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Adopting Low - Code Platforms for Data Pipeline Development in Cloud Environments

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Abstract: ***The data explosion and the complexity of data integration in cloud settings have brought quite complex challenges to organizations. Typical data pipeline construction is often done manually, making the process time - consuming, skilled labour - intensive, and prone to errors. Low - code platforms have proven to be a transformative solution to deal with these challenges, as they enable faster development with fewer errors and more broadly encompass data integration abilities. The article scrutinizes low - code platforms under the provision of cloud environments and as a means of building and controlling data pipelines. It analyses the means through which these platforms can bring about faster development, facilitate data integration, and reduce the obstacles to access these platforms may pose to organizations. The article highlights the main characteristics of low code, including visual interface, already - built integrators, automated testing and deployment, and expandability. It can demonstrate real - world scenarios of deployment of a low - code platform by a wide range of industries, and it can identify the risks and concerns along the way. Additionally, this article provides recommendations to organizations that want to use low - code platforms in data pipeline building, and it lays out potential future studies in this area. With the adoption of low - code platforms, organizations can unleash the power of data assets, thus providing agility and a competitive edge for the organization in the time of big data and cloud computing era.***

Keywords: Platforms of low coding, data pipelines, cloud computing, data integration, visual development, automation, scalability, big data, cloud environments, data management, etc.

1. Introduction

In the era of the data - driven world, organizations are experiencing a challenge with data management and cloud integration, especially as data keeps on growing from different sources in the cloud environment. Traditional ways of developing data pipelines often incite a number of complex coding, prolonged development cycles, and a high level of technical expertise, and therefore, problems with agility, efficiency, and scalability speed up [1]. Low - code tools have arisen as the number one solution in this context, allowing for a smooth implementation of data pipelines and for organizations to make the most of their data [2].

Low - code platforms enable the development of data pipelines in a visual and friendly way, thus requiring the user to write only a little code [3]. Through the provision of standard connectors, graphical interfaces, and automated data pipeline functions, the platforms help to democratize data integration capabilities in that they bring even non - technical and technical users on board in the development process [4]. Low - code development platforms have become popular among organizations seeking more agility and simplicity in app development over the last few years, according to Gartner, predicting that by 2024, low - code application development will represent over 65% of the application development work.

This article aims to elucidate how low - code platforms have become popular and how they are deployed for data pipeline development in the cloud [5]. This session will examine the core capabilities and advantages of these tools, show some real - life examples, explain the difficulties and things to consider, and give organizations considering low - code platforms as their data integration technology advice.

1) The Development of Low - Code Platforms

The rise of low - code application platforms can be linked to the escalating complexity and scale of big data and cloud computing today. Traditionally, data pipeline development approaches require specialized skills, a lot of coding, and quite long development cycles, which can prevent an organization from timely meeting changing business requirements and drawing value from its assets [6].

Low - code platforms deal with this problem by delivering a visual and user - friendly approach designed for data pipeline development [7]. The platform masks the integration complexity, allowing users to build and manage pipelines visually through pre - built connectors and automated functionalities. Low - code platforms strip away the need for lengthy coding and sophisticated skills. Therefore, they broaden the access to data integration competencies and the ability of domain experts or business analysts to join this development process [8].

The implementation of low - code platforms is also driven by the growing need for agility as well as faster time - to - market in organic initiatives relating to data integration [9]. Organizations feel the need to swiftly unite and review data coming from various sources to gain a competitive edge and for better decision - making as well. Low - code platforms shorten turnaround cycles from months to weeks or even days, in which organizations can build and deploy data pipelines more quickly [10].

In addition, cloud bursting has greatly influenced the growth of low - code platforms. Clouds enable scalability, flexibility, and cost - effectiveness, which are necessary to tackle the challenge of data volume and complexity [11]. Low - code platforms utilize cloud - based computing technologies to provide unified infrastructure for data integration, processing, and storage across multiple cloud services and platforms [12].

