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Automating Resource Management in Big Data Environments to Reduce Operational Costs

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Abstract

This research article aims at evaluating the automation of resources in the big data environment especially in relation to the impact on the cost and operation. Automation incorporates real time data and predictive analytics which can enhance efficiency of resource management, reduce operation complications and significantly minimize cost. The article also provides examples of frameworks, technologies, methodologies, from current literature, to show how automation, and other intelligent algorithms enhance the performance and economy of the system. Others are future development as quantum, and edge computing that are also highlighted as future possibilities in big data adaptation.

Keywords: Automation, Big Data, Resource Management and Predictive Analysis.

1.0 Introduction

The use of big data environments in organizations is a reality in the current world with lots of advantages and difficulties. Positive performance together with enhanced cost efficiency can be achieved within these systems, only if effective resourcing is accomplished inside it. Through automating resource management there is the possibility for streamlining the processes, enhancing communication, effectiveness and cutting operational costs significantly. This research article aims at exploring the automation of the big data environment, in terms of its objectives, and impact on operating costs. Management requires better control of resources, reduction of costs, and better decisions from the use of advanced automated technology in organizations.

2.0 Literature Review

2.1 The Role of Big Data Analytics in Industrial Internet of Things

According to the author Rehman *et al.*2019, it states that the aim of this research was to analyze BDA application on IIoT with the overall objective of enhancing the IIoT systems. The focus was to discuss BDA technologies, algorithms, and methods applicable to IIoT and distinguish data sources, analytics tools, methodologies, and applications taxonomy. Other activities consisted of use of literature review and assessment of distinct frameworks and information from corporations that have been benefited from BDA. The identified insights illustrate that BDA enhances operational and customer-level insights in IIoT and brings significant advantages; it also provides more issues at the same time. The future works should aim at addressing these issues while developing BDA technologies to enhance IIoT systems.

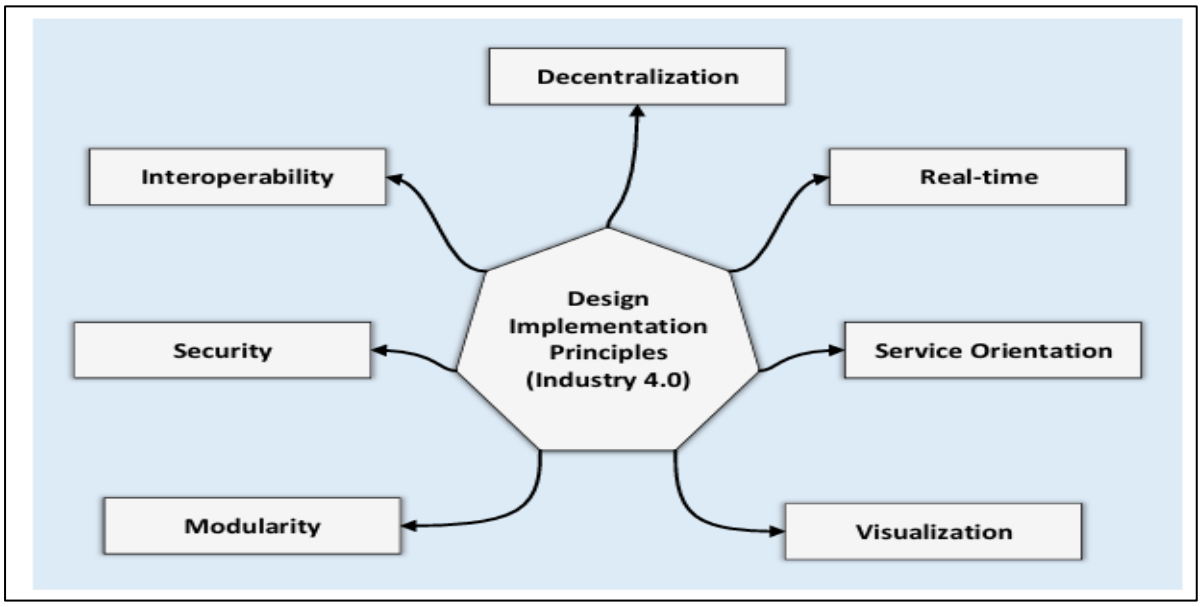

Figure 1: Seven design implementation principles for Industry 4.0 systems

(Source: https://www.sciencedirect.com)

