



ICT Center of Excellence For Research, Innovation, Education, and life-long Learning
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Toward a framework for Semantic Organizational Information Portal: a demonstration

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<http://seip.cefriel.it/>

<http://etechdemo.cefriel.it/semanticweb/portal>

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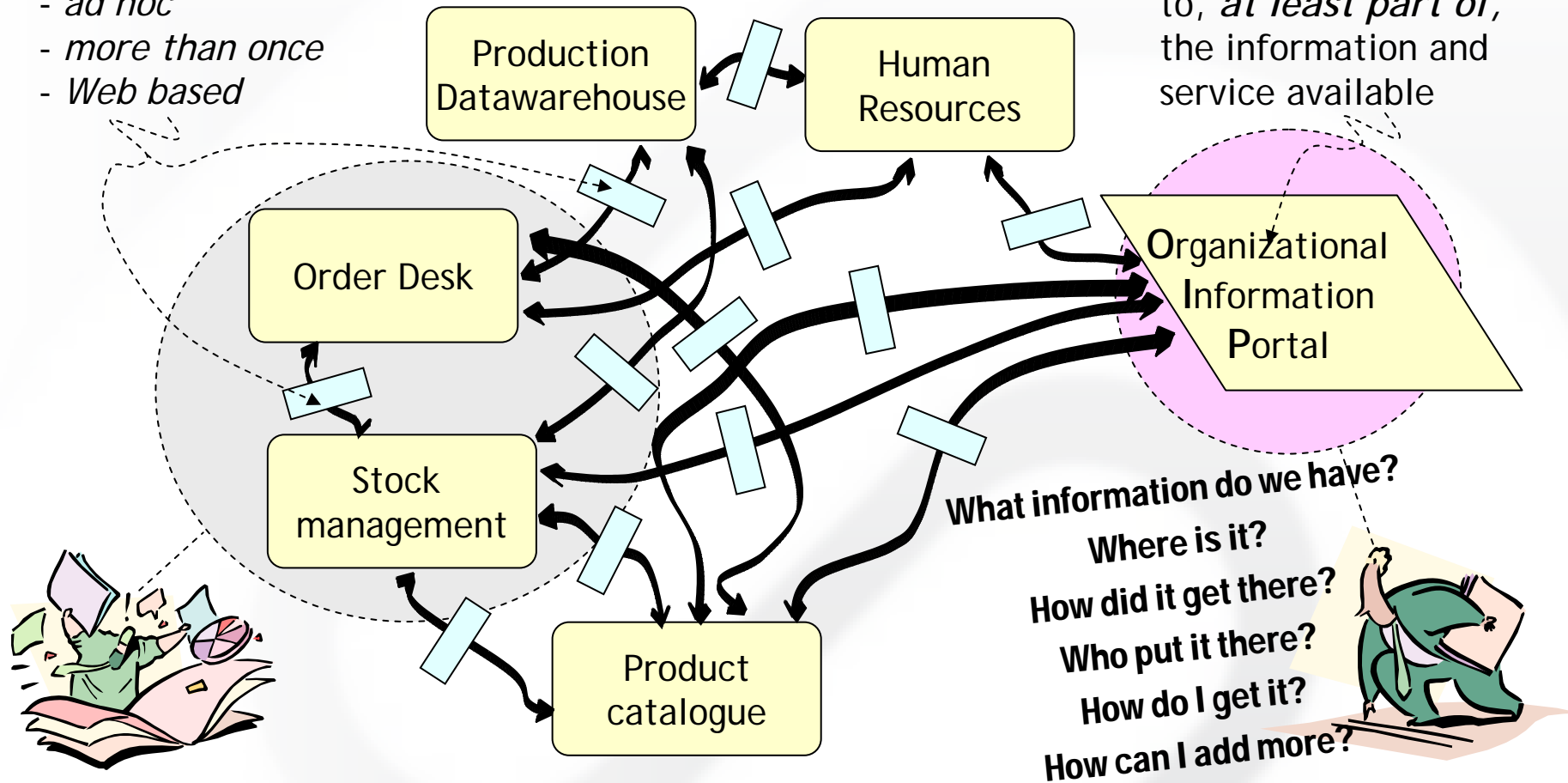
Intro / The success story of Information Portals

many integration

- *ad hoc*
- *more than once*
- *Web based*

Numerous Autonomous systems

Single access point to, *at least part of*, the information and service available



- **Information Portals** have **gathered lot of attention** among many organizations interested in a single point of access to their information and services.

