



EDAG CITYBOT

An autonomous transport and working vehicle
for the smart city of tomorrow.

Johannes Barckmann
EDAG CityBot Concept-
and Product-Owner



“Only in combination with digitalisation is autonomous driving the biggest opportunity to effectively combat gridlocks.

Relying solely on alternative drive systems and autonomous vehicles will not help us to achieve our objectives. Unless these are integrated in an intelligently controlled, maximum-efficiency traffic system, they, too, are just stuck in jams.”



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CITIES AT AN IMPASSE

Mobile? You've got to be kidding! Congested roads, chronic lack of parking space, crowds everywhere – in constantly expanding cities all around the world, is it realistic to even be talking about traffic flow? What we can talk about, though, are smog and fine dust alarms, increasing health risks and the diminishing quality of housing, living and working conditions. It is time for a completely new concept.

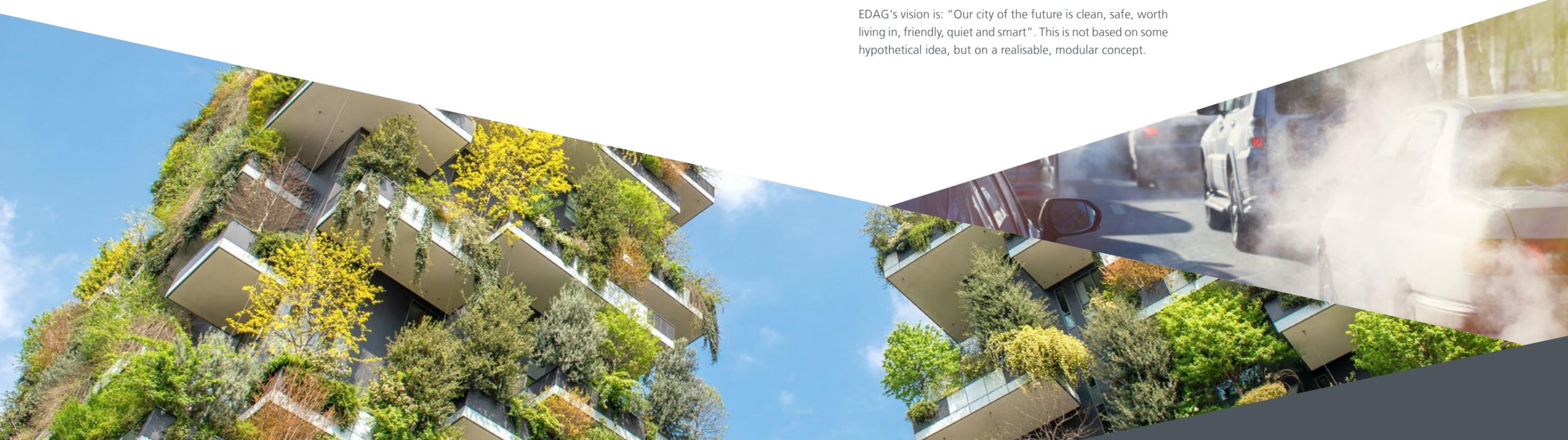
Influx into the cities remains unchecked. So migration from the land does, too. All the signs are pointing to urbanisation. Cities are now sounding the alarm. More than 40 cities and municipalities in Germany have recently declared a climate-related state of emergency. In China, familiar with these concerns for a long time, eMobility and therefore radical technological change have been prescribed by the state. The findings are identical the world over: it is becoming increasingly evident that individual, delivery and service traffic, which has been growing constantly for decades, has reached its limits. Traffic congestion is becoming a health risk and a serious burden on the quality of housing, living and working conditions in urban areas.

Urbanity at a new level Simply shutting down road traffic is not a feasible alternative. Mobility and being on the move do, after all, determine our daily life. They are an essential part of our social life at work and school, in our leisure activities, and in supplying our everyday needs. For individual transport to continue to be possible even in densely populated areas, further traffic and mobility services that will genuinely ease the situation in our inner cities are called for. Not in the form of add-ons, that will only lengthen traffic jams, but as game changers: mobility all-rounders that will take the urban future to a whole new level.

EDAG's vision is: "Our city of the future is clean, safe, worth living in, friendly, quiet and smart". This is not based on some hypothetical idea, but on a realisable, modular concept.

EDAG's vision:

"Our city of the future is clean, safe, worth living in, friendly, quiet and smart."

