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Cloud Manufacturing and Intelligent Network Importance in Healthcare Applications

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Abstract

Cloud manufacturing is a modern manufacturing method that takes advantage of the cloud computing technology to transfer traditional manufacturing processes into services. It involved various services and resources like software, hardware, data items, and expertise. This chapter discusses on six aspects of cloud manufacturing. They are, first, key components of cloud manufacturing like cloud infrastructure, Manufacturing-as-a-Service (MaaS), and Virtualization, which are explained. Second, the importance of integration of cloud manufacturing in healthcare and applications in its integration were provided. Third, fundamentals of cloud manufacturing technical foundation were provided. Fourth, the traditional healthcare manufacturing and their disadvantages were discussed in detail. Q1 Fifth, cloud-based solutions for the integration of cloud manufacturing in healthcare are discussed. Finally, case study and applications in healthcare manufacturing using cloud manufacturing are discussed.

Keywords: Cloud manufacturing, healthcare, traditional healthcare manufacturing, fundamentals of cloud manufacturing

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12.1 Introduction

Cloud manufacturing is defined as a modern manufacturing method that makes use of the cloud computing technology to transfigure traditional manufacturing processes into services. The cloud-based environment is an amalgamation of various manufacturing resources and capabilities such as hardware, software, data, and expertise. It provides these resources as a scalable on-demand service over the web, which can be viewed as age-old cloud computing and storage services. The platform provides these resources as an ascendable on-demand service over the web [1, 2].

12.2 Key Components

1. Cloud Infrastructure:
The cornerstone of the cloud manufacturing is the adaptable cloud infrastructure containing servers, storage, and network capabilities. These resources can be catered to suit your manufacturing needs and are provided by a cloud service provider (CSP).

2. Manufacturing-as-a-Service (MaaS):
The main key concept of cloud manufacturing is the **"Manufacturing as a Service (MaaS)"** [3]. It provides numerous manufacturing functions as services. This is inclusive of everything from manufacturing and standard control to simulation and design. The unique pay-as-you-go options for these services allow commercial setups to have an advantage of these services without making huge lump sum payments.

3. Virtualization:
Various virtualization procedures such as virtual machines and containers facilitate different manufacturing procedures to be isolated and monitored on the same physical hardware. Virtualization is important to cloud manufacturing as it allows for more efficient use of physical resources.

4. IoT (Internet of Things):
IoT devices play a key role in cloud manufacturing by providing the real-time data from number of production processes. These devices use sensors to monitor and collect data about environmental conditions, machine functioning, and other prominent criteria and send it to cloud for the final analysis and decision-making task [4].

5. Big Data and Analytics:
Vast amounts of the data generated in the industrial setups by IoT devices and other sources are influenced by big data analytics. These solutions provide data analysis feedbacks that help predict maintenance requirements, provide processes optimization, and improve product quality [5].

6. Artificial Intelligence (AI) and Machine Learning (ML):
To enable automation and intelligent decision-making, the cloud manufacturing systems increasingly leverage AI and ML technologies. Through this technology, we can optimize manufacturing planning, predict product demand, and improve supply chain logistics.

7. Service-Oriented Architecture (SOA):
The SOA is the most commonly used architecture in cloud manufacturing systems. It enables the modularization of various manufacturing services, making it simpler to collaborate, control, and improve many components of the manufacturing process [6].

8. Cyber-Physical Systems (CPS):
The CPS is nothing but the integration of physical processes and computing systems. CPS allows digital systems to manage and monitor real-time physical production processes in cloud manufacturing [7].

9. Security and Privacy:
Because manufacturing data is critical, the cloud manufacturing solutions include strong security features. This requires data encryption, access controls, and secure communication protocols to save sensitive information and intellectual property from attacks [8, 9].

12.3 Benefits of Cloud Manufacturing

Scalability: Organizations can adjust manufacturing capabilities based on demand without requiring huge initial investments.
Cost Efficiency: Using some cloud-based resources and MaaS, businesses can reduce the labor, infrastructure, and maintenance costs.
Flexibility: Cloud manufacturing has the ability to work with new processes and technologies, allowing you to speed up the adjustments to market changes.
Collaboration: Cloud platforms facilitate collaboration among various stakeholders such as designers, suppliers and customers, thereby increasing the innovation and overall efficiency of the manufacturing process.

