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A situation-aware framework for early warning systems

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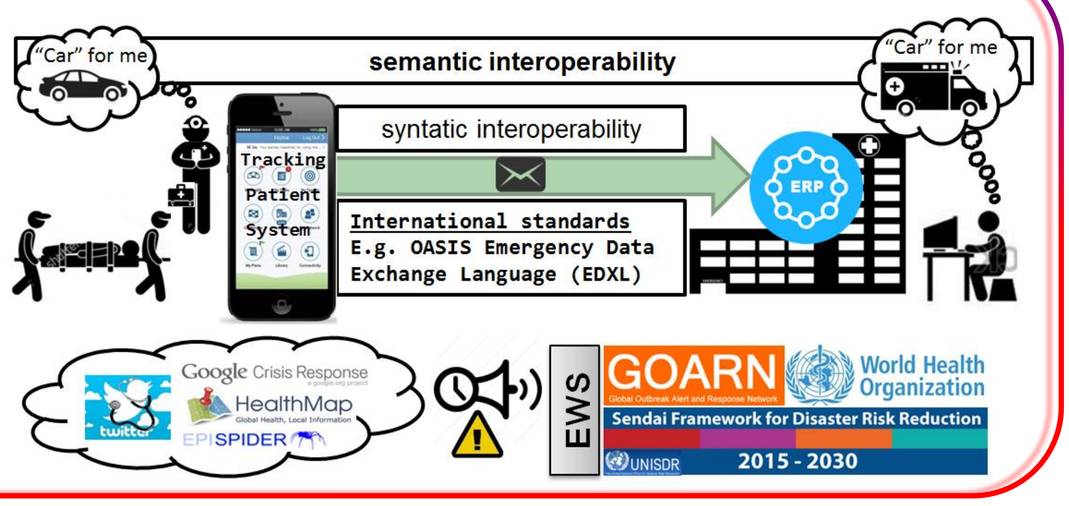
Challenges

How to improve the **semantic interoperability** among early warning systems (EWS) for epidemiological surveillance:

- How to design and implement the detection of pre-epidemic situations and the adequate response actions?
- How to exchange the detected situation messages among EWS and their components?
- How to identify pre-epidemic situations not specified a priori (at design-time) from existing data?



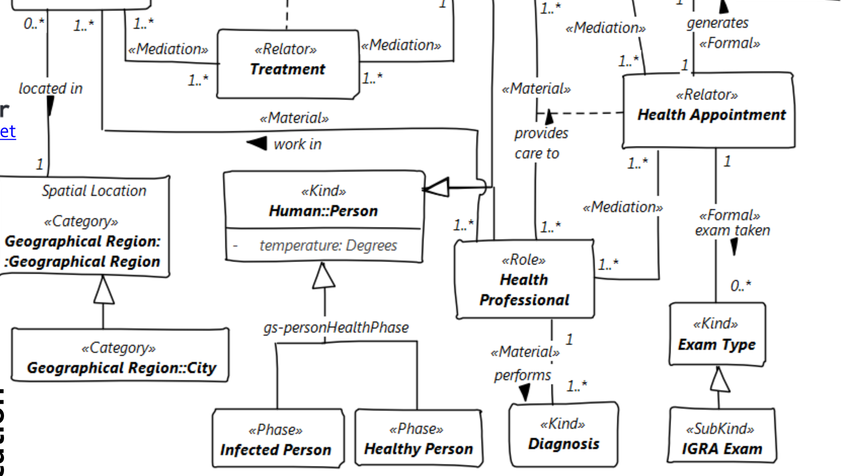
Our solution

- Ontology-driven situation identification mechanism based on the situation awareness theory
- Graphical specification of context, situation and decision
- MDE transformations to generate interoperable systems