2.2 High Performance Cloud Computing for Remote Sensing Big Data Management

According to the author Wang *et al*.2018, it states that the aim of this research was to develop measures for addressing the issues related to handling large multi-temporal, and multi-spectral remote sensing information for enhanced regional and global monitoring. The objective was to develop pipsCloud, the combination of cloud computing and high performance computing for on-demand, real-time processing of remote sensing data feeds. The techniques which were adopted included using the advantages of the cloud computing model, utilizing Hilbert-R+ indexing system for efficient data searching and constructing a parallel file system for remote sensing data of high dimensionality. The results of pipsCloud experimentation elaborated that data localisation enhances I/O performance and that pipsCloud allows for flexibility when executing complex remote sensing operations. Future work should focus on enhancing the system and expanding its application to enhance real time monitoring and addressing more towards emerging environmental or catastrophe conditions.

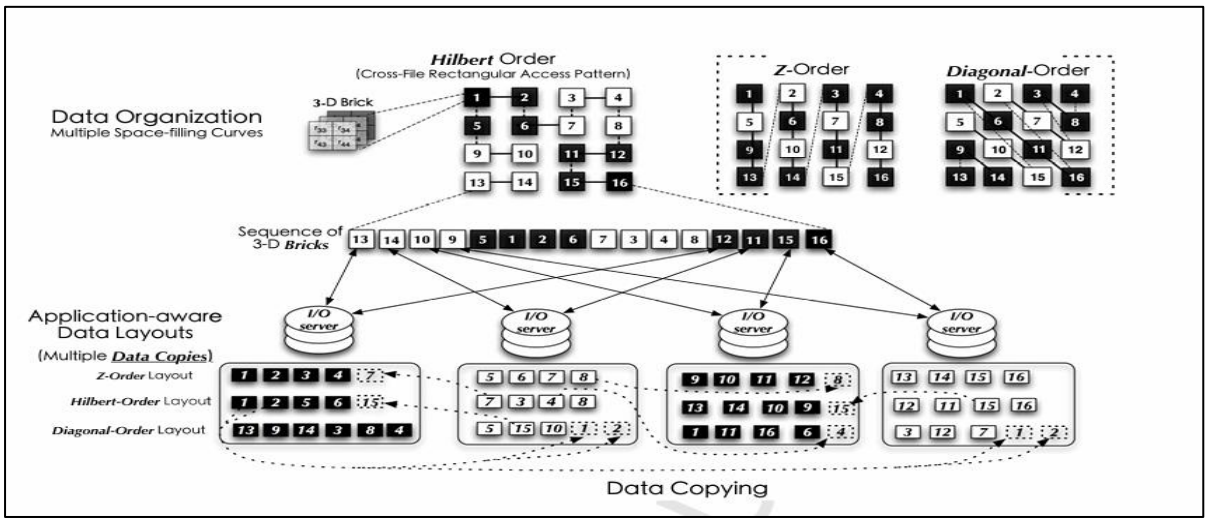

Figure 2: The Application-aware Data Layout and Data Copies

(Source: https://www.sciencedirect.com)

2.3 Impact of big data on supply chain management

According to the author Raman *et al*.2018, it states that the aim of this research was to assess the impact of big data in enhancing the working of the supply chain management with specific focus on operation strategy, cost reduction and enhancing customer satisfaction. The objective was to measure the impact of the big data related technologies including demand management, vendor rating, IoT, analytics and data science in the context of the supply chain sector. Self-completed questionnaires were given to employees of multinational firms from different countries and then the data collected was put through multiple regression analysis using structural equation modeling. The analysis established that big data significantly improves operational performance, cost optimization, customer satisfaction, and potential relationships between demand management as well as SCM. It is evident from the research that big data is valuable as well as financially elaborated, whereas besides having the capacity to set a benchmark for a new generation. Future works have to explore how big data can be integrated into the SCOR model and what are the Practical Implications of this integration for several specific scenarios.

