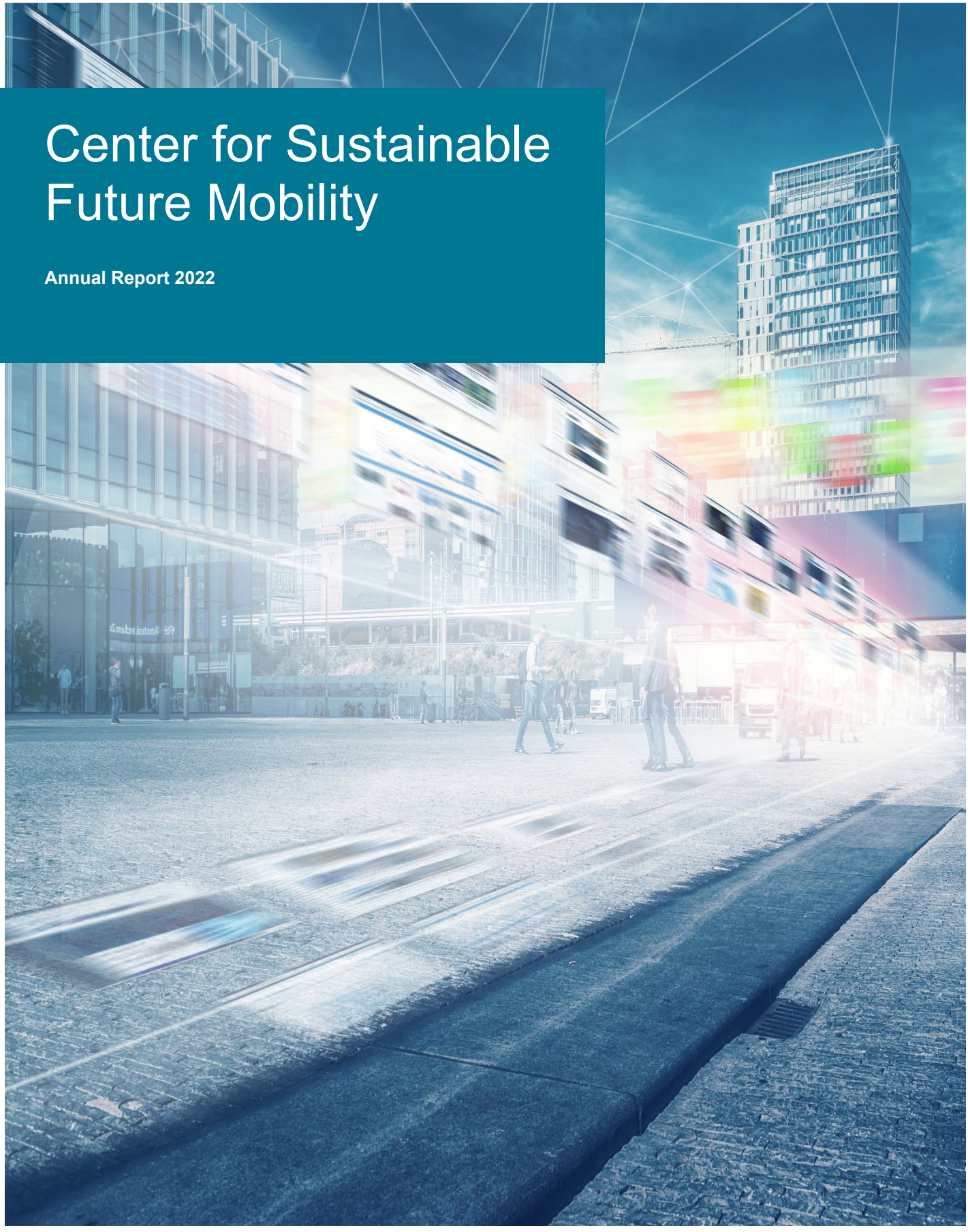
ETH zürich

Center for Sustainable
Future Mobility

Center for Sustainable Future Mobility

Annual Report 2022



CSFM

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Introduction

The mobility sector is of paramount importance for a modern society. Economic and societal well-being relies heavily on safe, reliable, affordable, high-capacity and clean transport infrastructure for the efficient movement of people and goods at a local/regional, national, and global scale.

However, in Switzerland mobility accounts for about 40% of the domestic GHG emissions and 48% of CO_2 emissions. This means that a radical overhaul in terms of energy sources, infrastructure and assets, management and planning systems will be indispensable for maximizing efficiency and achieving sustainability. The required transformation must be accomplished within about 30 years and will affect all Swiss households, industries, and local authorities. It will also have profound impacts on the Swiss energy system and on the import and export flow of goods and services.