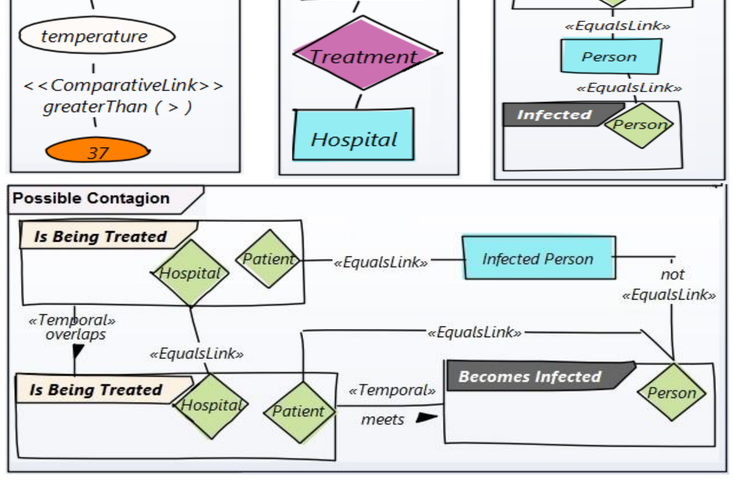
Intended contributions

- Disaster risk reduction through effective and efficient use of available resources aiming at less casualties and damage
- Semantic interoperability improvement in EWS
- Distributed and meaningful big data integration

EWS components: Sensor → Detection → Decision → Broker → Response
Situation awareness: Perception → Comprehension → Projection → Decision → Action
Our framework: Context model: UFO/OntoUML → Situation model: SML → Action model: BPMN

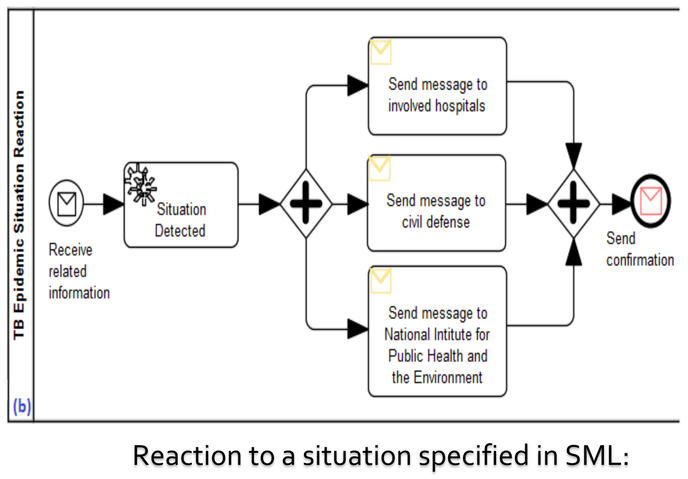


OntoEmerge ontology



Complex rules graphical design (for non-IT experts), composition (for reuse), temporal (Allen) and comparative relations, event x situation

Scenario: EWS for tuberculosis (TB) epidemics detection



Reaction to a situation specified in SML: emergency procedures

Model Driven Engineering (MDE)
Specification
Implementation

(A) Simulation: verification and validation of models for semantic expressiveness improvement (design-time)

1

(B) MDE transformations: (runtime)

- Rule-based + complex event processing (CEP)
- Distributed system
- XML-based international standards
- Business process suite

Scene Drools · SIMPLE EsperTech · OASIS (EDXL) Emergency Data Exchange Language · SiNoS Situation Notification Service Platform

