



MRO & 3D Printing: *Benefits to MRO Chief Engineers & Directors of Engineering*

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Maintenance technicians, chief engineers and directors of engineering can all realize direct benefits from 3D Printing (Additive Manufacturing) for their Maintenance, Repair and Operation (MRO) departments. The question is not if your MRO will adopt 3D printing-it is when.



3D Printed Parts in the High Performance Superpolymer-PEEK

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In this short paper, we will present the specific ways that 3D Printing is currently enhancing MRO departments by helping technicians, chief engineers and directors of engineering deliver on their roles and responsibilities more effectively and efficiently.



**3D printed Electrical Connector
in High Performance Superpolymer-PEEK
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9 specific ways 3D Printing impacts MRO goals for the better.



1

Bring an Asset Back to Service Faster

3D printing helps maintenance technicians in reducing downtime by increasing availability of replacement parts or repair fixtures – in many cases at a lower cost and with faster turnaround time.

How 3D Printing Benefits MRO

MRO Goal

3D Printing Benefit

Reduce interruptions to critical operations.

Removes the wait for special deliveries from parts suppliers.

Immediately print preventative spare or reactive replacement parts by searching database for part file and sending file to the printer.

Proactively design customized tool kits for uncommon purposes where regular tooling will not work and print when needed.

Just In Time scan/design and print on-demand fixtures for unusual purposes (not in already in database) where regular fixtures will take time to outsource or purchase. Ideal for exotic hard to reach locations.

2

Extend the Lifespan of Outdated or Damaged Assets

If maintained properly, assets can operate for many years. But inevitably, a machine will become outdated and spare parts may be difficult to find or too expensive to order. 3D printing is becoming one of the technologies that can help MRO departments solve such issues. With a digital manufacturing technology that relies on digital workflows and there is no need for additional tools, like molds, to create a part. The part can be made from a digital file.

