The Production Dilemma:

In-House vs. External Parts Manufacturing

Decision factors
for your metal Additive
Manufacturing strategy

SEURAT

AMPOWER

About this guide

Additive Manufacturing (AM) applications span the entire value chain, encompassing prototyping, tooling, and end parts, including spare parts. In the realm of Metal AM, end parts currently dominate, especially in high-end industries such as Aerospace and Medical.

As companies consider integrating AM into their manufacturing processes, they inevitably need to decide between bringing additional capabilities in-house or working with external partners. In recent years, various strategies have emerged, and no clear market tendency is evident. Numerous factors must be carefully weighed, and determining the optimal strategy is often complex. Some companies opt for hybrid approaches, maintaining limited in-house capacity for development and qualification and outsourcing serial production to external manufacturing suppliers while others choose to rely entirely on qualified external suppliers.

This paper aims to provide users with a comprehensive guideline, addressing the key considerations involved in deciding between in-house and external Additive Manufacturing capacities.

Matthias Schmidt-Lehr
Managing Partner of AMPOWER

The world of metal additive manufacturing is in constant flux, with technologies advancing at an unprecedented pace. As a business leader, you face critical decisions: Are you prototyping, or are you looking for serial production? What additive technology is best for your part? What is your financial and IP risk tolerance?

When you're ready for serial parts production, the choice between purchasing a printer and developing your own in-house expertise versus collaborating with an external partner introduces an additional layer of complexity to your decision making.

To help you navigate this complexity, we partnered with AMPOWER, the leading strategy consultancy and thought leader in the field of industrial Additive Manufacturing to create this guide. In this, AMPOWER provides a framework and unbiased insights to help you identify and evaluate the key criteria you need to consider for the build versus buy decision for your company, your part, and your risk tolerance.

James DeMuth
Co-Founder and CEO of Seurat Technologies

Executive summary

Metal Additive Manufacturing (AM) has emerged as a transformative technology across various industries, but its applications vary significantly by sector. In the automotive industry, AM is primarily used for tooling and prototypes, while in aviation and medical fields, it is applied to end-use parts. As the technology matures, companies face a critical decision: whether to invest in internal AM capabilities or outsource production to service bureaus.

Key challenges in this decision include high upfront costs for AM machines and facilities, as well as the expertise required to manage AM processes. In-house AM provides control over quality, intellectual property, and lead times but requires substantial investment and resources. Service bureaus, on the other hand, offer flexibility and lower initial costs, though companies must consider risks related to quality control, intellectual property, and supplier capability.

Industries like medical and aerospace have pioneered in-house AM development due to stringent quality and certification requirements. However, many organizations adopt a hybrid approach, balancing in-house capabilities with external service providers to scale production while managing risks. The decision to make or buy should be based on an organization's risk appetite, long-term strategy, and collaboration opportunities with external suppliers.

Ultimately, the choice depends on factors such as market volatility, production volumes, and intellectual property considerations. Both approaches have benefits, and best practices suggest starting with in-house capabilities to build expertise and later outsourcing for scalability and cost-effectiveness.

Introduction

Where Metal Additive Manufacturing adds value

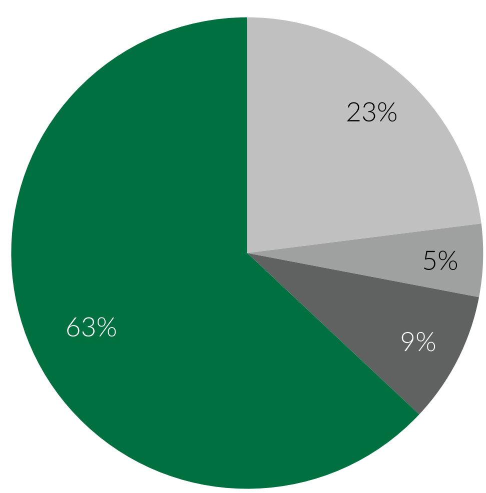
Metal Additive Manufacturing (Metal AM) has established itself as a transformative technology across many industries. However, the applications differ in each industry. In the automotive sector, metal AM is extensively used for tools, jigs, fixtures, also for prototyping and development parts. Due to high cost and limited throughput, production car parts are only found in high-end or custom vehicles. In the aviation industry, applications are more focused on end-use, but due to the lengthy qualification cycles in this sector, many applications have a gestation period with serial production taking many years. In the medical field, metal AM has been used for end-use parts since its inception. The endoprosthesis market, in particular, has adopted the technology as a major advancement due to its capability to create customized complex lattice structures with minimal post-processing. The combination of improved products with enhanced bone ingrowth at lower costs than traditional manufacturing presents an ideal business case for Additive Manufacturing.

