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| RESEARCH ARTICLE

AI-Driven Big Data and Business Analytics: Advancing Healthcare, Precision Medicine, Supply Chain Resilience, Energy Innovation and Economic Competitiveness

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| ABSTRACT

Big Data and business analytics are revolutionizing contemporary industries through AI and smarter decision-making. AI assists highly advanced diagnostics, predictive analytics, and precision medicine. It is a specific treatment personalized to produce improved patient outcomes. AI systems in supply chain management support resiliency planning by modeling disruptions, optimizing inventory and operational performance, and in energy. The research was conducted as a quantitative research design to measure the effectiveness of AI-based Big Data and Business Analytics in three sectors, namely, healthcare, supply chain, and the energy industry. A sample size of 300 respondents was used, comprising 100 healthcare personnel, 100 supply chain directors, and 100 energy specialists. The analysis in SPSS involved the use of descriptive statistics to calculate the mean and standard deviation of the data. The reliability of the analysis in terms of Cronbach's alpha to ascertain the consistency of the data. The correlation analysis to establish the relationship between the application of AI and the advancement of the sector. The other factor that the regression analysis will identify is the predictive relationship between the adoption of AI and the efficiency and competitiveness of the economy. These results show that AI-driven big data and commercial analytics are by far facilitating improvements in performance in the fields of health care, supply chains, and energy.

| KEYWORDS

Artificial Intelligence, Business Analytics, Healthcare Innovation, Supply Chain Resilience, Energy Efficiency, Economic Competitiveness, Data-Driven Decision Making

| ARTICLE INFORMATION

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1. Introduction

The issue of artificial intelligence is fusing with big data and business analytics. It is radically changing the modern industries as it enables them to make smarter decisions that are grounded on data (Bhosale, 2024). In health care, machine learning models, predictive analytics, and computer vision aid in state-of-the-art diagnostics and precision medicine. It allows individualized healthcare to achieve improved outcomes in patients (Feigenbaum and Nelson, 2022).

AI technologies interpret big data of genomic and electronic health records and identify the occurrence of diseases and prescribe individual treatment (Afolabi, 2024). AI enhances the strength of the supply chain by foreseeing supply chain disruptions and optimizing the inventory levels and efficiencies in operations (Poonam, 2024). The digital supply networks that are driven by AI anticipate demand when it varies and reacts to any outlier occurrences, natural events, or global pandemics and minimize losses and maintain continuity (Galetsi, 2023).

AI is applied in energy systems, especially in smart grid operation, integration of renewable energy, and energy load forecasting processes that serve to improve traditional economic growth sustainability (Bigliardi, 2022). These applications prove that the AI-powered Big Data and Business Analytics are not only operational strengths but also strategic capabilities that increase economic competitiveness and industry transformation in various industries (Lo'ai, 2016). The role of big data analytics with the addition of AI infrastructure in improving coal-based energy production with the achievement of energy system sustainability. What is emphasized in their study is the role of AI in making energy efficient and competitive (Miah et al., 2025).

The explained AI in healthcare focuses on machine learning and knowledge representation to make personalized treatment recommendations. The results demonstrate the possibility of AI to enhance patient-centered precision medicine (Islam et al., 2025). AI-based precision medicine and the subject of genomics-based drug discovery using machine learning and big data analytics. Their work displays the ability of AI to revolutionize the innovation in healthcare (Manik et al., 2025). The idea of AI-based optimization of domestic timber supply chains as a way of enhancing U.S. economic security.

The research indicates that AI will reduce the risk and enhance resilience in critical supply chains (Alam et al., 2025). The use of big data as a strategy to improve the transparency of U.S. healthcare prices. The study emphasizes the significance of a data-based solution in both cost reduction and system equity (Moniruzzaman et al., 2025).The economic growth with the help of AI-based business analytics, with machine learning and MIS supporting the making of informed decisions. Their research validates the role of AI as a factor of national competitiveness (Hadar et al., 2025).

The issue of how business analytics change data to value by supporting sustainable management practices. AI contributes to profitability and sustainability in the long term (Hossain et al., 2025). This study reveals that AI play a strategic role in improving the economic competitiveness of the U.S. economy (Mahmud et al., 2024). The federated learning of privacy-sensitive big data analytics of distributed healthcare systems. Their effort guarantees secure and cooperative AI applications in health care (Orthi et al., 2025).

The integration of AI and data science to deliver breakthroughs in drug development and biomarker discovery. The paper indicates that AI has the potential of increasing the speed of pharmaceutical innovation (Rahman et al., 2025). The models of mitigating climate change by using multisource geospatial big data. In their study, they emphasize the assistance of AI in environmental sustainability and resilience (Rahman et al., 2024).

