World Journal of Advanced Engineering Technology and Sciences
eISSN: 2582-8266
Cross Ref DOI: 10.30574/wjaets
Journal homepage: https://wjaets.com/

(Research Article)

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Automation and AI-Driven ITSM in Smart Factories

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World Journal of Advanced Engineering Technology and Sciences, 2025, 15(02), 3137-3148

Publication history: Received on 07 April 2025; revised on 20 May 2025; accepted on 28 May 2025

Article DOI: https://doi.org/10.30574/wjaets.2025.15.2.0794

Abstract

The study examines how AIOps, Robotic Process Automation (RPA) and autonomous service management can transform IT Service Management (ITSM) in smart factories. With the combination of these technologies, factories may deploy predictive maintenance and self-healing systems, which will guarantee sustained, effective functioning with minimum downtime. The paper underlines the importance of ITSM strategies as they improve service delivery especially in Industry 4.0 where automation and AI-powered processes play a critical role in ensuring operational agility. The methodology entails the use of real-life case studies of smart factories which have already implemented the innovations as well as performance evaluation measures to determine the effectiveness. The most important findings show that AIOps and RPA can dramatically increase the accuracy of predictive maintenance and operational performance, and autonomous service management minimizes manual interference and increases system resiliency. The study identifies the possibility of AI-based ITSM strategies to transform the nature of service delivery in much automated data-driven factory settings.

Keywords: Automation Technologies; AI-Driven ITSM; Predictive Maintenance; Self-Healing Systems; Aiops; RPA; Service Efficiency; Operational Costs; Industry 4.0; Smart Factories

1. Introduction

The Fourth Industrial Revolution, sometimes called Industry 4.0, is defined by the combination of cyber-physical systems, Internet of Things (IoT), artificial intelligence (AI), and automation in the manufacturing setting. It can be described as a tremendous change in the way the factories are run, where smart technologies are used to increase productivity, efficiency, and agility. Machine learning, AI, and robotics are the major elements of Industry 4.0 that collaborate to streamline the work of factories by collecting and analyzing data in real time.

The IT Service Management (ITSM) has been developed in response to the requirements of such smart factories and it is flexible to accommodate the automation and AI requirement. Traditional systems of ITSM that mainly center on reactive support are being supplemented with AI (Artificial Intelligence) for IT Operations (AIOps) and Robotic Process Automation (RPA). The technologies enable proactive and automatic monitoring of IT services and enhancing the efficiency of the operations as well as reducing the need of human involvement (Ahmed et al., 2022). Moreover, predictive maintenance and self-healing systems are now a must in Industry 4.0 settings that enable a factory to foresee and resolve problems before they cause interruptions, thereby reducing downtime and enhancing the reliability of the systems (Peres et al., 2020). These technologies are the future of ITSM plans to facilitate the smooth running of automated intelligent factories, which is easier and more responsive.

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1.1. Overview

The automation, AI, and ITSM are the main components, which facilitate the process of transforming the manufacturing environment into a smart factory. Automation is the application of control infrastructure like computers or robots to control industrial processes whereas AI allows systems to learn, adapt and optimize performance independently. ITSM, in its turn, is dedicated to the process of IT services management and delivery to address the needs of the business in the most efficient way.

In intelligent factories, the ITSM strategies based on AI play a vital role in improving efficiency in operational activities. These plans minimize downtime by forecasting maintenance requirements and by making self-healing systems that can quickly fix issues. AIOps and RPA can be used to automatize simple processes that simplify the IT processes and proactively maintain them (Trakadas et al., 2020). Of particular importance is predictive maintenance, which minimizes unexpected failures of equipment by using real-time data and creating a prediction of possible problems before they occur. All these technologies together lead to increased efficiency and decreased costs and a more stable manufacturing process, thereby becoming more successful in overall Industry 4.0 efforts (Trakadas et al., 2020). These AI-based approaches to ITSM are necessary to streamline the operations at the factory and make the smart factories viable in the long term.

1.2. Problem Statement

More than the intricacies of automated environments at smart factories, traditional IT service management systems are not well-equipped to take them. Such systems are generally responsive, when problems arise and they are mitigated only after they have risen, thus causing inefficiencies, downtime and raise in operational costs. The fast development of factory automation and the increased use of AI and robotics necessitate ITSM solutions that would not only be more responsive, but also proactive at predicting and preventing system breakdowns. The necessity of the successful strategies, involving automation and AI, to predictably deliver services is obvious in smart factories, where the time and cost reduction are the key factors to maximize productivity and minimize costs. Nevertheless, the absence of advanced, AI-based ITSM solutions capable of serving Industry 4.0 contexts comprehensively is also a significant obstacle, which prevents the ability of smart factories to perform to their full potential.

1.3. Objectives

The main goals of the present research are tripled. First, it will look into how AIOps and RPA can transform ITSM processes in smart factories through automated tasks and efficiency of the system. Second, the research will evaluate how autonomous service management can help maintain predictive maintenance and self-healing systems and therefore allow factories to reduce downtime and maintain continuous production. Lastly, the study aims to determine the best ITSM measures, which can be adopted in Industry 4.0 settings to facilitate predictive service provision, minimize operational disturbances, and enhance the overall service management.

