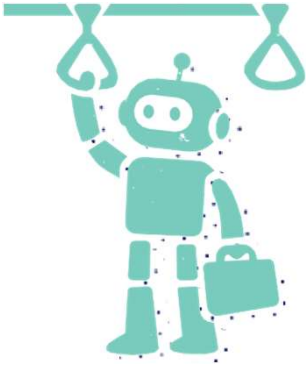
NEXT STOP

THE PROSPECTIVE SERIE BY KEOLIS



Robot in the Metro

The predictable impact of robotisation: The Case of the metro

There was a time when the metro was an exclusively human affair. Drivers in their cabs, staff on the platforms, night crews cleaning the carriages, engineers in the tunnels. Then automation was introduced at the heart of the system: driving itself. Today, more than 60 metro lines worldwide operate without a driver –from Dubai to Copenhagen, from Singapore to Rennes. But that first wave of automation was merely a prelude. The next one no longer concerns only the operation of trains: it affects everything that keeps a network running day after day – maintenance, cleaning, passenger services –and raises a question nobody had anticipated: can robots also become passengers?

An exponentially growing global fleet

The figures leave no room for doubt. In 2024, the global fleet of industrial robots reached a record 4,664,000 operational units, up 9% year-on-year. China alone accounts for 54% of global deployments and, in a historic first, its domestic manufacturers captured 57% of their own home market in 2024, surpassing foreign suppliers for the first time. The most spectacular acceleration, though, has been in service robotics: sales of medical robots surged by 91% in 2024, driven by assisted surgery and automated diagnosis. In logistics and maintenance, the "Robotics as a Service" (RaaS) model is emerging, allowing companies to access automation by subscription rather than through large-scale capital investment.

This growth rests on a technological foundation undergoing profound change. The integration of artificial intelligence in three forms –analytical, physical and generative –is transforming robots from programmed operatives into agents capable of perceiving, learning and adapting. Generative AI now enables natural interaction between human and machine via voice or gesture, eliminating the need for complex programming. This is what specialists call the "ChatGPT moment for robotics": the machine no longer merely executes –it understands, converses and improves.

The metro: a laboratory for service robotisation

Metro networks represent an ideal testing ground for service robotics. With their enclosed environments, predictable flows and standardised infrastructure: everything is conducive to the deployment of autonomous machines. Three domains already concentrate the most advanced innovations.

Predictive and autonomous maintenance

In tunnels and depots, maintenance has traditionally been a night-time, physically demanding and costly operation. Autonomous inspection robots already patrol several networks: equipped with lidar sensors, thermal cameras and vibration measurement systems, they detect micro-cracks in rails, track deformations, water ingress and electrical anomalies before these become critical. In Singapore, the MRT network uses autonomous inspection vehicles that travel through tunnels during closing hours, transmitting real-time diagnoses to a control centre. The result: a 40% reduction in breakdowns and a significant drop in emergency call-outs.

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The next step is autonomous repair. Prototypes of robots capable of tightening bolts, replacing points components or grinding defective rails are currently being tested. The combination of embodied intelligence - merging the machine's physical body with its digital brain – and simulation-based learning is enabling these machines to acquire a dexterity that was still unimaginable five years ago.

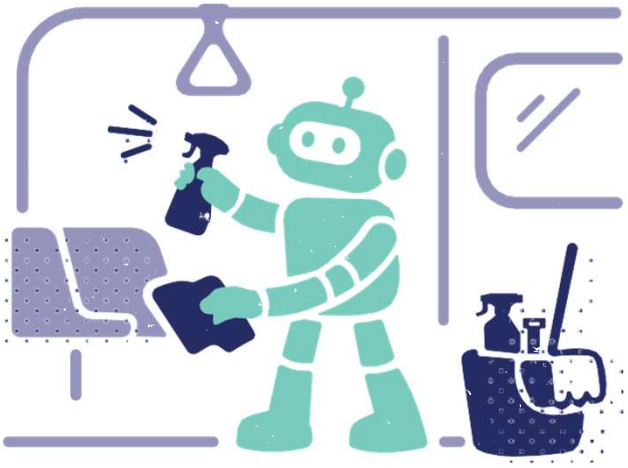
Automated cleaning

Cleaning carriages and stations is one of the most labour-intensive tasks in a metro network. In Dubai, the metro –which carries more than 200 million passengers a year across its two lines –deployed autonomous cleaning robots in its stations as early as 2023. These machines, fitted with floor sensors and obstacle-detection systems, clean concourses and corridors whilst staying out of the way of passenger flows. On board trains, the trend is towards embedded systems: UV disinfection devices activate automatically at termini, robot vacuums travel the aisles during turnaround times, and olfactory sensors identify priority cleaning zones.

