



MELTIO

Past. Present. Future

# RAILWAY SECTOR

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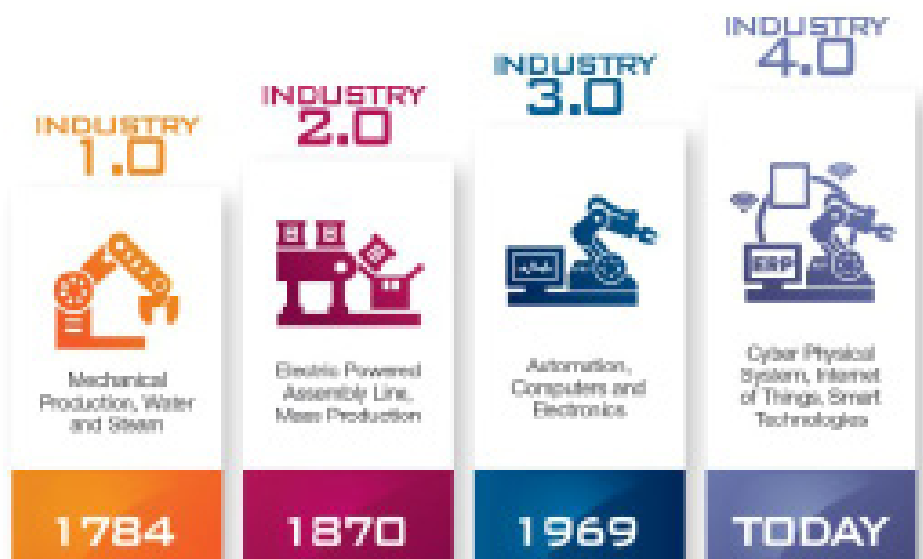
# TABLE OF CONTENTS

Industry 4.0	<b>3</b>
Digital Enablers	<b>5</b>
Objectives of the Railway Sector	<b>8</b>
Components of Railway Sector	<b>10</b>
Typology of Railway Parts	<b>11</b>
Materials used in the Railway Sector	<b>14</b>
Additive Manufacturing in the Railway Sector	<b>18</b>
Advantages	<b>20</b>
New Applications	<b>23</b>
FAQ	<b>25</b>



# INDUSTRY 4.0

Industry 4.0 emerges as a new Industrial Revolution, which consists of incorporating new technologies (Cloud, cyber-physical systems, sensors, 3D printing, etc.) to the industry. It is established as a new industrial path that leading developed countries are already traversing.



Source:  
[hipermediaciones.com](http://hipermediaciones.com)

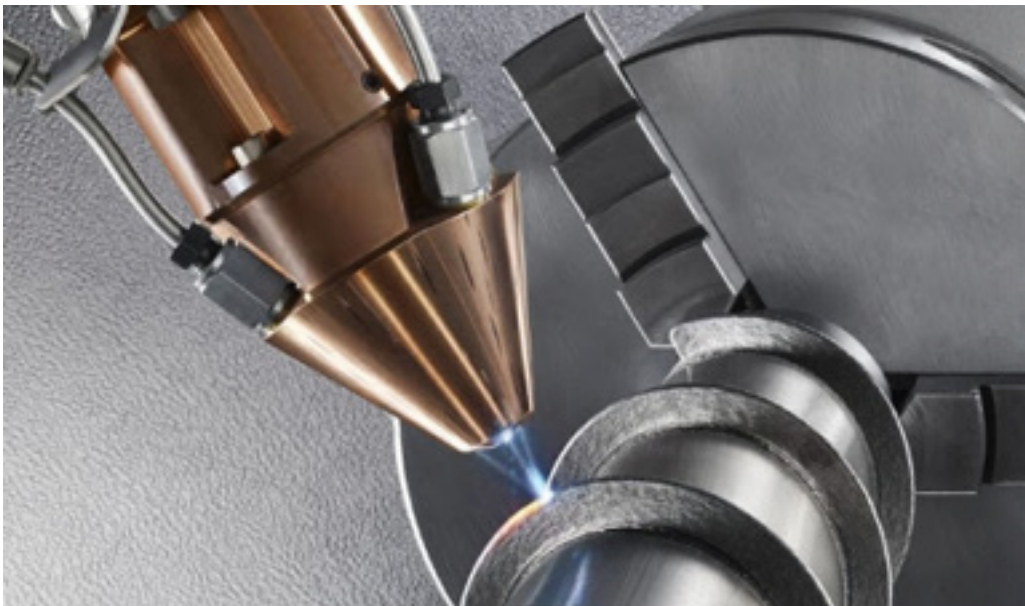
Digital transformation is a challenge for the global industry, but it also offers the opportunity to improve its competitive position.