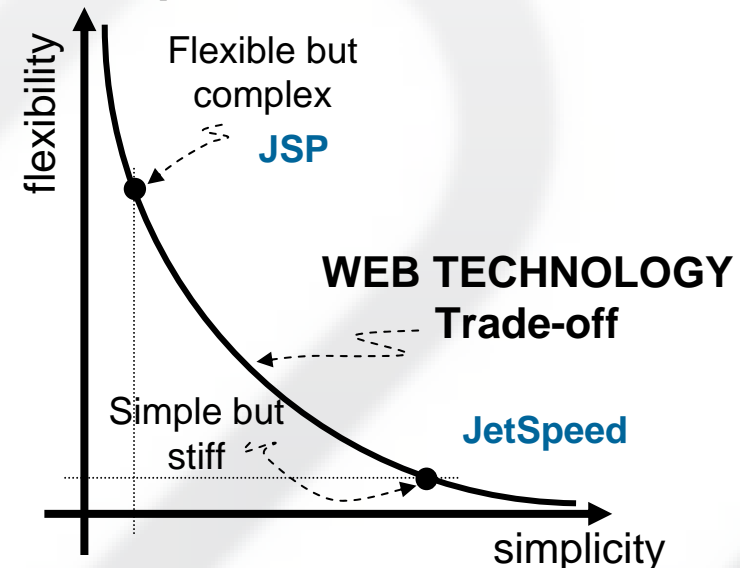
Intro / The Navigation Problem

- ❑ **Surfing the web** appears sometimes troublesome to navigators, especially if **compared to navigation in** a familiar environment like a PC **filesystem**, because of some strong differences:
 - ▶ Web is **not** a **personal** space (its structure is unknown to users)
 - ▶ Web is a **hypertextual** space (graph vs. tree)
- ❑ Interacting with an OIP can be compared to a **travel** in which:
 - ▶ **Travelers** are **organization members**
 - ▶ The **environment** is the **organization web**
 - ▶ The **aim** of the journey is **to find useful information** to support users daily job and to achieve their tasks within the organization
- ❑ **OIPs provide a solution** to manage navigation problem, because they:
 - ▶ present **information space** to users in a **structured** way
 - ▶ **guide** users in their traveling **through resources** (e.g. navigation bars, menus, links to similar resources, search boxes, ...)
 - ▶ facilitating and **improving** users **mobility**
 - ▶ giving users **proper tools** (“*vehicles*” in travel metaphor) that can help them in getting oriented and attaining their aims



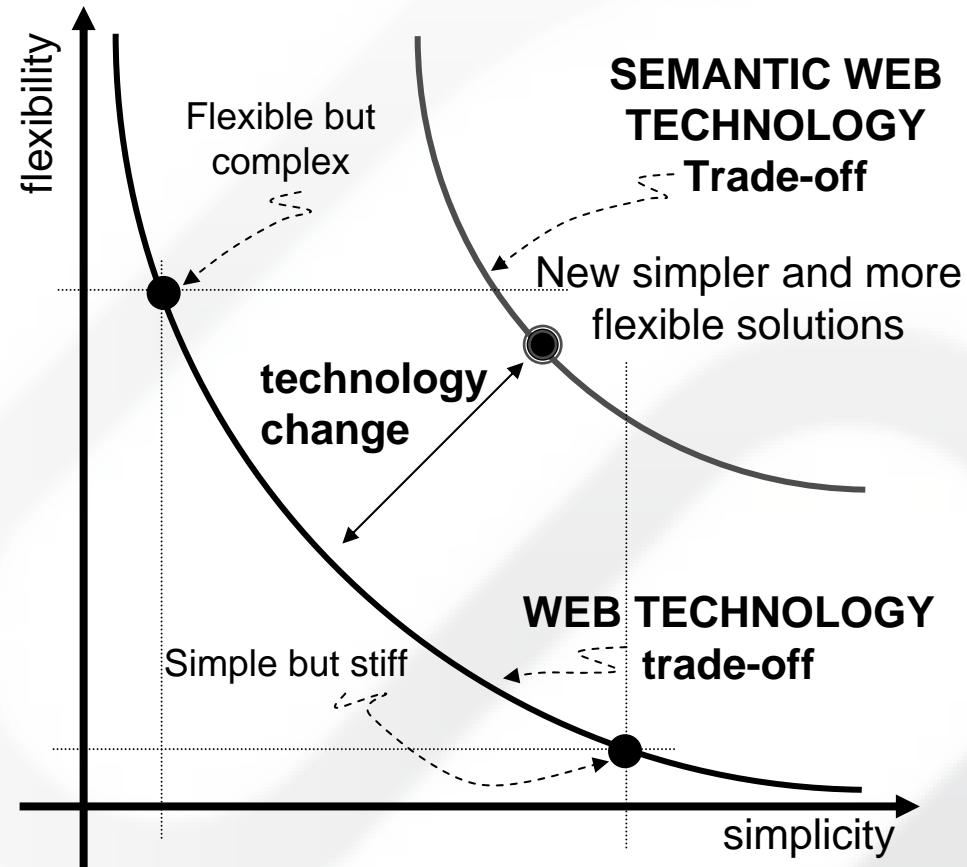
Intro / Requirements for a OIP framework