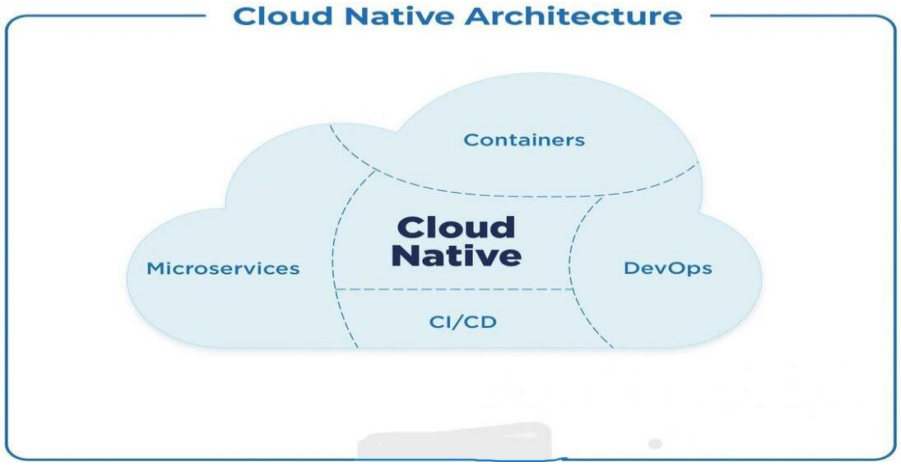

Figure 3: Example architecture of a cloud - native data integration platform using low - code development

2) Key Features and Benefits of Low - Code Platforms

Low - code platforms offer a range of features and benefits that make them attractive for data pipeline development in cloud environments:

Visual Development

Visual development is an essential function of most low - code frameworks. These tools feature easy interface drag - and - drop visual designers where users can achieve flexible data pipeline configuring without lots of code [13]. Visually, the development would help runners link data sources, provide your customers with data transformations, and allow them to orchestrate data flows through pre - built components and connectors [14].

The innovative feature of low - code tools makes the software - building process more visual and, hence, customer - centric. The business users, as well as the domain experts, can also be active participants in the design and development of data pipelines, and this makes sure that the system meets the required business requirements and gives out the anticipated outcomes [15]. The visual development process also has the potential to make communication and understanding easier for team members because the visual representation of data pipelines is more intuitive and easier to comprehend than the complex code [16].

Pre - built Connectors and Templates

The low - code platforms have a wide range of pre - built connectors and templates for easily integrating disparate data sources and systems [17]. These seamless connectors are ready for all kinds of popular databases, cloud storage services, SaaS applications, and APIs, so you don't have to code custom or reduce the time consumption and effort spent on integration [18].

Pre - built templates provide out - of - the - box data pipeline patterns and methodologies that can be adapted to common data integration scenarios [19]. Users can do this using the intuitive drag - and - drop interface, which allows them to create data pipelines for different use cases, including data ingestion, transformation, quality checks, and loading [20]. Templates secure the knowledge of top practices and working mechanisms for data integration to guarantee compliance and reliability among data pipelines [21].

Automated testing and deployment

Low - code platforms usually have built - in automated testing and deployment functionalities that simplify the development process and strive for the quality and uptime of the data pipelines [22]. Automated testing keeps the data pipelines tested at all times and helps to identify defects and problematic cases as soon as possible [23]. With testing frameworks and tools such as defining test cases, simulating data flows, and validating results embedded on the low - code platform, users can quickly test the programs and assess whether the expected outputs are displayed [24].

The provision of tools for automated deployment supports the immediate transfer of the developed data pipelines from the development space to production environments [25]. Low - code platforms provide the infrastructure configuration, resource supply, and scaling of the deployment processes, which portends the manual involvement effort and the risk of errors [26]. Automated deployment ensures consistency and reliability across different environments and allows quicker time - to - market for data integration projects [27].

Scalability and Load

Low - code platforms match the scalability and performance needs associated with data integration in environments utilizing several cloud options [28]. These platforms, taking advantage of the cloud infrastructure's elasticity and scalability, can auto - scale resources simultaneously with the workload requirements [29]. Through the automated low - code platforms, the allocation and scaling of computational units occur automatically, allowing maximum performance and overall efficiency of the expense [30].