How 3D Printing Benefits MRO

MRO Goal

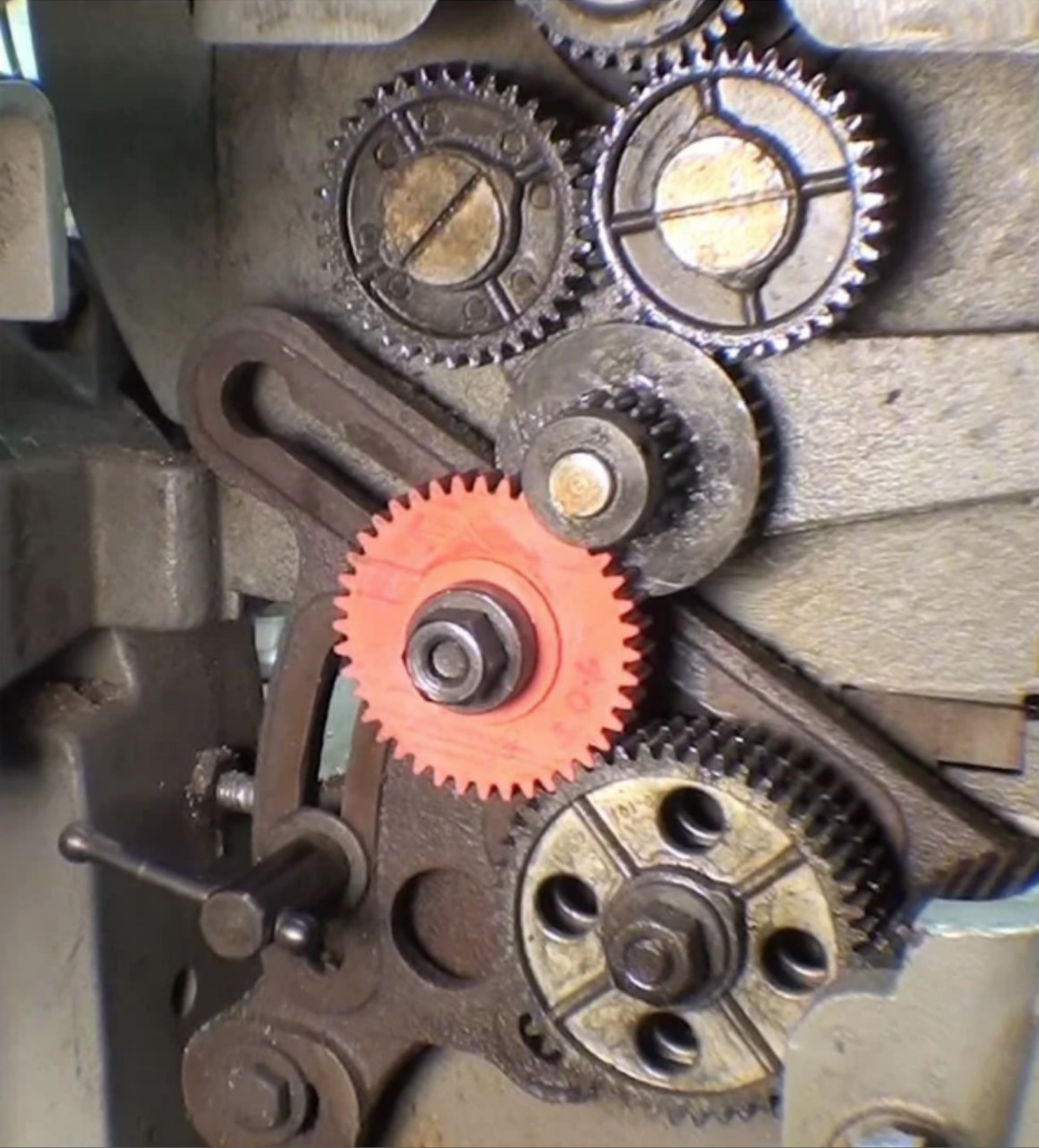
3D Printing Benefit

Increase asset life locally and throughout the organization.

Repair machines that were previously not repairable or outdated by printing the discontinued parts at low volume.

Remove the costs of making customized tooling to continue to make the discontinued parts for critical outdated machines

Increase the outdated parts availability throughout the company by adding the files to the centralized parts database.



Replacement Gear 3D Printed in Nylon

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3

Enables a more Flexible MRO Inventory Management

Maintaining an inventory of spare parts isn't cheap: prices can go up to thousands of dollars each year just to maintain a warehouse full of spare parts. Some parts are expensive, and companies only need to keep a couple of spares on hand to avoid machine downtime. For such parts, 3D printing can provide a solution in the form of a digital inventory. 3D printing only requires digital files to produce a part, so once the design is approved, it can be stored in a virtual part catalogue on a local disk, in a central disk, or even in the cloud for the entire company to access.

How 3D Printing Benefits MRO

MRO Goal

Increase spare and replacement part availability while decreasing the size of inventory of spare and replacement parts.

3D Printing Benefit

Part files can be obtained from OEM with permission to print spare parts using licensed CAD files.

Part files can be designed using engineering software by engineering staff once and then used repeatedly.

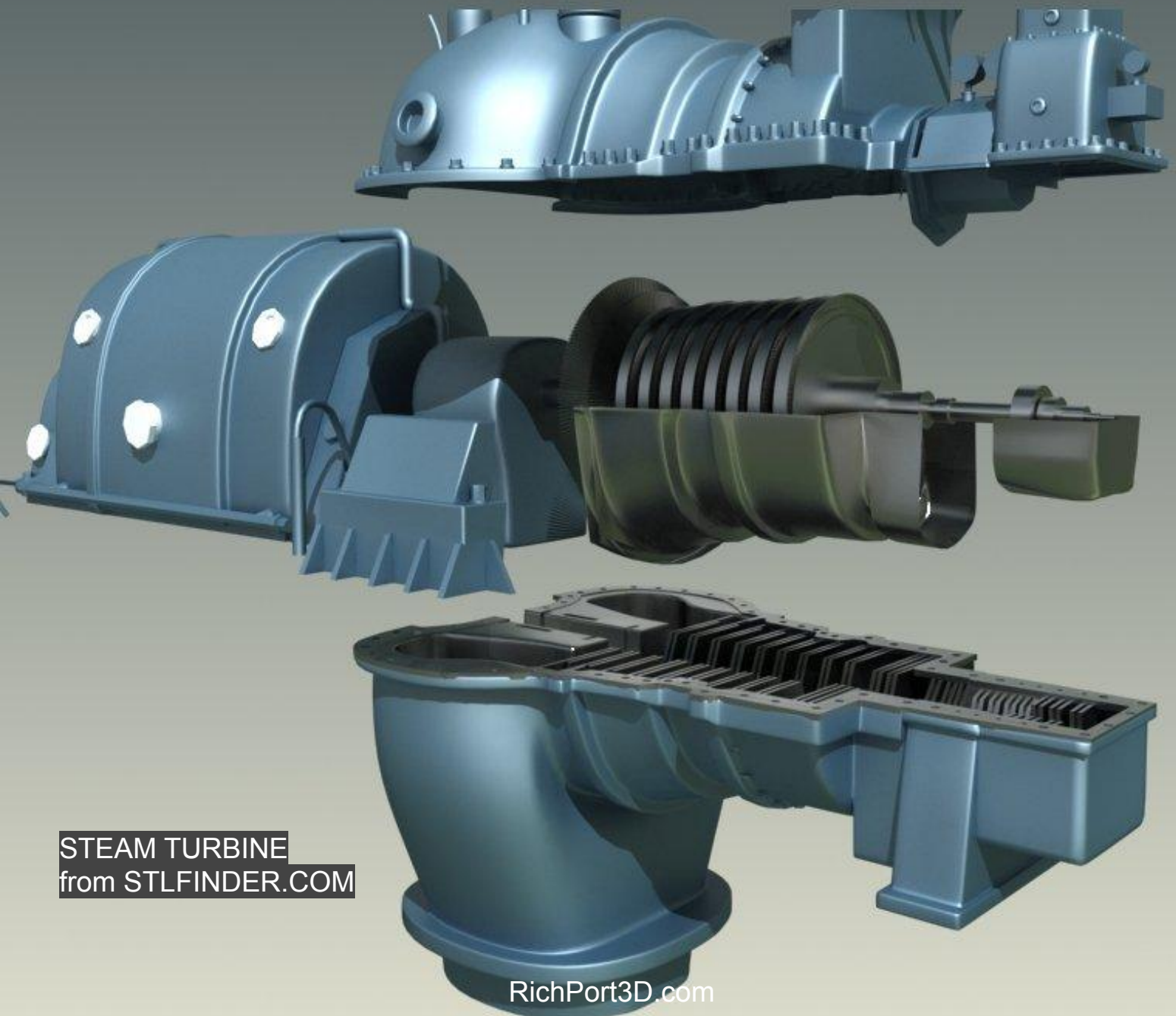
Part files can be made from broken parts using a scanner on the broken part then refined using engineering software and then used repeatedly.

