Enhancing Architecture Design Decisions Evolution with Group Decision Making Principles

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SERENE 2014, Budapest, October 2014

Resilience

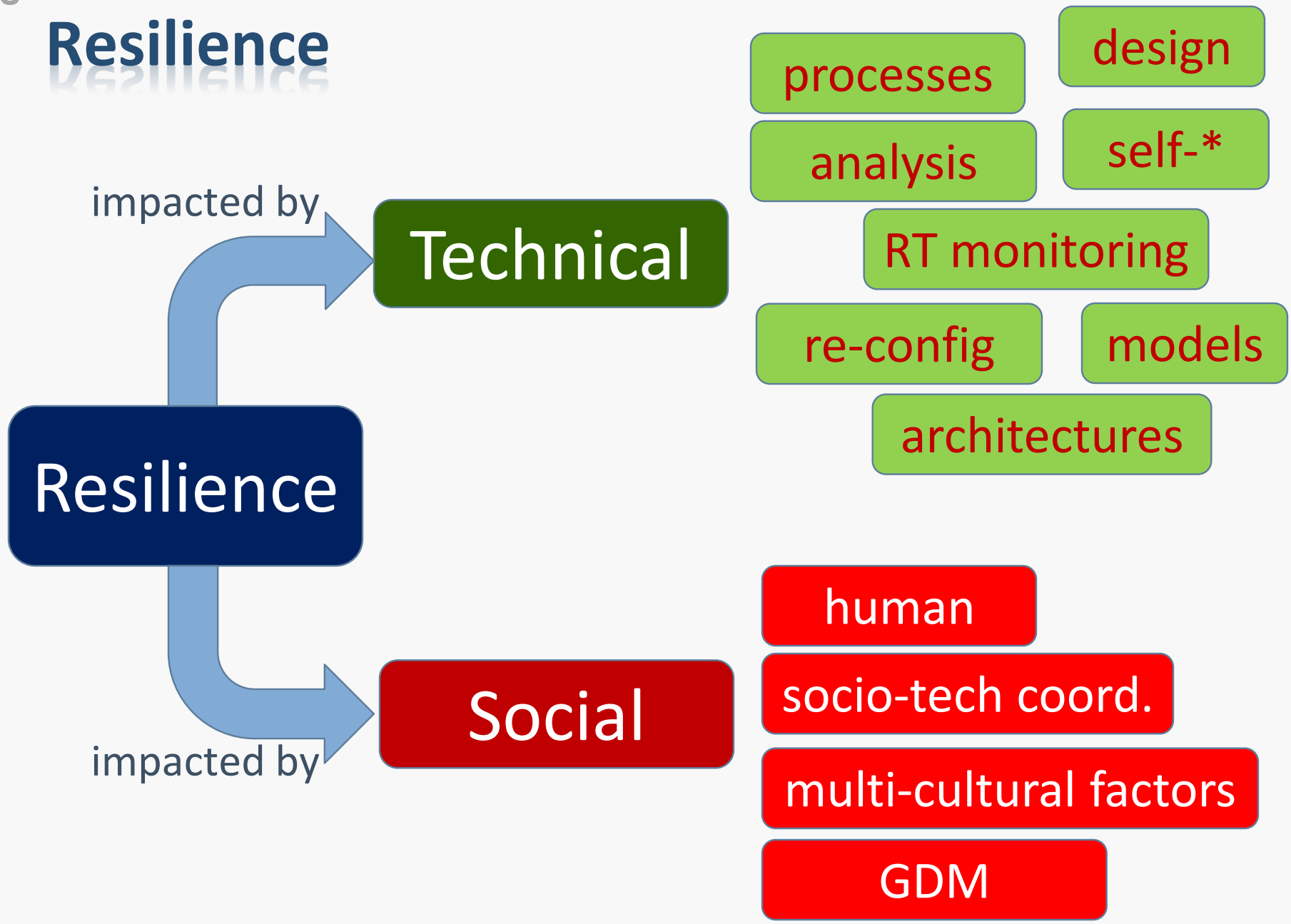
"The persistence of dependability when facing changes"

[Laprie, DSN04]

