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SWARCO Global Portfolio: Today and Tomorrow

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AGENDA

1. ***Our vision***
2. *Tackling 21st Century Challenges*
3. *Global Portfolio – at a glance*
4. *It's all about addressing pain points*
5. *Building the future*

OUR LEADING IDEA

ROAD MARKING SYSTEMS

LANE MARKINGS

CYCLE PATHS

ROAD WORK ZONES

PARKING LOTS

AIRFIELDS

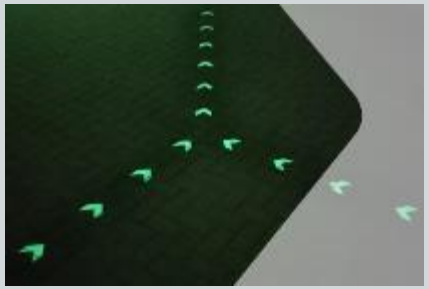
INDOOR MARKINGS

PLAYGROUNDS

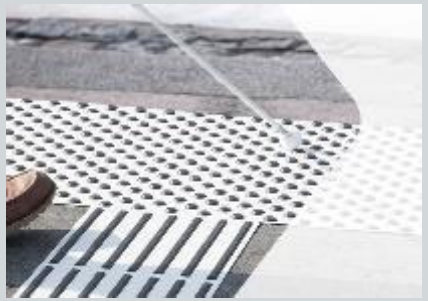
RACE COURSES

SPORTS GROUNDS

SPECIAL SYSTEMS



AFTERGLOW SYSTEMS



TACTILE MARKINGS

INTELLIGENT TRANSPORT SYSTEMS

MOBILITY MANAGEMENT

- SWARCO urban mobility management
- Traffic control centres
- Intersection control
- LED traffic lights
- Detection
- Emission reduction concepts
- Prioritization of emergency vehicles
- C-ITS / I2V communication
- Traffic Light Assistant
- Micromobility

HIGHWAYS AND TUNNELS

- Highway guidance systems
- LED Variable Message Signs
- Lane control signs
- Use of hard shoulder
- Automated incident detection
- Tunnel operation and monitoring software
- WIM integration
- Truck parking
- C-ITS / I2V communication

PARKING

- On-street parking
- Off-street parking
- City-wide parking guidance systems
- Access control
- Single space monitoring
- Parking & Charging
- Parco App
- Corporate parking solutions
- Markings for parking
- License plate recognition
- Payment solutions

PUBLIC TRANSPORT

- Fleet management
- Real-time passenger information
- Terminal management
- Priority at intersections
- On-board units
- Security and monitoring
- Payment schemes

INTELLIGENT TRANSPORT SYSTEMS

PORT SOLUTIONS

BIG EVENTS

MICROMOBILITY

E-MOBILITY

INTERSECTION OF THINGS

LIVABLE CITY

CONNECTED DRIVING

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GLOBAL **TRENDS**

Urbanization

- **5.1 billion people** (60%) living in cities by 2030
- **Congestion +20-35%** since 2010

Autonomous driving

- Most OEMs launch **L4/5 autonomous vehicles** not before 2023 (new players earlier)

Connectivity and IoT

- **80% of cars** with embedded connectivity in 2030
- ~EUR 400-600+ bn expected value pool increase by 2030 from connected car use cases

Sustainability and regulation

- **Decarbonization** targets of cities (EU Green Deal)
- Increasing willingness to regulate

Transport mode shift

- Serious modal shift in cities (new modes such as e-scooters and e-hailing emerging; shift from car to public transport and micro-mobility)

Big data / adv. analytics

- By 2030, **70%** of companies might have adopted at least one type of **AI technology**

E-Mobility

- **~20-40% of new vehicle sales** in urban areas with xEV powertrains in 2030

CHALLENGES AND OPPORTUNITIES FOR TRAFFIC INDUSTRY

Urbanization

- **Urban sector** continues to be the focus (today more than **50% of our revenues**)
- **New traffic management offerings** should address congestion and all transportation modes

Autonomous driving

- Role of **TM Infrastructure** being re-defined
- **Traffic guidance** and control at network level will still be required

Connectivity and IoT

- New **C-ITS use cases emerging**
- Currently **C-ITS market is in build up phase**
- **New players** (e.g., telecom, automotive, cities) are assessing their offering/willingness to pay

Sustainability and regulation

- **New** software based business cases (e.g., emission management, noise control, street safety) are emerging

Transport mode shift

- **New data** sources to support strategic transportation modes (PT priority, Green wave for bikes etc.)
- Protection of **vulnerable road** users

Big data / adv. analytics

- Evaluate better use of **currently available** data sources and integrate and use of alternative data sources in TM solutions

E-Mobility

- Increased need for **integrated parking/charging** solutions

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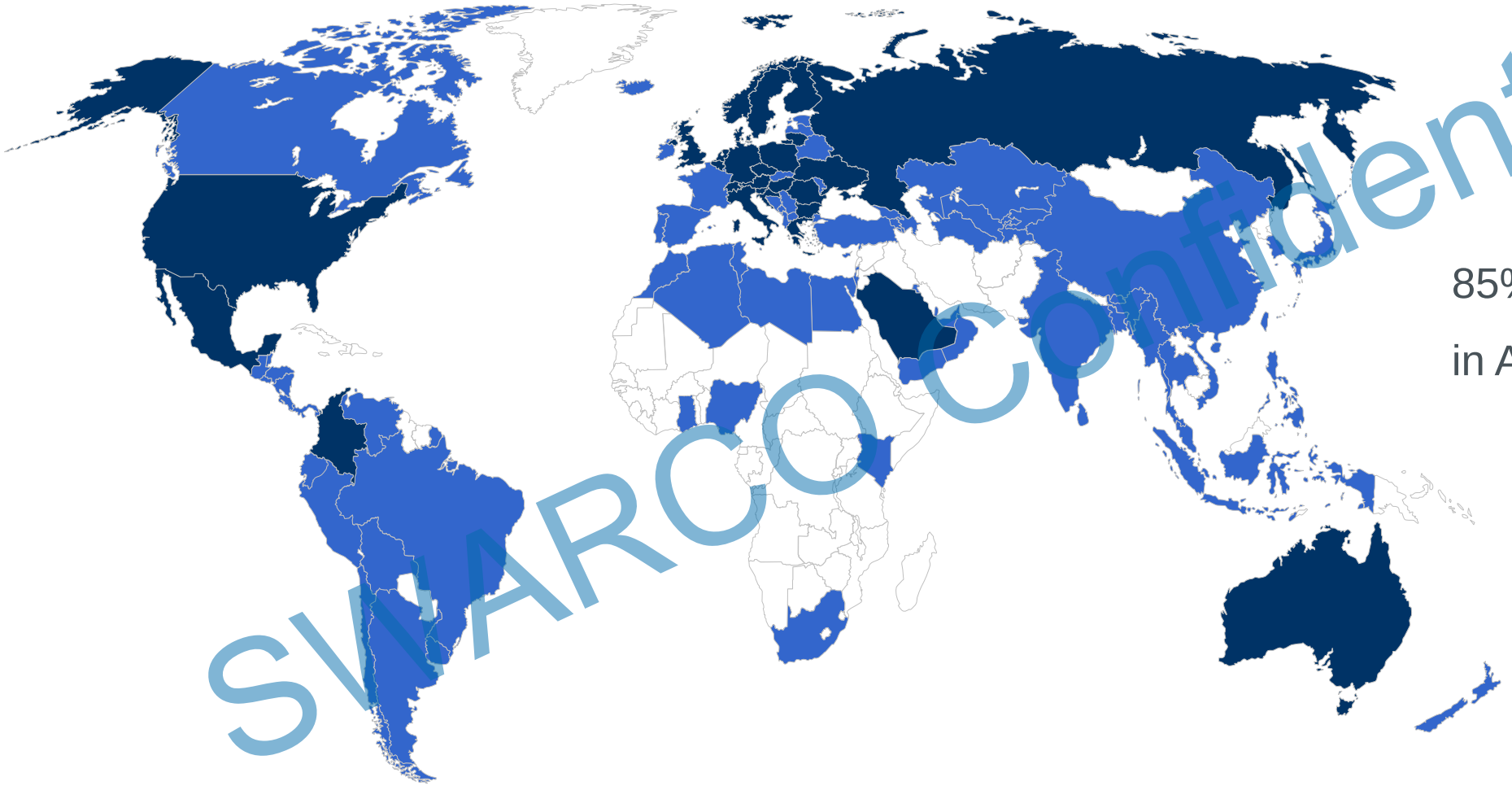
ONE COMPANY, ALL SOLUTIONS