In this context, the decarbonization of the transport system is a key goal to which the research activities should contribute significantly. Following the targets of the Paris Agreement and the Swiss Federal Council, a fast transition towards virtually zero GHG emissions is necessary.

Within this context, we started last year our path towards establishing a competence center within the ETH Domain that aspires to become a reference in the field: A reference in the broad scope and variety of research topics that interconnects, as well as in the resulting broad perspective on considering different aspects of sustainable future mobility. A reference also in the close collaboration with our current industry partners: SBB, AMAG, and Siemens Mobility and hopefully others in the future. The Center has been hosting the ETH Mobility Initiative since 2021 and has contributed to launching six new projects in the field of sustainable future mobility research in cooperation with the industry partners. Finally, the center aims at connecting the relevant stakeholders as well as establishing and maintaining a dialogue with the related centers and institutions.

We are aware of the challenging tasks ahead, but we also have a productive year behind us, and this is what we want to share with you. The management office is always happy to receive suggestions, ideas, and feedback for the center, so please do not hesitate to contact us!

Prof. Kay W. Axhausen
Chair

Dr Gloria Romera
Managing Director

1 CSFM Mission and Strategy

1.1 A center for interdisciplinary research on sustainable mobility at ETH Zurich

The Center for Sustainable Future Mobility (CSFM) consolidates and coordinates research efforts of about 40 research groups within ETH Zurich, Empa, and PSI. The center contributes to addressing the grand challenges of the transport sector and to deliver research-based solutions for the design and implementation of sustainable transport systems which will be safe, reliable, fast, socially desirable, environmentally friendly, and cost-efficient. In particular, the decarbonization of the transport system is a key goal to which the research activities should contribute significantly.

The mission

The Center for Sustainable Future Mobility (CSFM) aims at creating an internationally highly visible hub for research, education, and knowledge transfer towards the implementation of a sustainable mobility system in interaction with the Swiss industry and government/policymakers.

It represents a joint effort of about 40 ETH Zurich Chairs who committed to join forces internally and with other relevant institutions, such as stakeholders from business, society, and public administration. For that, the center builds on the strategic partnership established in 2018 with SBB followed by Siemens and AMAG.

Strategy

The CSFM's thematic scope extends beyond multidisciplinarity to a cross-sectoral functionality, exploiting innovation potentials across all modes and services (road, rail, air, waterborne, low-speed, non-motorized, etc.). Transferring insights, models, and methods from one sector/mode/service to the other and using synergy potentials whenever meaningful, can be a powerful tool for global system improvement.

Research on new vehicles and energy carriers as well as the required infrastructure is critical to achieve a more sustainable transportation system and reduce emissions. The increased digitalization of modern society as well as the potential automatization of vehicles represent an opportunity to increase the efficiency of the system, for example facilitating Mobility as a Service solutions. However, it also represents a risk in terms of inducing a higher transportation demand. The way cities and spaces are designed and built also influences the demand side. Research to understand the transportation demand is therefore needed as well. Finally, transportation is a complex system with multiple interactions between all related socio-economic and policy factors. This represents the complex research field in which the Center wants to define its operation as in the diagram to the right.

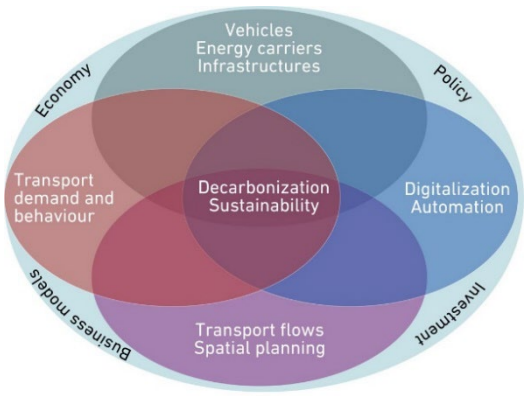


Figure 1: Representation of the CSFM research areas

1.2 Organizational Structure

The governing bodies of the CSFM are the General Assembly, the Steering Committee, and the Managing Office.

1.2.1 General Assemby

The General Assembly is the supreme body of CSFM. It is currently composed of 38 members from 8 different ETH departments as well as of groups from Empa and PSI.

