

Drones in Manufacturing

Matthew N. O. Sadiku¹, Paul A. Adekunle², Janet O. Sadiku³

¹Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA

²International Institute of Professional Security, Lagos, Nigeria

³Juliana King University, Houston, TX, USA

ABSTRACT

Drones, also known as unmanned aerial vehicles (UAVs), are rapidly taking the world by storm, and their impact on manufacturing is significant. They are generally unmanned aerial vehicles. They can navigate treacherous terrain, gather critical data, and perform assessments without risking human lives. In the world of rapidly evolving technology, drone manufacturing stands out as a field combining innovation with precision. From agriculture to construction, logistics to environmental conservation, drones have found their way into diverse sectors. This paper delves into the applications, benefits, and challenges of drones in the manufacturing sector.

KEYWORDS: *drones, unmanned aircrafts, unmanned aerial vehicles (UAVs), manufacturing*

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INTRODUCTION

Drones, once known as outdoor toys for kids and teenagers, turned out to have immense potential to transform various industries. This is due to their ability to reach difficult or dangerous areas for humans or traditional machinery to access. They have made impressive strides in various industries, with applications ranging from aerial photography to environmental monitoring. Drones embedded themselves as a crucial technology in Industry 4.0, offering a range of benefits for industries such as manufacturing, logistics, and agriculture. They have quickly become indispensable tools in the manufacturing industry and are revolutionizing the way manufacturing facilities operate. Their integration into the manufacturing industry offers immense potential for improving efficiency, safety, and cost savings.

Drones generally are unmanned aerial vehicles, with nobody on board, and the pilot is controlling the craft from the ground. They are far from being just fancy flying cameras. They have been used for all kinds of purposes. Their sophisticated technology allows them to obtain and record information where humans

cannot, such as in dangerous environments and difficult to access areas. The prohibition on beyond visual line of sight operations has also been lifted for drones that weigh more than five kilograms. This allows bigger drones, ideal for commercial and industrial applications, to be used more consistently in manufacturing. Drones can also aid manufacturers in increasing compliance by recording temperature checks, production line observations and faults from the drone images.

WHAT IS A DRONE?

The FAA defines drones, also known as unmanned aerial vehicles (UAVs), as any aircraft system without a flight crew onboard. Drones include flying, floating, and other devices, including unmanned aerial vehicles (UAVs), that can fly independently along set routes using an onboard computer or follow commands transmitted remotely by a pilot on the ground. A typical drone is shown in Figure 1 [1]. Drones can range in size from large military drones to smaller drones. Drones, previously used for military purposes, have started to be used for civilian purposes since the 2000s. Since then, drones have continued to

be used in intelligence, aerial surveillance, search and rescue, reconnaissance, and offensive missions as part of the military Internet of things (IoT). Today, drones are used for different purposes such as aerial photography, surveillance, agriculture, entertainment, healthcare, transportation, law enforcement, etc.

Drones work much like other modes of air transportation, such as helicopters and airplanes. When the engine is turned on, it starts up, and the propellers rotate to enable flight. The motors spin the propellers and the propellers push against the air molecules downward, which pulls the drone upwards. Once the drone is flying, it is able to move forward, back, left, and right by spinning each of the propellers at a different speed. Then, the pilot uses the remote control to direct its flight from the ground [2],

Drone laws exist to ensure a high level of safety in the skies, especially near sensitive areas like airports. They also aim to address privacy concerns that arise when camera drones fly in residential areas. These include the requirement to keep your drone within sight at all times when airborne. In the United States, drones weighing less than 250g are exempt from registration with civil aviation authorities. If your drone exceeds 250g in weight, you will also require a Flyer ID, which requires passing a test [3]. It is necessary to register as an operator, be trained as a pilot, and have civil liability insurance, in addition to complying with various flight regulations, and those of the places where their use is permitted.

Most drones have a limited payload, usually under 11 pounds. Drones are classified according to their size. Here are the different drone types:

- Nano Drone: 80-100 mm
- Micro Drone: 100-150 mm
- Small Drone: 150-250 mm
- Medium Drone: 250-400 mm
- Large Drone: 400+ mm

One of the emerging trends in drone use for factories is the utilization of LiDAR technology. LiDAR stands for Light Detection and Ranging. This technology provides accurate depth information essential for understanding the three-dimensional structure of the environment. LiDAR sensors emit laser beams to measure distances to objects, creating high-resolution 3D maps of the surrounding terrain and objects. The ability to capture detailed data through LiDAR technology has opened up opportunities for better predictive maintenance, reduction in inspection times, and overall cost savings [4].