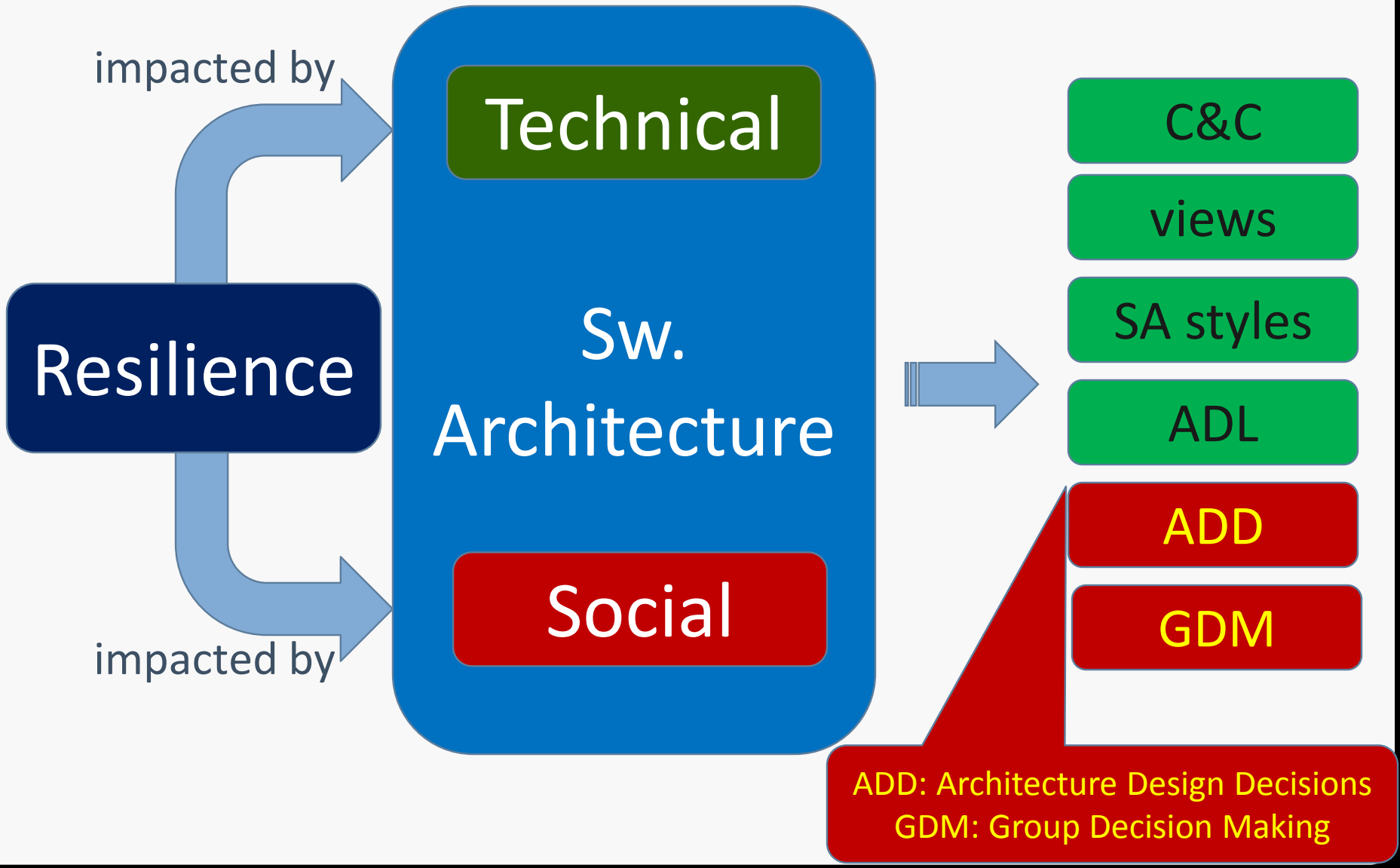
"resilience engineering is about flexibility of people and organisations, not just in reacting to individual incidents and anomalous situations, but also in learning from them and thus developing an ability to react…"

[Strigini, bookChapt12]

Resilience


impacted by
Technical
processes
design
analysis
self-*
RT monitoring
re-config
models
architectures
Resilience
impacted by
Social
human
socio-tech coord.
multi-cultural factors
GDM

Resilience and Software Architecture



Goal of this work

Enhance the design of Resilient Systems…

by explicitly modeling **Group Decision Making** mechanisms and by **linking** them to **architectures** and other artifacts

