[25] Dam, H. K., Tran, T., Grundy, J., Ghose, A., & Kamei, Y. (2019, May). Towards effective AI-powered agile project management. In 2019 IEEE/ACM 41st international conference on software engineering: new ideas and emerging results (ICSE-NIER) (pp. 41-44). IEEE.

[26] Demesure, G.; Charpentier, P.; Siadat, A.; Mouayni, E.; El, I.; Mouayni, E. Jobs scheduling within Industry 4.0 with consideration of worker's fatigue and reliability using Greedy Randomized Adaptive Search Procedure. Isc. FAC Pap. 2019, 52, 85–90.

[27] Demirkan, H., & Delen, D. (2013). Leveraging the capabilities of service-oriented decision support systems: Putting analytics and big data in cloud. *Decision Support Systems*, *55*(1), 412-421.

[28] Ekanayake J, Li H, Zhang B, Gunarathne T, Bae S-H, Qiu J, Fox G. Twister: a runtime for iterative mapreduce. In: *ACM International Symposium on High Performance Distributed Computing* (*HPDC*), 2010, New York, NY, 810–818.

[29] Ericson K, Pallickara S. On the performance of high dimensional data clustering and classification algorithms. *Future Gener Comput Syst* 2013, **29**: 1024–1034.

[30] Fan, J., Han, F., & Liu, H. (2014). Challenges of big data analysis. *National science review*, *1*(2), 293-314.

[31] Feng,C.; Wang,Y.; Chen, Q.; Ding, Y.; Strbac, G.; Kang, C. Smart grid encounters edge computing: Opportunities and applications. Adv. Appl. Energy 2021, 1, 100006.

[32] Glaab E, Bacardit J, Garibaldi JM, Krasnogor N. Using rule-based machine learning for candidate disease gene prioritization and sample classification of cancer gene expression data. *PLoS One* 2012, **7**: e39932.

[33] Grossman RL, Gu Y. Data mining using high performance data clouds: experimental studies using sector and sphere. In: *14th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining* (*KDD*), 2008, Las Vegas, NV, 920–927.

[34] Gupta R, Gupta H, Mohania M. Cloud computing and big data analytics: what is new from databases perspective? In: *1st International Conference on Big Data Analytics* (*BDA*), New Delhi, India, 2012, 42–61.

[35] Gupta, S., Qian, X., Bhushan, B., & Luo, Z. (2019). Role of cloud ERP and big data on firm performance: a dynamic capability view theory perspective. *Management decision*, *57*(8), 1857-1882.

[36] Hadji, S.; Gaubert, J.; Krim, F. Real-Time Genetic Algorithms-Based MPPT: Study and Comparison (Theoretical an Experimental) with Conventional Methods. Energies 2018, 11, 459.

[37] Han J, Haihong E, Le G, Du J. Survey on nosql database. In: *6th International Conference on Pervasive Computing and Applications*, (*ICPCA*), Port Elizabeth, South Africa, 2011, 363–366.

[38] Hasan, M.K.; Alkhalifah, A.; Islam, S.; Babiker, N.B.M.; Habib, A.K.M.A.; Aman, A.H.M.; Hossain, M.A. Blockchain Technology on Smart Grid, Energy Trading, and Big Data: Security Issues, Challenges, and Recommendations. Wirel. Commun. Mob. Comput. 2022, 2022.

[39] Hasan, M.K.; Ismail, A.F.; Islam, S.; Hashim, W.; Pandey, B. Dynamic spectrum allocation scheme for heterogeneous network. Wirel. Pers. Commun. 2017, 95, 299–315.

[40] Hasan,M.K.; Habib, A.K.M.A.; Islam, S.; Balfaqih, M.; Alfawaz, K.M.; Singh, D. Smart Grid Communication Networks for Electric Vehicles Empowering Distributed Energy Generation: Constraints, Challenges, and Recommendations. Energies 2020, 16, 1140.

[41] Hausenblas M, Nadeau J. Apache drill: interactive ad-hoc analysis at scale. *Big Data* 2013, **1**: 100–104.

[42] Huemann, M., Eskerod, P., & Ringhofer, C. (2017). Rethinking project management: A structured literature review with a critical look at the brave new world. International Journal of Project Management, 35(10), 16941707.

[43] Hughes, L., Dwivedi, Y. K., Rana, N. P., Simintiras, A., & Raghavan, V. (2019). Blockchain research, practice and policy: Applications, benefits, limitations, emerging research themes and research agenda. International Journal of Information Management, 49, 114-129.