APPLICATIONS

A drone in the manufacturing environment is shown in Figure 2 [1]. Drones have many applications in

manufacturing, including quality control, inventory management, and safety inspections. Drones are undoubtedly a game-changer for the manufacturing industry. Common applications of drones in manufacturing include the following [1,4]:

- *Factory Surveillance and Maintenance:* One of the most promising applications of drones is their use in factory surveillance and maintenance. This allows for remote inspection capabilities and offers a cost-effective solution that enhances safety while increasing productivity. Integrating drones into factory operations has the potential to improve efficiency, reduce costs, and enhance safety measures in infrastructure management. Drones can be equipped with high-resolution cameras and sensors to monitor machinery and detect potential problems before they become major. They can inspect equipment without disrupting operations, providing a more accurate assessment of the situation while ensuring worker safety. They can also inspect hard-to-reach areas, such as tall chimneys, roofs, or narrow tunnels where human intervention is difficult or dangerous.
- *Inventory Management:* Drones can potentially transform the supply chain and inventory management in manufacturing facilities. By using RFID technology, drones can perform swift and accurate inventory counts in warehouses, significantly reducing time and labor costs associated with manual stocktaking.
- *Improving Quality Control:* Manufacturers can enhance their quality control processes by employing drones to monitor production lines continuously. This proactive approach to quality control can result in fewer product returns and improved customer satisfaction.
- *Inventory Management:* Drones automate stocktaking processes by flying through storage areas and warehouses to scan barcodes and QR codes on items for accurate inventory checks. This technology significantly reduces the time and labor required for manual inventory checks.
- *Inspection and Maintenance:* Drones are equipped with cameras and sensors can capture high-resolution images and data, allowing for more detailed inspections of large and complex infrastructures such as bridges, wind turbines, and oil rigs. These inspections can be performed remotely, reducing the risk of injury to workers and increasing safety. Transporting parts between different areas of a manufacturing plant or warehouse can also be unnecessarily time-

consuming. Drones can transport parts weighing up to five kilograms and fly to warehouses to collect and deliver. Figure 3 shows drones are used for inspection and maintenance [5].

- *Automation:* Drone technology represents a revolutionary advancement in automation. There are several tasks that drones can automate in warehouses and production lines. Someone with little to no experience flying a drone can use the automation technology that accompanies the drone to carry out the flight mission. Using drones can relieve human staff from potentially dangerous jobs like retrieving products from tall racking, troubleshooting dangerous equipment during work stoppages, and responding to spills.
- *Delivery:* Drones can quickly deliver goods to customers. The journey of a product – from manufacturing, to delivery, to the customer – involves many steps. Many organizations integrate delivery drones into their assets to address this very problem. Figure 4 shows some typical delivery drones [6].
- *3D Printing Drones:* Also known as additive manufacturing, 3D printing is revolutionizing the drone manufacturing industry by enabling the creation of complex geometries and custom designs that were previously difficult or impossible to achieve with traditional manufacturing methods. This process involves layer-by-layer fabrication of parts directly from digital models, offering several key advantages. It allows designers and engineers to quickly produce and test prototypes. A 3D printing drone is shown in Figure 5 [7].

BENEFITS

Drones offer unparalleled benefits for companies in the manufacturing sector, revolutionizing the way forward in areas like surveillance, maintenance, and workflow efficiency. They can help companies save time and money, and increase compliance.

A notable advantage of using drones in industrial settings is their ability to access hard-to-reach or dangerous areas. Drones are sophisticated pieces of technology that can collect and record data humans cannot. Other benefits of using drones in manufacturing include the following:

- *Efficiency:* Efficiency and cost-saving measures are at the heart of using drones in manufacturing. Integrating drones in manufacturing adds a new standard of automation and efficiency. By utilizing drones, manufacturers can reduce the risk of workplace accidents, enhance overall safety, and improve productivity. Manufacturing

drones cost-effectively is essential to making the technology accessible and sustainable.