Generally, applications for metal AM can be categorized into four segments: Prototypes, Jigs & Tools, Molds, and End-Use Parts. End-use parts do not necessarily mean mass-produced items as seen in traditional manufacturing. They also include one-off parts or customized products, often seen in medical devices or for spare parts.

According to the AMPOWER Report 2024, the share of end-use parts in metal AM has increased steadily over the past five years, from 53% to 63%. Similarly, the mold segment nearly doubled in the same period, rising from 5% to over 9% in terms of material volume consumed.

Application category of printed metal parts 2023[1]

- Prototype and R&D
- Jigs / tools
- Molds
- End parts and spare parts



[1]Source: additive-manufacturing-report.com

How companies approach metal AM today

Many companies with high-value metal products have already engaged with Additive Manufacturing. Depending on their applications and company culture toward innovative manufacturing technologies, users have varying levels of AM implementation today.

Medical and aviation companies recognized the potential for end-use applications early. Many leading players in these fields hired skilled engineers to develop the technology internally, viewing metal AM as core intellectual property for superior products. Companies like Stryker and GE Aviation are known for their structured approach to AM, employing large teams and maintaining substantial in-house metal AM capacity. Both companies have extensive internal fleets, showing a preference for in-house production. However, many companies also adopt a hybrid approach, using pure-play AM service bureaus, which only offer AM services, or qualifying existing sub-tier suppliers. For example, Airbus and several U.S. defense companies have outsourced significant manufacturing capacities to external part manufacturers, maximizing production volume flexibility.

Other industries or companies that adopted AM later have smaller AM footprints, often with a small team or a single dedicated staff member responsible for exploring advanced manufacturing technologies. Given metal AM's broad application range, these roles are often cross-functional, spanning R&D, product development, and manufacturing departments. As companies' AM approaches mature, many have established cross-functional AM excellence centers providing expertise and printing capacity.

Staff members dedicated to Additive Manufacturing face multiple challenges. They must become knowledgeable about various AM technologies and disseminate that knowledge to multiple stakeholders. They are also involved in qualification procedures, developing process parameters, materials, and internal manufacturing standards. It takes years to become an AM expert, requiring proficiency in engineering and machine operation. Additionally, transforming manufacturing from conventional to additive often necessitates changes in design, materials, and processes, requiring engagement with many stakeholders. Consequently, AM staff must also navigate internal company culture, which can hinder innovation.

At some point, companies face the challenge of developing an integrated AM strategy. This is often not a simple "make or buy" decision due to the complex nature of Additive Manufacturing and the variety of applications. Deciding whether to invest in internal manufacturing equipment, qualify an external supplier, or pursue a hybrid approach involves multiple considerations. From financial aspects to quality and intellectual property concerns, each company must make its own decision based on numerous factors that will be discussed in this paper.