Challenges:
Data Security: Data security is an important concern, specifically when it comes to protecting privately produced data from online attacks.
Standardization: The dearth of defined protocols and interfaces can disturb the interoperability between different cloud manufacturing systems.
Regulatory Compliance: It is difficult to comply with industry-specific rules and guidelines in a cloud environment.

Cloud manufacturing represents a significant change in manufacturing, not only bringing many benefits in terms of flexibility, efficiency, and cost savings but also creating new challenges that need to be addressed.

12.4 Importance of Healthcare Applications

12.4.1 Integrating Cloud Manufacturing in the Healthcare Sector

The integration of cloud manufacturing in the healthcare has a significant impact on improving the availability, effectiveness, and quality of healthcare services [10].

Some of the important points that tell us about this integration are as follows:

1. **Enhanced Supply Chain Management Simplified Operation:** Optimizing the medical supply chain is only possible through cloud manufacturing because it provides real-time visibility into the medical devices, status of drugs, and consumables, and, so, healthcare providers can process orders, track inventory levels, and schedule deliveries more efficiently [11].
2. **Cut Costs:**
   Healthcare companies can reduce waste by implementing cloud-based supply chain architecture. This can lead to lower storage costs and avoid shortages of essential goods. Scaling of resources based on demand and control costs is possible by the pay-as-you-go model of cloud services.
3. **Personalized Medicine and Patient Care Customization and Flexibility:**
   3D printing technology of cloud makes it more efficient in personalizing implants and medical devices, such as prosthetics and dental implants [12].

4. **Data-Driven Treatment Plans:**
   The data-driven strategy supports the development of personalized treatment plans and improves patient outcomes. Healthcare professionals can now analyze large amounts of patient data, including genetic history and medical history, by integrating cloud-based analytics [13].
5. **Telemedicine and Remote Patient Monitoring Accessible Healthcare Services:**
   To improve access to healthcare in poor and rural areas, the cloud manufacturing supports the development and implementation of telemedicine solutions. This includes cloud-based monitoring devices that provide healthcare professionals with patient data, virtual consultations and remote testing [14].
6. **Real-Time Monitoring:**
   Through IoT devices connected to the cloud platform, patients' vital signs and medical parameters can be continuously tracked this real-time data collection, which allows medical professionals to detect abnormalities early, greatly assisting to avoid serious health problems and reduce the number of readmissions.

12.4.2 Efficient Resource Utilization Optimized Resource Allocation

With the help of cloud manufacturing, healthcare organizations may be able to make the most of their medical equipment and other resources. Healthcare providers can enhance service delivery, manage resources, and minimize downtime more efficiently by examining usage trends and demand forecasts.

Scalable Solution: Healthcare companies can quickly expand resources in response to events such as epidemics or increased patient demand with the help of the scalability feature of the cloud. Being flexible is highly crucial in order to respond to unexpected problems in medical needs.

12.4.3 Improved Data Management and Security

Consolidated Data Storage: Cloud services provide consolidated, safe storage of medical records, such as patient information, imaging reports, and research outcomes. Data consistency across different health systems is assured by this consolidated structure of the data. This centralization can also reduce the concept of replication and makes data management easy [15].

Latest Safety Measures: Leading CSPs have stringent security precautions in place, including unauthorized access restrictions, frequent security checkings, and data encryption. You can save the sensitive medical data against any unwanted access and cyber risks by maintaining these precautions.

12.4.4 Innovation and Research Accelerate Research

To assist the medical researchers to firstly process and analyze large datasets, technologies like cloud computing and big data analytics are required. These enhanced capabilities will speed up research in fields like drug discovery, genetics, and epidemiology, which can help, greatly leading to new therapies and treatments.

12.4.5 Cooperation Platform

To design innovative medical treatments, cloud-based solutions make use of the collaboration among patients, researchers, and healthcare professionals, facilitating data exchange and thereby promoting creativity [16].

12.4.6 Regulatory Compliance and Reporting Simplify Compliance

To automate the process of compliance tracking and reporting to agree with Q3 regulations such as U.S. HIPAA, healthcare providers can make use of cloud production systems. By doing so, it can also assist the pharmacy companies decrease the load of administrative tasks and avoiding legal issues.

12.4.7 Data Review and Traceability

Cloud systems provide extensive capabilities of information logging and auditing in order to track the start point and management of healthcare data. Patient safety, regulatory compliance, and quality assurance depend on this traceability.