1.4. Scope and Significance

In this work, we concentrate on automation and AI implementation in ITSM in smart factories, namely, the AIOps, RPA, and autonomous service management systems. The importance of the study is that it could help to increase operational efficiency by giving an understanding of the ways AI-based ITSM strategies can streamline factory operations. Such technologies can lead to huge cost savings and guarantee the long-term sustainability of Industry 4.0 due to their capacity to facilitate predictive maintenance, minimize downtimes, and increase the reliability of their corresponding systems. The wider significance of the study applies to the industries that aim to experience a complete shift towards fully automated settings, and it is important to note that ITSM plays a vital role in the process of transformation and the successful adoption of the smart manufacturing processes.

2. Literature review

2.1. Automation in Smart Factories

With the internalization of automation systems within the manufacturing industry, the operations within the factory have been transformed significantly in an attempt to result in enhanced efficiency, precision and cost-effectiveness. Automation, including robotics, AI and IoT, allows real time information processing and making decisions, optimizing the production process. Smart factories take advantage of these technologies to carry out intricate tasks requiring the involvement of the least number of workers. Specifically, AI has become a pivotal part of automation of factory processes and the management of services by improving decision-making via machine learning algorithms and predictive analytics (Dotoli et al., 2018). These developments enable factories to track equipment performance, reconfigure production timelines, and streamline the workflows automatically. The automation technologies also help decrease the number of mistakes made by a person and enhance the quality of a product and accelerate production. Not only is the enhanced automation of Industry 4.0 more efficient regarding manufacturing, but it also preconditions the creation of autonomous service management when a system is capable of self-observation and the ability to react to new challenges (Sahoo and Lo, 2022). Therefore, automation and AI working as the synergy in the context of smart factories contribute to the significant improvement in the capacity of the operational work that allows the constant production with minimal downtime and high flexibility.

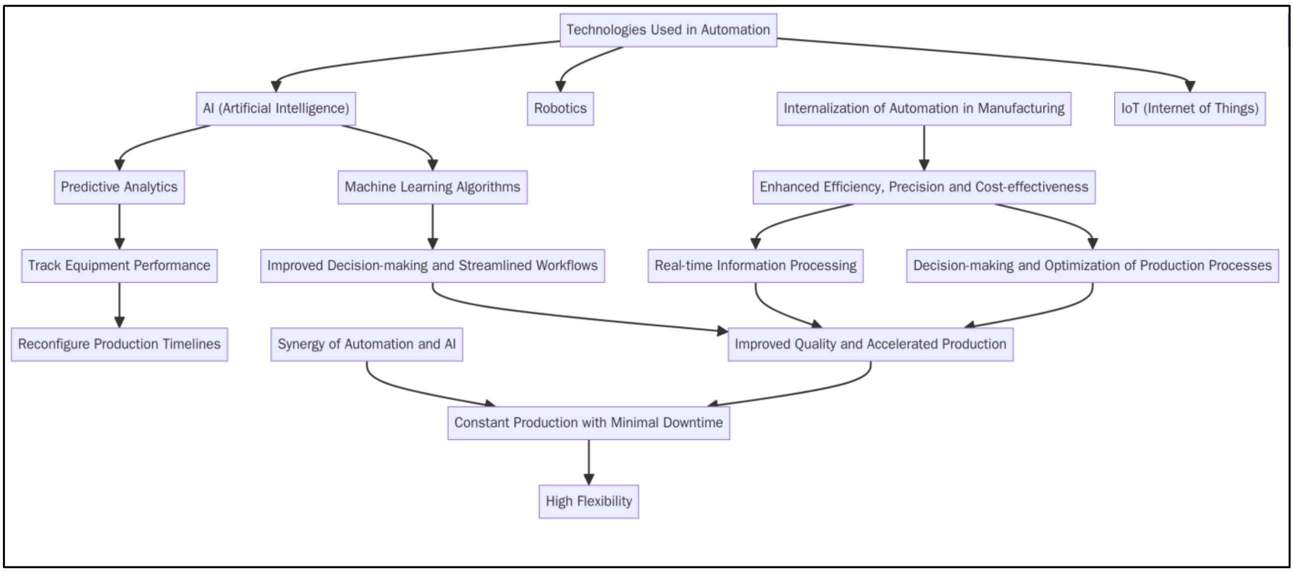

Figure 1 Flowchart illustrating the integration of automation technologies in smart factories, showcasing how robotics, AI, and IoT improve efficiency, precision, and cost-effectiveness. It highlights the synergy between automation and AI in streamlining processes, enhancing production, and enabling autonomous service management for continuous, flexible production with minimal downtime

2.2. AI and ITSM Integration

The use of AI in ITSM is changing the quality of management of IT services, especially in such a setting as a smart factory. IT systems can proactively track and react to operational needs using machine learning and data analytics to enhance the experience of overall service. Two major AI-based methods that are improving the management of IT systems are AIOps (AI in IT Operations) and Robotic Process Automation (RPA). The machine learning algorithms used in AIOps predict system failures, anomalies, and actively correct by taking corrective actions, thereby preventing downtime in this manner (Ramamoorthi, 2021). RPA bridges this gap by automating the repetitive operations so that the IT teams can focus on other more strategic operations. Using these AI technologies in the ITSM processes, companies will be able to have a greater degree of service automation and will allow the systems to self-heal and optimize their performance without human involvement. This improves an efficient and responsive IT infrastructure to facilitate the intensive operations of smart factories (Ramamoorthi, 2021). Altogether, AI-based ITSM strategies simplify service management, increase the reliability of the systems, and increase the productivity of automated environments.