Founding General Assembly
The Founding General Assembly took place on July 7, 2021, just after the positive recommendation of the ETH Research Foundation and the provisional approval of the Center by the ETH Executive Board. The main output of the first assembly was the election of the Steering Committee and the ratification of the membership fee.

The 1st General Assembly took place in March 2022. On this occasion two new members joined the CSFM.

New members in 2022

The CSFM welcomes two new members in 2022:

Miriam Elser, Head of the Vehicle Systems Group at the Automotive Powertrain Technologies Laboratory (APTL), EMPA

The group focuses on reducing pollution and GHG emission from road vehicles. The team brings the following competence to the Center:

- measurements and modelling of vehicular emissions and energy consumption,
- analyses of the Swiss passenger vehicle fleet and its operation as well as
- investigations of sensor performance and the development of test procedures for autonomous vehicles

Fisher Yu, Visual Intelligence and Systems (VIS). Information Technology and Electrical Engineering Department, ETH Zurich

“Our group focuses on learning representations for object recognition and motion understanding in images and videos as well as building perceptual robotic and software systems based on the visual representations. Our team has developed influential algorithms, models, software, and datasets to push the scientific frontiers of fundamental computer vision problems and visual learning systems.”

1.2.2 Steering Committee

The Steering Committee is the operational governing body of the center. The members of the Steering Committee are elected by the general assembly for a period of four years. The Steering Committee appoints a chairperson and her/his deputy.

Prof. K. Axhausen

Traffic Planning
Transport Modelling (D-BAUG)
Chair

Prof. E. Frazzoli

Dynamic systems and control (D-MAVT)
Deputy Chair

Prof. M. Filippini

Energy & Public Economics (D-MTEC)

Prof. A. Patt

Climate Policy (D- USYS)

Prof. C. Onder

Institute for Dynamic Systems and Control (D-MAVT)

Prof. M. Raubal

Geoinformation Engineering (D-BAUG)

Prof. U. Grossner

Advanced Power Semiconductors (D-ITET)

Prof. T. Bernauer

International Environmental Policy (D-GESS)

1.2.3 Partnership Council

In 2018, ETH Zurich launched the ETH Mobility Initiative together with the Swiss Federal Railways (SBB) as first partner, followed by Siemens joining in 2019 and AMAG Group AG in 2020 to further expand research and education in mobility. These remain strategic partners of the Center for Sustainable Future Mobility. Additional partners are expected to join soon.

The strategic long-term partners SBB, Siemens, and AMAG together with most relevant private donors constitute the Partnership Council. The Partnership Council gathers twice a year to engage in a strategic dialogue with the Steering Committee. In particular, it is one of the central competences of the Partnership Council to approve the thematic scope of the yearly calls of the Mobility Initiative program.

1.2.4 Management Office

The Management Office of the Center has been established in September 2021 at the UNO building (Universitätstrasse 41, 8092 Zürich), centrally located as well as strategically connected to the interdepartmental ISTP currently led by Tobias Schmidt.

Gloria Romera has been appointed as the Managing Director of the Center. She brings several years of experience managing the Mobility Initiative since 2018, back then under the umbrella of the SCCER Mobility.

Patrick Scherer is the web-master and and regularly updates the web page, the news channel, and the social media pages since September 2021.

Uta Fink joined the team in February 2022 to support the Management Office in all administrative and organizational processes.

Jascha Grübel joined in July 2022 to initiate the project «Digital Twin of the Swiss Mobility System". The idea of this integrative project is to generate a platform of mobility data to support research projects of the different CSFM research groups.

2 Research

2.1 Mobility Initiative Program

2.1.1 Projects approved in 2022

The Future Mobility program is a long-term research program focusing on finding solutions that address the needs regarding decarbonization, digitalization, and infrastructure development in the coming decades. Projects approved under this framework provide a unique opportunity for close collaboration with the Mobility Initiative industry partners, which are AMAG, SBB, and Siemens. The following projects were approved and will be starting soon.

Socio-technical interaction in high-risk environments (ExplainAI, G. Grote**)**

Machine-learning-based systems should be ready for collaboration and accountability. The project addresses the challenge of designing explainable AI within an overarching design framework for socio-technical integration based on the concept of networks of accountability. This approach outlines the interdependencies created between technology developers, organizational and individual users, and regulators in automaton-supported decision-making. The project will be carried out with SBB and Siemens as partners, focusing on solutions for application domains in traffic control and operations, inspections, and predictive maintenance.