- A common set of requirements an **organization asks for**:
 - ▶ **easiness** (velocity and bargain rate) **to develop upon**;
 - ▶ **interoperability** with the broadest set of existing information sources and web-based services;
 - ▶ **scalability** and **adaptability** in serving users that are accessing the OIP, not only within the intranet but more and more from the extranet using portable devices;
 - ▶ last but not least, **long time maintainability**.
- But **developing** portals **from scratch is** sometimes too **expensive**, so many vendors have proposed **frameworks to make it affordable**
Vendors offering portal frameworks: BEA, Broad Vision, Hummingbird, IBM, Microsoft, Oracle, Plumtree and Sybase
- Most of **these requirements are partially incompatible**:
 - ◆ some call for **simplicity**,
 - ◆ others involve **flexibility**.
 - ▶ So a common problem in developing a OIP framework is trading off between simplicity and flexibility
 - ▶ the **market offers frameworks that seem stuck in such a simplicity vs. flexibility trade off** imposed by the Web technologies they are built with.



Intro / A technology change is needed

- We believe that
 - ▶ **a technology change is required** in order **to set forth** in the direction of **a better trade-off**



- ▶ **Semantic Web technology can play a key role in developing** a new, Semantic, generation of **simpler and**, at the same time, **more flexible frameworks** for Organizational Information Portal.