SWARCO IS PRESENT IN 80 COUNTRIES



85% of value creation in Austria is exported.

Additional export markets of SWARCO

Country with SWARCO production site / company

A SUCCESS STORY DOHA, QATAR

THE CHALLENGE

Implement an intelligent traffic management strategy that will enable traffic operators to focus road network performance on achieving journey time reliability, rapid incident detection and automated response and increased road safety

SERVICES

Design, develop, supply, install and maintain a state-of-the-art integrated country wide “Intelligent Transportation System” (ITS) software platform

TECHNOLOGY

SWARCO integration platform featured with tunnel management system, macro and micro traffic modelling, advanced traveler information and automated incident response strategies

PROJECT DURATION

02/2019-03/2025

Enhanced ITS Solution for the Smart City Doha

Public Works Authority (PWA), also known as ASHGHAL is an autonomous government body, established with a mandate of providing world class infrastructure facilities in Qatar, especially roads, drainage and other government facilities. PWA has been constructing a Roads Management Centre (RMC): a state-of-the-art facility, using high technology systems and equipment, to maintain, monitor and manage the roads assets under the responsibility of Assets Affairs.

The main aim of this RMC project is to deliver a comprehensive Intelligent Transportation System (ITS) platform hosted in the RMC, henceforth called RMC Software Solution. The RMC Software Solution shall be the ITS platform for PWA – supporting and integrating all existing and future ITS implementations planned by PWA over the coming years. This project incorporates design, develop, supply, install and maintain an integrated “Intelligent Transportation System” (ITS) software platform:

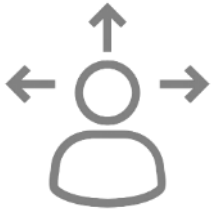
- Software Module to/for: Monitor and Control of the existing and new ITS equipment e.g. CCTV / VMS / RWIS / WiM / Overheight Detection
- System / Microsimulation & Traffic Forecasting / SCATS Traffic Control / SCADA Tunnel Management System / Automated Incident Detection System / Integration of several existing systems.

A SUCCESS STORY: THE CHALLENGES

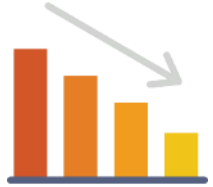
Manage congestion	Where ,How much, When, Why and What to do?
Manage road incidents	Fault and incidents Detection, Impact and Mitigation
Manage planned events	Impact assesment and traffic mngmt. Plans
Automation of response plans	Scenario modelling, predictive and preemtive mitigation
Stakeholder collaboration	Real-time data sharing, pre-emptions, VVIP and priorities (SC, MOI, MOTC, Lusail, Internal stakeholders,suppliers etc)
Real-time traffic reporting	KPIs,Mitigation plans, and Media publishing
Real-time traveler information	Accurate, reliable and relevent
Smart Mobility and Innovation	Strategy and plans, Technology adoption, Connected Vehicle, V2X, Virtual Signs, and MaaS
RMC Technology Integration	Many legacy and new sub-systems, protocols, standards, suppliers and vendors, fragmented data and information, CCC and security

A SUCCESS STORY: THE BENEFITS

Help make better decisions



Slower build-up of congestion



Quicker incident recovery time

Predictive traffic flow capability

Intelligent Incident Response Plans

Improved Customer Experience

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Our customers' needs are drastically changing, and **SWARCO is there to provide solutions.**

PROBLEM STATEMENT

- **Urban traffic congestion**
- **Poor air quality**
- **Budget constraints**
- **Staying on top of innovation**
- **Scarcity of parking spaces**
- **Increasing safety for VRUs**
- **Lack of skilled resources**
- **Lacking interoperability of systems**
- **Interurban traffic congestion**
- **Road user safety on highway & in tunnels**

URBAN TRAFFIC CONGESTION
THE PROBLEM

- **Congestion in cities** around the globe **increases travel times by 25-60%**
- **Every hour lost** has a social cost of about €15, which **adds up to many millions of euros** per city per year
- A driver spends the equivalent of **148 hours per year stuck in day-to-day traffic jams**
- Congestion leads to an **increase in the number of accidents**

WHAT DOES THE FUTURE LOOK LIKE?

- **Building more roads** will lead to an **increase in traffic**
- **Urbanization** will result in more movement in **less space,** and by 2030 the **populations in cities will have increased by 35%**
- Every year more than **3 million cars are added to the existing car fleet in Europe** alone
- **Road authority policies are becoming more complex** as a result of the changing state of daily traffic and the long-term increases in vehicle numbers

CURRENT LIMITATIONS TO REDUCING CONGESTION

- **Limited space**
- **A shortfall** in the number of **open platforms**
- **Outdated** traffic management systems
- Not enough **integration and connectivity**
- **Silo systems** limiting the holistic view
- **A shortage of proactive** mobility management
- **Lack of adaptivity** in a suitable level of granularity

URBAN TRAFFIC CONGESTION
THE SOLUTION

AUTOMATED, SCHEDULED & MANUAL COMMANS

DATA COLLECTION

Sensors:
TRAFFIC DATA

+

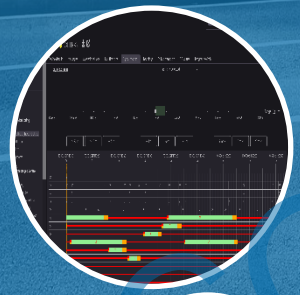
Eco-system of mobility e.g.
APPS, FLOATING CAR DATA

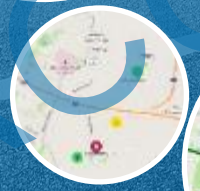
+

PARKING DATA

PROCESSING & STORAGE

DATA VISUALIZATION





ALERTS & NOTIFICATIONS in case of any equipment failure

REPORTING TO ANALYZE IMPROVEMENTS

ACTIONS

ADAPTIVE NETWORK CONTROL
Automatically predicts and adjusts traffic signal controls to maximize throughput and reduce traffic jams.

REROUTE & INFORM
Steer traffic away from congested areas and motivate a modal shift to reduce the overall traffic volume.