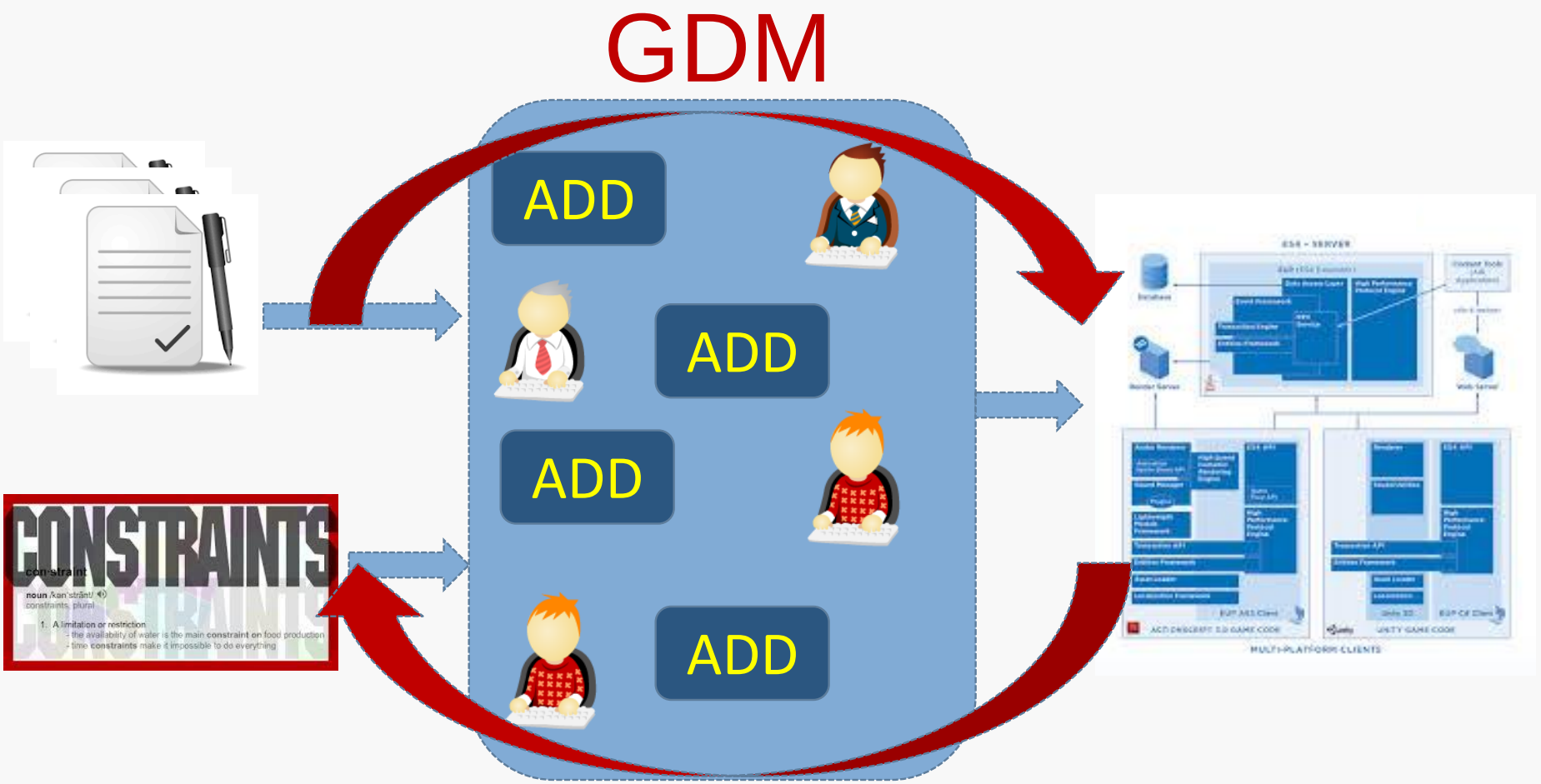
Architecting today

Architecting is the process of creating software architecture **knowledge** and artifacts for engineering software systems

