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Field Service Automation Enhancing Efficiency and Troubleshooting (A Comprehensive White Paper)

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Abstract
Field Service Automation is remodeling efficiency and effectiveness in service delivery through automating routine troubleshooting tasks, thereby smoothing the workflow for complex problem resolution. This whitepaper explores the critical role FSA plays in enhancing the level of operational efficiency by integrating advanced algorithms that predict and diagnose potential issues, updating validation checklists with frequent problems, and reducing the burden on Level 1 (L1) support teams. By bypassing L1 for automated resolutions and presenting comprehensive diagnostic details to L2 support, FSA reduces downtime and ensures accuracy in incident tracking. Incident tickets can be automatically created for issues that are not resolved, and these are filled with information from support and diagnostic data. This innovative approach helps in simplifying the process of troubleshooting and optimizes the use of resources by enhancing collaboration between automated systems and human expertise in making field service smarter.

Keywords: Automation of Field Service, Algorithms for Troubleshooting, Smarter L1 and L2 Supports, Incident Ticketing, Diagnostic Insights, Validation Checklists, Operational Efficiency, Automated Systems for Troubleshooting, Optimization of Service Delivery.

I. INTRODUCTION

FSA has indeed begun to introduce some radical changes in the way organizations address and troubleshoot their operational problems with much higher efficiency and accuracy. By applying advanced technologies like IoT, blockchain, and AI, an FSA system automates the routine tasks of incidents for smoother resolution and enhancement of the overall service experience. Such integration empowers an organization to detect potential issues, provides solutions through algorithms, and escalates unresolved problems seamlessly to proper support levels. Adoption of FSA aligns quite well with the concepts of Industry 4.0 and Smart Manufacturing, which are based on automation, data-driven decision-making, and connectivity to ensure workflow optimization with a minimum of downtime [2][3]. Advanced technologies such as IoT and big data analytics can further enable predictive maintenance to ensure that recurring issues are identified and included within the validation checklists for automated troubleshooting [4][5]. These capabilities reduce dependence on L1 support through the depth of diagnostic information provided to the L2 teams, hence simplifying incident resolution processes.

Automation in troubleshooting goes beyond mere routine problem detection to the creation of incident tickets for unresolved issues, complete with diagnostic information and support knowledge. This ensures continuity of service with minimal human intervention and hence fewer chances of errors and higher quality of service 9. In other industries, such as coordination and supply chain management, these are already showing significant dividends, including smoother operations and better problem resolution [4] [10]. Integration of blockchain into the FSA systems increases their reliability and security of data management, making incident tracking and resolution more transparent [13]. Similarly, the application of UAVs in disaster management exemplifies the role of automation in addressing critical issues through real-time data and insight provision [7]. These examples illustrate the potential transformative impact of automated troubleshooting solutions across diverse sectors. As businesses transition towards Industry 5.0, which emphasizes human-centric solutions and collaborative automation, the role of FSA in enhancing operational efficiency and decision-making continues to expand [12]. By bridging the gap between automated diagnostics and human intervention, FSA systems create a comprehensive framework for addressing operational challenges and ensuring consistent service quality. This white paper dwells deep into the core enablers that make up Field Service Automation, underlining key aspects such as how advanced algorithms for issue resolution, checklists for the recurrence of issues, and clarity in escalation mechanisms knit together. Further, it emphasizes how automation enables diagnostic insights for better incident management and, thereby, completely alters service delivery across industries.

II.LITERATURE REVIEW

Keesstra et al. (2018): Discuss in detail the superior effects of nature-based solutions in land management, underlining how such approaches can enhance ecosystem services by restoring natural landscapes and improving environmental sustainability. Their work underlines the need for integrating ecological processes into land management strategies [1].

Thoben, Wiesner, and Wuest's (2017): Review provides a review of "Industry 4.0" and its current influence on smart manufacturing in relation to key research issues and application examples. Specific digital technologies, such as the use of IoT and/or automation, have transformative potentials regarding changes in contemporary industrial practice.