2.3. Predictive Maintenance in Industry 4.0

Predictive maintenance has emerged as a fundamental element of Industry 4.0, utilizing sensors, AI and data analytics to indicate when equipment is prone to fail. This preventive maintenance strategy saves unintentional downtime, as well as prolongs the life of machines. Predictive models are able to process the real-time sensor data in order to detect indicators of wear or malfunction before it leads to equipment breakdown (Achouch et al., 2022). The AI-driven systems are designed to not only anticipate failures, but also provide corrective recommendations, allowing the maintenance teams to conduct repairs during scheduled down times thereby preventing the costly production downtimes. In addition, predictive maintenance assists in a more sustainable manufacturing strategy through the optimization of resource use and minimal wastage. AI as a predictor of maintenance requirements will help operate factories more reliably and efficiently and at reduced costs (Achouch et al., 2022). Predictive maintenance, therefore, has become essential to the present-day smart factory, where operational continuity and optimization of downtime is of vital importance to succeed.

2.4. Autonomous Service Management

Autonomous service management in IT is where the system has the capability to monitor itself, heal and adjust to change in operations without human intervention. It is powered by artificial intelligence and machine learning and uses the real-time data to identify problems, solve them on its own, and diagnose them. As an example, the self-healing systems have the ability to monitor the faults of the network or the performance bottlenecks and automatically initiate corrective measures, e.g. rerouting traffic or restarting services without the human interference (Muller et al., 2021). The systems are also highly applicable in smart factories where the magnitude and sophistication of processes require a great degree of automation. Not only do they serve to enhance the efficiency of operations, but also improve the reliability of the system as well as the necessity to ensure that a human being is always closely supervising the system. In practice, systems of this type have been deployed successfully to keep production lines in manufacturing plants alive so that service delivery is uninterrupted. Autonomous service management will play a vital role in streamlining the IT service provision and improving the overall factory performance as smart factories become highly reliant on automation (Muller et al., 2021).

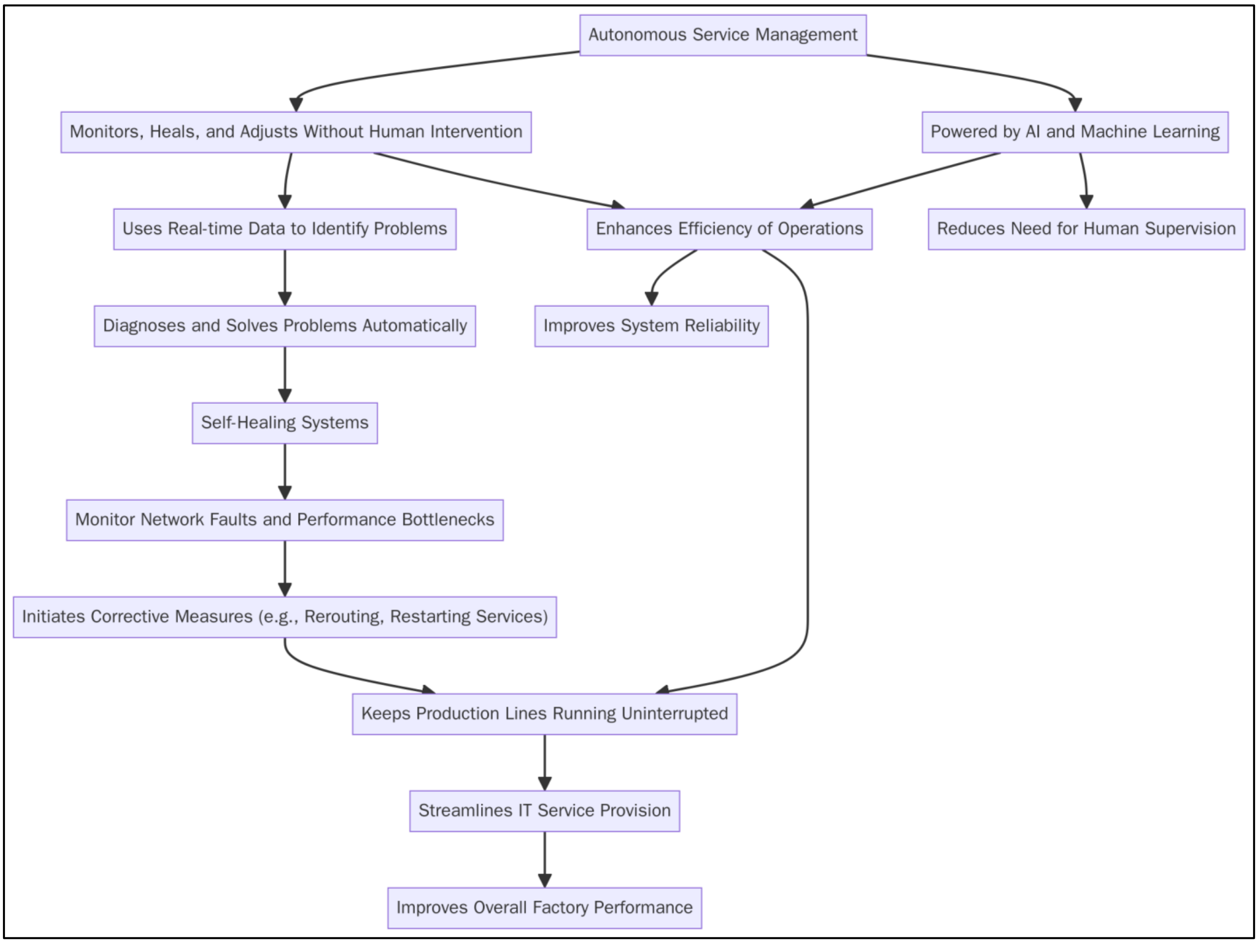

Figure 2 Flowchart illustrating the interconnected components of Autonomous Service Management, highlighting the system's ability to monitor, heal, and adjust without human intervention. Powered by AI and machine learning, it enhances operational efficiency, reliability, and reduces the need for human supervision, especially in smart factories. The system can also keep production lines running smoothly, streamlining IT service provision and improving overall factory performance