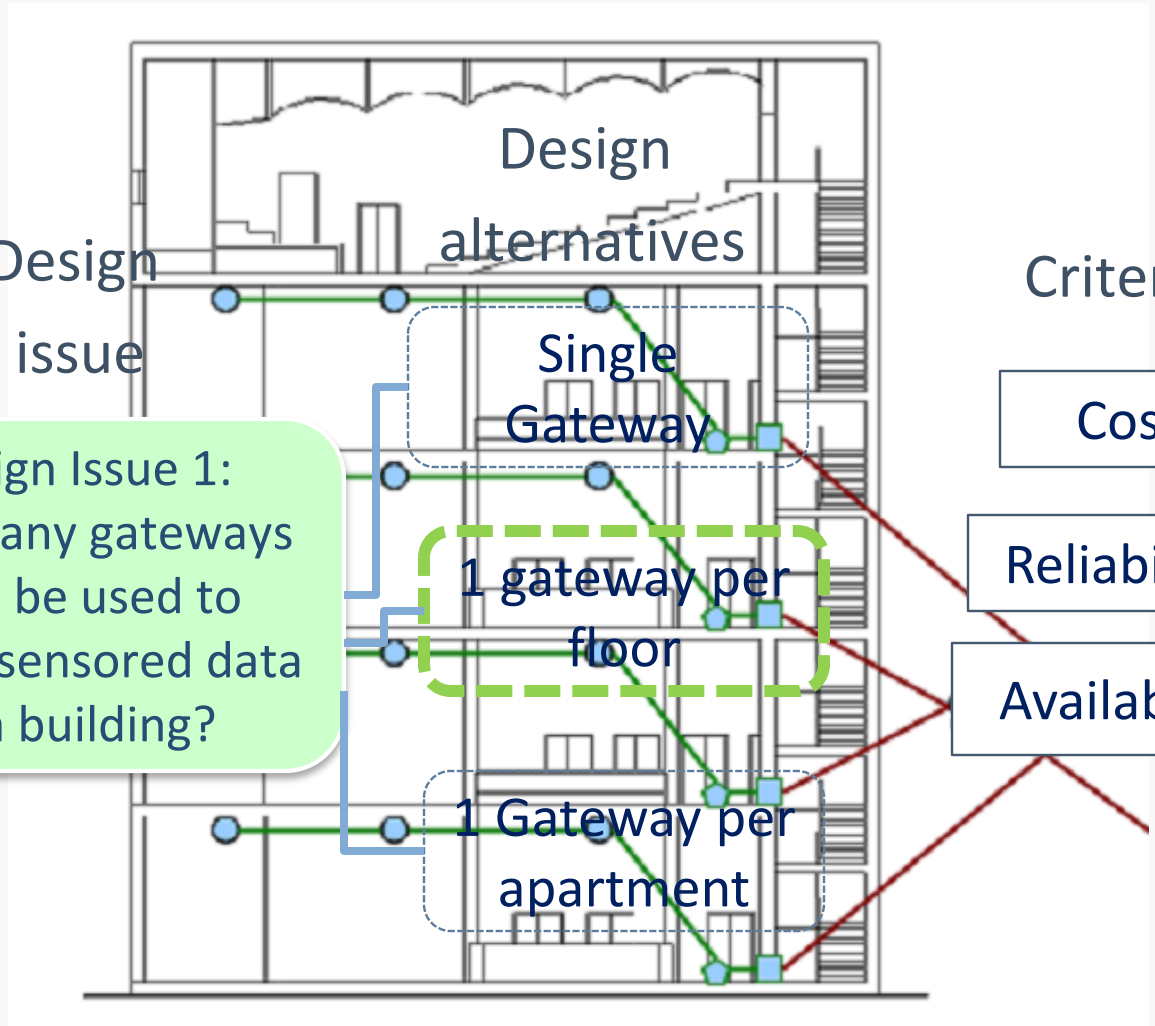
A Software Architecture consists of

- A blueprint for the chosen solution (product)
  - A set of components and connectors communicating through interfaces
- A set of design decisions (co-product)
  - A set of architecture design decisions taken to generate the architecture artifact

Architecting in a picture



ADD for the Fire Monitoring System



GDM for the Fire Monitoring System

GDM

Design issue

Design Issue 1: how many gateways shall be used to collect sensored data in a building?

Design alternatives

- Single Gateway
- 1 gateway per floor
- 1 Gateway per apartment

Criteria

- Cost
- Reliability
- Availability

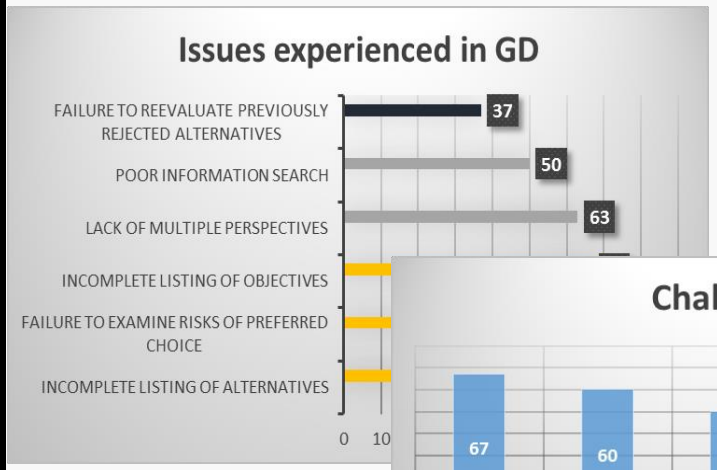
Stakeholders' concerns
Stakeholders' reputation
Stakeholders' roles
Consensus Mechanisms
Social links
Decision Patterns

Why to care about GDM?!?

