AMFG | Autonomous Manufacturing

Unlocking Distributed Production With Additive Manufacturing

What organisations need to succeed in the new manufacturing paradigm

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The Rise of Distributed Manufacturing

The global manufacturing ecosystem is undergoing a tumultuous change: the complexity of supply chains is increasing, consumer behaviours are changing and the world continues to grapple with economic and geopolitical challenges.

Against this background of instability, business leaders can no longer rely on old responses in the new manufacturing environment. That's why global organisations have started to actively explore new strategies to keep up with the dynamic manufacturing ecosystem.

Companies are increasingly looking for solutions that can help them build supply chain resilience and increase flexibility in production. It's, therefore, unsurprising that over 90 per cent of companies are investigating new supply chain and business models.[1]

As organisations are looking to reduce dependency on China, many have begun to consider a regional strategy of producing a part of key goods within the region where they are consumed. In fact, more than 50 per cent of companies are considering geographic diversification to achieve supply chain flexibility.[2]

Similarly, 59 per cent of companies are evaluating hybrid models and 52 per cent are looking into localised production, according to HP's Digital Manufacturing Trends Report.

What these stats signal is the rise of a distributed manufacturing model, which can spark substantial new opportunities in how products are produced, stored and shipped to consumers.

In distributed manufacturing, goods are produced in flexible quantities by a network of smaller-scale factories, which are located closer to the end consumer. Also called localised manufacturing, this model can help companies cut costs on freight, decrease lead time and provide higher responsiveness.

The Key Benefits of Distributed Manufacturing

- **Faster delivery:** Lead time is impacted both by the production efficiency and the location where your products are manufactured. With localised factories, production takes place closer to the end consumer, reducing the delivery time from months and weeks to days.

- **Reduced costs:** Localised factories allow manufacturers to reduce logistics and transportation costs due to proximity to the end-users.

- **Support for regional markets:** Smaller, distributed factories with accompanying ecosystems can better serve regional markets, compared to a large production centre that ships products worldwide.

- **Mass customisation:** When a company is physically close to its customers, it can be more flexible in meeting increasingly diverse demands. Greater flexibility means greater customisation: a decentralised company can more easily relate to the local customer and adapt to the individual or regional tastes.

[1] Digital Manufacturing Trends Report, HP, 2020
[2] Supply Chain Resilience Report, 3D Hubs, 2020

How Does AM Support Distributed Manufacturing?

To shift more easily to a distributed manufacturing model, companies need to adopt advanced technologies, which will allow them to accelerate lead time and switch more flexibly among the products they manufacture. Additionally, these technologies should also be easy to integrate into a digital environment.