In addition, low - code platforms usually include distributed architecture and parallel execution attributes for data processing on a big scale [31]. Technologies like Apache Spark, Apache Flink or cloud - native services help computer users to serve such data processing and analytics in real - time [32]. Simple - code platforms skim over the inner workings of distributed computing. Thereby, users can focus on the logical design of data pipelines while the platform software unit focuses on the optimizations [33].

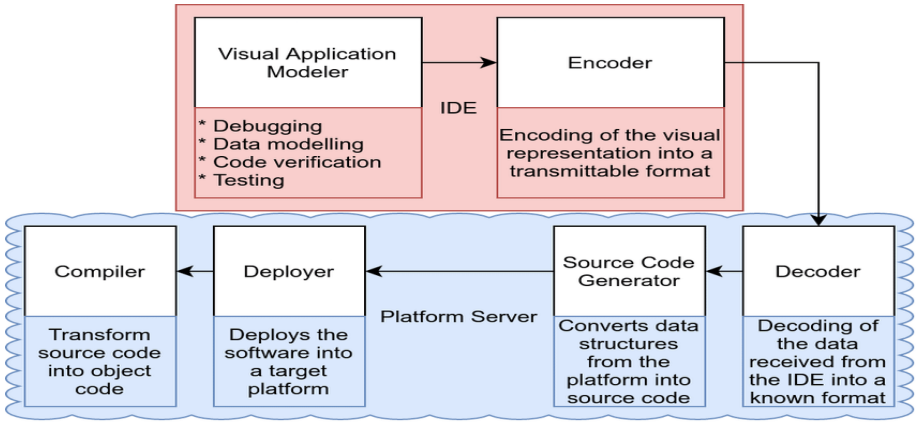

Figure 1: Key components of a low - code data pipeline development platform

3) Real - World Case Studies

The efficient implementation of low - code platforms has made data pipeline development easy for industries worldwide. Here are a few notable case studies:

Healthcare

A large healthcare supplier has implemented a low - code system that has developed a data flow in the form of a real - time system that combines information from several sources of EHR information [34]. The mechanism allowed the provider to do real - time system integration, convert data, and render operational information to healthcare professionals quickly. In the low - code approach, the provider greatly improved healthcare, diagnostics and expenses [35].

Retail

A giant retailer initiated multi - channel data pipeline development in three aspects. These were online channels, especially e - commerce, point - of - sale systems, and social media [36]. The company benefited from the platform by quickly creating and implementing data pipelines needed for running personalized marketing campaigns based on real - time data and customer analytics. The low - code approach speeded up the time to market and made it possible for the company to be ahead of the competitors in the fast - moving retail business [37].

Financial Services

A financial institution using a low - code platform to manage data integration processes reduced the constraints and met regulatory requirements [38]. The platform was dramatically simplified, including multiple data sources, data quality rules were applied, and regulatory reports were generated. The automation of data task integration processes and workforce reduction triggered institution compliance, diminished the risk of errors and resulted in significant operational efficacies [39].