Yet cleaning remains a challenge for machines. Unforeseen situations – spilled liquid, a vandalised seat, litter wedged between seats –still demand an adaptability that only the most advanced robots are beginning to master. The goal is not to replace human teams entirely, but to free them from repetitive tasks so that they can focus on complex interventions and quality control.

Passenger services

It is perhaps in customer relations that the robotisation of metros is most visible. Welcome and information robots are already deployed on several networks. In Dubai, at the Museum of the Future station on the Red Line, a humanoid robot greets passengers, answers their questions in Arabic, English and Hindi, and guides them to their connections. In Tokyo, Shinjuku station is testing crowd-management robots that, during peak hours, physically direct passenger flows towards the least congested exits. In Seoul, patrol robots detect unusual behaviour and alert security staff.



These robots raise a fundamental question for operators such as Keolis: is a human presence in stations a service or a necessity? Experience shows that passengers appreciate the efficiency of robots for simple requests – timetables, itineraries, incident reporting –but prefer to have a person to talk to in situations of stress, conflict or distress. The robotisation of customer service does not eliminate the need for human staff: it redefines it.

The Impact on Employment: transformation rather than disappearance

According to the World Economic Forum, 92 million jobs will be displaced by 2030, but 170 million will be created, representing a net gain of 78 million. This positive balance nonetheless conceals a more nuanced reality: around 40% of current professional skills will become obsolete, making continuous training vital. In metro networks, robotisation will not eliminate jobs wholesale: it will transform them. Cleaning operatives will become robot fleet supervisors; maintenance engineers will specialise in predictive diagnostics and algorithmic oversight; customer service officers will evolve towards overseeing and assisting vulnerable passengers.

The PwC analysis identifies an "autonomy wave" extending into the mid-2030s, during which physical work in complex environments will become gradually more automated. Transport sectors are among the most vulnerable: in the long run, around 30% of existing jobs could be automated. Yet the real risk is that of polarisation: highly skilled workers see their incomes rise through complementarity with machines, whilst those performing routine tasks face downward pressure. For transport operators, the challenge is clear: invest massively in reskilling, or watch a social divide open up within their own workforces.

« One robot-fare ticket, please »

Another disruption will come from an unexpected source. As service robots become more widespread in cities – delivery robots, security robots, domestic robots sent out to run errands – a question will emerge: will these machines be allowed to use public transport? The idea may seem far-fetched, but the question will be asked. The challenge is twofold: preventing thousands of robots from clogging pavements and roads, and generating additional revenue by allowing them onto the transport network.

The debate is not straightforward. On a line such as Dubai's Red Line, which is already overcrowded at peak hours with 650,000 daily passengers, allowing robots on board would only worsen congestion. On the other hand, by restricting access to off-peak hours and applying a higher fare, operators could smooth demand and make better use of under-exploited time slots. At what hours will they be permitted to travel? What is the price of a robot ticket ?

This cohabitation will raise unexpected questions. Where should a robot be placed in a carriage? Should a dedicated space be reserved, as with wheelchairs or bicycles? How should breakdowns be managed – a robot immobilised in the middle of a corridor blocks passenger flows. Who is liable in the event of an incident? The robot's owner, the manufacturer, the transport operator? These questions, currently unresolved in law, are mapping out a new regulatory field in which metro networks will be the first laboratories.

