

Deliverable D4.2 Arrowhead Tools toolchain design

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Abstract

This document constitutes deliverable D4.2 of the Arrowhead Tools project. The main objective of this document is providing a tool chain architecture design and reference definition for WP5, which is devoted to the definition and the implementation of the tools. This is achieved by providing a proper definition of the basic concepts, an examination of each use case from the toolchain point of view and an analysis of the semantic concepts that revolve around the project.

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1. Introduction

The toolchain reference aims at providing an overview of all parts contributing to the Arrowhead Tools development and maintenance toolchain. The project itself proposes an extension of IEC 81346 automation engineering model, called further the extended automation engineering model (EAEM). The described parts are accommodated within EAEM through appropriate mapping. Within each functional block of the toolchain, examples of suitable tools are provided. Further, the means of providing a well-integrated toolchain with efficient transfer of engineering data from one tool to another is described. The toolchain shall be flexible and possible to rearrange in a simple way.

More in detail, the objective of WP4 at large is given by two major points:

- [T4.1] Provide a toolchain architecture that:
 - Supports engineering both in design time and run time
 - Is in-line with the engineering process defined in WP2
- [T4.2] Investigate toolchain architecture and feasibility of tool data semantics like e.g. OSLC and others

This deliverable document addresses the objectives defined in Chapter 2, further strengthened by the advances of Y1, by:

1. Providing a definition of the concepts of tool, toolchains, and extended engineering process.
2. Providing the best practices for defining tools within a toolchain and their compatibility with the Arrowhead Framework.
3. Providing an evolved definition of the toolchain architecture for each vertical use case in the project, updated after the final demos of Y1.
4. Providing a definition and best practices for semantics within the project and an analysis of the semantic concepts that are proposed to be used within the project and their purposes.
5. Providing an extensive description of toolchains developed impartially, without a specific association with a use case (this is split into two documents).

2. Deliverable content

In this section the content of the deliverable is shortly described with appropriate links for specific documents. The content has been divided into definitions, architecture, and semantics.

2.1 Deliverable content: A definition of Arrowhead toolchains

2.1.1 Objectives

This table shows which objectives are addressed by this part of the deliverable and how these are supported.

Objective	Contribution
O1: Identifying and explaining core AHT architectural concepts	A document with definitions of Arrowhead tools, toolchains, and design principles

Initial definitions for the Arrowhead Tools design principles

1.1.1 Content

The definition of the Arrowhead Tools toolchains basic concepts has been initially carried out during a physical meeting that took place in Gdansk between leaders and co-leaders of WP3, WP4 and WP5 and has been further strengthened by the contributions of leaders of WP1 and WP2. In the beginning of Y2, a scientific paper has been published with these concepts which have evolved since the beginning of the project.

The content of **O1** is elaborated in Appendix 1.

1.2 Deliverable content: Architecture

1.2.1 Objectives

This table shows which objectives are addressed by this part of the deliverable and how these are supported.

Objective	Contribution
O2: Outlining the best practices for defining Arrowhead tools	This document is a collection of definitions as well as best practices when defining and describing Arrowhead tools
O3: Evaluating the use cases in terms of their toolchains and mapping them to the proposed engineering process	In this document, each use case is analyzed in terms of its tools and their mapping to the proposed engineering process. These toolchains are analyzed with respect to the toolchains (if present) before the project with a specific focus on which gap they aim to fill.

1.2.2 Content

In order to gather information from each and every use case in the project, WP4, together with WP1 and WP2, provided all the AHT partners with a survey that was intended to gather a detailed description of the use cases, in particular:

- The use case baseline
- The engineering process adopted, and the modifications needed
- The tools that are currently used in the baseline and the explicit statement of the gaps in the toolchain together with the new declared tools that are intended to cover such gaps.
- The standards used by each use case.

- The survey can be found in D1.2

WP4, with the collaboration of WP2, provided then the document O2, that is intended to facilitate and homogenize the declaration of new tools in the toolchain.

The responses of the Use Case leaders have been hard to obtain on time, and it needed more than one round due to misunderstandings. The results of the analysis of the survey from the WP4 side are reported in O3, which outlines, for each use case, the use case overview, the identified gaps and the definition of the proposed tools according to the best practices proposed in O2.

