

## **Final Project Report**

### **Digital Transformation in Manufacturing: The Case of General Electric (GE)**

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## **Digital Transformation in Manufacturing: The Case of General Electric (GE)**

### **Abstract**

The manufacturing industry is facing challenges such as supply-demand imbalances, waste, and downtime, making digital transformation crucial for competitiveness. This report explores the significance of digital transformation in the manufacturing industry, focusing on General Electric (GE) as a case study. It highlights GE's emphasis on digital transformation, data analytics, and sustainability to address manufacturing challenges and promote sustainable growth. By leveraging data-driven decision-making and optimization, GE has improved operational efficiency and achieved positive outcomes. The report emphasizes the role of advanced technologies, such as AI and IoT, in driving innovation and transforming GE's operations. GE Digital has played a crucial role in supporting digital transformation efforts and offering software solutions to customers. Sustainability goals were also achieved through reduced resource consumption. Overall, GE's experience highlights the significance of digital transformation for addressing manufacturing challenges and promoting sustainable growth.

*Keywords: Manufacturing industry, General Electric, Digital, Decision making, Sustainability*

## **1. Introduction**

In the face of supply-demand imbalances, waste, and downtime, digital transformation has emerged as a crucial strategy for the manufacturing industry to maintain competitiveness. General Electric (GE) serves as an exemplary case of a company that has prioritised digital transformation in its manufacturing operations. By embracing digital technologies and harnessing the power of data analytics and optimization, GE has experienced a multitude of benefits.

Through its digital transformation efforts, GE has witnessed improved decision-making and streamlined operations (Daecher, A.,n.d.). By leveraging data analytics, the company gains valuable insights into its manufacturing processes, enabling it to identify inefficiencies, optimize resource utilization, and enhance overall operational efficiency. This data-driven approach empowers GE to make informed decisions in real time, leading to faster problem-solving and better outcomes. (Daecher, A.,n.d.)

Furthermore, GE's digital transformation journey has also contributed to achieving sustainability goals. By reducing resource consumption through optimized energy usage, water conservation, and material efficiency, the company has successfully minimized its environmental impact while improving profitability. GE's experience serves as a testament to the transformative power of digital transformation in addressing manufacturing challenges and promoting sustainable growth in the industry.

## **2. Need of the Study**

The manufacturing industry encounters various challenges that necessitate the need for digital transformation (Parris, C., n.d.). These challenges include:

- **Supply Chain Complexity:** Manufacturing operations rely on intricate supply chains that involve multiple suppliers, distributors, and logistics providers. Managing and optimizing these complex networks can be a significant challenge, particularly when dealing with global operations and fluctuating market demands. (Parris, C., n.d.)
- **Cost Management:** Manufacturers face constant pressure to optimize costs while maintaining quality standards. Rising raw material prices, labor costs, and overhead expenses pose challenges to profitability and competitiveness. (Parris, C., n.d.)
- **Operational Inefficiencies:** Inefficient processes, manual tasks, and outdated systems can hinder productivity, lead to delays, and increase operational costs. Streamlining operations and eliminating inefficiencies is crucial for maintaining a competitive edge. (Parris, C., n.d.)
- **Quality Control and Compliance:** Manufacturers must adhere to stringent quality control measures to ensure consistent product quality and comply with industry regulations. Monitoring and maintaining quality standards across production processes can be complex and resource-intensive. (Parris, C., n.d.)
- **Rapid Technological Advancements:** The manufacturing landscape is rapidly evolving with the advent of technologies such as artificial intelligence, automation, and the Internet of Things (IoT). Keeping up with these advancements and effectively integrating them into existing operations can be a challenge for manufacturers. (Parris, C., n.d.)
- **Skills Gap and Workforce Development:** The industry faces a skills gap, with a shortage of skilled workers who possess the necessary expertise in emerging technologies. Upskilling the existing workforce and attracting new talent is crucial for leveraging digital tools and driving innovation. (Parris, C., n.d.)

- **Global Competition:** Manufacturers operate in a highly competitive global market, facing competition from both domestic and international players. Staying ahead requires continuous innovation, efficient production processes, and the ability to meet customer demands quickly and effectively. (Parris, C., n.d.)

Digital transformation offers solutions to these challenges by leveraging advanced technologies, data analytics, automation, and connectivity (Daecher, A., n.d.). By embracing digital transformation, manufacturers can optimize supply chain management, improve operational efficiency, enhance quality control, adopt innovative technologies, bridge the skills gap, and stay competitive in the global market. It enables manufacturers to transform their operations, enhance productivity, and drive sustainable growth in an increasingly digital and competitive industry landscape (Parris, C., n.d.).

### 3. Aim

This study aims to examine the significance of digital transformation in the manufacturing sector, with a specific focus on General Electric (GE) and its digital transformation initiatives through GE Digital.

### 4. Objectives

- Investigate GE's data analytics culture, including their approach to data-driven decision-making and data governance practices.
- Understand how GE utilizes AI and BI to drive business decisions and offer client products, assessing their impact on operations, reliability, and innovation.
- Assess GE's readiness for Industry 4.0 and evaluate their global impact and potential for success.

## **5. Methodology**

This study employs an intense qualitative research approach to explore the significance of digital transformation in manufacturing, with a specific focus on General Electric (GE) as a case study. The methodology involves a comprehensive analysis of various sources, including research publications, websites of GE, YouTube videos, news articles, and blogs.

To gather relevant and reliable information, research publications related to digital transformation in manufacturing, case studies, and industry reports are extensively reviewed. These publications provide insights into the benefits, challenges, and best practices associated with digital transformation in the manufacturing sector.

The websites of GE serve as a valuable source of primary information regarding the company's digital transformation initiatives. By exploring GE's official website, specifically sections related to manufacturing, innovation, and digital transformation, valuable insights and case studies are gathered to understand the specific strategies and approaches implemented by GE.

YouTube videos provide visual and auditory content that showcases GE's digital transformation journey. These videos may include interviews with GE executives, demonstrations of digital technologies in manufacturing, and discussions on the benefits and outcomes of digital transformation.

News articles and blogs from reputable sources are analyzed to gain a broader perspective on GE's digital transformation efforts in manufacturing. These sources may provide industry insights, expert opinions, and case studies that highlight the impact and significance of digital transformation in the manufacturing sector.

By synthesizing and analyzing information from these diverse sources, this study aims to provide a comprehensive understanding of the benefits, challenges, and outcomes of digital transformation in manufacturing, using GE as an exemplar. The qualitative research approach

allows for an in-depth exploration of the subject matter and offers insights into the strategies and practices that can drive successful digital transformation in the manufacturing industry.

## **6. Overview of General Electric Company**

General Electric (GE) began with the merger of two electrical companies in 1892: the Edison General Electric Company and the Thomson-Houston Electric Company (Gaille, B., 2013). These companies were at the forefront of the electric revolution and were founded by prominent inventors and businessmen, including Thomas Edison and Charles A. Coffin. The merger created a powerful entity that could offer a wide range of electrical products and services. (Gaille, B., 2013).

In its early years, GE focused on the development and manufacturing of electric power systems, electric motors, and lighting. The company played a crucial role in the widespread adoption of electricity and the establishment of power grids across the United States and internationally. GE has a rich history of innovation and has been responsible for groundbreaking inventions that have shaped various industries. Some notable examples include the electric toaster, developed in the early 20th century, and the X-ray machine, which revolutionised medical diagnostics (Gaille, B., 2013).