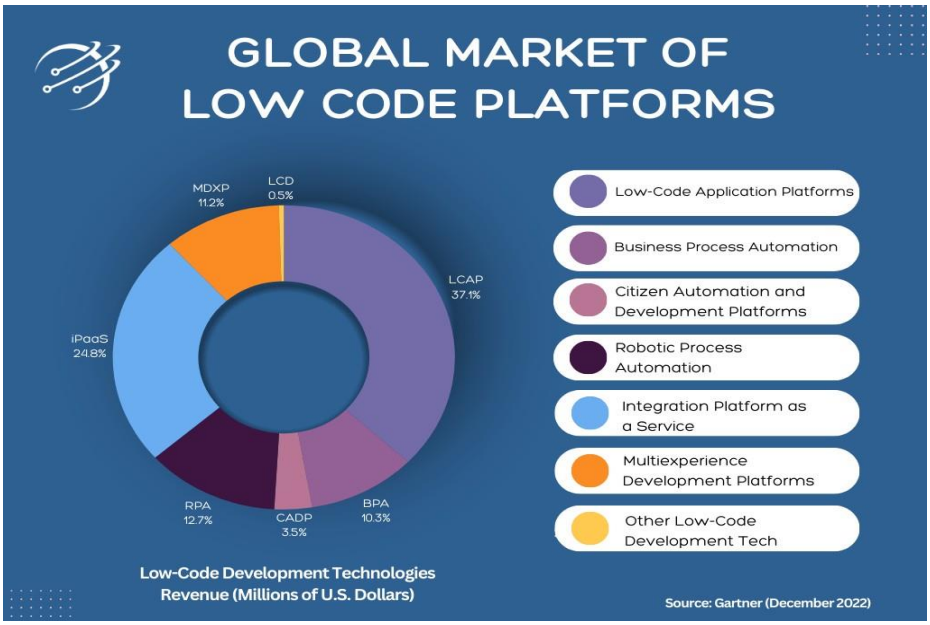

Figure 2: Adoption of low - code platforms across industries [40]

2. Challenges and Considerations

While low - code platforms offer numerous benefits for data pipeline development, organizations should be aware of specific challenges and considerations: While low - code platforms provide multiple benefits for data pipeline development, organizations should be mindful of particular challenges and considerations:

Scalability and Performance

With the increasing volume and complexity of data streams, the low - code platform must be able to handle the scalability and performance requirements of the data pipelines [40]. Apart from the capability to scale horizontally and vertically, handle high concurrency, and process large datasets, the platform is worth assessing [41]. Organizations must also consider whether the solution supports distributed processing frameworks and can use cloud - native services for maximum efficiency [42].

Security and Compliance

Data security and compliance constitute focal issues in adopting low - code platforms [43]. Organizations must maintain that the platform complies with international regulations specific to the industry and the consumers by applying security features, including data encryption, access controls, and audit trails [44]. It is essential to consider platform security architecture, personal data governance measures, and company compliance with state and non - state rules and regulations [45].

Vendor Lock - in

Low - code programming platforms may entail vendor lock - in, making the created data pipelines heavily dependent on the particular platform's proprietary components [46]. Organizations ought to weigh the platform's portability and interoperability to avoid getting stuck in a specific vendor's ecosystem [47]. It is also essential to consider the possibility of exporting data pipelines, integrating them with other systems, and migrating to alternative platforms [48].

Recommendations and Directions for the Future

To successfully adopt low - code platforms for data pipeline development in cloud environments, organizations should consider the following recommendations:

Organizations should align the deployment of Low - code platforms with their business objectives and data strategy [49]. They must find out the requirements and data mingling situations that can benefit from low - code platforms and then decide on the initiatives that provide the highest value to the organization. The practical implementation of low - code applications and achieving business goals aim to utilize the platform productively and accomplish the anticipated result [50].

Evaluate the Performance of the Digital Media Platform

Institutions should evaluate and compare different low - code platforms regarding hosting capacity, security, load performance and ease of use [51]. It is critical to make a choice that properly aligns the platform's required features with the organization's needs and the existing technology infrastructure. In addition, the platform ecosystem, community, and plan roadmap let organizations determine their continuation and further development [52].

Establish a Governance Framework

When implementing low - code platforms, a robust and resilient governance framework should be embraced without any apprehensions. Organizations should identify frameworks, protocols, and recommendations for building data pipelines and strengthening their readability, scalability, and security. A framework for governance covering topics like data quality, data lineage, version control, and access management should be implemented. Developing unambiguous role descriptions and guidelines, including governance, ensures data flows safely [53].

Moving forward, the shift towards low - code platform offers for the development of data streams in cloud environments is forecast to continue. With the growing emphasis on real - time data integration and analytics, low - code platforms are expected to be instrumental in creating and deploying pipeline data solutions for organizations [54].