Our approach / Semantic Web Technologies on stage

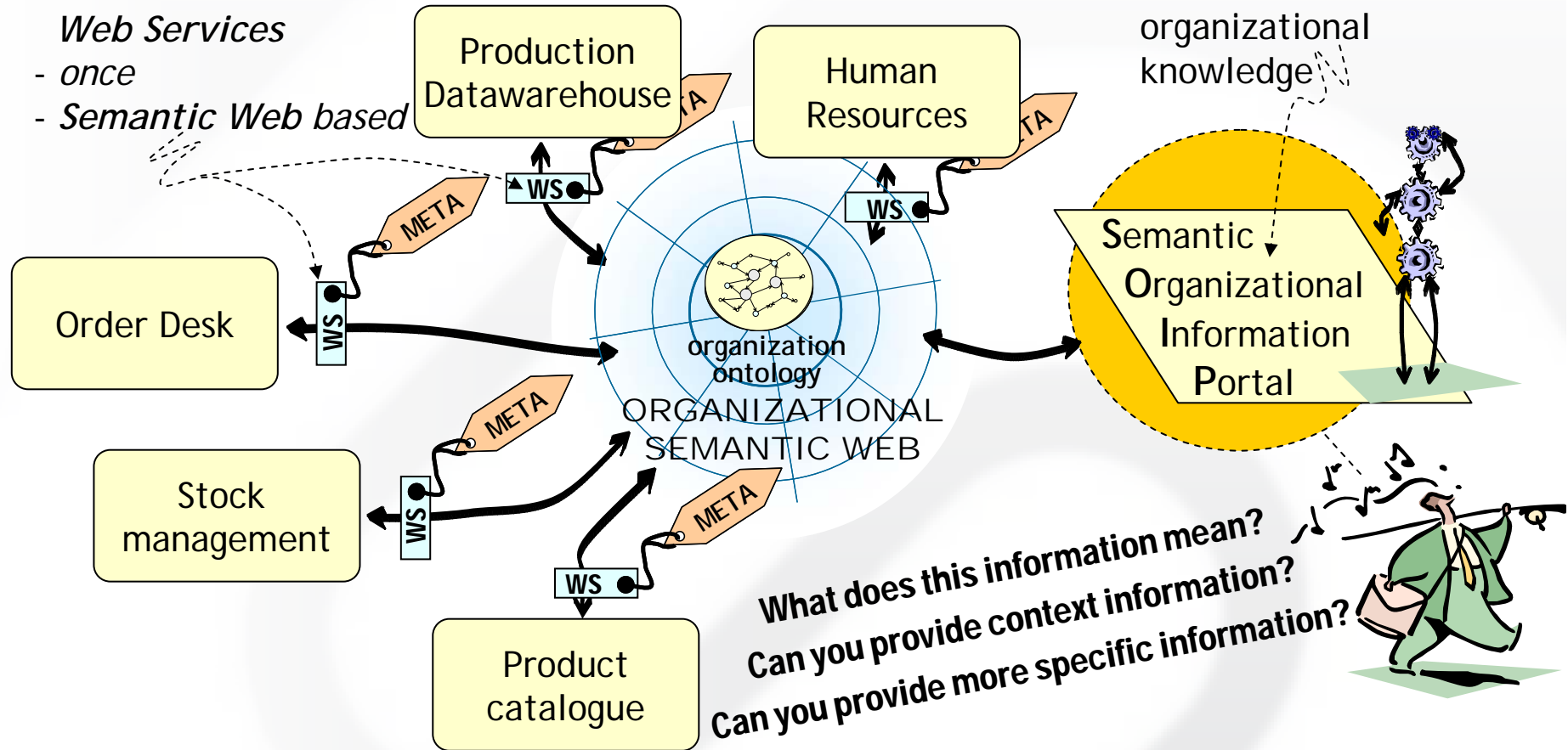
Few integration

- *standard via Web Services*
- *once*
- *Semantic Web based*

Numerous Autonomous systems

Single access point

to *the entire* organizational knowledge



- **a little semantics**, provided by explicitly augmenting resources (both content and services) with **metadata**, whose meaning is formally defined using **ontologies**, **can help in automatically finding, extracting, representing, interpreting and maintaining resources.**

Our approach / Ingredients we picked

It might appear as a radical new departure for organizations, but **we bring together existing and well understood technologies:**

- ❑ **Web Frameworks,**
such as Velocity, Struts, Jetspeed, Tapestry and Cocoon, that, following **Model-View-Controller** design pattern, propose to separate data, business logic, and presentation.
- ❑ **WWW conceptual models,**
such as **WebML**, W2000, HDM, Araneus, WSDM, and OOHDM, **that are proposals for the conceptual specification and automatic implementation of Web sites.**
- ❑ **Ontologies,**
to model:
 - the **domain information space**, a **shared understanding** of the information present in the OSW (organizational semantic web) that changes slowly, over the time.
 - the **navigation**, represents the **heterogeneous paths adopted in traversing the OSW**, not necessarily shared among users, but jointly employed by homogeneous categories of users.
 - the **access**, represents **collections of resources** not strictly homogeneous, highly variable and sometimes even related to a specific user, **a sort of views.**
 - the **presentation** represents the **visualization setup of a subset of information** about a resource; it takes in account what information is relevant to a **specific user** or to accomplish a **particular task.**
 - and possibly even the **operation** offered by a portal
- ❑ **Metadata**
to make resource descriptions available to machines in a processable way.

Our approach / Goal and Road map

Main investigation:

- ▶ Can we use metadata defined by ontologies to support the construction of portals?
- ▶ And if so, does it help?