Over the years, GE has expanded its operations into various industries, including power generation, aviation, healthcare, renewable energy, and finance (Gaille, B., 2013). In recent years, GE has faced challenges and embarked on strategic transformations to refocus on its core businesses. This has involved divesting non-core assets and streamlining its operations. Despite these challenges, GE remains a significant player in the industries it operates in.

Sustainability and environmental responsibility are key priorities for GE. The company is committed to providing advanced solutions that reduce environmental impact and promote



the transition to cleaner energy sources. It has invested in renewable energy technologies and aims to be a leader in the renewable energy sector (Gaille, B., 2013).

Overall, GE's legacy of innovation, commitment to sustainability, and diverse range of business operations make it a notable and influential company in the global market.

## **7. General Electric Digital**

As technology advanced and the digital era emerged, GE recognized the need to transform its operations and leverage digital solutions to stay competitive. The company embarked on a digital transformation journey to harness the power of data and analytics, enhance its products and services, and drive operational efficiency (Daecher, A., n.d.). GE Digital was officially launched as a subsidiary of General Electric (GE) in 2015. It was established to drive the company's digital transformation efforts and harness the power of data and technology to enhance operational efficiency and drive innovation across GE's businesses. (Finnegan, J., 2021)

The decision to establish GE Digital was driven by several factors. One key factor was the increasing recognition of the potential of digital technologies to transform industries, including manufacturing. GE saw the opportunity to leverage data analytics, automation, and connectivity to optimise its operations, improve productivity, and deliver better outcomes for its customers. (Anthonysmoak, 2018)

Additionally, GE recognized the need to adapt to the changing landscape of the industrial sector, often referred to as the Industrial Internet of Things (IIoT) or Industry 4.0. The proliferation of connected devices, the availability of massive amounts of data, and advancements in analytics presented new possibilities for driving efficiency, predictive maintenance, and overall business performance. (Anthonysmoak, 2018)

By establishing GE Digital, the company aimed to consolidate its digital capabilities and expertise under a dedicated entity. This allowed for focused efforts on developing software solutions, data analytics, and industrial automation technologies to drive digital transformation within GE and its customer base. (Anthony Smoak, 2018)

## 8. Data Analytics Culture at GE: Before and After

To understand the data analytics culture at GE and its impact on company operations, it is important to examine the before and after scenarios of data analytics adoption. The culture surrounding data analytics at GE has undergone significant changes, resulting in a more data-driven and analytical approach to decision-making (Massachusetts Institute of Technology, 2014).

### 8.1 Before Data Analytics:

During this period, GE's data analytics culture may have exhibited the following characteristics:

- **Limited Use of Data in Decision-Making:** Data was not extensively used to inform decision-making processes. Hierarchical structures, experience, and intuition played a larger role in decision-making than data and analytics. Overall, GE's decision-making processes relied more on experience and intuition rather than data and analytics. Data was not extensively used to drive strategic efforts or operational improvements. (Massachusetts Institute of Technology, 2014).
- **Data and Information Silos:** Data and information were stored in separate silos across different departments or business divisions, making it difficult to obtain a holistic view of the company's operations. This siloed approach hindered collaboration and limited

the organisation's ability to leverage data effectively. (Massachusetts Institute of Technology, 2014).

- **Lack of Data Literacy and Skills:** GE faced challenges in finding employees with the necessary data literacy skills to accurately analyse and interpret data. This limited the organisation's ability to extract meaningful insights from available data sources. (Massachusetts Institute of Technology, 2014).
- **Manual Reporting and Analysis:** Data collection and analysis processes relied heavily on manual methods, such as spreadsheets and manual data entry. The focus was primarily on historical data and static reports, lacking real-time or predictive insights. Data analysis was a manual and labour-intensive process, resulting in limited responsiveness and adaptability to market dynamics. This approach was time-consuming, prone to errors, and limited responsiveness to market dynamics. (Massachusetts Institute of Technology, 2014).
- **Limited Data-Driven Innovation:** GE had a limited focus on utilising data to drive innovation and explore new opportunities. Data analysis and insights were not actively used to identify emerging trends, customer preferences, or operational efficiencies. (Massachusetts Institute of Technology, 2014).

## 8.2 After Data Analytics Culture:

Following the adoption of data analytics at GE, the company's data analytics culture underwent significant transformations, characterised by:

- **Data-Driven Decision-Making:** There has been a shift towards a data-driven decision-making approach across all levels of the organisation. Analytics provided GE with insightful information and predictive power, enabling more informed and knowledgeable decision-making. GE utilises data insights to make informed choices,

optimise strategies, mitigate risks, and identify new possibilities. (Massachusetts Institute of Technology, 2014).

- **Integrated Data Management:** GE has implemented integrated data storage systems and platforms, enabling a unified view of data across departments. This integration promotes collaboration and facilitates more effective analysis by providing a comprehensive understanding of the company's operations.(Massachusetts Institute of Technology, 2014).
- **Advanced Analytics and AI Adoption:** GE has embraced advanced analytics techniques and AI technologies to enhance data analysis capabilities. Machine learning algorithms, predictive analytics models, and real-time data processing are utilised to derive valuable insights and enable proactive decision-making. (Massachusetts Institute of Technology, 2014).
- **Data Infrastructure Investments:** GE has made significant investments in data infrastructure, such as cloud computing and big data technologies. These investments have improved data storage, processing, and accessibility, enabling faster and more efficient data analysis and utilisation. (Massachusetts Institute of Technology, 2014).
- **Promoting Data Literacy:** GE prioritises the development of data analytics skills and data literacy among its employees. Training programs, workshops, and resources are provided to enhance employees' understanding of data analytics concepts and tools, enabling them to contribute effectively to data-driven initiatives. (Massachusetts Institute of Technology, 2014).
- **Data Governance and Quality Management:** GE implements robust data governance practices to ensure data accuracy, integrity, and security. Data quality standards, cleansing processes, and privacy protocols are established to maintain high-quality data for analysis. (Massachusetts Institute of Technology, 2014).

- **Agile Data-Driven Initiatives:** GE embraces agile methodologies in data-driven initiatives, enabling iterative and adaptive approaches to data analysis and decision-making. This promotes quicker insights, rapid experimentation, and continuous improvement. (Massachusetts Institute of Technology, 2014).
- **Data-Driven Innovation:** GE leverages data analytics to drive innovation by identifying market trends, customer preferences, and areas for product enhancements. Data insights are used to improve product development processes and explore new opportunities. (Massachusetts Institute of Technology, 2014).

The transformation of GE's data analytics culture has resulted in a more data-driven, collaborative, and agile approach. The integration of data, advanced analytics, and data literacy has empowered decision-making processes, improved operational efficiency, and facilitated innovation within the organisation (Massachusetts Institute of Technology, 2014).