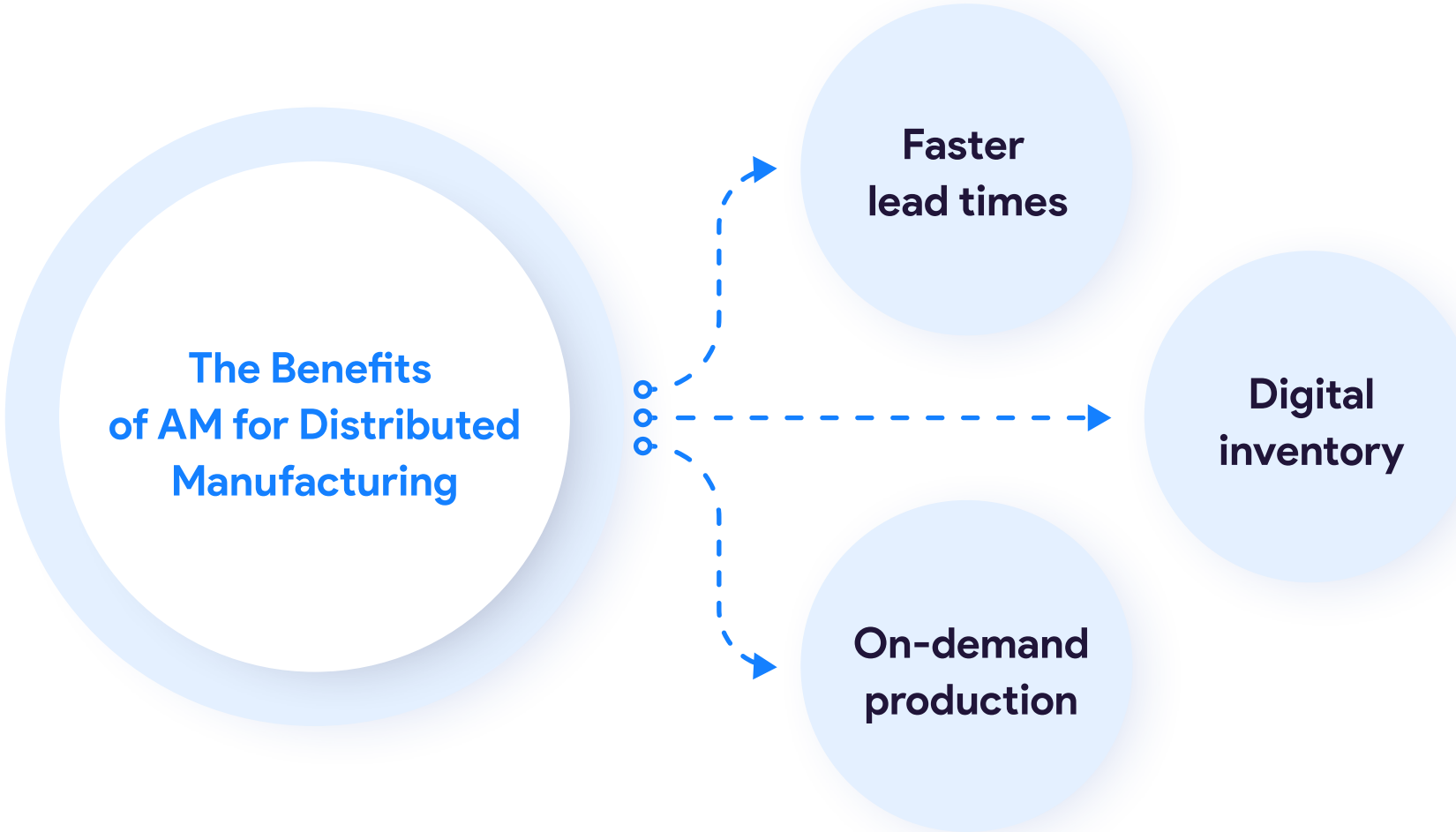
One such technology is additive manufacturing. This production method, also known as 3D printing, enables products to be made in batches as small as one.

Setup time and switching costs are low and while per-unit manufacturing costs are not as low as a mass-manufactured product, AM brings great flexibility and customisability to the manufacturing process.

In AM, the process of manufacturing a part is controlled by software, making it a highly digitised process.

It involves creating a 3D model in CAD and then converting it into two-dimensional layers. This data is then sent over to a 3D printer, which begins to print the part layer by layer, as specified by the file. Unlike conventional processes that rely on moulds or cutting tools, the only tool needed in AM is a 3D printer.

Given its digital nature, the AM technology is well-suited for the distributed manufacturing model.



Faster Lead Times

Accelerating lead time is one of the primary goals of distributed manufacturing. Lead time is an important factor for customer satisfaction and inventory management. The quicker you can produce parts, the faster customers can get their products and the less stock you need to hold in your inventory.

Additive manufacturing makes perfect sense for the distributed manufacturing model because the technology is capable of accelerating lead times both for prototypes and end-use parts.

73% of the companies say lead time is one of the most important measures of success for 3D printing activity.[3]

Since AM doesn't rely on long-to-produce moulds, the production can start right after the order is received, if the materials are available. The AM production typically takes between a few hours and a few days, which is a world of difference from a typical lead time of weeks or months in injection moulding.

Furthermore, AM can be used to produce parts, which were previously assembled using several components, as a single piece. This process, known as part consolidation, eliminates the need for assembly, fasttracking lead times even further.

While it should be noted that not every component can benefit from AM production, the technology, applied at local factories, can still help lessen dependence on distant suppliers of parts and tooling.

Digital Warehouse

Worldwide, companies spend an estimated $350 billion a year on warehousing, and that number grows each year.[4]

With digital manufacturing, there is a potential to reduce warehousing costs by switching to digital inventories.

As a digital manufacturing technology, AM allows boxes of parts taking up space in warehouses to be replaced with digital files that can be stored in the cloud or on a local disk and easily accessed and produced when they are needed.