Our Goal

- Elaboration of a **framework** to support **information portal building** in order to:
 - ▶ provide organizations with a **single access point** to all their knowledge
 - ▶ allow singular independent parts of the organization to keep their degree of **autonomy in developing and managing** distributed and heterogeneous systems
 - ▶ offer to final users a **personalized view** on organization knowledge and a **homogeneous experience of navigation**


Our Roadmap

- Step 1 **SEIP** – Semantic Enterprise Information Portal:
 - ▶ Object: building a **demonstrative portal** leveraging metadata and ontologies
Status: completed in 2002
- Step 2 **SOIP-F 0.8**: framework for Semantic OIP
 - ▶ Object: elaborating a **simple concept for a framework for Semantic OIP** around the idea of **link automatic creation** and prototyping it
Status: completed in October 2003
- Step 3 **SOIP-F 0.9**: multiple view for SOIP
 - ▶ Object: refining the concept for a framework for SOIP introducing the **multiple view requirement** and prototyping it
Status: completed in June 2004
- Step 4 **SOIP-F 1.0**:
 - ▶ Object: refining the concept for a framework for SOIP leveraging **semantic search**
Status: partially evaluated in first 2004 semester

Concept step 2 / Addressing the browsing problem

- Users navigate through **heterogeneous resources** that come from **several distributed and autonomous sources** in different forms or styles
- This implies that OIPs must integrate and structure data to **make fruition easier**, because **production information space** (that reflects editors point of view and needs) is often very **different from portal information space** (that, on the contrary, is consumer-oriented)
- Our Semantic OIP can help users in finding useful information, **making lever on “semantics”** added to resources via metadata defined by ontologies

What does this information mean?
Can you provide context information?
Can you provide more specific information?



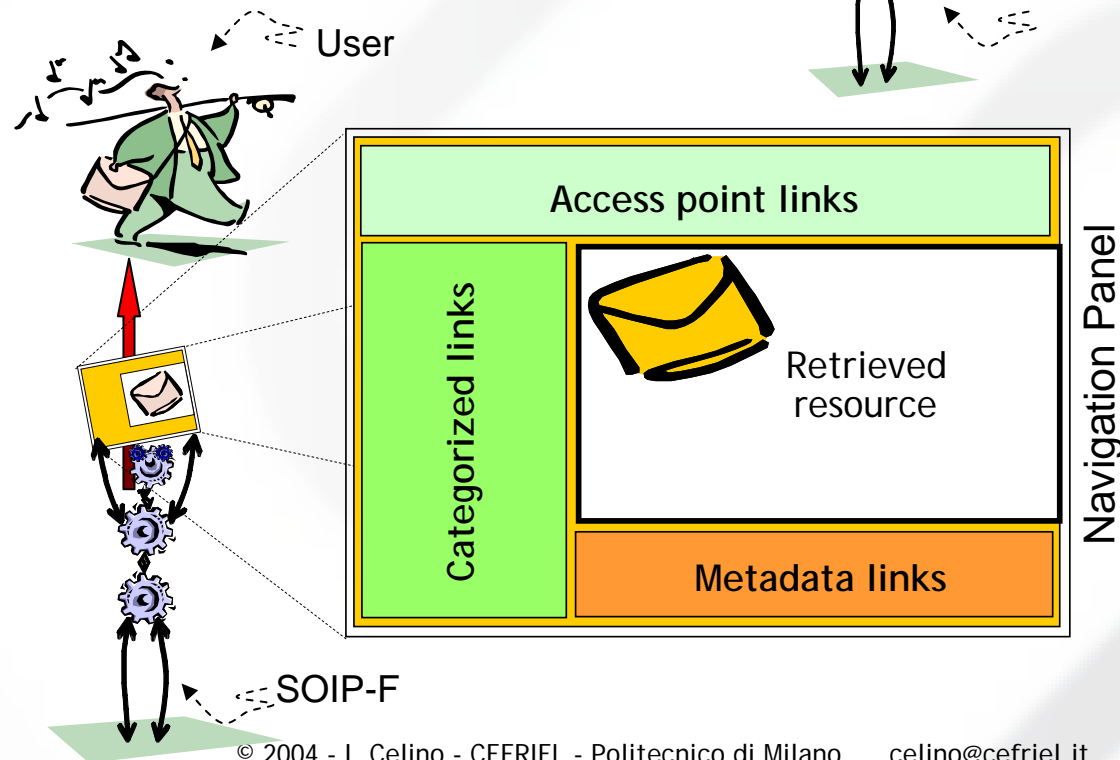
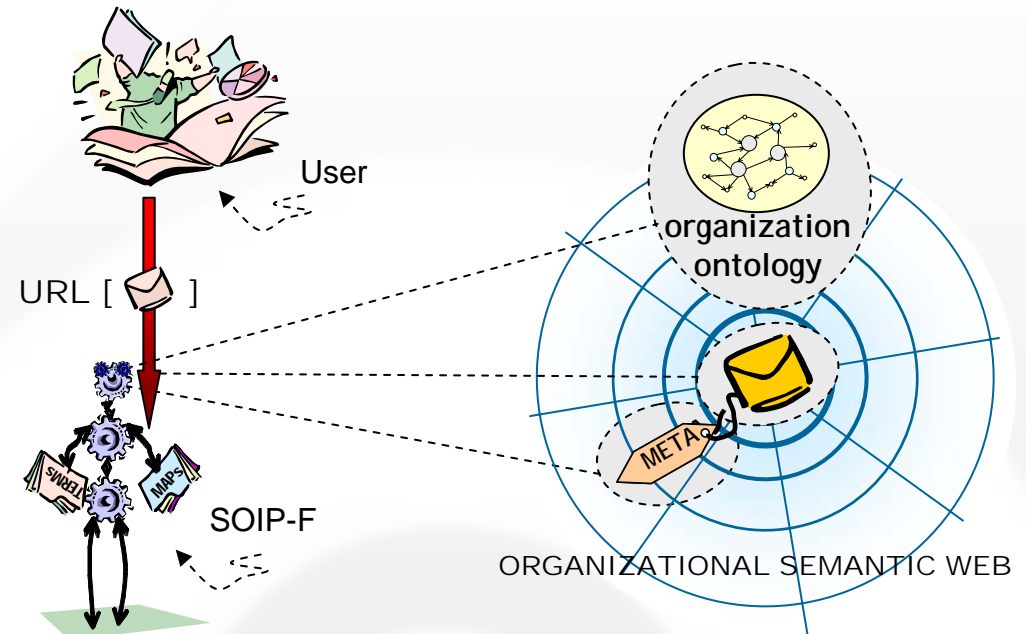
- Thus, a SOIP prevents users from getting lost in portal environment, **enriching each “navigable” resource with automatically created links** to other resources semantically related (“framing” it in organizational knowledge)