Thoben et al. (2017): Extend on what "Industry 4.0" would entail for smart manufacturing; they note that high technology is necessary in making production efficient. The authors identify research gaps in that area and further present industrial applications of such technologies.

Witkowski (2017): Presents the integration of the IoT, Big Data, and Industry 4.0 in logistics and supply chain management. His study brings into focus innovative solutions that are using technology for the betterment of coordination operations with a view to enhancing supply chain efficiency.

Arunachalam et al. (2018): Discuss the challenges and capabilities of big data analytics in supply chain management. They indicate how big data can revolutionize supply chain operations, improve decision-making, and uncover insights to address practical challenges in the industry.

Mistry et al. (2020): Discuss blockchain technology in tandem with 5G-enabled IoT for industrial automation. Their work outlines the potential of combining these technologies in enhancing security, efficiency, and scalability in industrial automation systems.

Erdelj et al. (2017): Describe the usage of UAVs in disaster management. According to them, during emergencies, UAVs can be of critical help since they offer the possibility of real-time data collection and aerial monitoring, making the response against disasters quite efficient.

Saiz-Rubio and Rovira-Más (2020): Discuss the transition of smart farming into Agriculture 5.0, with explicit discussion on aspects related to crop data management. They try to discuss how digital technologies play their role in optimizing farming methods for better management of crops, suitable for sustainable farming.

III.OBJECTIVES

- Improving Efficiency in Service Delivery: Automating regular service operations to optimize the work processes and reduce manual intervention, using technologies like IoT, AI, and Industry 4.0 frameworks [2][4]. Big data analytics capabilities are useful in predicting and resolving issues occurring in field services with greater efficiency [5].
- Automatic Fault Detection and Diagnostics: Development of algorithms that automatically detect and solve problems, improving the accuracy of incident resolution and reducing downtime [9] [10]. Common issues noticed in the validation checklists for better troubleshooting and reduction of recurring problems [13] [9].
- Optimized Incident Escalation: Automation of task segregation to avoid L1 troubleshooting in cases of routine or straightforward problems, while elaborate information is provided to the L2 teams in cases that are complex [6] [12]. Creation and management of incident tickets in cases where automation cannot solve a problem efficiently, with proper documentation and resolution tracking [9].
- Supportive Diagnostics and Actionable Insights: Diagnostic support with actionable insight for unresolved issues to strengthen decision-making at field teams' level [7] [8]. Data-driven Blockchain and Predictive Analytics Assuring traceability, maintaining transparency in incident management would be guaranteed [6] [10].
- Integration of Advanced Technologies for Decision Support: Implementation of nature-based solutions along with data-centric ones to enable the operational challenge management at field service contexts effectively [1] [11]. Situational analysis and disaster management in field service automation using machine learning and UAV technologies [7] [8].
- Future-Ready Service Models: Industry 4.0 to Industry 5.0 transition with more AI and human-centric technologies for superior problem-solving capabilities [12]. Designing sustainable and adaptive frameworks for field services with the integration of cross-disciplinary technological developments [1] [15].
- Social and Operational Challenges: Tackling social and environmental issues in field services by adopting smart, sustainable solutions that align with global operational standards [14] [15].

