MBSE-IT Final Presentation

MBSE-IT Team

07.02.2024

CGI

Agenda

- Introduction

- Activities

- GSEF updates

- Demo

- Conclusion

Introduction

- Background
- Objectives
- Benefits
- Timeline
- Team

Introduction – Background

- MBSE-IT – Digital ground segment management through integrated MBSE and IT provisioning.

- Separation of ground segment system development teams and IT infrastructure teams results in loose coupling of information such as physical or virtual resources supporting a particular mission (not easily queried).

- The main idea of this activity was to provide a digital link between ground segment systems and the infrastructure on which the software is deployed.

- Potential users – flight control team of a mission, MOI-IT service managers or engineers, the data system manager of a given mission, etc.
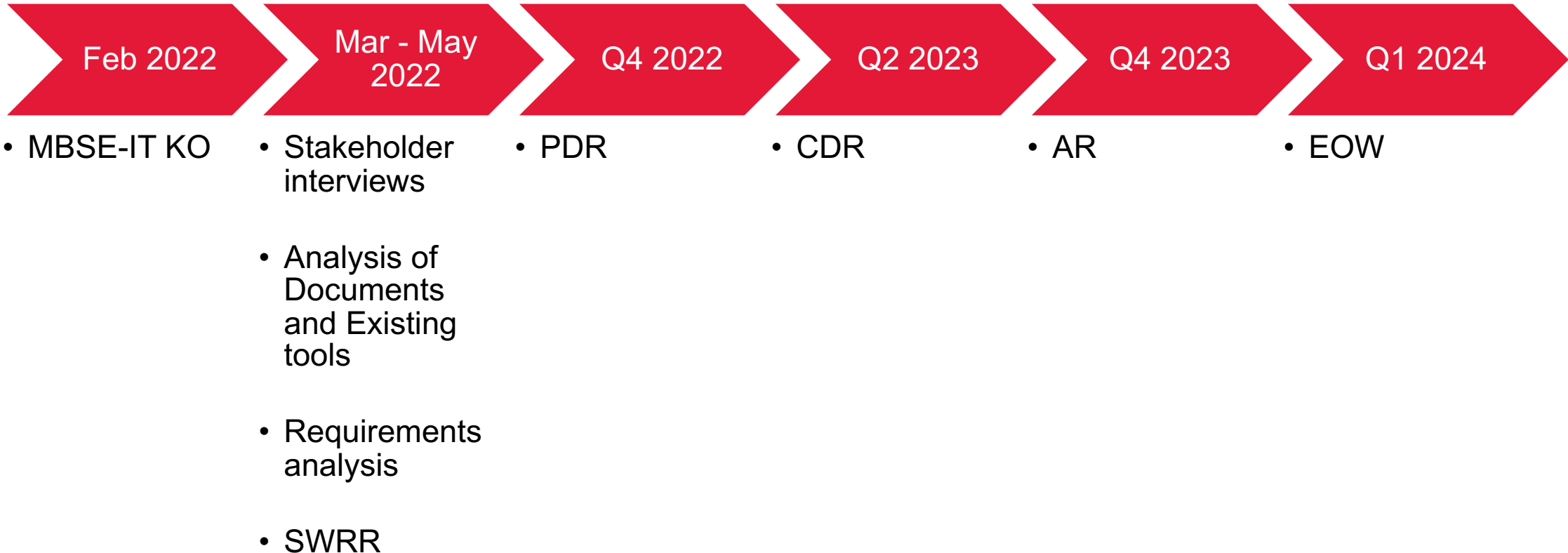
Introduction – Objectives

- Analysis and improvement of existing approaches capturing software system deployment information within ESOC.

- Extension of the GSEF system models to capture the physical architecture / deployment viewpoint.

- Provide a query-able mapping of functional models / software to the associated physical IT infrastructure (including the networking elements).

- Develop the integration of the resulting modelling environment with external information sources and other domain specific tools.

Introduction - Benefits

- The provision of a holistic view of the system with traceability across functional and logical architecture through to physical architecture, offering a single source of truth for the overall system design, configuration and deployment, including also software and operating system baseline versions.

- Improved resource utilization forecasting and clarity on deployment plan and deployment status.

- Ability to have a machine-readable and query-able, bi-directional link between IT systems and ground segment software deployment.

