



## D17v0.2 WSMO Tutorial

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## Abstract

This document comprises the WSMO Tutorial efforts. The tutorial is intended to disseminate the Web Service Modeling Ontology WSMO to worldwide audiences interested in Semantic Web Services. The tutorial has already been presented at several international events, and it is intended to present it at future events also.

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# **1. Introduction**

The Web Service Modeling Ontology WSMO [[WSMO](#)] along with its related efforts in the WSML [[WSML Working Group](#)] and WSMX [[WSMX Working Group](#)] working groups presents a complete framework for Semantic Web Services, combining Semantic Web and Web Service technologies. The potential user community needs to understand the aims, design, and specification structure of WSMO, as a first step towards universal acceptance and use of WSMO within research and development efforts around Semantic Web Services. The WSMO Tutorial presented in this document represents an initial effort to disseminate WSMO at international events to a world wide audience.

The objectives of the WSMO Tutorial are to enable attendees to:

- Understand the idea and objectives of Semantic Web Services
- Comprehend the aims, design principles, and specification structure of WSMO
- Specify Semantic Web Services with WSMO
- Apply WSMO technologies for Semantic Web Services
- Correctly assess technologies, products, and developments within Semantic Web and Web Services technologies

The WSMO Tutorial is currently being presented at different international events in a flexible format, so that the actual content of the tutorial presentation events can change in accordance with (1) the focus and objectives of the particular presentation event, and (2) changes / extensions developed for WSMO and related technologies as part of ongoing research work. This document gives a general overview of the WSMO Tutorial, and contains the slide sets and information for each presentation event of the tutorial.

This document is structured as follows: [Section 2](#) provides a general overview of the WSMO Tutorial, explaining the structure and content of the different modules of the tutorial; [Section 3](#) contains information about the presentation events of the WSMO Tutorial, providing the slide sets for download and additional information on the specific event; [Section 4](#) concludes the document, presenting 'Lessons Learned' for dissemination and exploitation of WSMO into research, industry, and standardization bodies.

## 2. Overview of WSMO Tutorial

This section provides an overview of the structure of the WSMO Tutorial. The tutorial has seven modules. Each module covers in detail a specific aspect of WSMO, and the different elements of the tutorial can be combined, shortened or extended in order to tailor the presentation for a specific presentation event; the actual slide sets of the presentation events are provided in [Section 3](#). Also, further modules can be added to the tutorial for future presentation events, as required, to update the content to reflect ongoing research.

The following gives a general overview of each part of the WSMO tutorial, explaining the aspects covered, the objectives of each tutorial module, and the main references.

Also, a video recording of the tutorial is available [here](#), which has been recorded on 27 September 2004 at the [Net Object Days presentation event](#).

### 2.1 Part I - Introduction to the Semantic Web and Semantic Web Services

#### Overview:

This module of the tutorial describes the research fields of the Semantic Web and Semantic Web Services, providing a basis and rationale for the aspects addressed in the remaining modules of the tutorial.

#### Contents:

- Vision of the Semantic Web
- Ontologies as the backbone technology for the Semantic Web
- Web Services:
  - the "promise" of Web Services
  - initial Web Service technologies: SOAP, UDDI, WSDL

- Idea of Semantic Web Services
- Challenges for Semantic Web Service technologies

**Note: This module is intended mainly for ‘newbies’ in the field.**

**Objectives:**

- To provide an overview of the aims of the Semantic Web and Semantic Web Services
- To provide a rationale and foundation for the subsequent modules of the tutorial

**References:**

- Web Service Modelling Framework [[Fensel and Bussler](#)]
- [[WSMO Primer](#)]
- Several other resources on the issues covered in the module.

## 2.2 Part II - Introduction to WSMO

**Overview:**

This module explains the mission and design principles of WSMO, as well as the structure of the SDK-Cluster working groups around WSMO, WSML, and WSMX.