Setting up a digital system that facilitates secure storage and fast sharing of production files and designs underpins the successful transition to distributed manufacturing.

Distributed manufacturing facilities can use a centralised virtual storage place for 3D designs, send data between facilities and produce a part when the customer needs it, bypassing the need to maintain a physical inventory.

On-Demand Production

Digital inventories will not only allow companies to reduce warehousing costs but also maintain lean and agile operations by manufacturing goods on-demand and at an optimal amount of units.

In traditional manufacturing, it can be challenging to produce parts in smaller quantities. The setup and tooling costs dictate the minimum amount of parts that must be produced, and if your order is below that amount, you may end up with additional stock, taking up additional space in your warehouse and tying up working capital.

In this regard, companies can overcome the challenge of the minimum production volume with AM. Since the cost of production in AM doesn't depend on set up and tooling costs, it's possible to produce the exact amount of parts you need. The process can be further accelerated by using digital inventories, which store parts with already saved and qualified production settings.

So instead of wasting time and money on building stock, AM opens the door to on-demand production. This way, companies can produce parts in the exact quantities they need, without exposing parts to risks of being unsold or taking up space in a warehouse.

[3] State of 3D Printing 2020 Survey, Sculpteo, 2020
[4] Improving warehouse operations—digitally, McKinsey, 2020

The Current Challenges To Distributed Additive Manufacturing

As promising as the vision of distributed additive manufacturing is, achieving it can often pose a range of challenges.

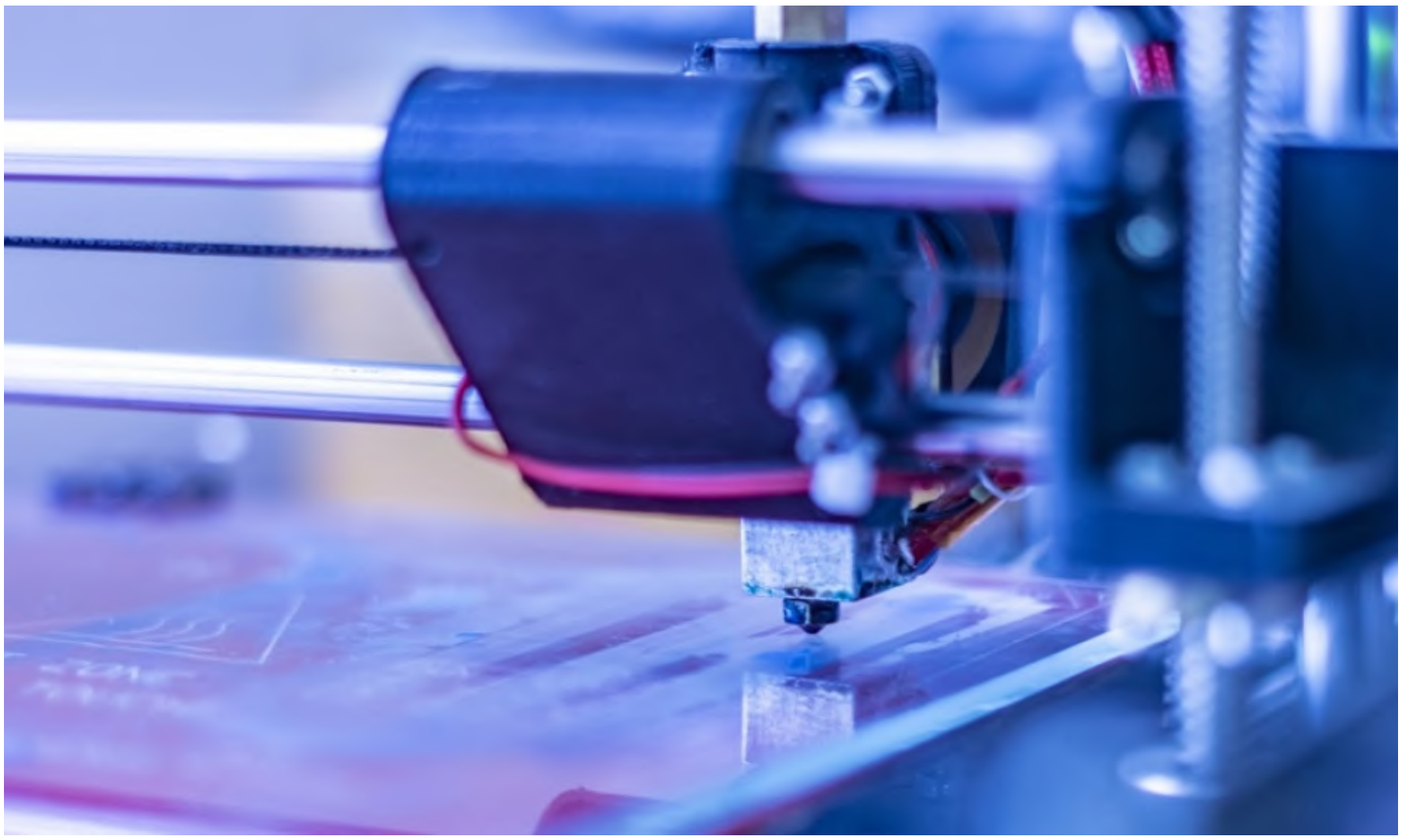
The distributed manufacturing model requires coordination across several facilities. These facilities can be located in different countries and time zones, which makes streamlined communication difficult to achieve.