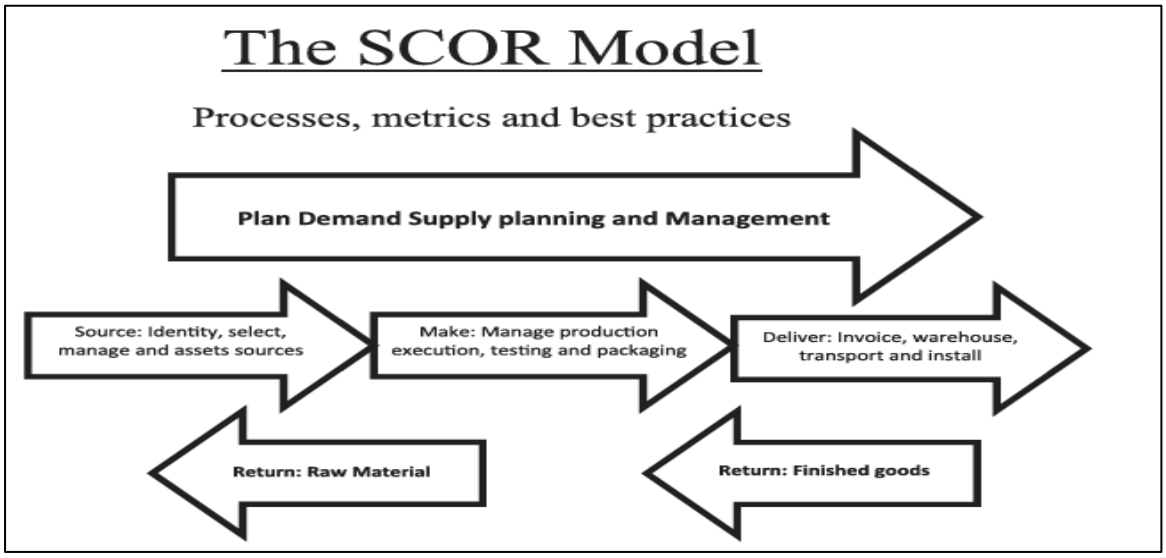

Figure 3: The SCOR model

(Source: https://www.tandfonline.com)

3.0 Methods

3.1 Data Collection and Processing

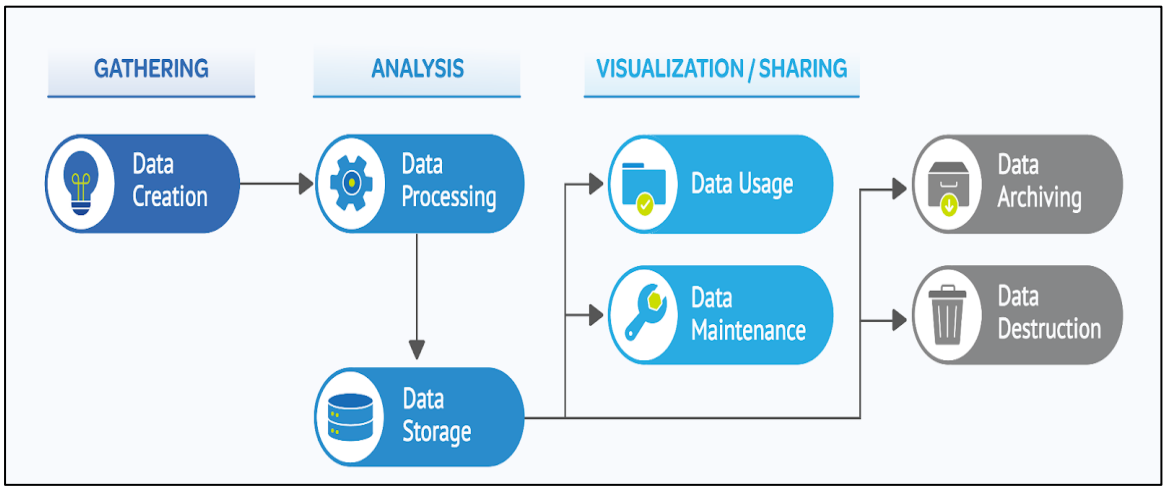

Figure 4: Data Management

(Source: https://assets.datamation.com)

It provides information regarding the certain specific method which is applied to gather the data and after gathering the data how it will be processed. The system logs, performance indicators and transactional records from different BDPs provide adequate data sources. It is vital for deriving resource utilization patterns and for reflecting choices for enhancement. Specific sets of information reveal that this data is also collected a lot of times by merging multiple sources using distributed computing frameworks that include Hadoop as well as Spark. The research article signifies the importance of the data cleaning methodologies for overcoming the issues like the impoundment of data, gaps, and twines (Rehman *et al.* 2018). The tools used in the aggregation and cleaning of data are often associated with increase in data correctness and work efficiency, provided the creation of an effective automated environment for model implementation and are connected with the minimization of operating costs significantly and the enhancement of resource management can be noticed.