- *Safety:* In addition to being cost-effective and time-efficient, the use of unmanned aircraft in factories also reduces safety risks by eliminating the need for workers to climb tall structures or navigate hazardous areas.
- *Detecting Anomalies:* Through machine learning techniques, drones equipped with AI can detect anomalies that may indicate structural damage or wear-and-tear faster than a human inspector could ever do so manually. This includes monitoring changes over time that can highlight potential issues before they become major problems.
- *Accuracy:* Accuracy in drone manufacturing is paramount, as it directly impacts the performance, safety, and reliability of aerial vehicles. Precision in crafting each component ensures that the drone operates as intended, maintaining stability and efficiency in flight. This accuracy is crucial for components like propellers and motors, where even minor imbalances can lead to flight instability or mechanical failures.
- *Collaboration:* A worker doing a complex task may need support from a supervisor or team member elsewhere. A drone can help facilitate communication between these two parties by letting them see and talk to each other.

CHALLENGES

In spite of the many benefits of incorporating drones into manufacturing, there are challenges that companies must address to ensure the successful implementation of this technology. Keeping pace with rapid technological changes is a significant challenge. The main problem of flying drones in a factory is their malfunctioning and crashing. Like every technical device, drones sometimes fail and fall to the ground. The greatest concern is if it falls on a worker. Other challenges include the following [4]:

- *Privacy:* Drones can capture images and videos of sensitive information, leading to privacy concerns for employees and the company.
- *Legal Regulations:* Companies must adhere to local and federal regulations regarding drone usage. Strict compliance with these regulations is critical in maintaining safety, security, and responsible drone operation.
- *Cybersecurity:* As drones rely on wireless communication and data sharing, addressing cybersecurity concerns must be a top priority for manufacturers to protect their sensitive information and maintain secure operations.

- **Training and Skills Development:** Proper drone operation and maintenance training is essential for companies to maximize the benefits of incorporating this technology into their processes.
- **Regulation:** Most countries are now grappling with regulatory issues related to drones, as using drones has implications for public safety. Regulation plays a critical role in shaping the future of drone use in manufacturing since drones operate in a regulatory environment. As the use of drones in manufacturing continues to grow, regulations and policies must be implemented to ensure safety, security, privacy, and responsible use. Adhering to local and federal regulations is becoming a pivotal concern for drone manufacturers. Effective regulation will ensure the safe integration of drones into our manufacturing systems. Regulators are charged with thoroughly evaluating the implications of new drone uses, including potential safety issues, before they reach the market. In the United States, The Federal Aviation Administration (FAA) has implemented rules for commercial drone use, such as requiring pilots to obtain a remote pilot certificate and limiting altitude and speed restrictions.
- **Interoperability:** Manufacturing sites often use a diverse range of machines, equipment, and production systems, leading to issues with interoperability and the integration of new technologies. It is essential to establish a standardized ecosystem for seamless connectivity between various systems beforehand.
- **Quality Control:** Ensuring high quality and safety standards is paramount, given the potential risks associated with drone operation. For the successful implementation of AI drones, high-quality, clean, and meaningful data is vital. Since industrial settings can produce biased, outdated, or error-filled data, ensuring that the data we use to train the AI models is verified for quality is critical.
- **Supply Chain Management:** Managing the supply chain efficiently is a challenge, especially with the global nature of manufacturing. Issues like sourcing materials, managing logistics, and dealing with tariffs or trade restrictions can significantly impact production costs and timelines.
- **Cost:** Another major problem is the cost of running the drone. This is pretty much a question if you need a pilot, or if the drone runs autonomously. If you have a drone pilot, then you

add labor cost to the drone when you use it and that makes it quite a bit more expensive. By using autonomous drones or incorporating advanced drone solutions into operations, companies can reduce the need for human experts and cost.

The challenges of drone manufacturing are significant, but with the right expertise and technology, they can be effectively addressed.

CONCLUSION

It is evident that drones will continue to play a significant role in shaping the future of manufacturing. It is never too late to start incorporating drones into your business.

The biggest obstacle, apart from certification and regulations, is that certain factories, facilities, and assembly plants may be too complex or hazardous for drones. Although there are still some limitations to commercial drone operation, including high initial costs or consistent and transparent regulations, the future of drones in manufacturing looks promising, as they are becoming increasingly popular for their ability to inspect and monitor structures and processes with greater efficiency and accuracy than traditional means.