Without streamlined communication, stakeholders would use inefficient processes for data transfer, for example, send emails with attached 3D files and production requirements. Sharing data this way can lead to time-consuming back and forth emails, loss or misinterpretation of data, which also can't be easily tracked.

Another intrinsic complexity in the distributed manufacturing model is that companies must be able to produce identical parts in facilities across the globe, where standards and regulatory requirements may differ.

Without proper coordination of orders, processes, machines, materials and staff, it will be near impossible to create a consistent, reliable workflow.

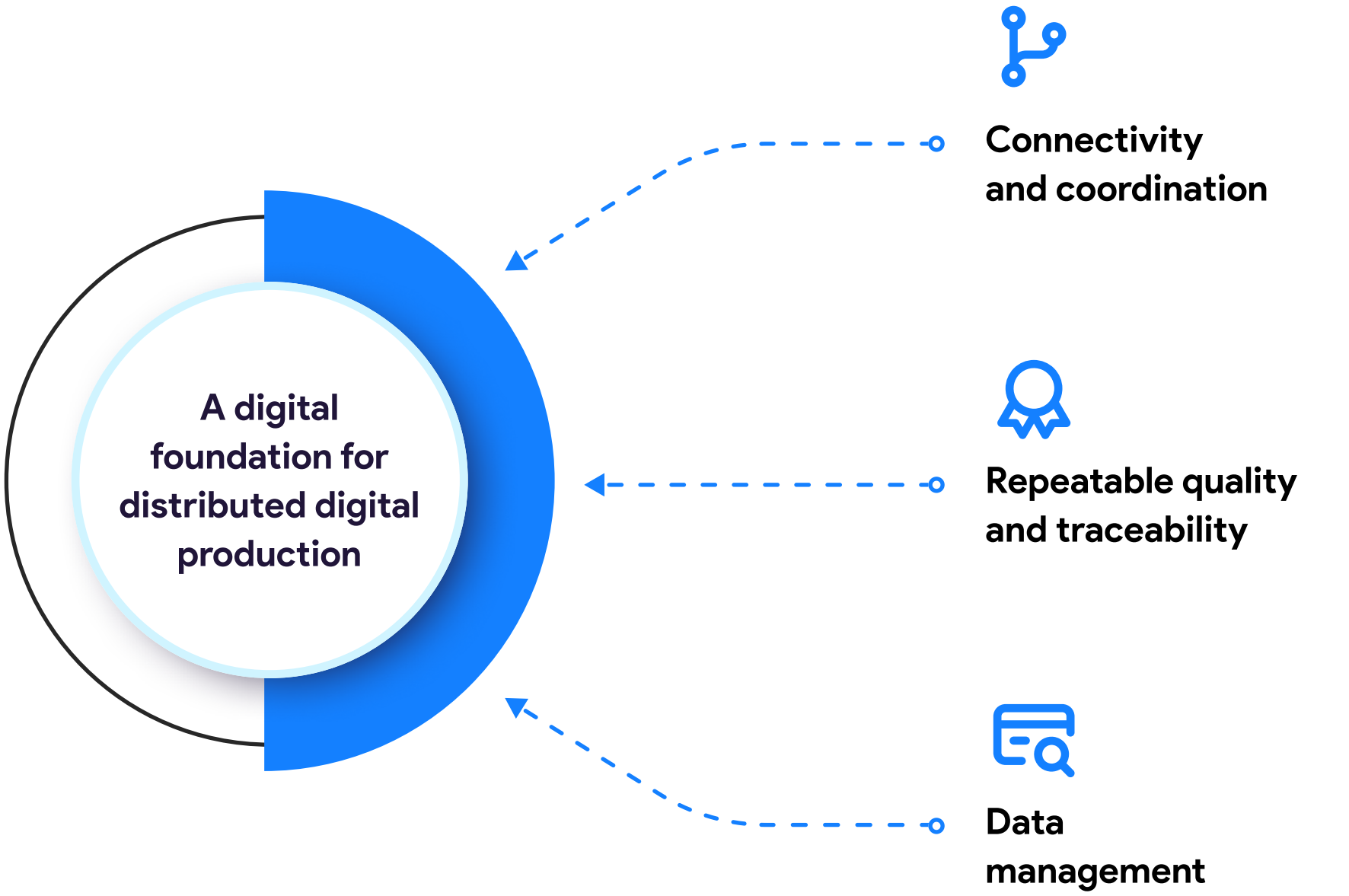
Finally, protecting IP and ensuring file security needs to be considered when adopting the distributed manufacturing model. Without a proper system in place, it's not uncommon for employees to use unauthorised third-party file-sharing tools, which make traceability and security of file data difficult to guarantee.