The term 'Industry 4.0' shows the beginning of the fourth industrial revolution. This is driven by digital transformation, signifying a qualitative leap in the Organization and Management of the value chain of each sector.

# 4

Past. Present. Future **Railway Sector**

The digital transformation of the industry implies the application of a set of technologies throughout its entire value chain. These changes generate benefits both at the process level, as well as at the product / service and business model level. Likewise, these changes have a direct impact on the strategy, personnel, and infrastructures of companies.



# 2

## DIGITAL ENABLERS

Business models must identify which technologies (digital enablers) can help you in each case to get closer to your goals and how to integrate them. The process by which each company establishes a roadmap towards these objectives is called Digital Transformation.

### Communication and data processing

These enablers are increasingly demanding greater capacity at lower cost. They collect the information from the first category of enablers, transport it, offer processing capacity, and guarantee its security to make it available to the last layer of enablers, the management applications. It also conducts this communication in the reverse direction: from management applications to enablers that make the hybridization of the physical and digital world possible.



## Management applications intra and intercompany

These enablers process the information obtained from the first two enablers and apply intelligence to make use of this information. There are three types of management applications that are especially relevant to the industry: business solutions, intelligence and control solutions, and collaborative platforms.

Business solutions, in turn, are classified into four groups: supply chain, commercial, financial, and human resources.

## Hybridization of the physical and digital world

These technologies make it possible to connect the physical world with the digital one, capturing information from the physical world (through sensory or social networks), or transforming digital information into a physical element (through 3D printing or virtual reality). There are enablers that make this relationship possible in a bidirectional sense (through advanced robotics or embedded systems).

Within the hybridization of the physical and digital world we find additive manufacturing (3D printing).



Additive manufacturing is characterized by making the parts based on the superposition of layers of material. It is not a single technology but encompasses different technologies that vary depending on the material, how it is supplied and its state (solid, powder, liquid...) as well as the energy source. In all of them there is a digital file that a machine (3D printer) is able to read and transform into a real part by adding material layer by layer.



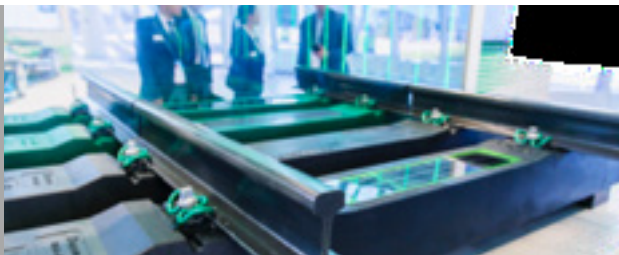
*Meltio [...] is it much cheaper technology, but much faster, more flexible and, also, more efficient than previous technologies .*

The industrial sector comprises a great diversity of companies with different needs and priorities. The ability of additive manufacturing to adapt to this heterogeneity means that this technology is of great interest to a wide range of industrial companies. There are implementation barriers for the different technologies used in metal additive manufacturing, Meltio solves some of the problems that commonly present, not only is it much cheaper technology, but much faster, more flexible and, also, more efficient than previous technologies .

# 3 OBJECTIVES OF THE RAILWAY SECTOR

## 1. Streamline the manufacture of customizable parts

One of the paradigms of Industry 4.0 is to focus the product on consumer demands, the consumer is not the one who must adapt to the products, but rather these must be customized to the different consumers. Side panels, ceilings, lights, seats, floors, access doors, etc. can be adapted and modified according to local tastes.



## 2. Production flexibility

The diversity of companies in the railway sector, the need for adaptation and innovation in their designs and competition create an urgent need for flexible manufacturing systems. The

sector requires manufacturing systems that can be adapted to different products and that can be combined with traditional manufacturing methods, thus allowing great flexibility in the sector.