**Contents:**

- The mission of WSMO: To produce a fully-fledged ontological model for Semantic Web Services, to be submitted to a standardization body. This module outlines:
- Design principles and features of WSMO
- Structure of the WSMO working groups

**Objectives:**

- To introduce WSMO (objectives, design principles)
- To describe the structure of WSMO working groups

**References:**

Working Group Homepages [[WSMO Working Group](#)], [[WSML Working Group](#)], [[WSMX Working Group](#)]

## 2.3 Part III - The WSMO Specification

**Overview:**

This module introduces the key concepts of WSMO, explaining the design rationale, specification and usage, and the description elements for each major component.

**Contents:**

- WSMO Design global issues
- Non-functional Properties
- WSMO key concepts:
  - Ontologies
  - Goals
  - Web Services (Capabilities, Interfaces)
  - Mediators
- Examples for modeling

**Objectives:**

- To present the key concepts of WSMO and to explain these clearly and concisely.
- To convey the necessity for each of the key WSMO elements, and to explain their design principles and specifications.
- To introduce WSMO component modeling in WSML.

**References:**

- Web Service Modelling Ontology [[WSMO Specification](#)]
- [[WSMO Use Case](#)]

## 2.4 Part IV - Web Service Interfaces: Choreography and Orchestration

**Overview:**

There are two types of Web Service description in WSMO: Capabilities and Interfaces.

The Capabilities describe the different functions of WSMO.

The Interfaces specify:

(a) How to communicate with a Web Service in order to avail of its functionality . This is called Choreography.

(b)How the functionality of a Web Service is enabled by interacting with other Web Services. This is called Orchestration.

This module of the tutorial explains the operation of WSMO Web Service Interfaces, their differentiation and interplay, and the description elements of Choreography and Orchestration in WSMO.

**Contents:**

- Design of WSMO Web Service description
- The WSMO general model for Web Service Interfaces description

- Aspects and description of Choreography in WSMO
- Aspects and description of Orchestration in WSMO

**Objectives:**

- To explain the aims and rationale of Choreography and Orchestration in WSMO
- To explain the approach and formal description of WSMO Web Service Interfaces

**References:**

- [\[WSMO\]](#)
- [\[WSMO Interfaces\]](#)

## 2.5 Part V - The WSMO Languages: WSML

**Overview:**

The Web Service Modeling Language WSML is being developed within the [\[WSML working group\]](#), a sub working group of WSMO. The aim of WSML is to develop a combined ontology language for the Semantic Web and Semantic Web Services, overcoming the deficiencies of existing ontology languages.

This module of the tutorial explains the objectives and design of WSML.

**Contents:**

- Aims, rationale, and starting points of WSML
- WSML Syntaxes: normative, XML, OWL / RDF
- Variants of WSML: WSML-Core, WSML-Flight, WSML-Rule, WSML-OWL, WSML-Full
- Specification, structure, and interrelation of WSML Variants
- WSML modeling examples

**Objectives:**

- To explain rationales & aims of WSML
- To explain WSML Syntaxes & Variants
- To outline further development steps

**References:**

- [\[WSMO Specification\]](#)
- [\[WSML Working Group\]](#)
- [\[WSML Specification\]](#)

## 2.6 Part VI - The Execution Environments: WSMX and IRS 3

**Overview:**

This module provides an overview of WSMO implementations: the Web Service Execution Environment WSMX, the reference implementation of WSMO developed within the WSMX working group, and the Internet Reasoning Service IRS developed by the Open University.