How To Succeed With Distributed Additive Manufacturing

A strong digital foundation lies at the heart of distributed digital manufacturing.

Such a foundation helps to overcome the existing challenges, while also supporting each benefit AM provides for distributed manufacturing. This means fast and secured data management and sharing, connectivity, traceability and automation.



Connectivity and coordination

Manufacturers wanting to benefit from distributed digital manufacturing must be able to connect with their partners to securely exchange data and track processes.

A centralised digital platform that can provide integrated communication and data sharing tools will help to establish a high level of coordination between processes and teams.

This, for example, means the possibility of digitally transferring orders, with all their production requirements, from one facility to the other. This approach eliminates communication downtime while keeping the data secure and reducing missteps in the processes.

A centralised digital system also helps to organise and synchronise operations management across different locations. This enables stakeholders to track production-relevant data, such as the volume of orders, machine statuses and utilisation, the number of failed and produced prints, which are instrumental in measuring KPIs.

Repeatable quality and traceability

Integrating a digital system that supports standardisation and data traceability will equally be key to a successful distributed manufacturing network.

For manufacturers operating from multiple sites and in multiple locations, standardised processes facilitate economies of scale, cost-savings and repeatability. For example, a standardised interface for ordering optimises the order management process and facilitates better communication between stakeholders.

Integrating a digital system will help organisations create a single source of truth, that eliminates blind spots and enables them to log and track each step in the AM process.

File versioning is one example where greater transparency can significantly enhance AM production and provide added traceability in the pre-production process. In a scenario where 3D printing files undergo several iterations, the ability to not only save but also to track new versions of the files immediately provides greater transparency for the stakeholders.

Finally, with the automation of manual processes, like entering data into a spreadsheet or calculating order cost, a digital system also helps to reduce the chance of human error, preventing costly mistakes and driving greater productivity.

Ultimately, accurate tracking of the AM process steps, including various things like certification, quality checks, materials used and technical documentation is key to adopting distributed digital manufacturing.

To enable traceability, however, a digital system must also meet security requirements, such as compliance with ITIL security standards. This, for example, may include the ability to set specific user access permissions to restrict access to areas of the platform by unauthorised users.

