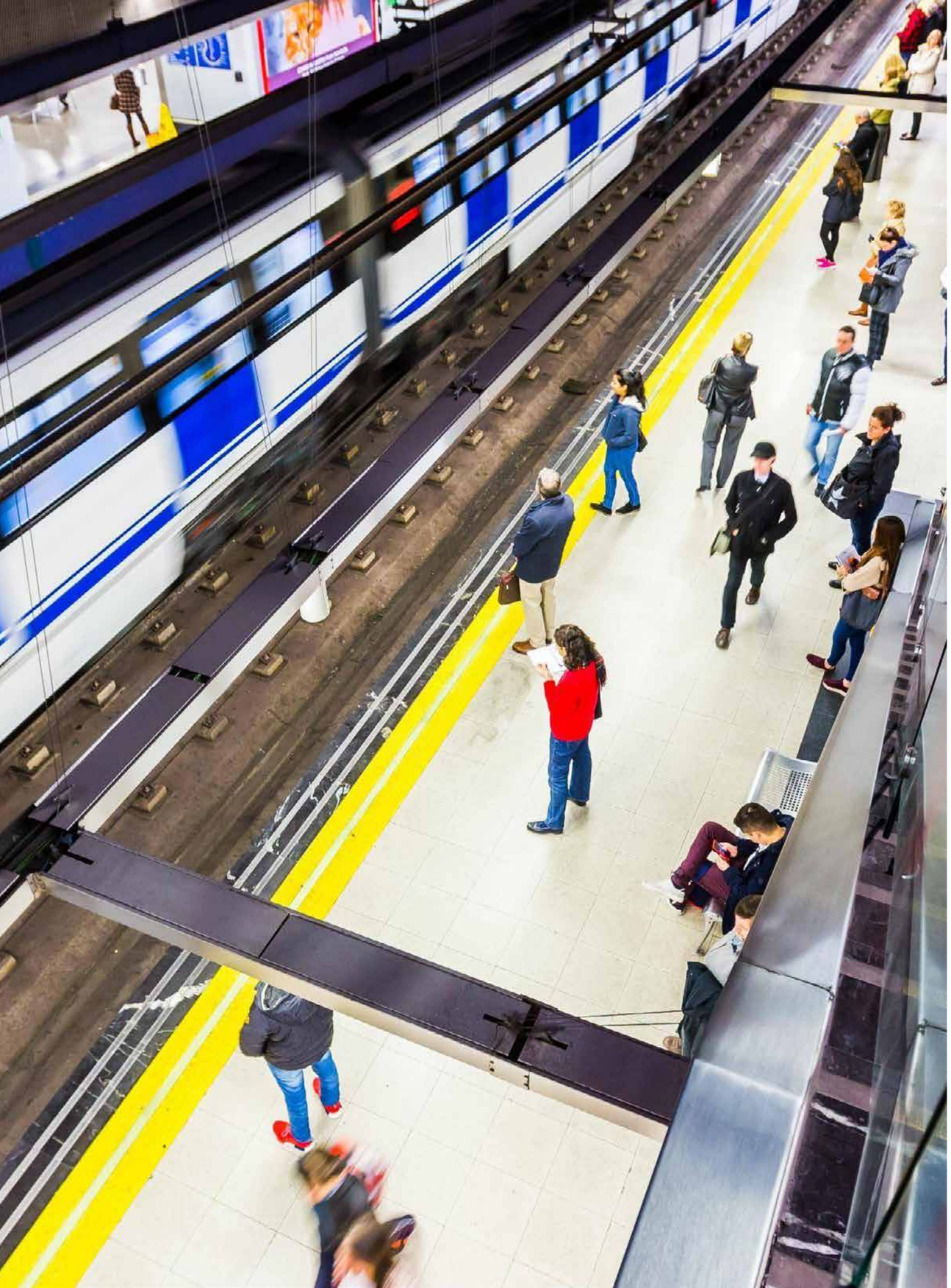
Metro
1919 - 2019

Madrid Metro

100 YEARS AS THE ARTERIES OF SPAIN'S CAPITAL CITY

www.metromadrid.es

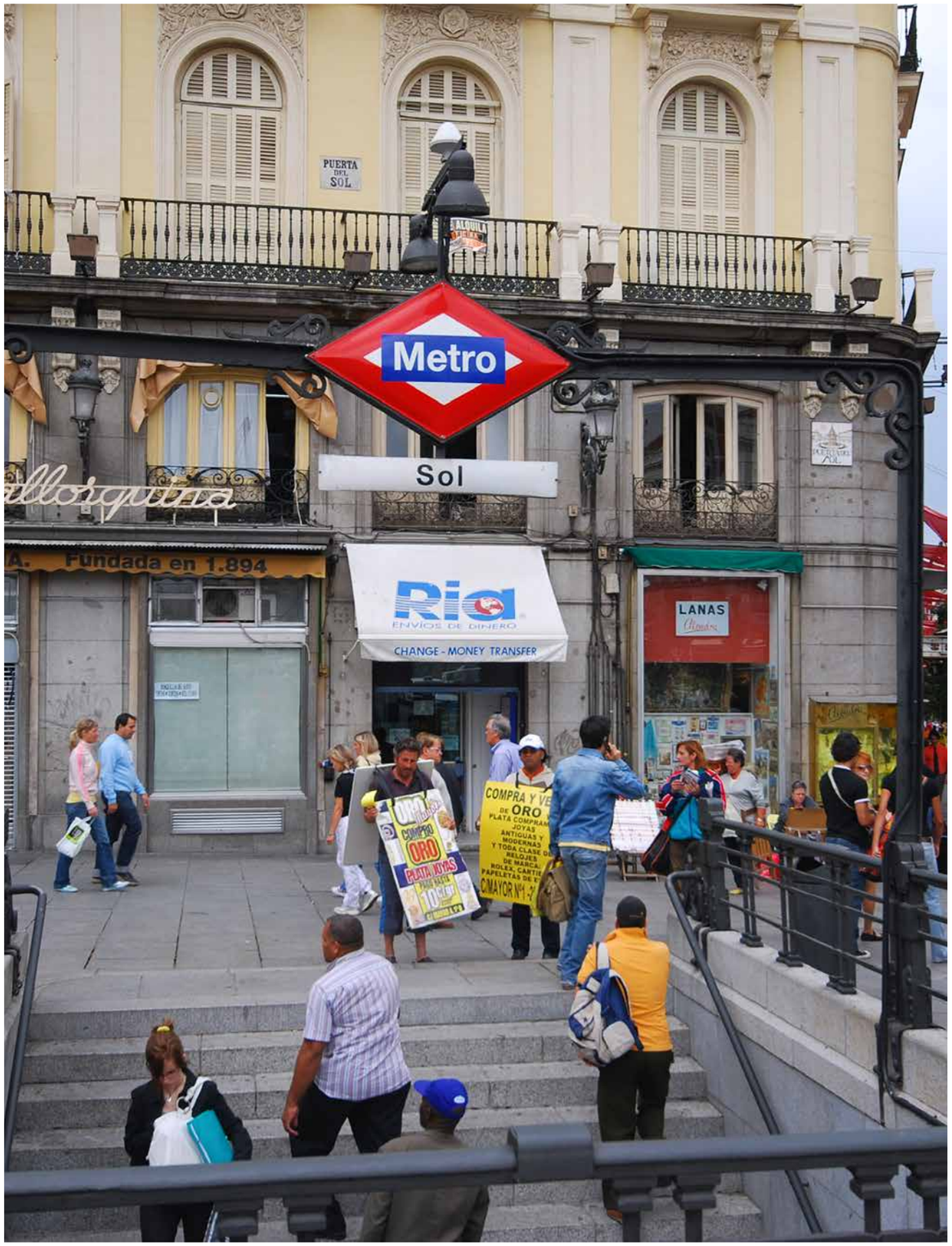


100 YEARS AS THE ARTERIES **OF SPAIN'S CAPITAL CITY**

Madrid Metro

It's nearly impossible to imagine the impact that Metro Madrid had on residents of Spain's capital city when it first arrived one hundred years ago in 1919.

RESEARCH BY *Fernando Ruiz*



It's nearly impossible to imagine the impact that Metro Madrid had on residents of Spain's capital city when it first arrived one hundred years ago in 1919. The city's overground tram system had been in operation for nearly 50 years, having opened in 1872, but the metro was truly a game-changer. The route between the stations Sol and Cuatro Caminos on tram had previously taken more than half an hour; now it is a 10-minute journey.