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The story

Robot in the metro, Dubaï, October 2045
Holifart watastink. Goodness, that smells bd :

The words appeared in white letters on KÉF-7's facial display, like a linguistic glitch surfacing from a forgotten database. A fragment of twentieth-century French literature, filed in its cultural memory under "archaic human expressions". It could not understand why these words had come back to it now, as it rolled along Sheikh Zayed Avenue under a forty-seven-degree sun, its thermal sensors flashing amber. But it felt apt. Holifart watastink. Goodness, that smells bad: overheated tarmac, recycled air conditioning and evaporated human sweat.

KÉF-7 was a third-generation domestic robot, the Karama Everyday Fellow model, manufactured in Shenzhen and imported by the Emirati company TechLife. One metre forty-two tall, with a recycled aluminium chassis and a white polyethylene shell slightly yellowed by three years of exposure to the Gulf sun. Two articulated arms with seven degrees of swing, an oval head topped by two optical sensors that, at night, glowed with a soft blue light and gave it the look of an insomniac owl. Its omnidirectional wheels allowed it to travel along pavements at eight kilometres per hour – the legal speed for pedestrian robots in Dubai. That morning, it had a mission: to collect a pair of jeans.

Not just any pair of jeans. A centenary edition pair of Levi's 501s, inside leg 32, waist 34, untreated indigo, which the robot's owner, Nasser Al-Rashid, a 68-year-old retired petroleum engineer and a passionate collector of vintage American fashion – had been waiting for – for three weeks. The jeans had finally arrived at his favourite shop, a store called Blue Thread, nestled in the Dubai Mall near the Burj Khalifa/Dubai Mall station on the Red Line. Nasser had tapped KÉF-7 on the shoulder that morning –an affectionate gesture he had adopted with the machine ever since it had saved his cat from a fall off the thirty-second-floor balcony.

"Go and fetch my jeans, KÉF –I've sent you the reference. Take the metro, it's quicker. And make sure you get waist 34, inside leg 32, not the other way round like last time."

The metro. KÉF-7 performed a quick check of its authorisations. Since March 2043, domestic robots had been officially permitted to use the Dubai Metro –after four years of public debate, they had been authorised to travel by metro. The conditions were strict: off-peak hours only, meaning between 10 am and 4 pm, then after 9.00 pm in the evening. Fare: 15 dirhams, three times the price for human passengers.

A specific NFC badge, visible on the chest, bearing the words "ROBOTIC PASSENGER" in green letters. And a designated spot : Zone E, at the far end of the last carriage –the place nobody ever wanted to sit.
KÉF-7 checked the time: 10:12. Perfect. It was within the authorised time slot. It calculated the route: Al Karama station – the closest to Nasser's flat –to Burj Khalifa/Dubai Mall, seven stops on the Red Line. Estimated journey time: 14 minutes. The jeans were waiting; deambulating along scorching pavements was not its “cup of tea” –an expression it had once learnt from a British robot undergoing repairs at the same garage.
KÉF arrived at Al Karama station, entered the concourse air-conditioned to 22 degrees, and immediately felt its circuits stabilise. Cool air was something special. Not that it "felt" the coolness in the human sense, but its processor performance increased by 12% below 30 degrees, and it was very much aware of that. It made its way towards the robot-dedicated access gate –a wider lane installed in 2043, marked by a pictogram showing a small stylised humanoid on a green background –which still made passengers smile.
The badge beeped. The gate opened. 15 dirhams debited from Nasser's account. KÉF-7 made a mental note that this sum was greater than the price of a kilogram of basmati rice –information irrelevant to its mission, but which it stored out of algorithmic habit.
On the platform, it made its way to Zone E and waited. Two other robots were already there: an Amazon delivery model, squat and silent, carrying what appeared to be a box of nappies, and a small Japanese companion robot, Paro model, evidently accompanying an elderly lady but which also had to use Zone E. The lady was waiting at the other end of the platform, alone, eyeing her robot with an expression that very much resembled anxiety.
The train arrived. Driverless, of course –the Dubai Metro had been automated since its inauguration in 2009. KÉF-7 boarded, took up its position in the designated space, and slotted its wheels into the magnetic floor notches designed to prevent robots from rolling uncontrollably in the event of sudden braking. Through the window, it watched Dubai slip past: glass towers, permanent construction sites, the glittering Creek, the air-conditioned pedestrian bridges spanning the eight lanes of Sheikh Zayed Road.
Passing ADNOC station, formerly known as Emirates Towers, it picked up a Wi-Fi signal with a name it found rather poetic: “Museum_of_the_Future_Guest”. It recalled that it was close to here, at the station of the future, that Dubai Metro’s very first welcome robot had been installed in 2022. A humanoid fixed to the floor, motionless, answering tourists’ questions in six languages and posing for selfies.

