Method for Business Function Allocation and Interface Definition in System-of-Systems Architecture

Dr. Andrzej J. Knafel
**System-of-Systems Architecture**

*Session introduction*

**SITUATION**

Existing system-of-systems (public transport systems)
various functionality (e.g., up-hill transport, luggage capability)
various Quality Attributes (e.g., performance, weather dependency)
various interfaces (e.g., stations with escalators)

**LEARN**

How to implement process (moving from A to B)
using existing systems (tram, bus, train, cable car, ship)
or introducing new systems (bike rental)?

How to design the interfaces (stations, stops)?
System-of-Systems at Roche Diagnostics

Method Walkthrough

Experience Summary & Conclusions
Roche Diagnostics

Systems for In-Vitro Diagnostics
System-of-Systems

Example 1 of System-of-Systems at Roche

Total Laboratory Automation

- multiple pre-analytical* and post-analytical** systems
- multiple analytical*** systems connected by automatic specimen transport system
- controlled by software management system
- exchanging data with hospital IT systems and Roche IT

* centrifuges, aliquoters, sorters, …
** specimen storage, …
*** clinical chemistry, immunology, hematology, coagulation, …
System-of-Systems

Example 2 of System-of-Systems at Roche

Roche Remote Solutions

• multiple Roche enterprise IT systems (ERP, CRM, …)
• deployed on premises or in cloud to support multiple business processes
• exchanging data among them and with connected $n \times 10^6$ devices at customer sites worldwide
System-of-Systems

Definition

System-of-systems is a system in which its components:

- Fulfill valid purposes in their own right, and continue to operate to fulfill those purposes if disassembled from the overall system

- Are managed (at least in part) for their own purposes rather than the purposes of the whole; the component systems are separately acquired and integrated but maintain a continuing operational existence independent of the collaborative system.

Reference: "The Art of Systems Architecting" (Maier 2000) by Maier and Rechtin
System-of-Systems at Roche Diagnostics

Method Walkthrough

Experience Summary & Conclusions
System-of-Systems Architecture

Overview of Roche Customized Method

Business Function Allocation and Interface Definition

- Supports decisions of allocation of business functions to specific system components.
- Defines interface design baseline
  - Events
  - Data resources
- Consists of six steps with descriptions and criteria
System-of-Systems Architecture
Roche Customized Method – Organization

Documentation of each step
- participants
- pre- / post-conditions as entry / exit criteria
- input / output artifacts
- activities

Participants summary
- Core-team for each business (sub-)process:
  - Business Analyst
  - Architect
- Extended-team as knowledge source & reviewer
  - Stake-holders
  - Architects of involved systems

Table form based on SEI – ATAM® Reference Guide (ARG) Version 9.3
System-of-Systems Architecture

Roche Customized Method – Walkthrough

- Business drivers
- Value stream
- Business capabilities
- Business functions
- User stories
- Workflows
- Constraints
- Known Issues
- Quality Attributes

IDM Workflow X

IDM Workflow Y

IDM Workflow Z
System-of-Systems Architecture

**Roche Customized Method – Walkthrough**
Integrated dynamic model (based on DoDAF Conceptual Data Model)

EVENTS trigger ACTIVITIES performed by PERFORMERS to produce and consume RESOURCES in LOCATIONS under specified RULES and CONDITIONS

System-of-Systems Architecture
Roche Customized Method – Walkthrough
System-of-Systems Architecture
Roche Customized Method – Walkthrough

Derivation from the model:
- EVENTS, RESOURCES & LOCATIONS – primary focus for interface design
- PERFORMERS, ACTIVITIES, RULES & CONDITIONS – functionality allocation

![Diagram showing the relationships between Performer, Event, Activity, Resource, and Location with a table listing elements like Name, Type, and Description]
System-of-Systems Architecture
Roche Customized Method – Walkthrough
System-of-Systems Architecture
Roche Customized Method – Walkthrough

Alignment of IDM elements

Work activities
- Joint core teams (Business Analysts + Architects)
  - Identify IDM elements of common concerns
  - Align elements of common concerns
  - Consolidate elements of common concerns and elaborate corresponding list/table
- Optional: each individual core-team
  - Update the IDMs to reflect alignment

Output
- List/table of aligned elements of common concerns based on all elements from IDMs for all relevant workflows
System-of-Systems Architecture

Roche Customized Method – Walkthrough

- Events
- Activities
- Functionality catalog
- Functionality overlap
- Missing functionality
- Resources
  - Data
  - Processors

Is Business Process fulfilled?

Are Quality Attributes fulfilled?

Architecture:
- Data Model
- Process Model
- Deployment Model
- ...

Interface(s) design

Continue Design & Implementation
System-of-Systems Architecture
Roche Customized Method – Walkthrough

Business Function Identification and Allocation

- Evaluation of options for function allocation according to business criteria
- High level overview of business process realization by participating systems
  - Functionality allocated to systems
  - Data object resources & their locations
  - Data processor resources
  - Events for intra- & inter-system transfers
- Fulfillment of business process objectives and constraints verified by the stakeholders
System-of-Systems Architecture

Roche Customized Method – Walkthrough

- Events
- Activities
  - Functionality catalog
  - Functionality overlap
  - Missing functionality
- Resources
  - Data
  - Processors

Is Business Process fulfilled?

Architecture:
- Data Model
- Process Model
- Deployment Model
- ...
- Interface(s) design

Are Quality Attributes fulfilled?

Continue Design & Implementation
System-of-Systems at Roche Diagnostics

Method Walkthrough

Experience Summary & Conclusions
System-of-Systems Architecture

Experience Summary & Conclusions

- Applied at Roche to business processes related to Remote Solutions and IoT
- Quick definition of models and deriving of data thanks to small core-teams
- Good support of decision making process
  - identification of common resources - data object catalog and glossary
  - allocation of business functions and resources to existing and to be developed systems
  - identification of events and transfer resources for interface design
Doing now what patients need next