### All this is about to change!

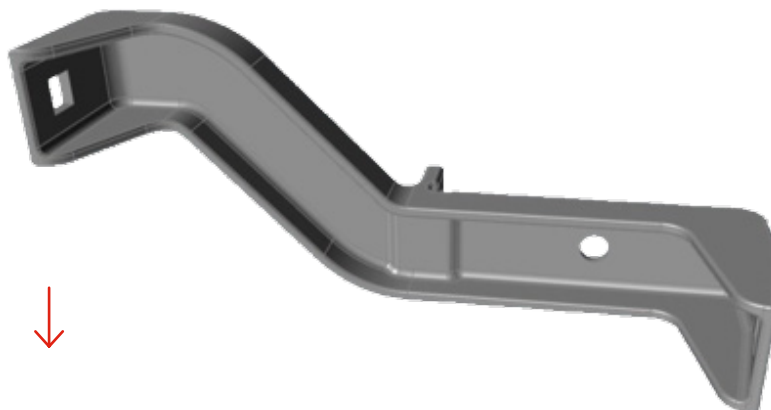
Metal 3D printers will consolidate production lines, shorten the supply chain and customize production. The products can be adapted to local needs and tastes. The flexibility of additive manufacturing allows the ability to manufacture a much wider variety of products produced by the same machine.

## 3. Less dependence on suppliers

The third industrial revolution or scientific-technical revolution generates capacities never seen before in the sector, knowledge and data become the pillars of this revolution, allowing the redirection of manufacturing to areas that had been de-industrialized. Additive metal printing is one of these technologies that will mark Industry 4.0. Generating the possibility of reducing repair times, the sector is making different bets to digitize and obtain component libraries that reduce and optimize maintenance.

## 4. New products

Design and manufacture of innovative products, in an increasingly competitive and global sector that seeks new differentiating products, additive manufacturing generates a new world of possibilities. Metallic 3D printing allows optimizing the dimensioning of parts and reducing the number of assembly operations, improving or creating new features for products. This type of additive manufacturing makes it possible to overcome difficulties and unleash the creativity of engineers.



Additive manufacturing based on reverse engineering and topological optimization of a subway support in Madrid, by CAFDM

# 4

## COMPONENTS OF RAILWAY SECTOR

The components that we can find in the railway sector can be classified according to:

### Railway rolling stock

High speed

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Electric locomotives

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Diesel locomotives

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Electric self-propelled

---

Diesel self-propelled

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Cars

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Auxiliary rolling stock

---

Historical material

### Railway infrastructure

Railway stations

---

High speed lines

---

Conventional lines

---

Goods

---

Heritage

# 5

## TYOLOGY OF RAILWAY PARTS

The railway sector has been updating its manufacturing processes over time, incorporating advances in technology, and adapting them to its needs. Given the multitude of types of parts in the sector and their dimensional variability, the railway industry uses practically all existing manufacturing methods.



## 01 Machining



By means of different subtractive material techniques, a multitude of components are made in the sector, it is one of the methods most used today, allowing finishes and precisions unattainable by other manufacturing methods. One of the most significant disadvantages is the waste of material, which depending on its value is a key factor in the choice of the manufacturing method. Large chip removal machines are used in the railway sector.

## 02 Forging



Forging is the oldest method of forming metal. Forging makes it possible to produce a large number of the same products, but they require further treatment.

## 03 Stamping



Metal stamping or stamping is a type of manufacturing process by which a metal is subjected to a compression load between two molds. The main advantages of stamping are given by facilitating that the resulting pieces can have complex shapes, there are a wide variety of materials that can be worked with, and the production of a high number of pieces has a low economic and labor cost. In addition, the surface finish is satisfactory, although it can be further processed to improve properties.

Instead, it has a number of disadvantages, highlighting the fact that the thickness of the part may be limited. Furthermore, it is a process with several operations and phases.

## 04 Casting



The casting and molding process is a procedure to manufacture parts without loss of material and is carried out by melting the material and pouring it into molds that reproduce the shape of the part. It is also known by the name of casting or casting and is mainly applicable for the manufacture of metal parts, plastics, glass, cement, etc

The mold is a container that has a cavity into which a material in the molten state is introduced which, when solidifying, takes the shape of the cavity. Then it is allowed to cool the necessary time until it solidifies and is removed from the mold. The molds, in general, consist of two pieces, perfectly coupled.

By means of this method we can manufacture and obtain parts of vastly different shapes, being widely used in the field of product containers and machine housings.

## 05 Cutting / folding



The cutting and bending of sheet metal are two of the fundamental processes in the manufacture of auxiliary elements in the sector. There are different methods of sheet metal bending that are more or less suitable depending on the type of piece we want to make.

Bending and curving are sheet metal shaping processes that are carried out by cold deformation of the material, and in which a piece with a developable surface is obtained from a flat sheet (which can be extended or opened on a plane) with one or more folds.

The difference between bending and curving basically resides in the value of the bend radius of curvature, which is greater in bending.