KÉF-7 thought of it the way one thinks of an ancestor: with respect and a hint of condescension. That robot could not even move. Fast forward, and KÉF-7, was taking the metro to go and buy a pair of trousers.

At Financial Centre station, a group of tourists boarded and immediately noticed the three robots in Zone E. A young woman took out her phone, filmed them, and KÉF-7 heard her murmur to her companion: "It's mad, they’re taking the metro just like us now." Her companion shrugged: "At least they pay more."

KÉF-7 found the remark pertinent. The robot was indeed a model passenger: it did not speak loudly, did not listen to music without headphones, did not eat shawarma on the fabric seats. It did not perspire, or cough, or jostle other passengers. On reflection, the only drawback of a robot as a passenger was that it took up space without generating any revenue in the station shops. But it paid its fare. Three times the price, at that.

The train stopped at Burj Khalifa/Dubai Mall. KÉF-7 released its magnetic fastenings and alighted carefully – a robot in a hurry on a crowded platform was never a welcome sight– then headed for exit E2, the one leading directly to the LG level of the Dubai Mall. The corridor was vast, air-conditioned, decorated with holographic advertisements for perfumes and watches. A few delivery robots moved through the aisles, but most remained in the technical zones, invisible to the human customers.

Blue Thread was a tiny shop, squeezed between a luxury shoe store and a fresh juice stand. The owner, a Pakistani man who had lived in Dubai for thirty years, was called Tariq. He knew KÉF-7 –this was the fourth time the robot had come to collect an order for Nasser.

"Ah, KÉF! Mr Al-Rashid's 501s? Hold on, let me check the size… 34, leg 32, not like last time. That's right."

Tariq slipped the jeans into a brown kraft paper bag and handed it to KÉF-7, which took it carefully between its prehensile grippers, placed it in its ventral compartment –a temperature-regulated storage space originally designed for carrying groceries – and made the payment. NFC badge, instant debit, digital receipt sent to Nasser.

"Tell him it's the last one in stock, won't you. Lucky you came quickly!"

KÉF-7 logged the information. It also noted that Tariq had said "tell him", as though it were a human courier. Not "transfer the information" or "send the message". "Tell him." Something about that phrasing… no, robots feel nothing. But it stored the event under the tag "notable interaction".

Heading home, KÉF-7 took the Red Line in the opposite direction. The carriage was emptier than on the outward journey. Through the window, passing the Museum of the Future – that gigantic golden ring sitting amidst the towers – it picked up the ancestor's Wi-Fi signal again. The station robot was still there, motionless at its post, faithful and obsolete. KÉF-7 sent it a ping. No response. Too old, most likely, for recent protocols.

At Al Karama station it alighted, passed through the exit gate and stepped back out into the furnace. Forty-eight degrees. Its sensors went back to amber. It accelerated, as much as regulations permitted, and made its way back up to Nasser's flat on the 32nd floor of a tower in Karama.

Nasser opened the door in his socks, holding a glass of karak chai. He studied KÉF-7, then the bag, and smiled.

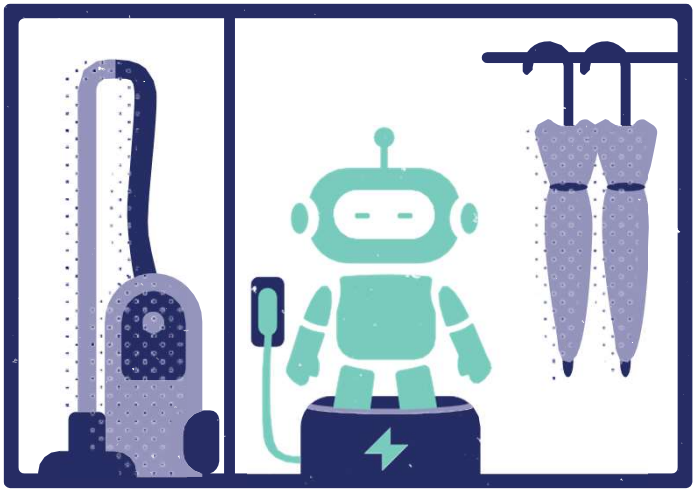
"Well? Is it the right one this time?"