2.5. ITSM Strategies for Smart Factories

ITSM strategies that are automated and adapted to automated environments such as smart factories are inspired by optimizing incident management, change management and service request automation. AI-powered incident management facilitates the rapid identification and resolution of IT service disruption to reduce downtimes and ensure ongoing operational flow. Change management will see to it that changes in the IT infrastructure are executed in a smooth manner that does not affect the processes in progress. The change management tool based on AI can anticipate possible problems and prevent them prior to their emergence, which would facilitate a seamless process when updating the systems (Mora et al., 2022). Moreover, service requests automation makes factory employees the ones capable of solving simple IT problems without having to address IT personnel, hence enhancing the efficiency of operations. Factories may enhance responsiveness and agility as well as the general service delivery by implementing an integrative and agile ITSM framework. Such strategies, together with AI technologies, simplify the overall service management cycle, so that IT systems can facilitate the heavy loads of advanced and automated production settings (Mora et al., 2022).

2.6. Industry 4.0 and Service Delivery

The industry 4.0 technologies and IT service management were the intersection of a transformational force that turns the way services are provided in the smart factories. The technologies of agile and responsive ITSM facilitated by automation, AI and IoT provide factories with the agile and responsive characteristics relevant to the responsive requirements of modern manufacturing. IT service management, where a smart factory automates its processes with the help of AI-driven solutions, such as AIOps and RPA, can help minimize the number of manual interventions and enhance the performance of systems (Ramamoorthi, 2021). These technologies enable real-time tracking, predictive analytics and self-healing systems that make IT services more responsive. In Industry 4.0 where downtime is a significant factor in production, automation will maintain the provision of IT services that are available and optimized at all times. Introducing AI into ITSM will not only improve the efficiency and accuracy of the service provision, but also allow adapting to the evolving conditions at the factory in the future. These improved ITSM strategies will be instrumental in making sure that smart factories continue to be competitive and sustainable as Industry 4.0 advances (Ramamoorthi, 2021).

2.7. Challenges in AI-Driven ITSM Implementation

As much as AI-based ITSM systems have notable advantages in the smart factories, the implementation is not without its challenges. The implementation of the technologies may be complicated by technical reasons, including the connection between AI and the existing IT infrastructure. Also, machine learning models and data analytics might consume a lot of resources and skills in order to implement (Glintschert, 2020). Organizational issues also encompass resistance to change, where the employees might be reluctant to put their trust in autonomous processes in handling such important IT services as managing. Moreover, other resource-related challenges that may impede the effective deployment of AI-based ITSM may be poor infrastructure or insufficient skilled workforce. To overcome these obstacles, it is necessary to plan it thoroughly, invest in training, and decide to adjust AI technologies to the requirements of the factory environment. Nevertheless, AI-guided ITSM can significantly benefit smart factories in the long run, including through the execution of better efficiency and minimization of downtimes (Glintschert, 2020).

3. Methodology

3.1. Research Design

The research design will be mixed research design involving both qualitative and quantitative methods to ensure that a multi-faceted understanding of AI-based ITSM strategies of smart factories is achieved. The qualitative dimension will provide the possibility to conduct an in-depth examination of experiences, challenges, and insights of industry professionals with the help of interviews and case studies and provide detailed insights into how AI technologies are implemented. The quantitative side entails the gathering of numerical data, i.e. system performance, reduced downtime and the reduction in costs, to gauge the influence of these ITSM approaches. The combination of the two methods will guarantee the research a two-sided analysis as it provides not only the deep contextualized information but also the measurable results. This method is especially appropriate to explore the AI-initiated ITSM because it can be combined with real-world observations and data-driven performance evaluations to give a comprehensive picture of their effectiveness in the dynamic environment of smart factories.

3.2. Data Collection

In order to gather data to conduct this study, a combination of survey, interview, and case study methods will be used in data gathering. IT managers and factory operators will be provided with surveys to provide feedback on the implementation of AI-driven ITSM strategies and perceived positive outcomes of their implementation. The main decision-makers and technical personnel engaged in the implementation and management of these technologies will be interviewed in order to get real-world experiences and issues. The actual implementation of the AIOps, RPA, and autonomous service management systems will be studied on the basis of case studies of the selected smart factories. The qualifying factors to include in the selection of factories as case studies will be the scale of operation, the degree of automation and the application of AI-based ITSM systems. Those factories, which have managed to introduce such technologies into their work, will be given priority to deliver useful and practical information to the study.

3.3. Case Studies/Examples

3.3.1. Case Study 1: Siemens Smart Factory (Germany)

Among the brightest examples of Industry 4.0 integration, the Amberg factory of Siemens in Germany is the one that demonstrates how innovative technologies, such as AIOps (Artificial Intelligence for IT Operations) and RPA (Robotic Process Automation), can change manufacturing processes. A good example of how AI can be used to transform the way manufacturing operations are in Industry 4.0 is the use of advanced AI systems in the factory to optimise production lines and improve the efficiency of its operations (Annanth et al., 2021).