From then until now, Metro Madrid has grown in line with the city. From one short line in its year of construction to a total of 13 (and one branch line) today. Whereas in 1919, the world was about to be transformed by the automobile (less than 5,000 cars were sold in Spain in 1919, compared to over 1.5 million in 2018), in 2019 we may be reaching the end of cares as we know them. Not so for the metro, this becomes increasingly important and relevant. In this article, we look at some of the highlights of Metro Madrid's history that brought it to 100 years old, and one of the world's largest and most well-regarded metro underground systems.

"Metro Madrid was first conceived in the second decade of the 20th century, at a very challenging time across Europe"

The World's First Electric Underground System

Metro Madrid was first conceived in the second decade of the 20th century, at a very challenging time across Europe. Spain was able to grow its trade links with many countries and invested its resources in public projects, the most significant of these projects being Metro Madrid. In September 1915, a royal decree was signed by King Alfonso XIII for beginning work on an underground system for Madrid.

The metro was funded through a combination of corporate funds (50%), the public (40%) and the Spanish royal family (10%). Its first line, which was just under three and a half kilometres and eight different stops, was delivered on time and on budget in October 1919 - a truly remarkable turnaround time for such an ambitious project. On its delivery, the Spanish king said it was "a miracle." Evidently, public enthusiasm reflected that of the king. In the metro's first month, an average of over 40,000 people used it every day.

An inevitable consequence of the metro's popularity was that new lines quickly followed. Within two years, line 1 had been extended and joined by line 2. By 1936, a third line had been added and a fourth came in 1944. In fact, extension and maintenance on the Metro Madrid was practically a constant throughout the 20th century. This is underlined by the fact that by the end of the 1970s, there were already 10 separate lines in the system. One of the drivers of this was an explosion in Madrid's urban population from around 1.5 million in 1960 to over 3 million 1980 - faster growth than any European capital city.

Expansion, Improvement and Modernization

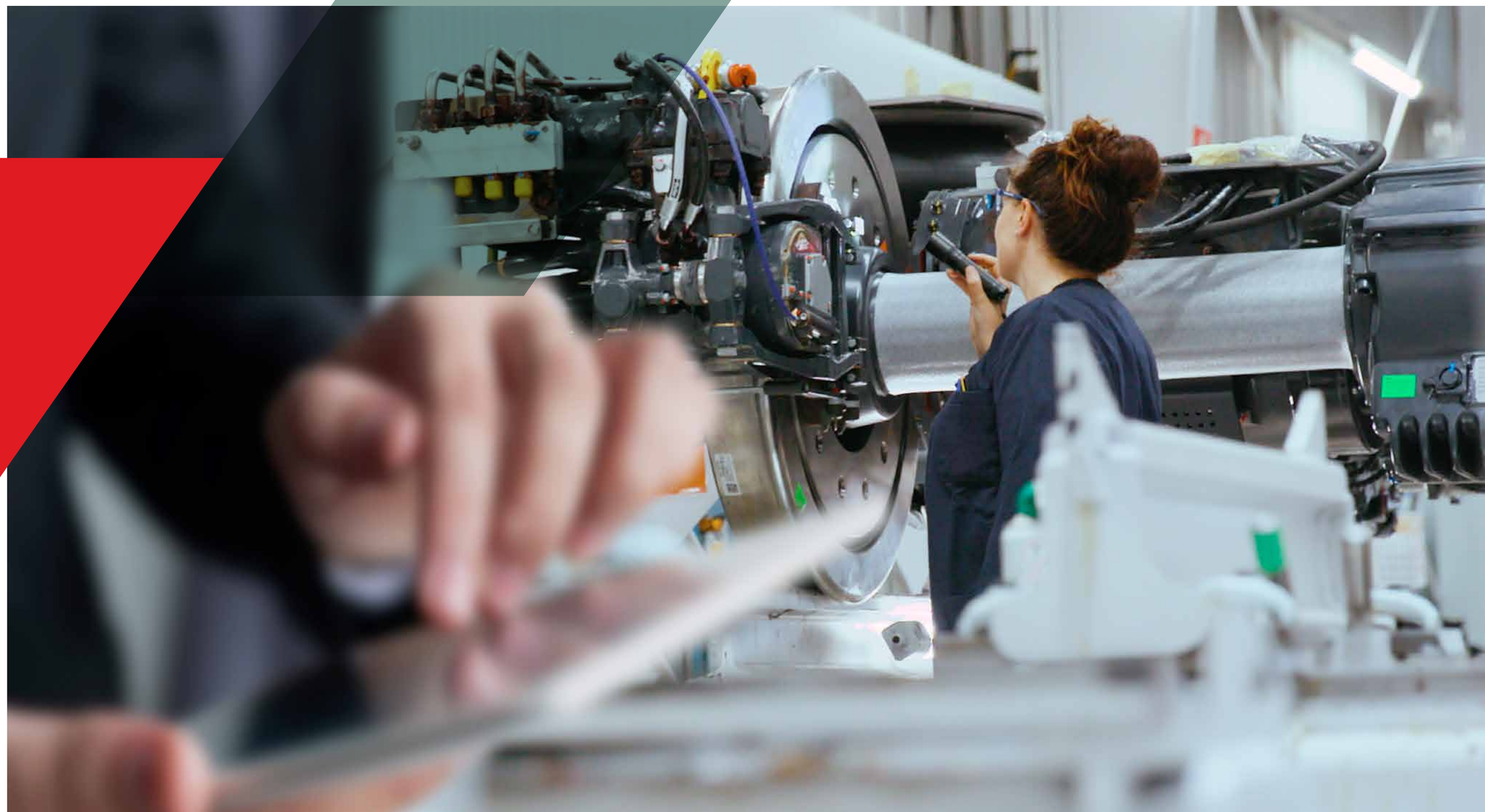
The transition of the company to a public enterprise in 1990 signaled no reduction in ambition for Metro Madrid. New works included extensive expansion of lines 1, 4, 7