- Overview of which IT systems and infrastructure is used by each ground segment software system at any time.

- Enabling impact analyses of unavailability of systems e.g. of planned or unexpected downtime or of security incident occurrence on IT infrastructure verses the resulting mission / functional impact.

Introduction – Timeline

Feb 2022	Mar - May 2022	Q4 2022	Q2 2023	Q4 2023	Q1 2024

- MBSE-IT KO

- Stakeholder interviews

- Analysis of Documents and Existing tools

- Requirements analysis

- SWRR

- PDR

- CDR

- AR

- EOW

Introduction – Team

- Project Consortium

  - CGI (Estonia and Germany)

    - Interviews and tool analysis

    - Development

  - SpaceCube (Germany)

    - Focus on MBSE-IT domain meta model

    - Support development

- ESOC TO Petros Pissias

  - Supported by Marcus Wallum

- Other stakeholders

  - Interviews

  - Existing tools

Introduction – GSEF

- Ground Segment Engineering Framework

- Community licenced collaborative web-based model-based system engineering (MBSE) framework

- Supports users in a transition from paper-based engineering processes to a single digitalised platform

- Developed by CGI Estonia, SpaceCube, and Solenix

Introduction - GSEF Features

- Collaborative web based model editing environment

- SysML v2 based core GSEF Domain Model Library

- Model-based formal review process

- Document generation and editing

- SysML v2 REST API

- Reuse through libraries and SysML level extensions

- Model browsing and query capabilities

- History, tagging and branching support

- Model based comparisons

- Project-based security

MBSE-IT Activities

- Review of mission IT management
- Review of existing tools
- Requirement analysis
- Development

Activities – Review of mission IT management (1)

Mission representatives

- EUCLID - Astronomy & Physics

- AEOLUS - Earth Observation

- SOLO - Interplanetary & Solar Systems

- EGOS-MG – considering multi-mission approach

Analysis was based on relevant documents (GCCP, SDD, MCS Operational Concept, ...)

Interviews with representatives to understand the needs, the flows and to collect feedback for target scenarios for GSEF

Results were captured as requirements

Activities – Review of existing tools

Existing tools used for IT management at ESOC

- DASP

- CoCKPIT/UCMDB

- ECDB

Based on the analysis, requirements were derived for:

- Suitable meta model

- User interactions

- The level of integration

Report available in Technical Note

Activities – Review of mission IT management (2)

Results:

- Generally diagrams and tables are used to convey information
- There is no standard way of presenting the IT infrastructure information
  - There are similarities and differences for the approaches (e.g. what are the relevant documents) and captured info (e.g. availability of HW specification)
- Mix of concepts (system vs function vs component) makes completeness and traceability complex to follow
- Inter-related information is scattered over multiple documents
  - Also half-repetition across documents
- Multi-mission approach needs to be represented on the meta model level

Report available in Technical Note

Activities – Requirement analysis

- Based on the input

    - Mission IT management analysis

    - Existing tools analysis

    - Existing requirements from ADGE

Requirements evaluation:

- New requirements to cover meta model and domain specific integration

- Existing requirements identified from the ADGE project that were relevant and high priority for MBSE-IT

Activities – Development

- Based on existing GSEF code base from ADGE

- Document updates for baseline in SOCCI Confluence

- Using Codev platform for source code and code reviews

- CGI internal infrastructure for build, dev and test environments
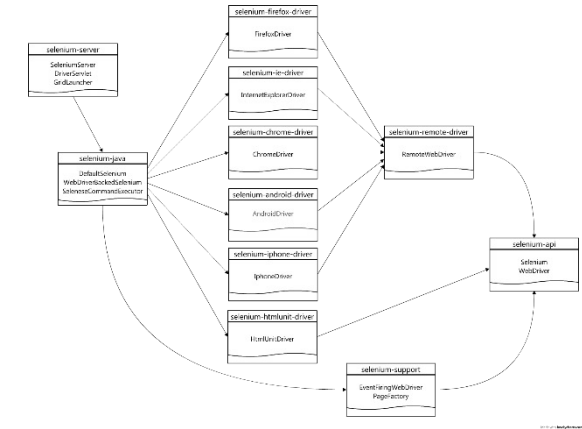
GSEF Updates

Libraries

Example project

Server side jobs

Other GSEF improvements

GSEF Updates – Libraries (1)