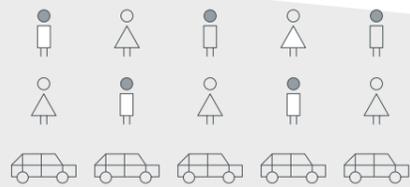


INDIVIDUAL TRANSPORT IN METROPOLISES – MOTOR AND BRAKE OF EVERYDAY MOBILITY



100

CityBots for every 1,000 inhabitants could completely cover all inner city mobility and service requirements.



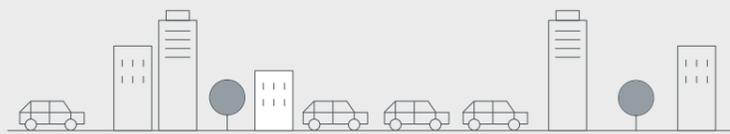
527

cars per 1,000 inhabitants in private households. (Infas | BMVI)



45

minutes is the average time a passenger car is in use a day, which is equivalent to 3 % of the entire day. (Infas | BMVI)



558 Mio

kilometres is the distance travelled every day by people in German metropolises. (Infas | BMVI)



5.300

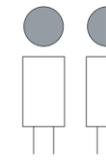
square kilometres serve as parking space in Munich. For 0.49 cars per inhabitant, 12.5 percent of the total traffic area is used for parking.

(Telepolis)



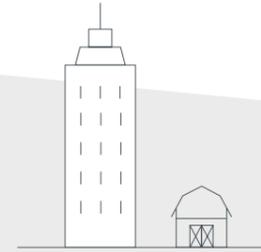
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percent of climate-damaging emissions come from cities. (Potsdam Institute for Climate Research)



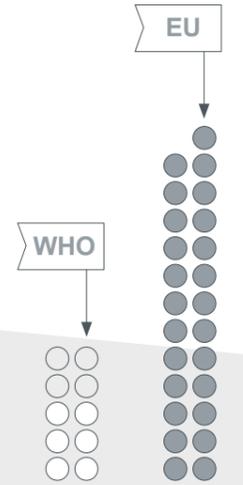
1,5

persons, on average, share a car per trip. (Infas | BMVI)



78,6

percent of the population in Germany will live in cities in 2030. Worldwide, the proportion of people living in urban areas in 2005 was 49.1 percent, an increase to 60.0 percent is forecast for the year 2030. (Statista)



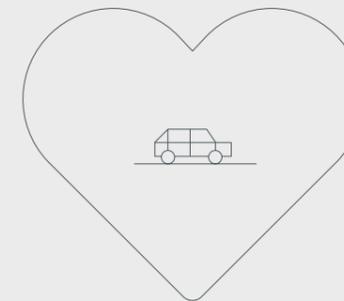
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micrograms of particulate matter per cubic meter of air is the annual average classified by the World Health Organization (WHO) as the maximum permissible threshold value for the prevention of environmental diseases such as asthma or cardiovascular diseases. In the EU, 25 is the limit. Environmentalists have long been calling for stricter EU limits on particulate matter. (WHO)



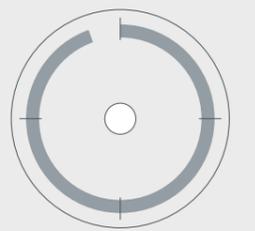
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kilometres per hour is the average speed a car travels in the city of London, so in commuter traffic it is as fast as a bicycle (Stern)



34

percent of those asked in the German Mobility Study said that they preferred to use public transport, whereas the popularity of the car stands at 77 per cent. (Infas | BMVI)



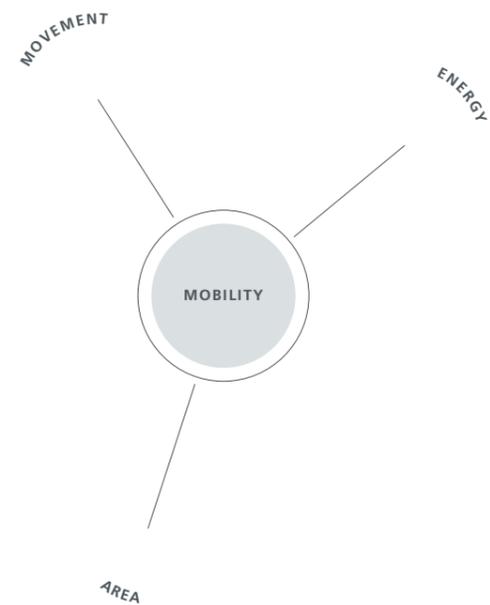
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hours and more a day is how long a car is parked, mainly at home. (Infas | BMVI)

PREMISES OF A NEW MOBILITY CONCEPT

The only way to make the city of tomorrow smarter and more human is to re-think growth and spatial development.

