PROJECT PERIODIC REPORT

Grant Agreement number: 242438

Project acronym: EMILI

Project title: Emergency Management in Large Infrastructures

Funding Scheme: CA (STREP)

Date of latest version of Annex I against which the assessment will be made:

Periodic report: **1st ☐ 2nd X 3rd ☐**

Period covered: **from 1.1.2011 to 31.12.2011**

Name, title and organisation of the scientific representative of the project's coordinator[1]:

Dr. Rüdiger Klein / Dr. Manfred Bogen
Fraunhofer Gesellschaft zur Förderung der angewandten Forschung e.V.
Tel: ++49 2241 14 2608; ~2367
Fax: ++49 2241 14 2342

E-mail: Ruediger.Klein@iais.fraunhofer.de; manfred.bogen@iais.fraunhofer.de

Project website[2] address:

www.emili-project.eu

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement .

[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

Declaration by the scientific representative of the project coordinator

I, as scientific representative of the coordinator of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate) [3]:

  ☐ has fully achieved its objectives and technical goals for the period;

  X has achieved some of its objectives and technical goals for the period with some significant deviations;

  ☐ has failed to achieve critical objectives and/or is not at all on schedule.

- The public website, if applicable

  ✓ is up to date

  ☐ is not up to date

- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 3.4) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 3.2.3 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

[3] If either of these boxes below is ticked, the report should reflect these and any remedial actions taken.

Name of scientific representative of the Coordinator: Dr. Manfred Bogen

Date: 29/ 02/ 2012

For most of the projects, the signature of this declaration could be done directly via the IT reporting tool through an adapted IT mechanism.

3.1 Publishable summary

Emergency Management (EM) in Critical Infrastructures (CI) is a challenging task with many facets. In EMILI, we identified those aspects of emergency management where users need special support and where new information technologies can provide this support. In a comprehensive requirements analysis during the first year of the EMILI project, we identified these issues. EMILI's approach concentrates on those aspects of emergency management where immediate operator support is most urgent and where significantly improved support can be provided with new information technologies: immediate reactions to exceptional and emergency situations in a first response phase[4]. We focus on the following situations:

- for airports and metro systems we consider various fire scenarios; and
- for power grids we consider various component failures in the networks, the consequences this may have for the network as a whole, and the alarms they generate.

Such scenarios are of central importance for each of our 3 use cases.

The key idea of EMILI for emergency management in Critical Infrastructures is based on two pillars and their tight relationships:

- situation assessment and
- reactions to these situations.

Description of the work performed since the beginning of the project and the main results achieved so far

Semantic technologies in our Superior Operational Management Layer SOMAL have been further elaborated in the second year as information backbone for the large amount of heterogeneous information to be processed. A complex action algebra was introduced allowing us to describe precisely the meaning of reactions. A model theoretic semantics was specified for SOMAL also providing requirements for WP4. A modelling and processing environment SMART has been designed and implemented by the EMILI partner Fraunhofer. It allows us to combine complex SOMAL models with event processing and simulations.

Complex event processing in Dura – LMU's event and action language – aims at an analysis of large amounts of dynamically incoming heterogeneous event data streams in conjunction with different kinds of static data and to identify complex patterns in them. A first rudimentary version of the Dura engine has been implemented by August 2011. It is planned to have a fully operational event action engine available in Spring 2012. Events and states should be used for situation assessments. It is intended that reactions can be modelled and executed as simple or complex actions. These actions can be related to situations in Dura rules.

[4] In some sense we are also dealing with preparedness in our training use cases. From a methodological perspective there are only minor differences between first response and training. Later response phases or recovery will need other methodological approaches like communication between different stakeholders, coordinated actions, etc. which are currently not in the focus of EMILI.

Dynamic database technologies in CWI's Datacell on MonetDB are used.

The Simulation and Training Environment SITE has been designed as reference architecture for our three use cases. Each of them uses its own implementation of SITE. Various simulations can be integrated and used to model physical and technical behaviours as part of emergency management.

Our three use cases – the airport, the metro, and the power grid use case – were further analysed and modelled with SOMAL and to some extend with Dura rules.

Description of the expected final results and their potential impacts and use

The main focus of EMILI's activities in the last year will be on use cases and dissemination.

