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Operations

DIGITAL REVOLUTION IN AFTERMARKET SERVICES

MARSH GUY CARPENTER MERCER OLIVER WYMAN

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The exponential development of data and connectivity is shifting the aftermarket services towards a new era, generating opportunities both for new efficiency and up-selling. Industrial companies need to seize this major trend and solve the following issues: Which Digital Technologies are the most relevant to disrupt their current aftermarket services and generate value? What are the impacts on their business model and organization?

A NEW ERA FOR AFTERMARKET SERVICES

SHIFTING TOWARDS A NEW ERA

Aftermarket services segments cover all services related to a product after it has been sold to the customer, from support to operations (such as communication and control, training), maintenance and repairs (such as periodical checks and spare parts management) to end-of-life management (including upgrading or dismantling).

These segments represent a significant and profitable revenue source in a product's life cycle, continuously increasing over the past few years. As an example, Airbus forecasts predict that, over the next 20 years, commercial aviation aftermarket services will represent a cumulated amount of $3 trillion, with an average year-on-year growth of about 5 percent.

However, the aftermarket value chain is still highly segmented in silos: Each player focuses on its own perimeter, where it exerts a strategic control thanks to its assets (parts IP, global network, integrated offering, and so on). Business models are often still basic in this field, relying on service contracts (diagnosis, repair, parts, and maintenance) using a transactional mode (cost per operation).

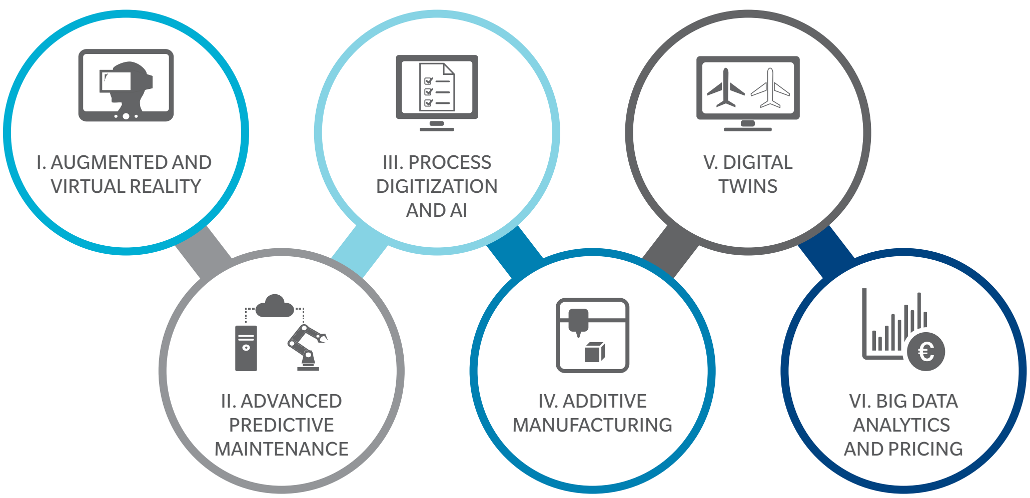
The exponential development of data and connectivity in manufacturing is shifting aftermarket services towards a new era. The next generation of tools and processes is equipped with technologies that enable unprecedented collection and transmission of data, which can be exploited to improve aftermarket operations. As an example, a fleet of 100 rail cars produces about 100 to 200 billion data points every year. A single hybrid plug-in vehicle can generate data up to 25 gigabytes in just an hour and the next generation of aircraft engines will monitor around 5,000 or more parameters continuously throughout a flight.

The analysis and continuous monitoring of collected data provide new opportunities to optimize traditional aftermarket operations with faster, cheaper, and high-quality aftermarket services, such as improved spare parts management, and optimized maintenance planning. In parallel, new technologies (for example augmented reality and process digitization) allow real-time and automated remote support to operations, increasing the reactiveness of aftermarket services. Going forward, this new level of customer intimacy generates new after-sales business models and service offers to optimize customer operating cost and asset life cycle.

These digital applications will allow the manufacturing companies that master these key digital technologies to perform a breakthrough in their after-sales business models and operations, and transform current aftermarket operations threatening thus the survival of the players who miss this revolution.