Smart logistics on wheels and legs (MILE, M. Hutter)

A wheel-legged robot being developed by the Robotic Systems Lab at ETH Zurich has the potential to outperform traditional delivery because it can carry a payload of up to 70 kg over long distances efficiently and fast while overcoming challenging obstacles. This project aims at expanding the localization and trajectory planning capabilities of the robot as well as providing opportunities for testing and evaluating the robot's performance in a real application.

Digitally supported maintenance (OptXR, B. Adey, M. Pollefeys)

Rolling stock is crucial for on-time rail service. With secure and punctual maintenance processes this quality aspect can be achieved and improved, thanks to the application of digital twins in combination

with extended reality. Optimized and rationalized maintenance processes will be beneficial to the appropriate industry partners, mainly to SBB.

Automatic detection of de-energized overhead lines (Pythia, J. Biela)

A new automated system should detect changes in the electric field around the overhead lines in front of a locomotive during operation. If the system detects non-electrified track sections, it will lower the pantograph automatically. This, eventually, decreases damage which is normally caused by faulty operation of the pantograph. A sensor system enabling this technology is still missing and will be addressed in this project.

Safekeeping SBB rail services, in winter-gaps too (RESAIL, T. H. Demiray)

The “winter gap” is the anticipated lower availability of energy in Switzerland during winter in future energy systems dominated by renewable sources and it represents a risk for the reliable operation of trains. In this project different options to optimize the electricity consumption of SBB will be investigated in a “sector coupled” approach that consider the synergies among possible energy carriers (electricity, hydrogen, synthetic fuels) and the competing energy demand sectors (e.g., electricity demand of SBB and heat demand of a city).

Strategic interactions-of-mobility offers in different regions (Interactions-Mobility, E. Frazzoli)

This project aims to investigate how mobility services could be combined and integrated flawlessly in different regions. The project will provide theoretical and algorithmic tools to solve the present problems. The methods will be implemented by extending existing simulation tools, and real-world case studies will be targeted to evaluate future Swiss scenarios, designed by experts. Ideally, a better understanding of how to optimize different and overlapping mobility services could be achieved by this project.

2.1.2 Projects finalized in this reporting period

Empirical use and Impact analysis of MaaS (Call2 – 2019, M. Raubal, K. W. Axhausen)

This project was designed around the launch of yumuv, a new MaaS product offered by SBB and PT providers in Basel, Berne, and Zurich. The two main goals of the project were to investigate how bundles impact human mobility behavior and how to create machine learning applications tailored to the needs of such novel mobility applications, notably the possibility of combining many different data sources while being memory and computationally efficient.

In order to answer these questions, the team collected empirical data in a 3-month tracking study with a total of 498 participants. The result of the tracking study is the largest empirical dataset on MaaS usage that was so far recorded. The main outcomes of this study are that the available MaaS bundle jointly increased the usage of e-scooters and public transport and that the effective sustainability of shared modes (especially e-scooters) strongly depends on the transport modes they replace. This research project was led by Professor Martin Raubal who is head of the Geoinformation Engineering group at the Institute of Cartography and Geoinformation at ETH Zurich. The usage analysis and the sustainability of e-scooters was performed by Daniel Reck from ETH Zurich's Institute for Transport Planning and Systems, led by Professor Kay Axhausen.

Vision-based localization and mapping for high-precision positioning of trains with on-board sensing (Call 1- 2018, R. Siegwart, M. Chli)

This project aimed at finding an appropriate and feasible sensor setup to resolve issues with respect to temporal synchronization and to enable unified data collection in general. Amongst the works that resulted from this phase the VersaVIS - An Open Versatile Multi-Camera Visual-Inertial Sensor Suite and CalQNet - Detection of Calibration Quality for Life-Long Stereo Camera Setups as well as the Unified Data Collection for Visual-Inertial Calibration via Deep Reinforcement Learning should be highlighted.

The implementation and investigation of suitable visual-aided odometry pipelines, focusing on the chosen sensing modalities from the first milestone as well as the specifics of on-board train environments. Finally, the project targeted the (re-)localization within partially (or fully) known path-constrained environments with direct applicability to localization aboard trains. Algorithms and data sets resulting of the project have been published and can be accessed for further development or utilization.