[44] Isard M, Budiu M, Yu Y, Birrell A, Fetterly D.. Dryad: distributed data-parallel programs from sequential building blocks. In: *2nd ACM SIGOPS/EuroSys European Conference on Computer Systems* (*EuroSys*), New York, NY, 2007, 59–72.

[45] J. Cohen, B. Dolan, M. Dunlap, J.M. Hellerstein, C. Welton, MAD skills: new analysis practices for big data, Proceedings of the VLDB Endow 2 (2) 1481–1492, 2009. https://doi.org/10.14778/1687553.1687576

[46] Jafarnejad Ghomi, E.; Rahmani, A.M.; Qader, N.N. Applying queue theory for modeling of cloud computing: A systematic review. Concurr. Comput. Pract. Exp. 2019, 31, e5186.

[47] Kitchin, R. (2014). *The data revolution: Big data, open data, data infrastructures and their consequences*. Sage. Lakshman A, Malik P. Cassandra: a decentralized structured storage system. *Oper Syst Rev* 2010, **44**: 35– 40.

[48] Li, C.; Zhang, J.; Luo, Y. Real-time scheduling based on optimized topology and communication traffic in distributed real-time computation platform of storm. J. Netw. Comput. Appl. 2017, 87, 100–115.

[49] Li, X.; Jia, S.; Wang, K.; Yin, X. Distributed parallel processing of mobile robot PF-slam. IET Conf. Publ. 2012, 2012, 927–930.

[50] López V, del Río S, Benítez JM, Herrera F. Cost-sensitive linguistic fuzzy rule-based classification systems under the mapreduce framework for imbalanced big data. *Fuzzy Set Syst* in press. doi: 10.1016/j.fss.2014.01.015.

[51] Lv, X.; Cheng, X.; Lv, Y.X. Distributed cloud storage and parallel topology processing of power network. In Proceedings of the 2016 Third International Conference on Trustworthy Systems and their Applications (TSA), Wuhan, China, 18–22 September 2016; pp. 142–146.

[52] Magoulès F, Zhao H-X, Elizondo D. Development of an rdp neural network for building energy consumption fault detection and diagnosis. *Energy Build* 2013, **62**: 133–138.

[53] Malewicz G, Austern MH, Bik AJ, Dehnert JC, Horn I, Leiser N, Czajkowski G.. Pregel: a system for large-scale graph processing. In: *2010 ACM SIGMOD International Conference on Management of data*, Indianapolis, IN, 2010, 135–146.

[54] Marx V. The big challenges of big data. *Nature* 2013, **498**: 255–260.

[55] Meng,L.; Sanseverino, E.R.; Luna, A.; Dragicevic, T.; Vasquez, J.C.; Guerrero, J.M. Microgrid supervisory controllers and energy management systems: A literature review. Renew. Sustain. Energy Rev. 2016, 60, 1263– 1273.

[56] Meroni, G., & Meroni, G. (2019). Implementing and Evaluating Artifact Driven Process Monitoring. Artifact-Driven Business Process Monitoring: A Novel Approach to Transparently Monitor Business Processes, Supported by Methods, Tools, and Real-World Applications, 107-120.

[57] N. Leavitt, Will NoSQL Databases Live Up to Their Promise? Computer 43 (2) 12–14, (2010). https://doi.org/10.1109/MC.2010.58

[58] Naqvi, R., Soomro, T. R., Alzoubi, H. M., Ghazal, T. M., & Alshurideh, M. T. (2021, May). The nexus between big data and decision-making: A study of big data techniques and technologies. In *The international conference on artificial intelligence and computer vision* (pp. 838-853). Cham: Springer International Publishing.

[59] Narayan, A.; Krüger, C.; Göring, A.; Babazadeh, D.; Harre, M.C.; Wortelen, B.; Luedtke, A.; Lehnhoff, S. Towards future SCADA systems for ICT-reliant energy systems. In ETG-Kongress 2019-Das Gesamtsystem Fokusder Energiewende; VDE: Esslingen am Neckar, Germany, 2019; pp. 364–370.

[60] Narayanan, V.; Kavitha, R.; Srikanth, R. Performance Evaluation of Brahmagupta-Bhaskara Equation Based Algorithm Using OpenMPBT.Proc. Data Anal. Manag. 2022, 90, 21–28.

[61] Navarro, A.; Hitschfeld-kahler, N.; Mateu, L. A Survey on Parallel Computing and its Applications in DataParallel Problems Using GPUArchitectures. Commun. Comput. Phys. 2014, 15, 285–329.