Part files can be obtained on open databases, downloaded to central database, tagged (refined if necessary) and then used repeatedly

Building a Digital Inventory

The existence of maintenance related STL files uploaded to several of the free online 3D printing databases can help jumpstart MRO departments in the accumulation of digital files for maintenance projects.

As the adoption of industrial 3D printing continues, we expect to see more industry focussed databases (ie. databases dedicated to MRO related STLs, automotive STLs, etc.) in the future.



STEAM TURBINE
from STLFINDER.COM

4

Facilitates a More Agile MRO Supply Chain

The supply base for maintenance and repair materials is highly fragmented, due to the nature of specialised parts for varied equipment. Procuring such parts often comes with long lead times, a challenge for manufacturers that need access to spare parts or tools immediately. A 3D printer provides the ability to print repair parts on demand and closer to the point of need, reducing the lead time as well as logistics costs.

Delocalized Part Production Prevalent Today



Localized & Customized Part Production: the Norm in Coming Years



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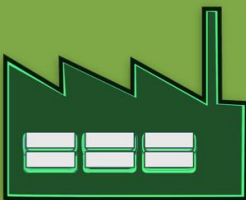
Impact of Supply Chain

Subtractive Manufacturing

Long lead times



High Transport Costs



High Labour Costs



Remote Factories



Additive Manufacturing

Long lead times



Low Volume Segments



High Transport Costs



High Labour Costs



Remote Factories



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5

Improves Reporting on Repair Instances

Improved data management can help organizations reduce costs by anticipating machine breakdown and repair costs. The ability to create a centralized parts database can provide company-wide data on machine breakdown and repair much more reliably and efficiently.

How 3D Printing Benefits MRO

MRO Goal

3D Printing Benefit

Maintain a centralized parts database that will service all facilities and provide company-wide data on the instances of machine breakdown and repair.

Ability to create a searchable and centralized database of digital part files over the internet, stored at one location on the main server and accessed by all company maintenance staff.

3D Printers can use server database part files from anywhere in the company as long as the printer is connected to the database over the internet or cloud.

A centralized log of parts made with high performance 3D printers can be sent back to the central database over the internet.

Analysis of the centralized log can be performed on company-wide data for the instances of machine breakdown and repair and its associated repair costs.

6

Better Control of MRO Budgets

3D Printing helps MRO departments have better control over budgets associated with spare parts for preventative maintenance and repair or replacement parts for equipment repair.

How 3D Printing Benefits MRO

MRO Goal

3D Printing Benefit

Better control of budget associated with spare parts inventory for asset preventative maintenance.

Remove costs associated with parts supplier:

- maintenance agreements,
- pricing changes,
- packaging and shipping costs,
- paperwork,
- time delays, etc.)

Remove the costs associated with warehousing parts:

- Warehouse
- Environmental controls
- Warehouse Personnel
- Insurance
- Location tagging

Remove the supplier costs of ordering an unnecessary surplus of parts because suppliers won't deal with low volumes.

Remove costs associated with parts supplier:

- maintenance agreements,
- pricing changes,
- packaging and shipping costs,
- Paperwork,
- time delays, etc.)

How 3D Printing Benefits MRO

MRO Goal

3D Printing Benefit

Better control of budget associated with replacement parts for asset repair.

Reduce associated breakdown costs by reverse engineering the part design to make it stronger (and reduce breakdown).

Reduce associated energy costs by reverse engineering the part design to reduce the weight (and decrease energy consumption).

Reduce associated costs of assembling a composite parts (manual labor, time delay) by printing already assembled parts.

A log of prints from the printer can help keep the chief engineer aware of printer material usage and its associated part purpose and costs.