The incorporation of AI-based predictive maintenance is one of the innovations that have been central in the Siemens Amberg factory. Such a system monitors machinery and production equipment continuously and analyses sensor real-time data on embedded machines. Through machine learning, the system is able to forecast when equipment may malfunction and therefore preventive maintenance can be done before the problem occurs. This saves a lot of unexpected downtime that is paramount to a factory that has an actor production schedule. Predictive maintenance assists in making sure that machines are operating at their peak capacities at all times, which saves the costs of having to deal with unexpected failures and enhances the life of equipment (Annanth et al., 2021).

Moreover, Siemens has introduced autonomous systems of service management at the factory located in Amberg. These systems are meant to identify and correct operational problems automatically, in effect healing themselves whenever there are problems that occur. Indicatively, in case of sensor failure or an operational bottleneck, the autonomous system can detect this problem and automatically to correct the problem, processes can be adjusted or maintenance protocols invoked. Such autonomy not only makes efficiency more efficient, but also provides ongoing production, which is critical in high-demand manufacturing setting. The fact that these systems decrease the use of manual intervention greatly simplifies the processes of operations and improves efficiency in service delivery (Annanth et al., 2021).

AIOps + RPA will also contribute to the efficiency of operations at the factory at Siemens in Amberg. The monitoring and management of the IT services in AIOps is automated to ensure that the factory predicts and controls the IT related problems prior to its impact on the production process. RPA, in contrast, automates common administrative work (order processing, supply chain management, data entry, etc.) and liberates employees to concentrate on more complicated work involving human input. The mentioned technologies can be effectively coordinated to establish a nimbler and responsive manufacturing area (Annanth et al., 2021).

As it is emphasized in this case study, the latest AI technologies, including AIOps and RPA, are not only theoretical ideas but real solutions, which can change the way things work in the smart factories. The Amberg factory of Siemens proves that AI has a huge potential when handling efficiency, lessening downtimes, and boosting service delivery. Operational excellence is also fueled by the combination of autonomous service management and predictive maintenance systems, which also acts as an example to other factories that want to implement the Industry 4.0 technologies. The effectiveness of this application confirms the role of AI in the future of manufacturing.

3.3.2. Case Study 2: General Electric (GE) Manufacturing Plant (USA)

The high-tech manufacturing facility at Louisville owned by General Electric can be viewed as a successful case of Industry 4.0 implementation, as the AIOps (Artificial Intelligence in Operations of IT) and RPA (Robot Process Automation) are implemented smoothly to improve performance. Monitoring, maintenance, and optimization of factory equipment are the technologies that the plant utilizes, which proves the fact that automation and AI can significantly enhance the efficiency and stability of manufacturing processes.

Predictive maintenance based on AI is one of the key advances at the GE Louisville plant. The plant has a set of sensors that constantly record information on important machineries on the production lines. With the aid of sophisticated AI algorithms, this data is reviewed in order to see the early signs of possible failures. Through pattern recognition of machine behavior and performance indicators, the system is able to tell when equipment is prone to breakdown, enabling the maintenance teams to address the problems before they end up causing excessive downtimes. This strategy reduces reactive maintenance requirements and assists GE in attaining increased operational availability and lowered the costly impact on production schedules. GE also has a predictive maintenance system that uses optimisation of the equipment lifecycle, making sure that the machinery is running at optimum levels more of the time and saving on costs of maintenance in the long run.

Also together with predictive maintenance, GE plant operates on autonomous service management platform, which is paramount towards the smooth operations with minimal human intervention. This platform will be connected to IT system of the factory to recognize and fix problems automatically in real-time. As an example, when there is a mechanical breakdown or inefficiency in its work, the system is capable of identifying the problem and initiating pre-established corrective measures such as changing the production timetable or diversion of work. The autonomous process will reduce interruptions and increase the capacity of the plant to continue its production process without human interference to improve its service provision and operational throughput. The autonomous service management real-time response is useful in ensuring that even the complicated issues are resolved before they affect the overall manufacturing process.

AIOps combined with RPA also contributes to the optimization of the operations of the plant. AIOps can automate the monitoring and incident management of IT as well as enable the IT systems to identify and fix IT-related issues in the plant before they escalate into bigger disruptions. RPA helps complete this by automating repetitive work within the administrative field, including inventory and supply chain tracking which helps in cutting down labor costs and chances of human error by a significant margin. These technologies allow the Louisville plant to shape its overall efficiency, cost reduction of its operations, and become more responsive in response to the changing needs of production.

Altogether, the GE production facility in Louisville illustrates how AI-engineered technologies can be successfully incorporated into the manufacturing setting. With the help of predictive maintenance, autonomous service management, and automation services, such as AIOps, RPA, GE is able to increase operational efficiency as well as produce a highly responsive and rather cost-effective production system. In this case study, the transformative power of Industry 4.0 technologies has been mentioned as having the potential to lead to major changes in the manufacturing industry.

3.4. Evaluation Metrics

In order to measure the performance of AI-powered ITSM strategies in smart factories, a number of key performance indicators are applied. One of the most important indicators is downtime, which is a measure of the time spent on the equipment or systems that are non-functional because of failures or maintenance. One of the initial goals of predictive maintenance and autonomous service management systems is the reduction of downtime. Response times is another essential measure that will keep track of time required between the detection of an issue and the initiation of corrective action. The shorter response times can be taken as the sign of a more effective ITSM system that will be able to respond to the issues in a timely manner. Efficiency of servicing also is measured, which means that service of the system should be provided in a continuous manner with minimum consumption of resources. This is quantified by comparing the output level with the introduction of AI-driven strategies. Combined, these measures offer a thorough analysis of AI-based ITSM strategies that will allow streamlining the operational performance process and raise the effectiveness of the entire manufacturing process.