In EDAG's new mobility concept, previously separate individual systems are transformed into integrated systems.

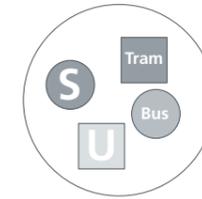


Mobility is a function involving energy, movement and space. In growing cities, space is a very limited and increasingly valuable asset. The availability and designability of space determines whether and how people achieve their professional and private goals, how their wishes and requirements can be reconciled and how they can improve the quality of their living and working conditions. This is conditional on inner-city centres being planned for fewer vehicles, with less parking space and less environmental pollution, and on previously separate and individual mobility systems becoming integrated systems.

This calls for technical and urban planning conditions such as the following



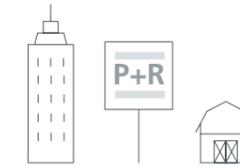
Defining an area for the new mobility concept, where, apart from bicycles, no other individual or private vehicles are permitted. For CityBots, pedestrians always have the right of way – without zebra crossings.



Integration of public **transport** into the system.



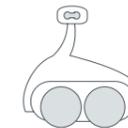
Open data and open standards, as well as interoperability und barrier-free principles.



Integration of **Park+Ride zones** in the outskirts into the system.



Extension of cycle paths in newly vacant areas.



Autonomous transport systems should always be in motion – self-learning, intelligent and forward-looking.



Control and coordination of the traffic by means of appropriate software. There is no longer any need for traffic lights.



Development and expansion of the concept in **collaboration** with municipalities, industry and the civil society.

THINK AGAIN!

Unchecked growth, declining quality of life, mobility that has just about come to a halt: cities and their inhabitants are under pressure.

This calls for completely new mobility and transport concepts – and with them, cultural change.

What will the future bring? To provide answers to this question, futurologists are targeting so-called megatrends. In addition to demographic change, the focus is on urbanisation, individualisation, digitalisation and mobility.

URBANISATION

What will become of our cities?

The majority of the population wants to, and indeed will live in a city. In Germany's metropolises, too, all the signs are pointing to growth. The Institute of the German Economy anticipates that by 2035, the population in Frankfurt will have grown by 80,000, by 200,000 in Munich and by 500,000 in Berlin. There is neither the room nor the infrastructure for a corresponding increase in individual vehicles.

INDIVIDUALISATION

Who has the final say?

Individuality and individual mobility are deeply rooted cultural elements of liberal societies, and very much taken for granted. They arise from the desire to be self-determined and independent at all times and to always decide for oneself when, how and where one is going. The services offered by transport systems which take the place of predominantly individual transport must meet this cross-cultural requirement.

DIGITALISATION

How are our means of transport networked?

In the smart city, data analyses help to combine city and traffic functions in real time, and therefore play a decisive role in determining the ability of mobility systems to perform, change and adapt. By networking the individual modes of transport with each other and their surroundings, traffic in the smart city can then be controlled, by means of swarm intelligence and AI for example, in such a way that it flows better, congestion and traffic-related emissions are reduced, and accidents are avoided. This will enhance life in the cities of tomorrow, making them greener and quieter.

MOBILITY

Who controls what?

The Future Institute predicts that, whereas cars used to dominate cities, in the future it will be the cities that dominate the cars. Or to be more precise, the optimum traffic systems for them in an intelligent mix of modes. Thanks to digitalisation and networking, the combination of different modes of transport will have to function more and more smoothly, and include open data-based, fully integrated booking and payment options. The technological conditions are already in place. This brings the advantages of the system within reach: more comfort, less stress, lower consumption and therefore less environmental pollution, optimised traffic flow, mobility regardless of age and, above all, greater road safety.



EDAG CITYBOT

Excuse me, may I introduce myself? I am the future of mobility and work in the smart city. Here is a small sample of what I can do:

Patented* coupling system
to serve as a robust mechanical connection with the modules. This ensures data transmission, HV power supply and optional connections with additional hydrogen tanks.