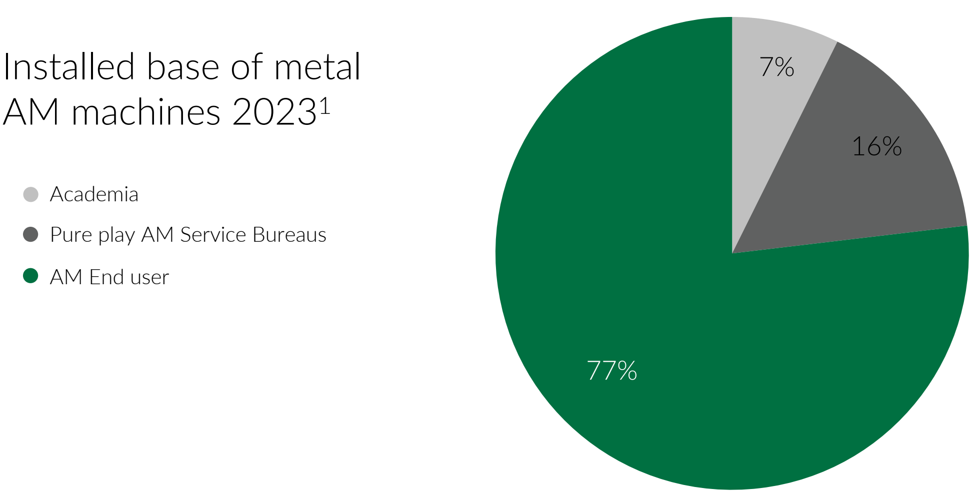
The rise of metal AM service bureaus

Companies today have numerous options to access metal AM parts beyond owning or leasing an internal machine. Currently, over 500 service bureaus are accessible globally for customers. The landscape is highly diverse and fragmented ranging from companies with multiple technology offerings across AM to traditional machining service bureaus, who add AM machines to their capabilities.

Service bureaus play a pivotal role in the industrialization of Additive Manufacturing. They enable users to access a variety of technology and material combinations, significantly reducing the need for upfront investments and the associated risks. Over the past decade, an increasing number of online AM marketplaces have emerged, further lowering the entry barriers for procuring AM parts. Online marketplaces offer direct cost comparison which creates high cost pressures for the more traditional part manufacturing service bureaus, however, the trade-off is that achievable quality of parts is often not transparent to the customer. To solve this problem, companies that require high-volume production, usually qualify parts with one or more service bureaus to ensure consistent quality.

Besides service bureaus that cater to a broad range of technologies and customers, recent years have seen many companies focusing on specific technologies and industries to enhance quality and competence. These specialized service bureaus often emerge as sub-tier suppliers for OEMs, qualifying their production processes according to industry standards such as AS9100 (aviation) or ISO 13485 (medical).

Installed base of metal AM machines 2023[1]



[1]Source: additive-manufacturing-report.com

Decision factors

The decision factors for in-house vs. external manufacturing

When companies transition to Additive Manufacturing, they inevitably face the decision of whether to produce AM parts internally or externally. In the past, many companies made management-driven decisions to explore Additive Manufacturing in-house, often resulting in initial investments in machine equipment. However, some encountered difficulties identifying viable business cases, leading to low machine utilization and minimal return on investment. Alternatively, companies may develop successful applications but opt to purchase parts externally. This raises the question: what decision factors should be considered in a “make vs. buy” scenario?

Cost is the most obvious factor. Metal AM equipment investments typically cost several hundred thousand USD (or more) to buy or lease, with additional expenses for infrastructure, auxiliary equipment, and safety measures for metal powder. However, if a machine can be fully utilized, internal equipment may be justifiable.

Beyond cost, there are numerous "soft factors" that may outweigh financial considerations.

Internal machines may require hiring experienced operational and R&D staff as well as requiring ongoing training. The benefits from in-house however are that direct application development fosters long-term internal technology knowledge crucial for industry demands. Quality is also critical, and not just related to the parts, as a number of industries like Aerospace and Medical often require industry-specific accreditation which may limit or constrain the capabilities of some service bureaus. Additionally, the IP relevance of AM applications can confer a competitive advantage by enhancing product performance.

Last but not least, the decision around internal vs. external manufacturing capacities is also a risk evaluation. While internal manufacturing keeps IP and know-how in-house, process development may be slower and ties up capital and resources. External manufacturing offers flexibility, and companies benefit from the know-how of the supplier, lower initial costs, and access to technology otherwise not commercially available.