ADVANCED SOLUTIONS TO ENSURE **RAIL AVAILABILITY**

RAILWAY COMPONENTS
AND DEPOT EQUIPMENT

RL GROUP CAF
COMPONENTS

P.I. Apatta Erreka, Uzturre Kalea 1,
20400 Ibarra- Spain
T +34 943 028 646
E info@rlcomponents.net
rlcomponents.net



RL Components, leader in railway workshop equipment

RL Components, belonging to the CAF Group, is a company that offers advanced solutions for the supply of railway components and workshop equipment throughout the world through its three business areas: components and spare parts, workshop equipment and engineering services.

Within its component and spare parts area, RL Components provides a highly efficient supply chain management service, from warehouses, stock management, Lean transport or customized spare parts kits. It also has the "Parts as a service" solution, which includes the supply of spare parts in flat rate formulas. It also covers the management of repairs. This, added to the availability guarantee on the agreed materials, makes that RL Components has become one of the main companies trusted by the big clients of the sector.

For its part, through its workshop equipment area, RL Components offers turnkey project services, ranging from the initial design phase of workshop layout and the management of interfaces with rolling stock and civil works, to the Supply of all types of Workshop Equipment. It should be noted that the CAF Group, in which RL Components is integrated, is specialized in the design and manufacture of bogies, being today the reference in the supply of components such as suspensions, shock absorbers, bearings and elastic wheels. Something that has placed him at the head in railway workshop equipment worldwide. In fact, it is the first manufacturer of railway workshop equipment that also designs, manufactures and maintains rolling components and bogies. Gorka Tamayo, General Director of RL Components states: "This makes our proposals in this field differentiating, covering the needs of the most demanding bogie maintainers, providing the best technical solutions as well as good advice on the best practices that allow to obtain the highest possible efficiency in the overhaul processes."

It also has a maintenance engineering area focused on providing solutions for product management, offering a reverse engineering service, 3D printing and product management and alternative suppliers. Gorka Tamayo, adds: "From RL Components we contribute to the availability through engineering services adapted in a pioneering way to each operator and maintainer of rolling stock". It should be mentioned that RL Components has become the first manufacturer worldwide in 3D printing manufacturing services, both in series and in large format pieces. This area also works on what RL Components define as "efficient workshops", providing complete solutions for railway maintenance workshops that adjust safely and productively to the real demands of maintenance operations.

"From RL Components we contribute to the availability through engineering services adapted in a pioneering way to each operator and maintainer of rolling stock"

VOCATION BY THE CLIENT

If there is something that characterizes RL Components is the vanguard, commitment and capacity, providing customers with future solutions, alternatives, agile, secure and competitive, where personalized advice is a service much appreciated and demanded by them. Among its clients are, for example, Metro Madrid, Helsinki Metro, NS Holland or TfNSW Australia. "We listen and understand the needs of our customers, offering them a high added value consulting service. We work hand in hand with them, "says Gorka Tamayo, Managing Director of RL Components. "And", he adds, "all this under the guarantee of CAF, one of the international reference companies in the implementation of integral transport systems. The experience accumulated in its more than 100 years of trajectory allows us to design global and complete solutions of high added value in the field of sustainable mobility". ■

RL Components is the first company in the world to develop railway fairings entirely manufactured with 3D technology and has been a pioneer in providing a front fairing of tramway completely manufactured in additive technology and compatible with the most demanding standards of fire, smoke and impact.