In GSEF provisioning and maintaining libraries:

- Needs to be supported by an expert
- Provide additional domain meta models
  - Can refer to Core meta model or any other dependencies
  - UI configuration for the meta model
  - Example:
    Provide a project specific requirement type extending the Core requirement and additionally defining project-specific attributes
- Provide reference elements
  - Generic elements intended to be reused by extending existing templates and tailoring them for current context
  - Examples: SFIRD, GOIRD

GSEF Updates – Libraries (2)
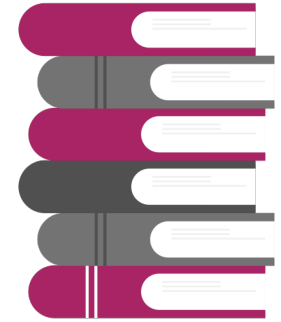
MBSE-IT generic updates to libraries:

- After adding libraries to the project, the project UI configuration is merged
  - meta model elements from the newly added library are added to the right-click context menu
- System libraries can contain engineering model with elements
  - The elements are available in the project model tree under the library
  - table views with queries can now be published with a library
  - documents with static resources like stylesheets and images can be maintained as part of system libraries

GSEF Updates – Libraries (3)

MBSEIT library:

- IT infrastructure metamodel
- Stored table views for basic reports

SFIRD library:

- Contains an example metamodel for maintaining SFIRD catalog services
- Example SFIRD document with queries for parameter values

GSEF Updates – MBSEIT Example project

- Example entities to demonstrate MBSE-IT meta model
  - Services, deployments, functions, etc

- Example SFIRD services document
  - Chapter 2.1 - Requirements per service
  - Chapter 3 Appendix A – single table of all parameters

- Example Freeze note using topics
  - Annex A – target items grouped/filtered by topic/tag

GSEF Updates – Server side jobs (1)

- New plugin based extension mechanism for GSEF
- Can extend functionality outside of original provided system scope
  - The execution is on server side
  - Examples: Gitlab integration for test reports, Jira integration for syncing issues
- Plugins can be provided by adding them to the Data Access Server classpath
  - Implementation for the factory and adapter

- Web UI provides a method to instantiate the adapter with a user provided name, description and configuration
  - Configuration is adapter specific
  - Jobs are triggered by the user

GSEF Updates – Server side jobs (2)

CoCKPIT data import

- Based on PowerBI CSV export

- Steps:

  - Export and filter the data to be imported

  - Attach the raw data to a model element

  - Configure and trigger the CoCKPIT import job

  - Download the generated files

  - Import the persons, projects, software hosts to the engineering model with the provided import configurations

GSEF Updates – Other GSEF improvements

- CSV import/export

  - Composite features not listed in feature list

  - Export table view as CSV

- Derived relations

  - Enable type specific queries

Demo

Conclusion

Objectives coverage

Next steps

Objectives coverage

Objective 1: Analysis of existing approaches to capturing software system deployment information within ESOC

<u>Fulfilled</u>

Objective 2: Extension of the GSEF system models to capture the physical architecture / deployment viewpoint

<u>Fulfilled</u>

Objective 3: Provide a query-able mapping of functional models/software to the associated physical IT infrastructure

<u>Fulfilled</u>

Objective 4: Develop the integration of the resulting modelling environment with external information sources and other domain specific tools

<u>Fulfilled</u>

Conclusion - Next steps

- MBSE-IT output published with an ESA community license

  - Available on [CODEV platform](#) ; [adgedev.eu](#)

- Backlog of issues in SOCCI Jira

  - Subject to re-visit in future activities

- Related projects:

  - Digitalisation of Ground Segment and Operations Integration in Early Phase 0/A Studies (DSGO-A; ESA Basic Activity)

  - ITT GOF9

  - GT1D-605GD Integrated web-based digital engineering framework software (GTSP 2022 Compendium)

    - Opportunity to follow up on the developments and build on the experience gained by the ADGE team

Thank you

Questions?

Contacts

Petros Pissias petros.pissias@esa.int

Marcus Wallum marcus.wallum@esa.int

Hylle Kägu hylle.kagu@cgi.com

Martin Jüssi martin.jussi@cgi.com

Rauno Ots rauno.ots@cgi.com

Anton Perepelenko anton.perepelenko@cgi.com

Todor Stoitsev t.stoitsev@space-cube.de