1 Cost, upfront investment and ROI

2 Manufacturing flexibility

3 IP sensitivity

4 Quality and know-how

5 Risk evaluation

1 Cost, upfront investment and ROI

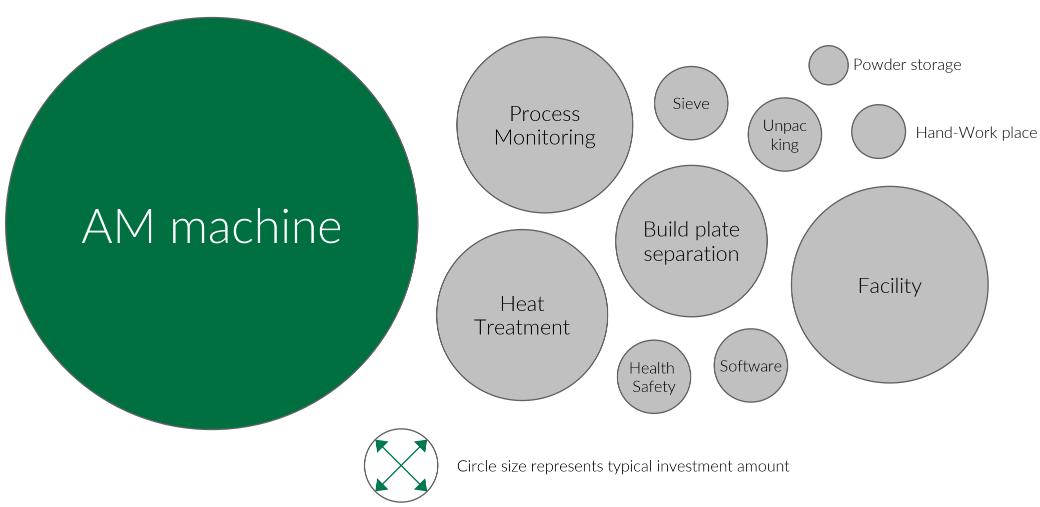
The average investment in metal Additive Manufacturing machines today exceeds 600 thousand USD, equivalent to a state-of-the-art dual-laser Laser powder bed fusion machine with a platform size of 250-400 mm. Entry-level machines, priced around 100 thousand USD, typically feature a single laser and a smaller platform.

In addition to the machine itself, companies must budget for facility upgrades, such as utilities (power and cooling), as well as auxiliary equipment such as saws, powder sieving, heat treatment equipment, software, and other auxiliary processes such as machining. The initial upfront investment can easily exceed 1.5 million USD before the first print job begins. Whether companies decide to make the investment as a cash purchase or go for a leasing option, the return of investment must be clear to stakeholders and some components of the decision such as facility upgrades, are not easily reversible.

This significant upfront cost serves as a barrier to entry for many companies, especially when manufacturing volume is unpredictable, serial applications are undeveloped, or applications require various platform sizes and materials. Metal AM machines are usually dedicated to one material, and changing materials entails significant downtime for cleaning.

While initial internal AM machines often serve as R&D prototyping investments, when companies advance to full-scale production, they eventually face the decision between manufacturing in-house and investing in multiple AM machines or qualifying external AM manufacturing capacities. The question of Return on Investment arises. External capacities require less investment and offer flexibility with fluctuating manufacturing volumes, while internal investments demand a long-term strategy and sufficient machine utilization for a positive ROI within a given timeframe.

Typical investment for a metal AM production setup



② Manufacturing flexibility

Most companies exploring metal Additive Manufacturing develop a variety of applications, ranging from tools and molds to spare and end parts, resulting in diverse geometries and requirements. Printing volumes, materials, and part sizes often fluctuate, making consistent and predictable utilization of a single machine unlikely.

Companies can address this challenge in two main ways: some assign their internal machine to the most commonly used material across their applications and utilize service bureaus for temporary demand spikes or different requirements. Others establish an "AM Center" as an internal service provider, incorporating multiple machines, technologies, and materials. However, this setup is more challenging to maintain profitably compared to using a service bureau, especially for smaller companies.

Apart from manufacturing flexibility, lead time is also a crucial consideration for the make vs. buy decision. In industries like Oil and Gas, short-term availability of spare parts is vital, often making internal machines more attractive than external service bureaus. On the other hand, when production volumes need to increase, service bureaus often face fewer obstacles in scaling their manufacturing capacities, while large companies often run into shop floor restrictions, extended overheads and compete internally with other manufacturing departments for resources.

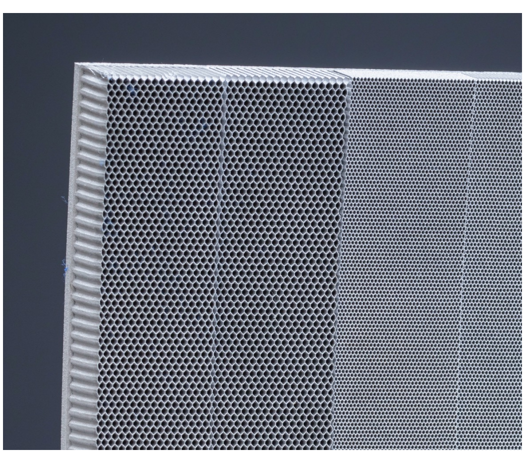
Ultimately, Additive Manufacturing offers three main advantages: part complexity, short lead time, and manufacturing volume flexibility. When deciding whether to purchase parts externally or manufacture them in-house, prioritizing the latter two factors is essential. While internal manufacturing may offer slightly faster lead times, achieving flexibility internally is more challenging and may not be profitable.