> 85% of the decisions made by software architects are made by groups

5-10 people involved in decision making

21 different roles represented



Lack of support in current architecture design decisions methods of GDM

[Smrithi&Muccini,WICSA2014]

[Smrithi&Muccini,ECSA2014]

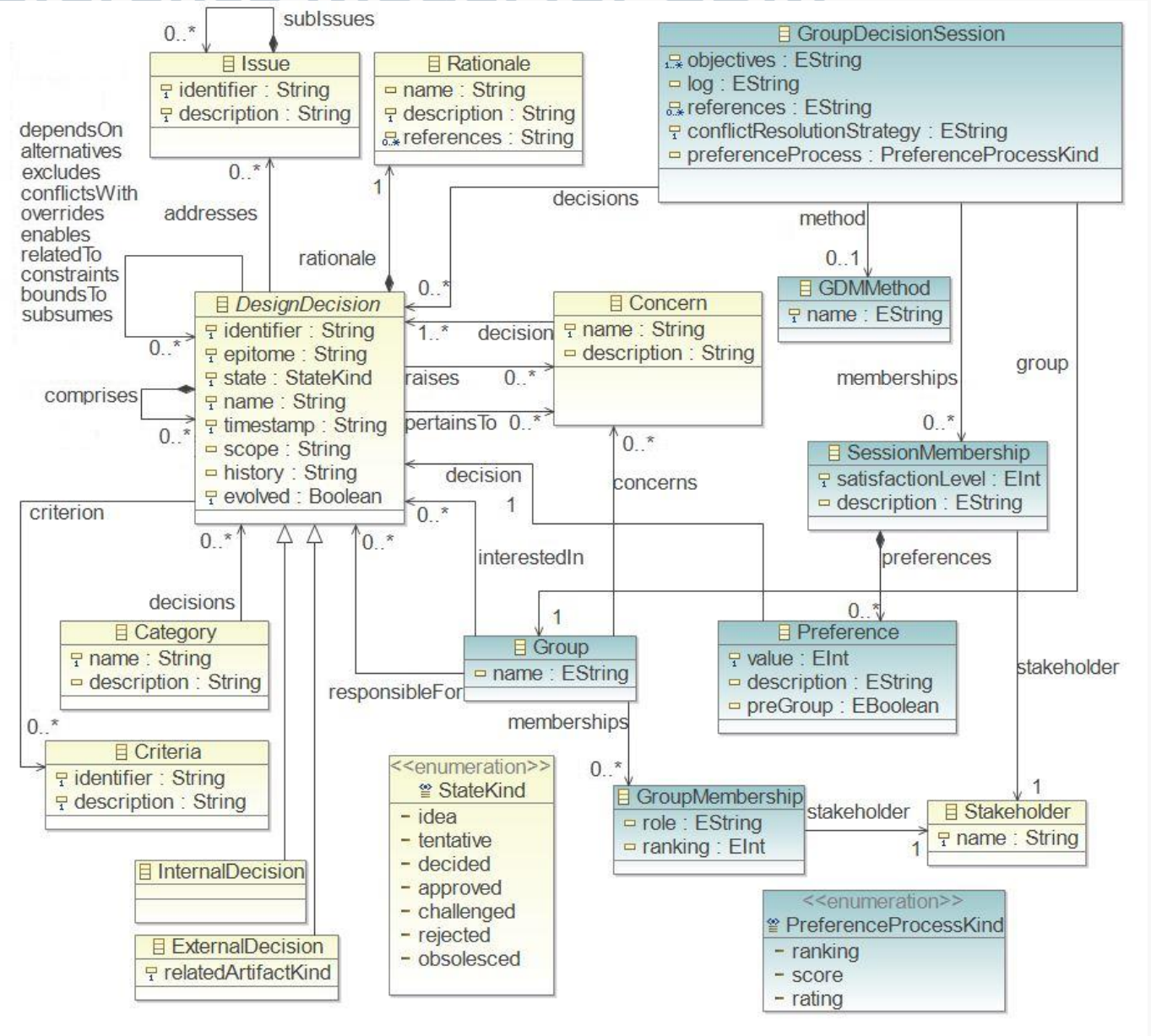
Goal of this work (extended)

