

## Contacting the OrGaMIR project partners

For further information on general project outcomes and specific solutions please contact any of the project partners listed below.



### Institut für Mikrotechnik Mainz GmbH

potje@imm-mainz.de; www.imm-mainz.de

**Focus:** Detection of hazardous substances

- Creation of database for hazardous substances, including hydrolysis products
- Selection of sensors for detection of volatile compounds based on risk analysis
- Analysis of applicable sensor principles for detection of hazmat, incl. cost and market analysis
- Development and fabrication of modular sensor platform, incl. control unit for sensor monitoring, data acquisition, processing, and routing; also applicable as isolated application (microcontroller-based operation)
- Hazardous substance detection and event triggering



### Ruhr-University of Bochum, Department of Geography

andreas.pflitsch@rub.de;

<http://www.ubahn-klimatologie.de/projekte.html>

**Focus:** Tunnel-climatology

- Analysis, determination and interpretation of climatological phenomena in subway stations and systems
- Setup of a measurement system for the registration of current air flow conditions; long term investigation and measurement of airflow and air temperature in selected subway stations, at the tunnel portals, inside tunnels close to the platforms, in station entrances/exits
- Propagation experiments and spreading prognosis for subway systems
- Providing reliable information on current and upcoming air flow and dispersion conditions inside a subway-system (tunnels and stations)
- Development of a model for the short-term prognosis of the stability of the prevailing air flow conditions and the identification of danger zones



### Ingenieurbüro Lohmeyer GmbH & Co. KG

thomas.flassak@lohmeyer.de; www.lohmeyer.de

**Focus:** Computational fluid dynamics (CFD) flow and dispersion simulations on subway station level

- Localisation of source based on the CBRNE substance and velocity measurements on subway station level
- Determination of non-contaminated areas and entrances/exits of the subway station during the self-evacuation phase based on Lagrangian dispersion calculations (online) and three-dimensional flow fields calculated in advance and stored in a “flow-field library” (e.g. see: <http://www.youtube.com/watch?v=P90YBNDCJms>)



### Züblin AG

info@zueblin.de; www.zueblin.de

**Focus:** Obstructions for contamination in the design and planning phase of new stations

- Assessment of stations through simulations using relevant criteria to identify obstructions for the spread of volatile substances
- Design of safer stations with inbuilt solutions for technical devices, e.g. sensors and speakers



### University Paderborn

m.plass@cik.upb.de; www.uni-paderborn.de/en

**Focus:** Combination of spreading prognosis and egress time calculation

methods for online guidance of escape routes based on established calculation methods from preventive fire protection

- Core IT-system for information fusion from sensor data to condensed high-level information
- Supply of context sensitive information and adaptive to-do lists to support tasks and decisions
- Optimizing collaboration of fire brigades, rescue services and operating companies through requirements analysis, evaluation and generalization



### Indanet AG, Munich

info@indanet.de; www.indanet.de

**Focus:** Integrated management systems for control-centers; software and interface development

- Integration of OrGaMIR-application in control-room systems
- Data visualisation of complex information
- Graphical user interface of the IT System



### Friedrich-Schiller-University Jena

Stefan.Strohschneider@uni-jena.de; www.iwk-jena.de

**Focus:** Inter-organizational cooperation and communication for crisis management

- Psychological requirements of inter- and intra-organizational cooperation
- Specification of relevant information for stakeholders involved
- Integration of human factors
- Aspects of guidance for passenger evacuation and support of first responders
- Training set-up for civil crisis management staff



## Research for civil security in public transport systems

### Background and motivation

Nowadays, public transport systems play a crucial role in the daily life of millions of passengers. In all of the 94 subways all over the world, people spend time waiting within underground stations and their respective entrance and exit areas. In these environments, emergencies potentially affect large numbers of passengers and adjacent structures.

The limited access to the location is the biggest obstacle for rescue operations in underground railway hazard prevention. Up to the present day, no reliable statement could be made on accessible, non-contaminated rescue paths or unaffected neighboring train stations. To remedy this situation and reduce the number of people affected, rescue teams and operators need precise and reliable information on the current and future situation in order to allow for appropriate decisions and actions.