+34 943 028 646
info@rlcomponents.net
rlcomponents.net

and 11. At the beginning of the 21st century, an unprecedented 50 kilometers of track were added. Importantly, this included a link to Madrid's Barajas Airport, and an important transport link to the 50 million people that pass through it every year, many of them destined for Madrid city Centre. Between 1996 and 2011, the length of the metro doubled to a total of 294 kilometers of route on 12 lines with just under 300 stations.

These statistics meant that Madrid Metro joined the ranks of the largest metro systems (measured by line length and station numbers) in the world, pushing it to sixth - and currently, eighth - largest system in the world. It's also the third largest in Europe, coming in just behind London and Moscow, but still larger than that of Paris, despite being Madrid being a much smaller city in terms of area and population. It's also important to note that size isn't a vanity metric - it's used by some analysts as a measure of quality of life: In the context of line length of line per capita, which is a proxy for the accessibility and quality of transport in modern cities.

"An inevitable consequence of the metro's popularity was that new lines quickly followed."

ACCENTURE

Accenture has helped Metro de Madrid develop and implement a self-learning AI-based ventilation system to reduce its energy costs for ventilation by 25 percent and cut CO2 emissions by 1,800 tons annually.

On average, 2.3 million commuters use Metro de Madrid's network of 294 kilometers of track and 301 stations every day. To help passengers stay cool inside stations, particularly during the hot summer months, Metro de Madrid operates 891 ventilation fans, which were consuming as much as 80 gigawatt hours of energy annually.

The system deploys an optimization algorithm that leverages vast amounts of data to explore every possible combination of air temperature, station architecture, train frequency, passenger load and electricity price throughout the day. The algorithm uses both historic and simulated data, factoring in outside and below-ground temperatures over the next 72 hours. Because the algorithm uses machine learning, the system gets better at predicting the optimal balance for each station on the network over time.

The system also includes a simulation engine and maintenance module, which allows for, among other things, tracking for failures in the fans' operation. This enables Metro de Madrid to easily monitor and manage energy consumption, identify and respond to system deficiencies, and proactively conduct equipment maintenance.

www.accenture.com

METRO MADRID

Continuous expansion was possible through a love for the metro among Madrileños (as the citizens of Madrid are known) which goes right back to 1919. This means that there are seldom any objections when the metro wants to expand in an area, unlike other cities, where objections from various stakeholders can delay projects by years. It's also a testament to the quality of partner and contractor that Metro Madrid has worked with, ranging from Arcelormittal España, S.A. to Construcciones Auxiliar de Ferrocarriles, S.A. (CAF) and Acciona Construcción, S. A., all of whom are quick to put plans into action once the green light is achieved.

One hundred years after the inauguration of the first metro in Madrid, the system's

KAPSCH

Transport is one of the biggest problems facing cities and, in fact, is the main sector that is leading the Smart Cities industry. New technologies have improved the user experience by making public transport more accessible and usable. The future of the transport network must move towards an integrated and sustainable mobility model.

Since Metro de Madrid began work on its first line 100 years ago, which linked Sol with Cuatro Caminos, until it became the sixth largest metro network in the world, modernisation actions have been promoted with technology as an ally. Kapsch TrafficCom, an international provider of technology, services and solutions for Intelligent Transport Systems (ITS), joined in 2001 a project that walks towards a metro of the future. Since that first project focused on the implementation of toll equipment for passenger control until now both companies have gone hand in hand and the multinational is proud to have made history together with Metro de Madrid.

There are many large metropolises around the world that are circling their urban mobility strategy to make it truly intelligent and sustainable. Rising levels of urban pollution are a reality. Transport is responsible for 28% of CO2 emissions, and traffic is the main culprit for poor air quality data in Spain's big cities. No measures have been taken to limit the car fleet and, without new models combining public transport and car-sharing as an alternative to the private vehicle, another subsequent problem arises: congestion. Traffic jams cost more than 140 billion euros a year. Cooperative Intelligent Transport Systems (C-ITS) and multimodality management are the steps towards intelligent mobility that helps cities become "Smart Cities".