A. to provide a reference model for **Group Decision Making**

B. to define bidirectional **traceability links** between ADDs, Architectures, and other artifacts

C. to outline a **change propagation** engine

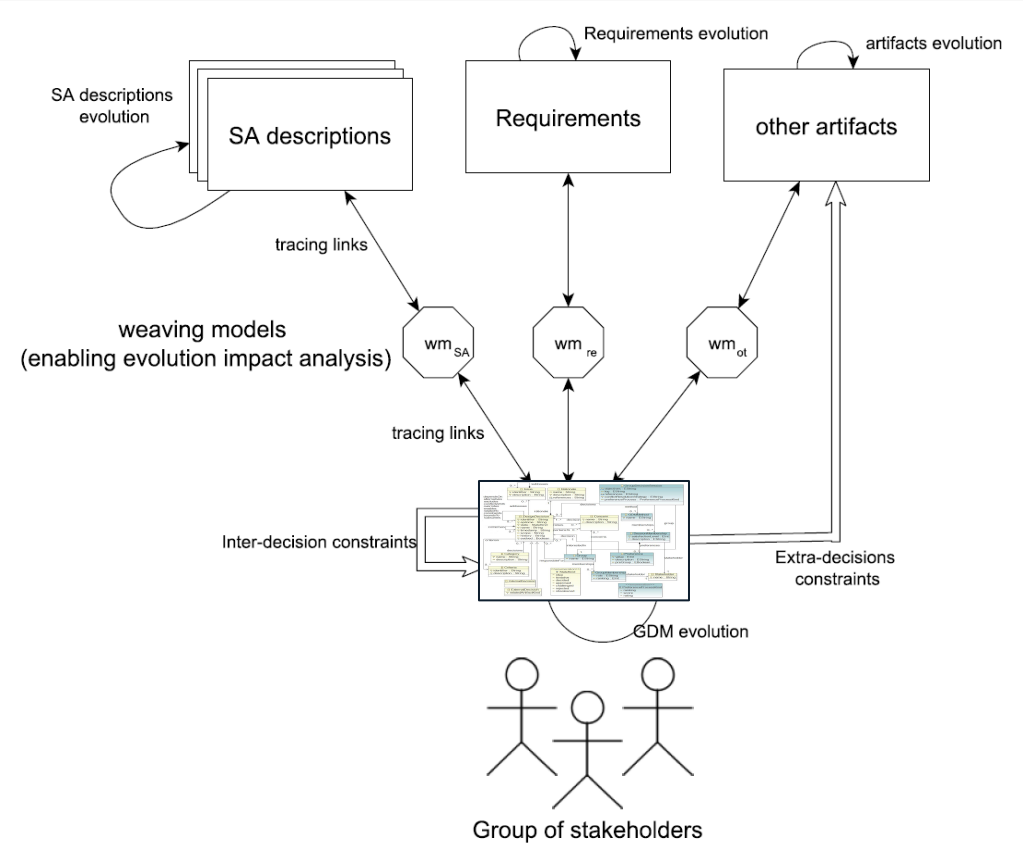
A. Reference Model for GDM



B. Traceability Links

Tracing design decisions to/from other artifacts

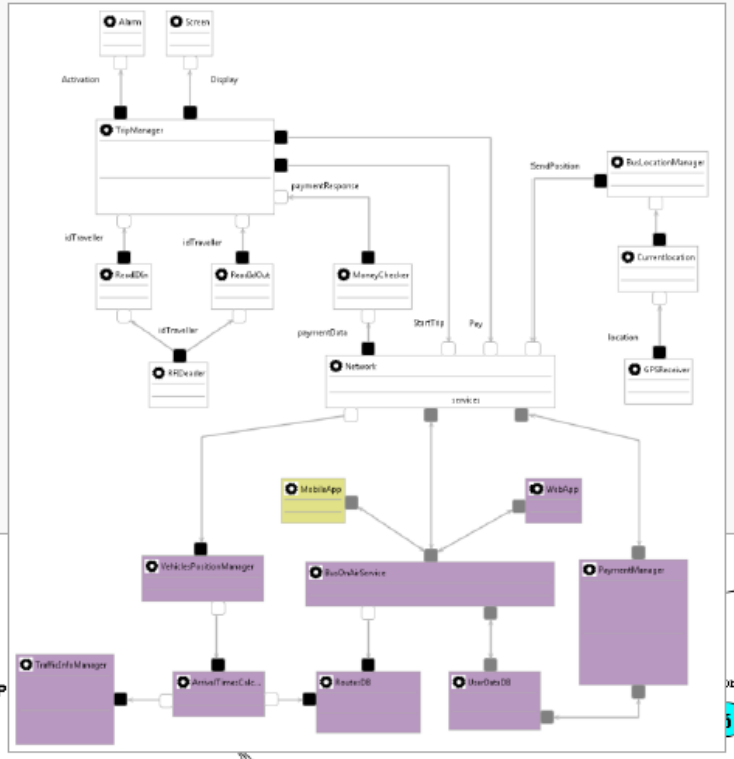
- We defined a DD weaving metamodel, to create traceability links among DDs and between DDs and other artefacts