[62] Neumeyer L, Robbins B, Nair A, Kesari A. S4: distributed stream computing platform. In: *2010 IEEE Data Mining Workshops* (*ICDMW*), Sydney, Australia, 2010, 170–177.

[63] Ngai EWT, Wat FKT. Literature review and classification of electronic commerce research. *Inf Manage* 2002, **39**: 415–429.

[64] Niu, Y., Ying, L., Yang, J., Bao, M., & Sivaparthipan, C. B. (2021). Organizational business intelligence and decision making using big data analytics. *Information Processing & Management*, *58*(6), 102725.

[65] Novak, A., Bennett, D., & Kliestik, T. (2021). Product decision-making information systems, real-time sensor networks, and artificial intelligence-driven big data analytics in sustainable Industry 4.0. *Economics, management and financial markets*, *16*(2), 62-72.

[66] Obaid, T., Abdaljawad, R., & Mdallalahc, S. A. (2020). Factors Driving E Learning Adoption In Palestine: An Integration of Technology Acceptance Model And IS Success Model. Available at SSRN 3686490.

[67] Pan Y, Zhang J. Parallel programming on cloud computing platforms—challenges and solutions. *J Convergence* 2012, **3**: 23–28.

[68] Pan, Y., & Zhang, L. (2021). A BIM-data mining integrated digital twin framework for advanced project management. *Automation in Construction*, *124*, 103564.

[68] Pawade, P.A.; Gaikwad, P.V.T. Semi-Distributed Cloud Computing System with Load Balancing Algorithm. Int. J. Comput. Sci. Inf. Technol. 2014, 5, 2942–2947.

[69] Peng, Z.; Gong, Q.; Duan, Y.; Wang, Y. The Research of the Parallel Computing Development from the Angle of Cloud Computing. J. Phys. Conf. Ser. 2017, 910, 012002.

[70] Plummer D, Bittman T, Austin T, Cearley D, Cloud DS. Defining and describing an emerging phenomenon. Technical Report, Gartner, 2008.

[71] Provost F, Fawcett T. *Data Science for Business. What You Need to Know about Data Mining and DataAnalytic Thinking*. 1st ed. Sebastopol, CA: O'Reilly; 2013.

[72] Rashid, Z.N.; Zebari, S.R.M.; Sharif, K.H.; Jacksi, K. Distributed Cloud Computing and Distributed Parallel Computing: A Review. In Proceedings of the ICOASE 2018-International Conference on Advanced Science and Engineering, Duhok, Iraq, 9–11 October 2018; pp. 167–

[73] Rothnie JBJ, Bernstein PA, Fox S, Goodman N, Hammer M, Landers TA, Reeve CL, Shipman DW, Wong E. Introduction to a system for distributed databases (sdd-1). *ACM Trans Database Syst* 1980, **5**: 1–17..

[74] Saber, T.; Marques-Silva, J.; Thorburn, J.; Ventresque, A. Exact and Hybrid Solutions for the MultiObjective VM Reassignment Problem. Int. J. Artif. Intell. Tools 2017, 26, 1760004.

[75] Shariff, S.M.; Alam, M.S.; Faraz, S.; Khan, M.A.; Abbas, A.; Amir, M. Economic approach to design of a level 2 residential electric vehicle supply equipment. In Advances in Power and Control Engineering: Proceedings of GUCON; Springer: Singapore, 2020; pp. 25–40.

[76] Shetty, S.D.; Vadivel, S.; Gandhi, N. A cloud enabled online quiz application deployed on Google cloud. In Proceedings of the 2012 International Conference on Cloud Computing Technologies, Applications and Management, ICCCTAM, Dubai, United Arab Emirates, 8–10 December 2012; pp. 108–113.

[77] Simão, J.; Esteves, S.; Pires, A.; Veiga, L. GC-Wise: A Self-adaptive approach for memory-performance efficiency in Java VMs. Futur. Gener. Comput. Syst. 2019, 100, 674–688.

[78] Sobie, R. Distributed cloud computing in high energy physics. In Proceedings of the 2014 ACM SIGCOMM workshop on Distributed cloud computing, Chicago, IL, USA, 18 August 2014; pp. 1–4.

[79] Soualhia, M.; Khomh, F.; Tahar, S. Task Scheduling in Big Data Platforms: A Systematic Literature Review. J. Syst. Softw. 2017, 134, 170–189.

[80] Stonebraker M, Abadi D, DeWitt D, Madden S, Paulson E, Pavlo A, Rasin A. Mapreduce and parallel dbmss: friends or foes? *Commun ACM* 2010, **53**: 64–71.

