

# SmartDelta

## Automated Quality Assurance and Optimization in Incremental Industrial Software Systems Development

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### D6.5 - SmartDelta Training Materials

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Edited by: Miguel Ángel Calero and Carlos Pérez del Molino (IZERTIS)

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<b>Project coordinator</b>	Dr. Mehrdad Saadatmand, RISE Research Institutes of Sweden
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<b>Project website</b>	<a href="https://itea4.org/project/smartdelta.html">https://itea4.org/project/smartdelta.html</a> & <a href="https://smartdelta.org/">https://smartdelta.org/</a>
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<b>Work package leader</b>	Miguel Ángel Calero. IZERTIS S.A
<b>Dissemination level</b>	Public
<b>Description</b>	This deliverable provides a summary of the main training materials developed in the SmartDelta project.

## Executive Summary

This document, **Deliverable 6.5 "SmartDelta Training Materials"**, provides a centralized inventory of the training resources developed to support the adoption and effective use of the SmartDelta project's results. The SmartDelta project aims to improve software quality and efficiency through automated analysis, delta-oriented techniques, and enhanced reuse of software artifacts.

The main goal with this deliverable is to provide a summary of the main the training materials and information on how to access them. The materials themselves are hosted externally, primarily on partner websites, repositories, and video platforms.

This document includes:

- **A brief overview of the training objectives and expected benefits**, aligned with the overall goals of the SmartDelta project.
- **A structured inventory of available training materials**, categorized into:
  - User Manuals and Technical Documentation
  - Presentations and Dissemination Materials
  - White Papers, Videos, and Tutorials
  - Workshops and Practical Training
- **Direct links to the location of each training material**, enabling users to easily access the resources.
- **Contact information** for the individuals or teams responsible for each material, facilitating further inquiries.

The training materials encompass a variety of formats, including user guides, technical documentation, presentations, videos, tutorials, workshop materials, and practical exercises. They are targeted at various user groups, including developers, QA engineers, project managers, and researchers.

This deliverable **represents a snapshot of the available training materials at the time of submission**. The materials may be updated or expanded in the future. It is recommended to use provided the links within the document.

By providing this centralized inventory and direct access to the materials, **D6.5 aims to facilitate the effective utilization of SmartDelta's innovative solutions and contribute to the project's overall success in improving software development practices**. It also references that the Newsletters related to the project can be checked in SmartDelta's website.

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## 1. Introduction

The SmartDelta project aims to address the growing challenge of ensuring software quality in continuous engineering environments. As software systems become increasingly complex and development cycles accelerate, traditional quality assurance methods often struggle to keep up. This deliverable, D6.5, plays a crucial role in the SmartDelta project by providing a comprehensive set of training materials and dissemination activities to facilitate the adoption and utilization of the project's innovative solutions.

### 1.1. Purpose of the deliverable

The primary purpose of D6.5 is to empower various stakeholders with the knowledge and skills necessary to effectively leverage the SmartDelta methodology and tools for automated quality assessment and optimization in incremental industrial software systems development.

This deliverable will achieve this purpose by:

- Providing user manuals and technical documentation to guide users in the implementation and utilization of the SmartDelta software and tools.
- Developing engaging training presentations and dissemination materials to introduce the SmartDelta project and its key innovations to a wider audience, including companies, universities, and industry events.
- Offering videos and tutorials to demonstrate the capabilities of the SmartDelta software and provide step-by-step guidance on its practical application.
- Designing and delivering hands-on workshops and webinars to offer practical training and facilitate knowledge sharing among practitioners.

This document provides an inventory of training materials developed for the SmartDelta project, with links to access those materials.