## 9. Impact of Digital Transformation at GE

Digital transformation has revolutionised numerous industries and manufacturing is no exception. In an era driven by technology and data, manufacturers are increasingly recognizing the benefits of embracing digital transformation to enhance their operations. By leveraging advanced technologies, data analytics, and automation, digital transformation brings a multitude of advantages to the manufacturing sector (General Electric.,2022). From improving operational efficiency to enabling predictive insights and optimization, and driving sustainability and cost reduction, the impact of digital transformation is far-reaching. The impact of digital transformation at General Electric (GE) has been significant across various aspects of the company's operations:

- **Operational Efficiency:** By leveraging advanced analytics and data-driven insights, GE has been able to analyse and optimise its operational processes across various business divisions. The adoption of data analytics has allowed GE to track and evaluate operational workflows, identify bottlenecks, and allocate resources more effectively. As a result, GE has experienced increased productivity and streamlined procedures. By identifying inefficiencies and waste through data analysis, GE has been able to take proactive measures to address them in real-time. This has led to enhanced overall operational efficiency within the company. Furthermore, GE's focus on leveraging data analytics has also contributed to improved product quality. By utilising data to identify and address quality issues, GE has been able to optimise its manufacturing processes and ensure that its products meet the highest standards. It has resulted in improved operational effectiveness, reduced costs, and increased customer satisfaction (General Electric.,2022). By optimising resource utilisation and continuously analysing processes, GE has been able to enhance efficiency and deliver greater value to its customers.
- **Predictive Insights and Optimization:** By analysing data and utilising advanced analytics, GE can forecast future events and trends, allowing proactive decision-making and operational optimization. This includes identifying patterns, detecting anomalies, and predicting potential disruptions in the supply chain and production processes. With these insights, GE can take preemptive actions, such as adjusting production schedules and reallocating resources, to ensure smooth operations and improved efficiency. Additionally, GE has been able to scale software solutions across its operations, ensuring consistent and effective optimization efforts. In terms of asset management and maintenance, GE utilises sensor data, historical performance records, and predictive algorithms to predict equipment failures, improve asset performance, and

optimise maintenance schedules. This proactive approach has resulted in increased dependability, extended asset longevity, and reduced maintenance expenses for GE. (General Electric.,2022).

- **Sustainability:** GE leverages data analytics to optimise energy consumption, water usage, and material utilisation in its manufacturing processes. Through real-time monitoring and analysis of energy usage, GE identifies areas of high consumption and implements energy-saving measures to reduce its environmental impact. Similarly, GE optimizes water usage by identifying inefficiencies and implementing strategies to minimize waste. By leveraging data analytics, GE also optimizes material utilization, reducing waste and lowering its environmental footprint. Overall, digital transformation enables GE to proactively address sustainability goals and contribute to a more sustainable future. (General Electric.,2022).
- **Cost Reduction:** Digital transformation at General Electric (GE) has led to significant cost reduction by improving operational efficiency, optimizing resource utilization, and reducing waste. Through the use of advanced analytics and enhanced visibility into operations, GE can identify areas of inefficiency and implement measures to streamline processes and reduce costs. By leveraging data-driven insights, GE can make informed decisions that result in cost savings across its operations. This includes optimizing resource allocation, ensuring efficient use of materials and equipment, and identifying and mitigating sources of waste. The combination of operational improvements and data-driven decision-making enables GE to identify cost-saving opportunities and enhance profitability throughout its business divisions. Overall, digital transformation has played a crucial role in driving cost-reduction initiatives and improving financial performance at GE. (General Electric.,2022).

- **Customer-Centric Approach:** Digital transformation has empowered GE to adopt a customer-centric approach by leveraging advanced analytics. Through the analysis of customer data, GE gains deeper insights into customer preferences, needs, and behavior. This enables the company to tailor its goods and services to better align with customer expectations. By adapting marketing tactics based on data-driven insights, GE can effectively reach its target audience and deliver personalized experiences. This customer-centric strategy enhances client satisfaction, fosters stronger customer relationships, and ultimately drives revenue growth for GE. (General Electric.,2022).
- **Innovation and Product Development:** GE has embraced analytics as a crucial element of its innovation and product development endeavors. Through the utilization of data analytics, GE gains the ability to analyze industry trends, collect valuable customer input, and acquire insights into emerging technologies. This wealth of intelligence empowers GE to drive innovation by creating new products and improving existing offerings. By staying ahead of market trends and leveraging data-driven insights, GE maintains a competitive edge in a rapidly evolving market landscape. The integration of analytics into its innovation and product development process enables GE to make informed decisions, adapt to changing customer needs, and deliver cutting-edge solutions to the market. (General Electric.,2022).

## 10. Digital Transformation Strategy

GE Digital plays a crucial role in driving digital transformation in the manufacturing industry by providing software solutions and supporting customers in their optimization efforts. With its advanced tools and technologies, GE Digital enables manufacturers to harness predictive insights, reduce waste, and improve overall performance (Digital, G., n.d.). By leveraging data analytics, automation, and connectivity, manufacturers can streamline



operations, optimize resource utilization, and make informed decisions in real-time. Additionally, GE Digital empowers customers to achieve sustainability goals while enhancing profitability by optimizing energy consumption, water usage, and material utilization (Digital, G., n.d.). Through its comprehensive solutions, GE Digital is instrumental in helping manufacturers embrace digital transformation and thrive in an increasingly competitive and data-driven landscape.

GE's digital transformation strategy included several key initiatives:

- **Predix Platform:** GE developed Predix, an industrial Internet of Things (IoT) platform designed specifically for the needs of industrial companies. Predix enables the collection, analysis, and utilization of data from various machines and devices, enabling predictive maintenance, optimizing performance, and improving operational efficiency. (Digital, G., n.d.)

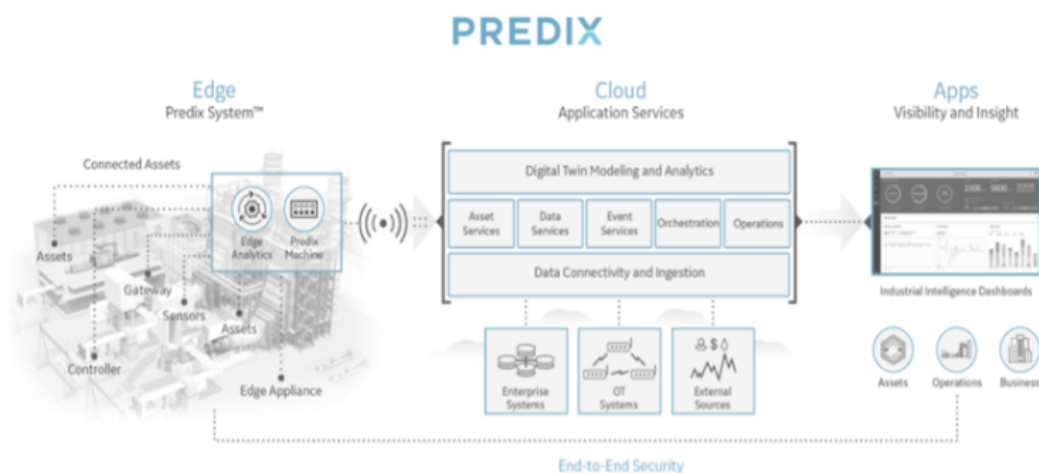


Figure 1: Process of Predix Machine

Source: How Does Predix Machine Fit into the Predix Platform? | Predix Edge Documentation | GE Digital. (n.d.).