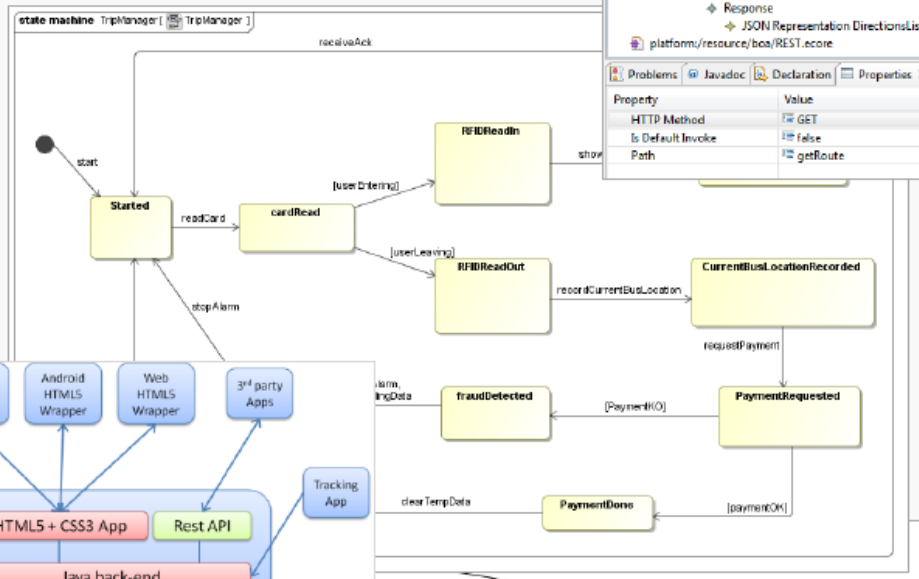


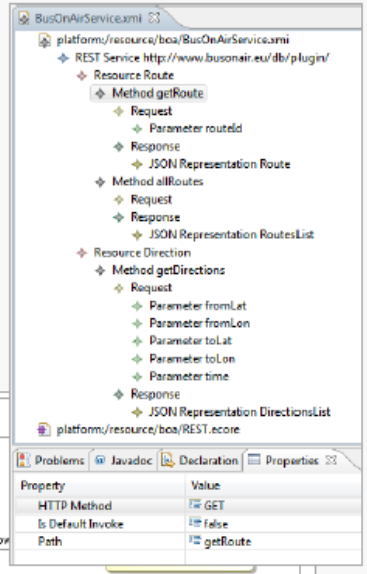
Why Linking Models together?

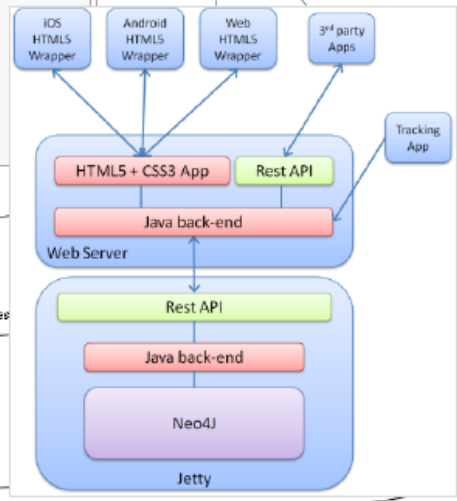
A system can be represented by “n” models