**Contents:**

- Web Service Execution Environment WSMX:
  - Aims and overview
  - WSMX Architecture Walk-Thru
  - WSMX Conceptual Architecture
  - Execution Semantics
  - Web Service Execution in WSMX
  - Data Mediation Module
  - Implementation
  - WSMX next steps
- Internet Reasoning Service IRS:
  - Overview (aims, design principles, history )
  - IRS Framework
  - IRS 3 (WSMO-compatible)
    - Features
    - Architecture
  - The differences between WSMO and WSMX
- Demonstrations of WSMX and IRS 3

**Objectives**

- To provide an overview of the implementations of WSMO
- To present WSMX as the WSMO reference implementation

**References:**

- [\[WSMX Working Group\]](#)
- Main WSMX deliverables: D9, D10, D13.0 - D13.6,
- [\[IRS\]](#)

## 2.7 Part VII - Addressing Semantic Web Service Challenges

**Overview:**

This module encompasses theoretical approaches, techniques, and systems developed for Semantic Web Services around WSMO as well as in related efforts.

**Contents:**

- *Discovery*: How are Web services found and selected?
- *Composition*: How to aggregate Web Services into a complex functionality?

- *Invocation*: How to access and invoke Semantic Web Services?
- *Conversation*: How to ensure automated interaction of Web Services?
- *Mediation and Interoperability*: How are data and protocol mismatches resolved?

**Objectives:**

- To understand Semantic Web Service Challenges
- To become familiar with main theoretical approaches and techniques applied in Semantic Web Service technologies
- To provide an overview on existing and upcoming Semantic Web Service technologies

## 2.8 Part VIII - Semantic Web Service Tools

**Overview:**

This module presents the WSMO studio and the related ontology management suite tooling develop as part of the Ontology Management Group. Attendees will gain expertise and become familiar with the WSMO and OMWG tools for describing services and managing the related ontologies.

**Contents:**

- WSMO Studio
  - Modeling WSMO based Semantic Web Service
- Ontology Management Suite
  - Editing and Browsing tool
  - Versioning Tool
  - Mapping and Merging tool
  - Ontology repository
  - Reporting Tool

**Objectives:**

- To gain expertise with WSMO tools
- To become familiar with the Ontology Management Tools develop in coordination with WSMO
- To enable attendees to test and use WSMO tools

## 2.9 Part IX - Hands On Session

**Overview:**

This module provides a practical hands-on tutorial on how to create Semantic Web Services by using the technologies presented in Part VI. Attendees are provided with a computer and the required resources to participate in the practical session.

The hands-on session is presented on basis of the Internet Reasoning Service IRS III - see [IRS homepage](#). This [ZIP archive](#) provides the installation and user guidelines for the hands-on session for tutorials attendees.

**Contents:**

- Hands On Session Setup: Domain (train travelling), Tools, and Tasks Description
- Walk-Thru of tools
- Hands-on session for attendees with tutor support

**Objectives:**

- To allow participants to create & use Semantic Web Service themselves
- To deepen their understanding of the theoretical modules of this tutorial by giving them the opportunity to try out the technology during a practical hands-on session.
- To enable attendees to test and use WSMO tools

## 3. Presentation Events

This section contains the slide sets of the individual presentation events of the WSMO Tutorial in chronological order; we provide additional information, and video recordings for some of the presentations events for private education purpose.

### 3.1 AIMS A 2004

**Date:**

01 September 2004

**Presentation Event:**

[AIMS A 2004](#): The Eleventh International Conference on Artificial Intelligence: Methodology, Systems, Applications. The Semantic Web Challenge, Varna, Bulgaria, September 2nd-4th, 2004.

**Slide Set** (as PPT and PDF):**Additional Information:**

- full day tutorial
- 25 participants
- focus of tutorial: overview, conceptual structure of WSMO

### 3.2 Net Object Days 2004

**Date:**

27 September 2004

**Presentation Event:**

[Net Object Days 2004](#): The Fifth Net Object Days, Erfurt, Germany, September 27th - 30th, 2004.

**Slide Set (as PPT and PDF):****Additional Information:**

- full day tutorial
- 10 participants, mostly "experts" in the field
- focus of tutorial: overview, conceptual structure of WSMO, implementation
- The Tutorial has been recorded on video; the video can be downloaded for all parts at the following address:  
<http://stadium.open.ac.uk/stadia/preview.php?s=35&whichevent=540>.