- **Digital Twin Technology:** GE pioneered the concept of digital twins, which are virtual replicas of physical assets or systems. Digital twins enable real-time monitoring,

simulation, and analysis, allowing companies to optimize performance, predict failures, and improve product design and development. (Digital, G., n.d.)

- **Advanced Analytics and AI:** GE utilizes advanced analytics and artificial intelligence (AI) technologies to analyze large volumes of data generated by its industrial equipment and systems. This enables the identification of patterns, anomalies, and optimization opportunities, leading to improved performance, cost savings, and better decision-making. (Digital, G., n.d.)
- **Smart Manufacturing and Automation:** GE has embraced smart manufacturing and automation technologies to enhance its manufacturing processes. This includes the use of robotics, additive manufacturing (3D printing), and advanced automation systems to increase productivity, reduce costs, and improve product quality. (Digital, G., n.d.)
- **Digital Solutions and Services:** GE has expanded its offerings to include digital solutions and services that leverage its expertise in various industries. This includes remote monitoring, asset performance management, cybersecurity solutions, and cloud-based platforms for data storage and analytics. (Digital, G., n.d.)

Through these digital initiatives, GE has transformed its operations, products, and services. The company has become more data-driven, leveraging digital technologies to improve efficiency, enhance customer experiences, and deliver value-added solutions. By embracing digital transformation, GE has positioned itself as a leader in the industrial Internet of Things and continues to drive innovation in the digital era.

## 11. Application of AI and data analytics at GE

GE uses analytics software, which employs advanced analytics and modeling techniques to analyze historical data, uncover patterns and trends, and make data-driven

predictions. This helps in identifying risks, opportunities, and outcomes, enabling informed business decisions. GE Digital provides a range of analytics solutions designed to improve operations, reliability, and cost-effectiveness in industrial settings. These solutions utilize AI and data analytics to optimize asset performance, detect equipment failures, and enhance process efficiency. (Digital, G., n.d.)

GE utilizes AI and data analytics to drive business decisions and offer client products in the following ways:

- **Asset Performance Management (APM):** GE Digital's APM software suite utilizes predictive maintenance technologies to monitor assets, reduce downtime, and increase reliability. By detecting problems early and enabling planned maintenance, it helps in making proactive decisions and optimizing asset performance. (Digital, G., n.d.)

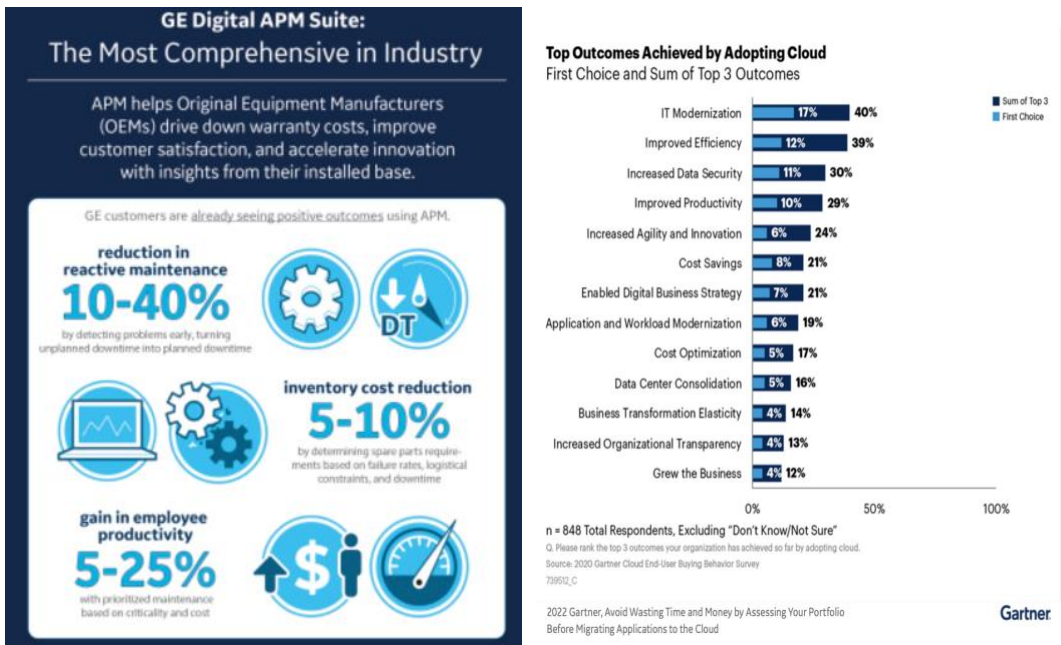


Figure 2: Impact of Asset Performance Management

Source: GE Digital announces latest version of its Asset Performance Management solution. (n.d.).

- **SmartSignal:** GE Digital's SmartSignal software enables the detection, diagnosis, forecasting, and prevention of equipment failures. By utilizing digital twin analytics, it

improves reliability and optimizes maintenance efficiency, leading to better decision-making and enhanced product offerings. (Digital, G., n.d.)



- **Process Analytics:** GE Digital offers TrendMiner, a web-based process analytics application that provides visualization and analysis of sensor-generated data. This helps in optimizing processes, troubleshooting issues, and driving continuous improvement, resulting in better business decisions and client products. (Digital, G., n.d.)
- **Grid Analytics:** GE Digital's grid analytics applications leverage AI and machine learning to deliver predictive insights for power networks. By optimizing network performance and providing real-time data-driven recommendations, GE enables effective decision-making and offers improved products and services to clients (Digital, G. n.d.-a).



Figure 4: Grid Analytics Software

Source: Grid Analytics Software | Energy Analytics | GE Digital. (n.d.).

- **Visual Intelligence:** GE Digital's Visual Intelligence platform combines AI and advanced analytics for vegetation management and asset inspection in power utilities. By identifying risks, reducing costs, and improving reliability and safety, GE enhances their business decisions and provides valuable products to clients. (Digital, G., n.d.)
- **Proficiency CSense and Proficiency Operations Analytics:** GE Digital's Proficiency CSense and Proficiency Operations Analytics are cloud-based software solutions that utilize AI and machine learning. They help in analyzing manufacturing data, optimizing operations, improving quality, and reducing costs. These solutions drive informed business decisions and enable the delivery of enhanced client products. (Digital, G., n.d.)

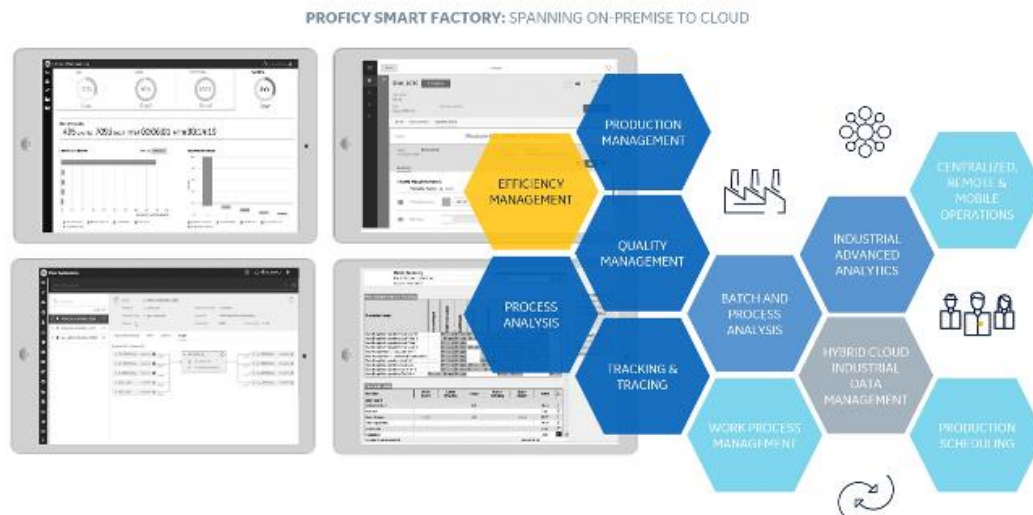


Figure 5: Proficy Smart Factory

Source: Proficy Smart Factory from GE Digital Transforms Manufacturing Efficiency, Quality and Throughput Through Insights and Intelligence | GE News. (n.d.)