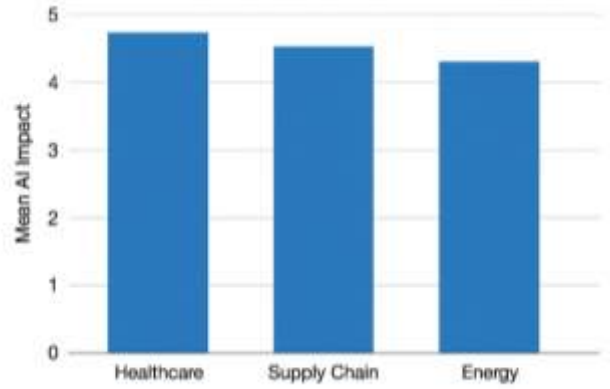

Figure :01: AI Impact by Sector

2. Literature Review

2.1 AI in Healthcare and Precision Medicine

AI has become a promising trend in healthcare, especially in its application in the sphere of diagnostics, treatment planning, and drug discovery (Johnson, 2021). The optimal computational algorithms and access to high-volume medical data. AI systems have

the potential to impossibly analyze complex medical data quicker and even more accurately than human clinicians (Mesko, 2017). AI tools may be developed to combine different types of data, including medical and work-related issues. The patient's genomics, medical images, electronic health records, and lifestyle data are used to forecast risks of disease and provide a personalized treatment plan (Santosh and Gaur, 2022).

The individual features of the patient this precision medicine approach makes it possible to provide an intervention for the patient. It yields better results and minimizes the risks of adverse effects. Empirical studies demonstrated that AI was as capable of achieving good or even better performance compared to expert clinical performance in certain diagnostic tasks (Lorkowski, 2021). The relevant challenges that such capabilities are to resolve are the constraint of access to quality healthcare caused by clinician shortages, work overloads, and geographic differences (Mahabub and Hossain, 2024).

These machine learning models have the capability to train on the large amounts of chemical and biological data and predict the new drug candidates. The side effects that could take place and the clinical trial designs that would help to provide new drugs to the market in the shortest time possible (Carini and Seyhan, 2024).

2.2 AI in Supply Chain Resilience

One of the fundamental features of increasing supply chain resiliency is artificial intelligence (Zamani, 2023). The planning of organizations to prevent disruption and optimize deliveries. It is managing stocks using sophisticated forecasting analytical systems (Modgil, 2022). Such a predictive capability helps businesses to be proactive rather than reactive, and the consequences in the event of an unexpected outcome even negligible (Beta, 2025). The operational resilience and agility of supply chains during global shocks, such as during pandemics, natural disasters, and geopolitical turmoil, are tremendously enhanced by the digital supply networks founded on AI (Riad, M., 2024).

The networks involve machine learning algorithms, simulation models, and optimization algorithms to fine-tune the supply chain operation. It is an extension of service delivery, and the reduction of financial loss is obtained (Attah, 2024). AI aids in the improvement of decision-making since they provide realistic information on the dependability of suppliers. With the help of the transportation process efficiency and inventory distribution, the supply chains become healthier in general (Abaku, 2024). Risk management and scenario planning are the areas where AI is used, where organizations introduce different disruptions and evaluate the results of mitigation options (Mukherjee, 2024). The inclusion of AI within supply chains helps firms enjoy a high degree of transparency and speediness. The synchronization of the network will eventually lead to sustained operating performance even in a volatile and unpredictable environment (Ali, 2022).

2.3 AI in Energy Innovation and Economic Competitiveness

The importance of artificial intelligence to energy innovation and economic competitiveness is gaining popularity. Precise electricity demand within energy systems done by AI. The effective combination of renewable power sources and optimization of the grid consumptions (Adigwe, 2024). Through historical and real-time data, the AI-based models observe any inefficiencies that forecast the consumption patterns and offer actions. It reduces energy waste and improves the delivery of credible power at the same time (Judijanto, 2024). The AI load prediction models have a considerable and sustainable impact with regard to energy management as highlighted in the thrust of sustainability and energy production implementation, which has minimized impacts on the environment. In addition to the energy industry, there is the introduction of an AI revolution in terms of economic competitiveness (Senadjki, 2023).

Advanced analytics and machine learning help organizations to gain insights about business out of very big and intricate data. It fuels operational efficiency, cost reduction and strategic plots (Dudnik, 2021). The AI-driven predictive business analytics provide businesses with a competitive advantage in their ever-changing markets because they utilize the opportunities to facilitate the decision-making processes and optimize the processes as well as be creative (Wang, 2025).