7

Increase the Quality of Maintenance Performance

3D Printing allows MRO departments to use the part they need when they need it. It will no longer be necessary to make another part fit the repair in order to get machines up quickly. Repurposing parts often degrade the performance of machines.

How 3D Printing Benefits MRO

MRO Goal

3D Printing Benefit

Increase the quality of maintenance performance.

Work more accurately by making and using exactly the part that you need and not repurposing a part that you have.

Improve maintenance efficiency because assets repaired with the right part or re engineered parts perform better.

8

Increase Employee Engagement

Technicians will immediately recognize that they are being trained in a new skill that will be of vital importance to the future of maintenance management.

How 3D Printing Benefits MRO

MRO Goal

3D Printing Benefit

Increase employee engagement.

Technicians will recognize that they are being trained in a new technology that is set to become an important part of future maintenance management.

Leaders in this new technology from the MRO staff will emerge that can be promoted to help pave the way for uptake of the technology within the organization.



9

Contribute to Sustainability

The impact of climate change is being felt worldwide with more active hurricane seasons, newly created fire seasons, droughts etc. The ability to contribute to the reduction of waste associated within MRO is an obvious plus for any organization.

How 3D Printing Benefits MRO

MRO Goal

3D Printing Benefit

Contribute to Sustainability.

Reduce material waste by using an additive manufacturing technique to make parts that does not make the wastes associated with regular cut away machining.

Reduce part waste by making strong parts that last longer.

Reduce part waste by removing the packaging associated with supplier parts.

Reduce part waste by using a printer that makes parts out of recyclable thermoplastic materials.

Reduce part waste by removing the wastes associated with shipping parts.



Bypass metal casting by 3D printing your part with a metal replacement super polymer like Carbon PEEK.