Data management

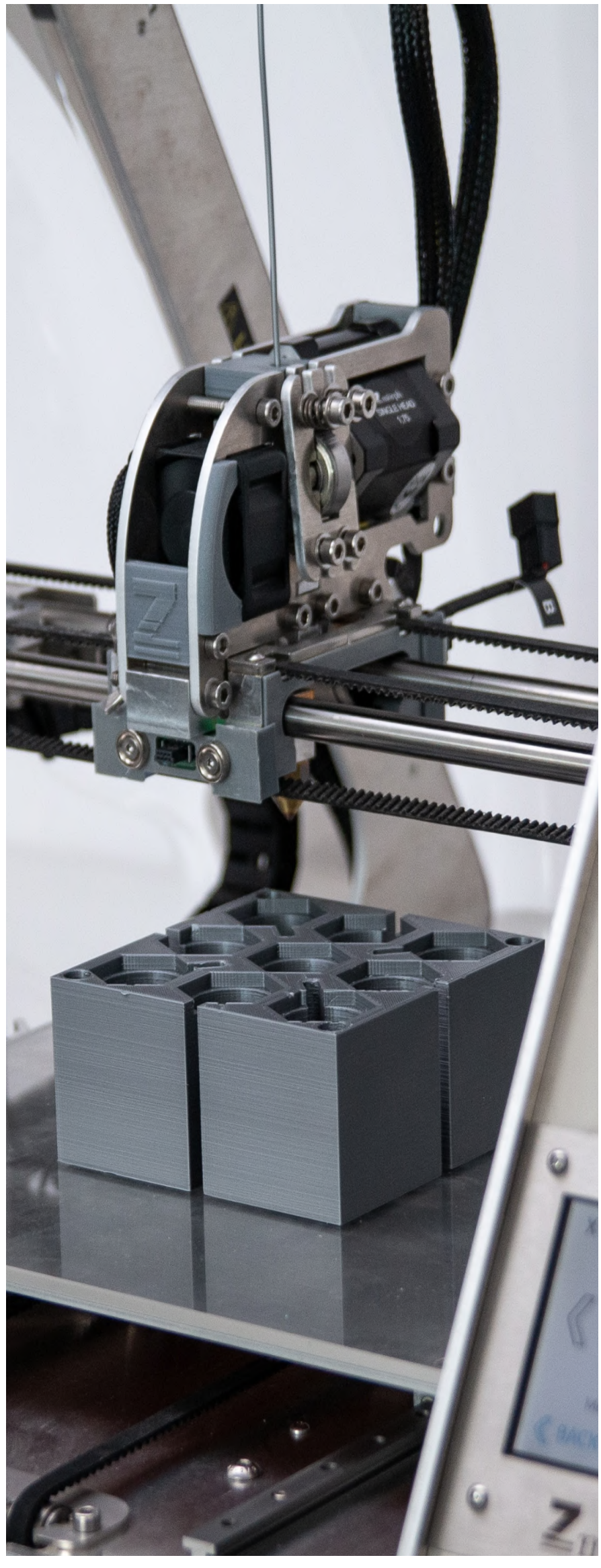
Additive manufacturing has made the prospect of on-demand production a reality.

However, to get the most of on-demand manufacturing, organisations need detailed and accurate inventory data that can be made available to the right user at the right time.

One way to make this possible is by setting up a digital catalogue of AM parts. Such a catalogue can store all information relevant to the production, including 3D files, production parameters, material, post-processing and quality assurance requirements.

With a digital part catalogue, the process of finding, ordering and producing a part becomes straightforward, saving huge amounts of time and effort.

Furthermore, a digital inventory enables AM manufacturers to keep the production data in a single, validated system, ensuring that parts are produced according to their specifications each time. Ultimately, this helps to establish a repeatable process that supports scalability.