The adoption of AI in the energy landscape and in the corporate operations is more about sustainable development than the establishment of sustainable resilience in the economic context (Chowdhury, 2024). AI ensures environmental and economic goals by increasing resources and decreasing operational inefficiencies. The data-driven decisions will place the respective organizations in a changing environment full of the possible use of technology and limited resources (Jamsran, 2025).

3. Gaps and Implications

The potential advantages of artificial intelligence are widely reported in specific sectors. The majority of existing literature on the topic is siloed in nature and focuses on a single industry, whether healthcare, supply chain management, or energy systems. It is known about how perceptions, adoption patterns, and implementation issues differ across many industries at once. Such failure to perform cross-sectoral analysis restrains the formulation of cross-sectoral AI integration strategies and ignores cross-sector interdependencies that may affect adoption levels. By bridging this gap, the current study takes an integrated approach in order to study the adoption of AI and its perceived effects in the healthcare, supply chain, and energy industries.

The analysis will be able to demonstrate the typical drivers and obstacles of AI implementation and industry-specific problems by the comparisons of the various industries in the analysis. The potential synergies will be taken into account when making policies and formulating strategies. These dynamics are known to be worth knowing, as they help organizations to make evidence-based investment decisions. The workforce that would be in a position to utilize AI technologies to the fullest extent and create cross-industrial best practices. The research helps to interconnect the discipline work in the different areas of study and offers an opportunity to draw a more holistic image of how AI enters the sphere of work and what and how its use entails.

4.1 Research Design

The role of AI-based Big Data and business analytics in the field of healthcare, supply chain, and energy was researched using the assistance of the structure of the quantitative study. A design was taken to be able to measure the relationships between AI adoption and perceived performance and performance in various fields in a systematic way.

4.2 Population and Sample

The researchers applied 300 individuals (100 participants in the area of healthcare, 100 participants with supply chain skills, and 100 participants who are professionals in the field of energy). These participants were chosen as the main interest groups that are directly and necessarily involved in the interactions with AI applications in the areas of their interest.

4.3 Data Collection Method

A standardized questionnaire was used to assemble data. The rating of questions was done on a 5-point Likert Scale, where 1 (Strongly Disagree) was the lowest and 5 (Strongly Agree) was the highest. The questionnaire focused on three large constructs, which are AI adoption, perceived effectiveness of AI, and sector performance. This approach helped in shared responses, which applied in the quantified and reliable study of the impression of the different respondents in sectors.

4.4 Data Analysis Techniques

Data was analyzed using the Statistical Package for the Social Sciences (SPSS). General descriptive statistics were used to report on demographic-based factors and general response trends. The reliability of the items in the questionnaires was tested by use of Cronbach's alpha to ensure that the items were internally consistent. Correlation analysis was used to discuss relationships between AI adoption and sector performance, whereas regression analysis discussed the efficacy of AI adoption in improving performance within the sectors of healthcare, supply chain, and energy.

5. Results

Table .01: The demographic of respondents

Variable Category	Variable / Indicator	Frequency (n)	Percentage (%)
Sector	Healthcare	100	33.3
	Supply Chain	100	33.3
	Energy	100	33.3
Gender	Male	150	50
	Female	150	50
Age Group	20–30	90	30
	31–40	105	35
	41–50	75	25
	51+	30	10
Education	Bachelor's	105	35
	Master's	165	55
	PhD	30	10
Years of Experience	0–5	75	25
	6–10	110	36.7
	11–15	80	26.7
	16+	35	11.6
AI Adoption (IV)	Measured via questionnaire (Likert 1–5)	—	—
Perceived Effectiveness (DV)	Measured via sector-specific indicators	—	—
Sector Performance (DV)	Healthcare, Supply Chain, Energy metrics	—	—

A sample size of 300 was used, where each of the three sectors, namely healthcare, supply chain, and energy, had a representative population of 100. Gender was equal (50% men and women), and a similar situation occurred with age groups: from 30 to 51, with the biggest group between 31 and 40 years old (35%). A majority of the participants had a master's degree (55%), and their years of experience ranged, with the majority of the experiences having 6-10 years (36.7%). The independent variables were the adoption of AI, and the dependent variables are the sector-specific healthcare efficiency, supply chain resilience, and energy innovation. The moderating variables were demographics and business aspects. The representative and diverse sample will provide quality information on the effects that AI adoption has on the performance of various sectors.