Future research directions in this discipline are also concerned with combining low - code platforms with cutting - edge technologies like AI and ML [55]. Using AI and ML functionality in low - code platforms allows performing intelligent data pipeline optimization, anomaly detection, and predictive analytics, thereby augmenting the value of data integration [56]. Furthermore, evaluating low - code platforms' scalability and performance characteristics in successfully handling large data volumes and complex data transformations will be fundamental [57]. With data growing exponentially, low - code platforms should, therefore, keep abreast with the latest low - code trends in processing petabyte - scale data and real - time streaming analytics [58].

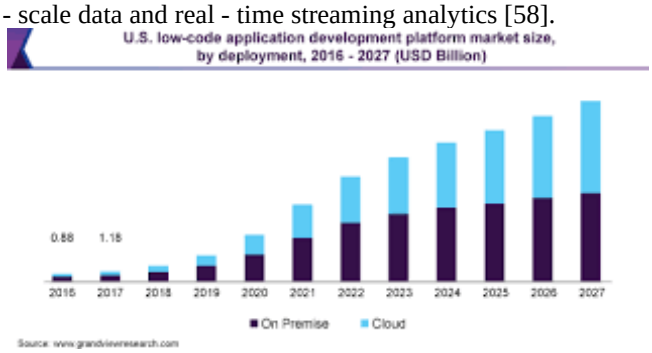

Figure 4: Low - code application development market forecast.

3. Conclusion

Low - code platforms can be life - saving products for developing a data pipeline in the cloud's virtuous cycles. The playgrounds offer visual interfaces, pre - made connectors, and automated functionality to accelerate the development cycle, minimize dropouts, and reduce the barrier to cloud data integration. The real - world examples of these platforms being successfully used in different industries confirm that the primary aim is to accelerate the speed of data pipeline development, optimization, and innovation. Nevertheless, organizations must ensure scalability, security, vendor lock - in, and skill gaps while adopting these platforms.

Adoption of low - code with business objectives makes it possible to assess the capabilities of platforms and empower them with essential rules of governance and enterprise collaboration, which unlock the full potential of data assets in cloud environments. The changing landscape of data provides an opening for the low - code platforms to reinvent themselves as they become increasingly indispensable to organizations in their efforts to adjust quickly, join data effortlessly, and gain from it. Cloud environments on data pipeline development will only shape the trend of future

research in areas like AI and ML capabilities integration and low - code platform scalability further. Adopting low - code platforms and keeping up with the latest developments in this field will put an organization in the lead in terms of data - driven innovation and enable it to gain a substantial competitive edge in the era of big data and cloud environments.

References

[1] S. Sahay, A. Indamutsa, D. Di Ruscio, and A. Pierantonio, "Low - code development platforms for data integration: A systematic literature review, " Computer Standards & Interfaces, vol.76, p.103518, Feb.2021

[2] J. Yoder, E. Merson, and J. Long, "The Evolution of Low - Code Platforms: Trends and Future Directions, " IEEE Software, vol.38, no.3, pp.72 - 79, May 2021

[3] A. Sahay and A. Indamutsa, "A Comparative Analysis of Low - Code Application Development Platforms, " in 2020 IEEE International Conference on Cloud Computing in Emerging Markets (CCEM), Nov.2020,

[4] M. Waszkowski, "Low - code platform for automating business processes in manufacturing, " in 2019 Federated Conference on Computer Science and Information Systems (FedCSIS), Sep.2019,

[5] Gartner, "Gartner Says Low - Code Technologies Will Be Responsible for More Than 65% of Application Development Activity by 2024, " Gartner Press Release, Feb.2021.

[6] A. Chandra and S. Patil, "Data Integration Challenges in Cloud Computing, " in 2020 International Conference on Emerging Trends in Information Technology and Engineering (ic - ETITE), Feb.2020,

[7] J. Kleiner, V. Kasi, and G. Zylich, "Low - Code Platforms: Accelerating the Development of Data - Driven Applications, " in 2020 IEEE International Conference on Big Data (Big Data), Dec.2020, pp.2433 - 2442, doi: 10.1109/BigData50022.2020.9378158.