3 IP sensitivity

Many end-use applications in metal Additive Manufacturing are prevalent in industries such as medical, energy, aerospace, and defense, where companies leverage the technology to enhance product performance. Examples include fuel injection nozzles in gas turbines or hydraulic manifolds. The design freedom offered by metal AM enables functional optimization, often improving the efficiency of larger assemblies and providing a competitive edge in the market. Consequently, many designs have inherent intellectual property sensitivity, favoring internal manufacturing decisions.

In addition to design, groundbreaking applications in metal AM often involve specific materials and processes developed for particular parts. Users may possess intellectual property related to the part itself, metal feedstock characterization, or other quality and performance aspects. However, entrusting an external manufacturing partner with such knowledge poses a risk and it is key that customers have confidence that their manufacturing partner will respect their IP and is located in a jurisdiction with strong protections for IP rights holders.

On the flip side, service bureaus can utilize their own intellectual property across a broad range of customers to enhance the performance and quality of AM parts and accelerating time to market due to their AM expertise and experience with a broader range of applications.

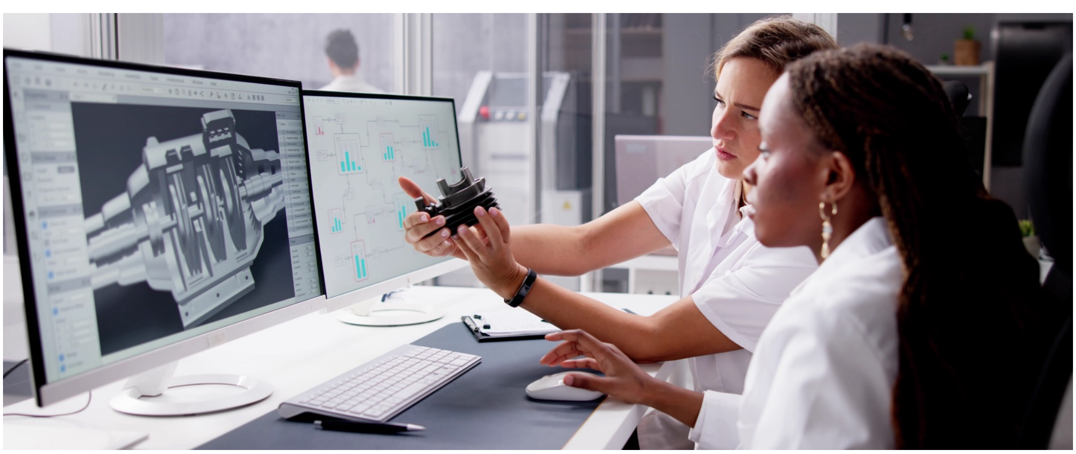


4 Quality and know-how

Metal Additive Manufacturing (AM) applications in industries such as medical or aerospace typically have stringent quality requirements regarding material properties, consistency of part quality, traceability, and documentation throughout the entire manufacturing process. Suppliers in these industries must undergo several qualification steps to become approved vendors. To qualify a supplier, companies first need to develop the necessary know-how internally. In these industries, it has become standard practice for users to initially implement their own internal metal AM machine capacity to develop the application and the requisite qualification documentation before engaging with potential service bureaus.

Know-how, in general, is a crucial component of Additive Manufacturing. This encompasses expertise ranging from design and application development to the entire manufacturing process chain. Often, these elements are closely interrelated. The know-how acquired while operating the machine and developing print parameters can have a direct impact on material properties and design aspects.

Additionally, once a product is ready for serial production, companies may also set up a qualified supplier for their components. Here, OEMs often have to distinguish between a proven sub-tier supplier, who has industry experience but often lacks additive experience, and a proven AM supplier, who may be less familiar with the intricacies of the specific industry and OEM requirements but possesses extensive AM know-how.