[81] Storey, V. C., & Song, I. Y. (2017). Big data technologies and management: What conceptual modeling can do. *Data & Knowledge Engineering*, *108*, 50-67.

[82] Suganya, R.; Pavithra, M.; Nandhini, P. Algorithms and Challenges in Big Data Clustering. Int. J. Eng. Tech. 2018, 4, 40–47.

[83] Tan, Y.; Member, S.; Ding, K. A Survey on GPU-Based Implementation of Swarm Intelligence Algorithms. IEEE Trans. Cybern. 2016, 46, 2028–2041. [CrossRef] [PubMed]

[84] Thakur, V. Perspective Study and Analysis of Parallel Architecture. Int. J. Comput. Appl. 2016, 148, 21–25.

[85] Tripathy, L.; Ranjan Patra, R. Scheduling in Cloud Computing. Int. J. Cloud Comput. Serv. Archit. 2014, 4, 21–27.

[86] Tu T, Rendleman CA, Borhani DW, Dror RO, Gullingsrud J, Jensen M, Klepeis JL, Maragakis P, Miller PJ, Stafford KA, Shaw DE. A scalable parallel framework for analyzing terascale molecular dynamics simulation trajectories. In: *ACM*/*IEEE Conference on Supercomputing* (*SC*), Austin, TX, 2008, 1–12.

[87] Vaquero LM, Rodero-Merino L, Caceres J, Lindner M. A break in the clouds: towards a cloud definition. *SIGCOMM Comput Commun Rev* 2008, **39**: 50–55.

[88] Varghese, B.; Buyya, R. Next generation cloud computing: New trends and research directions. Futur. Gener. Comput. Syst. 2018, 79, 849–861.

[89] Waller MA, Fawcett SE. Data science, predictive analytics, and big data: a revolution that will transform supply chain design and management. *J Bus Logistics* 2013, **34**: 77–84.

[90] Wamba, S. F., Gunasekaran, A., Akter, S., Ren, S. J. F., Dubey, R., & Childe, S. J. (2017). Big data analytics and firm performance: Effects of dynamic capabilities. *Journal of business research*, *70*, 356-365.

[91] Wang, J., Yang, Y., Wang, T., Sherratt, R. S., & Zhang, J. (2020). Big data service architecture: a survey. *Journal of Internet Technology*, *21*(2), 393-405.

[92] Witten IH, Frank E, Hall MA. *Data Mining: Practical Machine Learning Tools and Techniques*. Morgan Kaufmann Series in Data Management Systems. Amsterdam: Morgan Kaufmann; 2011.

[93] Wu X, Zhu X, Wu G-Q, Ding W. Data mining with big data. *IEEE Trans Knowl Data Eng* 2014, **26**: 97–107.

[94] Wu, X., Zhu, X., Wu, G. Q., & Ding, W. (2013). Data mining with big data. *IEEE transactions on knowledge and data engineering*, *26*(1), 97-107.

[95] Xiao Z, Xiao Y. Achieving accountable mapreduce in cloud computing. *Future Gener Comput Syst* 2014, **30**: 1–13.

[96] Yang, C., Huang, Q., Li, Z., Liu, K., & Hu, F. (2017). Big Data and cloud computing: innovation opportunities and challenges. *International Journal of Digital Earth*, *10*(1), 13-53.

[97] Yassine, A., Singh, S., Hossain, M. S., & Muhammad, G. (2019). IoT big data analytics for smart homes with fog and cloud computing. *Future Generation Computer Systems*, *91*, 563-573.

[98] Yazici, A.; Mishra, A.; Karakaya, Z. Teaching Parallel Computing Concepts Using Real-Life Applications*. Int. J. Eng. Educ. 2016, 32, 772–781.

[99] Yu Y, Isard M, Fetterly D, Budiu M, Erlingsson L, Gunda PK, Currey J. Dryadlinq: a system for generalpurpose distributed data-parallel computing using a high-level language. In: *Operating Systems Design and Implementation*, San Diego, CA, 2008, 1–14.

[100] Yue, S.; Ma, Y.; Chen, L.; Wang, Y.; Song, W. Dynamic DAG scheduling for many-task computing of distributed eco-hydrological model. J. Supercomput. 2019, 75, 510–532.

[101] Zhou, Y., Xia, Q., Zhang, Z., Quan, M., & Li, H. (2022). Artificial intelligence and machine learning for the green development of agriculture in the emerging manufacturing industry in the IoT platform. Acta Agriculture Scandinavica, Section B—Soil & Plant Science, 72(1), 284-299.