# 6 MATERIALS USED IN RAILWAY SECTOR

The materials used in the railway sector are very varied, with the aim of taking advantage of the advantages, qualities, or peculiarities that each of them can offer. Generally, there are products, components in which elements of different nature are combined.

In general, the main reasons that justify the existence of different materials in the manufacture are to reduce the manufacturing cost and improve the characteristics of the set. Among the materials currently stand out:

## 1. Composite materials

Composite materials are of great interest in the railway sector due to their excellent properties, including the stiffness-to-weight and strength-to-weight ratio. The environmental effects generate repercussions in composite materials, which are generally less than in metallic materials. The weight reduction has a direct impact on the reduction of energy consumption, being a key factor in the railway sector. One of the main problems for the use of these compounds lies in the requirements established by the EN 45545-2 standard on flame, smoke and toxicity, although the new composite materials adapt to these requirements make their application more expensive.



## 2. Plastic materials

“Plastic” is the common term to describe a wide range of synthetic or semi-synthetic materials that are used for a huge number of applications. Plastic is an immensely versatile material, ideal for a wide range of railway applications. The relatively low

density of almost all types of plastics gives plastic products the benefit of lightness. They are resistant to corrosion from many substances that attack other materials, making them durable and ideal for use in very demanding applications. They can be easily molded to complex shapes and allow the integration of other materials to form ideal products for a wide range of functions.



## 2. Metallic materials

“The metallic alloys are receiving a new impulse thanks to the metallic additive manufacturing, since they allow to obtain pieces with the benefits of the plastic and composite materials and with the advantages of the metallic ones”.

### Ferrous alloys

Ferrous alloys are classified on the basis of their carbon content in steels and cast iron. Within these two great families we find a multitude of materials with very varied characteristics and applications. Converting ferrous alloys into the most widely used metal alloys.



## Aluminum

Aluminum alloys are the second most used metal alloys, they are used in practically all sectors. Among its qualities, its resistance to corrosion and its low density stand out. Aluminum alloys are known as light alloys due to their low density, which allows the manufacture of light parts, in addition they are easily machinable and inexpensive alloys..



## Titanium and Magnesium

Titanium is a transition metal that forms alloys with unique characteristics, which combine high hardness, high melting and boiling points, low density, and are very good conductors of electricity and heat.

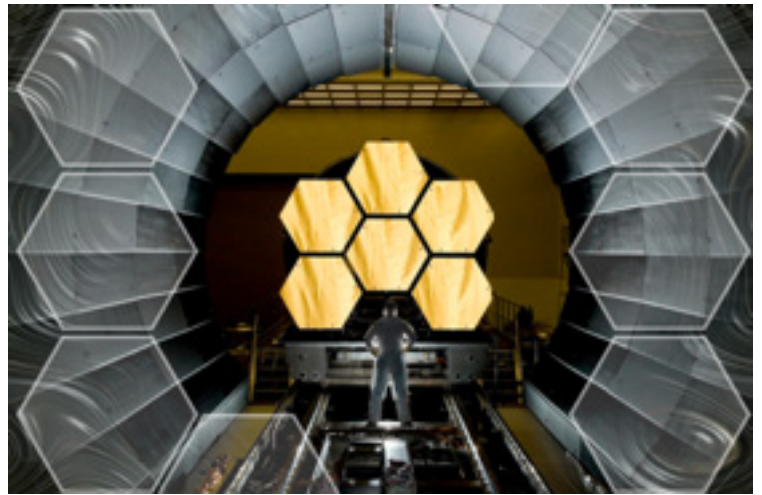
In turn, magnesium and its alloys show a potential for applications in the railway sector due to their attractive mechanical properties, the latest manufacturing processes that are being developed, cost efficiency and the existence of high reserve sources of raw materials . In particular, the components of magnesium alloys show a high resistance to efforts and an ideal lightness for components of the railway industry.