4 Quality and know-how

A common challenge for early adopters of Additive Manufacturing is the rapidly evolving technological landscape. Similar to the persistent increase in integrated circuit performance described by Moore's Law, metal AM is expected to continue advancing in terms of productivity, quality, and cost per part. Some companies have qualified specific AM applications on machines that became outdated five years later due to advancements such as multi-laser technology or increased platform sizes. In-house manufacturing capacities may struggle to keep pace with technological advancements, while service bureaus may be more incentivized to continuously invest in upgrading to more productive machine technology to stay competitive. This allows users to take advantage of the latest machine technology at service bureaus and learn best practices from them.

		2024	2027	2030'S
FEATURE SIZE [µm]	Area Printing	100 µm	75 µm	25-50 µm
	L-PBF	150-500 µm	100-500 µm	75-500 µm
	DED	1,000-2,000 µm	750-5,000 µm	500-10,000 µm
	Binder Jet	1,000 µm	~500 µm	~500 µm
LAYER THICKNESS [µm]	Area Printing	25-50 µm	25-75 µm	10-100 µm
	L-PBF	30-90 µm	30-120 µm	30-200 µm
	DED	500-6,000 µm	500-6,000 µm	500-6,000 µm
	Binder Jet	50	50	75
SPEED [kg/hr.]	Area Printing	**up to 3 kg/hr.**	**up to 30 kg/hr.**	**up to 1,700 kg/hr.**
	L-PBF	up to 2 kg/hr.	up to 4 kg/hr.	up to 5 kg/hr.
	DED	up to 6 kg/hr.	up to 15 kg/hr.	up to 30 kg/hr.
	Binder Jet	up to 3 kg/hr.	up to 5 kg/hr.	up to 8 kg/hr.
BED SIZE AVG. [mm^3]	Area Printing	450 mm	1-2 m	2-10 m
	L-PBF	600 mm	1 m	2 m
	DED	1-5 m	1-7 m	1-10 m
	Binder Jet	400 x 250 x 200 mm	600 x 500 x 350 mm	~1 m