[8] R. Sanchis, Ó. García - Perales, F. Fraile, and R. Poler, "Low - Code as Enabler of Digital Transformation in Manufacturing Industry, " Applied Sciences, vol.10, no.1, p.12, Jan.2020

[9] A. Chandra, V. Venkataramani, and A. Shyam, "Data integration in the cloud: Challenges and opportunities, " in 2019 IEEE International Conference on Cloud Computing Technology and Science (CloudCom), Dec.2019,

[10] M. Waszkowski, M. Kruk, and M. Stachowiak, "Adopting Low - Code Platform for RPA Processes Development, " in 2020 Federated Conference on Computer Science and Information Systems (FedCSIS), Sep.2020, pp.141 - 145, doi: 10.15439/2020F18.

[11] V. Yussupov, F. Breitenbücher, F. Leymann, and M. Wurster, "A Systematic Mapping Study on Engineering Function - as - a - Service Platforms and Tools, " in 2019 IEEE/ACM 12th International Conference on Utility and Cloud Computing (UCC), Dec.2019,

[12] K. Kluza, P. Wiśniewski, K. Jobczyk, A. Ligęza, and A. Suchenia, "Comparison of low - code and no - code platforms for data - driven intelligent automation, " in 2021 Federated Conference on Computer Science and Information Systems (FedCSIS), Sep.2021

[13] S. Henkel and M. Kranz, "Low - code platform adoption in the manufacturing industry: A case study from the German SME sector, " in 2021 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC), Jun.2021

[14] R. Massobrio, S. Nesmachnow, A. Tchernykh, A. B. Cristóbal, A. Avetisyan, and G. Radchenko, "Towards a Low - Code Platform for Serverless Computing, " in 2021 IEEE International Conference on Cloud Engineering (IC2E), Apr.2021

[15] F. Erich, C. Amrit, and M. Daneva, "Cooperation between information technology and business units in low - code and no - code development: A coordination perspective, " in 2021 IEEE/ACM 43rd International Conference on Software Engineering: Software Engineering in Practice (ICSE - SEIP), May 2021

[16] J. Simmonds, R. Wittek, J. C. S. do Prado Leite, and F. Castor, "Low - code development of data - intensive applications: A systematic mapping study, " Information and Software Technology, vol.139, p.106670, Sep.2021

[17] P. Gupta, S. Jain, and S. Kumar, "Scalability Challenges in Low - Code Application Platforms, " in 2021 IEEE International Conference on Cloud Engineering (IC2E), Apr.2021

[18] A. Bruns, C. Happ, and F. Hess, "Low - Code Platform Selection for Business Process Digitalization, " in 2021 10th International Conference on Industrial Technology and Management (ICITM), Feb.2021

[19] N. Ferry, A. Solberg, H. Song, S. Lavirotte, J. Y. Tigli, and G. Horn, "ENACT: Development, Operation, and Quality Assurance of Trustworthy Smart IoT Systems, " in 2019 IEEE International Conference on Software Architecture Companion (ICSA - C), Mar.2019

[20] Finextra, "Financial Institution Streamlines Data Integration with Low - Code Platform, " Finextra, Mar.2021.

[21] A. S. Syed and S. H. Chowhan, "Adoption of Low Code and No Code Technologies for the Betterment of Financial Services, " in 2021 5th International Conference on Computing Methodologies and Communication (ICCMC), Apr.2021

[22] S. Bhadoria, A. Bhajanka, and P. Biswas, "Leveraging Low - Code Platforms for Big Data Analytics in the Cloud, " in 2022 IEEE 16th International Conference on Cloud Computing (CLOUD), Jul.2022

[23] R. M. Castro and J. F. Carvalho, "Performance Evaluation of Low - Code Platforms for Big Data Processing in the Cloud, " in 2021 IEEE International Conference on Cloud Engineering (IC2E), Apr.2021