In the line of improving mobility, Mobility as a Service (MaaS) will play a fundamental role in providing efficient, economic, accessible and green mobility options. The key elements of this intelligent mobility are intermodality, intelligence, personalisation and loyalty, through a single platform that accesses and allows payment for the different mobility services available in the city. For this purpose, Kapsch TrafficCom offers its customers its Fluid Hub platform that allows the integration of the entire mobility offer in a common marketplace and Fluid Biz and Fluid Go, which allow payment and provide user Apps respectively.

www.kapsch.net

With more than 125 years of experience, COMSA specialises in railway projects that cover the areas of construction and maintenance of high-speed lines, trams, as well as metropolitan and regional railways. Its high level of specialisation in this field allows the company to offer value-added solutions, with a significant technological component, in accordance with quality standards and sustainability principles, to meet the needs of its customers. Prominent among them is Metro de Madrid, with a close link born during the twentieth century.

COMSA is pleased to be one of the Metro de Madrid collaborating companies with the greatest presence and relevance in different areas. Thanks to this collaboration, COMSA has executed various projects, including the construction of new sections on the network, such as between the stations of Fuente de La Mora and Virgen del Cortijo, new stations such as the Arganzuela station, modernisation of stations such as the Tirso de Molina station until catenary renovations, in addition to leading track maintenance over the last 10 years. For COMSA, the execution of major platform activities have been of special interest, such as those carried out between lines 3, 8, 10 and 12 of high technical complexity and with very tight deadlines, in which logistics and the planning of means and resources have formed the key to success.

COMSA's team of professionals appreciate the confidence that Metro de Madrid has placed in them and would like to send Metro de Madrid their most heartfelt congratulations on their centenary.
www.comsa.com

"As mentioned above, Metro Madrid was the world's first fully electric metro system, so in a way, it can be said that sustainability is in the company's DNA."

statistics speak for themselves; 293 kilometers of line, 522 elevators, 1,698 escalators and 301 stations. About 25% of the local population uses the system, traveling an average distance of 9.5 kilometers. By any measure, the system has made an extraordinary difference to the city it serves in its first century.

Sustainability

As mentioned above, Metro Madrid was the world's first fully electric metro system, so in a way, it can be said that sustainability is in the company's DNA. This is exemplified by the fact that it produces an in-depth sustainability report every year, based on the UN's SDGs (Sustainable Development Goals). Its objectives include being transparent, providing employment opportunities in the community (for example, through the Women in Transport initiative), Improving awareness around sustainability and building social inclusion - for which it has a well-established program called La Linea Social, the Social Line. It's interesting, for example, how the metro

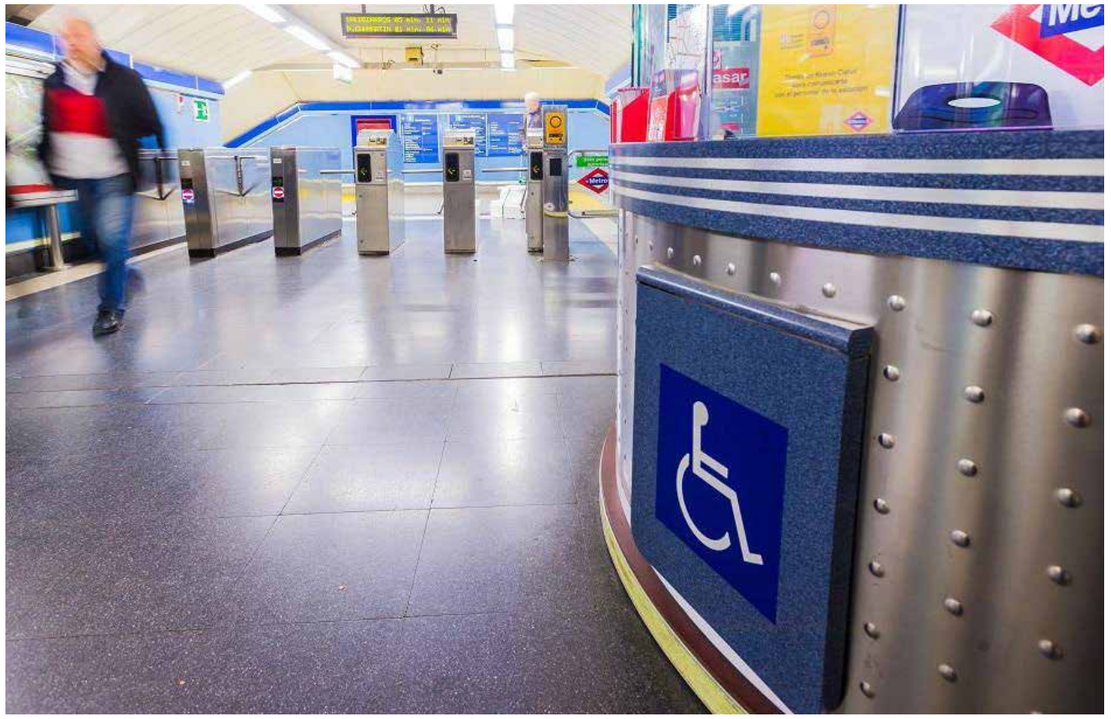
is often mentioned in various publications as having more elevators than any other metro system in the world. While this is treated by some as a quirk, in fact it can be seen as a commitment to improving accessibility for the old and immobile.