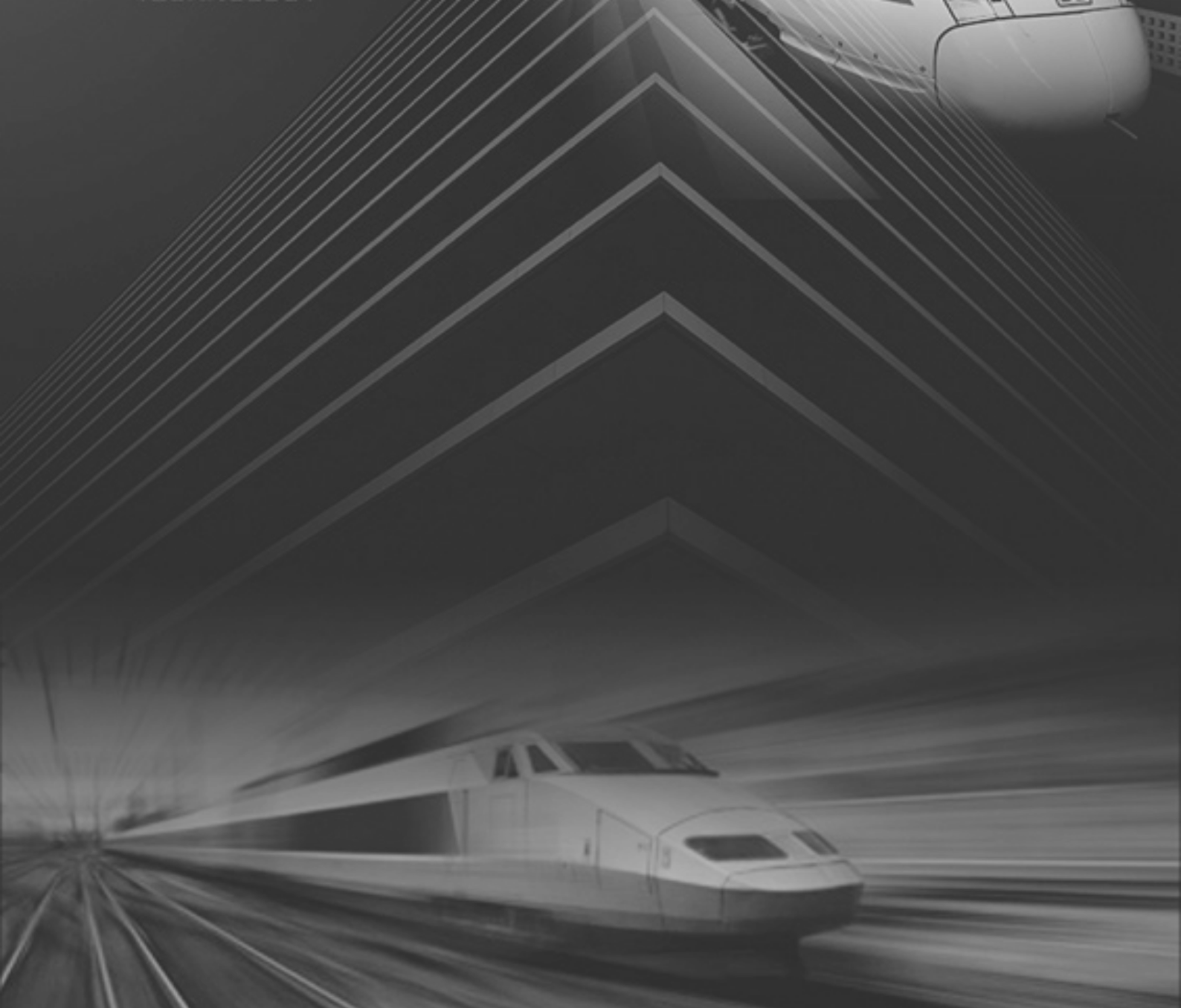




## New alloys

The demand of the railway sector between mechanical performance, cost, life of the material, maintenance, etc., implies a continuous search for new materials and compounds. In this sense, new alloys are currently being constantly developed with the aim of improving any parameter that offers a differentiating value and generates a competitive advantage.





# **ADDITIVE MANUFACTURING IN THE RAILWAY SECTOR**

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In recent years additive manufacturing in the railway sector has experienced a great boom, large companies in the sector have positioned themselves with different initiatives:

### **Caf Digital Manufacturing**

It is a business unit of CAF DDS, totally oriented to additive manufacturing and 3D digitization

### **Ferrovial**

It has a Digital Hub including a 3D printing laboratory

### **Deutsche Bahn**

“With the advancement in metal printing, we can now guarantee a step-by-step supply of spare parts, and vehicles will be back on track quickly,” said Professor Sabina Jeschke, member of the DB Board for Digitization and Technology. “The goal is to make around 10,000 different spare parts available through 3D printing by 2021”