SPEED ADJUSTMENT
Adjust the speed limit to ensure an optimized traffic flow along critical corridors.

TRAFFIC ENGINEERING
Evaluate controls based on current guidelines, plan, test and simulate traffic-actuated controls, upload data to controllers directly or remotely and evaluate real-time data.

POOR AIR QUALITY
THE PROBLEM

- **Outdoor air pollution** is **linked to 3.4m deaths** per year globally
- **97% of cities in low- and middle-income countries fail** to meet World Health Organization (WHO) air quality guidelines
- **49% of cities in high-income countries fail** to meet WHO air quality guidelines
- Apart from the devastating human cost, the **financial cost equals roughly €1 trillion per year**

HOW DID IT GET SO POLLUTED?

- **Rapid urbanization:** by 2030, the average population in cities **will have increased by 35%**
- **Increase in vehicle numbers:** every year more than 3m vehicles are added to the car fleet in Europe alone
- **Day-to-day traffic**: transport accounts for **30% of all pollution**. This is estimated to increase to 60% by 2050
- **Searching for a parking space:** the average time to find a space is roughly 8 minutes, which **results in an additional 730 tons of CO_2 emissions**

AIR, NOISE AND LIGHT POLLUTION ARE ASSOCIATED WITH AN INCREASED RISK OF:

- Stroke
- Heart disease
- Lung cancer
- Chronic and acute respiratory diseases, incl. asthma

Pollution is causing more than three million premature deaths worldwide

- Pollution once was an acceptable by-product of urbanization, but is not anymore

POOR AIR QUALITY
THE SOLUTION

DATA COLLECTION

Sensors:
ENVIRONMENTAL DATA

+

Sensors:
TRAFFIC DATA

+

Eco-system of mobility e.g.
APPS, FLOATING CAR DATA

PROCESSING & STORAGE

DATA VISUALIZATION

ALERTS & NOTIFICATIONS
e.g. too high CO_2 levels

REPORTING TO ANALYZE IMPROVEMENTS

ACTIONS

ADAPTIVE NETWORK CONTROL
E.g., make the traffic signal green-time in the suburbs shorter for cars entering the city to reduce traffic jams in the center.

RE-ROUTING TRAFFIC
E.g., trigger new scenarios where traffic is steered away from highly congested areas.

SPEED ADJUSTMENT
High speed & CO_2 are higly connected. Lower the speed for less emission.

REAL-TIME DATA SHARING
E.g., tolling system get informed about the air pollution, leading to a dynamic price adjustment.

BUDGET CONSTRAINTS

THE PROBLEM

- An investment of approx. **14% of the global GDP is needed to put the right infrastructure in place**
- Meeting the sustainable development goals **requires the use of cost-cutting technologies and solutions**
- Complex, customized developments with a **lack of modularity are slowing down the implementation of the strategies** that are needed
- City infrastructures are increasingly **lagging behind new digital infrastructures** to the point where they are incompatible

WHAT DOES THE FUTURE LOOK LIKE?

- **The global charging network** is going to need an **investment of 272 billion EUR** by 2030 to accommodate the expected growth in Electrical Vehicles
- **Rapid urbanization:** the average population in cities **will have increased by 35% by 2030**
- Modernization of the infrastructure to **enable connectivity and data exchange** is a prerequisite of the **transition to green and smart cities**
- **A transition to sustainable mobility** could deliver savings of 64 trillion EUR by 2050

CURRENT LIMITATIONS

- **Large, up-front payment** to permanently purchase the software is a major obstacle
- **12+ months and high costs for external services to** select a vendor, as well as long-term commitments to static solutions
- Mobility has moved up the agenda as a result of **pandemic-related budget shortages**
- **Lack of data sharing capabilities via APIs;** 3rd party integrations; flexibility due to vendor lock-in

BUDGET CONSTRAINTS
THE SOLUTION

INCLUSIVE PRICING MODELS

'One-off' Purchace $

Hybrid $

Modular Subscription $

- **Flexible pricing structures to fit the needs and budgets** of the customer. E.g., hybrid one-off with ongoing maintenance services
- **Additional services allowing you to share & process data** from different systems with SWARCO as a contractual aggregator
- Ensure to purchase only what is needed via **"try & buy" offering**

Cybersecurity team

MODERN MOBILITY MANAGEMENT SYSTEM

- **Dynamically grows with emerging needs** & technologies
- **Compose your ideal system** via software modules
- **Integrations on a micro, macro & cross-domain level**
- **Open platform** preventing vendor lock-ins
- All operated via a **single platform**
- **Savings on the maintenance of the IT infrastructure,** greater IT stability

+ ECONOMICALLY SUSTAINABLE HARDWARE

- Product longevity leading to **minimal total cost of ownership**
- Open platform approach leading to **future-readiness and preventing investments to evolve**
- Fully integrated SWARCO offering **removing costly customizations and integration efforts**
- **Maintenance automations minimizing staffing cost** to ensure uptime of field equipment
- **Revenue generation via e-charging and parking fees** to support investments

STAYING ON TOP OF INNOVATION

THE PROBLEM

- **Urban infrastructure isn't optimized for micro-mobility**
- Technological innovation is **outpacing the traffic management industry**
- **Implementation of Automated Vehicles** is a challenge for every city
- Within just four years, **e-scooter services have expanded into 626 cities** in 53 countries
- **Micromobility utilization increased by 60% in just one year**

WHAT DOES THE FUTURE LOOK LIKE?

- The EU requires cities to improve **public transport and support walking and cycling** through infrastructure improvements
- The goal is to have a **zero emission fleet by 2050**
- The EU will facilitate Electrical Vehicle charging by **installing 1 million charging stations by 2025**
- **95% of new vehicles will have connectivity functions by 2030**

CURRENT LIMITATIONS

- Many national or international **innovation programs don't focus on individual customer needs**
- **Budget constraints**
- **Limited knowledge and expertise** at consultancy agencies on innovations

THERE IS A LACK OF:

- **Digitization of traffic data** (speed limits, roadworks, etc.)
- **Open platforms**
- **Integration** with 3rd party providers

STAYING ON TOP OF INNOVATION
THE SOLUTION

DATA COLLECTION

24/7

Cybersecurity team

HIGH RESOLUTION EVENT DATA

Third-party data, e.g.
APPS, IN-VEHICLE DATA

Sensors:
ENVIRONMENTAL DATA

MODERN MOBILITY MANAGEMENT SYSTEM

- **Dynamically grows with emerging needs** & technologies
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- **Re-use of assets** in new solutions
- **Integrations on a micro, macro & cross-domain level**
- **Open platform** preventing vendor lock-ins
- All operated via **a single platform**
- **Urban Mobility Eco-System**

OPEN ECO-SYSTEM ALLOWING TO INNOVATE STEP BY STEP

With inclusive pricing models

'One-off' Purchace	Hybrid	Modular Subscription
$	$	$

TRANSITION TO SMART CITY & MaaS

- Support both existing and new technology (e.g. intelligent infrastructure)
- Data fusion (e.g. detection and FCD)
- CCAM use cases
- Comms network
- Analytics
- Asset management
- Predictive maintenance