On the environmental side, it could be said that the metro's mere existence is a contribution to the environment. However, it further commits to improving its waste disposal methods, using renewable materials in the delivery of its stations and various other plans to reduce the emissions. As an example, the many elevators mentioned in the previous paragraph - mostly provided by partner firm Kone Kone Elevadores, S.A.are the most efficient elevators on the market, ensuring the minimum energy input to deliver the service.

Naturally, safety is a core component of the sustainability practices of metro systems and Metro Madrid prides itself on its record in this regard. It leverages the resources of various partner firms to deliver on its service promise. This goes for whether the safety in question is getting passengers from A to B with minimum fuss (where its partnership with SGS Tecnos, S. A. ensures there are no glitches in the system) or safety in and around the metro system, where it is assisted by local firms such as Ombuds Compañía de Seguridad, S.A. and Segurisa, Serv. Int. de Seguridad, S.A.

Its commitment to community involvement can also be seen in the effort to ensure that each metro station goes above and

"On the environmental side, it could be said that the metro's mere existence is a contribution to the environment."

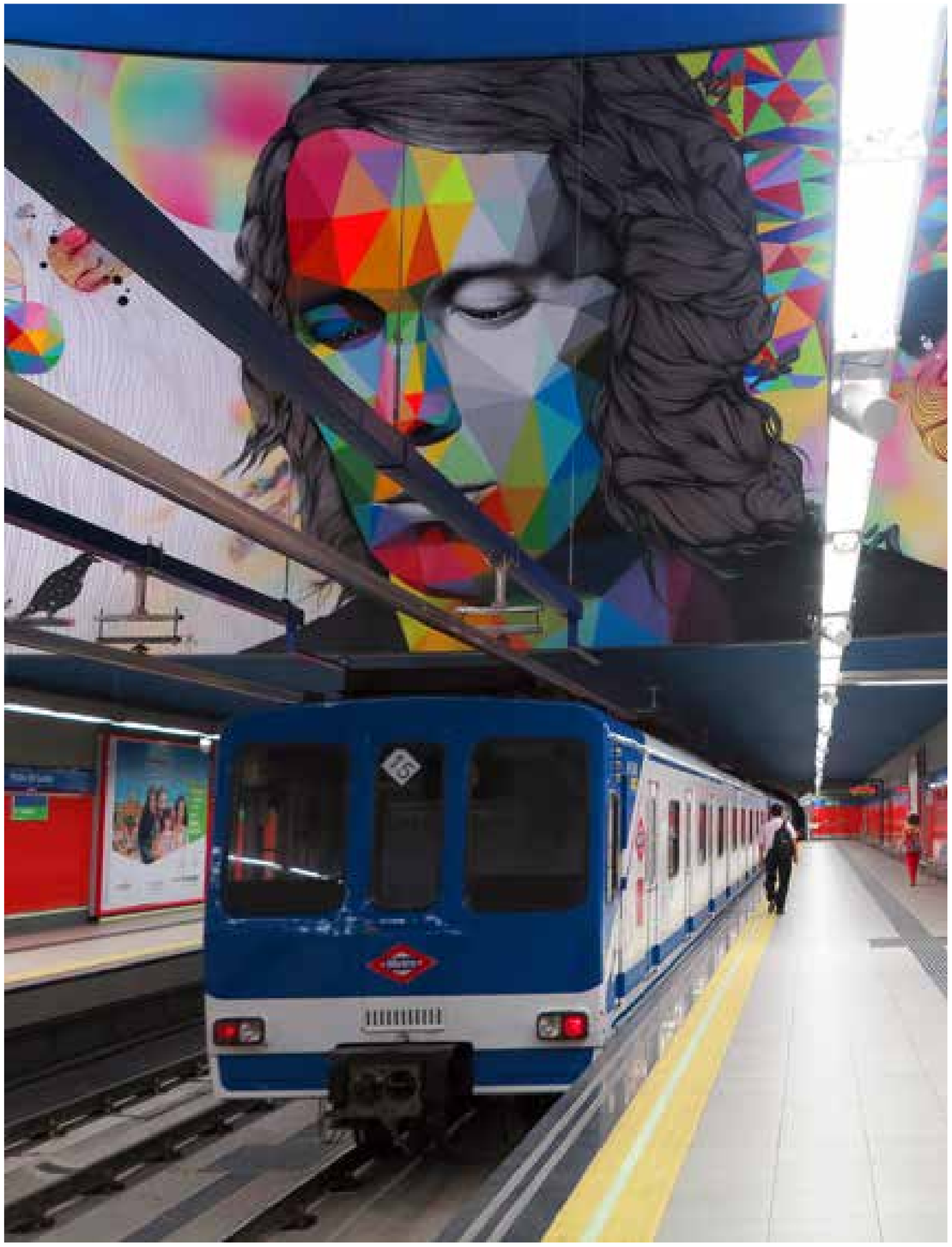


"Its commitment to community involvement can also be seen in the effort to ensure that each metro station goes above and beyond a simple utilitarian transport hub."

beyond a simple utilitarian transport hub. For example, Carpetana station features archeological deposits which go right back to the foundation of Madrid; Gaya station has a permanent exhibit of over 60 Francisco Goya paintings, one of Madrid's most beloved artists; finally, other stations such as Paco de Lucía, Hortaleza "Phortaleza" and Argüelles give prominence to the works of local artists through murals and other artworks. It's a rare week in Madrid, where passengers aren't greeted by a group of school children being brought by their teachers to some of these exhibits - not something that can be said of many metro systems.

Innovation

There are metro systems which are old and give the feeling of being old by virtue of the fact that they've never had the opportunity to modernize. This is simply not the case with Metro Madrid. The station Principe Pío on Line 10 is a case in point. Although it's one of the oldest train stations in Madrid, it feels entirely modern, through blending new architecture with the old and even housing one of Madrid's