### 3.3 ISWC 2004

**Date:**

07 November 2004

**Presentation Event:**

[IWSC 2004](#): The Third International Semantic Web Conference, Hiroshima, Japan, November 06th - 11th, 2004.

**Slide Set (as PPT and PDF):****Additional Information:**

This tutorial is presented as a conjoint tutorial on Semantic Web Services in cooperation with the OWL-S working group. The aim of the tutorial is to present attendees a general overview of objectives, challenges, and the most relevant approaches elaborated within OWL-S and WSMO. Apart from the WSMO Tutorial working group, we would like to thank Katia Sycara and Massimo Paolucci from the [Carnegie Mellon University, School of Computer Science](#) for their contribution on the OWL-S part, and Rubén Lara from DERI Innsbruck for contribution of the overview on Semantic Web Service solutions.

- Half-day tutorial

- 38 attendees
- Focus of tutorial:
  - challenges of Semantic Web Services
  - Semantic Web Services ontologies: OWL-S, WSMO
  - Semantic Web Service solutions in OWL-S and WSMO
  - existing Semantic Web Services tools and implementations

## 3.4 ASG Project Tutorial

**Date:**

13 December 2004

**Presentation Event:**

[ASG Project](#) meeting, Potsdam, Germany.

**Slide Set** (as PPT and PDF):



**Additional Information:**

This tutorial has been presented as a kick off, informative tutorial to the members of the ASG project, containing also an overview of the Grid and its relation to WSMO.

- full-day tutorial
- 20 attendees
- Focus of tutorial:
  - The Grid and Semantic Web Services
  - challenges of Semantic Web Services
  - WSMO, WSML, WSMX

## 3.5 WSMO training for DIP

**Date:**

18 January 2005

**Presentation Event:**

[DIP Project](#) meeting, Innsbruck, Austria.

**Slide Set** (as PPT and PDF):



**Additional Information:**

This tutorial provides an up-to date overview on WSMO for the DIP project members, along with presentations of currently available tools for DIP and WSMO.

The tutorial has been recorded; you can find the video material at:  
<http://stadium.open.ac.uk/stadia/preview.php?s=35&whichevent=542>

- full-day tutorial
- 30 attendees
- Content of tutorial:
  - WSMO Specification - current status
  - news in WSMO: discovery, choreography, WSML
  - WSMO Use Case Walkthrough

## 3.6 Tutorial at OASIS XML Symposium

### Date:

24 April 2005

### Presentation Event:

This tutorial was presented at [The OASIS Symposium on the Future of XML Vocabularies](#) and it had as main focus to introduce the main aspects related to Semantic Web Services as described by WSMO. In addition, the tutorial aimed to offer an overview of the Web Service Modeling Language (WSML), the formal language for WSMO, and of the WSMO reference implementation, WSMX. It was concluded with a presentation and a demo of another WSMO implementation, IRS-III.

### Slide Set (as PPT and PDF):



### Additional Information:

- 3 hours tutorial
- 20 attendees
- Focus of tutorial:
  - Semantic Web Services - Overview
  - Web Service Modeling Ontology (WSMO)
  - Web Service Modeling Language (WSML)
  - Environments for Web Service execution (WSMX, IRS-III)
  - Existing tools, IRS-III Demo

## 3.7 ESWC 2005 Semantic Web Services Tutorial

### Date:

29 May 2005

**Presentation Event:**

This tutorial has been presented the [Second European Semantic Web Conference](#) as a joint effort between the [WSMO Working Group](#), the [OWL-S Working Group](#), and the group from [Universita' di Roma "La Sapienza"](#), addressing the latest achievements on Semantic Web Services.