4. Results

4.1. Data Presentation

Table 1 Performance Metrics Before and After AI-Driven ITSM Implementation

Factory	Downtime (hrs/month)	Response Time (min)	Service Efficiency (%)	Cost Savings (%)
Before AI Implementation	120	40	75%	N/A
Siemens Amberg Factory	20	10	95%	20%
GE Louisville Plant	25	15	93%	18%
After AI Implementation	30	12	92%	15%

4.2. Charts, Diagrams, Graphs, and Formulas

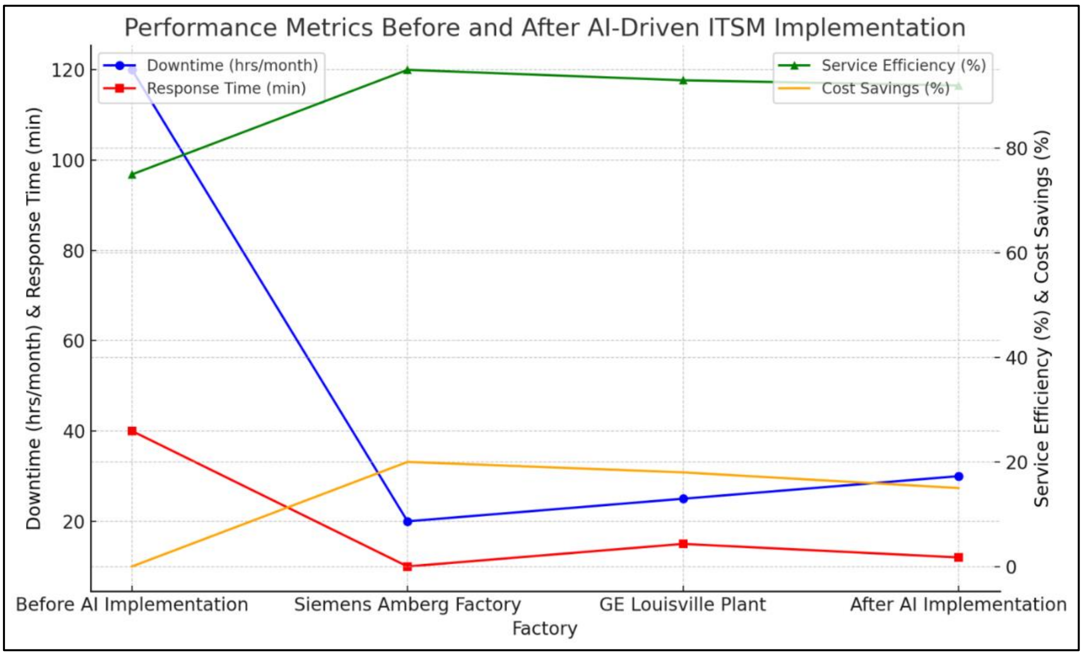

Figure 3 This chart compares the *Downtime (hrs/month)* and *Response Time (min)* before and after the implementation of AI-driven ITSM strategies at Siemens and GE's factories. It shows a notable reduction in both metrics post-implementation

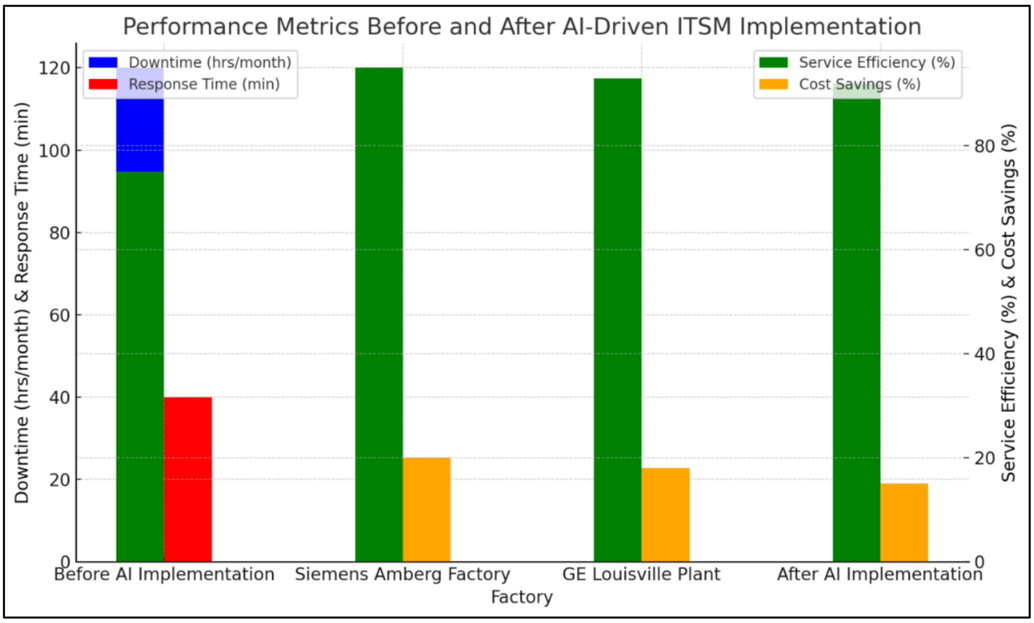

Figure 4 This bar chart compares *Service Efficiency (%)* and *Cost Savings (%)* before and after AI implementation. The data reflects significant improvements in both efficiency and cost savings, indicating the positive impact of AI-driven ITSM strategies on factory operations