3.2 Designing Automation Models

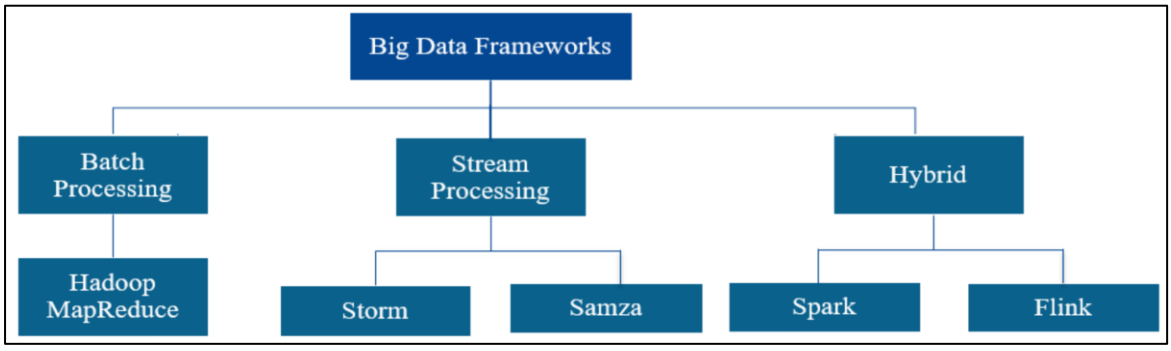

Figure 5: Big Data Frameworks

(Source: https://www.mdpi.com)

A certain specific analysis of automation frameworks in the sector of big data landscape points towards the fact that appropriate frameworks and algorithms must be used to manage the resources. Based on specific studies, there are frameworks that have been found effective in training Apache Spark and Tensor Flow that are considered as notable among them. Such learning models as reinforcement learning as well as evolutionary algorithms are often mentioned in recent studies due to its ability to adapt the distribution of resources to current inputs (Velásquez *et al.* 2018). Adequate data elaborates that big data is necessary for effective model training with performance measurements and methods to counter overfitting which is noticed to be common such as cross-validation. Metrics such as accuracy, recall, and F1 score are often applied to determine the model's efficiency.

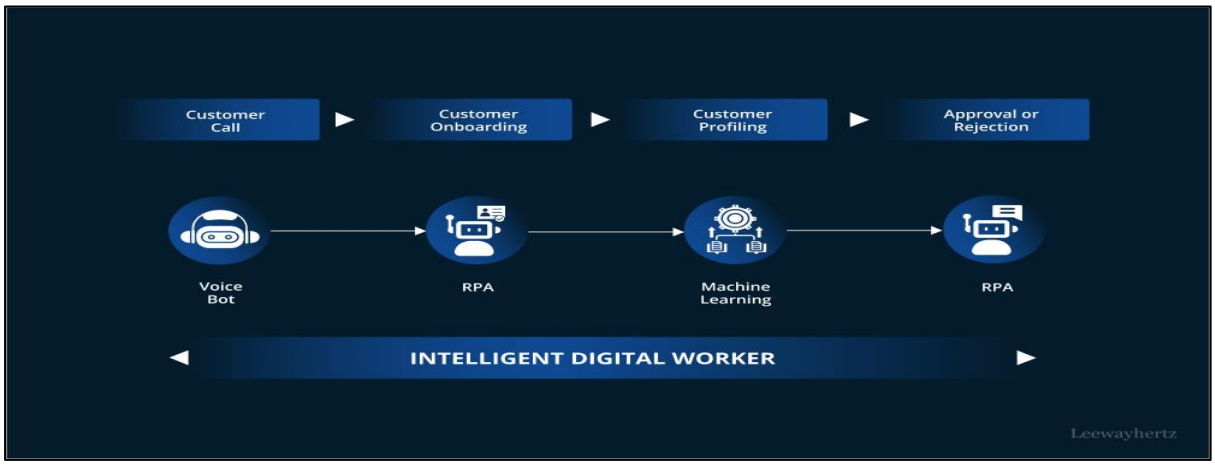

Figure 6: Business Process Automation

3.3 Implementation and Deployment

(Source: https://d3lkc3n5th01x7.cloudfront.net)