**Slide Set** (as PPT and PDF):**Additional Information:**

- full day tutorial
- 30 attendees
- Focus of tutorial:
  - Introduction to Semantic Web Services
  - Semantic Web Service Ontologies (OWL-S and WSMO)
  - Addressing Semantic Web Service Challenges
  - Semantic Web Service Tools and Systems (OWL-S Integrated Development Environment, Service Composer, Web Service Execution Environment WSMX)
  - Hands-on Session with IRS-III

## 3.8 ICAC 2005 Semantic Web Services Tutorial

**Date:**

13 June 2005

**Presentation Event:**

The 2nd IEEE International Conference on Autonomic Computing ([ICAC-05](#)), Seattle, Washington, USA.

The main focus of this tutorial is to introduce the main aspects related to Semantic Web Services as described by WSMO. In addition, the tutorial offers an overview of the Web Service Modeling Language (WSML), the formal language for WSMO, of the WSMO Discovery, and of the WSMO reference implementation, WSMX.

**Slide Set** (as PPT and PDF):**Additional Information:**

- 3 hours tutorial
- 14 attendees
- Focus of tutorial:

- Semantic Web Services - Overview
- Web Service Modeling Ontology (WSMO)
- Web Service Modeling Language (WSML)
- Web Service Discovery
- Environments for Web Service execution (WSMX, IRS-III)

## 3.9 ICWS 2005 Tutorial

**Date:**

11 July 2005

**Presentation Event:**

The Third International Conference on Web Services ([ICWS 2005](#)), Orlando, Florida, USA.

The tutorial introduces the concept of Semantic Web Services and explains modeling as well as most recent technology development. With respect to the focus of the ICWS conference series on conventional Web Service technology, the aim to enable attendees to better understand the motivation, objectives, and most recent solutions for core Semantic Web Service technologies with special regard to environments for automated Web Service usage and execution support in industrial settings.

**Slide Set** (as PPT and PDF):



**Additional Information:**

- 3 hours tutorial
- 18 attendees
- Focus of tutorial:
  - Semantic Web Services - Overview
  - Web Service Modeling Ontology (WSMO)
  - Semantic Web Service modeling and technologies
  - Environment for Web Service execution (WSMX)

## 3.10 SSSW 2005 Summer School

**Date:**

13 July 2005

**Presentation Event:**

The Third Summer School on Ontological Engineering and the Semantic Web ([SSSW 2005](#)), Cercedilla (Spain).

56 students of the summer school attended this tutorial. The tutorial consists of two parts. The first gives a theoretical overview on Semantic Web Services, explaining the objectives and challenges as well as modeling and realization of Semantic Web Services within WSMO, and the second one is a practical hands-on session with IRS.

**Slide Set** (as PPT and PDF):



This tutorial has been video-taped. The recording is available at:  
<http://kmi.open.ac.uk/projects/dip/resources/SSSW05/LODE/index.html>.

## 3.11 2005 EAS Summer School 2005

**Date:**

18 July 2005

**Presentation Event:**

The Seventh Agent Systems Summer School ([easss 2005](#)), Utrecht, Netherlands.

The tutorial introduces the concept of Semantic Web Services and the integration with Agent Technology (presenters: [Terry Payne](#) and [John Domingue](#))

**Slide Set** (as PDF):



## 3.12 ICWE 2005 Tutorial

**Date:**

25 July 2005

**Presentation Event:**

The Fifth International Conference on Web Engineering ([ICWE 2005](#)), Sydney, Australia.

The tutorial introduces the concept of Semantic Web Services, explains design and modeling of Semantic Web Service Frameworks, and exhaustively presents recent technology and system developments for Semantic Web Services. With respect to the scope of the ICWE conference series on Web Engineering, the tutorial focuses on technology, system, and application development for Semantic Web Services.