Smoke in the subway

The joint research project OrGaMIR, funded by the German government, focused on crisis management due to **accidents, major incidents and acts of terrorism** in the domain of underground public transportation. The project provided an innovative approach by integrating ideas from research, science and industry. The mission was to save directly affected persons during the self-rescue phase and to improve crisis management. Consequently the **OrGaMIR Prognosis and Decision Support System** was realized in an IT-based model for public transport companies to support rescue personnel and operators on-site. The OrGaMIR System provides reliable and up-to-date information together with different options for action. Now, personnel on site, in the control centers, and on different management levels can more easily contribute to managing an endangering event in a metro station. As a result, passengers will be guided into a safe area unscathed.

### Scenario-based approach

A scenario-oriented approach guaranteed conducive results and detailed information. The emergency scenario chosen was: an **emission of hazardous airborne substances in underground railway system** – be it heavy smoke in consequence of a fire; or chemical substances and noxious gas as a result of an accident or terrorist attack. Defining such a complex scenario involved the commitment to study several challenging aspects of coordinated countermeasures for rescue operations, e.g. infrastructure, first responders and passengers.

<sup>1</sup> Cross-organizational hazard prevention to protect human life and critical infrastructures by optimized prevention and reaction

## Objectives and solutions

The main objective of the OrGaMIR project is to improve preparedness for emergency response and to provide more security for rescue operations in case of emergency. The key element is the determination of the actual and prospective contamination within the subway system resulting from the spread of hazardous substances.

Direct advice and context-sensitive information should be given to passengers, rescue forces, the transportation company, and to all stakeholders involved. This was to be achieved by means of an integrated IT-System. Towards this solution, several sub-goals were investigated by the project partners within the OrGaMIR scenario:

### Detecting the propagation of hazardous substances in subway stations and the subway system

Substance detection was the focus of Institut für Mikrotechnik Mainz GmbH (IMM). With CBRNE hazardous materials being as numerous as they are, it is unfeasible to detect every single possible substance individually. Instead, IMM created a database of selected hazardous substances. Based upon this database an analysis platform equipped with gas sensors was developed and tested in an underground station. It detects hydrolysis products resulting from the release of one or more hazardous substances. The analysis platform is continuously monitoring the air in the surrounding area. If a hazardous substance is released and a threshold is exceeded according to the database, it communicates with all other platforms and triggers the OrGaMIR System to start working.



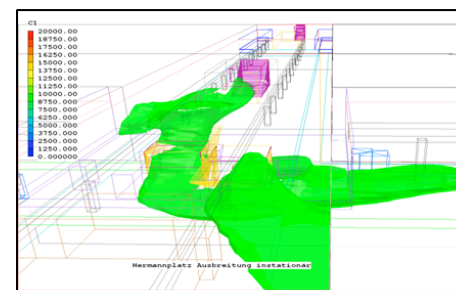
Sensor platform

The Ruhr University of Bochum (RUB) worked on improving the forecast of propagation by conducting research in the field of subway climatology. RUB set up a measurement system for registration of current air flow conditions with separate sensors at the tunnel portals, inside tunnels and at station gateways. RUB also developed a model for the short-term forecast of the stability of the prevailing air flow conditions and the identification of danger zones within subway-stations.



Sensor in use

### Forecasting the propagation of hazardous substances by calculation and simulation



Propagation of hazardous substances

Engineers from Lohmeyer (LOH) integrated research results and online data provided by gas sensors and subway climatology. LOH developed a computational model for the calculation and simulation of the propagation of hazardous substances on subway station levels based on present airflow conditions. Data from the subway system was accumulated and integrated into a database - the "flow-field library". A software tool was developed for fast simulation of the propagation of hazardous substances based on present detection and present flow-field conditions to provide forecasts into the near future. Furthermore, the location of the release of a substance can be identified.

## Information management and system integration

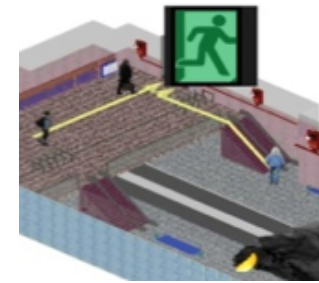
First responders, especially fire fighters, have to face different challenges in emergency management with regard to self-protection and the rescue of people affected. Therefore, quick arrivals on site, effective and efficient use of resources, and coordination with the public transport company has to be managed. This is done by providing a shared basis for information. The public transport company needs to stop carrying passengers to the affected areas and it has to support passengers escaping from the danger locations.