- **Healthcare Imaging:** In the healthcare domain, GE applies AI in medical imaging to enhance diagnosis and treatment planning. AI algorithms can analyze medical images, detect anomalies, and assist radiologists in identifying potential health issues. (Digital, G., n.d.)
- **Natural Language Processing (NLP):** GE employs NLP techniques to extract insights from unstructured data sources such as text documents and customer feedback. NLP enables sentiment analysis, topic modeling, and text classification, which helps GE understand customer preferences, improve products, and enhance customer experiences. (Digital, G., n.d.)
- **Robotics and Automation:** GE utilizes AI and robotics in manufacturing and industrial processes to automate tasks and improve efficiency. Robots equipped with AI algorithms can perform complex tasks, enhance precision, and improve safety in various operations. (Digital, G., n.d.)





Figure 6: Robotics and Automation

Source: StackPath. (n.d.).

- **Intelligent Transportation Systems:** GE incorporates AI technologies in transportation systems to optimize traffic flow, manage congestion, and improve safety. AI-based algorithms analyze real-time data from sensors and cameras to make intelligent decisions for traffic management. (Digital, G., n.d.)
- **Energy Optimization:** AI is applied in energy management to optimize energy usage and reduce waste. GE uses AI algorithms to analyze energy consumption patterns, identify areas of improvement, and suggest energy-saving strategies. (Digital, G., n.d.)

Overall, by leveraging AI and data analytics, GE drives business decisions by gaining valuable insights, optimizing operations, improving reliability, and offering innovative products and solutions to their clients.

## 12. Application of BI and data analytics at GE

With a strong commitment to innovation and technological advancements, GE utilizes BI and data analytics across various areas of its operations, enabling informed decision-making, optimizing performance, and delivering enhanced products and services. By

harnessing the vast amounts of data available, GE is able to uncover patterns, trends, and opportunities that shape its business strategies and offerings. (General Electric., 2022)

GE utilizes various BI platforms to support its data analytics and decision-making processes. Some of the BI platforms used by GE include (General Electric., 2022):

- **Microsoft Power BI:** GE leverages Power BI for its data visualization and reporting capabilities. Power BI allows users to create interactive dashboards and reports, making it easier to analyze and interpret data.
- **Tableau:** Tableau is another popular BI platform used by GE. It offers advanced analytics and visualization features, enabling users to explore data and gain insights through interactive visualizations.
- **SAP BusinessObjects:** GE utilizes SAP BusinessObjects for enterprise reporting and ad-hoc analysis. This platform provides tools for data integration, reporting, and querying, enabling users to access and analyze data from various sources.
- **IBM Cognos:** GE also leverages IBM Cognos for enterprise reporting and business intelligence. Cognos offers a wide range of capabilities, including reporting, analysis, and dashboarding, to support data-driven decision-making.

BI and data analytics allow GE to make better business decisions and enhance its product offerings in several ways (General Electric., 2022):

- **Data-driven Insights:** BI platforms enable GE to analyze large volumes of data from multiple sources, helping them uncover valuable insights and trends. These insights drive informed decision-making across various business functions, such as operations, marketing, and sales.
- **Real-time Reporting:** With BI platforms, GE can generate real-time reports and dashboards that provide up-to-date information on key performance indicators (KPIs).



This allows stakeholders to monitor performance, identify areas for improvement, and make timely decisions.

- **Enhanced Data Visualization:** BI tools offer advanced visualization capabilities, allowing GE to present complex data in a visually compelling and easily understandable manner. This facilitates data exploration and communication, enabling stakeholders to grasp insights quickly and make informed decisions.
- **Predictive Analytics:** BI platforms often incorporate predictive analytics capabilities, enabling GE to forecast future trends, identify potential risks, and make proactive decisions. Predictive analytics helps GE optimize operations, reduce costs, and deliver better products and services to customers.
- **Improved Operational Efficiency:** BI and data analytics enable GE to identify inefficiencies and bottlenecks in its processes. By analyzing operational data, GE can streamline workflows, optimize resource allocation, and improve overall efficiency, leading to cost savings and better productivity.
- **Customer Insights:** BI platforms enable GE to analyze customer data and gain a deep understanding of customer behavior, preferences, and needs. This insight helps GE develop tailored products and services, enhance customer experiences, and drive customer satisfaction and loyalty.
- **Market and Customer Analysis:** BI and data analytics enable GE to gain valuable insights into market trends, customer behavior, and preferences. By analyzing large volumes of data, GE can identify market opportunities, understand customer needs, and develop targeted product offerings. This data-driven approach helps GE make informed decisions regarding product development, marketing strategies, and customer engagement, leading to increased customer satisfaction and competitive advantage.

- **Demand Forecasting and Inventory Management:** With the help of BI and data analytics, GE can accurately forecast demand for its products and optimize inventory management. By analyzing historical sales data, market trends, and other relevant factors, GE can predict future demand patterns, adjust production levels, and optimize inventory levels to ensure sufficient supply while minimizing excess inventory. This enables GE to meet customer demands efficiently, reduce carrying costs, and avoid stockouts or overstock situations.
- **Personalized Marketing and Customer Experience:** BI and data analytics enable GE to personalize its marketing efforts and enhance the customer experience. By analyzing customer data, such as purchase history, preferences, and demographics, GE can segment its customer base and deliver targeted marketing campaigns. This personalized approach improves customer engagement, increases conversion rates, and fosters customer loyalty.
- **Product Innovation and Development:** BI and data analytics provide GE with insights into market trends, customer feedback, and emerging technologies, which drive product innovation and development. By analyzing customer feedback, market research, and competitor data, GE can identify areas for improvement, uncover new product opportunities, and prioritize research and development efforts. This data-driven approach helps GE stay ahead of market demands and deliver innovative products that meet customer needs.

In summary, BI and data analytics empower GE to harness the power of data, make data-driven decisions, and optimize its business operations. These capabilities enable GE to improve its product offerings, enhance operational efficiency, and deliver value to its customers.

### **13. Case Study: GE Healthcare Transforms Healthcare with BI and Data Analytics**

GE Healthcare, a subsidiary of GE with a century-long legacy in the healthcare industry, is committed to revolutionizing healthcare through advanced technology. In partnership with Microsoft Azure and Power BI Embedded, GE Healthcare has developed the cloud-based Centricity™ Clinical Archive Analytics service. This case study examines how GE Healthcare leveraged BI and data analytics to optimize clinical decision-making and improve patient care outcomes. (GE Healthcare, n.d.)