OVERVIEW OF THE SIX DIGITAL AFTERMARKET TECHNOLOGIES

Six technologies have been identified as particularly promising and are developing at a rapid pace.



These applications – hardware and especially software – go beyond the testing phase, with several successful examples already in the field. Very substantial growth and adoption rates are expected in the coming years. For instance, a compound annual growth rate (CAGR) close to 100 percent by 2020 is expected for augmented and virtual reality and artificial intelligence. Such growth, while the technologies are also maturing, will push manufacturing companies to rethink and enhance their after-sales structures in a very short time period.

OVERVIEW OF THE SIX KEY TECHNOLOGIES

	AUGMENTED AND VIRTUAL REALITY	ADVANCED PREDICTIVE MAINTENANCE	PROCESS DIGITIZATION AND AI
	Augmented and virtual reality comprises the extension of human visuals through hardware, such as glasses or smartphones, and can be used for operations, maintenance, provision of training, etc.	Predictive maintenance describes the process of detecting potential failures through measurement of machine parameters as well as its operating environment upfront and reacting accordingly to avoid high maintenance costs at a later stage.	Process digitization and artificial intelligence (AI) allow autonomous answering of incoming customer communication, perform remote diagnosis (pattern recognition), and propose suggestions for up-selling and services.
EXPECTED VOLUME	**~$5 billion** Software market with engineering use in 2025	**~$1–3 billion** Expectation by 2021/2022	**~$5 billion** Expected AI market for manufacturing by 2020
DEPLOYMENT COSTS	HIGH / LOW Hardware Development of apps/interfaces	HIGH / LOW Software and machine upgrades (sensors, ...)	HIGH / LOW Migration/integration in existing ecosystem Programming
UTILIZATION COSTS	HIGH / LOW Updates Purchase of new programs	HIGH / LOW Self-running with occasional updates	HIGH / LOW Constant improvement Monitoring
BENEFITS	• Faster and enhanced training of personnel • Performance of advanced/new tasks • Identification of defects • Faster and enhanced maintenance support • Increased control and safety	• Elimination of maintenance tasks • Reduction of component replacement costs and downtime • Better equipment availability • Extension of asset life cycles • Product quality • Optimization of maintenance personnel	• Cost savings due to efficiency improvement • Faster, better, and more efficient handling of tasks (like client requests) • More efficient administration and personnel • Improved customer/supplier understanding and contact
CHALLENGES	• Integration into existing IT infrastructure • Addition of intelligence to machines and equipment • Maturity of technology • Training of personnel	• Data storage and real-time analysis capacity • Homogeneity of data formats • Advanced analytics to identify trends • Reviewed spare parts logistics management	• Deep review of operational and sales processes • Salesforce and operational workforce training to use new tools • Effective cybersecurity prevention
USE CASES AND INDUSTRIES	• Real-time repair instruction via visual communication tools, such as glasses, from engineers to on-site personnel, (airline, aerospace, rail) • Monitoring of status of machines to identify pre-warning signs (airline, aerospace, rail) • Sales force wearing smart glasses to detect damaged parts in IoT-connected equipment • Augmented reality glasses to service technicians in far away locations: better visibility on installed machine base, and control of the spare part bus	• In the rail industry, optimization of maintenance cycles and strong reduction of delays due to equipment failure in operation, through the implementation of predictive maintenance approach in trains	• Sales force effectiveness using apps: Despite offering its customers access to a performance tool including maintenance information, job lists are generated for each technician based on real-time analysis and create most efficient routes based on the location of assigned jobs. As jobs change throughout the work day, the route adjust in real time

ADDITIVE MANUFACTURING

Additive manufacturing describes the process of producing 3D objects by successively adding material layer by layer, for example through 3D printing, rapid prototyping, or direct digital manufacturing.

EXPECTED VOLUME

~$11 billion

Expectation by 2020

DEPLOYMENT COSTS

HIGH / LOW

Machine and system setup

UTILIZATION COSTS

HIGH / LOW

Build failure, part rejection

Manual processes

BENEFITS

- Cost effectiveness
- Fast production lead time
- Spare parts stock reduced along with the storage space needed
- Decreased working capital requirement

CHALLENGES

- Powder quality and material properties
- Equipment performances (size/speed limitations and cost of 3D printers)
- Process repeatability and certification
- Integration into existing IT infrastructure

USE CASES AND INDUSTRIES

- In the rail industry, use of 3D printing to manufacture spare parts more cost-effectively and closer to the operators maintenane centers, thereby generating significant cost savings

DIGITAL TWINS

A digital twin is a dynamic digital model of an industrial asset or process to simulate an integrated outlook of any project, to any user, at any point in the product's life, thus allowing for monitoring and failure prediction.