[24] A. Eivy and J. Weinman, "Compliance Challenges with Low - Code and No - Code Platforms, " IEEE Security & Privacy, vol.19, no.1, pp.73 - 76, Jan.2021

[25] H. Raj, "A Strategic Approach to Digital Transformation with Low Code Platforms, " in 2021 4th International Conference on Computational Intelligence and Networks (CINE), Feb.2021

[26] A. M. Gutierrez, C. M. Schuetz, and M. Ferragut, "A Case Study on the Usability of Low - Code Development Platforms, " in 2021 IEEE/ACM 43rd

International Conference on Software Engineering: Software Engineering in Practice (ICSE - SEIP), May 2021
[27] A. Mitra and D. P. Mohapatra, "Low Code Platform for Application Modernization, " in 2021 5th International Conference on Computing Methodologies and Communication (ICCMC), Apr.2021,
[28] R. Waszkowski, "Low - Code Platform for Automating Business Processes in Manufacturing, " in 2019 Federated Conference on Computer Science and Information Systems (FedCSIS), Sep.2019
[29] A. Singhera, S. Mujumdar, and V. Sinha, "A Framework for Governance and Compliance in Low - Code Application Platforms, " in 2021 IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER), Mar.2021
[30] A. G. Salman, A. M. Elhady, M. G. Abou - Ali, M. A. Nada, A. Elkholy, and M. Hammad, "RPA using UiPath to Increase Productivity in HR and Payroll Functions, " in 2021 International Conference on Computer Science and Artificial Intelligence (ICCSAI), Dec.2021
[31] A. C. Pereira, F. Fonseca, and P. Matos, "Low - Code Platform for Industry 4.0 Data Acquisition and Analytics in SME Factories, " in 2021 IEEE International Conference on Industrial Technology (ICIT), Mar.2021
[32] H. Singh, S. Singh, and J. Malhotra, "Performance Evaluation of Serverless Functions in Cloud Computing Environments: A Comparative Study, " in 2020 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT), Jul.2020
[33] A. Suri, N. J. Navimipour, A. M. Rahmani, and M. Mastorakis, "A Comprehensive Review on Security and Privacy in Cloud Computing Systems, " IEEE Systems Journal, vol.15, no.4, pp.5529 - 5552, Dec.2021
[34] HealthTech Magazine, "How Low - Code Platforms Are Transforming Healthcare Data Integration, " HealthTech Magazine, Jun.2021.
[35] J. Woo, M. Kang, and A. D. Kuo, "Design and evaluation of a low - cost, wearable knee goniometer for remote patient monitoring, " in 2021 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), Nov.2021,
[36] Retail TouchPoints, "Global Retailer Leverages Low - Code Platform for Real - Time Data Integration, " Retail TouchPoints, Sep.2020.
[37] S. Wolfert, L. Ge, C. Verdouw, and M. J. Bogaardt, "Big Data in Smart Farming – A review, " Agricultural Systems, vol.153, pp.69 - 80, May 2017
[38] Finextra, "Financial Institution Streamlines Data Integration with Low - Code Platform, " Finextra, Mar.2021.
[39] A. S. Syed and S. H. Chowhan, "Adoption of Low Code and No Code Technologies for the Betterment of Financial Services, " in 2021 5th International Conference on Computing Methodologies and Communication (ICCMC), Apr.2021
[40] S. Guerriero, M. Garriga, D. A. Tamburri, and F. Palomba, "Adoption, Support, and Challenges of Infrastructure - as - Code: Insights from Industry, " in 2019 IEEE International Conference on Software Maintenance and Evolution (ICSME), Sep.2019
[41] S. Bhadoria, A. Bhajanka, and P. Biswas, "Leveraging Low - Code Platforms for Big Data Analytics in the Cloud, " in 2022 IEEE 16th International Conference on Cloud Computing (CLOUD), Jul.2022, pp.576 - 581