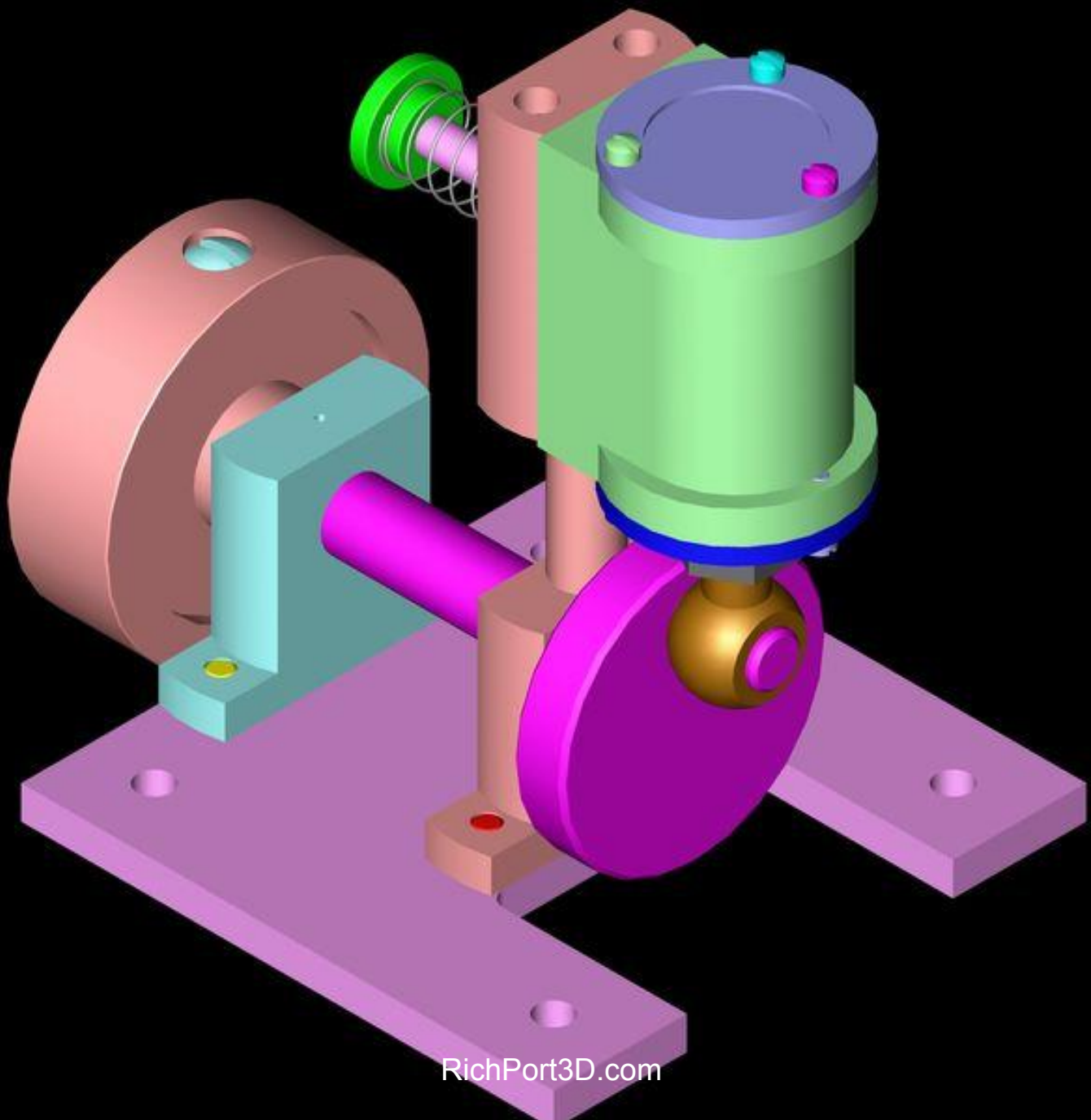


**3D Printing
Benefits**

MRO GOALS

The benefits of industrial 3D printing specifically optimizes the accomplishment of common MRO goals, for any company or organization, including but not limited to: inventory management, asset maintenance and budget management.

6 specific ways 3D Printing impacts the roles and responsibilities of the chief engineer for the better.



How 3D Printing Benefits MRO Chief Engineer

Role of Chief Engineer

Manage engineering budget.

MRO Goals w/ 3D Printing

Better control of budget associated with replacement parts for equipment repair & preventative maintenance.

Ability to Increase asset life locally and throughout the organization.

Contribute to Sustainability.

How 3D Printing Benefits MRO Chief Engineer

Role of Chief Engineer

MRO Goals w/ 3D Printing

Maintain an adequate inventory of parts and supplies.

Increase spare and replacement part availability while decreasing the size of inventory of spare and replacement parts.

Better control of budget associated with replacement parts for equipment repair & preventative maintenance.

How 3D Printing Benefits MRO Chief Engineer

Role of Chief Engineer

Troubleshoot and repair malfunctions in all systems and equipment throughout the facility.

MRO Goals w/ 3D Printing

Ability to have a large inventory of spare and replacement parts at your disposal.

Ability to access the analysis of company-wide printing logs for data on the instances of machine breakdown and part replacement.

Better reduction of interruptions to critical operations.

Improved ability to increase asset life locally and throughout the organization.

Improved ability to increase the quality of maintenance performance.

How 3D Printing Benefits MRO Chief Engineer

Role of Chief Engineer

Oversee preventative maintenance assignments.

MRO Goals w/ 3D Printing

Ability to have a large inventory of spare and replacement parts at your disposal.

Ability to access the analysis of company-wide printing logs for data on the instances of preventative maintenance.

Better reduction of interruptions to critical operations.

Improved ability to increase asset life locally and throughout the organization.

Improved ability to increase the quality of maintenance performance.

How 3D Printing Benefits MRO Chief Engineer

Role of Chief Engineer

MRO Goals w/ 3D Printing

Provide training for engineering associates.

Increase employee engagement.

Increase the quality of maintenance performance

How 3D Printing Benefits MRO Chief Engineer

Role of Chief Engineer

Create work schedules for engineering associates.

MRO Goals w/ 3D Printing

Better reduction of interruptions to critical operations.

Ability to access the analysis of company-wide parts printing logs for data on the instances of machine breakdown and part replacement.

Increase the quality of maintenance performance.

Better control of budget associated with replacement parts for equipment repair.

Improved ability to Increase asset life locally and throughout the organization.