The contents of **O2** and **O3** are elaborated in Appendices 2 and 3, respectively.

1.3 Deliverable content: Semantics

1.3.1 Objectives

This table shows which objectives are addressed by this part of the deliverable and how these are supported.

Objective	Contribution
O4: Evaluating semantic models for interoperability	This document contains an explanation of how different semantic approaches serve as the basis of interoperability in the Arrowhead Tools project and a set of semantic models proposed from the partners in T4.2.
O5: Providing a full-fledged semantic approach	This document contains a solution towards providing semantic capability to the use cases in the project.
O6: Providing general-purpose toolchains	This document focuses on toolchains that are not bound to any use case, rather they are intended to serve multiple use cases.

1.3.2 Content

The definition and best practices for semantics in the AHT project have been defined by the WP4 and T4.2 leaders in order to give a guideline to all the partners involved in the semantics definition. The single contributions from T4.2 members are then collected and reported by T4.2 leader in the O4 and O5 documents, through the help of weekly calls. O6 has been filled through incremental contributions.

The contents of **O4**, **O5** and **O6** are elaborated in Appendices 4, 5 and 6, respectively.

2. Appendices

1. Appendix 1: O1 AHT Definitions.docx
2. Appendix 2: O2 AHT Best Practices
3. Appendix 3: O3 AHT use case analysis
4. Appendix 4: O4 The Arrowhead Tools Data Semantics Catalogue: An Initial Evaluation
5. Appendix 5: O5 Semantic Interoperability and Ontology Design
6. Appendix 6: O6 General-Purpose Toolchains

3. References

1. D1.2, an input to this deliverable:
<https://atmospheres.research.ltu.se/owncloud/index.php/f/1889797>
2. D2.1, an input to this deliverable:
<https://atmospheres.research.ltu.se/owncloud/index.php/f/1517380>
3. D3.2, an input to this deliverable:
<https://atmospheres.research.ltu.se/owncloud/index.php/f/1462677>

4. Conclusions

The work has progressed at a constant pace, proper contributions have been again hard to get in the first place, nonetheless, the deliverable has now reached a satisfactory status and all the use cases are on track and have provided a first definition of their toolchain, a primary goal of this document. The outcome of such difficulties is a slightly delayed delivery, however, the objective of this second milestone has been reached, as now the evolved and multi stakeholder toolchains have been defined for each demonstrator. This does not affect negatively subsequent phases in the delivery process within this project, in fact the delay of Y1 has been reduced by 1 month.

The distinction of Definitions, Architecture and Semantics organizes the content of the deliverable into three pillars, on which each toolchain is founded. The definitions are provided to have a common understanding of the basic concepts consortium-wide. Architecture consists of representative examples, how the definitions can be applied in the context of toolchain integration, while the O3 document presents approaches coming from the use cases. Finally, to manage the data exchange between subsequent tools, one of ontologies should be applied, and adequate semantic representation of the data is desired to obtain a true interoperability. Only connection of these three elements can be a base for achieving the interoperability between different systems, and thus – multi-stakeholder operation. Without common vocabulary, understanding of systems' architecture and semantic representation of data (explaining the data passed between systems) this would not be possible.

5. Revision history

5.1 Contributing and reviewing partners

Contributions	Reviews	Participants	Representing partner
X		DAC	Marek Tatara
X		IUNET	Federico Montori
X		IQL	Géza Kulcsár
	X	IQL	Ákos Horváth
	X	IFAG	Patrick Moder
	X	Wapice	Laurentiu Barna

5.2 Amendments

No.	Date	Version	Subject of Amendments	Author
1	2020-10-26	1.1	Insertion of new material	Federico Montori
2	2020-11-02	2.0	Review and sanity check	Marek Tatara, Federico Montori
3	2020-11-25	2.0	Internal Review	Patrick Moder
4	2020-12-02	2.0	Internal Review	Laurentiu Barna
5	2020-12-03	2.1	Addressing comments of the internal reviewers	Federico Montori, Marek Tatara

5.3 Quality assurance

No	Date	Version	Approved by
1	2020-12-08	2.1	Jerker Delsing