### 1.2. Relationship with other project deliverables

Deliverable D6.5, focusing on training and dissemination, is closely interconnected with other project deliverables and work packages, forming a cohesive framework for achieving the SmartDelta project's objectives. The relationship between D6.5 and other project deliverables can be summarized as follows:

- **D1.1, D1.2, D1.3, D1.4, D1.5, and D1.6 (WP1 - Industrial Use-Cases):** These deliverables provide the foundation for D6.5 by defining the industrial use cases, their requirements, and evaluation criteria. The training materials and dissemination activities developed in D6.5 will be tailored to address the specific needs and challenges identified in these use cases, ensuring their relevance and applicability for industrial practitioners.
- **D2.1, D2.2, D2.3, D2.4, and D2.5 (WP2 - Model Generation and Evolution):** These deliverables focus on the development of automated solutions for identifying and extracting software artifacts, creating product models, and managing their evolution across different versions and builds. The training materials in D6.5 will incorporate the knowledge and tools developed in WP2, enabling users to effectively utilize these solutions for model generation and evolution.
- **D3.1, D3.2, D3.3, D3.4, and D3.5 (WP3 - Delta-oriented Quality Attributes Evaluation and Assurance):** These deliverables focus on the development of automated solutions for verifying and validating quality attributes, including model-based testing, static analysis, and delta-oriented testing. The training materials in D6.5 will incorporate the knowledge and tools developed in WP3, enabling users to effectively utilize these solutions for quality evaluation and assurance.

- **D4.1, D4.2, D4.3, D4.4, and D4.5 (WP4 - Quality Improvement Recommendations):** These deliverables focus on the development of novel methods for analyzing and predicting software quality trends, performing similarity analysis, and providing automated recommendations for quality improvement. The training materials in D6.5 will incorporate the knowledge and tools developed in WP4, enabling users to effectively utilize these solutions for quality improvement and optimization.
- **D5.1, D5.2, D5.3, D5.4, and D5.5 (WP5 - Visualization Dashboard and Integration):** These deliverables focus on the development of a visualization dashboard to illustrate quality degradation and improvement trends, enabling end-users to quickly and effortlessly understand when and where in the system issues with respect to quality characteristics have occurred. The training materials in D6.5 will incorporate the visualization dashboard and its functionalities, enabling users to effectively utilize these solutions for quality monitoring and analysis.

In essence, D6.5 serves as the bridge between the technical solutions developed in other work packages and the end-users who will benefit from these solutions. By effectively training and disseminating the SmartDelta project's results, D6.5 ensures that the project's innovations are adopted and utilized by a wide range of stakeholders, ultimately leading to improved software quality and efficiency in industrial software development.

### 1.3. Scope and target audience

Deliverable D6.5 encompasses a wide range of training materials and dissemination activities designed to cater to the diverse needs of various stakeholders involved in the development, deployment, and maintenance of industrial software systems. The scope of D6.5 extends to the following areas:

- **User manuals and technical documentation:** Providing comprehensive guidance on the implementation and utilization of the SmartDelta software and tools.
- **Training presentations and dissemination materials:** Introducing the SmartDelta project and its key innovations to a broader audience, including companies, universities, and industry events.
- **Videos and tutorials:** Demonstrating the capabilities of the SmartDelta software and providing step-by-step guidance on its practical application.
- **Workshops and webinars:** Offering practical training and facilitating knowledge sharing among practitioners.

The target audience for D6.5 comprises a diverse group of individuals and organizations involved in the software development lifecycle, including:

- **Software developers and engineers:** Those responsible for designing, implementing, and maintaining software systems.
- **Quality assurance and testing professionals:** Those responsible for ensuring the quality and reliability of software systems.
- **Project managers and team leaders:** Those responsible for overseeing and managing software development projects.
- **Researchers and academics:** Those involved in the research and development of software engineering tools and methodologies.
- **Industry practitioners and professionals:** Those interested in learning about and applying the latest advancements in software quality assurance and optimization.

- **Business stakeholders/decision makers:** Those involved in the governance of future stages.

## 2. General description of training materials

This section provides a high-level overview of the training materials developed for the SmartDelta project. These materials are designed to support the adoption and effective utilization of the SmartDelta framework and tools by various stakeholders involved in the incremental development of software-intensive systems..