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Roboze

FUNCTIONAL END-USE PARTS

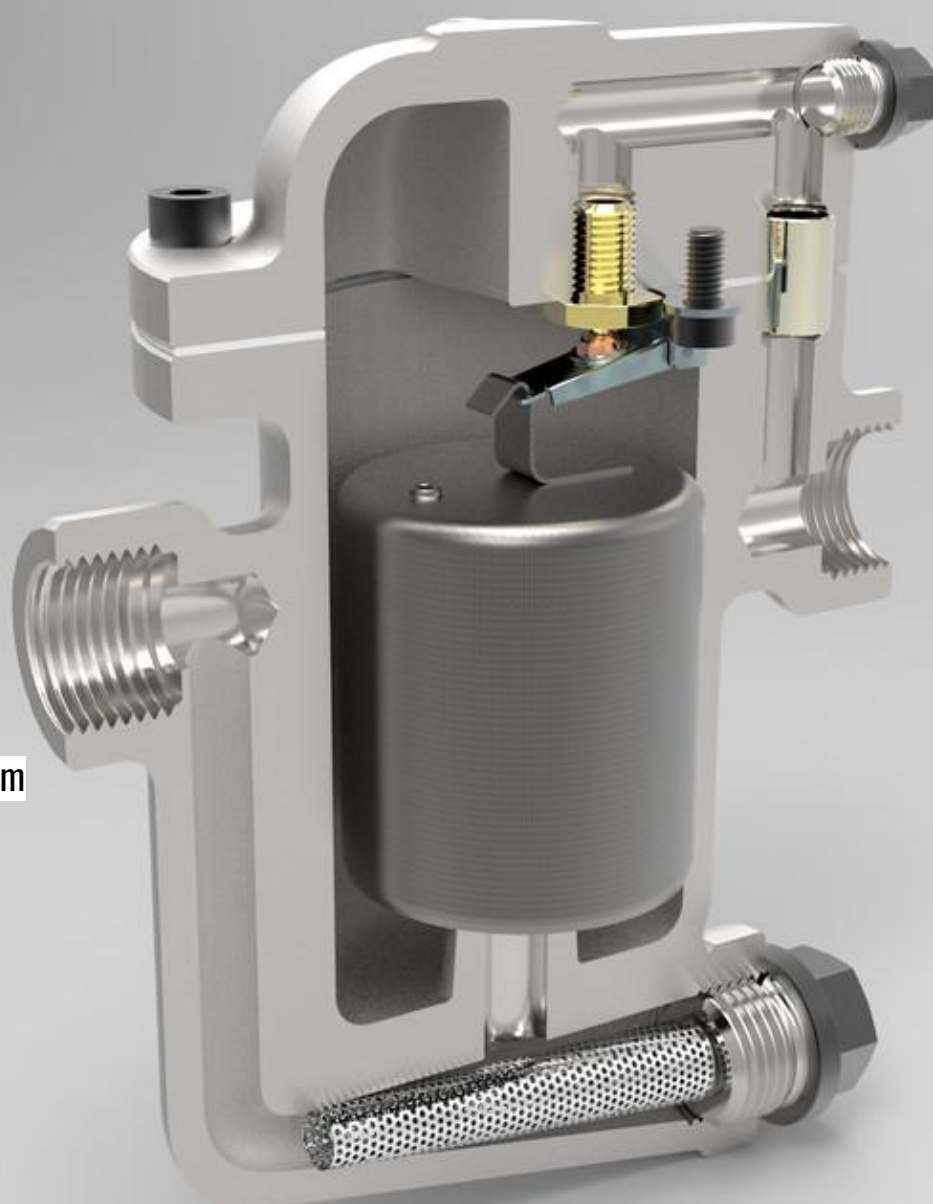
Just in time and On Demand with Roboze 3D Parts

3D Printing
Benefits

MRO GOALS

Chief Engineer
Roles &
Responsibility

In optimizing the accomplishment of MRO goals, industrial 3D printing specifically helps the chief engineer by providing technology that helps him/her perform his/her role & responsibilities more efficiently and effectively.



Inverted Bucket Steam
Trap for 3D Printing
on STLFINDER.com

5 specific ways 3D Printing impacts the roles and responsibilities of the director of engineering for the better.

How 3D Printing Benefits MRO Director of Engineering

Role of Director

Develop and execute strategies to optimize the process for the procurement and management of materials, and maintenance related services.

MRO Goals w/ 3D Printing

Your chief engineers can increase spare and replacement part availability while decreasing the size of inventory of spare and replacement parts by creating a digital inventory of part files for 3D Printing on demand.

How 3D Printing Benefits MRO Director of Engineering

Role of Director

Provide leadership and oversight for the materials team to ensure that proper market research is carried out for the procurement and repair of parts and components.

MRO Goals w/ 3D Printing

Your chief engineers will better manage their engineering budgets by using digital files instead of ordering physical parts.

How 3D Printing Benefits MRO Director of Engineering

Role of Director

Work closely with Engineering, Planning, and Supply Chain operations to manage the company's parts and inventory through product Life Cycle Management.

MRO Goals w/ 3D Printing

Your chief engineers can better reduce interruptions to critical operations, increase asset life locally and throughout the organization; and increase the quality of maintenance performance.

How 3D Printing Benefits MRO Director of Engineering

Role of Director

Deliver cost driven initiatives to promote the benefits across the organization.

MRO Goals w/ 3D Printing

Your chief engineers will have better control of budgets associated with replacement parts for equipment repair & preventative maintenance while increasing asset life locally and throughout the organization.