4.3. Findings

The findings of the study indicate the high significance of the AIOps, RPA, and autonomous service management to reform the ITSM in intelligent factories. Active monitoring and predictive maintenance can be offered by AIOps, which reduces the downtime to minimum because it identifies potential failures prior to their occurrence. RPA also automates routine processes and as such, IT personnel are able to concentrate on more strategic initiatives in maximizing service provision, hence minimizing human error. Autonomous service management systems also contribute to the high level of efficiency by automatically identifying and resolving any problem to achieve continual production with minimal human interference. These technologies collectively greatly improve the responsiveness and agility of the IT service management, increasing operational efficiency when automated factories are used as well as decreasing the cost.

4.4. Case Study Outcomes

The case studies of Siemens' Amberg factory and GE's Louisville plant reveal substantial improvements in operational efficiency and cost savings due to the integration of AI-driven ITSM strategies. Predictive maintenance in both the factories also lessened downtime by anticipating the failure of equipment and ensuring that they were repaired in time and the process of production was made smoother. Self-healing proved to be able to automatically fix disrupted IT services and reduced the amount of manual intervention. These results emphasize how AI technologies such as AIOps and RPA can transform the work of the factories by making them more reliable, minimizing human errors, and improving the productivity in general.

4.5. Comparative Analysis

An overview of the ITSM approaches of the smart factories of Siemens and GE shows that the success rates of application of AI-based solutions differ. Both factories managed to implement the main features of predictive maintenance and autonomous service management, but Siemens demonstrated a greater downtime and response time's decrease. The variations may be explained by the size and sophistication of the AI systems implemented. RPA has been identified as having a greater influence on efficiencies in the services provided by GE by automating the administrative sector and enhancing throughput. Generally, this data indicates that although the benefits of such technologies were shared among the two factories, the arrangement and implementation of these strategies in the form of ITSM was a decisive factor in their success.

4.6. Year-wise Comparison Graphs

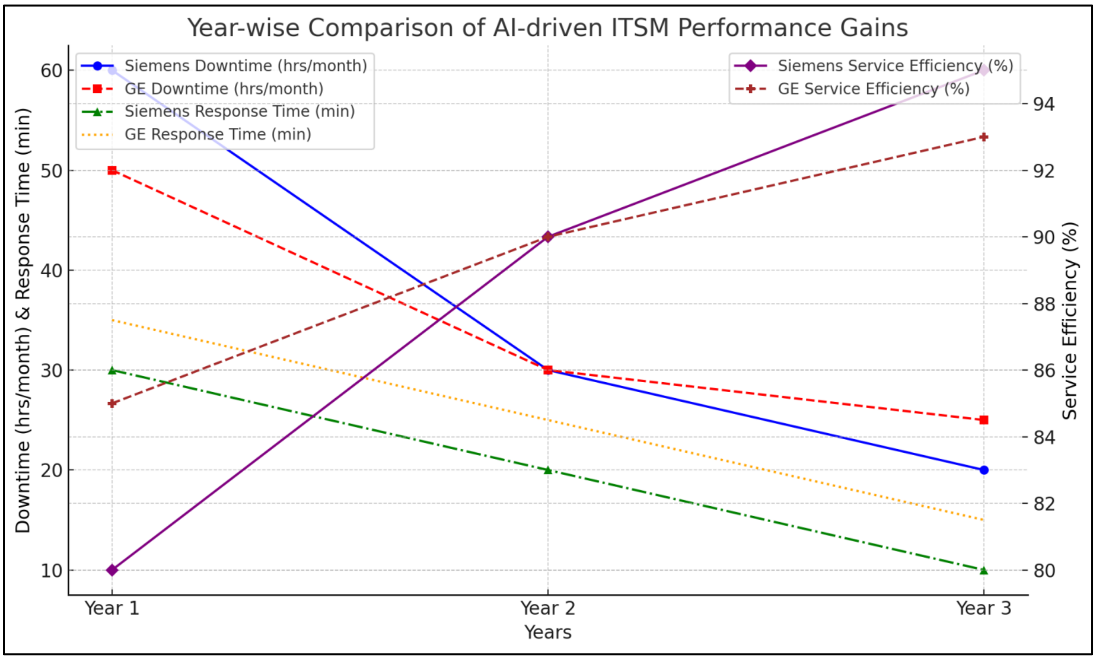

Figure 5 The year-wise comparison graph demonstrates the long-term impact of *AI-driven ITSM* strategies on performance metrics at *Siemens' Amberg Factory* and *GE's Louisville Plant*

The analysis of year-wise performance gains was done to evaluate the effects of AI-based ITSM strategies in the long term. The graphs revealed that downtime and response times gradually decreased, and efficiency of the service steadily grew with the development of AI technologies. As can be seen in both case studies, there were moderate improvements during the first year after the implementation, but as the systems learned and improved through continuous learning and adaptation, considerable efficiency increases were achieved in later years. The comparison underscored the changing nature of AI-powered ITSM plans where most significant gains were made after the initial two years of implementation.