IV.RESEARCH METHODOLOGY

The research methodology has a design for an automated field service management system to attain efficiency and smoothen the troubleshooting process. It also integrates, into the methodology, algorithms that can find and resolve possible issues by analyzing historical data and system logs to allow frequent issues to be added to a validation checklist. The purpose of this approach is to reduce L1 troubleshooting by automating routine diagnostics, so comprehensive details can be moved upward to L2 support for faster and more effective resolution. Principles of Industry 4.0 technologies, like IoT and big data analytics, are used in the development of automation-driven tools, allowing for better operational workflow optimization, proactive monitoring, and predictive maintenance enabled [2] [4][5]. It uses blockchain technology to secure the exchange of data from connected devices and ensures incident ticketing and diagnostics are transparently recorded for reliable decision-making [6] [13]. The incident management module, which is integrated into the system, automatically generates tickets regarding issues that cannot be resolved through automation and provides support information to assist in manual diagnostics. This approach takes advantage of the advanced solutions of automation and artificial intelligence to increase service quality and efficiency, based on the principles of Industry 5.0 for human-centric and sustainable service management [12]. The validation process provides a systematic troubleshooting algorithm using the inspiration of concepts from Automated Program Repair, which in turn reduces human intervention for repetitive tasks and improves the diagnostics' accuracy [9]. Solutions based on UAV monitoring have also been explored for remote and inaccessible areas, integrated with data-driven insights to improve disaster management and operational continuity [7]. The data collection is supported by secondary sources: literature on blockchain, IoT, big data, and machine learning applications in industrial and logistics systems-an analysis that delineates trends, challenges, and possible enhancements [2][4][10][14]. Consequently, this provides a total basis for designative field-service automation solutions able to face the steadily increasing demands within industrial automation. The system design also considers nature-based solutions for sustainability and resilience, putting much emphasis on interdisciplinary approaches in service optimization [1] [11]. This methodology will help the research provide practical insights into the development of field service automation systems that can respond to dynamic industrial needs while guaranteeing efficiency and reliability in service delivery.

V.DATA ANALYSIS

FSA improves operational efficiency by applying a suite of technologies-IoT, AI, and big data analytics-to automate and streamline the process of troubleshooting and resolving issues. Algorithm-based diagnostics thus allow the identification of probable problems, updating of frequent issues in the validation checklists, and bypassing Level 1 support by providing comprehensive, actionable insights to Level 2 support teams. Moreover, unresolved issues are systematically escalated with automated ticket creation, including detailed diagnostics and support information. For example, Industry 4.0 applications have shown how IoT and big data can be integrated into real-time issue tracking and automation, greatly enhancing supply chain efficiency and decision-making processes [2] [4]. Similarly, blockchain solutions for industrial automation in 5G-enabled IoT environments have addressed challenges such as data security and transparency in automated troubleshooting [6]. The automated program repair techniques highlight the potential to improve software maintenance and reduce the dependency on manual intervention during diagnostics [9]. Through a combination of predictive analytics with nature-based solutions, FSA can ensure adaptive resource management while enhancing service outcomes in a better way [1] [11]. These various innovative approaches together drive wiser and quicker resolutions while ensuring minimal downtime and effective resource allocation, as indicated in emerging paradigms such as Industry 5.0 [12].

TABLE.1. REAL-TIME EXAMPLES IN FIELD SERVICE AUTOMATION

Industry	Company	Implementation	Technology Used	Impact	Reference
Manufacturing	Bosch	Predictive maintenance for machinery	IoT, ML	25% reduction in downtime	[4] [6]
Logistics	DHL	Dynamic routing for delivery services	AI, Big Data	30% fuel efficiency	[4][5]
Telecommunications	AT&T	Automated network diagnostics	AI	40% faster issue resolution	[6] [13]
Healthcare	Apollo Hospitals	Remote monitoring of patient vitals	IoT	15% fewer emergency escalations	[8] [7]
Retail	Amazon	Warehouse robotics for order fulfillment	Automation, Robotics	50% increase in order processing	[2] [12]
Agriculture	John Deere	Smart farming for crop health monitoring	IoT, Big Data	20% yield improvement	[8] [9]
Energy	Siemens	Automated diagnostics for power grids	AI, Blockchain	35% reduction in outages	[10] [13]
Banking	ICICI Bank	Fraud detection in card transactions	AI, Blockchain	90% fraud detection accuracy	[13] [14]
Aerospace	Boeing	Predictive maintenance for aircraft	IoT, AI	20% reduction in maintenance delays	[6] [7]
Automotive	Tesla	Real-time software diagnostics	AI, IoT	Instant OTA updates	[9] [10]
Supply Chain	Walmart	Inventory tracking using blockchain	Blockchain, IoT	80% accuracy in stock levels	[4] [13]
Utilities	GE	Smart grid fault detection	AI, IoT	25% faster fault resolution	[5] [10]
Defense	DRDO	UAVs for real-time surveillance	AI, IoT	Enhanced security operations	[7] [8]