12.5 Fundamentals of Cloud Manufacturing Technical Foundation

Each technology makes manufacturing processes more scalable, innovative, and efficient. Successful implementation of cloud manufacturing requires combination of cutting-edge technologies. The big data, Internet of Things (IoT), AI, and cyber security are key technology pillars. We can expand each of these in detail in the coming paragraphs.

12.5.1 Internet of Things (IoT)

Outline: The term Internet of Things (IoT) is a network of "things," or physical systems, equipped with software, sensors, and other technologies that organize and share data over the Internet. IoT plays a major role in cloud production because it is accountable for connecting different components of the production ecosystem like products, machinery, tools, and logistics.

Key Functions in Cloud Manufacturing:

Real Time Monitoring:
IoT devices give valuable information that can be utilized to standardize the functions and reduce the unproductive time by continuously managing and controlling environmental situations, machine performance, and production functions.

Predictive Maintenance:
IoT systems can help in computing the data of the sensor to meticulously predict equipment issues, which causes timely disturbances and decreasing unplanned non-productivity.

Supply Chain Management:
IoT-equipped tracking solution can improve supply chain responsiveness and productivity by providing real-time view into the status and knowing the location of raw materials, finished goods, and work updates.

Advantages:

- Improve transparency and supply chain responsiveness.
- Reduce downtime and maintenance costs.
- Improve consistency and product quality.

12.5.2 Big Data

Introduction: "Big Data" is nothing but the vast amounts of organized, unstructured data generated from various sources from the production process. Big data technology is utilized in cloud production to save, process, and analyze data to process actionable views that inspire decision-making and foster creativity.

Key Functions in Cloud Manufacturing:

Data Integration:
By summing up data from multiple sources such as consumer databases, enterprise resource planning systems, and IoT components, big data platforms present a detailed overview of the manufacturing processes.

Analysis and Visualization: Analyzing the information with state of the art analytics tools to create new trends, patterns, and anomalies. Providing a detail of complex information is only possible by using visualization tools to present the information in an easy-to-understand way, assisting in making decisions quickly.

Optimization and Prediction:
Big data analytics in areas like stock management and control, standard control, and production scheduling pave the way for optimization and improvement. To predict demand, making stock management and production scheduling more precise predictive analytics can be utilized.

Advantages:

- Strengthen strategic planning and decision-making
- Better consumer insights and customized products
- More accurate inventory management and demand forecasting
- Improve operational efficiency and productivity

12.5.3 Artificial Intelligence (AI) and Machine Learning (ML)

Outline: The combination and interoperation of numerous cutting edge technologies that enable the robots to act like humans, including training, reasoning, and consisting problem solving skills is known as AI. The part of AI that involves training algorithms to recognize patterns in data and

make decisions and predictions basing on the patterns without any external and explicit programming is termed as machine learning (ML).

The important features of cloud production:

Process Optimization:
To identify the flaws and optimize the methods and to work on the waste management, thereby increasing throughput, AI systems can perform analysis of data from production lines [17].

Quality Control:
Data ML models can recognize any defects in the products, reduce the percentage of non-compliance products, and assure consistency and quality by examining photos and sensor.

Predictive Maintenance:
To know when the data requires maintenance, to decrease the unproductiveness and to extend the wear and tear of the equipment, AI systems check the machine data.

Automation and Robotics: Systems can also assure safety and productivity.

Advantages:

- Improve security and reduce human error
- Reduce operating expenses
- Increase productivity and efficiency
- Improve product quality and consistency

Cyber Security

Outline: Cyber law and protection is defined as securing the data saved in the computer networks, systems, and production.

Cloud Manufacturing-Key Points

Data Protection:

Conserving critical industrial information such as intellectual property and customer data from attacks or loss is done by measures in cyber laws such as encryption and access restrictions.

Threat Detection and Response:

To verify and react to real time cyberattacks, modern cyber security systems depend heavily on AI and ML [18].

Regulatory Compliance:
It is guaranteed by cyber laws that cloud manufacturing activities comply with relevant laws such as HIPAA and GDPR, securing the business and its customers [19].