Patented* avatar
with an integrated sensor set for autonomous driving and working systems. It also acts as an emotional communication point for its environment, can speak, nod and make eye contact.

Electric wheel hub motors
with up to 24 KW power for an economical power unit with the expected operational profile in the smart city's fully controlled and networked traffic.

Data communication
for the constant exchange of all data relevant to operation and the environment. Permits optimal traffic flow and resource planning, including necessary payments.

All-wheel steering
with integrated wheel hub motors and height-adjustable chassis. This enables the EDAG CityBot to drive sideways and support the gesture functions developed by EDAG psychologists.

Body components
additively manufactured for maximum integration of functions and just-in-time provision in production and maintenance.

Fuel cell
for the CityBot-specific energy requirements in 24/7 operation. Refuelling with hydrogen at smart city service stations takes just three minutes. If hydrogen is produced from regenerative energy, this leaves a very small CO2 footprint.

* patent-pending

EDAG CITYBOT: A BUSINESS IDEA IN EVERY ONE

CityBots are mobility all-rounders. Whether with a trailer or a "rucksack": thanks to its autonomous, mechanical connectivity, modularity sets no limits to the possible applications of the heroes and any related business models.

THE EMERGENCY CALL HERO
is there in case of emergency, works as a city guide or in security

THE CLEANING HERO
keeps the city and its parks clean, provides winter services and other services

THE LEAF COLLECTION HERO
automatically gathers up fallen leaves

THE RELAX POD HERO
creates wonderful worlds for you to experience

THE GROUP TAXI HERO
takes city dwellers from A to B

THE GARDEN MAINTENANCE HERO
does the gardening when everyone is asleep

THE PARTY HERO
sets a club feeling all of its own in motion

THE PARCEL STATION HERO
delivers all kinds of parcels

THE PIZZA HERO
delivers delicious food fresh to your door

THE SUPERMARKET HERO
provides a mobile shopping experience

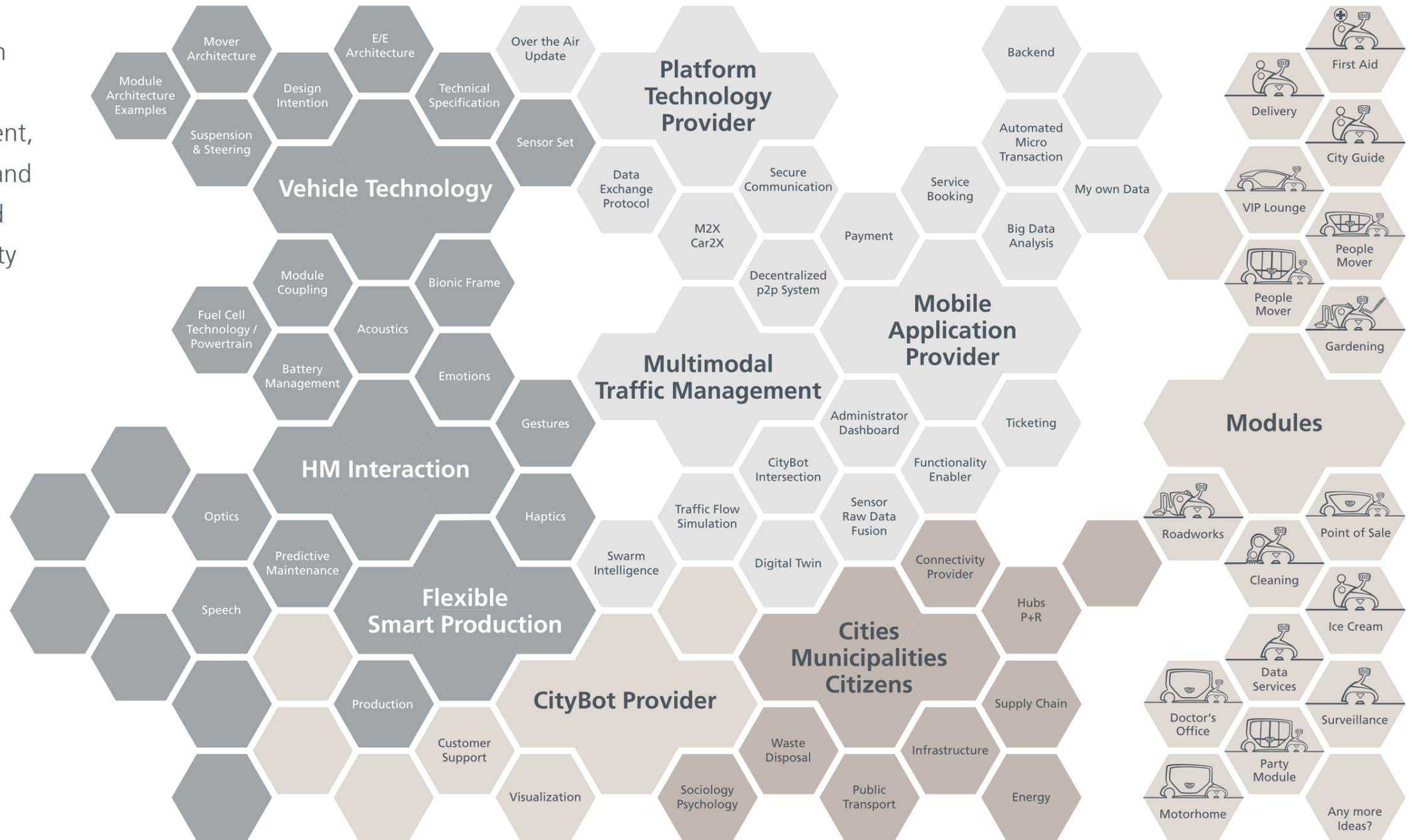
THE VIP LOUNGE HERO
offers a completely new dimension of mobile comfort