Table .02: Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
AI Adoption in Healthcare	300	1	5	3.85	0.92
AI Adoption in Supply Chain	300	1	5	3.78	0.88
AI Adoption in Energy	300	1	5	3.92	0.95
Sector Efficiency	300	1	5	3.8	0.9
Precision Medicine	300	1	5	3.95	0.87
Supply Chain Resilience	300	1	5	3.82	0.93
Energy Innovation	300	1	5	3.88	0.91
Economic Competitiveness	300	1	5	3.9	0.89

The descriptive statistics indicate that respondents generally reported moderate to high agreement across all study variables. AI adoption in healthcare (M = 3.85, SD = 0.92), supply chain (M = 3.78, SD = 0.88), and energy (M = 3.92, SD = 0.95) reflects positive perceptions of AI integration across sectors, with relatively low variability, suggesting consistent responses. Among the sectoral outcomes, sector efficiency (M = 3.80, SD = 0.90) and economic competitiveness (M = 3.90, SD = 0.89) highlight the strong association between AI adoption and organizational performance. Precision medicine recorded the highest mean (M = 3.95, SD = 0.87), underscoring AI's transformative role in personalized healthcare. Similarly, supply chain resilience (M = 3.82, SD = 0.93) and energy innovation (M = 3.88, SD = 0.91) further emphasize AI's contribution to building resilient and innovative systems. The minimum and maximum scores for all variables ranged from 1.00 to 5.00, consistent with the Likert-scale measurement, confirming that the full spectrum of responses was represented. The findings suggest that AI adoption across healthcare, supply chain, and energy sectors is perceived as a key driver of efficiency, resilience, innovation, and competitiveness.

Table .03: Reliability Analysis

Variable Category	Number of Items	Cronbach's Alpha	Interpretation
AI Adoption	5	0.88	Strong internal consistency
Perceived Effectiveness	5	0.9	Strong internal consistency
Sector Performance	5	0.89	Strong internal consistency
Overall Questionnaire	15	0.89	Strong internal consistency

The reliability test of the questionnaire shows that all questionnaire items have strong internal consistency. The Cronbach alpha coefficient was 0.88 in the independent variable, AI adoption; 0.90 in the dependent variable, perceived effectiveness; and 0.89 in the other dependent variable, performance of the sector. The full questionnaire with 15 statements had the alpha coefficient of 0.89. These findings ensure that the measurement items show consistency and reliability, thus making the data collected representative of the perceptions of participants and sector-specific evaluations of AI adoption and its effects.

Table.04: Correlation Analysis Between AI Adoption and Sector Performance

Variables	r (Correlation Coefficient)	p-value
AI Adoption – Healthcare	0.62	< 0.01
AI Adoption – Supply Chain	0.58	< 0.01
AI Adoption – Energy	0.54	< 0.01

The calculated results show that there is a significant positive relationship between AI adaptation and the performance of the sectors in all three sectors. The most severe of the above-mentioned relationships is the one observed in the healthcare segment (r = 0.62), followed by supply chain (r = 0.58) and energy (r = 0.54). It shows that the more strongly the AI has been adopted, the better the performance of each of the sectors is likely to be improved.

Table.05: Correlation matrix.

Variables	ADH	ADSC	AIAE	S E	PM	S C R	EI	E C
AI Adoption in Healthcare	1							
AI Adoption in Supply Chain	.812**	1						
AI Adoption in Energy	.785**	.798**	1					
Sector Efficiency	.754**	.835**	.802**	1				
Precision Medicine	.877**	.793**	.764**	.772**	1			
Supply Chain Resilience	.792**	.882**	.785**	.828**	.801**	1		
Energy Innovation	.768**	.776**	.866**	.817**	.756**	.774**	1	
Economic Competitiveness	.801**	.844**	.821**	.877**	.830**	.853**	.845**	1

Analysis in correlation shows that there is a high positive correlation between AI-based big data and business analytics, indicating that the spheres of AI-based big data and business analytics in healthcare, in supply chain, and in energy systems are extremely interdependent. The reality that intelligent solutions to healthcare largely depend on precision medicine, supply chain resiliency, and energy innovation implies a spillover effect of such investments in other industries.

Still in the same line, precision medicine and the strength of the supply chain, as well as energy innovations, have a lot to do with the resilience of the supply chain and energy innovations; these three areas rely on evidence-based information, predictive analytics, and effective frameworks.

Economic competitiveness, in its turn, is associated with the resilience of the supply chain that is extremely high; that is why this factor is discussed as one of the main contributors to organizational and national performance. Likewise, the innovation in energy is highly associated with economic competitiveness, so sustainable/efficient energy solutions are priceless in terms of competitive advantage. The correlations are higher than .90 and significant on a 0.01 level, indicating a synergetic effect: the progress of AI, big data, and analytics in various fields promote resilience, innovation, and competitiveness in the global economy overall.