The Right Digital Foundation For Distributed Manufacturing is MES

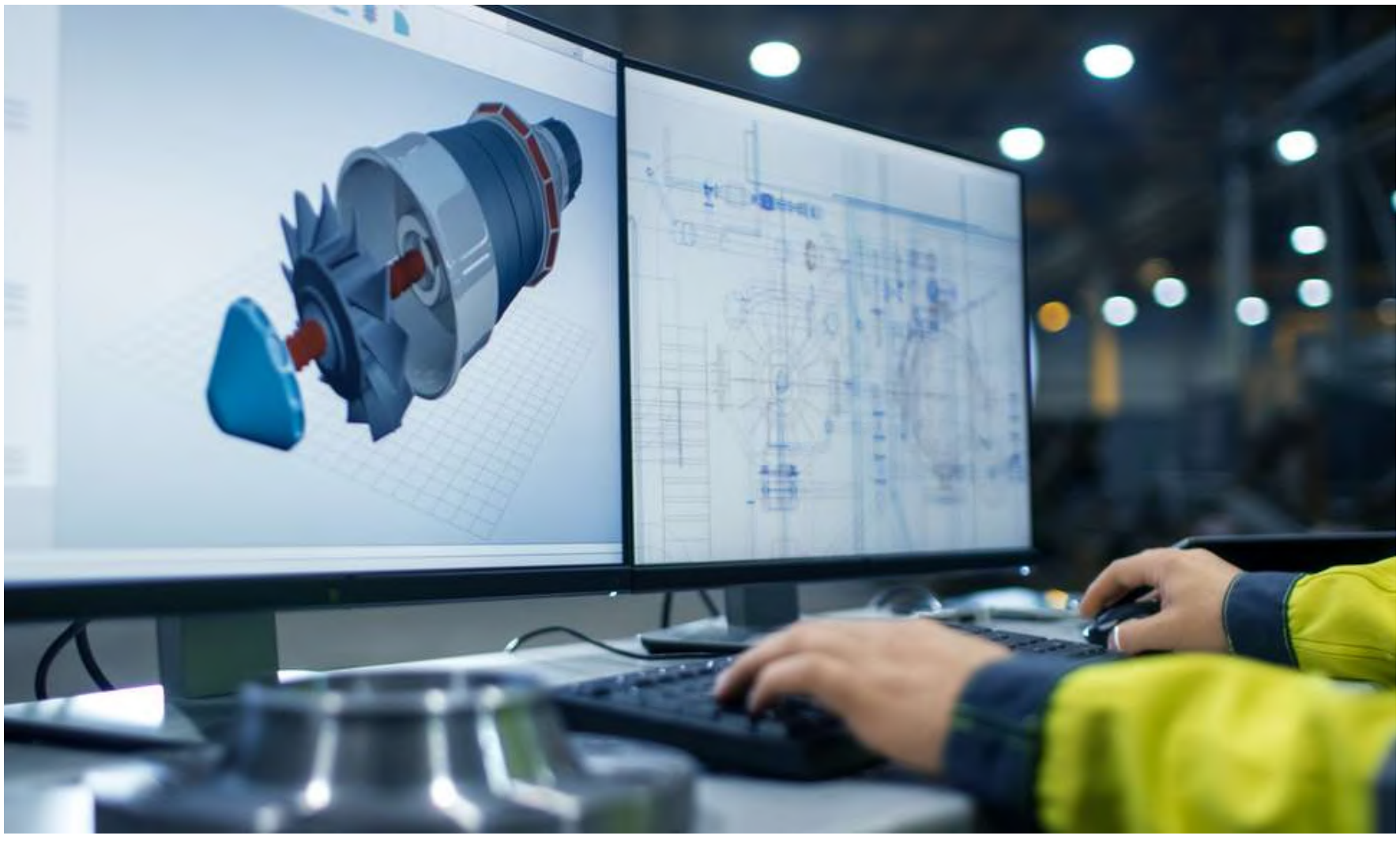
If organisations want to establish a digital foundation with the capabilities described bove, a Manufacturing Execution System (MES) for additive manufacturing checks all the boxes.

The right MES software helps to connect AM systems and processes, as well as cultivate a traceable, secure and repeatable workflow. Advanced additive MES solutions can also integrate a digital catalogue to enable part production at a click of a button.

Shifting to distributed digital manufacturing can't happen overnight. But with the right approach and a digital system like MES in place, organisations can lay the foundation that will fast-track the transition and ensure long-term success.

At AMFG, we've been developing our flexible MES solution to support organisations at different stages of their AM adoption, from rapid prototyping to distributed manufacturing.

A distributed digital manufacturing facility powered by AMFG's MES solution will better position your company to achieve a faster return on investment and reap the benefits of the new manufacturing paradigm.



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About AMFG

AMFG is a leading provider of MES software for additive manufacturing. Our software solutions empower manufacturers to manage their additive manufacturing workflows and achieve streamlined, automated processes.

With customers in 26 countries and across a range of industries, we specialise in enabling companies to successfully integrate AM into their wider manufacturing processes and scale their AM operations.

To learn more about AMFG and our Additive MES solutions, contact us at **info@amfg.ai** or visit: **www.amfg.ai**

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