Stakeholders involved

The University of Paderborn (UPB) integrated all data sources from the project partners into a software system, according to the needs and processes of the organisations involved, mainly the transport company. Each stakeholder receives targeted information from the forecast, in order to support rescue operations by means of consolidated, context-sensitive information.

Indanet (IND) integrated the new software application into a control room IT-system. As an overall software solution, this system supports the decision making process by providing information via a familiar user interface. For example, safe escape route time calculations and maps are displayed for control room staff, passengers, or search and rescue teams.



Guidance for passengers

### Identifying psychological requirements for crisis management procedures



Field Tests

Psychologists from the Friedrich-Schiller-University Jena (FSU) identified requirements for organizational crisis management procedures of public transport companies. Human Factors were consistently integrated into the OrGaMIR System. Especially evacuation dynamics during the self-rescue phase were specified, e.g., fear or anxiety of passengers and their resulting behavior. Based on evacuation exercises, the FSU defined requirements for suitable escape routes.

Furthermore, potentials of an adaptable OrGaMIR System were assessed to improve information quality for passengers, first responders, and transport-company staff.

### Integrating improvements into the design and planning of new subway systems and into existing stations

As an additional aspect, Züblin AG (ZUB) identified building obstructions for the spread of volatile substances in existing stations. Aspects like sloping of tunnels and stations, and architectural "smoke barriers" were assessed in simulations and tests. Together with inbuilt solutions for technical devices, e.g., sensors and speakers, these building aspects can be integrated into existing stations or in the planning and design of a next generation of stations for improved security.

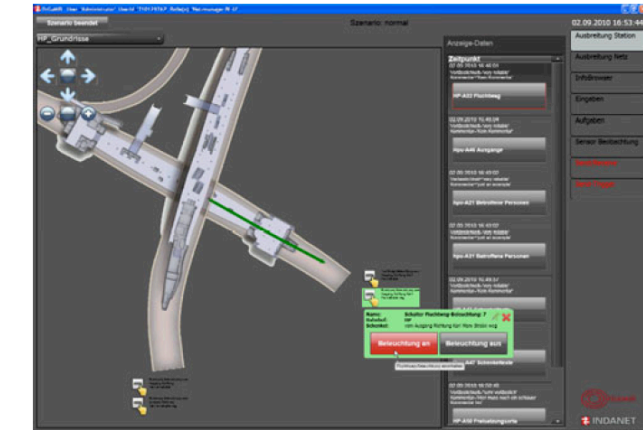


Designing novel stations

## Goals achieved

The consortium managed to contribute to an integrated OrGaMIR Prognosis and Decision Support System with the aspects of detection, simulation, escape-route calculation, and guidance, based on continuously updated and reliable data. The OrGaMIR project accomplished:

- enhanced chemical sensor technology (at decent costs)
- a complete, generic climate model for subway systems
- reliable information for improved crisis management, optimized action and decision-making
- an additional security component for subway control-centers
- operation procedures validated by emergency psychologists
- subway station and tunnel architectures optimized for containment of hazardous substance dispersion



OrGaMIR - decision support system (contributed by IND)

Further research is done to complement the OrGaMIR-system: means to guide passengers during the self-rescue phase to safe, non-contaminated exits and areas. In addition, the possibility of transferring the system to neighboring fields of application is studied, such as long-distance rail services, road tunnels or common fires.

### Extending efforts to improve subway-security

The joint research project OrGaMIR was funded by the German Federal Ministry for Education and Research. Being part of the high-tech strategy of the German government, the first consortium of OrGaMIR was funded within the research program for civil security from 2008 to 2011. Due to convincing outcomes, the follow-up research project OrGaMIR<sup>PLUS</sup> will be funded until 2013. In this context selected project partners continue to work on further improving cost-efficient technology for detection, forecast, and means of guidance for passengers.

The OrGaMIR System is a fundamentally new way to monitor, visualize and control what happens in tunnels and underground facilities. It is a powerful crisis and operation management tool that integrates data from multiple sources, providing decision makers with the ability to coordinate a multi-agency response in any given situation.