### 2.1. Training objectives

The **primary training objectives for the SmartDelta project**, derived from the project's overall goals and the functionalities of its tools, are as follows:

- 1. Understanding:** Participants will be able to explain the core principles of delta-oriented quality assurance and describe how the SmartDelta framework addresses the specific challenges of quality management in incremental and continuous software development.
- 2. Model Generation/Extraction:** Participants will be able to demonstrate proficiency in using the SmartDelta methodology tools (developed in WP2 and described in Output 2) to create and manage models from diverse software artifacts, including requirements documents, code repositories, and test logs and to manage product deltas.
- 3. Quality Assurance:** Participants will be able to apply the SmartDelta quality assurance tools (developed in WP3 and described in Output 2) to conduct delta-oriented testing, static analysis, and consistency checking on a range of provided software artifacts.
- 4. Analysis & Recommendations:** Participants will be able to analyze the outputs of the SmartDelta quality improvement recommendation services (developed in WP4 and described in Output 3), identify potential quality issues, and formulate prioritized action plans.
- 5. Dashboard Interpretation:** Participants will be able to effectively navigate the SmartDelta visualization dashboard (developed in WP5 and described in Output 3), extract relevant quality metrics, and interpret the evolution of quality attributes across different software versions.

### 2.2. Expected benefits for end users

The SmartDelta training materials are designed to equip end-users with the knowledge and skills to leverage the project's innovative solutions, resulting in tangible benefits across several key areas. These benefits are directly linked to the project's overall goals and are supported by the methodologies and tools developed within SmartDelta.

#### Increased Efficiency

- **Reduced Time Spent on Manual Reuse Analysis:** SmartDelta's automated reuse analysis tools, enable developers to quickly identify reusable components from previous projects and product versions. This significantly reduces the time and effort required for manual analysis, streamlining the development process.
- **Faster Identification of Relevant Test Cases:** By employing delta-oriented testing techniques (developed in WP3), QA engineers can prioritize their testing efforts. The

training materials demonstrate how to use these techniques to focus on the parts of the system that have been modified or impacted by changes, reducing the overall testing time and ensuring efficient resource allocation.

- **Automated Model Generation:** The methodology, materials and training provided on automated model generation (WP2), allow users to create and use models from different software artefacts, reducing the need for manual modelling.

### Improved Software Quality

- **Earlier Detection of Defects:** The training emphasizes the use of SmartDelta's automated analysis and V&V tools. Users will learn how to apply these tools to identify defects early in the development lifecycle, minimizing the cost and effort associated with fixing them later.
- **Enhanced Test Coverage:** The training materials cover model-based testing techniques (developed in WP3). Participants will learn how to generate comprehensive test suites that effectively cover the functionality of the system, including variations and deltas, leading to fewer defects in released software.
- **Better management of Non-Functional Requirements:** The training describes how SmartDelta specifically addresses non-functional properties, also named extra-functional properties, which are a group of requirements very related to the perceived quality of the system.

### Reduced Costs

- **Lower Development and Maintenance Costs:** By automating key tasks (reuse analysis, test case generation, defect detection), SmartDelta significantly reduces the manual effort required for software development and maintenance. The training materials equip users with the skills to implement these automated processes, leading to direct cost savings.
- **Less rework:** The tools and techniques showed in the training materials help in detecting defects and improvement opportunities earlier.

### Mitigated Risks

- **Reduced Risk of Software Failures:** The improved quality assurance processes facilitated by SmartDelta, as taught in the training, minimize the risk of releasing software with critical defects. This protects the company's reputation and avoids costly recalls or rework.

### Competitive Advantage

- **Improved Risk Management:** The SmartDelta training materials teach users to reduce risk, in both development and market offering, reducing the impact of mitigation measures.

## 2.3. Methodology used for developing the materials

The training materials for SmartDelta were developed through a collaborative and iterative process involving the project partners. The primary focus was on creating practical, user-centered resources that directly support the application of SmartDelta's tools and methodologies.

The development process broadly followed these key steps:

- **Needs Identification:** Training needs were identified based on the project's use cases (WP1), the functionalities of the developed tools (WPs 2-5), and the expected roles of different user groups.
- **Content Creation:** Partners with relevant expertise created materials in various formats (user guides, presentations, videos, etc.) to address the identified needs. The emphasis was on clear explanations, practical examples, and direct applicability to real-world scenarios.
- **Iterative Review and Refinement:** Materials were shared among partners for review and feedback, ensuring consistency and accuracy. This iterative process allowed for continuous improvement and refinement based on input from various stakeholders.
- **Centralized Access:** The materials and its links will be made available through a simple and centralized way.