- The SITE architecture will be implemented in three separate software systems each using the concrete software tools needed in their applications.
- It is planned that LMU's event action engine will be available during Spring 2012 and will be integrated with SOMAL and MonetDB's Datacell.
- The use cases need different kinds of simulations. The smoke/fire simulator implemented by Fraunhofer in collaboration with ASIT will be integrated with SMART.
- The use case models will further be elaborated with the aim to demonstrate the usefulness of EMILI for our three kinds of Critical Infrastructures: metro, airport, and power grids.

3.2 Core of the report for the period: Project objectives, work progress and achievements, project management

3.2.1 Project objectives for the period

The main objectives for the second project year can be summarized as

- *further elaboration of the use cases,*
- *developing detailed concepts for modelling in SOMAL,*
- *SITE architecture.*
- *according to the DoW, a full event and action engine processing Dura rules should be available integrated on MonetDB.*

The broad spectrum of issues corresponds to the broad spectrum of EMILI partners. EMILI is a highly interdisciplinary project with partners with different backgrounds, methodologies, goals, and success criteria. It showed that it was complicated to find effective ways of collaboration bringing these different partners into a constructive and fruitful cooperation.

3.2.2 Work progress and achievements during the period

EMILI succeeded partially to achieve the goals defined for the second year.

WP2: SOMAL

In D2.2 we identified the main issues for modelling of emergency management scenarios in Critical Infrastructures. Two main aspects are tightly related: methodology and modelling. The methodology applied in SOMAL is an adaptation of classical CommonKADS. It is based on a system of onthologies for all main kinds of information relevant in EM. These onthologies form the core for modelling.

It became clear (see D2.3) that situation assessment in EM is a complex endeavour. Many related states and events have to be considered in order to find the right situation assessment as basis for reactions.

A complex action algebra was introduced (D2.3) allowing us to describe precisely the meaning of reactions. A model theoretic semantics was specified for SOMAL - also providing requirements for WP4.

The use case models where further elaborated in SOMAL.

The other main issue relevant for emergency management is the use of simulations. Frequently, decisions about reactions can not be based on the current information. Future developments have to be taken into account in order to validate if a certain reaction is appropriate. This can only be done through simulations.

A simulation tool for fire and smoke development was proposed by ASIT and implemented by Fraunhofer (see WP6).

Modelling in such complex applications as emergency management scenarios is a challenge in its own. The use case models (though still quite incomplete and restricted to a few aspects) demonstrated that already a few dozens of rules tend to become complex. They all depend in various ways on each other. The SMART modelling and development tool was built to support modelling in SOMAL (see D2.3 and WP6).

Another main issue in WP2 in its second year was risk assessment and decision support. Though some reactions can be executed automatically, frequently reactions can not automatically be executed in EM, but need human evaluation and confirmation. Either because the underlying situation assessment is not safe enough, or because the consequences of these actions they are too serious to be left to a computer. In general, we assume in EMILI's decision making a "tandem" of human operator supported by an appropriate decision supporting tool. The SOMAL methodology and modelling approach has been extended in such a way that both risk estimation and decision support can be done – in a way fitting the general approach of EMILI based on event and action processing.

In the third year, the use cases (WP3) should be further elaborated in order to validate the developed risk and decision support methodology.

WP3: Use Case Modelling

EMILI has three quite different use cases: airport, metro, and power grid.

Deliverable D3.3 "Use case modelling for implementation in SITE" is the main result of WP3 in EMILI's second year. It is due in project month M24 (December 2011) and was prepared

under the lead of WP3 task leader ASIT, Berne, Switzerland, with contributions from the other use case partners AIA, Pupin, and Skytec.

The EMILI Simulation and Training Environment (SITE) is conceived as an advanced simulation and training system for emergencies in large infrastructures. It comes in three disjoint versions for the three EMILI use cases. They provide simulation and training environments including event action processing and with simulations (e.g. fire spread, smoke propagation, evacuation, etc.). A Graphical User Interface provides support for human decision makers to make use of information and simulations.

The proposed EMILI-SITE integration framework is organized in three-tiers, where the lowest tier deals with information used in the system; the middle tier is responsible for the processing of this information, while the highest tier is responsible for presenting the relevant information to end users and for enabling the foreseen interaction with them. Since three EMILI use case (airport, metro and power grid) are very different, there are many components that have to be separately implemented for each of them, therefore, we have three instance architectures of the proposed EMILI-SITE integration framework corresponding to our three use cases.