“Continuing its commitment to innovation, in 2018, Metro Madrid began a comprehensive digital transformation plan, by opening a Station 4.0 technological Centre.”

most popular shopping malls. This is indicative of how, the metro keeps moving - not just in a literal sense - but a metaphorical sense, too.

Looking at the metrics described in the sections above, it’s not difficult to see why Metro Madrid is seen as a benchmark in innovation. For example, when more recently built metro systems like those of Lima, Istanbul and Santiago de Chile were being planned, they all looked to Metro Madrid as their development template. This spirit of innovation in turn might have led to the International Association of Public Transport (UTIP) opening a Innovation and Training Centre in April 2019. Metro Madrid also keeps ahead of the posse through working closely with consulting firm Accenture, which has a specialty in transport innovation research.

Continuing its commitment to innovation, in 2018, Metro Madrid began a comprehensive digital transformation plan, by opening a Station 4.0 technological Centre. The aim of this Centre, located at Canillejas, is to research and develop new commercial products before they are released to the general public. It focus on three areas: information for the user, safety and station remote control (the staff are able to control the facilities of a station using an electronic device). It also recently patented a new technology which will significantly speed up the ability of passengers to buy tickets and access transport with less friction.

The Future

If 100 years of Metro Madrid teaches us anything, it’s that it will continue to improve, innovate and expand. If this is to become the

century of sustainability that we all hope it will, transport systems like Metro Madrid are more crucial than ever. The recently opened R&D lab will probably contribute not just to Metro Madrid but to metro systems everywhere. And with the increased data being generated through its partnerships with other partner firms like Indra Sistemas, S.A., it can make even more intelligent transport systems for its clients than already exist. In summary then, the future of Metro Madrid, looks bigger, better and more intelligent. Plenty to look forward to for the Madrileños. BE

MADRID METRO

917 796 399
info@metromadrid.es
@metro_madrid
www.metromadrid.es

Madrid Metro

917 796 399
info@metromadrid.es
@metro_madrid
www.metromadrid.es

Produced by:

BusinessExcellence

www.bus-ex.com