24 \ 7 \ 365

THE EDAG CITYBOT ECOSYSTEM

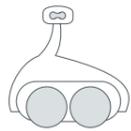
The whole is greater than the sum of its parts:

the EDAG CityBot ecosystem involves all the necessary participants in its development, implementation, operation and use. This means that it could be a game changer in the city of the future.



THE EDAG CITYBOT-WIKI

Key terms from the EDAG CityBot ecosystem and what is behind it.



1 \ EDAG CityBot

is the name of swarm-intelligent, multifunctional, fully autonomous robot vehicles that take emission-free energy from fuel cells and can be used around the clock thanks to their modularity and multi-functionality. Optionally, they also carry with them rudimentary tools integrated in the "mover", and add-on parts enable it to be configured as a passenger module, cargo carrier or city cleaning device, for example, according to requirements.

History of its development For the design of the EDAG

CityBot ecosystem, the EDAG Group, the world's largest independent engineering partner to the automotive industry, combined all of its engineering competencies: from Design through the EDAG segments Vehicle Engineering (VE), Electrics/Electronics (E/E) and Production Solutions (PS). The EDAG innovation, which was presented for the first time at the IAA 2019, is more than just a design study. It is a comprehensive mobility concept aimed at becoming a real game changer in the city of the future.

Fields of application

EDAG CityBot has positioned itself as a potentially groundbreaking autonomous transport and working system for urban centres suffering from high traffic and emission loads and seeking intelligent system-based mobility alternatives which, in the face of continued growth, are environmentally, economically and socially sustainable.

Functions and business models

In conjunction with the Internet of Things (IoT) and the digital micro payment solutions of EDAG partner IOTA, the EDAG CityBot offers not only new autonomous transport and working vehicles, but also possible new business models for their operators. This is what essentially sets the EDAG CityBot apart from other known autonomous vehicle concepts for the city of the future.

CITYBOTS

Top assets for investors and operators (a selection)

- ⊕ Incubator for the design of smart cities
- ⊕ Clear time frames for implementation: three to ten years (depending on the scenario)
- ⊕ Defined and secured financial flows in
 - Development
 - Production
 - Operation
- ⊕ 24/7/365 CityBot availability: Return on investment around the clock – no downtimes or loss of power
- ⊕ High scalability of the entire system on a global scale
- ⊕ Can be connected to existing and new business models with revenue opportunities for operators working in passenger and goods transport, service and work tasks, traffic flow planning, payment integration, maintenance and licences.



2 \ SmartCity

is the answer to the global megatrend of urbanisation and the predicted growth of cities. The collective term that has been in use in politics, business, administration and urban planning throughout the 2000s summarises holistic development concepts that aim to make cities more efficient, more technologically advanced, greener and more inclusive. The focus here is on technical, economic and social innovations.

The smart mobility factor

Smart mobility is a component of the smart city. In order to make this as energy-efficient, low-emission, safe and cost-effective as possible, information and communication technologies will be used and regulatory control measures such as the designation of zones for the exclusive use of certain modes of transport implemented to optimise the existing infrastructure.