### **Alstom**

It has a 3D printing hub

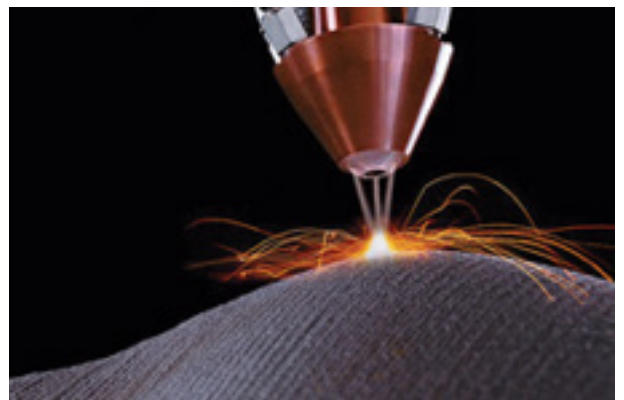
### **Siemens Mobility**

Invest in 3D printing to support rail maintenance operations

In recent times additive manufacturing is showing its potential thanks to the inclusion of new machines and materials.

Metallic printing has been a technological challenge in this sector, as the technology classically presented four barriers: size, time, production cost and materials that are currently being demolished.

It seeks to expand the potential of these machines to the widest range of possible materials. And among all of them, there is one that stands out as especially valuable for the railway sector, metal. Metal 3D printing allows you to create lighter and stronger parts with complex shapes, impossible to achieve with conventional metal fabrication methods.





# ADVANTAGES

## Topological optimization

Topological optimization in 3D printing allows the engineer to design by focusing on the needs of his project, be it cost reduction, complex shapes, strength, heat dissipation, etc. This allows to obtain parts that by other manufacturing methods would be impossible, obtaining more efficient designs or totally disruptive products.

Source:  
[new.abb.com/news/es/detail/25164/avances-en-el-diseno-y-la-fabricacion-de-productos-gracias-a-la-impresion-3d](http://new.abb.com/news/es/detail/25164/avances-en-el-diseno-y-la-fabricacion-de-productos-gracias-a-la-impresion-3d)



## Manufacture of complex preforms

Obtaining complex preforms drastically reduce machining times and avoid wasting large amounts of material. This combination of additive and subtractive methods is known as hybrid manufacturing, presenting itself as one of the most promising alternatives.



## Use of new materials

The search for materials with increasingly specific properties for a certain part, or the constant study of new metal alloys that offer high resistance to stress and reduced costs, have led to the obtaining of new metal alloys that are being used in the sector.

One of the great advances in metal additive manufacturing is the versatility to use a wide variety of materials, adapting to the most suitable material for each project.

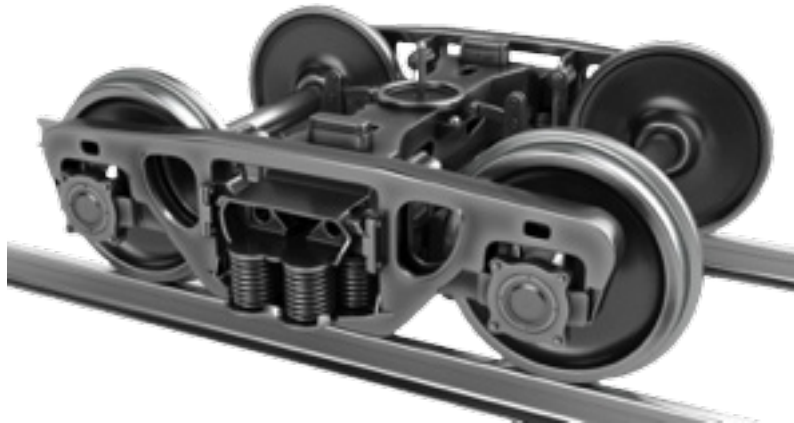


The inclusion of new materials in the design of parts in the railway sector, allows the current redesign towards parts much lighter, more resistant and optimized for the final application.