SCARCITY OF PARKING SPACES

THE PROBLEM

- In London, **50% of the city's land is used for roads and parking**
- **8,000 hectares** are used for **parked cars in London**
- In some cities, **searching for a parking space** takes on average 8 minutes, **resulting in 95,000 hours per year of wasted time**
- Los Angeles **drivers waste 95,000 hours and 47,000 gallons of fuel** searching for parking every year

SILO VIEW INCREASING SEARCH TRAFFIC FOR PARKING

- **30% of vehicles are cruising for parking spaces**
- The **number of cars** is expected to rise to **2 billion by 2040**
- **Parking & traffic** management systems are on **different platforms**
- Many municipalities **rely on revenue from parking**
- Cities struggle with managing **parking policies and pricing**

- **Parking is treated as a siloed topic**
- Current parking solutions **can't be connected to the overall traffic management solutions**

THERE IS A LACK OF:

- **Digital solutions** for efficient parking space management
- **Integration** to 3rd party systems (e.g. city app)
- **Open platforms**
- **Efficient parking pricing** management tools

SCARCITY OF PARKING SPACES
THE SOLUTION

DATA COLLECTION

PARKING DATA

+

Eco-system of mobility e.g.
APPS, FLOATING CAR DATA

+

Sensors:
OCCUPANCY & VEHICLE FLOW DATA

PROCESSING & STORAGE

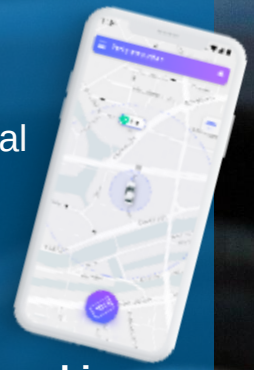
DATA VISUALIZATION

ALERTS & NOTIFICATIONS
in case of any equipment failure

REPORTING TO ANALYZE IMPROVEMENTS

ACTIONS

MANAGE TRANSACTIONS & PARKING ZONES
Set pricing, manage transactions, invoices, configure and adjust virtual parking zones.



PARKING GUIDANCE

VIA SIGNS	VIA APP
✓ On-street	✓ Find parking
✓ Off-street	✓ Book parking
	✓ Pay for parking

PREPARE FOR THE FUTURE WITH EV CHARGING
Add charging points, connect them to MyCity and manage your devices.

TRAFFIC ENGINEERING
Evaluate controls based on current guidelines, plan, test and evaluate real-time and historical data.

INCREASING SAFETY FOR VULNERABLE ROAD USERS

THE PROBLEM

- **Limited road capacity**, combined with increasing traffic, leads to unsafe situations
- **1.35m people lose their lives in traffic accidents** worldwide every year
- **50 million road users are injured** every year
- **Traffic fatalities** could **reduce GDP** by up to 5%
- **Reducing traffic fatalities could increase GDP by 22%** over two decades

LOSING LIVES BECAUSE OF TRAFFIC

- **22,700 lives were lost in the EU in 2019**, with a further 1.2m road users injured
- More than **20% of the fatalities were pedestrians**
- **Romania had 9.6 traffic fatalities per 100,000 population** (highest rate in the EU)
- **Norway has the lowest fatality rate** with only 2 per 100,000 road fatalities
- **City planners and authorities** should continually look to minimize accidents and fatalities

CURRENT LIMITATIONS TO PROTECT VULNERABLE ROAD USERS

- Infrastructure not always supporting **VRU leading to social exclusion**
- VRU's **need large portion of intersection** capacity
- Focus is on **managing motorized traffic**
- **Limited space** for all travelers to share
- **Limited information** to support VRU's
- **Lack of integration** of detectors for cyclists, pedestrians & e-scooters

INCREASING SAFETY FOR VULNERABLE ROAD USERS
THE SOLUTION

DATA COLLECTION

Sensors:
TRAFFIC EVENT DATA

+

Eco-system of mobility
e.g. **APPS, FLOATING CAR DATA**

MODERN MOBILITY MANAGEMENT SYSTEM

- **Dynamically grows with emerging needs** & technologies
- **Compose your ideal system** via software modules
- **Re-use of assets** in new solutions
- **Integrations on a micro, macro & cross-domain level**
- **Open platform** preventing vendor lock-ins
- All operated via a **single platform**
- **Urban Mobility Eco-System**

Cybersecurity team

PROCESSING & STORAGE

DATA VISUALIZATION

ACTIONS

WARNINGS & ALERTS
- Warn about dangerous situations via digital signs
- Warn drivers about VRUs e.g., cyclist in dead angle directly on car dashboard or app

ADAPTIVE TRAFFIC CONTROL
- Traffic management based on detection of VRUs, e.g. bicycle and e-scooter detection from distance to limit red light negation
- Re-route trucks from city centers by providing priority at main corridors

PRIORITY
- EV priority (limiting travel time)
- PT priority (increasing attractivity)
- *VRU priority*

LACK OF SKILLED RESOURCES
THE PROBLEM

- **25% of road fatalities,** and roughly 50% of traffic related injuries, occur at intersections
- **Signal phases**: only updated every 3-5 years
- **Manual analysis and strategy development** is not cost-efficient
- **Lack of engineering:** There are too few engineers to complete large-scale investments of local, national and international importance

TRANSPORTATION DEPARTMENT LEFT AS SCAPEGOAT

- **Citizens complain,** but manual analyses and strategy developments take too much time
- **Lack of proactivity** and deep understanding
- **Too few people** for constant monitoring
- **Connected eco-system** introduces new requirements
- **Increased complexity** including privacy and security

CURRENT TOOLS DO NOT SUPPORT TODAY'S NEEDS

- **In-depth analysis** missing from central traffic management systems
- **Lots of maintenance required**
- **Slow response time** when immediate action is required, such as equipment failure or unexpected events like an accident or flooding
- Current practices for many cities **rely on manual techniques**

LACK OF SKILLED RESOURCES
THE SOLUTION

DATA COLLECTION
24/7

HIGH RESOLUTION EVENT DATA

+

Eco-system of mobility e.g. **APPS, IN-VEHICLE DATA**

+

Sensors: **ENVIRONMENTAL DATA**

PROCESSING & STORAGE

AUTOMATED ANALYSIS
E.g., quickly identify issues. This solution transforms the typical report-centric user experience by having the system **automatically monitor signal performance and engage the end-user when needed.**

ALERTS & NOTIFICATIONS
e.g., signal performance is bad

e.g., signal performance is superior

AUTOMATED IN-DEPTH ANALYSIS FOR IMPROVEMENT
e.g., where and why the operational quality is low

- Savings because of automated work
- Planning of resource
- Measuring of effectiveness of new technologies

ACTIONS

SIGNAL PLAN ADJUSTMENT
Change signal plan to automatically or manually improve the traffic flow.

RE-ROUTING TRAFFIC
e.g., re route all heavy vehicles from the city center.

SPEED ADJUSTMENT
e.g., slow down speed for cars entering the city center.

ENGINEERING
Engineering tools made by engineers. SWARCO also offers expert knowledge.