Benchmarking

In order to render smart city strategies comparable in terms of buildings, energy and the environment, mobility, education, health, public administration, legal framework, infrastructure, stakeholders, coordination, plan and budget, Roland Berger has been publishing an annual Smart City Strategy Index since 2017.



3 \ Human-machine interaction (HMI)

describes the cooperation and interaction between man and machines. In the EDAG CityBot ecosystem, HMI stands for the user-oriented analysis and modelling of application contexts, principles, methods and tools for the design of interactive, networked systems relating to the CityBot.

Evolutionary history

EDAG development engineers are among the pioneers of advanced driver assistance systems (ADAS). The general system architecture involves the use of various mechatronic and electronic sensors and actuators, for example for steering the steering angle sensor and steering support. During environment sensing, the particular focus is on radar, lidar and camera. The basis for this is environment recognition, in a manner of speaking the “sensory perception” of the system: where is an object, what kind of object is it, what is the object doing?

Implementation in the EDAG CityBot ecosystem

EDAG creates the corresponding connectivity architecture, the functional integration and the entire validation chain for online services in the vehicle and relating to the associated digital “ecosystem”. To this end, EDAG’s Connectivity & UX program puts the central engineering focus on the valid end-to-end validation of the complex, continuously developing connectivity functions of vehicles. With EDAG positioned at the interface between the vehicle data acquired and the digital services derived from it, the elementary conditions for the realisation of the CityBots were created.



4 \ Traffic management

is the intelligent networking and control of all traffic systems involved in urban traffic and their players. One of the key factors is giving priority to pedestrians. In the process, current traffic data and dynamic information from the vehicles and their surroundings are used by all road users for real-time forecasts of when they will reach their destination or complete their task, and for planning efficient and “green” routes in the city.

Integration in the EDAG CityBot ecosystem

Within the ecosystem, EDAG PS creates the appropriate interfaces between the EDAG CityBots and the traffic flow, city function and work order data. This creates the ideal conditions for the deep, holistic integration of the EDAG CityBots into the cosmos of the smart city - to the benefit of users and operators alike.

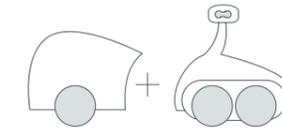


5 \ Data protocols

create the basis for the communication between a wide variety of different smart devices. EDAG ensures that systems “get along” together, so that together they can form the EDAG CityBot ecosystem. trive.me, an EDAG brand from the Electrics/Electronics segment, is breaking new ground in the networking of vehicles with the digital environment. As a think tank for the networked vehicle, trive.me can be seen as a multifunctional adapter that efficiently evaluates product ideas in the area of mobility services and, using agile development methods, takes them to product maturity.

Integration of payment systems

A safe, reliable payment experience is crucial for the success of a mobility concept. To this end, the EDAG CityBot uses the digital payment system IOTA. With this open source software, it is possible for the first time ever for people and machines to exchange payments and data directly with each other, without an intermediate platform and without additional fees. Tedious payment procedures such as registration, validation, verification und data privacy statements are replaced by a thoroughly positive mobility experience for the user.



6 \ Movers and modules

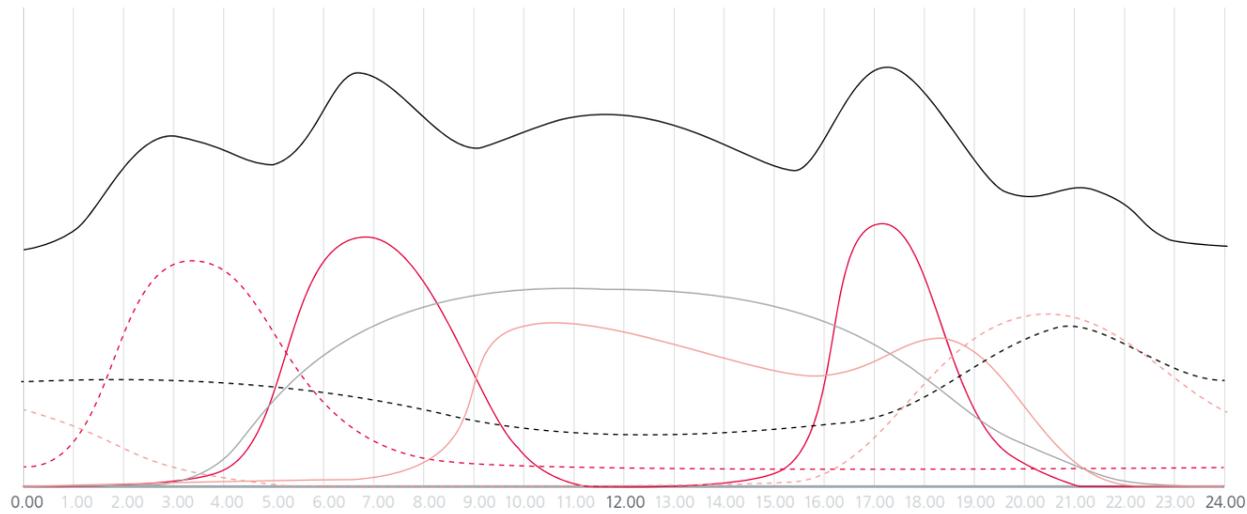
make CityBots into mobility all-rounders in der smart city. The focus here is on the efficient and comprehensive use of the sophisticated mover technology. Behind it is an extremely compact, lightweight and autonomous drive module - self-controlling, self-learning, swarm intelligent and equipped with the unlimited possibilities of the latest connected mobility services.