It states the Implementation and Deployment processes that are involved in specific automated solutions on big data environments and are considered to be very important. The initial plan and preparation process involves defining automation tools and development of deployment plans. The next step is integration with the current big data platforms like Hadoop or Spark that are used in the automation of solutions. This method requires additional adjustment of the automation tools in accordance to the platform's architectural settings and its data process. It also provides information that to actually implement and develop the system, constant observation provincially or at the server is required to analyze the risks and scarcities of the system (Oussous *et al.* 2018). It is beneficial in specific areas and parameters on the levels of resource consumption and the state of the subject system that are measured by automated monitoring tools, and objectives which are set with checklists. Such evaluations and changes help to keep efficiency and effectiveness and also prevents unnecessary resource allocation and high operational expenses.

4.0 Results

4.1 Impact of Automation on Resource Management

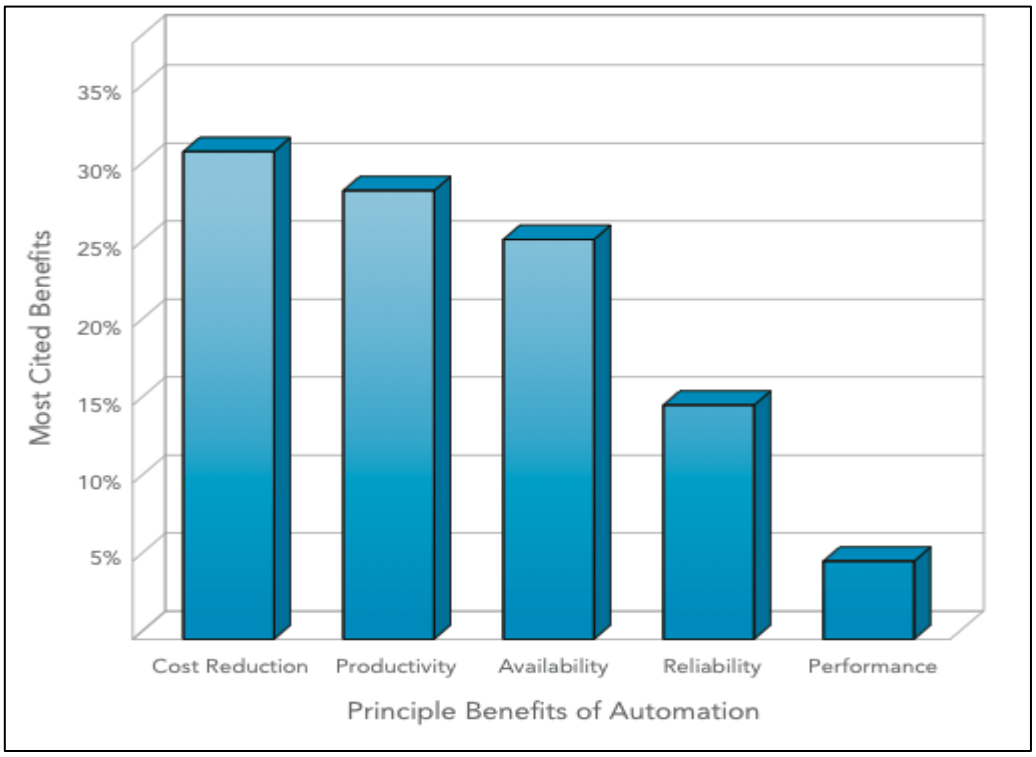

Figure 7: Impact of Automation on Resource Management

(Source: https://www.fortra.com)

The big data application of automation has impacted significantly on resource management. Due to the optimization of resource allocation and significant utilization, there are gains in efficiency. Real-time changes can also be made because of data analysis, which systematically eliminates constraints in the system. This results in management of resources and operations becoming more advanced as automated systems are capable of handling large volumes of data in a faster and less incorrect way as compared to manually managed systems. Another advantage of this approach is the reduction of expenses because there is no need for manual control (Kibria *et al.* 2018). The results reveal that although automated resource management systems may have a high up-front cost, it could return a high 'reduction in operating cost' by improving mean time between failure, decreasing labor costs

and increasing utilization of available resources. Organizations advance the modularity of the enterprise solution by more recent algorithm modernization, automated systems cost efficiency. All these advancements provide better administration of big data environments in the organizations, cutting costs, and boosting business outcomes.