Smart Rail 4.0 (Fast Track -2018, F. Corman)

The railway system needs to increase its capacity to match the ambitious targets set at plus 20 to 30%. Punctuality, travel time, and customer satisfaction should be kept at the same level or even increased for the system to remain attractive. At the same time, the costs of the railway system must be significantly reduced to remain competitive compared with the street. Having more trains in an infrastructure can only degrade its performanc if the traffic is not properly controlled and delay propagation is proactively limited and avoided

Traffic Management Systems (in an academic setting) solve this problem currently by computing a solution to complex optimization problems in the form of Mixed Integer Linear programs, which determine feasible, conflict free performing solutions for rail traffic. This project aimed at studying from an academic and practical point of view three clear points which currently hinder large-scale application and practical implementation of TMS, namely setup in a closed loop with state estimation, prediction, computation speed, and scalability to large instances. This project achieved the design and implementation of a mathematical optimization approach able to solve faster and larger instances. The work has been published and internationally acknowledged. Additionally, the algorithms for statistical learning and recurrent solutions have been even further developed. The project funded by the Mobility Initiative concluded in October this year. Two ongoing PhD projects will expand the work performed within this research by developing further aspects identified within the Smart Rail 4.0 project.

High-Performant Mobility Simulation on a National Scale (Fast–Track – 2018, K. W. Axhausen, F. Alonso**)**

In the last decade, agent-based microsimulation of travel and traffic has become a viable alternative to the aggregate transport models, especially for analyses of pricing, autonomous vehicles, and of the dynamics of the underlying behaviors and the resulting systems dynamics. SBB already uses an agent-based simulation model in-house as part of the travel modelling system SIMBA. As SBB is one of the first transport corporations world-wide to use this advanced technology in its planning practice, additional research is required to make the simulation more performant and to obtain more robust results.

This project advanced considerably the simulation performance and robustness of the results of the agent-based simulation model adapted and used in real operation. The project used an interdisciplinary approach: The Systems Group (Höfler/Alonso) implemented MATSim using tools and languages developed for high performance computing and the matching data bases. The IVT group developed and advanced these tools to improve their effectiveness in the context of a public transportation company. The project resulted in the development and implementation of highly efficient software packages that the industrial partner can use in its operating activities.

RAIL - Robust machine learning for safety-critical systems: Practical robust detection of railway defects using AI (Call 3, M. Vechev)

This project applied, adapted, and extended state-of-the-art techniques from the area of adversarial machine learning to assess the robustness of a computer vision model used to identify railway defects. Martin Vechev's team collaborated with SBB teams involved in the computer vision model for finding railway defects, and Siemens Mobility, whose team has extensive experience in the domain of safety certification. In the considered case, the machine learning model takes as input an image of a rail segment and identifies the presence of defects (if any). Inspecting railways for such defects is a safety-critical task, which requires that the machine learning model reliably identifies defects even in the presence of pixel noise and geometric rotations caused by the camera.

2.2 Digital Twin of the Swiss mobility System

The "Digital Twin of the Swiss Mobility System" is an integrative project with the objective to generate a platform of mobility data to support research projects within the different CSFM research groups. Jascha Grübel, who is responsible of launching this project, joined the CSFM in July, and an advisory board was recently established to guide the development of this platform.

The project work will focus, in its first phase, on data acquisition for the Digital Twin. We are looking for publicly available datasets both on a recurring basis, such as government data on traffic, but also specialized collections that may have been performed in different research groups before. The goal of the Digital Twin is to enable joining all these datasets to gain new insights.

In the long term, we are also interested in expanding the Digital Twin's capacity for data processing, data modelling, and data visualization. With this effort, we aim to obtain a Digital Twin that allows for insights into the Swiss Mobility System in (near) real-time through integration of data sources. We also want to engage with local and federal institutions in order to maximize the (policy) impact and visibility of this digital twin. We envisage to expand the interaction and collaboration opportunities between CSFM members and beyond. The project should become one of the flagship projects of the center.