EXPECTED VOLUME

~$15–18 billion

By 2025

DEPLOYMENT COSTS

HIGH / LOW

IT infrastructure

Sensors

Software costs

UTILIZATION COSTS

HIGH / LOW

Computing processes

BENEFITS

- Customization and improved planning
- Seamless testing and certification
- Early warning and failure prevention
- Optimized asset utilization
- Smart product upgrades
- Close customer interaction

CHALLENGES

- Unique clean data layer
- Real-time connection to the Twin
- Representativeness of the Twin
- Management of configuration updates
- Valorization of new services to the clients

USE CASES AND INDUSTRIES

- In the defense industry, use of the digital Twin to improve individual aircraft tracking: specific geometry of parts, aerodynamic models, engineering changes, material properties, inspection, and operation and maintenance data

BIG DATA ANALYTICS AND PRICING

A vast amount of information on machines, parts, customers, competition, transactions, and so on can be gathered through big data and analyzed for numerous purposes, including pricing.

EXPECTED VOLUME

~$40 billion

For discrete and process manufacturing in 2020

DEPLOYMENT COSTS

HIGH / LOW

Migration/integration in existing ecosystem

UTILIZATION COSTS

HIGH / LOW

Skilled resources

High management efforts

BENEFITS

- Optimization of machine setup and realization of cost savings
- Intra and inter-company benchmarking
- Enhanced supervision and management of machines
- Differentiated and optimized pricing for various customers

CHALLENGES

- Availability of data
- Advanced analytics

USE CASES AND INDUSTRIES

- New spare parts pricing mechanisms and pricing optimization potential (one equipment and machinery manufacturer was able to improve its gross margin by 10 percent through big data analytics)

EXPECTED BENEFITS OF THESE TECHNOLOGIES FOR MANUFACTURING COMPANIES

ADDITIONAL SUPPORT TO OPERATIONS

These new technologies address several challenges that manufacturing companies are currently facing with their cost structure, such as steamlining of operations, workforce turnover and training needs, remote monitoring of operations, high maintenance costs, poor feedback between engineering and production, and heavy administrative processes.

The first impact of these technologies will be to increase field force effectiveness through better training, more digitization and remote monitoring support of aftermarket activities. As an example, video reality technology is already used by airlines to solve technical problems with an aircraft that is a long way from the engineering team through connected devices such as connected glasses.

New technologies will also contribute to a reduction in product life cycle cost through better knowledge and monitoring of products. Thanks to predictive algorithms and simulations, the close monitoring of product behavior and parameters will help anticipate future breakdowns and then maximize product availability. For instance, in October 2016, BAE Systems was awarded an $8 million contract to enhance an obsolescence predictive maintenance tool to help keep US Air Force planes flying, through better management of data collected from aircraft operations.

Another effect is the facilitation of feedback between engineering, production and services departments: The data collected by these technologies during the product life cycle will be shared with different stakeholders and thus contribute to breaking down the silos between the different departments involved. As an example, data gathered through a digital twin can provide useful information to the engineering departments to optimize the design of the next generation of products.

In addition, digitization will help to simplify administrative processes and eliminate non-value-added tasks through increased automation. Bots and artificial intelligence are now able to process some ad hoc maintenance requests (such as understanding the request, responding, finding immediate solutions through software updates, and forwarding to appropriate technicians). Technicians are then mobilized only for process monitoring and specific ad hoc tasks, for example to manage unsolved maintenance requests.

Streamlining the cost structure of aftermarket operations, these technologies will generate significant margin improvement opportunities for aftermarket companies.

NEW STREAMS OF VALUE AND IMPROVED SALES PROCESSES

In addition to reducing costs, the technological leap forward will also enable manufacturing companies to improve their service level to their clients and create new value streams.