4.2 Predictive Analytics for Resource Optimization

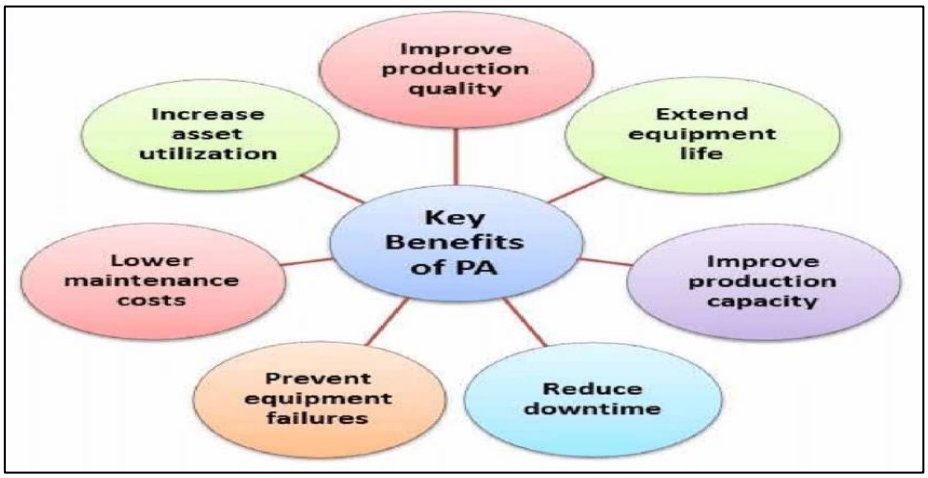

Figure 8: Benefits of Predictive Analytics for Resource Optimization

(Source: https://www.researchgate.net)

In the aspect of big data usage, predictive analytics is a vital tool for the management of resources since it has the qualities of revealing patterns in the utilization of data. These models involve analyzing historical data and current data in order to predict consumption patterns, shift in demand and future accumulations. In order to forecast the future needs of resources and fine-tune strategies of the distribution, both time series analysis and machine learning are employed. It can also suggest patterns of high usage that would help to allocate resources adequately to avoid system blockage. It also helps the businesses to make better future predictions by analyzing the trends in data consumption for better capacity planning and inventory management (Yaqoob *et al.* 2019). Through using predictive models, it may identify deviations and potential issues before it can cause an impact on performance. By applying this information, extensions can make better decisions in terms of allocation of resources, improving the operating efficiency and reducing costs. The usage of predictive analytics combined with resources management approaches, management of big data becomes more effective and less expensive.