Applications and areas of operation

In order to meet the needs of the smart city in terms of both passenger and freight transport and autonomous services, a wide variety of user modules can be coupled to a mover drive module at any time. The principle of “open interfaces” for coupling to the drive module enables the spectrum to be constantly expanded and makes the technology affordable. Scaling the technology for borderline areas is also conceivable.

TIME FOR ALL-ROUNDERS

With the EDAG CityBot, rush hours with congestion and tailbacks are a thing of the past. As they are able to multitask, they can be in action around the clock. This is how sophisticated technology pays off.



- Legend**
- EDAG CityBot: cumulative use in 24/7 operation
 - Commuter traffic
 - Goods transport
 - Private use (shopping, family, hobbies)
- Broken lines = CityBot deployment options**
- - - Police and security tasks
 - - - Road cleaning
 - - - Individually commissioned services
 - - - Entertainment and party

A VISION BECOMES REALITY

The EDAG CityBot concept core team



Johannes Barckmann
EDAG CityBot Concept- and Product Owner



Thomas Hasenauer
EDAG CityBot Project Designer



Karina Schäfer
EDAG-PS Segment Representative, Production Solutions



Gerhard Körbel
EDAG Segment Representative, Vehicle Engineering



Alexander Süssmilch
EDAG Representative trive.me



Stefan Fuchs
EDAG-BFFT Segment Representative, Electrics/Electronics

COMPETENCE WINS

The EDAG CityBot ecosystem is a fully integrated concept for the city of the future. To bring it about, EDAG has bundled all the engineering competencies of its core divisions Vehicle Engineering, Product Solutions and Electrics / Electronics in a unique way.

EDAG has been developing innovations for 50 years. The implementation of the EDAG CityBot creates the basis for a completely new interpretation of inner-city mobility and quality of life.

Not as a science fiction fantasy, but as a system that is actually feasible and at the same time economically viable.



»When developing new vehicle and mobility concepts, their technical validation is essential. This involves checking adherence to physical and kinematic laws and compliance with regulations, norms and standards. For a concept as far-reaching as the EDAG CityBots, most of these have to be redefined. This is a great challenge.«

Harald Keller

COO Vehicle Engineering of EDAG Engineering GmbH

»In the EDAG CityBot ecosystem, the CityBots interact with the traffic around them: pedestrians, cyclists, means of mass transport. Driving style and weather conditions also have a considerable effect on their successful and efficient integration. For an efficient development environment, this means that the depiction of realistic multi-mode scenarios in the virtual world becomes a decisive factor. It combines, for example, multi-mode traffic flow simulation with the EDAG PS traffic flow management.«

Rainer Wittich

Chairman of the Board of Management of EDAG
Production Solutions (EDAG PS)

»In the EDAG CityBot ecosystem, we have moved our E/E ADAS and eMobility service portfolio far beyond the boundaries of vehicles, into the digital world of the smart city.«

Volker Fink

Head of EDAG BFFT Electronics





www.edag-citybot.de

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Overall responsibility

Johannes Barckmann | johannes.barckmann@edag.com

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Marcus Schick | www.schick-kommunikation.de

Design

heiter&sonnig | www.heiterundsonnig.de

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