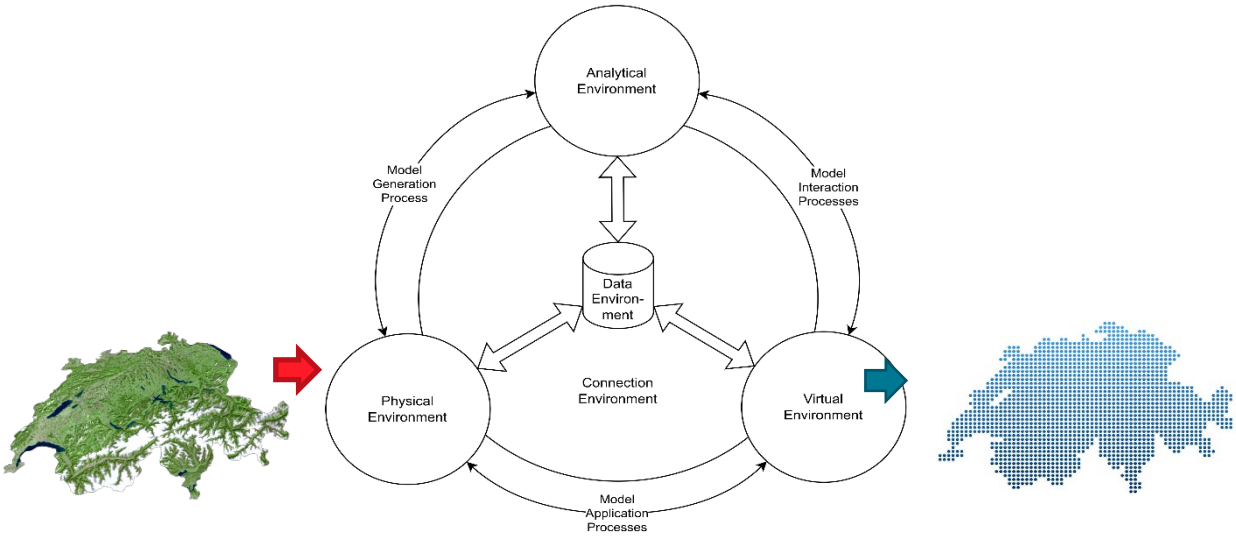


Figure 2: Schematic representation of the Digital Twin of the Swiss mobility system.

3 Communication and Outreach

3.1 Outreach and Networking Events

3.1.1 The CSFM Kick-off Symposium on 6 May 2022

The CSFM Kick-off Symposium took place on the 6th of May at ETH Zurich and hosted over 130 participants with the aim to present the new center to a wider audience, particularly to highlight the objective and progress of the Mobility Initiative research program, as well as to network the different members and partners.

The presentations by external guests and CSFM members, the panel discussion, as well as the poster sessions provided excellent opportunities to present latest research results and discussions.

Sonia Yeh (Professor at Chalmers University of Technology) discussed the challenges in modeling mobility and its associated energy demand. Particularly challenging are the different spatio-temporal scales used in the models and the need to combine those simulations in order to create a coherent system. The high uncertainty of mobility data in the baseline and the complex prediction due to insufficient projection theories impose further challenges.

Three ongoing projects within the framework of the ETH Mobility Initiative were highlighted:

- Eleni Chatzi presented the exploitation of on-board monitoring data to improve infrastructure performance. Combining data and physical models leads to improvement of predictability and system-understanding. Additionally, combining this information with complementary data and event classification through machine learning supports the planning of suitable interventions.
- The second project, presented by Francesco Corman, focuses on scheduling methods for automated railway timetabling, which is meant to improve the efficiency of the dense Swiss railway system by reducing capacity buffers. These advanced control systems have been already used on some tracks, however extending them to the complete system is a complex problem that ETH Zurich is addressing in cooperation with SBB.
- Martin Raubal presented the project Empirical Use and Impact Analysis of Mobility as a Service, an analysis of behavioral change induced by the deployment of new mobility services. In particular, the project addresses how mobility service bundles influence people's behavior, their transportation induced emissions, and how the data generated by those services can be handled appropriately in order to improve services and the understanding of transportation systems.

Harvey Miller (Professor at the Ohio State University) addressed the question, why sustainable mobility is so hard to achieve: The emphasis was not only on environmental and climate change issues, but also on social equity, safety, and economic sustainability aspects. All those make the transport system transformation an existential challenge ahead.

Cities are complex systems, and sometimes interventions have unintended effects. This is a wicked problem in the sense that conflicting values influence decision-making. This is also a collective social dilemma because individual rational decisions may have hideous collective outcomes. New data technology can be seen as the key to a new generation of tools which allow analyzing and optimizing of transportation systems and the shape of cities.

The perspective from the Mobility Initiative partners and how the cooperation with academia could help to address future challenges were presented by Dino Graf (AMAG), Heinz Brenner (Siemens Mobility), and Stephan Osterwald (SBB). Additionally, the keynote speakers together with Emilio Frazzoli (Professor at the Institute for Dynamic Systems and Control and deputy chairman of the CSFM) joined the discussion.

This last exchange closed this intense event with an overall impression that there is still a lot to do if we want to achieve sustainable mobility in the future. Nonetheless, the cooperation between industry partners and academia is giving the right impulse towards solving these complex challenges ahead.