#### **Objective**

In the field of medical imaging, the efficient storage, retrieval, and analysis of patient data are critical for healthcare providers. GE Healthcare, a global leader in medical imaging equipment and vendor-neutral archive (VNA) solutions, recognized the need to enhance their Centricity Clinical Archive (CCA) to enable healthcare providers to harness the power of data for improved patient care. (GE Healthcare, n.d.)

#### **Solution**

GE Healthcare implemented Centricity Clinical Archive Analytics, a solution built on Microsoft Power BI Embedded, as the business intelligence platform. After evaluating various analytics tools, Power BI Embedded emerged as the ideal choice due to its agility, efficiency, and ease of development. It enabled GE Healthcare to quickly transform their existing VNA into a powerful analytics-driven platform. (GE Healthcare, n.d.)

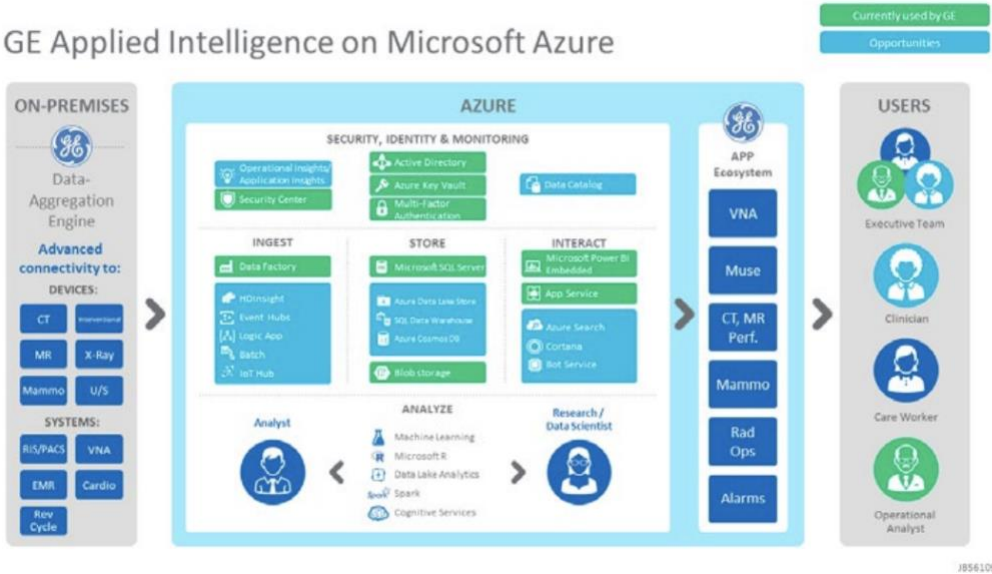
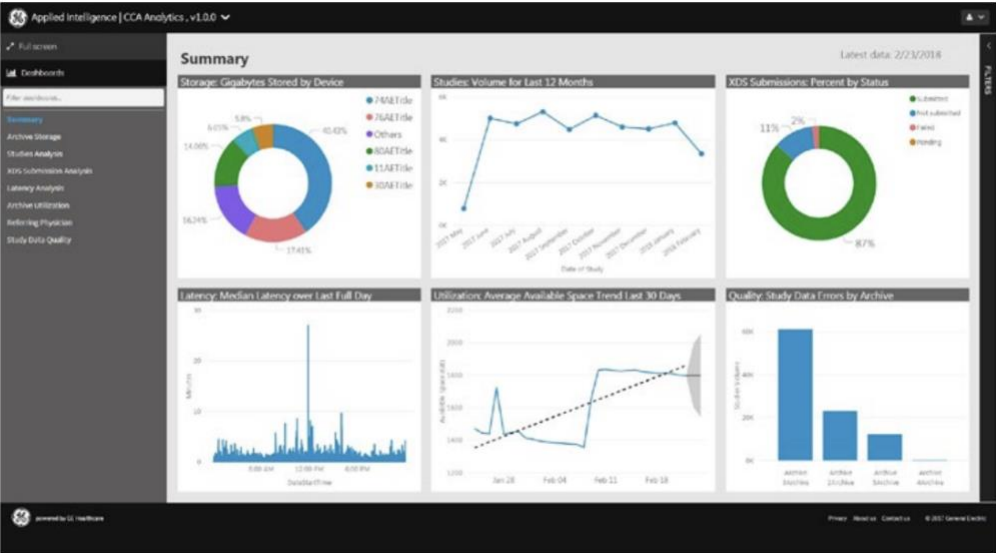


Figure 7: GE healthcare application using AI and BI

Source: GE Healthcare develops medical analytics solution in the cloud for better clinical outcomes. (n.d.). GE Healthcare.

Implementation

To validate the effectiveness of Centricity Clinical Archive Analytics, GE Healthcare conducted a pilot test with a leading academic medical center in the United States Northwest. The feedback received from the medical center's IT department helped refine the solution's functionality and usability, ensuring it met the specific needs of healthcare providers. (GE Healthcare, n.d.)

## Results

GE Healthcare's Centricity Clinical Archive (CCA) Analytics solution provided healthcare providers with valuable insights into their archive's usage and facilitated better decision-making. CCA Analytics plays a crucial role in ensuring assets in the archive have correct metadata, increasing the number of "diagnosis-ready" assets. Clinicians benefit from a more comprehensive view of their patients, enabling them to make well-informed decisions at the right time. The solution aligns with GE Healthcare's mission to enhance financial performance, operational efficiencies, and overall patient experiences. (GE Healthcare, n.d.)



Figure 8: Testimony from Director of Global Product Marketing of GE Healthcare

Source: GE Healthcare develops medical analytics solution in the cloud for better clinical outcomes. (n.d.). GE Healthcare.

## Market Differentiation

With the deployment of Centricity Clinical Archive Analytics, GE Healthcare established a unique position in the market by offering a cloud-based VNA analytics solution. Leveraging the capabilities of Microsoft Azure and Power BI Embedded, GE Healthcare differentiated itself from competitors and strengthened relationships with existing customers while attracting new partnerships. (GE Healthcare, n.d.)

### **Future Opportunities**

GE Healthcare views Centricity Clinical Archive Analytics as just the beginning of their larger mission to transform healthcare. With Azure services and Power BI Embedded, they have the scalability and potential to develop and deploy advanced algorithms aimed at further improving clinical care and operational efficiency. (GE Healthcare, n.d.)

GE Healthcare's successful implementation of Centricity Clinical Archive Analytics demonstrates the transformative power of BI and data analytics in healthcare. By leveraging Microsoft Azure and Power BI Embedded, GE Healthcare optimized clinical decision-making, improved patient outcomes, and strengthened their position as a leader in the industry. This case study showcases the value of BI and data analytics in driving better business decisions and delivering enhanced products and services in the healthcare sector.

### **14. General Electric - Stock Performance Trend using PowerBI**

The General Electric Company dataset available on Kaggle provides information and data related to the stock of General Electric (GE), a multinational corporation. The dataset includes historical stock prices, trading volumes, and other relevant financial metrics for GE (General Electric Stock Company Dataset., 2022).