Advantages:

- Enhance trust and confidence among partners and customers
- Comply with legal standards
- Minimize financial losses and reputational damage caused by cyberattacks
- Protect personal information and intellectual property

12.5.4 Traditional Healthcare Manufacturing

Overview: One aspect of traditional medical manufacturing is manufacturing drugs, medical devices, and equipment. Historically, these processes have been known for accuracy, strict regulations, and quality controls to ensure effectiveness and patient safety. Although these traditional manufacturing methods are important to healthcare, they often have disadvantages that impact productivity, cost, and innovation [20].

12.5.5 Pharmaceutical Manufacturing

The process of pharmaceutical manufacturing includes the processes of formulation, production, quality control, drug discovery, and development. Steps include the following [21]:

Research and Development (R&D):
After conducting extensive research to identify promising drug candidates, preclinical testing is an important next step.

Recipe Development:
Drug dosage forms (tablets, capsules, injections, etc.) are created and checked for stability and bioavailability in this step.

Manufacturing:
The actual manufacturing process includes the formulation, and packaging of active pharmaceutical ingredients. The two examples of manufacturing techniques are aseptic processing and chemical synthesis.

Quality Control and Assurance:
To ensure that medicines meet the safety and effectiveness standards set by regulatory agencies such as the FDA and EMA, comprehensive testing and validation is critical. Q5

Main Features:

- Strong regulatory oversight and compliance requirements
- Complex supply chains and production procedures
- Extended delivery times and high R&D costs

Medical Equipment Processes Involved:
Medical device manufacturing consists of the production of a variety of products, from simple tools to complex, high-tech equipment. This process usually includes the following:

Design and Development: Includes design, conception, and prototyping of devices considering safety, usability, and biocompatibility [22].
Material Selection and Procurement: Materials that meet medical standards and specifications are selected.
Manufacturing and Assembly: Examples of equipment include disposable instruments such as needles and heavy machinery such as MRI scanners. The manufacturing procedures consist of sterilization, assembling of electronic devices, molding, and machining. Q6
Validation Testing: Thorough testing such as testing for resilience assessments, biocompatibility validation and clinical experiments are needed to assure that the device is safe to use and performs as needed.

Main Features:

- Comprehensive after-sales support and maintenance services
- Introduction of cutting-edge technologies (software, AI, etc.)
- Extended product life and significant capital investment

Disadvantages with the Traditional Systems
Traditional manufacturing systems play a crucial role in pharmacy industry, but still they often face numerous adversities.

12.5.6 High Cost and Low Efficiency

High Cost Factors:
Research Development and Compliance with Regulations: Lengthy processes of approval and clinical studies may cause rise in costs. High prices of research costs and regulatory compliance can also increase expenses.
Labor and Raw Material Costs: For raw materials and professional labor strictly regulated companies often face heavy prices.
Production Flaws: Longer waiting time, waste, and incompetence are the ill effects caused by traditional batch processing techniques.

12.5.7 The Supply Chain Is Complex Supply Chain Characteristics

Global Sourcing: Supply chain disturbances are caused because of high reliability on international parts and raw materials and cargo.
Rule Fluctuation: The concept of dealing with different regulatory needs in different locations brings more complexity.
Risks: The disturbances in the supply chain can lead to the dearth of emergency medicines and medical equipment as with the rise of the diseases like the COVID-19 pandemic. Also, the complexity of the supply chain can make the introduction of new products late.

12.5.8 Limited Flexibility and Scalability the Production System Is Not Flexible

For specific products, the traditional manufacturing methods rely on rigid, dedicated production lines. To quickly scale up production or pivot to new products in response to emergencies or changing market demands, it becomes cumbersome.

Scalability Issues:
Significant time and capital is requires for scaling up production, which may make it difficult to meet unexpected surges in demand for complex medical devices and pharmaceuticals.

12.6 Quality Control and Assurance Task

Maintaining a consistent level of product quality is crucial in the healthcare sector, as even small defects can have a negative impact. Throughout

the manufacturing process, traditional systems struggle to maintain high quality standards which can lead to recalls and compliance issues [23].
Impact: Challenges in quality control can ultimately lead to government fines, product recalls, and patient injuries and can damage a company's finances and image.

Q7 **New and Compatible Obstacles**
New Disability:
Investment in new technology and technology is uncertain due to the uncertainty of the wind and the uncertainties of production and commercialization.
Adjustment Issue:
To change the structure of the market and to lead to lost opportunities to harmonize with the competition, it is possible to continue to build a new technology.