*Meltio can work with any weldable material. At present it already works with: Inconel, Copper, Aluminum, Stainless Steel, Titanium*

## Customization at its fullest expression

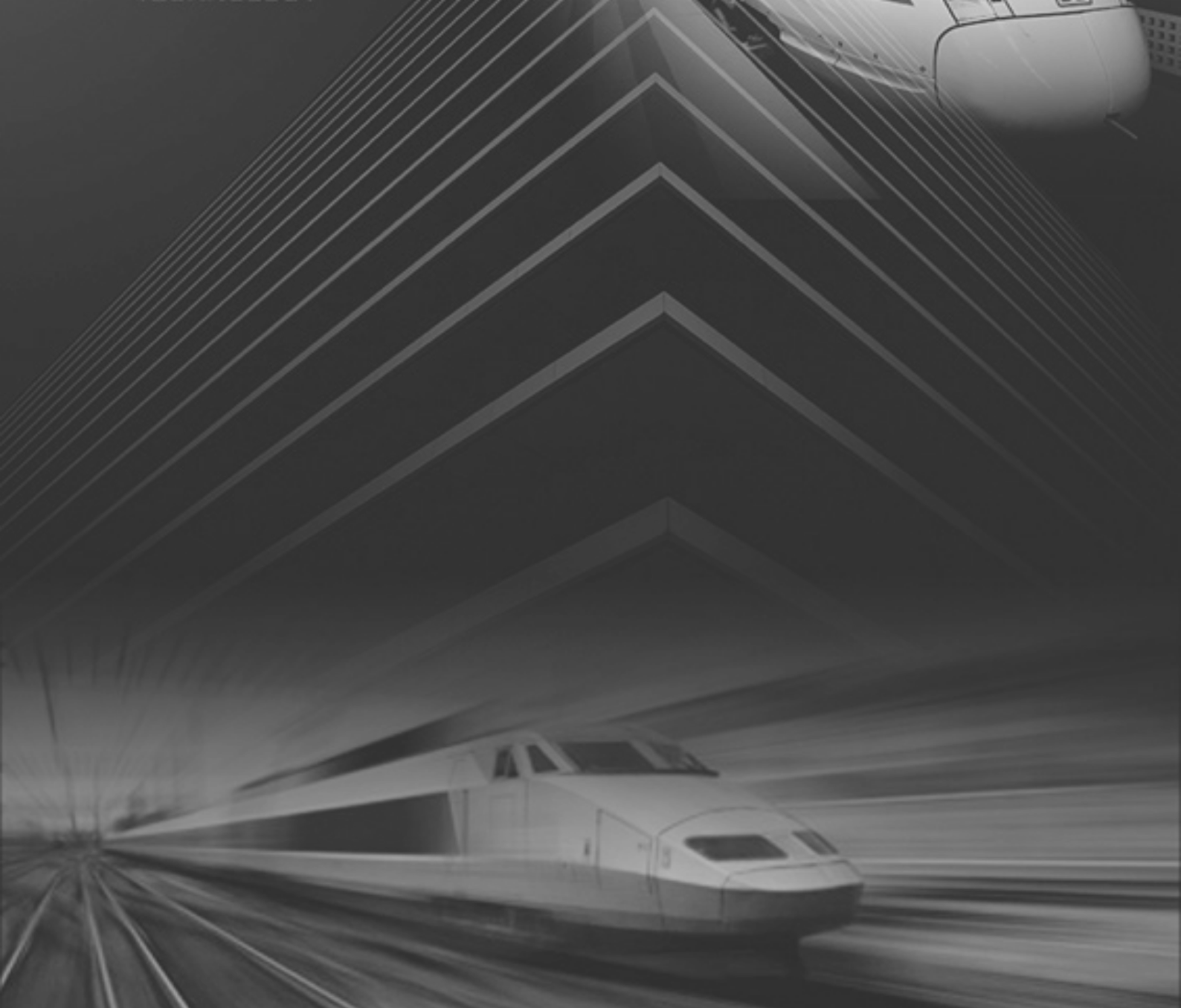
Additive manufacturing allows you to create products like never before. Allowing to produce complex shapes inaccessible until the irruption of this technology, in an individualized way with unique characteristics or shapes, this ability to produce complex and topologically optimized shapes generates unique products..



## Mold printing

Regarding the manufacture of molds through additive processes, there are two relevant points:

- Reduction of mold production costs due to the reduction of the material used and of machining hours.
- Improvement of cooling systems through optimized shapes and hollow interiors in complex molds.



**NEW  
TECHNOLOGIES.  
NEW APPLICATIONS**

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## Hybrid manufacturing

Hybrid manufacturing, which consists of the combination of additive and subtractive methods, is demonstrating an extraordinary viability and flexibility of these systems.