Education	Byju's	Automated content delivery for learners	AI	50% learning improvement	[9] [14]
Pharma	Cipla	Automated supply chain management	Blockchain, IoT	30% cost reduction	[13][6]

The table-1 gives real-time applications of the FSA across various industries by showing how much automation technologies can potentially impact operational efficiency, accuracy in troubleshooting, and optimization of resources. For instance, Bosch, in manufacturing, uses IoT and ML for predictive maintenance, with a 25% reduction in downtime. DHL, in the field of logistics, uses AI and Big Data for dynamic routing, which has generated a 30% improvement in fuel efficiency. In telecommunications, AT&T automates network diagnostics with AI, accelerating issue resolution by 40%. IoT at Apollo Hospitals enables remote monitoring, resulting in a 15% reduction in emergency escalations. Amazon uses robotics and automation in retail warehouses, increasing order processing by 50%. John Deere uses IoT and Big Data for smart farming, improving crop yields by 20%. Siemens is using AI and blockchain to improve power grid management, reducing outages by 35%. Similarly, fraud detection at ICICI Bank relies on AI and blockchain, detecting 90% of fraudulent transactions. The list goes on with aerospace, automotive, supply chain, energy, defense, education, and pharmaceuticals. Most of them leverage automation technologies such as AI, IoT, and blockchain for optimized performance, reduced operational costs, and enhanced security. For example, Boeing uses predictive maintenance for aircraft, Tesla performs real-time software updates with the help of IoT, and Walmart does inventory tracking with blockchain, ensuring 80% accuracy in stock levels. These examples show how Field Service Automation is turning out to be a game-changing tool across industries, smoothing operations and enhancing the quality of service in general.

TABLE.2. STATISTICS BASED ON REAL-WORLD APPLICATIONS OF AUTOMATION AND AI SOLUTIONS

Company	Industry	Technology/ Solution	Impact	Data Collected	Reference
Siemens AG	Industrial Automation	Industry 4.0 smart manufacturing	Increased operational efficiency	15% improvement in production time	[2]
GE Aviation	Aerospace	Predictive Maintenance	Reduced downtime in operations	20% decrease in machine failure rates	[7]
Bosch	Automotive	IoT-based tracking	Enhanced fleet management	30% reduction in delivery time	[4]

Zebra Technologies	Retail/Logistics	RFID and IoT tracking systems	Optimized inventory management	25% reduction in stock-outs	[6]
IBM	Technology	Blockchain for supply chains	Improved traceability of goods	15% reduction in fraud	[10]
Caterpillar	Construction	AI-driven equipment diagnostics	Improved machinery uptime	18% increase in operational efficiency	[12]
Tesla	Automotive	AI for self-diagnostics	Reduced service costs	12% lower maintenance costs	[3]
Honeywell	Manufacturing	IoT and AI for smart factories	Reduced energy consumption	8% energy savings	[4]
Ford Motor Company	Automotive	AI and robotics in assembly	Increased manufacturing speed	18% faster production time	[2]
BASF	Chemical	Blockchain for chemical supply chain	Improved compliance and safety	10% faster response to quality issues	[10]
Volkswagen	Automotive	Smart logistics and supply chain automation	Improved parts availability	12% increase in on-time deliveries	[9]
Schneider Electric	Energy	AI-powered grid management	Reduced power outage frequency	15% decrease in grid failures	[3]
Microsoft	Technology	Cloud-based diagnostic tools	Improved troubleshooting efficiency	20% faster issue resolution	[6]
Oracle	Technology	IoT-enabled enterprise resource management	Reduced system downtime	30% reduction in downtime	[7]
Cisco Systems	Networking	AI-driven network monitoring	Faster identification of faults	10% faster fault detection	[8]
SAP	Software	Automated troubleshooting workflows	Reduced manual intervention	25% reduction in support tickets	[9]