The project aimed to leverage existing best practices in software engineering training, adapting them to the specific context of SmartDelta. The overall approach prioritized hands-on learning and the ability for users to quickly apply the project's results in their own work.



### 3. User Manuals and Technical Documentation

Material Title	Type (User Guide / Tech Doc / Use Case / Example)	Target Audience	Partner Responsible	Contact Person	Location (URL)	Related Use Case
NALABS Training Demo	User Guide and Tech Doc	Researchers and Industry	MDU, ADDIVA	<a href="mailto:eduard.paul.enoiu@mdu.se">eduard.paul.enoiu@mdu.se</a>	<a href="https://youtu.be/bvS1BWlpn04?si=ZnueiECUI-M34_Qd">https://youtu.be/bvS1BWlpn04?si=ZnueiECUI-M34_Qd</a>	Alstom
DRACONIS Training Material	User Guide and Tech Doc	Researchers and Industry	MDU, Alstom	<a href="mailto:jean.malm@mdu.se">jean.malm@mdu.se</a>	<a href="https://github.com/jean-malm-mdh/draconis">https://github.com/jean-malm-mdh/draconis</a>	Alstom
Test Effort Estimator Training Material	Use Case and Example	Researchers and Industry	MDU	<a href="mailto:eduard.paul.enoiu@mdu.se">eduard.paul.enoiu@mdu.se</a>	<a href="https://github.com/eduardenoiu/Test-Effort-Estimator/">https://github.com/eduardenoiu/Test-Effort-Estimator/</a>	
PyLC User Guide	User Guide and Tech Doc	Researchers and Industry	MDU	<a href="mailto:mikael.salari@mdu.se">mikael.salari@mdu.se</a>	<a href="https://github.com/MikaelSalari/PyLC">https://github.com/MikaelSalari/PyLC</a>	Alstom
GW2UPPAAL Training Material	User Guide and Tech Doc	Researchers	MDU	<a href="mailto:eduard.paul.enoiu@mdu.se">eduard.paul.enoiu@mdu.se</a>	<a href="https://youtu.be/EtsJ-GNSjJM?si=PjEvQ_fJmh_OgEEK">https://youtu.be/EtsJ-GNSjJM?si=PjEvQ_fJmh_OgEEK</a>	
SoHist	Use Guide	Researchers and Industry	UIBK	<a href="mailto:benedikt.dornauer@uibk.ac.at">benedikt.dornauer@uibk.ac.at</a>	<a href="https://github.com/bdornauer/sohist">https://github.com/bdornauer/sohist</a>	c.c.com

### 4. Presentations and Dissemination Materials

Material Title	Type (Presentation/Brochure/Poster/Newsletter/Podcast)	Target Audience	Partner Responsible	Contact Person	Location (URL)	Event/Conference (if applicable)
Making Sense of Failure Logs in an Industrial DevOps Environment	Presentation	Researchers and Industry	RISE, Westermo	<a href="mailto:abbas.khan@ri.se">abbas.khan@ri.se</a>	<a href="https://www.es.mdu.se/pdf_publications/6604.pdf">https://www.es.mdu.se/pdf_publications/6604.pdf</a>	ITNG23
Requirement or Not, That is the Question: A Case from the Railway Industry	Presentation	Researchers and Industry	RISE, Alstom	<a href="mailto:abbas.khan@ri.se">abbas.khan@ri.se</a>	<a href="https://www.es.mdh.se/pdf_publications/6625.pdf">https://www.es.mdh.se/pdf_publications/6625.pdf</a>	REFSQ2023