Here's a brief overview of the dataset:

- **Date:** The dataset includes a column for the date of each recorded data point. This allows for the tracking of stock price and volume fluctuations over time.
- **Open, High, Low, Close:** These columns represent the daily stock price values for General Electric. The "Open" price is the price of the stock at the beginning of the trading day, while the "High" and "Low" prices indicate the highest and lowest prices reached during the day, respectively. The "Close" price represents the final price at the end of the trading day.

- **Volume:** The number of shares of General Electric stock that were traded during a specific trading day. It provides insights into the level of market activity and liquidity for GE stock.

The dataset can be used for various purposes, including analyzing historical price movements, identifying trends, conducting technical analysis, and developing predictive models related to General Electric's stock performance (General Electric Stock Company Dataset., 2022).

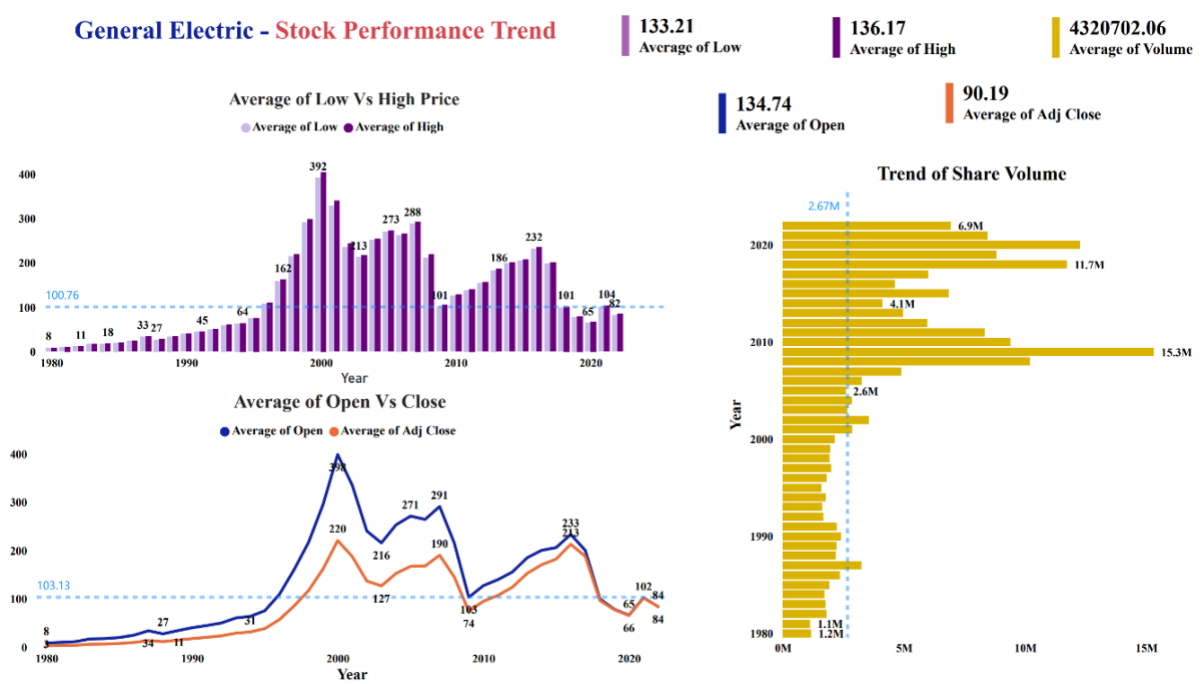


Figure 9: PowerBI dashboard of General Electric = Stock Performance Trend

Data Source: *General Electric Stock Company Dataset., 2022*

The above PowerBI dashboard provides the following key insights:

- General Electric's stock performance, based on the provided averages, indicates that the stock had a price range between \$133.21 and \$136.17. The average open price was \$137.74, suggesting initial trading sentiment, while the average close price was \$90.19, indicating potential declines by the end of each trading day. The average trading volume was 4,320,702.06 shares, reflecting moderate market activity and liquidity.

- From 1980 to 2000, General Electric stock exhibited a steady upward trend, indicating consistent growth and positive performance over the years. The highest stock prices in terms of high, low, open, and close were observed in 2000, indicating a peak year for General Electric's stock. However, it is interesting to note that the volume of shares traded during this period was below the average, suggesting that the price increase may have been driven by a smaller group of investors rather than widespread market participation.
- Following the peak in 2000, a decline was observed in the General Electric stock price, leading to an inconsistent pattern of fluctuating prices. The lowest stock price was observed in 2010, indicating a significant downturn in the company's stock value. Interestingly, during this period, the volume of shares traded was at its peak, suggesting heightened market activity and investor interest despite the declining stock price. This could imply that investors saw potential buying opportunities during the market downturn and actively traded the stock.

In conclusion, General Electric's stock performance has shown both positive and challenging periods. These trends indicate the importance of considering both price movements and trading volume for a comprehensive understanding of General Electric's stock performance.

The application of AI, BI, and digital transformation at General Electric (GE) has positively impact the company's stock price indirectly. By leveraging advanced analytics and AI technologies, GE can optimize asset performance, improve operational efficiency, and enhance customer experiences. These factors can contribute to improved financial performance and investor confidence, which may positively influence the stock price. However, the direct



impact of these technologies on the stock price could be influenced by various other factors as well.

## 15. GE as the Industrial Revolution 4.0 Leader

General Electric (GE) will need to adopt and accept a number of crucial strategies and considerations in order to maintain its position as a leader as Industrial Revolution 4.0 develops (General Electric., 2022):

- **Continuous Innovation:** GE should foster a culture of continuous innovation, encouraging employees to generate new ideas, explore emerging technologies, and develop cutting-edge products and solutions. By investing in research and development and staying at the forefront of technological advancements, GE can stay ahead of the competition and address evolving customer needs. (General Electric., 2022).
- **Strengthen Data Analytics Capabilities:** GE should continue to invest in data analytics capabilities and enhance its data literacy across the organization. This includes providing training and resources to employees to develop their data analytics skills and leveraging advanced analytics tools and platforms to extract valuable insights from data. Strengthening data analytics capabilities will enable GE to make more informed decisions, optimize operations, and drive innovation. (General Electric., 2022).
- **Strategic Partnerships:** GE should actively seek strategic partnerships and collaborations with other industry leaders, startups, and research institutions. By leveraging the collective expertise and resources of these partners, GE can accelerate innovation, access new markets, and co-create solutions that address complex challenges. Strategic partnerships can also help GE expand its technological capabilities and enhance its competitive advantage. (General Electric., 2022).