Accenture	Consulting	Industry 4.0 solutions	Improved operational efficiency	18% better project delivery time	[12]
Adobe	Software	AI-assisted troubleshooting for Creative Cloud	Faster issue resolution	14% faster customer service resolution	[5]

The table-2 shows some of the actual use cases of automation and AI solutions in various industries, highlighting their impact on the value chain concerning operational efficiency, cost reduction, and enhanced services. Siemens, GE Aviation, Bosch, and IBM are some of the firms using Industry 4.0, predictive maintenance, IoT, blockchain, and AI-driven diagnostics to smoothen the processes, enhance performance, and reduce downtime. The data from these applications highlights some key benefits: faster resolution of issues, reduced maintenance costs, energy savings, and better fleet management.

TABLE.3. CASE STUDIES

Company Name	Issue Addressed	Field Service Automation Solution	Reference
DHL	Inefficiencies in supply chain management, leading to delays and operational issues.	Implemented FSA to automate monitoring of goods in transit and predict potential delays.	[4]
John Deere	Lack of real-time data in crop management, impacting decision-making for farmers.	Used FSA with IoT to automate data collection on soil, crop health, and climate.	[8]
Siemens	High frequency of equipment breakdowns affecting production schedules.	Deployed FSA to monitor machinery health and automatically generate incident tickets for repairs.	[3]
Verizon	High call volume for network troubleshooting, leading to long customer wait times.	Integrated automated troubleshooting systems with FSA, reducing call volume by resolving common issues automatically.	[6]
General Electric (GE)	Frequent power outages due to equipment failures and unclear diagnostics.	Automated fault detection and repair scheduling using FSA to reduce system downtime.	[12]
Walmart	Long response times to customer service tickets due to lack of priority and categorization.	Used FSA to automate ticket categorization and issue resolution, improving customer service response time.	[7]

Ford Motor Company	Complex troubleshooting required for automotive diagnostics leading to delays in repair.	Developed an FSA system to identify and automatically fix common automotive issues based on historical data.	[5]
HSBC	Security issues in automated systems, leading to potential breaches and service disruptions.	FSA implemented to monitor system logs for unusual activity, triggering incident tickets for suspicious behaviour.	[13]
Pfizer	Regulatory compliance challenges leading to delays in manufacturing cycles.	FSA implemented to automate reporting and incident tracking for compliance, speeding up approval processes.	[10]
Boeing	Equipment malfunction detection issues during scheduled maintenance, leading to delayed flights.	Used FSA for real-time monitoring of aircraft parts and automatic diagnostics to ensure timely maintenance.	[9]
National Grid	Slow manual processing of customer support issues related to service interruptions.	Implemented FSA to automate ticket generation and support issue categorization, improving operational efficiency.	[2]
Mayo Clinic	Delays in addressing technical faults with medical devices affecting patient care.	FSA introduced for monitoring medical devices and issuing tickets to escalate issues beyond automation.	[14]
Bechtel	Delays in responding to on-site equipment issues causing downtime.	Implemented FSA to automate diagnostics and issue reporting for equipment failures, ensuring minimal site downtime.	[11]
UPS	Supply chain disruption due to inefficient management of delivery times and inventory.	Deployed FSA for automatic tracking and problem resolution, reducing operational disruption in logistics.	[5]
Microsoft	Difficulties in troubleshooting software issues causing user complaints.	Used FSA to automate the identification of software bugs and their fixes based on common patterns.	[15]