Each model focusses on a specific aspect





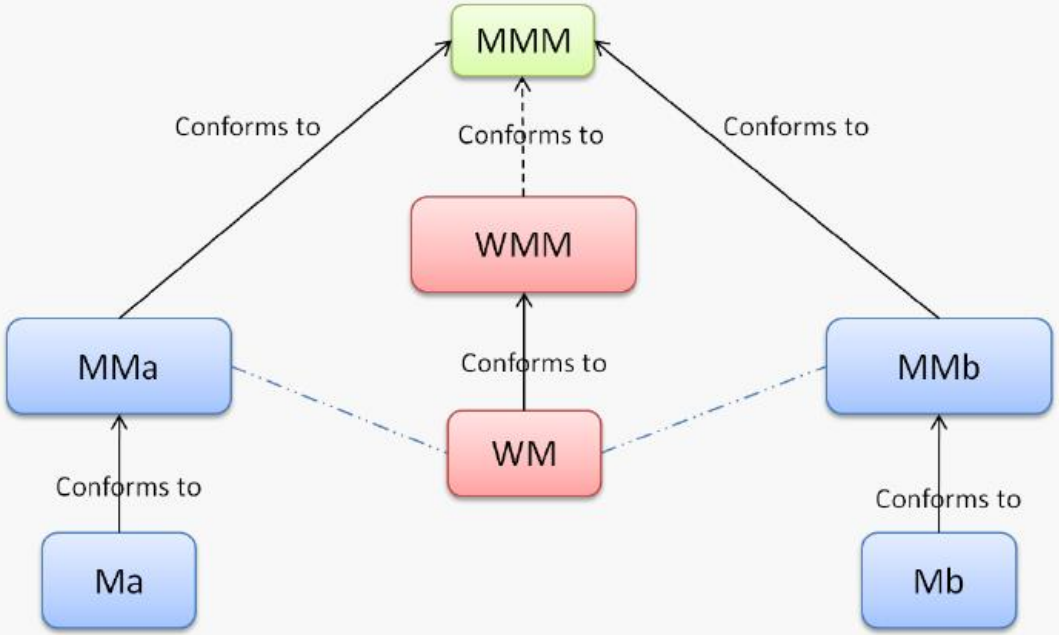




Weaving Models

Weaving models are special kinds of models that link together other models

In general a weaving model contains *a set of links* between elements of a model and elements of another model



Linked models are called **woven models**

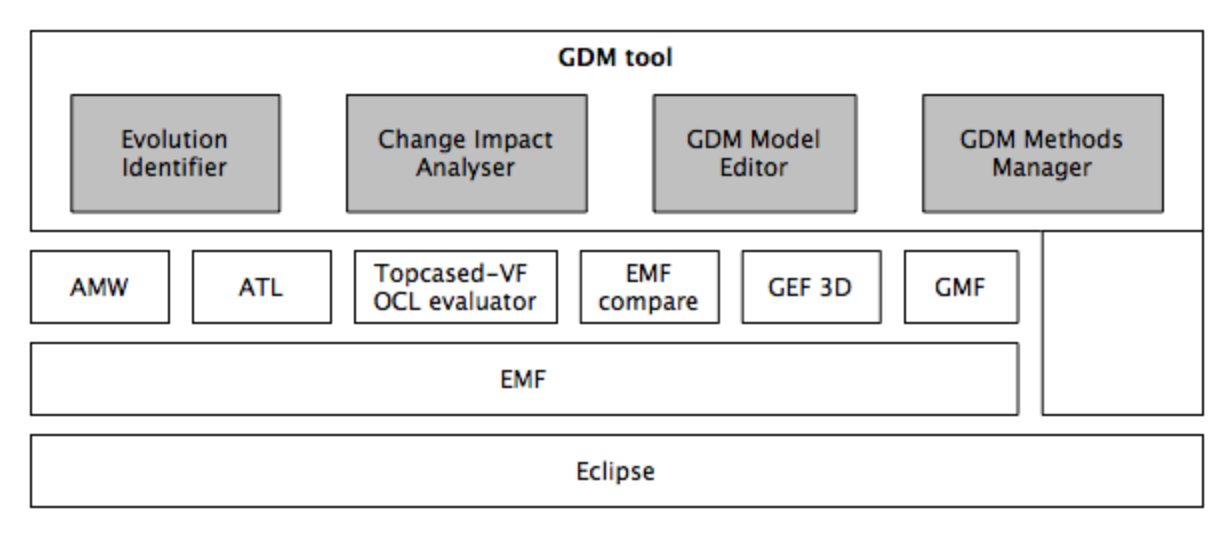
C. Change Impact Analysis

- OCL-based validation Engine
  - With new OCL constraints that can be defined for domain-specific validation purposes
- Inter-decisions constraints
  - E.g., all members of a group have to express at least a preference with respect to a design decision.
- Extra-decisions constraints
  - E.g., each design decision must be implemented by one (or more) components

Prototype Implementation

Implementation

- Eclipse plugin, extending the Atlas Model Management Architecture (AMMA)
- Atlas Model Weaver for the weaving models
- Four different GDM components



Wrap up

Robust architectures come from a robust decision-making process

- When an artifact evolves, its related GDM may evolve

Our GDM model enables to capture such evolution

- When a decision evolves, conflicts may arise and need to be managed
- Need of precise conflict resolution mechanisms, for rapid convergence
- Our approach supports multi-stakeholders awareness on the made decisions

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Thank you!

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