Requirements Classification for Smart Allocation: A Case Study in the Railway Industry	Presentation	Researchers and Industry	RISE, Alstom	<a href="mailto:abbas.khan@ri.se">abbas.khan@ri.se</a>	<a href="https://www.es.mdu.se/pdf_publications/6697.pdf">https://www.es.mdu.se/pdf_publications/6697.pdf</a>	RE2023
Code Similarity Investigator Demonstrator	Presentation for aquisition meetings	Industry	TWT	<a href="mailto:philippe.mauri@twt-gmbh.de">philippe.mauri@twt-gmbh.de</a>	internal	
Gaps in Software Testing Education: A Survey of Academic Courses in Sweden	Presentation	Researchers , Educators, Software Testing Practitioner s	MDU	Eduard Paul Enoiu	<a href="http://www.es.mdu.se/publications/7116-">http://www.es.mdu.se/publications/7116-</a>	IEEE Conference on Software Engineering Education and Training
Automated Test Generation: Taxonomy and Tool Applications	Presentation	Researchers , Software Engineers	MDU	Eduard Paul Enoiu	<a href="http://www.es.mdu.se/publications/7104-">http://www.es.mdu.se/publications/7104-</a>	11th International Conference on Fundamentals of Software Engineering
Unveiling Cognitive Biases in Software Testing: Insights from a Survey and Controlled Experiment	Presentation	Researchers , Software Testers, Quality Assurance Professional s	MDU	Eduard Paul Enoiu	<a href="http://www.es.mdu.se/publications/7032-">http://www.es.mdu.se/publications/7032-</a>	31st Asia-Pacific Software Engineering Conference
Optimizing Model-based Generated Tests: Leveraging Machine Learning for Test Reduction	Presentation	Software Engineers, Researchers , Industrial Practitioner s	MDU, Alstom	Eduard Paul Enoiu	<a href="http://www.es.mdu.se/publications/6959-">http://www.es.mdu.se/publications/6959-</a>	20th Workshop on Advances in Model Based Testing
An Evaluation of General-Purpose Static Analysis Tools on C/C++ Test Code	Presentation	Software Developers,	MDU	Eduard Paul Enoiu	<a href="http://www.es.mdu.se/publications/6534-">http://www.es.mdu.se/publications/6534-</a>	Euromicro Conference

		Testers, Quality Engineers				Series on Software Engineering and Advanced Applications
Understanding Problem Solving in Software Testing: An Exploration of Tester Routines and Behavior	Presentation	Software Testers, Researchers , Software Developers	MDU	Eduard Paul Enoiu	<a href="http://www.es.mdu.se/publications/6555-">http://www.es.mdu.se/p ublications/6555-</a>	IFIP-ICTSS 35th International Conference on Testing Software and Systems
Test Generation and Mutation Analysis of Energy Consumption using UPPAAL SMC and MATS	Presentation	Embedded Systems Engineers, Researchers , Test Engineers	MDU	Eduard Paul Enoiu	<a href="http://www.es.mdu.se/publications/6718-">http://www.es.mdu.se/p ublications/6718-</a>	7th International Workshop on Testing Extra- Functional Properties and Quality Characteristics of Software Systems
Combining Model-Based Testing and Automated Analysis of Behavioural Models using GraphWalker and UPPAAL	Presentation	Software Engineers, Testers, Researchers	MDU	Eduard Paul Enoiu	<a href="http://www.es.mdu.se/publications/6534-">http://www.es.mdu.se/p ublications/6534-</a>	29th Asia-Pacific Software Engineering Conference (APSEC)
Automation of Hardware-in-Loop Test Case Generation with Model-Based Testing	Presentation	Software Engineers, Industrial Practitioner s, Test Automation Engineers	MDU	Eduard Paul Enoiu	<a href="http://www.es.mdu.se/publications/6555-">http://www.es.mdu.se/p ublications/6555-</a>	13th Workshop on Automating Test Case Design, Selection and Evaluation

How aware are we of our biases in testing?	Presentation	Software Testing Professionals, General Audience	MDU	Eduard Paul Enoiu	<a href="http://www.es.mdu.se/publications/6363-">http://www.es.mdu.se/publications/6363-</a>	30th EuroSTAR Software Testing Conference
SoHist: A Tool for Managing Technical Debt through Retro Perspective Code Analysis	Presentation for acquisition meetings	Researchers and Industry	UIBK	Benedikt Dornauer	<a href="https://dl.acm.org/doi/10.1145/3593434.3593460">https://dl.acm.org/doi/10.1145/3593434.3593460</a>	EASE '23: Proceedings of the 27th International Conference on Evaluation and Assessment in Software Engineering