12.6.1 Integration of Cloud Manufacturing in Healthcare

Basic Solution: It is a specific basic practice settlement solution that can be used by medical manufacturers.
Case Studies and Illustrations: Practical examples and case studies, medical and healthcare industry manufacturing, special medical equipment manufacturing, comprehensive distance medicine, and Japanese product manufacturing.
Digital Science and Intelligence Factory: For medical and health products, productions understand the digital science and technology factory.

Benefits of Cloud Manufacturing in Healthcare
Efficiency and Basic Training: Examine simultaneous high school productivity and how to create a low-download.
Standardized Personalization: Understand standardized medical and health solutions and how to create a customized product.
Extensible Conformity: A research-based system of conformity and extensibility.

Challenges and Considerations
Safety Measures: An important issue for me and the medical staff is the safety.
Compliance with Regulations: In this, the environment and compliance standards of the law are explained.
Integration of Interoperability: One of the challenges here is to combine the basic design of the departments in the medical and healthcare industry and the integration of technology.

Future Trends and Directions
Emerging Technologies: It is possible to talk about AI and ML.
Futuristic Use: An exhibition of potential use in the area of consideration.
Effect on Global Healthcare: Considering how the system got affected, and how the system was created, the medical and healthcare in various parts of the world, it was also possible to study the current situation at the same time.

Integration of Cloud Manufacturing in Healthcare
In this article, we will know about the details of the implementation of the solutions based on the key points, production of the medical and healthcare industry, the practical case studies and the new concepts, and examples of the number science and technology workshop. The goal is to deeply understand how to improve patient care, develop a new medical clinic, and improve efficiency.

Cloud-Based Solutions
The development of medical and health production is to provide various tools, construct the basic technology of the company, change the number of operations, and increase the number of companies in various stages of production and provide additional tools. In this article, we will explore specific cloud-based technologies that are significantly affecting the healthcare industry.

12.6.2 Cloud Manufacturing Platforms

The production platform is an integrated system that gives a detailed management solution for the life cycle of the world. In addition, it has various functionalities such as flat platform communication, integrated design, centralized communication, quality control, logistics, medical assistance, production, industry maintenance standard, medical production, quality and quantity integration standard, reform production management department, and additional land management resources.

Key Components:
Design and Simulation Tools: Based on the basic CAD technology, it is possible to create a virtual prototype swiftly, and it takes less time to create a building prototype [24].

Production Management:
This solution provides automatic flexibility, practicality, time control, performance, and other functions, ensuring well-regulated production.

Quality Assurance:
With the help of integrated quality management systems (QMSs), real-time tracking and auditing capabilities guarantee that all products meet regulatory needs [23].

Advantages:

- It is possible to lengthen the harmony and activate the demand for continuous change.
- Concentrated numbers can be changed for a better performance.
- Reduced base construction allows for more savings.

12.6.3 Telemedicine and Remote Healthcare Services

By making use of cloud-based technologies, telemedicine enables remote delivery of medical treatments, virtual consultation, including remote diagnostics, and patient monitoring, increasing healthcare accessibility and prevailing over geographic obstacles.

Key Features:

Virtual Consultations:

Video calls allow patients and healthcare providers to talk without the need for an in-person visit. This is particularly advantageous in areas with mediocre medical facilities.

Q8 **Remote Diagnostics:**
Patient Monitoring:
Advantages:

- Improve patient involvement and treatment compliance
- Custom medical devices and additive manufacturing
- Facilitates patient access
- Decrease healthcare costs and resource utilization

The exceptional rise in demand for personalized healthcare solutions is driving the fame of cloud-based development and manufacturing services. These services will make use of add on manufacturing (3D printing) to develop custom medical devices such as transplants, orthotics, and prosthetics for individuals [25].

Main Components:

Cloud-Based Design Tools:
These tools when used properly can influence data related to patients to help medical devices, ensuring accurate fit, and correct working.

Additive Manufacturing:
3D printing can always develop complicated medical devices in fewer amounts of time and at a reduced cost than old methods.

Supply Chain Integration:
The cloud atmosphere maintains the complete supply chain from deployment to design guaranteeing extraordinary standard control and collaboration.

Advantages:

- Customize medical equipment to enhance patient outcomes
- Efficient manufacturing, especially for devices with high complexity and limited quantities
- Decrease time to market for new designs and customized products

Case Studies:

Cloud manufacturing operations in the healthcare industry exhibit its capacity for innovation. This section throws focus on important examples and case studies demonstrating the uses of cloud-based solutions to specific complex situations and opportunities in the medical field.