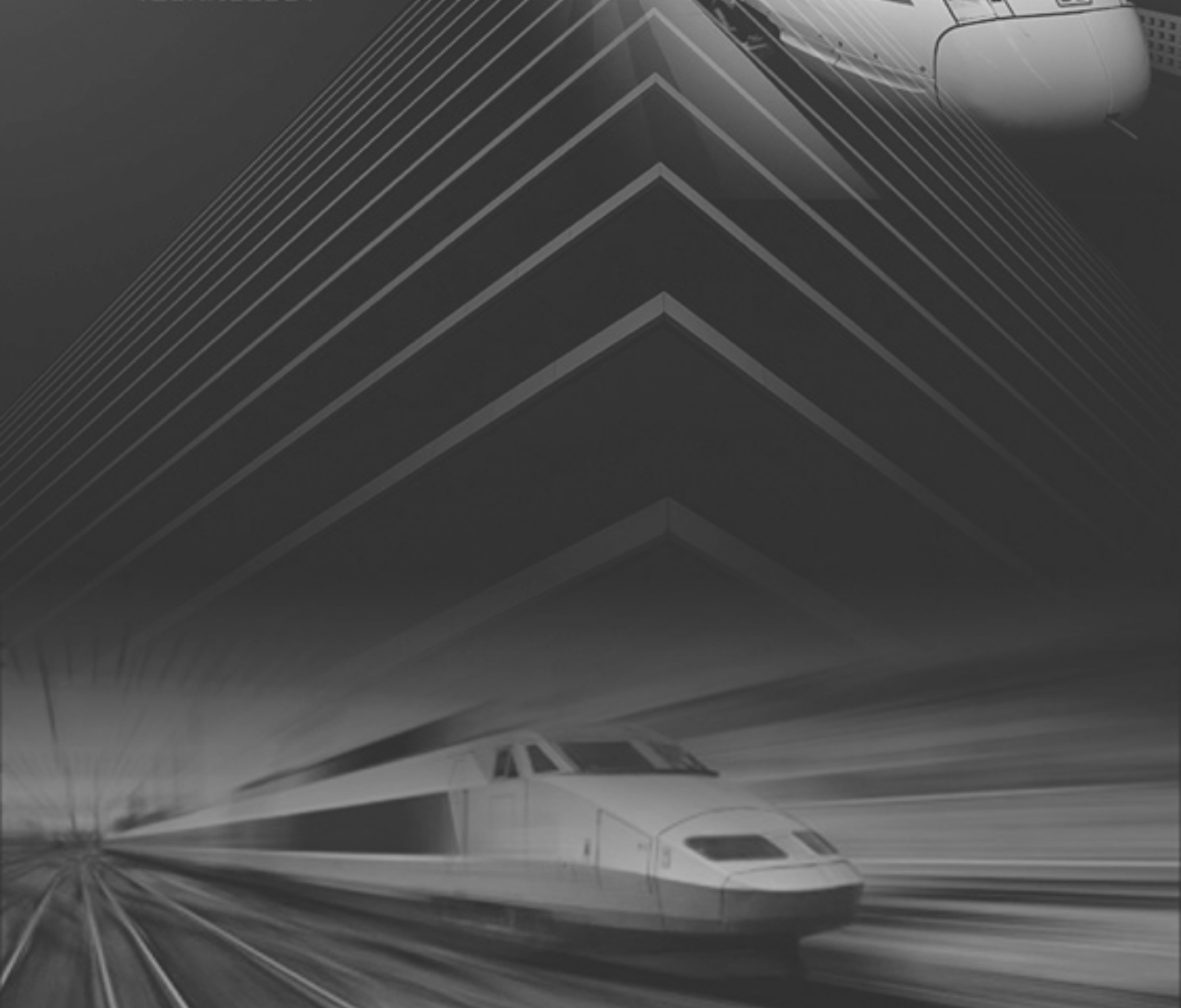
Wheel set bearing cover. 3D printed net shape (left) and post-machined part (right)  
[Source: Deutsche Bahn]

## Manufacturing of final parts and spare parts

Using additive methods, small parts to large volumes can be designed using metal 3D printing. The railway sector is benefiting from metal additive manufacturing in a multitude of components and products, from new parts to spare parts that reduce maintenance times and costs.







**AT MELTIO WE  
ANSWER YOUR  
QUESTIONS**

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**FAQ'S**

**What skills do I need?**

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**Is my sector updating?**

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**What value do I bring to my clients?**

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**Why don't they buy from me?**

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**Does it fit my facilities?**

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**Could I improve my business?**

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**Could you generate new business?**

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**Customization, is it a future option for me?**

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**Technology, is it flexible?**

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**Can I pay it off with financing?**

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**What training do I need?**

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**Can we make that transformation?**

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# MELTIO

**3E METAL DEPOSITION  
TECHNOLOGY**

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