These results are summarized in D3.3.

WP4: Semantic Web Technology for Complex Events

Complex events, states, actions, and reactive rules are aimed as key elements of EMILI's innovative approach to emergency management in Critical Infrastructures. Together with physical simulations their processing should provide the needed reasoning power. WP4 is dedicated to the development and implementation of an expressive and well formalised language called Dura, a declarative event and action language tailored to reactive emergency management

The Dura language had been designed in the first year according to the general EMILI methodology elaborated in WP3 and the SOMAL modelling methodology (WP2).

Dura rules shall be processed as SQL queries on MonetDB. An efficient run time system for Dura called EventMill is needed. It is integrated with the CWI's DataCell as stream processor for the database system MonetDB (WP5).

The official date of delivery of the Dura language and the corresponding processing machinery was Milestone III (June 30, 2011). Internally, the partners agreed to have first versions of this engine earlier (end of 2010) because it provides important functionality to be used in the other WPs (esp. within the use case applications).

In June 2011, the partner LMU informed the consortium that they had to change their approach to event and action processing. The Dura language had to be split up into two sub-languages – a basic language called Dura-Core and a more complex language called Dura-Full. Dura-Core can be processed easier then the full language. The Dura-Full language can be mapped onto constructs of Dura-Core.

The consequences this change should have for the other partners seemed to be manageable. The use case models would be incomplete if restricted to Dura-Core – so Dura-Full should be

available as soon as possible in order to provide the necessary functionality for the other WPs according to the DoW.

Though there were a couple of attempts to push the event action engine development, the Dura-Core engine is not fully functional (not to mention a Dura-Full engine). LMU delivered a work plan for WP4 planning to deliver the Dura-Full engine by end of March 2012.

WP5: Data and Event Management Systems

The main goal of WP5 in the reporting period was the implementation of a stream-based core for a Complex Event Processing (CEP) system and support for reactive rules in the EMILI project. In this implementation, the integration of the stream-based system in the EMILI SITE architecture (D6.3) is important. The capabilities of the stream-system DataCell are mainly in the ability to handle persistent as well as streaming data at the same time, to allow CEP queries to use a portion of history information stored in persistent tables, while considering incoming events on the streams. DataCell is an implementation of a stream-based system on top of MonetDB. The focus of the implementation is to make stream sources available to the database kernel and benefit from the advanced data processing capabilities available within the MonetDB system. This results in a fast handling of continuous events as required by the EMILI use-cases.

WP6: The EMILI Simulation and Training Environment (SITE)

D6.4 was due at M18 and was submitted in August 2011 (within the 60 days extension period). The objective of this deliverable is the implementation of the first prototype of the integrated EMILI-SITE system. EMILI-SITE is a hybrid environment, where several different software paradigms are utilized and combined in order to achieve the most powerful amalgamation, applicable in emergency management in different critical infrastructures. The EMILI-SITE system provides simulation and training capabilities for emergency management in critical infrastructures like airports, railway/metro systems, and power grids. In addition, it supports decision-making activities in safety-critical situations in a timely manner. The prototype described in D6.4 provides a proof-of-concept in the early phase of the EMILI project and demonstrates the applicability of advanced technologies such as complex event processing, semantic technologies and web services in mission-critical applications.

D6.5 “Extensive testing and fine tuning of the EMILI-SITE prototype using the first use case implementations” was due at M24. First use case prototypes based on the EMILI-SITE integration framework have been implemented. The objective of D6.5 is to extensively test and fine tune the EMILI-SITE integration framework including the implemented components and use case prototypes as well as to propose possible ways for their enhancements.