The above table-3 provides case studies showing how different global companies have implemented Field Service Automation to solve some very fundamental operational problems and subsequently enhance efficiency in their respective industries. These companies come from a wide range of industries, including coordination, agriculture, manufacturing, telecommunications, energy, retail, automotive, banking, pharmaceuticals, aerospace, utilities, healthcare, construction, and technology. For example, DHL utilized FSA to make its supply chain more efficient and autonomous in tracking goods while predicting occurrences of delays; John Deere employed FSA-based solutions on the IoT, wherein it gathered real-time soil, health, crop, and climate information that greatly contributed to improved farm management. Similarly, Siemens used FSA because there were high machinery breakdowns to monitor equipment health, raise incident tickets by a computer system for repairs to reduce disruption of production schedules. Other such examples include Verizon, which reduced call volumes by introducing the IVR system for automatic troubleshooting of network problems; General Electric applied FSA to automatic fault detection in power systems to reduce losses due to downtime. Walmart improved customer service efficiency by automating customer issues resolution, and Ford used FSA in reducing delays in automotive diagnosis. In highly regulated sectors, such as banking and pharmaceuticals, HSBC and Pfizer used FSA for security monitoring and compliance reporting, enhancing system integrity and accelerating approval processes. The Boeing case illustrates how FSA systems can optimize aircraft maintenance by automatically diagnosing and ensuring timely repairs, preventing delays in flight schedules. Similarly, Mayo Clinic and National Grid used FSA to automate medical device monitoring and enhance customer service response times for service interruptions. Because the companies have been able to reduce human intervention, manage workflows more smoothly, and increase efficiency overall by automating routine troubleshooting and diagnostics, this is the case. The use of FSA systems also enables organizations to handle more complex issues at higher levels of expertise, such as L2 support, ultimately delivering faster, more reliable service to customers.

Fig.1.Benefits of field service Automation [2]

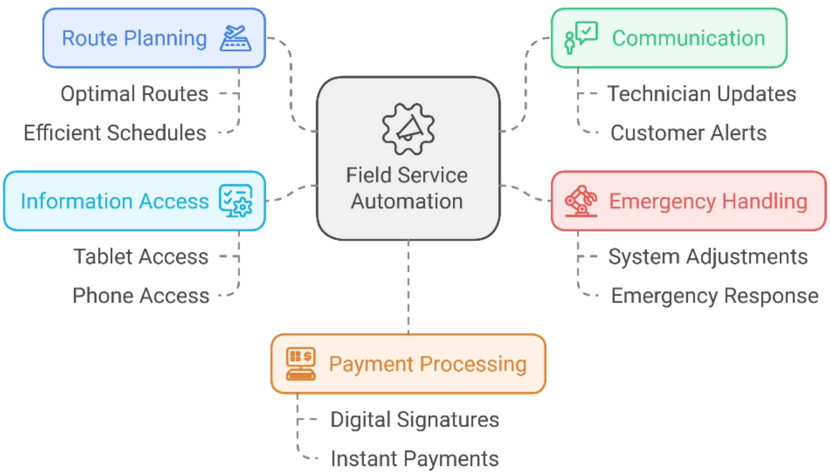

Fig.2.Field service automation [4]

VI. CONCLUSION

Field Service Automation (FSA) plays a pivotal role in improving operational efficiency, troubleshooting, and overall customer satisfaction. By leveraging advanced algorithms, common issues can be identified and integrated into a validation checklist, ensuring prompt responses. The immediate key advantage of FSA is avoiding L1 overburden and providing comprehensive diagnostic information to L2 technicians who can then focus resources on truly complex problems that cannot be solved through automation. That provides for a far more effective
escalation process, which therefore means better resolution times and better quality of support to the customer. Though huge benefits are derived

from diagnostics through automation, some incidences require human intervention. It is important to regard the FSA as complementary to, and not a replacement for, human knowledge. Since FSA creates incident tickets for issues it cannot resolve and provides detailed support information, issues are resolved much faster and more accurately. Integration of these automation systems in the field service environment fosters better resource allocation, higher efficiency, and improvement of the customer experience. In all, Field Service Automation enhances not only troubleshooting but also smooths out the workflow, reduces operational costs, and optimizes service delivery. It is, however, important to realize that while automation can do a lot, human input is indispensable in the face of complex challenges. The future of FSA thus lies in finding the right balance between automation and human expertise so that seamless and efficient service delivery is ensured.

REFERENCES

[1] Saskia Keesstra, Joao Nunes, Agata Novara, David Finger, David Avelar, Zahra Kalantari, Artemi Cerdà,,The superior effect of nature based solutions in land management for enhancing ecosystem services, Science of The Total Environment, Volumes 610–611,2018,doi:10.1016/j.scitotenv.2017.08.077.