Source: Seurat and AMPOWER

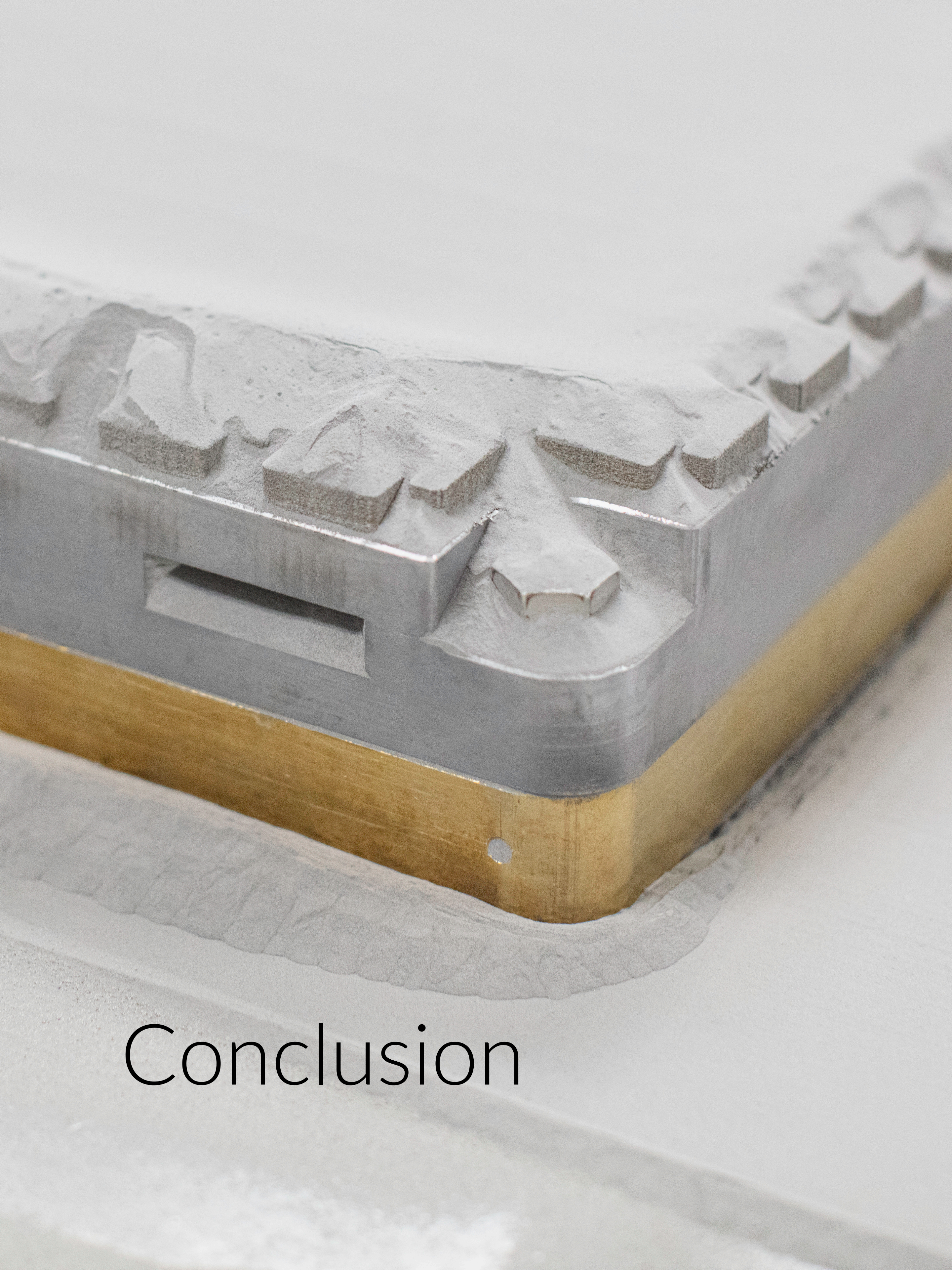
5 Risk evaluation

In the realm of an AM ecosystem strategy, the decision on whether to purchase parts externally or build up in-house manufacturing capability hinges greatly on risk assessment.

When evaluating the "make" or in-house option, a company assumes the risks inherent in maintaining internal production capabilities. This is especially the case for Additive Manufacturing, where the capital investment in equipment can be quite high. Also, the need for skilled labor, fluctuating operational costs, and the potential for production bottlenecks or quality control issues should be considered potential risk factors. Lastly, the fast-evolving technology landscape holds certain risks. The company may focus too early on the wrong technology basis for their application or invest heavily into internal equipment which may quickly become outdated, losing competitive advantage. However, by keeping production in-house, the company retains greater control over the entire process, from design to delivery, which can mitigate certain risks regarding supply chain resilience and foster innovation.

Conversely, the "buy" or external option transfers some of these risks to external suppliers. While outsourcing production reduces upfront investment and overhead costs significantly, it introduces new risks related to supplier reliability, quality consistency, supply chain disruptions, and intellectual property protection. Depending on the industry and market dynamics, these risks can vary significantly, impacting everything from product quality to time-to-market and brand reputation.

Ultimately, the make or buy decision revolves around risk management and the company's risk appetite. By conducting a thorough risk analysis, considering factors such as market volatility, supplier capabilities, and internal resources, organizations can make informed decisions that balance risk exposure with strategic objectives. Whether opting to make in-house or establish external sources, the goal is to minimize risk while maximizing value creation and competitive advantage in the marketplace.



Conclusion

Decision-making summary

In-house Manufacturing

Pros	Cons
▪ Fast lead time, assuming available capacity ▪ High internal know-how ▪ High degree of IP protection ▪ High control over quality ▪ Low supply chain interruption risk ▪ Lower hurdles for design changes ▪ Better integration with other internal processes, such as R&D, design, and production	▪ High upfront investment in equipment, personnel and associated risks ▪ High overhead cost ▪ Low flexibility in terms of manufacturing volume, technology choice and material ▪ Supply chain risk in case of machine failure ▪ High risk on ROI and difficult to plan total cost of ownership upfront ▪ No external know-how and collaboration may hinder good solutions

External Manufacturing

Pros	Cons
▪ Scalable manufacturing capacity ▪ Low upfront investment and low associated risk ▪ Transfers inevitable technology obsolescence risk to external partner ▪ Plannable cost predictions with predictable ROI ▪ Potential benefits and knowledge transfer from AM supplier expertise ▪ Ability to access a wider range of manufacturing and post-processing capabilities without extensive investment.	▪ Difficult to build internal technology know-how ▪ Potential IP risk ▪ Supplier qualification know-how needed ▪ Supplier management, ramp up and partnership required ▪ For lower volume production, costs may be higher ▪ Potential supplier switching costs

Conclusion

The decision on whether to make or buy AM parts depends on several strategic criteria and the outcome will be different for each user. Companies prioritize differently due to different approaches on risk mitigation and commercial aspects.