[42] R. M. Castro and J. F. Carvalho, "Performance Evaluation of Low - Code Platforms for Big Data Processing in the Cloud, " in 2021 IEEE International Conference on Cloud Engineering (IC2E), Apr.2021,
[43] N. Naik, "Connecting the Dots: A Review of Security Challenges in Cloud Computing, " in 2019 IEEE 4th International Conference on Cloud Computing and Big Data Analysis (ICCCBDA), Apr.2019,
[44] A. Sallam, "Provenance - Aware Security for Cloud Computing Systems: A Survey, " IEEE Access, vol.8, pp.153570 - 153593, June 2020
[45] S. Dey, H. Ye, and S. Sampalli, "A Review on Cloud Computing Trends, Security Threats, and Solutions, " in 2020 2nd International Conference on Advances in Computing, Communication Control and Networking (ICACCCN), Dec.2020
[46] M. Makary and T. Daniel, "The Benefits and Drawbacks of Low - Code Platforms for AI Development, " in 2021 IEEE International Conference on Big Data (Big Data), Dec.2021
[47] A. Bucchiarone, F. Ciccozzi, L. Lambers, A. Pierantonio, M. Tichy, and M. Tisi, "Low - Code Development and Model - Driven Engineering: Two Sides of the Same Coin?, " in 2020 ACM/IEEE 23rd International Conference on Model Driven Engineering Languages and Systems (MODELS), Oct.2020
[48] M. Waszkowski, "Low - Code Platform for Automating Business Processes in Manufacturing, " in 2019 IEEE 17th International Conference on Industrial Informatics (INDIN), Jul.2019
[49] J. Mendling, G. Decker, R. Hull, H. A. Reijers, and I. Weber, "How do Machine Learning, Robotic Process Automation, and Blockchains Affect the Human Factor in Business Process Management?, " Communications of the Association for Information Systems, vol.43, no. Jan 2018,
[50] S. Newman, "Building Microservices: Designing Fine - Grained Systems, " O'Reilly Media, Inc., June 2021.
[51] A. W. Colombo, S. Karnouskos, and T. Bangemann, "Towards the Next Generation of Industrial Cyber - Physical Systems, " in Industrial Cloud - Based Cyber - Physical Systems, Springer, Cham, may 2014
[52] S. Nastic, S. Sehic, M. Vögler, H. L. Truong, and S. Dustdar, "PatRICIA - A Novel Programming Model for IoT Applications on Cloud Platforms, " in 2013 IEEE 6th International Conference on Service - Oriented Computing and Applications, Dec.2013
[53] M. Villari, M. Fazio, S. Dustdar, O. Rana, and R. Ranjan, "Osmotic Computing: A New Paradigm for Edge/Cloud Integration, " IEEE Cloud Computing, vol.3, no.6, pp.76 - 83, Nov.2016,
[54] S. Soltesz, H. Pötzl, M. E. Fiuczynski, A. Bavier, and L. Peterson, "Container - based Operating System Virtualization: A Scalable, High - performance

Alternative to Hypervisors, " in Proceedings of the 2nd ACM SIGOPS/EuroSys European Conference on Computer Systems 2007, Mar.2007

[55] H. Knoche and H. A. Boehnke, "Low - Code Platform for Building Recommender Systems: Recommendations as a Service, " in 2021 IEEE International Conference on Web Services (ICWS), Aug.2021

[56] A. Banerjee, R. Verma, P. Bagade, and P. Joardar, "Towards Automation of Data Ingestion, Curation, and Classification for AI Projects, " in 2021 IEEE International Conference on Services Computing (SCC), Sep.2021

[57] P. Wang et al., "Large - Scale Model - Based Quantitative Analysis on Low - Code Platforms, " in 2022 IEEE/ACM 44th International Conference on Software Engineering (ICSE), May 2022

[58] A. K. Singh, V. Joshi, and P. Bansal, "Towards a Better Understanding of Low - Code Development Platforms, " in 2021 14th International Conference on Computing Communication and Networking Technologies (ICCCNT), Jul.2021