4.3 Innovations in Automation Technologies

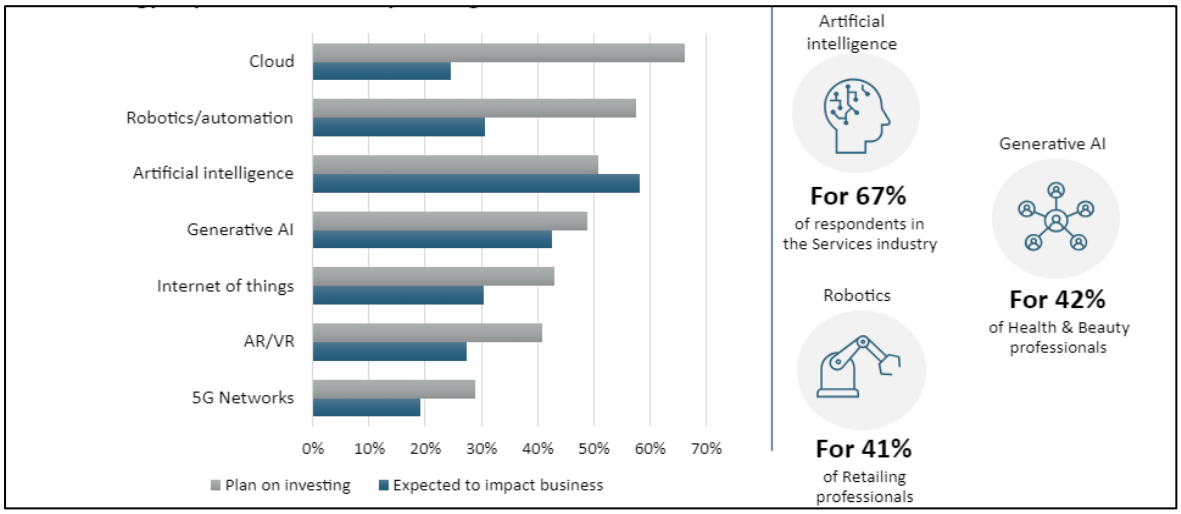

Figure 9: Innovations in Automation Technologies

(Source: https://www.euromonitor.com)

It states that in current scenarios there is a gradual enhancement in the area of advanced technologies where automation has recently received significant development in which resources are handled within big data environments. Technological innovations and strategies continue to enhance ways of automation in terms of both performance and reliability (Babar & Arif 2019). One significant area of development is, the development of strong orchestration tools such as Kubernetes that deal with containerized applications and make available resources more manageable. This supports the elasticity and Auto-Scaling that enhances the operational flexibility as well as flexibility of resource utilization. Tools like AutoML and adaptive algorithms provide the possibility to adjust and improve the model without the user's interference exponentially improving precision. The cloud-based automation solution presents a centralized and cost effective way to manage infrastructure to accommodate huge data platforms like Hadoop and Spark. The availability of advanced Artificial Intelligence enables interactive and smart interfaces. These technologies enhance the ability to process and analyze big data leading to newer breakthroughs in the estimation and decision-making systems. Such developments in technologies and strategies characterize the changes in the management of resources, which increases the performance and efficiency at lower costs.

5.0 Discussion

The results of automating big data have a revolutionary impact on resource management in terms of the obtained outcomes. The analysis of these outcomes proves that automation enhances operation effectiveness since such changes could be made depending on the data collected. It not only focuses on the significant resources efficiently but also minimizes errors and delay which in turn reduces the cost. The results for huge data operations are mixed and adequate, in this way the automated solutions make more flexible and efficient resource management that fits the organization's needs and can help tackle the challenges of dealing with large data environments. It is enhanced by predictive analytics as it provides valuable information concerning consumption patterns and more of potential issues improving on capacity and decision making. Automation provides advantage with regards to resource management when compared to more 'conventional' approaches (Mohamed *et al.* 2019). Automation adjusts resource usage in a manner that is optimal with the utilization of advanced algorithms and data that is in real time. This current strategy not only enhances the performance but also lowers the costs which are more valuable in the current data-oriented environment.

6.0 Future Directions

It states that it has become important to identify the future trends as automation technologies are getting advanced gradually and since the trends in big data resource management are likely to evolve in the future. New technologies such as quantum computing and edge computing are expected to revolutionize automation through offering significant computing and data processing capacity. It is expected that these developments will improve the capability to process large scale data environments. Future works might expand on creating better and more complex algorithms for machine learning to provide better predictive analytics and optimizations. There are improved systems incorporation of artificial intelligence in automation that may provide enhanced AI systems and can analyze on its own, it can adjust resource allocation as well. The studies regarding hybrid cloud systems and its role in automation may provide more information on more innovative and versatile infrastructure solutions. It should be noted that the constantly evolving trend of real-time data processing added to enhanced security measures will also be determining the future of cloud computing (Choi *et al.* 2018). As big data environments become even more demanding over time, it will remain significant towards regular integration and conduct research to adjust current challenges while at the same time develop a solution for future complications and opportunities.

7.0 Conclusion

In this research article it states that automation provides better resource management in big data environments. According to the main results, automation enhances the quality of operations and reduces errors while cutting most expenses by optimizing the use of resources and reducing time losses. Resource utilization is enhanced

through the application of PMS since necessary adjustments are done in advance when predictive analytics is being utilized. Organizations should prioritize automating business with complex business solutions and make sure that the current environment seamlessly interacts with the proposed solution and incorporate real-time data for decision making. Adopting these technologies leads towards increased cash flows and better performance. It means that constant research and adaptation will be necessary with the continuously shifting big data environments in order to achieve cost optimization and efficient distributions of resources.

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