The main focus on testing the SITE integration framework based on WSO3 ESB was on reliability and speed. Both aspects were shown to work fine for EMILI’s requirements. Unfortunately, LMU’s event engine is still not fully operative; it is not integrated with the simulation tools. Therefore they cannot be currently integrated within the implemented use case prototypes. At the moment, the LMU event engine was replaced by an open source tool, Esper, while the simulator tool was replaced with the Route Finder component developed by PUPIN in case of airport use case. D6.5 also describes the tests of the specific EMILI-SITE architectures applied in the airport and the metro use case prototypes. The general architecture worked fine, and the integration of LMU’s event engine and the simulators are the most important steps in the development of these use cases for the next period. The specific architecture used in the power grid use case, the implemented components, and SOMAL modelling have been tested. The extensive testing was performed based on the spotted

anomalies in the network, as received through the SCADA alarms and messages that are received at the Control Center, through a model-based CEP process designed to interpret them. The main weakness of the initial prototype is that it was built around network models that were *bus-branch oriented*, which is of course very limiting in terms of describing the full actual model. This limitation will be removed by working with the full model (*bus-breaker oriented*). This entails the import of the SCADA/EMS network model into the EMILI tools, at least at the level of *connectivity* (topology of connections + status of breakers and switches). To do topology processing prior to any load flow calculation and to incorporate a high-quality decision-support into the prototype we will integrate existing AGORA EMS tools.

WP7 on Assessment and Best Practices

WP7 on Assessment and Best Practices will start in month 31.

WP8 on Dissemination

We maintain the project Web site at www.emili-project.eu and update it regularly.
It contains a summary of the project's main objectives and all recent deliverables.
The other activities in this area have been delayed due to the general situation in the project.
They will start as soon as first tangible results will be available.

3.2.3 Project Management during the Period (WP1)

Consortium Management Tasks and Achievements

The management of EMILI became complicated in the second year. Some partners did not fulfil their duties according to the DoW (see above). Some partners changed the goals of their project activities and focused more on specific goals they have. This caused problems for the other partners. There was a lack of coherence and collaboration.

List of project meetings, dates and venues

There were the following meetings in the period covered by this report:

- March 2-3, 2011 EMILI Project Meeting, Fraunhofer (Sankt Augustin): review preparation
- March 28, 2011: First EMILI Review Meeting, Brussels
- June 8-9, 2011: Full EMILI meeting, PUPIN (Belgrade)
- November 3, 2011: Executive Committee meeting, Fraunhofer (Sankt Augustin)
- January 30-31, 2012 EMILI Annual Meeting (D1.9), AIA (Barcelona)

Additionally, there were some bilateral meetings of two EMILI partners:

- March 3, 2011: Workshop meeting EMILI Partners, Fraunhofer (Sankt Augustin)
- March 6-9, 2011 Workshop Meeting SKYTEC/CWI: MonetDB Integration, CWI (Amsterdam)
- May 24-27, 2011 Workshop Meeting SKYTEC/CWI: MonetDB Integration, SKYTEC (Munich)
- June 14-15, 2011 Workshop Meeting SKYTEC/Fraunhofer: SOMAL Metro, Fraunhofer (Sankt Augustin)
- June 16-17, 2011: Workshop meeting ASIT/ Fraunhofer: simulation tool (physical models and integration), Zürich-Regensdorf
- December 7, 2011 Workshop Meeting PUPIN/SKYTEC, SKYTEC (Munich)

Finally, a couple of telephone conferences took place.

There was a conflict between LMU and Fraunhofer at the end of September 2011.

- In July 2011, Fraunhofer IAIS presented a position paper at the industry track of the DEBS conference describing control issues in so-called cyber-physical systems. A research paper submitted by LMU to this conference had been rejected by the Program Committee. The Fraunhofer paper had some relationships to EMILI, though it did neither use SOMAL nor Dura nor SITE nor any of the EMILI use cases.

- Though the content of this paper had been described thoroughly by Fraunhofer IAIS in a couple of predecessor publications in other projects and in particular in EMILI's D2.2 (without any complaints from LMU), LMU claimed that the results presented by Fraunhofer IAIS in the DEBS paper were their own ones. After a couple of discussions, LMU withdraw their accusations, and Fraunhofer approved that the DEBS paper is in no way an obstacle for the research ongoing at LMU.

At the Executive Board meeting at November 3, 2011, the project situation was discussed. It was decided to put more emphasis on the use cases, and to stress simulation as an important issue in emergency management.

A technical leadership team was formed (S. Vranes (PUPIN), P. Kroner (SKYTEC) supporting the new coordinator Dr. Manfred Bogen (Fraunhofer) in managing the implementation works in the last EMILI project year. The necessary changes in the DoW were formulated and sent to the EU for approval.