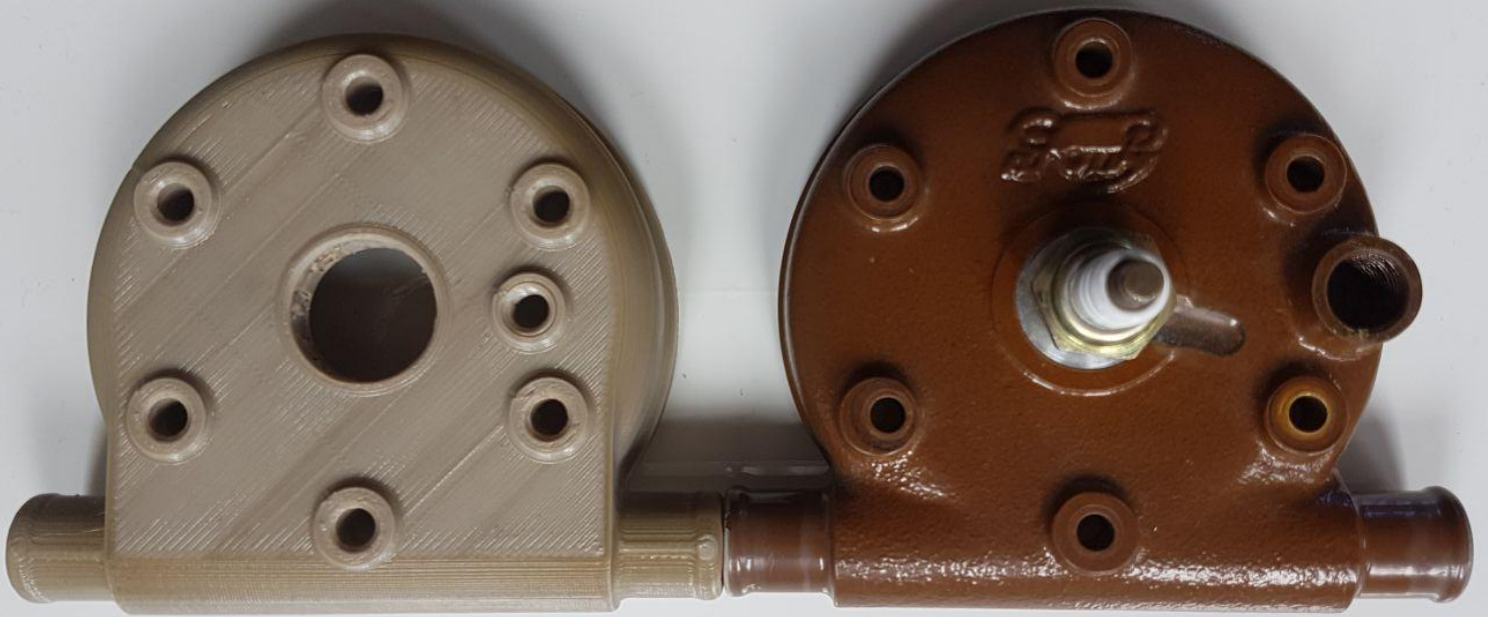
How 3D Printing Benefits MRO Director of Engineering

Role of Director

Lead the development and deployment of standardized and optimized Inventory Management policies, and processes.

MRO Goals w/ 3D Printing

A centralized digital inventory can provide your chief engineers with the ability to access the analysis of company-wide machine printing logs for data on the instances of machine breakdown and part replacement. This report will help in the optimization and standardization of policy and processes.



Motor Cover Metal Replacement part: From Magnesium Alloy (right) to 3D Printed PEEK (left).



In helping the chief engineer to perform his/her job more effectively and efficiently, industrial 3D printing specifically enables the director of engineering to deliver on his/her deliverables more effectively and efficiently.

Roboze 3D Parts

Print high resistance parts on demand



Conclusion

The two main pain points associated with MRO departments are unnecessary repetitive costs and extremely time-consuming workshop activities, In this short paper, we have shown that the benefits derived from industrial 3D printing are perfectly aligned with the goals of MRO departments and helps enhance the performance of these departments and minimize the two main associated pain points.