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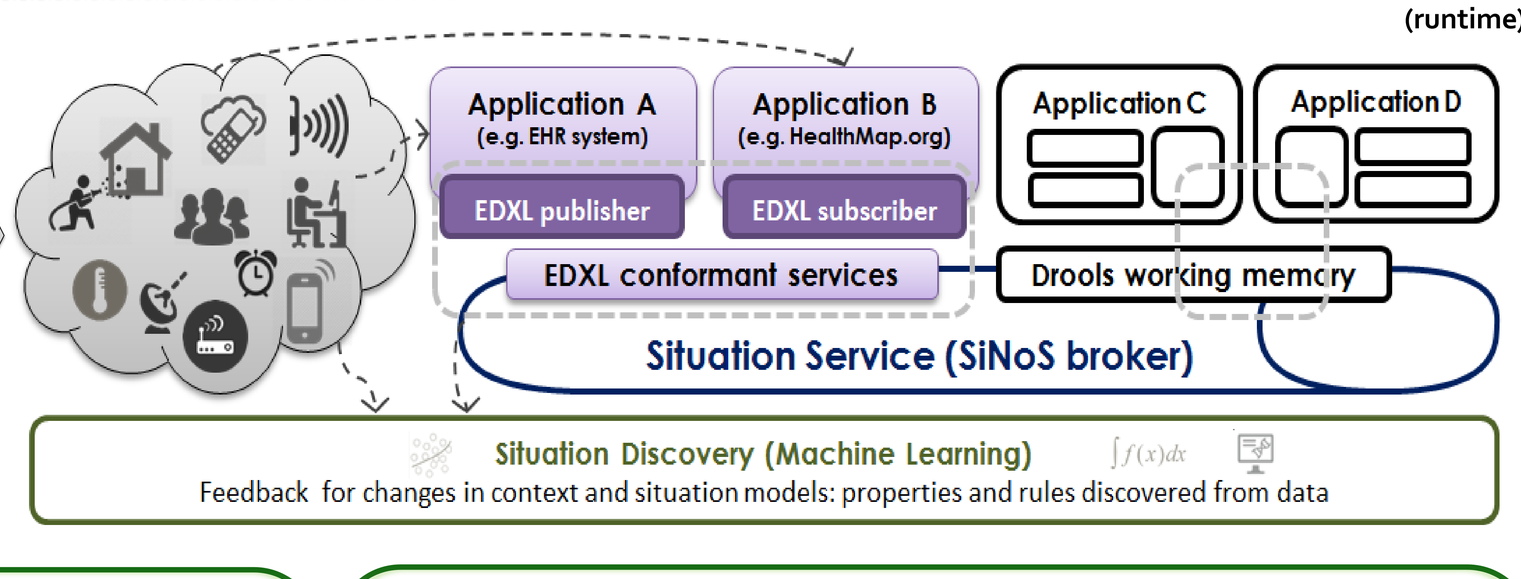

Preliminary results

- Framework architecture components and discussion about harmonization of situation-related concepts in UFO [1]
- Evolution of OntoEmerge ontology [2]
- Example case in tuberculosis epidemic scenario [3]
- EDXL standard for epidemiological surveillance [4]

Current and planned activities

- Systematic literature review about EWS interoperability
- Tooling support for SML (Sparx Enterprise Architect) and SiNoS (Apache Kafka and MQTT)
- Extension of OntoEmerge and alignment with BioOntology
- Framework validation with EWS prototype

[1] Moreira, J.L.R., Ferreira Pires, L., Sinderen, M. van, and Dockhorn Costa, P. (2015) *Towards ontology-driven situation-aware disaster management*. Journal of applied ontology, 10 (3-4).
[2] Ferreira, M.I., Moreira, J.L.R., Campos,M.L., Sales, T.P., Braga,B.F.B., Cordeiro,K.F. and Borges,M. (2015). *OntoEmergePlan: Variability of emergency plans supported by a domain ontology*. ISCRAM.
[3] Moreira, J.L.R., Ferreira Pires, L., Sinderen, M. van, and Dockhorn Costa, P. (2015) *Developing situation-aware applications for disaster management with a distributed rule-based platform*. RuleML Special Track.
[4] Moreira, J.L.R., Ferreira Pires, L., Sinderen, M. van, and Dockhorn Costa, P. (2016) *Improving semantic interoperability of big data for epidemiological surveillance*. I-ESA, BDI4E workshop.

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