A general recommendation regarding best practice setups that have proven valuable for various companies can be made. For instance, companies, that are new to metal Additive Manufacturing and are focusing on highly complex applications in general are well advised to invest in at least one in-house machine to develop internal know-how or alternatively hire an experienced team, that has worked on metal AM qualification before. This enables them to build a deeper understanding of the technology and develop applications. It also provides the know-how to enable them to qualify an external supplier for later stage serial production.

At this later stage, an external manufacturing decision also heavily depends on the relationship between the supplier and customer. Although decisions should be based on factual analysis, the human factor can never be ignored and can shift the needle towards a certain decision. A well committed supplier can support a user all the way from the first application development towards a high-volume serial production. On the other hand, when building a whole AM manufacturing facility in-house, companies may encounter unexpected internal struggles. Company culture and relationships should never be underestimated and can overrule any objective, number-based analysis.

In general, collaborations have proven valuable in AM when new applications are being developed. Be it software developers for the latest lattice structures, material supplier expertise with a specific alloy, or service bureaus to provide engineering and manufacturing know-how. Collaborations tend to reduce upfront investment risks and when managed right, lead to a competitive edge and increase in know-how for all stakeholders.

In the end, external manufacturers and AM part suppliers have an intrinsic motivation to be at the forefront of the Additive Manufacturing revolution. They can add value to users who are making their first move towards AM production and to experienced users by applying their expertise from many other AM projects. This collaborative potential can only be leveraged by a trusted external supplier relationship. While these relationships take time to nurture, it is often more beneficial than relying on a completely internal AM supply chain.

Ready to scale additive manufacturing. Ready now.

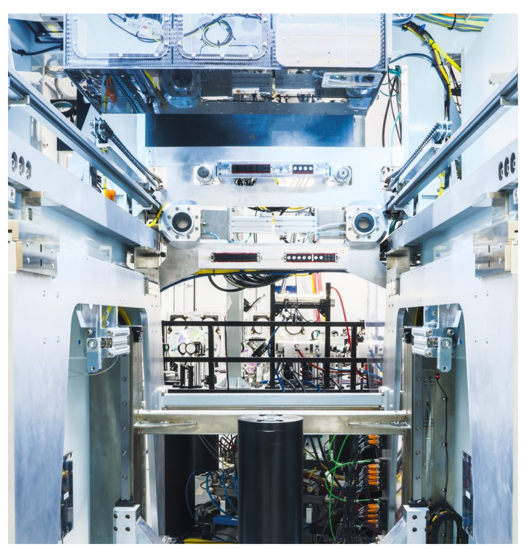
Seurat is an innovation company that has reimagined additive metal contract manufacturing.
We believe today's production processes are broken. They force companies to make unacceptable tradeoffs between speed, cost, and quality. Our unique Area Printing® technology and print depot are a next-generation solution to the age-old dilemma. Available exclusively from Seurat, our process delivers high-volume low-cost production, and high-fidelity craftsmanship.

Parts, not printers.
Seurat is the only contract manufacturer with our state-of-the-art depot. To be clear, we are not selling printers. And frankly, you don't want us to. That saves you the time of investing in expensive equipment, hiring specialized talent, and becoming a subject matter expert in a discipline you don't need to learn.

High performance. High fidelity. Low risk.
At Seurat, we understand our OEM customers want parts that meet their quality targets, at the right price, and are delivered at the right time. OEMs want to focus on their core business, not mastering new production technologies. Seurat's goal is to allow you to buy parts when needed and where needed. Partnering with Seurat is like a shortcut to serial additive manufacturing success, allowing OEMs to accelerate their additive journey and provide predictable, repeatable results.

Inhouse additive amplified by external production. Buying a 3D printer for R&D and single-digit production runs makes sense. When you are ready for serial manufacturing, you need a partner that can scale with demand while delivering on quality and cost. By matching your product expertise and our production know-how we enable you to bring innovative ideas to market faster. And, by eliminating the need to invest in your own printers, you free up the capital required to accelerate the development of your next innovation.

Scale your possible with Seurat.
We are looking for a select handful of forward-thinking companies who share our passion for scaling innovation. Companies that want faster timelines, more manageable deadlines, and healthier bottom lines. To scale your possible, contact us at info@Seurat.com

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