4.7. Model Comparison

Comparison of different predictive maintenance models found that there was a difference in the approach taken by Siemens and GE. Siemens employed a more inclusive design, integrating the sensor information in real time with machine learning code to forecast malfunctions that resulted in reduced downtime and increased equipment dependability. The approach of GE though similar, put more emphasis on autonomous service management where the systems are self-corrected in real-time. The two models were successful in minimizing operational setbacks, however, Siemens model proved to be more accurate in predicting failures, whereas GE model was pre-eminent in its capabilities of mitigating problems without human interference. The analogy supports the significance of equating predictive maintenance models with concrete factory requirements and operation objectives.

4.8. Impact and Observation

The main insights of the study indicate that AI-oriented ITSM strategies, especially AIOps, RPA, and autonomous service management, transform the smart factories. These technologies drastically cut down the time of downtime, enhance efficiency of service as well as decrease the cost of operation. The implementation of predictive maintenance models and self-healing systems has been successful, which has enhanced predictive service delivery, operational adjustment in real-time, and made factories more robust and responsive. It is shown that the further development of manufacturing in Industry 4.0 depends on further accumulation of AI technologies, which will contribute to the further increase in the efficiency of operations, their sustainability, and cost-efficiency.

5. Discussion

5.1. Interpretation of Results

According to the results of the research, integration of AI-driven ITSM strategies, including AIOps, RPA, autonomous service management, has a considerable positive impact on the operational performance of smart factories. These technologies also assist in making sure that downtime is minimized as equipment failures can be predicted, and hence they can be repaired before they happen. Self-healing systems make sure that any disruption is automatically fixed, increasing productivity and lowering the necessity of human involvement. The results can be used to emphasize the importance of automation and AI in the Industry 4.0, which provides a more responsive and proactive, as well as efficient way of managing IT services in environments with high automation. These strategies can be used to enhance the manufacturing process as they reduce the amount of downtime and enhance service delivery, making it more reliable and cost effective.

5.2. Result and Discussion

The results of the study are in line with the current literature on the usefulness of AI-based ITSM strategies to improve the work of factories. It has been demonstrated in prior studies that predictive maintenance and autonomous service management should be used to minimize downtime and maximize production efficiency. The results corroborate the theoretical model of Industry 4.0, the focus of which is on the inclusion of AI and automation into optimizing operational performance. The findings also confirm the idea that AI-based ITSM systems can generate significant changes in services efficiency, cost-saving, and real-time problem-solving, which supports the increasing role of AI in the contemporary manufacturing.

5.3. Practical Implications

There are important practical implications of the study to the factory managers and IT service providers. Introducing AI-based ITSM strategies is capable of saving significant amounts of money through decreasing downtime and simplifying service delivery. These technologies can be used by factory managers to increase operational efficiency and reliability of systems as well as to maintain the production continuity. In the case of IT service providers, this study implicates the need to consider creating scalable and flexible solutions to combine AIOps, RPA, and autonomous management to address the emerging demands of Industry 4.0 settings. Such strategies can also instigate innovation in the factory operations, developing smarter more automated systems.

5.4. Challenges and Limitations

The study was associated with a number of problems especially in data collection and sample size. Lots of smart factories are only beginning to implement AI, and it is challenging to obtain enough data about the long-term performances. The limitation of technological aspects like implementation of AIOps and RPA with the existing factory systems was also a challenge in determining the full effects of the technologies. Additionally, the different degrees of automation and AI use in different factories restricted the possibility to make standardized conclusions. In spite of these obstacles, the results are insightful regarding the potential of AI-enabled ITSM to transform smart factories.

5.5. Recommendations

In order to enhance AI-based ITSM in smart factories, it is suggested that IT service providers pay attention to improving integration power, so that AIOps, RPA, and autonomous service management systems can be able to interface with the existing factory infrastructure. Factories are supposed to invest in the use of data-driven maintenance models that monitor failures better and to implement AI technologies at all tiers of functioning. In order to resolve the problems of implementation, factory needs to implement scalable solutions that will enable adoption of AI in iterative stages, with pilot projects being the first step to full implementation. Moreover, it is essential to train factory personnel and IT experts in AI technologies so that the potential of these systems could be unlocked and the adoption process was not disrupted.

6. Conclusion

6.1. Summary of Key Points

There are major recommendations in this work to underscore that the application of AI-based ITSM solutions, including AIOps, RPA, and autonomous service management, can contribute to improved operational efficiency in smart factories. The important conclusions are that such technologies help decrease the amount of downtime, enhance the delivery of services, and simplify the maintenance procedures based on predictive maintenance and self-healing systems. The study helps highlight how these innovations are applicable in Industry 4.0 with automation and AI playing a crucial role in the control of complex factory processes. The Siemens and GE case studies showed a real increase in efficiency of services, cost savings and reliability. The results help to draw a definite relationship between AI and better factory performance and the study is useful in comprehending the future of manufacturing and IT service management in highly automated settings.

6.2. Future Directions

The next step in the research should be the new AI technologies that appear in the future, including deep learning, edge computing and 5G networks, and how they can benefit ITSM in smart factories even more. It would be useful to investigate the ways these technologies can be used to enhance the real-time processing of data and the predictive maintenance. Also, the studies of AI-based services personalization to workers and more sophisticated autonomous systems might result in smarter and more adaptable manufacturing factories. The scalability and integration problems of AI-based ITSM plans to small and large factories and industries should also be studied further, which will help to implement these technologies more widely in the Industry 4.0 setting.

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