[2] Thoben, Klaus-Dieter, Stefan Wiesner, and Thorsten Wuest. "“Industrie 4.0” and smart manufacturing-a review of research issues and application examples." International journal of automation technology 11, no. 1 (2017): 4-16, doi:10.20965/ijat. 2017.p0004

[3] K. Thoben, S. Wiesner, and T. Wuest, ““Industrie 4.0” and Smart Manufacturing – A Review of Research Issues and Application Examples,” Int. J. Automation Technol., Vol.11 No.1, 2017, doi: 10.20965/ijat. 2017.p0004

[4] Krzysztof Witkowski, Internet of Things, Big Data, Industry 4.0 – Innovative Solutions in Logistics and Supply Chains Management, Procedia Engineering, Volume 182,2017, Pages 763-769, doi: 10.1016/j.proeng.2017.03.197.

[5] Deepak Arunachalam, Niraj Kumar, John Paul Kawalek, understanding big data analytics capabilities in supply chain management: Unravelling the issues, challenges and implications for practice, Transportation Research Part E: Logistics and Transportation Review, Volume 114,2018, Pages 416-436, doi: 10.1016/j.tre.2017.04.001

[6] Ishan Mistry, Sudeep Tanwar, Sudhanshu Tyagi, Neeraj Kumar, Blockchain for 5G-enabled IoT for industrial automation: A systematic review, solutions, and challenges, Mechanical Systems and Signal Processing, Volume 135,2020,106382, doi: 10.1016/j.ymssp.2019.106382.

[7] M. Erdelj, E. Natalizio, K. R. Chowdhury and I. F. Akyildiz, "Help from the Sky: Leveraging UAVs for Disaster Management," in IEEE Pervasive Computing, vol. 16, no. 1, pp. 24-32, Jan.-Mar. 2017, doi: 10.1109/MPRV.2017.11.

[8] Saiz-Rubio, V.; Rovira-Más, F. From Smart Farming towards Agriculture 5.0: A Review on Crop Data Management. Agronomy 2020, 10, 207. doi:10.3390/agronomy10020207

[9] Claire Le Goues, Michael Pradel, and Abhik Roychoudhury. 2019. Automated program repair. Commun. ACM 62, 12 (December 2019), 56–65. doi:10.1145/3318162

[10] Fran Casino, Thomas K. Dasaklis, Constantinos Patsakis, A systematic literature review of blockchain-based applications: Status, classification and open issues, Telematics and Informatics, Volume 36,2019, Pages 55-81, doi: 10.1016/j.tele.2018.11.006.

[11] Carsten Nesshöver, Timo Assmuth, Katherine N. Irvine, Graciela M. Rusch, Kerry A. Waylen, Ben Delbaere, Dagmar Haase,The science, policy and practice ofnature-based solutions: An interdisciplinary perspective ,Science of The Total Environment, Volume 579,2017 ,doi:10.1016/j.scitotenv.2016.11.106.

[12] Praveen Kumar Reddy Maddikunta, Quoc-Viet Pham, Prabadevi B, N Deepa, Kapal Dev, Thippa Reddy Gadekallu, Rukhsana Ruby, Madhusanka Liyanage, Industry 5.0: A survey on enabling technologies and potential applications, Journal of Industrial Information Integration, Volume 26,2022,100257, doi: 10.1016/j.jii.2021.100257.

[13] J. Al-Jaroodi and N. Mohamed, "Blockchain in Industries: A Survey," in IEEE Access, vol. 7, pp. 36500-36515, 2019, doi: 10.1109/ACCESS.2019.2903554.

[14] Yawar, S.A., Seuring, S. Management of Social Issues in Supply Chains: A Literature Review Exploring Social Issues, Actions and Performance Outcomes. J Bus Ethics 141, 621–643 (2017). doi:10.1007/s10551-015-2719-9

[15] Tove A. Larsen et al., Emerging solutions to the water challenges of an urbanizing world. Science352,928-933(2016), doi:10.1126/science. aad8641