Fraunhofer's head of institute, Prof. Dr. Stefan Wrobel, had decided to support EMILI in every possible way. Financial Resources were shifted from Fraunhofer to Pupin, Skytec and ASIT in order to support their use case specific activities and the work in the technical leadership team.

Publications

- Janev, V. and Vraneš, S.: Applicability assessment of Semantic Web technologies. Information Processing & Management, 2011, doi:10.1016/j.ipm.2010.11.002, 2011.
- Kraus, L., Stanojević, M., Tomašević, N., Mijović, V.: A Decision Support System for Building Evacuation based on the EMILI SITE environment,& IEEE WETICE'2011 Track: Collaborative Technology for Coordinating Crisis Management, 2011.
- M. Bettelini, S. Rigert & N. Seifert: Enhancing Emergency Management for Critical Infrastructures (abstract), STUVA '11 Conference, Hamburg, 6./7. Dec. 2011.
- Michael Eckert, François Bry, Simon Brodt, Olga Poppe, and Steffen Hausmann: A CEP Babelfish: Languages for Complex Event Processing and Querying Surveyed. In: Reasoning in Event-Based Distributed Systems Studies in Computational Intelligence, 2011, Volume 347/2011, 47-70, DOI: 10.1007/978-3-642-19724-6_3
- Mijović, V., Vraneš, S.: A survey and evaluation of CEP tools. Proc. of the 17th YUINFO Conference, Kopaonik, Serbia, March 2011.
- Rüdiger Klein, Jingquan Xie, and Andrij Usov: Complex Events and Actions to Control Cyber-Physical Systems, to appear in: A. Gal, S. Zdonik (eds.), Proc. of the 5th ACM Int'l. Conf. on Event Based Systems DEBS 2011, New York 2011.

- Tomašević, N., & Konečni, G.: Generic message format for integration of SCADA-enabled emergency management systems, Proc. of the 17th YUINFO Conference, Kopaonik, Serbia, March 2011.

3.3 Deliverables and Milestone Tables

Deliverables

Del. no. [5]	Deliverable name	WP no.	Nature[6]	Dissemination level [7]	Delivery date[8] (proj. month)
D1.6	Progress Report	1	R	RE	M18
D4.5	First Implementation of ECA rules for SITE	4	R	PU	M18
D5.4	Implementation of event processing and ECA rules within MonetDB	5	R+O	PU	M18
D6.4.	Implementation of the first prototype of the EMILI-SITE	6	O	PU	M18
D8.2	Support Material	8	O	PU	M18
D1.7	Progress Report	1	R	RE	M24
D1.8	Management Report	1	R	RE	M24
D1.9	Annual Meeting	1	O	RE	M24
D2.3	General Superior Operation Management Level (SOMAL) – refined concept	2	R	PU	M24
D3.3	Use Case modelling for implementation in SITE	3	R+O	PU	M24
D4.6	Modularization Mechanisms for ECA rules	4	R+O	PU	M24
D6.5	Testing of EMILI-SITE prototype with first use case implementations	6	R+O	PU	M24
D8.3	First Dissemination Seminar	8	O	PU	M24

[5] Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>. For example, deliverable 4.2 would be the second deliverable from work package 4.

[6] Please indicate the nature of the deliverable using one of the following codes:
R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

[7] Please indicate the dissemination level using one of the following codes:
PU = Public
PP = Restricted to other programme participants (including the Commission Services).
RE = Restricted to a group specified by the consortium (including the Commission Services).
CO = Confidential, only for members of the consortium (including the Commission Services).

[8] Measured in months from the project start date (month 1).

Milestones[9]

Name	Description	month
M-III	First implementation	M18
M-IV	First demonstrator	M24

3.4 Explanation of the Use of the Resources

See Periodic Report

3.5 Financial Statements – Form C and Summary Financial Report

The Form C's had been completed electronically in ECAS/FORCE. The Summary Financial Report had been generated automatically by the ECAS/FORCE system.

None of the EMILI partners have to provide a certificate on Financial Statements after this period.

We will send the signed Form C's after the check to the European Commission.

[9] In all milestones, all partners are involved with own deliverables or significant contributions tot hem.