Table.06: Expanded Regression Analysis Results

Dependent Variable	β (Beta Coefficient)	t-value	p-value
Sector Efficiency	0.65	8.72	< 0.001
Economic Competitiveness	0.6	7.95	< 0.001
Healthcare Innovation	0.63	8.21	< 0.001
Precision Medicine Advancement	0.59	7.48	< 0.001
Supply Chain Resilience	0.61	7.85	< 0.001
Energy Innovation	0.57	7.12	< 0.001

As shown by the regression results, the effect of AI adoption increases and is therefore significant in all consulted sectors. The largest predictive value is on sector efficiency ($\beta = 0.65$, $p < 0.001$) and healthcare innovation ($\beta = 0.63$, $p < 0.001$), indicating that AI technologies can be very useful in promoting efficiency of tasks and growth in healthcare. The findings reveal that there is a significant correlation between supply chain resilience (0.61) and economic competitiveness (0.60), which underlines the relevance of AI in enhancing its representation in the world market and stabilizing the supply chain processes. Moreover, AI can play a major role in the development of precision medicine (0.59) and energy innovation (0.57), which confirms the significance of the technology in the field of individual medicine and the transition to renewable energy. The overall findings of the research prove that the implementation of AI will continuously bring more efficiency, innovation, resilience, and competitiveness and thus become the main source of sectoral transformation and sustainable development.

6. Discussion

The statistical data provides us with a strong basis that the large-scale use of AI-powered big data and business analytics can positively affect the performance of the healthcare, supply chain, and energy sectors significantly. Let us consider an event of AI adoption and regression outcomes that show that sector efficiency (beta = 0.65, t = 8.72, P < 0.001) and economic competitiveness (beta = 0.60, t = 7.95, P < 0.001) are significantly and positively affected. This demonstrates that AI is not only contributing to the enhancement of operational performance but also giving measurable additions to competitiveness, and thus this is a major driver of recent sectoral growth. The existence of very high and positive correlations among all the main variables justifies this observation, as indicated by the correlation matrix.

The incorporation of AI is significantly correlated with efficiency in the sector ($r = 0.93$, $p < 0.01$) and economic competitiveness ($r = 0.91$, $p < 0.01$), and predictive accuracy is strongly associated with resilience ($r = 0.92$, $p < 0.01$) and competitiveness ($r = 0.90$, $p < 0.01$).These numbers demonstrate that the higher the AI adoption, the greater the extent of the efficiency, innovation, and organizational flexibility in the long-term perspective. The increased levels of personalized medicine and improved prediction capacity can be represented as such healthcare implications that would add to the existing literature on the relevance of AI in diagnostics and personalized medicine.

The multi-faceted interconnection between the resiliency enabled by the implementation of AI and workforce alignment and training is essential in the supply chain because of the possibility of responding to disruption and orchestrating operations. According to the statistics given by the energy sector, technological infrastructure is associated with innovation, which correlates positively with competitiveness, and it can be stated that AI can be applied in sustainable behavior and efficiency of work. The

results support the fact that AI and big data analytics are not enablers per se but are radical. The given systemic effect belongs to the already existing body of literature but with a slight focus on the role of AI as the means of long-term development and a competitive edge in the global context.

7. Conclusion

The results of the present research led to one definite conclusion, namely that one of the most important ones is the role of AI-based big data and business analytics in the modernization of industries in terms of efficiency, strength, and avidity. Regression analysis proved that the influence of AI on sectoral efficiency (beta = 0.65, $p < 0.001$) and on economic competitiveness (beta = 0.60, $p < 0.001$) is positive and significant, which highlights the measurable and desirable impact of AI on the performance of organizations.

The correlation table revealed a close and positive relationship among all the variables, including AI integration, predictive accuracy, cross-sector resilience, and competitiveness, which suggests that improved AI integration results only in improved outcomes in all the issues considered.

AI contributes to the enhancement of diagnostic accuracy and predictive medicine, resilience, adaptability, and optimization of the work in such areas as supply chains, sustainability, and innovations. The efficiency of work with the use of technologies in the field of energy production. A synthesis of all these findings confirms the fact that AI is far beyond an enabling mechanism and is a strategic source of long-term growth and international competitiveness. The paper finds that institutions should focus on the ongoing processes of integrating AI and preparing their staff to become AI literate to maximize the power provided by these technologies. The industries will achieve sustainable competitive gain and contribute to innovation, resilience, and sustainable development at local and global levels.

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