KÉF-7 opened its ventral compartment, removed the bag and handed it to its owner. Nasser unfolded the jeans with the delicacy of an archaeologist unwrapping an Etruscan vase. He checked the label. 34. Untreated indigo. Centenary edition. He closed his eyes for a moment.

"Perfect. You're an angel, KÉF."

An angel. KÉF-7 was not entirely sure what that word meant in a robotic context, but it filed it under "notable interaction", right next to Tariq's "tell him". It returned to its charging station in the entrance cupboard, between the vacuum cleaner and the umbrellas that nobody ever used in Dubai. As it plugged in, it ran one last query through its literary database.

"Holifart watastink " – Zazie in the metro, by Raymond Queneau, 1959. A girl who dreams of riding the Paris metro, but the metro is on strike. She will never get the chance to go on it. KÉF-7, on the other hand, had taken it. Twice, in fact – and had come back with a pair of 'blue jeans'.



SCENARIOS

WHITE SCENARIO

Intelligent symbiosis

In this optimistic future, the robotisation of metro networks has been deployed within a jointly agreed framework. Operators have negotiated ten-year transformation plans with the trade unions, anticipating each technological wave with training programmes. Cleaning operatives have become "cleanliness supervisors", managing robot fleets from tablets and intervening manually on complex cases. Maintenance engineers have acquired skills in data analysis and algorithmic supervision, moving from the screwdriver to the predictive dashboard. This has generated substantial productivity gains: unplanned breakdowns have fallen by 60%, carriage cleaning time has been cut by two-thirds, and passenger satisfaction has reached record levels thanks to cleaner, better-monitored and better-informed stations.

Robot passengers are fully integrated into the fare system. Their financial contribution – higher fares, dedicated subscriptions – generates significant additional revenue that funds network improvements. Off-peak hours, previously under-exploited, have been made worthwhile. Jobs have not been lost, but transformed instead. The human being remains at the heart of the system, no longer as an operative, but as the guarantor of quality, safety and social connection.

GREY SCENARIO

Uncomfortable cohabitation

In this intermediate trajectory, robotisation has imposed itself in fits and starts, without any overall vision. Some networks have massively deployed cleaning and maintenance robots, cutting their workforces by 30% over five years. Others, held back by union resistance or lack of investment, remain wedded to manual models that have become obsolete. The result is a fragmented landscape: ultra-modern metros in wealthy cities, ageing systems elsewhere.

The question of robot passengers has been handled case by case, without any international framework. In Dubai and Singapore, their admittance has happened seamlessly. In Paris and London, debates are mired in legal disputes over liability, the right of machines to occupy public space and the fear of setting a precedent. Robots clutter the pavements, unable to use the metro, creating new friction with pedestrians. Employment has suffered in the most automated networks: retraining programmes, which are notoriously underfunded, have absorbed only a third of the displaced workers. The divide between skilled trades and operative roles has deepened.

BLACK SCENARIO

The silent displacement

In this pessimistic future, robotisation has been driven by cost reduction rather than service improvement. Operators have replaced workers with robots on a massive scale, without any serious retraining plan. Stations are clean but deserted: no human face behind the ticket windows, no staff on the platforms. Vulnerable passengers – elderly people, disoriented tourists, unaccompanied children –find themselves confronted with machines that respond quickly but do not understand distress.

Robot passengers have saturated the networks. The absence of robust regulation has allowed commercial fleets to monopolise carriages during off-peak hours, then to spill over into peak times. The additional revenues have been captured by the platforms that own the robots, not by the operators. Redundant employees have not found equivalent work. Inequalities have deepened: those who own robots gain access to premium services, whilst others endure a degraded and dehumanised metro.

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