The digital technologies will contribute to improve service levels for customers, allowing aftermarket companies to propose quick, flexible, and adapted answers. Digital twins, big data, and predictive maintenance will help anticipate customer needs while additive manufacturing, augmented reality, and digitization will facilitate very quick responses from manufacturers with remote analysis of the situation and on-demand spare parts production.

As an example, in September 2015, Mercedes-Benz Trucks allowed customers to 3D-print more than 30 different spare parts for cargo trucks at their nearest facility, instead of waiting for original factory spare parts to be delivered, to improve the related lead time and reduce the total maintenance cost.

In a further example, UTC Aerospace Systems launched "Vigor Systems", its Health and Usage Management Systems (HUMS) service, enabling to provide early detection of incipient flaws and fast troubleshooting, but also to improve equipment life cycle management through thorough utilization to its clients data.

In addition to this service level increase, substantial volume of data created will enable companies to refine their knowledge of customers and will bring new monetization opportunities. For instance, the spare parts business can be further optimized using advanced operations analytics by machine learning algorithms will help optimize the pricing of spare parts and thus maximize the value captured by the manufacturer. Remanufactured and used machine sales will also benefit from an increase in technology maturity: Analytics and connectivity will improve knowledge of the product life cycle to accurately assess and forecast how reusable the product is.

Valorization of the data can also be oriented towards the client to generate new streams of revenues. Manufacturers now have sufficient databases to develop new offers of software to help the client optimize operation costs. As an example, Rolls-Royce signed a five-year agreement in June 2015 with Singapore Airlines to support the airline company with its tool VisiumFuel, which aims to optimize fuel consumption through big data analytics. This new offer will complete the service panel proposed by Rolls-Royce to support the aftermarket operations of their customers.

Exhibit 3: Opportunities offered by digital services for manufacturing aftermarket services

	Augmented and Virtual Reality	Advanced Predictive Maintenance	Process Digitization and AI	Additive Manufacturing	Digital Twins	Big Data Analytics and Pricing
Completion of product **portfolio**	✓✓				✓	
Penetration of **installed base**	✓	✓✓			✓✓	
Optimization of **spare parts** business		✓		✓	✓	✓✓
Monetization of **software**						✓
Field force effectiveness	✓✓					
Streamlined **administrative** processes			✓✓		✓✓	

✓✓ Highly applicable ✓ Applicable

THE WAY FORWARD: PREPARE YOUR TRANSFORMATION

To seize these opportunities, management should initiate the global intent to digitize aftermarket services, combining both optimization and new value-generation targets. In most of the cases we have observed, companies launch initiatives in various departments without any common or shared vision, which does not result in a clear, comprehensive, and profitable strategy.

A structured bottom-up approach is needed, involving the workforce and committing it to the design process. This will help to identify not only the most relevant and pragmatic use-cases to address, but also the mature technological solutions that will support them.

Proof of concepts (PoCs) must be launched as soon as possible to ensure collaborators buy in to the transformation, validate the feasibility of solutions, and justify the return on investment (ROI). The roll-out of the POC must be supported by extensive communication (both internal and external), to help everyone understand and project into the future target vision. The global roll-out strategy must then be defined, based on deployment of the POC.

This journey implies a restructuring of the internal organization and skills base by: implementing data governance to manage the digital transformation; transforming the legacy workforce and defining the right skills to attract and retain; and achieving proactive change management (for example through awareness sessions, training, and reverse coaching).

It also implies managing innovation through, among other things, collaboration with an ecosystem of innovative start-ups that will support fast development and testing of key technologies.

Finally, to ensure the transformation is firmly anchored in the company's (and its suppliers' or clients') systems, it is key to anticipate the required evolutions of IT infrastructure (servers, network, and infrastructure), applications (like ERP, MES, and PLM), and cybersecurity. The target end-to-end data architecture, as well as mechanisms for collecting and accessing data, must be defined early, from engineering to services. Any data and metadata format and availability issues, in internal and external systems, must be mapped and addressed to reach an end-to-end solution. Modular solutions can be the most relevant to facilitate agile implementation and enable scalability in the medium to long term.

Oliver Wyman has developed a framework named "Digital Wheel", to support its clients in this transformation (see Exhibit 3). A roadmap must take into account all the elements of the wheel.