- **Sustainability Focus:** GE should continue to prioritize sustainability and integrate sustainable practices across its operations. This includes developing eco-friendly products, reducing energy consumption and carbon emissions, promoting circular economy principles, and supporting renewable energy initiatives. By aligning with sustainability goals, GE can attract environmentally conscious customers and contribute to a greener future. (General Electric., 2022).
- **Customer-Centric Approach:** GE should maintain a strong focus on understanding customer needs and delivering value-added solutions. This requires actively listening to customers, gathering feedback, and adapting products and services accordingly. By providing personalized experiences, addressing pain points, and delivering superior customer service, GE can strengthen customer relationships and differentiate itself in the market. (General Electric., 2022).
- **Cybersecurity:** As digital transformation advances, GE should prioritize cybersecurity to protect its systems, data, and customer information. This includes implementing robust cybersecurity measures, conducting regular audits, and staying updated on the latest cybersecurity practices and threats. By ensuring the security and integrity of its digital infrastructure, GE can instill trust and confidence in its customers. (General Electric., 2022).
- **Agile and Adaptive Operations:** GE should embrace agile methodologies and flexible manufacturing processes to respond quickly to market changes and customer demands. This includes embracing technologies like robotics, automation, and additive manufacturing to increase operational efficiency, reduce costs, and improve product quality. By being agile and adaptive, GE can stay competitive and effectively navigate the evolving business landscape. (General Electric., 2022).

By implementing these recommendations, GE can further strengthen its leadership position, drive sustainable growth, and continue to make a positive impact in the Industry 4.0 era.

## **16. GE's Commitment to Global Needs and Sustainability**

In today's rapidly changing world, the need for companies to address global challenges and support sustainable development has become more crucial than ever. General Electric (GE) is actively working towards this goal by focusing on reducing wastage, energy consumption, carbon emissions, and promoting proper utilization of oil and gas resources. With their extensive expertise and commitment to innovation, GE is positioning itself as a key player in driving positive change and addressing pressing global needs. (General Electric., 2022). By leveraging advanced technologies, investing in renewable energy, and developing sustainable solutions, GE is actively contributing to a more sustainable future and striving to make a lasting impact on a global scale. They have implemented various initiatives and solutions to tackle these challenges:

- **Energy Efficiency Solutions:** GE develops energy-efficient technologies and solutions across industries. They offer advanced gas turbines, energy management systems, and smart grid solutions to optimize energy consumption and reduce wastage.
- **Renewable Energy Technologies:** GE is a major player in the renewable energy sector, particularly in wind power. They have developed advanced wind turbine technologies to harness clean and renewable energy, reducing dependence on fossil fuels and lowering carbon emissions.
- **Digital Solutions for Efficiency:** GE leverages digital technologies like AI, IoT, and data analytics to optimize operations and improve efficiency. Through predictive

maintenance and real-time monitoring, they help industries reduce energy wastage, improve asset utilization, and minimize downtime.

- **Oil and Gas Optimization:** GE provides technologies and solutions to optimize oil and gas operations. They offer advanced drilling and production systems, asset performance management, and digital solutions to improve efficiency and reduce wastage in the extraction, processing, and distribution of resources.
- **Sustainable Energy Solutions:** GE's focus on clean, renewable energy sources aligns with the global need to transition to sustainable energy. Their technologies and solutions contribute to lowering carbon emissions and mitigating climate change.
- **Healthcare Innovations:** GE's healthcare sector creates digital solutions, diagnostic tools, and medical imaging technologies to enhance patient care globally. These technologies improve diagnostics, enable remote healthcare delivery, and increase access to quality healthcare in underserved areas.
- **Infrastructure Development:** GE's expertise in power generation, transportation, and industrial solutions contributes to global infrastructure development. Their goods and services help build effective transportation networks, reliable power grids, and industrial processes that promote economic development and raise living standards worldwide.

While GE has faced challenges, its resilience and adaptability have been demonstrated throughout its history. The company's success will depend on its ability to navigate the changing business environment, invest in digital transformation, and leverage emerging technologies. Innovation, customer satisfaction, and competitiveness will also be crucial for GE's performance in the global market.

Overall, considering GE's commitment to sustainability, industry experience, and focus on innovation, they have the potential to be successful in supporting global needs. By

continuing to invest in clean energy, driving efficiency, promoting resource utilization, and embracing digital technologies, GE can contribute to a more sustainable future and address the pressing global challenges.

### **Conclusion**

General Electric (GE) has made significant strides in embracing digital transformation, data analytics, and sustainability to maintain its leadership role in the era of Industry 4.0. By integrating data-driven decision-making, collaboration, and agility into its culture, GE has improved operational efficiency, facilitated innovation, and empowered its workforce. The company has leveraged advanced technologies, such as artificial intelligence, IoT, and automation, to optimize performance, reduce waste, and drive sustainability. GE Digital has played a crucial role in driving digital transformation in the manufacturing industry, providing software solutions and supporting customers in their optimization efforts. GE's digital transformation strategy has encompassed initiatives like the Predix Platform, digital twin technology, advanced analytics, and AI, smart manufacturing and automation, and expanded digital solutions and services. Through these initiatives, GE has transformed its operations, products, and services, positioning itself as a leader in the industrial IoT and driving innovation in the digital era.

### Recommendations

In today's rapidly evolving manufacturing landscape, embracing digital transformation is no longer an option but a necessity for staying competitive. As the fourth industrial revolution continues to reshape the industry, companies must adapt and leverage advanced technologies to enhance their operations. Based on the learnings from GE and GE Digital's strategies and initiatives, here are some recommendations for other manufacturing industries looking to embrace digital transformation and enhance their operations:

- **Develop a Data-driven Culture:** Foster a culture that values data-driven decision-making and encourages employees to embrace data analytics. Provide training and resources to enhance data literacy across the organization, empowering employees to leverage data for problem-solving, process optimization, and innovation.
- **Leverage Industrial IoT and Connectivity:** Invest in Industrial Internet of Things (IoT) technologies and connectivity solutions to capture real-time data from machines, equipment, and processes. Implement sensors, gateways, and data integration platforms to enable seamless data flow and facilitate data-driven insights.
- **Implement Advanced Analytics and AI:** Utilize advanced analytics and artificial intelligence (AI) techniques to unlock the value hidden in your data. Leverage machine learning algorithms to identify patterns, anomalies, and optimization opportunities, enabling predictive maintenance, quality improvements, and supply chain optimization.
- **Optimize Operations with Digital Twins:** Explore the concept of digital twins, which are virtual replicas of physical assets or systems. Digital twins enable real-time monitoring, simulation, and analysis, facilitating performance optimization, predictive maintenance, and continuous improvement.

- **Focus on Sustainability and Efficiency:** Prioritize sustainability and efficiency in your operations. Use digital technologies to optimize energy consumption, reduce waste, and enhance resource utilization. Embrace renewable energy sources and develop sustainable solutions that align with global sustainability goals.
- **Invest in Cybersecurity:** As you embrace digital technologies, prioritize cybersecurity to protect your data, systems, and intellectual property. Implement robust cybersecurity measures, conduct regular audits, and stay updated on the latest security practices to mitigate cyber risks and ensure the integrity of your digital infrastructure.
- **Continuously Innovate and Experiment:** Encourage a culture of innovation and experimentation. Allocate resources for research and development to explore emerging technologies and identify new opportunities. Foster an environment where employees are encouraged to propose and test innovative ideas that can drive operational improvements and create new revenue streams.
- **Monitor Performance Metrics and KPIs:** Define and track key performance metrics and KPIs to measure the impact of your digital transformation initiatives. Regularly monitor and analyze these metrics to evaluate the effectiveness of your strategies, identify areas for improvement, and make data-driven adjustments to achieve your business objectives.

By implementing these recommendations based on GE's experiences, manufacturing industries can unlock the full potential of digital transformation, optimize operations, enhance productivity, and drive sustainable growth.

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