REFERENCES

- [1] “Transforming operations with drones: 10 smart drone applications in manufacturing,” March 2024, <https://dac.digital/drone-applications-in-manufacturing/>
- [2] “How drones work and how to fly them,” May 2024, <https://dronelaunchacademy.com/resources/how-to-do-drones-work/>
- [3] “What are the main applications of drones?” June 2024, <https://www.jouav.com/blog/applications-of-drones.html>
- [4] “Drones in manufacturing: A game-changer for industry,” <https://viper-drones.com/industries/infrastructure-drone-use/manufacturing/#:~:text=The%20integration%20of%20drones%20into,on%20manufacturing%20is%20no%20exception.>
- [5] “Drones’ critical role in Industry 4.0,” <https://consortiq.com/uas-resources/drones-critical-role-in-industry-4-0#:~:text=Drones%20can%20quickly%20deliver%20goods,constant%20improvement%20and%20great%20efficiencies.>
- [6] J. Marsh, “The developing role of drones in manufacturing,” August 2022.

<https://www.roboticstomorrow.com/story/2022/08/the-developing-role-of-drones-in-manufacturing/19274/>

2022, <https://penntoday.upenn.edu/news/Penn-Design-Engineering-3D-printing-build-repair-while-flying>

- [7] “3D printing drones work like bees to build and repair structures while flying,” September



Figure 1 A typical drone [1].

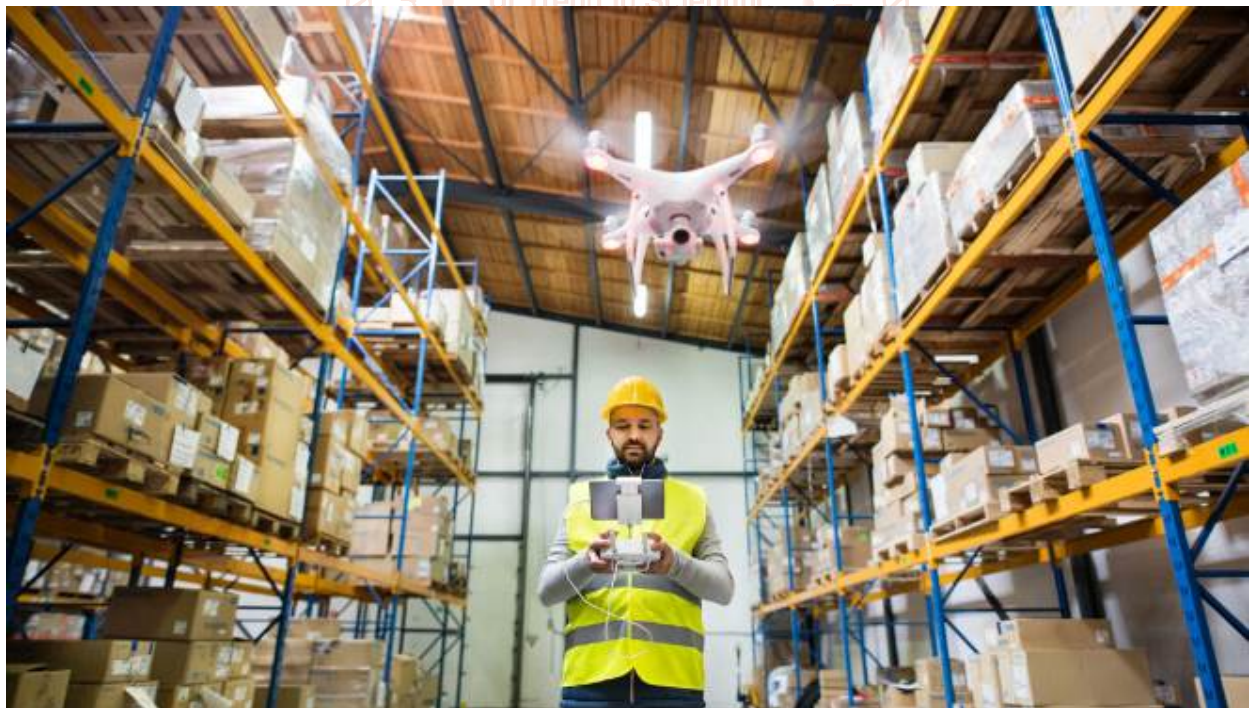


Figure 2 A drone in the manufacturing environment [1].



Figure 3 Drone is used for inspection and maintenance [5]



Figure 4 Typical delivery drones [6].



Figure 5 A 3D printing drone [7].