LACKING INTEROPERABILITY OF SYSTEMS

THE PROBLEM

- **The complexity of systems – over 1,200 standards** are relevant for the Future of Transport
- Road administrations and cities struggle with **static systems limiting connectivity**
- **Lack of integration** & risk of vendor lock-ins
- Existing solutions **difficult to adapt to new standards**
- Increasing need for **open platforms**
- Increased need for **cyber security expertise & resources**

ECO-SYSTEM REQUIRES CROSS-DOMAIN AND MULTI-VENDOR SOLUTIONS

- **Interurban & urban travels are not connected** and therefore treated as siloed topics
- **Switching between systems or not being able to share or access data** creates not only inefficient traffic flows but also disrupts safety on roads
- **Lack of understanding of journey times & vehicle types** creates congestion and puts travelers at risk

CURRENT TOOLS DO NOT SUPPORT TODAY'S NEEDS

- **Lack of technology connecting all aspects** of tunnel, highway & urban traffic management
  - **E.g., travel times, vehicle types**
  - **System connected with the facility management system (FMS)** including fire detection, electrical control, light control and ventilation control
- **Lack of ability to make sustainable decisions**, to innovate in a specific area without needing to change the environment

LACKING INTEROPERABILITY OF SYSTEMS
THE SOLUTION

DATA COLLECTION

24/7

HIGH RESOLUTION EVENT DATA

Common technology platform incl. cross-domain applications

Connected with the INFRASTRUCTURE & ASSET MANAGEMENT SYSTEM

MODERN MOBILITY MANAGEMENT SYSTEM

- **Mobility Eco-System** Urban & Interurban combined
- **Dynamically grows with emerging needs** & technologies
- **Compose your ideal system** via software modules
- **Re-use of assets** in new solutions
- **Integrations on a micro, macro & cross-domain level**
- **Open platform** preventing vendor lock-ins
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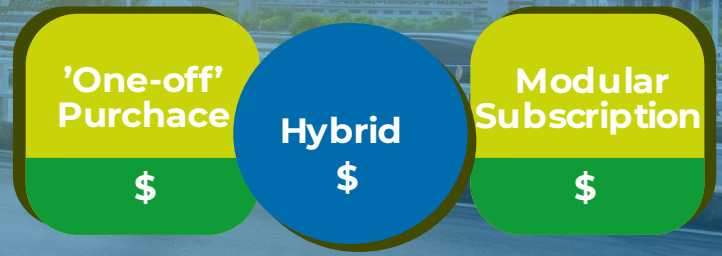
PROCESSING & STORAGE

Cybersecurity team

CONNECT INTERURBAN, URBAN & PARKING EXPERIENCE

- E.g., in case of an incident on a ring road or tunnel, the SWARCO system recommends re-routing information on VMS based on real-time traffic information in the city. Provide park & ride recommendations via VMS or App to the road user.

INCLUSIVE PRICING MODELS



FROM SILOED TRAFFIC MANAGEMENT TO INTERMODAL APPROACH / MaaS

- Data fusion (e.g., detection and FCD)
- CCAM use cases
- Comms network
- Analytics
- Asset management
- Predictive maintenance

TRAFFIC CONGESTION IN INTERURBAN AREAS

THE PROBLEM

- **In 2018, there were more than 1,528,000 km of traffic jams** and 457,000 hours wasted on the German motorways
- **Every lost hour** is equivalent to about 15 € social costs **adding up to many millions per year**
- Congestion can occur due to **accidents, breakdowns, road works, etc**.
- **Road authority policies are becoming more complex** as a result of the changing state of daily traffic and the long-term increases in vehicle numbers

NEED TO OPTIMIZE THE SPACE FOR OUR FUTURE

- More than **50% of freight transport occurs by road**
- The average annual **distance traveled by car is about 11,300 km**
- **Building more roads** will lead to an **increase in traffic**
- Every year more than **3 million cars are added to the existing car fleet in Europe** alone

CURRENT LIMITATIONS TO REDUCING CONGESTION

- **Limited space**
- **A shortfall** in the number of **open platforms**
- **Outdated** traffic management systems
- Little **integration and connectivity**
- **Siloed systems** limiting the holistic view
- **A shortage of proactive** mobility management
- **Lack of adaptivity** in a suitable level of granularity

TRAFFIC CONGESTION IN INTERURBAN AREAS
THE SOLUTION

DATA COLLECTION

HIGH RESOLUTION REAL-TIME TRAFFIC DATA

+

DATA FUSION & ANALYZING
Eco-system of mobility e.g.
FCD, IN-VEHICLE DATA

+

Connected with the INFRASTRUCTURE & ASSET MANAGEMENT SYSTEM

PROCESSING & STORAGE

Real-time traffic monitoring and control

ALERTS & NOTIFICATIONS in case of any equipment failure

REPORTING TO ANALYZE IMPROVEMENTS

ACTIONS

AUTOMATED, SEMI-AUTOMATED & MANUAL CONTROL

RE-ROUTE & INFORM
E.g., steer traffic away from congested areas, guide drivers concerning closed lanes, upcoming road works or accidents.

SPEED HARMONISATION
Adjust the speed limit to ensure an optimized traffic flow along critical corridors.

DYNAMIC TRAFFIC CONTROL
Evaluate controls based on current standards, traffic-actuated controls, upload data to controllers directly or remotely and evaluate real-time data.

INCREASING SAFETY FOR ROAD USER ON HIGHWAYS & IN TUNNELS

THE PROBLEM

- **Limited road capacity**, combined with increasing traffic, leads to unsafe situations
- **1.35m people lose their lives in traffic accidents** worldwide every year
- **50 million road users are injured** every year
- **Road fatalities** could **reduce GDP** by up to 5%
- **Reducing road fatalities could increase GDP by 22%** over two decades

LOSING LIVES BECAUSE OF TRAFFIC

- **22,700 lives were lost in the EU in 2019**, with a further 1.2m road users injured
- Nearly **50% of fatalities were drivers** and passengers in cars
- EU to set goals to **halve road deaths by 2030** & to have **zero road deaths by 2050**
- **In 2020, road work accidents have risen by 10%**
- In 2020, there were more than **15,000 traffic accidents on German motorways**

ROAD WORKS AND ACCIDENTS

- More than two Americans die every day due to highway work zones & 200,000 were injured in the past five years
- 85% of the fatalities in the work zones concern motorists
- The number of fatalities in tunnels is 1.5 times higher than on an open highway
- Safety systems are needed to detect possible hazards or incidents in tunnels

INCREASING SAFETY FOR ROAD USER ON HIGHWAYS & IN TUNNELS

THE SOLUTION

Cybersecurity team

DATA COLLECTION

HIGH RESOLUTION REAL-TIME DATA

+

DATA FUSION & ANALYSIS
Eco-system of Mobility e.g.
AID, IN-VEHICLE DATA

+

Connected with the
INFRASTRUCTURE & ASSET MANAGEMENT SYSTEM

PROCESSING & STORAGE

MODERN MOBILITY MANAGEMENT SYSTEM

- **Mobility Eco-System**
  Urban & Interurban combined
- **Dynamically grows with emerging needs** & technologies
- **Compose your ideal system** via software modules
- **Re-use of assets** in new solutions
- **Integrations on a micro, macro & cross-domain level**
- **Open platform** preventing vendor lock-ins
- All operated via a **single platform**

REAL-TIME INCIDENT DETECTION

ACTIONS

AUTOMATED, SEMI-AUTOMATED & MANUAL CONTROL

WARNINGS & ALERTS

- Warn about dangerous situations via digital signs
- Warn drivers about upcoming road works on the dashboard or via digital signs
- Reduce speed around road works
- Close lanes, roads, and tunnels in case of incidents