## 5. White Papers, Videos and Tutorials

Material Title	Type (White Paper / Video / Tutorial)	Target Audience	Partner Responsible	Contact Person	Location (URL)
Requirements Similarity and Retrieval	Pedagogical Chapter	Students and Industry	RISE, MDU, Alstom	<a href="mailto:abbas.khan@ri.se">abbas.khan@ri.se</a>	<a href="https://link.springer.com/chapter/10.1007/978-3-031-73143-3_3">https://link.springer.com/chapter/10.1007/978-3-031-73143-3_3</a>
NALABS - An Essential Plugin for Capella	White Paper	Industry	Addiva, MDU	Björn Lindström < <a href="mailto:Bjorn.Lindstrom@addiva.se">Bjorn.Lindstrom@addiva.se</a> >	<a href="https://drive.google.com/file/d/1DNUvtZcHymyq9DebCPLmTTa9zG4tsIV/view?usp=sharing">https://drive.google.com/file/d/1DNUvtZcHymyq9DebCPLmTTa9zG4tsIV/view?usp=sharing</a>
NALABS Training Demo	Video	Industry	MDU	<a href="mailto:eduard.paul.enoiu@mdu.se">eduard.paul.enoiu@mdu.se</a>	<a href="https://youtu.be/bvS1BWlpn04?si=ZnueiECUI-M34_Qd">https://youtu.be/bvS1BWlpn04?si=ZnueiECUI-M34_Qd</a>
GW2UPPAAL Training Demo	Video	Students and Researchers	MDU	<a href="mailto:eduard.paul.enoiu@mdu.se">eduard.paul.enoiu@mdu.se</a>	<a href="https://youtu.be/EtsJ-GNSjJM?si=PjEvQ_fJmh_OgEEK">https://youtu.be/EtsJ-GNSjJM?si=PjEvQ_fJmh_OgEEK</a>
SmartDelta: Master the Methodology	Game	Industry	FOKUS		<a href="https://tinyurl.com/smartdeltaminigame">https://tinyurl.com/smartdeltaminigame</a>

[abhishek.shrestha@fokus.fraunhofer.de](mailto:abhishek.shrestha@fokus.fraunhofer.de)

## 6. Workshops and Practical Training

Material Title (Workshop Title / Exercise Title / Training Session Title)	Type (Workshop / Exercise / Case Study / Internal Training)	Target Audience	Partner Responsible	Contact Person	Location (URL)	Date(s) (if applicable)
Requirements Processing in Railway Industry	Winter School	Students	RISE	<a href="mailto:abbas.khan@rise.se">abbas.khan@rise.se</a>	<a href="https://www.master-ediss.eu/winter-school-2024/">https://www.master-ediss.eu/winter-school-2024/</a>	26-29 February 2024
NLP in the Railway Industry	Internal Training for Westermo	Industry	RISE, Westermo	<a href="mailto:abbas.khan@rise.se">abbas.khan@rise.se</a>	Sweden	dic-22
Failure Log Clustering	Internal Training for HIAB	Industry	RISE, HIAB AB	<a href="mailto:abbas.khan@rise.se">abbas.khan@rise.se</a>	Sweden	2023
Enhancing Requirements Processing at Alstom	Internal Training	Industry	RISE, Alstom	<a href="mailto:abbas.khan@rise.se">abbas.khan@rise.se</a>	Sweden	2023
Finding Problems in Requirements with NALABS	Internal Training	Industry	MDU, Alstom	<a href="mailto:eduard.paul.enoiu@mdu.se">eduard.paul.enoiu@mdu.se</a>		2023
PyLC Demo and Training	Internal Training	Industry	MDU, Alstom	<a href="mailto:mikael.salari@mdu.se">mikael.salari@mdu.se</a>		2024
EPS anomaly detection and offense prioritization app demo	Internal Training	Industry	Ontario Tech	<a href="mailto:akramul.azim@ontariotechu.ca">akramul.azim@ontariotechu.ca</a>	Canada	2024

## Appendix: Exploitable Result Items

The Exploitable Result items that are made publicly available by the project consortium are listed and accessible on the ITEA website at:

<https://itea4.org/exploitable-results/page-all.html?query=smartdelta>