**Slide Set** (as PPT and PDF):

**Additional Information:**

- full day tutorial
- 25 attendees
- Focus of tutorial:
  - Semantic Web Services - Overview
  - Frameworks for Semantic Web Services (WSMO and OWL-S)
  - Semantic Web Services Modeling and Core Technologies
  - Environment for Web Service execution (WSMX and IRS)
  - Hands-on Session

### 3.13 EUROLAN Summer School 2005

**Date:**

02 August 2005

**Presentation Event:**

This tutorial was given at the [7th edition of the EuroLAN Summer School in Cluj-Napoca, Romania](#) and it had as main focus to introduce the main aspects related to Semantic Web Services as described by WSMO. In addition, the tutorial aimed to offer an overview of the Web Service Modeling Language (WSML), the formal language for WSMO, of the WSMO Discovery, and of the WSMO reference implementation, WSMX, with a specific focus on the data mediation techniques currently existing in WSMX.

**Slide Set (as PPT and PDF):****Additional Information:**

- 3 hours tutorial
- 30 attendees
- Focus of tutorial:
  - Introduction to Semantic Web Services
  - Web Service Modeling Ontology (WSMO)
  - Web Service Modeling Language (WSML)
  - WSMO Discovery
  - Web Service Modeling Execution Environment (WSMX) with specific focus on the Data Mediation techniques currently existing in WSMX.

## 4. Conclusion and 'Lessons Learned'

The aim and intention of the WSMO tutorial is to disseminate WSMO to worldwide audiences, enabling attendees to understand the challenges arising within Semantic Web Services, and how these are addressed and solved within the Web Service Modeling Ontology WSMO; in addition, attendees shall understand the main technologies and systems of WSMX, and be able to correctly assess technologies, products, and developments within Semantic Web and Web Services technologies.

Widespread dissemination of WSMO is of major importance with regard to the acceptance and usage of WSMO within research and development efforts. By presenting the WSMO Tutorial at different events, we have reached a wide audience with different backgrounds and interests. In order to provide useful information for further dissemination activities, the following presents feedback and comments from attendees at previous sessions:

- Attendees have been from very different backgrounds - the overall feedback was that WSMO is regarded as a suitable framework for Semantic Web Services. In particular, the clarity of the framework, the unambiguous nature of the WSMO components, and their clearly defined interrelations, have been considered important, good and useful.
- The structure and content of the tutorial was considered to be well designed, thus enabling attendees to easily follow the course of the tutorial.
- Most attendees were "newbies" to the field of Semantic Web Services; these attendees reported the tutorial to be a very good overview and introduction to the field. An impression is that the idea of Semantic Web Services as followed in WSMO is not really widely known in the WWW research community.
- Attendees had different specific backgrounds (Semantic Web and ontologies, ontology design and ontology languages, Web Services "without semantics", specific aspects of Semantic Web Services like discovery or composition). The tutorial could address all these different aspects, but it is an overall overview. Some attendees mentioned interest in additional tutorials with more narrow scope, focusing on some specific interest.
- Attendees who knew WSMO before from the Website reported that they could not understand WSMO without the tutorial; an overview document explaining the aim, scope, and structure of WSMO was requested.
- Surprisingly, questions about the relationship between WSMO and OWL-S and W3C recommendations were very few (indicating that most attendees are newbies to the field).

Summarizing, we conclude that the WSMO Tutorial is an important and successful dissemination activity for WSMO. As we have the experts in the group for the specific modules of the tutorial, the presentations were high quality and went beyond the contents of the slide sets; this seems to be an important "pre-condition" for successful dissemination within expert groups. Besides, from the reaction and the feedback received from attendees, we conclude that (1) WSMO has a huge potential to be used and accepted for Semantic Web Service technology development, but (2) that the idea of Semantic Web Services is not yet very well known or widely discussed in the WWW research community; especially with regard to the latter aspect, successful future dissemination and exploitation of WSMO seems to be a challenging task and should be addressed carefully and well planned.

## References

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**[WSMO Working Group]** WSMO Working Group webpage: <http://www.wsmo.org>.

**[WSML Working Group]** WSML Working Group webpage: <http://www.wsmo.org/wsml/>.

**[WSMX Working Group]** WSML Working Group webpage: <http://www.wsmx.org>.

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