Exhibit 4: Oliver Wyman Digital Wheel

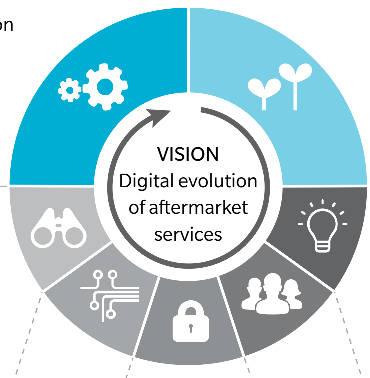
DIGITAL INTENT

OPERATIONAL PERFORMANCE

- Resource and labor optimization
- Fast MRO lead time
- Higher equipment availability
- Maintenance costs reduction
- Better Feedback and collaboration between engineering and production
- Lead time and inventory reduction
- Non-quality reduction
- Safety improvement
- Remote monitoring of operations

VALUE CREATION

- Product agility and customization
- Product launch optimization/ acceleration
- TCO reduction (smart purchasing, predictive maintenance, aftermarket)
- New after-sales services
- Smart business models



TECHNOLOGY

- Product and processes digitization
- Advanced data analytics
- Predictive maintenance
- Artificial intelligence
- Digital Twin
- Additive manufacturing

CULTURE

- Innovation
- Collaboration and Design Thinking
- Labs & FabLabs
- Experiment and learn

DATA AND INFRASTRUCTURE

- Data collection
- Data sharing and security
- Advanced analytics and capabilities
- IT Infrastructure

CYBERSECURITY

- Infrastructure security
- Data security

ORGANIZATION AND SKILLS

- Leadership and inspiration
- Talent strategies
- Agility, multi-skills, DevOps, new capabilities
- Digital organization structure
- Middle management skills and mindset

DIGITAL CAPABILITIES

Oliver Wyman and its Digital Operations Practice have built a thorough expertise and capabilities to accompany corporations in this journey:

- A unique mix of pragmatic skills, combining sectorial expertise, operational excellence expertise, sharp technical expertise (engineering and production), IT experts (such as data scientist, and architects).
- A rich ecosystem of more than 150 start-ups to quickly deliver proof of concepts, and an ecosystem of FabLabs and Design Centers.
- A complete content library, with more than 200 use cases from our experience and market best practices.
- Deep expertise in cultural change to embrace digital transformation, through facilitation of Design Thinking sessions, and partnership with communication agencies to visualize concepts.
- Apps to assess digital maturity.
- A network of more than 30 Factories of the Future, to illustrate our recommendations with concrete examples.

Oliver Wyman is a global leader in management consulting that combines deep industry knowledge with specialised expertise in strategy, operations, risk management, and organisation transformation.

Oliver Wyman's global Operations Practice specializes in end-to-end operations transformation capabilities to address costs, risks, efficiency, and effectiveness. Our global team offers a comprehensive and expert set of functional capabilities and high-impact solutions to address the key issues faced by Chief Operating Officers and Chief Procurement Officers across industries.

For more information please contact the marketing department by email at info-FS@oliverwyman.com or by phone at one of the following locations:

EMEA
+44 20 7333 8333

AMERICAS
+1 212 541 8100

ASIA PACIFIC
+65 6510 9700

AUTHORS

Eric Ciampi
Partner
Eric.Ciampi@oliverwyman.com
+33 6 62 08 09 34

Markus Mentz
Partner
Markus.Mentz@oliverwyman.com
+49 89 939 49 548

Archag Touloumian
Principal
Archag.Touloumian@oliverwyman.com
+33 6 77 39 95 08

CONTACTS

Lars Stolz
Global Head of Operations
Lars.Stolz@oliverwyman.com

Greg Kochersperger
EMEA Head of Operations
Gregory.Kochersperger@oliverwyman.com

John Seeliger
Americas Head of Operations
John.Seeliger@oliverwyman.com

Xavier Nouguès
Head of Value Sourcing
Xavier.Nougues@oliverwyman.com

Michael Lierow
Head of Supply Chain
Michael.Lierow@oliverwyman.com

Alex Lyall
Head of Digital Operations
Alex.Lyall@oliverwyman.com

Brian Prentice
Head of Manufacturing and Process Operations
Brian.Prentice@oliverwyman.com

www.oliverwyman.com

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