3.1.2 CSFM Speed Talks: Research on Sustainable Mobility in 4 minutes

To leverage the presence of the visitors, Professor Sonia Yeh (Chalmers) and Professor Harvey Miller (Ohio State University), we organized an event dedicated to PhD students and postdocs willing to present their work to the CSFM community. This represented a great opportunity for PhD students to share their latest research and get feedback from the high-ranking visitors and also from the CSFM community.

The contributors had 4 minutes for their presentation, during which they were encouraged to present key ideas, hypotheses, results, and their meaning/implication.

- E-Bike City – An urban transformation for sustainable future? Lucas Ballo, IVT - Transport Planning, D-BAUG
- Simulation of cycling flows in Zurich, Adrian Meister, IVT - Transport Planning, D-BAUG
- Modeling work from home preferences while incorporating feasibility, Daniel Heimgartner, IVT-Transport Planning, D-BAUG
- Co-design and Coordination of Future Mobility Systems, Gioele Zardini, Dynamic Systems and Control, D-MAVT
- Managing Battery Lifetime in an Electric City Bus, Fabio Widmer, Dynamic Systems and Control, D-MAVT
- Intervention planning process of the SBB, Steven Chuo, Infrastructure Management, D-BAUG
- Estimating Railway Bridge Interventions for Specific Planning Periods Using Digital Support, Hamed Mehranfar, Infrastructure Management, D-BAUG
- Towards commercial solar thermochemical production of sustainable drop-in fuels, Vikas Patil, Renewable Energy Carriers, D-MAVT
- Decarbonization of lithium-ion batteries,Leopold Peiseler, Energy and Technology Policy / Materials and Device Engineering, D-GESS, D-ITET
- The Future of Freight: A roadmap for policy-makers to assess and support the low-carbon commercial road transport transition, Bessie Noll, Energy and Technology Policy Group (EPG), D-GESS
- Incentive-based traffic control targeting electric vehicles, Carlo Cenedese, Automatic Control Laboratory, D-ITET
- Road pricing preferences in Switzerland, Florian Lichtin, International Political Economy and Environmental Politics, D-GESS
- A research agenda for developing a (net-zero) goal-oriented transport planning research and practice, Lucas Meyer de Freitas, IVT - Transport Planning, D-BAUG

3.1.3 Mobility Initiative Workshop

The Center launched the 5th call of the Mobility Initiative on 5th of April 2022. The workshop brought together about 24 researchers and partners to discuss project ideas for the Mobility Initiative call for proposal. 16 project ideas were presented and discussed at this occasion.

The workshop connected the domain experts and the Mobility Initiative partners. A particular asset of the workshop is that it allows to explore potential synergies between ideas proposed by different partners.

3.1.4 ISTP Colloquia in cooperation with CSFM:

Tradable performance standards (TPS) – insights from real-world applications in the transportation sector, Prof. Dr. Sonia Yeh.
During the semester, the Institute of Science, Technology and Policy regularly holds colloquia talks with presentations by invited guest speakers from academia and practice/policy. The series is open to the public. On May 4th 2022, CSFM co-organized the ISTP Colloquia on this very relevant topic for both communities.

3.2 Communication Measures

in November 2021, the CSFM launched a dedicated webpage that includes a repository of Mobility Initiative and CSFM projects. The webpage is also the main vehicle to disseminate the Mobility Initiative call for proposals, news, and events of the CSFM. We regularly post news and achievements of the CSFM members and partners.

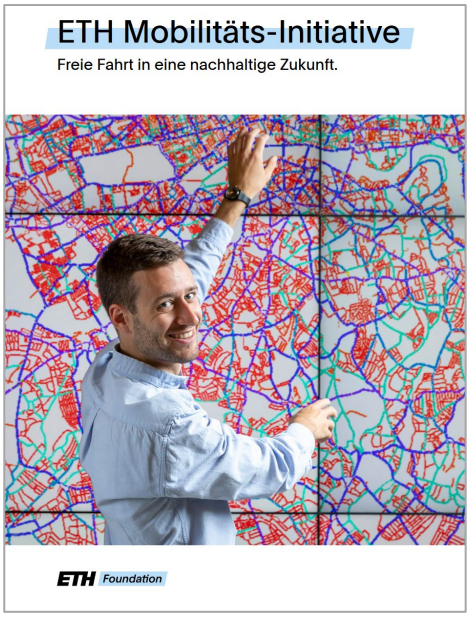
The published CSFM news so far mainly related to the launch of the Center and the approval or completion of Mobility Initiative projects, see examples below.