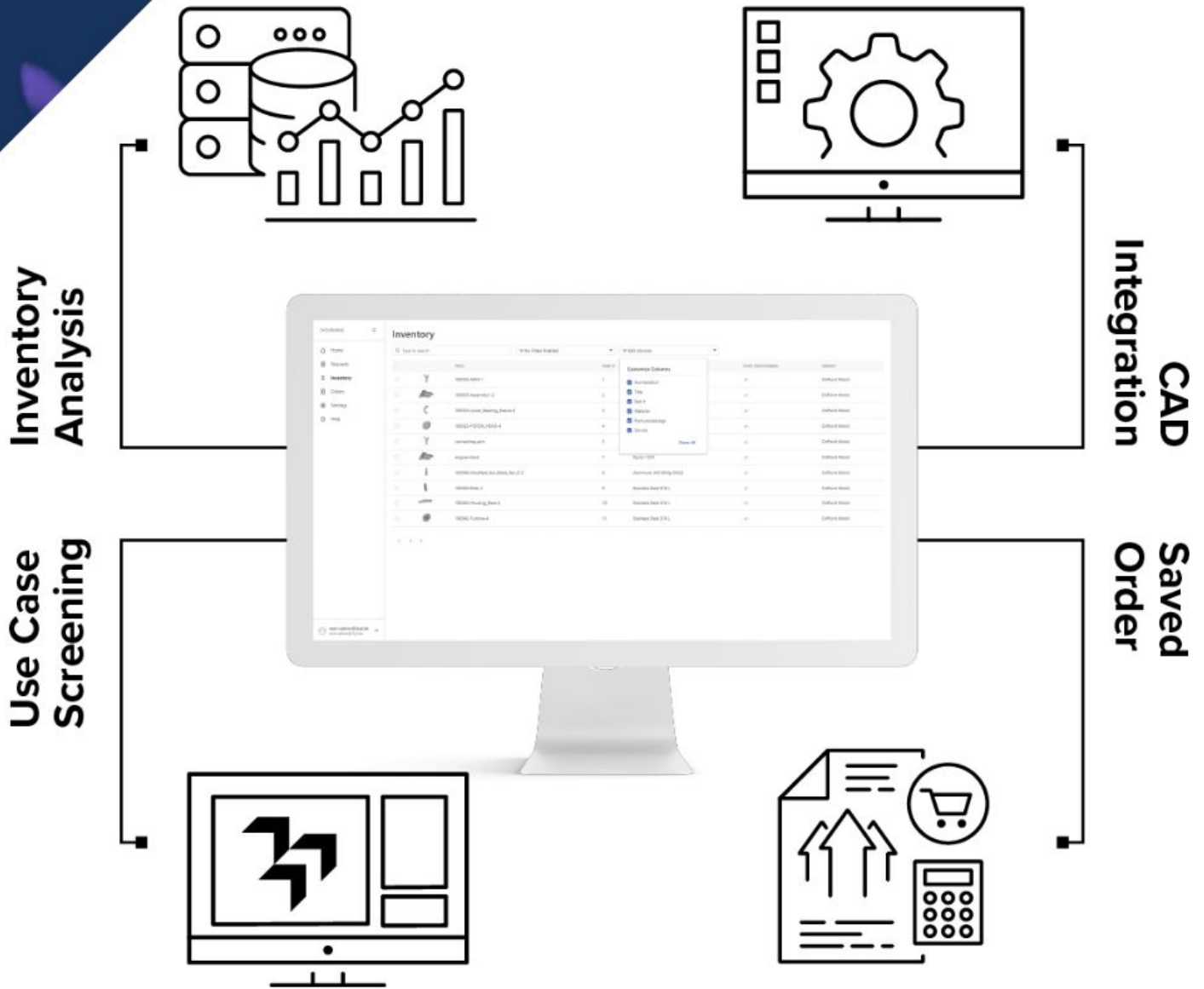
APPENDIX

How do I begin to implement 3D printing into my MRO department?

1. The first step would be to invest in an industrial 3D printer that is versatile enough to allow you to reap the benefits outlined in this paper. Here are some characteristics that we think are important:
 - a. The variation in materials & their properties available to the printer.
 - In order to get the most use out of the printer, it is best to get a printer that can use materials with a wide range in material characteristics. Printers that can print in flexible materials as well as strong, lightweight materials with high heat resistance would be ideal.
 - b. The accuracy and precision of the printer.
 - It would be best to invest in an industrial printer with the greatest degree of accuracy and precision available. This insures that you will be able to print parts for a variety of applications.
 - c. Material usage during printing.
 - We believe that MRO departments would be best served with printers that utilize very accurate FFF technology. This is a clean technology where most of the materials winds up in the final printed part. There are no need to deal with messy powders or resins. (Although powders and resins have their place for other applications.)
 - d. Ease of use and FTE usage.
 - Ideally you would like to get a printer that is easy to use and can run automatically, during and after hours, for true hands off printing. This minimizes the FTEs needed to run the printer.
 - e. Printer warmup and cooldown.
 - In order to print in high performance super polymers it is necessary to heat the system before printing and cool the system down before part removal. In order for a printer to contribute to JUST IN TIME delivery, it needs the warmup and cooldown to happen in a quick manner. We do not recommend printers that take 12-24 hours for this warmup and cooldown to be used in MRO departments.

The Roboze ARGO series has all the above qualification needed for MRO 3D printing.

Roboze Argo Industrial Printers
Learn More



2. Invest in an inventory software application specifically made for industrial 3D printing. Industrial 3D printing software will help you manage the following:
 - a. A simplified transfer of a CAD files to 3D printers for part production.
 - b. The performance of inventory analysis to help find strong use cases on existing part data.
 - c. The automation of the movement of parts from their order management to a digital inventory for future use.

We recommend 3YourMind Agile Product Life management Software.

[Learn More](#)

- 3. Designate one person to be in charge of the 3D printing initiative at your organization. Make him/her the subject matter expert in the introduction of industrial 3D printing into your MRO department.**

About Rich Port 3D Solutions, Inc.

Rich Port 3D Solutions is a consulting and industrial 3D printer reselling company headquartered in the US territory of Puerto Rico-servicing the Caribbean since 2014. As an industrial 3D solutions resource, we are dedicated to helping Caribbean businesses compete on the world stage in additive manufacturing technologies by paving the way for its uptake in the Caribbean.