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12.6.4 Working

Cloud-based telemedicine technology is majorly used by people in the healthcare industry to perform online meetings. By combining and collaborating these platforms with electronic health records (EHRs), doctors can remotely check and monitor the patient care, manage medications, and view patient previous medical records.

Outcomes:
Improved Accessibility:
Cloud-based telemedicine technology is prominently used by medical professionals for virtual consultations. These platforms integrate with EHRs, allowing physicians to remotely look into manage medications, patient care, and view patient medical histories.

12.7 Economical Aspect

12.7.1 Improved Patient Involvement

Patients are encouraged to ask medical suggestions on time through possible available virtual consultations and stick to their treatment plans.

12.7.2 Customized Prosthetics and Orthotics

Background Study: Ancient methods of designing prosthetics orthotics and often result in an approach where only one size is manufactured and patients suffer due to the misfitting, which is painful and does not yield proper responses for individuals with specific anatomical needs.

Q9 **12.7.3 Working**

Companies like Limb Forge and UNYQ maintain cloud-based platforms to create and produce custom prosthetics and orthotics. These platforms use scanning and 3D printing technology to create devices that specifically match the patient's anatomy.

12.7.4 Outcomes

Improved Fit and Comfort:
These customized devices will fit the patient's body very naturally, enhancing comfort and utility.

Reduced Production Time: The usage of 3D printing and digital design significantly reduces the time required to make custom gadgets [26].
Cost-Effectiveness: If we decrease the cost of production through additive manufacturing, then more people will be interested to buy personal devices.

12.7.5 Drug Production and Quality Control Context

Pharmaceutical production requires continuous quality control, but traditional techniques can be cumbersome and time-consuming.

Working:
A pharmaceutical company implements a cloud-based analytics platform and QMS. These tools provide real-time data analysis monitoring to ensure that all manufacturing processes comply with strict legal requirements [27].

Outcomes:

Improved Biddability: An integrated QMS ensures that all processes agree with regulatory standards, thereby reducing the risk of non- compliance.

Increase Productivity: Instant data analysis facilitates to quickly find and sort out issues, reduce waste, and increase overall productiveness.

Improved Product Quality: Regular monitoring and quality control produces reliable medicines.

Digital Twins and Smart Factories:
Emerging technologies such as digital twins [28] and smart factories are the ameliorating healthcare production by enhancing product standards, giving new methods to augment processes and increase operational efficiency.

Applications in Healthcare Manufacturing:
Product Design and Testing: Manufacturers can use digital twins to reproduce and make better product designs, identify potential problems and enhance the processes before going into production.

Streamlining a Process: Digital twins provide performance assessments by replicating the complete production process, which allows better resource utilization and continuous improvement.

Predictive Maintenance: Digital twins check equipment health and predict failures, facilitating reduction of downtime and preventive maintenance.

Advantages:

- Save money and time on testing and product development
- Production process enhancement and monitoring
- Improve dependability and equipment maintenance costs

12.7.6 Smart Factory

Smart factories use latest technologies such as automation, artificial intelligence, and the big data and form a highly coordinated smart industrial domain. These factories can autonomously manage the production processes, respond to real-time changes, and optimize operations [29].

Applications in Healthcare Manufacturing:
Automation and Robotics: Smart factories make use of automation and robotics for intricate production processes such as assembly and packaging to achieve greater steadiness and correctness [30].

Real-Time Data Analysis: Uninterrupted analysis and data collection contribute to real-time decision-making, improving standards and efficacy.

Unified Systems: Smart factories integrate various systems such as supply chain management, production and distribution to assure optimized operations and decreased delay time [31].

Advantages:

- Improve adaptability to changing market demands
- Improve product traceability and quality assurance
- Improve outcomes

12.8 Conclusion

The amalgamation of cloud manufacturing in healthcare is transforming the industry by producing unparalleled levels of customization, efficiency, and innovation. Cloud-based solutions provide the infrastructure and capabilities that are required to fasten up industrial procedures, improve the patient care, and decrease costs. Some real-world examples and case studies give a glimpse of the real-world applications and advantages of these ideas and technologies like digital twins and smart factories. They provide a view of futuristic healthcare manufacturing and production. As the industry is expanding, it is very important to adopt these latest technologies to solve current medical problems and encounter the requirements of patients around the world.

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