- Interview with the CSFM Chairman in the ETH News: https://csfm.ethz.ch/en/outreach/whats-on/2022/05/its-important-to-factor-in-how-people-feel.html
- To what extent is MaaS changing travel behavior? ETH Zurich together with SBB addressed the issue in a project funded by the ETH MobilityInitiative. https://csfm.ethz.ch/en/outreach/whats-on/2022/11/maas-changing-travel-behavior.html

We also communicate news and announce events via LinkedIn and Twitter channels.

The Management Office contributed and supported the ETH Foundation to edit the Mobility Initiative impact report available in German and English, which also highlights the establishment of the Center for Sustainable Future Mobility.

https://ethz-foundation.ch/wp-content/uploads/de-wirkungsbericht-mobilitaet-web-ds-klein2.pdf



4 Outlook

Events and outreach

We plan a symposium also in 2023. It will include a general session dedicated to establishing a dialogue between the members of the CSFM and different stakeholders. The afternoon will be dedicated to highlighting the achievements of the Mobility Initiative research program and to exchange about what are the research questions that need to be addressed next.

A seminar series will be launched in the spring semester. With this series, we aim at creating a communication vehicle within the community addressing issues relevant to the rather interdisciplinary CSFM community. One of the objectives of this series is also to facilitate the interaction and exchange between CSFM members that may not be aware of the research work being conducted in other groups. The idea is to also invite speakers from external institutions to bring relevant knowledge and topics to the community.

Projects

The Mobility Initiative is already in place since 2018. Five calls took place so far. This year, the Mobility Initiative program's scheme will be adjusted, based on feedback from and in agreement with the different stakeholders. The new scheme should allow more flexibility and, in particular, facilitate funding bigger projects, aiming at fostering collaborative projects between the CSFM members and the Mobility Initiative partners.

The Management office is also active in maintaining the dialogue with several funding institutions and exploring other suitable schemes.

In 2023, the integrative platform, Digital Twin of the Swiss Mobility System, recently started, should gain momentum. The first prototype is expected to be running with selected cases already in summer. A series of workshops around this project is also currently being planned.

Annex

Members

DEPARTMENT/ Name	Institute / Lab
BAUG	
Brian Adey	Infrastructure Management
Kay W. Axhausen	Traffic Planning, Transport Modelling
Eleni Chatzi	Structural Mechanics and Monitoring
Francesco Corman	Transport Systems
Irena Hajnsek	Institute of Environmental Engineering
Stefanie Hellweg	Institute of Environmental Engineering
David Kaufmann	Institute for Spatial and Landscape Development
Anastasios Kouvelas	Traffic Engineering and Control
Martin Raubal	Institute of Cartography and Geoinformation
Konrad Schindler	Geodesy and Photogrammetry
CHAB	
Thomas Schmidt	Electrochemistry
GESS	
Thomas Bernauer	International Political Economy and Environmental Politics
Tobias Schmidt	Energy Policy
Bjarne Steffen	Climate Finances and Policy
INFK	
Marc Pollefeys	Institute for Visual Computing
Siyu Tang	Computer Vision and Learning Systems
ITET	
Florian Dörfler	Institute for Automation
Ulrike Grossner	Advanced Power Semiconductors
Gabriela Hug	Power Systems Laboratory
Johann Walter Kolar	Power Electronic Systems Laboratory
John Lygeros	Automatic Control Lab
Christian Franck	Technologies for future electric energy transmission systems
Fisher Yu	Computer Vision
MAVT	
André Bardow	Institute of Energy and Process Engineering
Paolo Ermanni	Lightweight Systems
Emilio Frazzoli	Institute for Dynamic Systems and Control
Marco Hutter	Institute of Robotics and Intelligent Systems
Maria Lukatskaya	Electrochemical Energy Systems Laboratory
Marco Mazzotti	Institute of Energy and Process Engineering
Nicolas Noiray	Institute of Energy and Process Engineering
Christopher Onder	Institute for Dynamic Systems and Control
Roland Siegwart	Autonomous Systems Lab
Aldo Steinfeld	Institute of Energy and Process Engineering

MTEC	
Massimo Filippini	Energy and Public Economics
Volker Hoffmann	Sustainability and Technology
USYS	
Anthony Patt	Climate Policy
Michael Stauffacher	Tdlab
Empa	
Miriam Elser	Vehicle Systems

Partnership Council

AMAG Group

Siemens Mobility

Swiss Federal Railways (SBB)

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