DYNAMIC TRAFFIC CONTROL

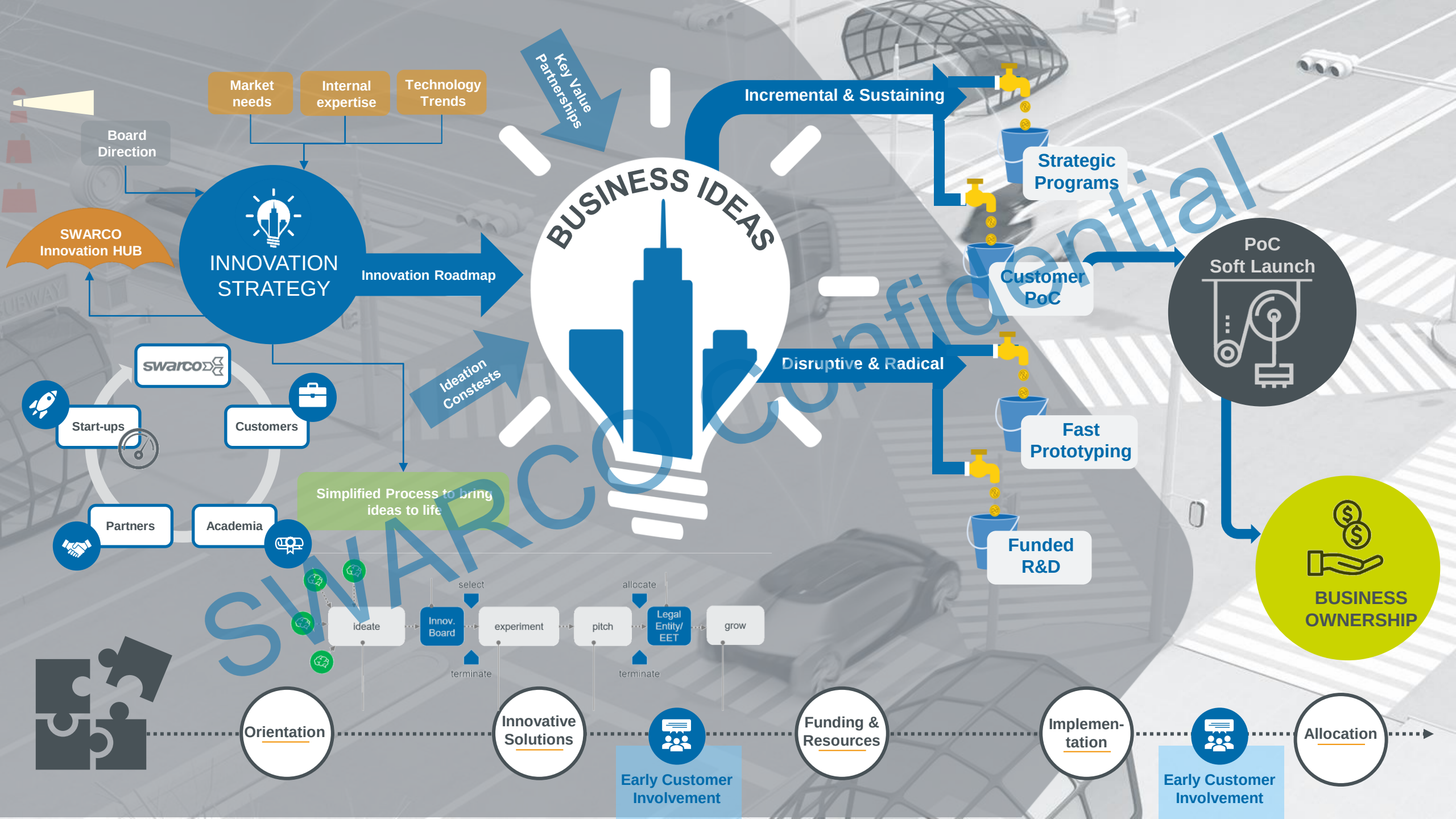
- Convey to road users on highways and in tunnels dynamic information in line with the current traffic situation.

WEIGH-IN-MOTION

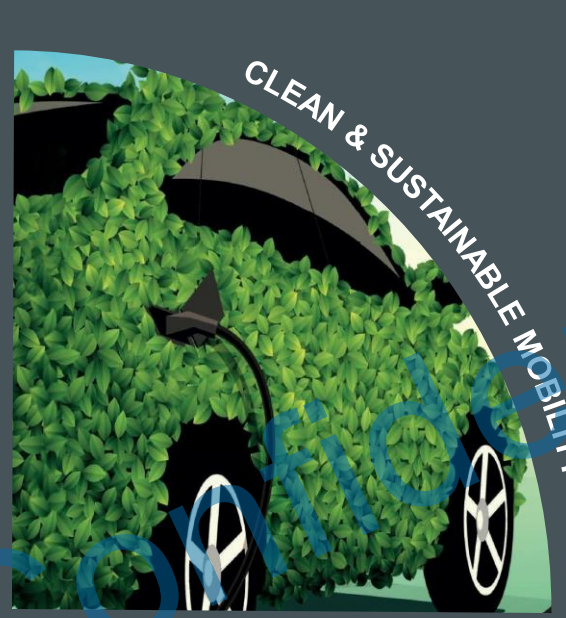
- Weigh passing trucks on the highway to preselect vehicles with overloads.

AGENDA

1. *Our vision*
2. *Tackling 21st Century Challenges*
3. *Global Portfolio – at a glance*
4. *It's all about addressing pain points*
5. ***Building the future***


Market needs
Internal expertise
Technology Trends
Key Value Partnerships
Board Direction
SWARCO Innovation HUB
INNOVATION STRATEGY
Innovation Roadmap
BUSINESS IDEAS
Incremental & Sustaining
Disruptive & Radical
Strategic Programs
Customer PoC
Fast Prototyping
Funded R&D
PoC Soft Launch
BUSINESS OWNERSHIP
Ideation Constests
Simplified Process to bring ideas to life
swarco
Start-ups
Customers
Partners
Academia
ideate
select
Innov. Board
terminate
experiment
pitch
allocate
Legal Entity/ EET
terminate
grow
Orientation
Innovative Solutions
Early Customer Involvement
Funding & Resources
Implemen-tation
Early Customer Involvement
Allocation
SWARCO Confidential

Safety and efficiency of all road users through C-ITS applications as well as support features towards road automation



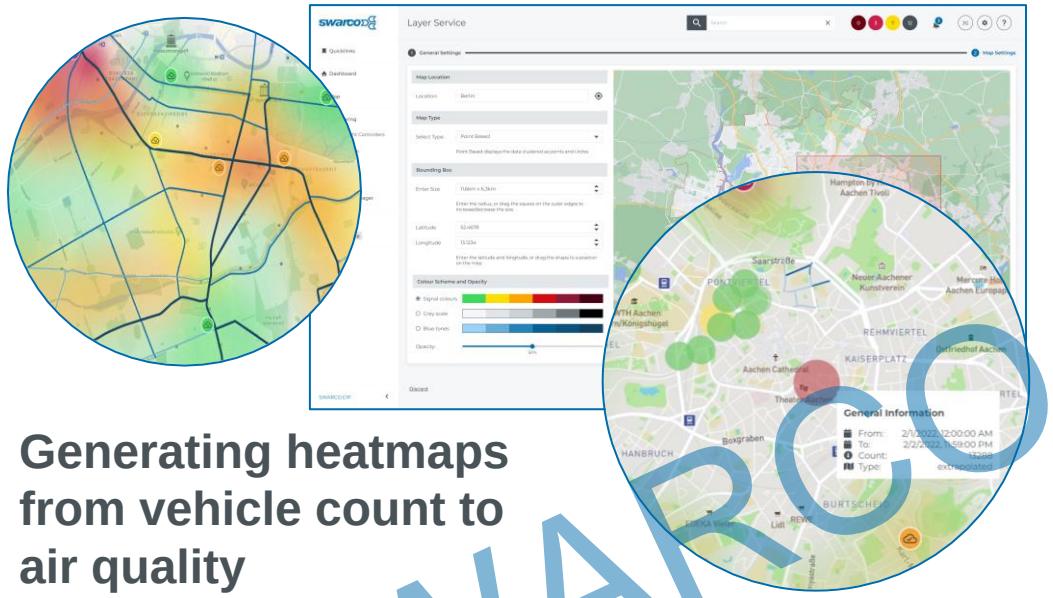
Solutions for **improving air quality**

Strategy manager evolution towards interaction, multimodality and decision-support

Solutions for enhancing the **comfort and safety for bikes, pedestrians and e-scooters**

FAST PROTOTYPING PROJECTS: 2022 (1/2)

Heatmap Service Layer



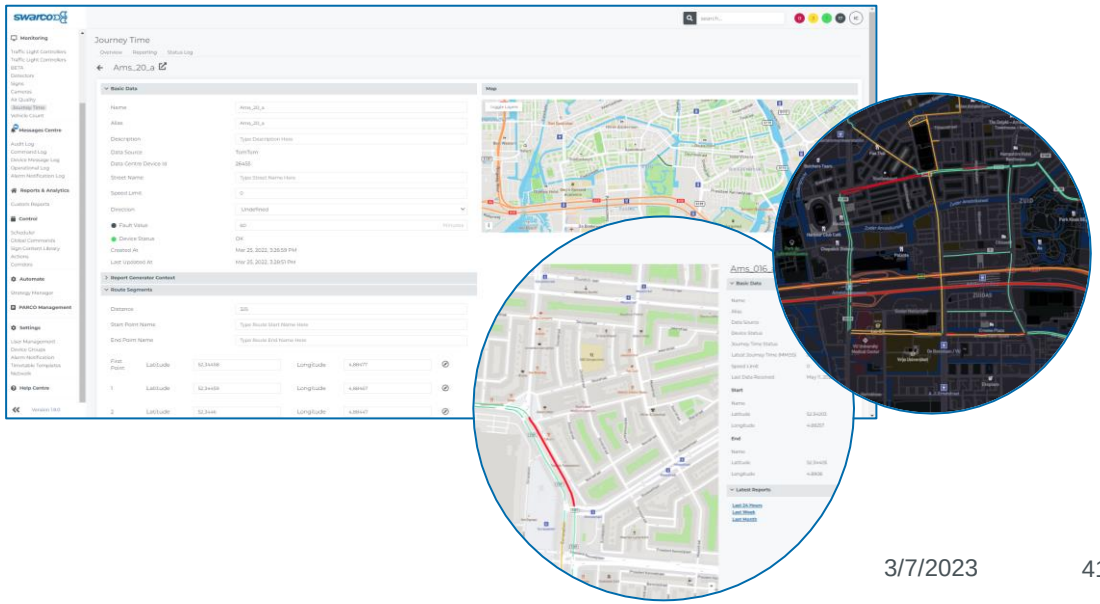
Generating heatmaps from vehicle count to air quality

- 3 types of visualization: Point, Polyline and Area based
- Plug and play approach: integration of different data sources
- Extrapolation of data: wider overview of the area through forecasting

TomTom Traffic Data Integration

Integrating Floating Car Data

- Visualization of travel time data on desired routes: wider network access
- Integration to Strategy Manager: defining scenarios to trigger control measures



FAST PROTOTYPING PROJECTS: 2022 (2/2)

Delivery Robots Integration

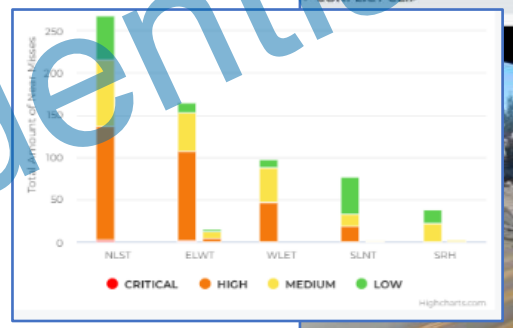
Starship Delivery Robots

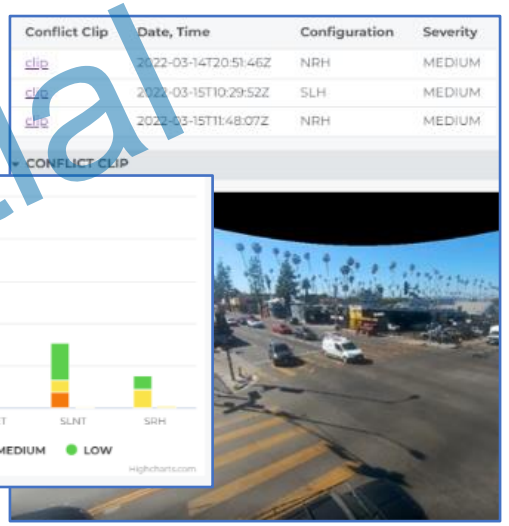
- Concept, last mile delivery services in Towns, Cities or Campuses

Automatic Pedestrain Crossing Request

- Developments in the city of Espoo to provide pedestrian crossing request for Starship robots
- UK development for the city of Leeds to provide pedestrian crossing request
- Future use cases discussed for deeper robot integration with urban mobility services

Intersection Safety Risk Analysis

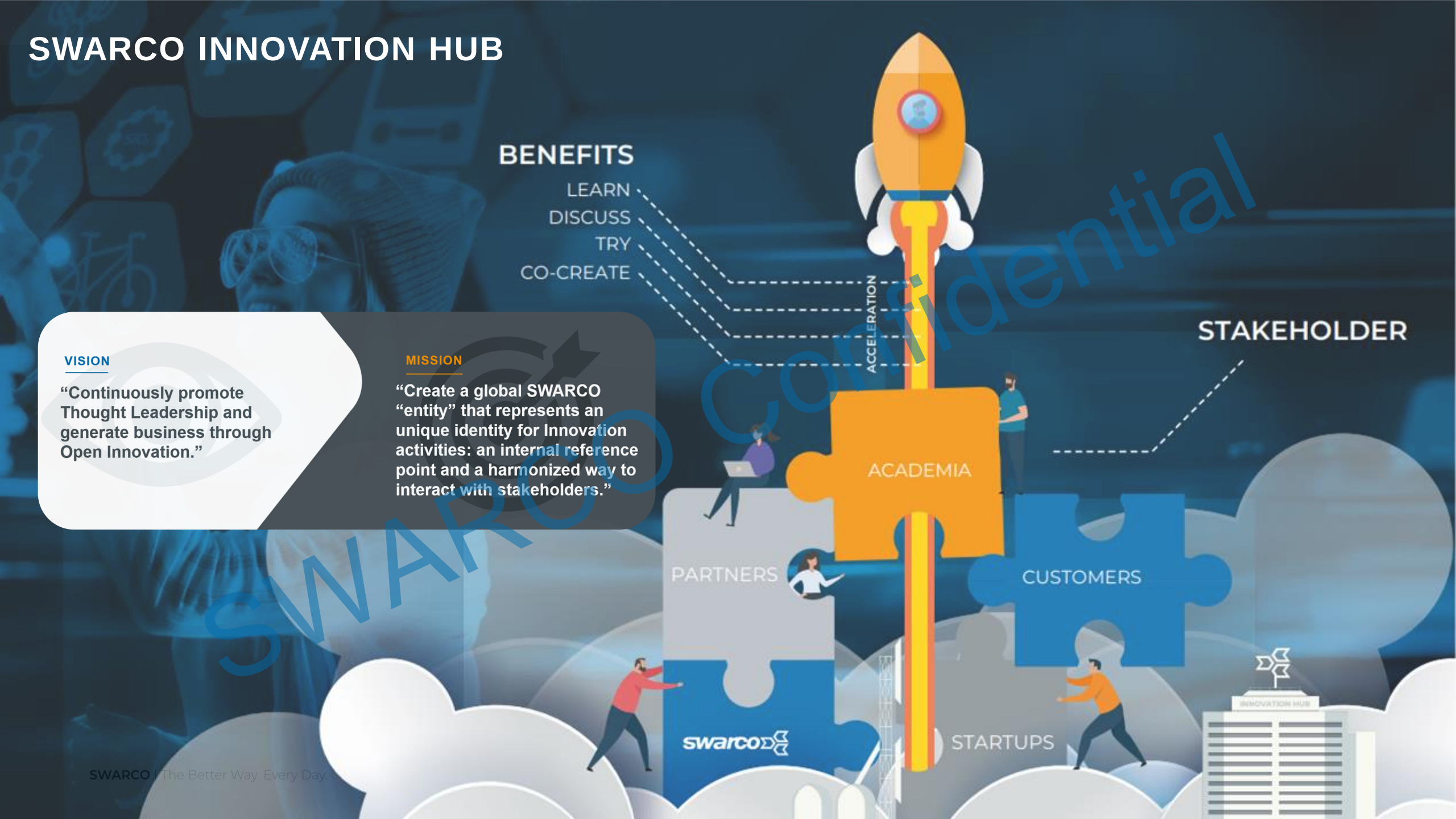




Near Miss Risk Analysis

- Uploaded CCTV processed data integration
- Location visualisation of near miss data
- Severity split of near miss data (Trajectory/Kenetic)
- Modal spit of near miss (Car/Car Ped/Car Bike/Car)
- Intersection configuration chart of near miss data
- Post Intervention analysis and comparison
- CCTV near miss clip library
- Future edge processd data use cases (notifications, alarms, strategy deployment)

SWARCO INNOVATION HUB



VISION

"Continuously promote Thought Leadership and generate business through Open Innovation."

MISSION

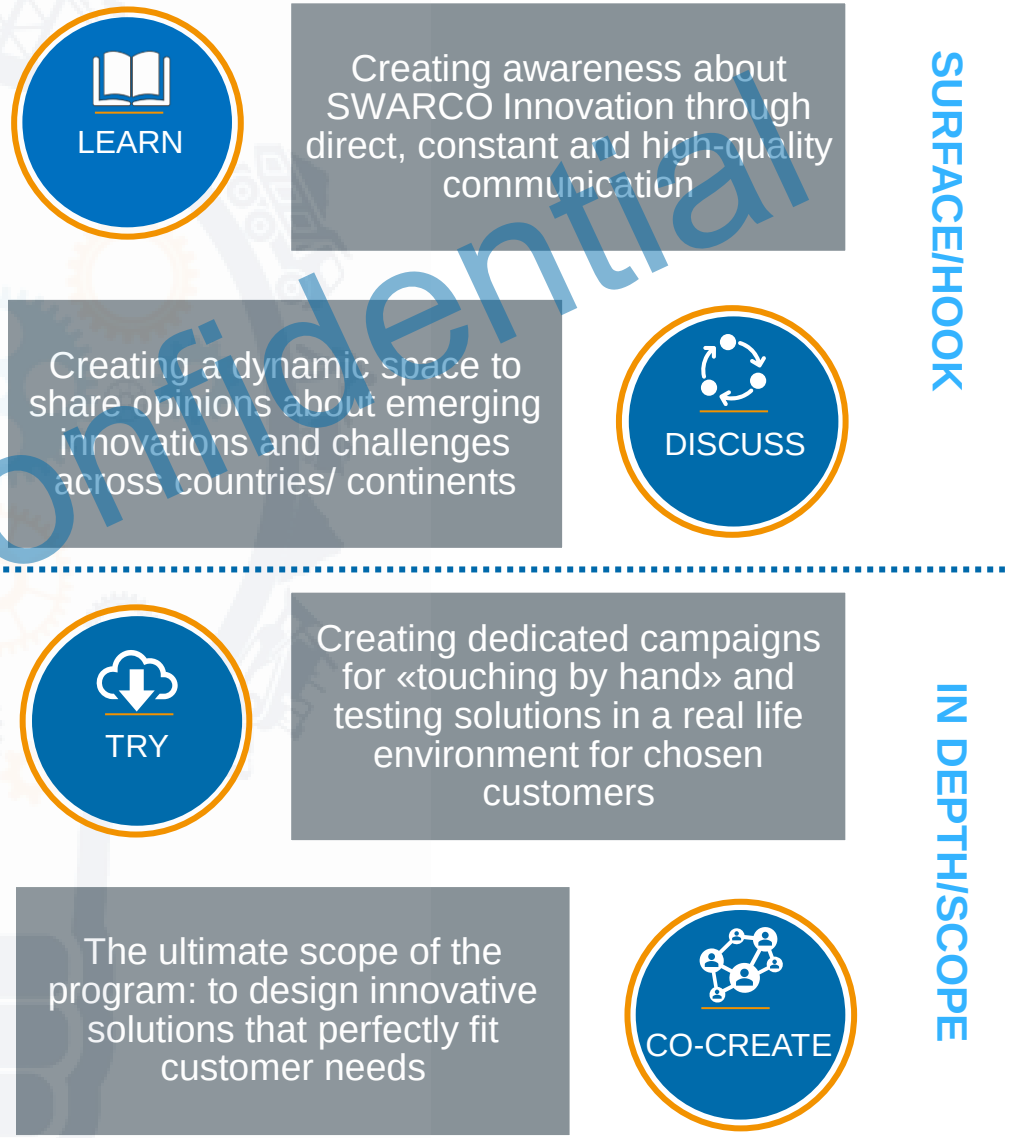
"Create a global SWARCO "entity" that represents an unique identity for Innovation activities: an internal reference point and a harmonized way to interact with stakeholders."

LIGHTHOUSE CUSTOMERS PROGRAM
BASIC CONCEPT

WHAT DO WE AIM?

- Combine information-based and interaction-based approach
- Balance between **Future Vision** and **Practical** innovation
- Promote **Innovation Roadshows** in coordination with local Business Development
- Continuous customer connection and get **early feedback** on new ideas
- Ultimately, Call our customers “To Action” **for co-creation**

Interested to be a lighthouse customer? Contact Klaus to learn more about it: klaus.pollhammer@swarco.com



Thank you for your attention!

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