Concept step 2 / Link automatic creation

- Our concept accomplishes the objective **to improve navigation by creating links automatically and displaying them in a navigation panel.**
- The **rational** behind is straight forward:
 - ▶ A Semantic OIP built using **our framework can**, in a way, “**understand**” the meaning of the **metadata** used to describe a resource and its relationships with other resources; so, when a user asks the Semantic OIP to retrieve a resource at a given URL, it **returns the required resource inserted in a navigation panel** that automatically provides the user with additional links.
 - ▶ So beside the common links already provided by the resource itself, it becomes possible to **automatically render links to context data or to more detailed information**, as long as the relationships connecting resources can be inferred by a **reasoning service**.

Concept step 2 / The navigation panel

When a user retrieved a resource at a given URL, **SOIP framework locates the resource** in the OSW and **“understands”** (knowing RDF, OWL, its own terminology and user-defined mappings) the **metadata** that describes the relationships between the retrieved resource and other resources and concepts.



Then **SOIP framework returns the required resource inserted in a navigation panel** that contains automatically generated links to the related resources and concepts.

Concept step 2 / Three kinds of links

- In our vision there are, at least, three different kinds of links our framework for semantic OIP can generate:
 - ▶ **access point links**,
 - ◆ that, contextualizing the retrieved resource in the *access model*, render both **global and contextual access point** to the retrieved resource, where global access points are a sort of landmarks that help users in taking their bearings, while contextual access point are links to one or more resources in the same collection, a sort of compass that guides users in accessing the information.
 - ▶ **categorized links**,
 - ◆ that, contextualizing the retrieved resource in the *navigation model*, render a set of boxes populated with links that are the result of a simple property-based queries (e.g. all the resources related via a given property) over the metadata describing the retrieved resource. Links in this category are provided in order to give users an idea of **the context in which the retrieved resource is located**.
 - ▶ **metadata links**,
 - ◆ that should provide an intuitive navigation from and to the retrieved resource following **the RDF properties** used to describe it.

Concept step 2 / Our approach in modeling

To support users browsing we choose:

1. to **define a navigation and access terminology (contains, contained, related, next, Home, ...)**, known by the portal and used to offer automatically created links



we do NOT assume any binding between domain information model (captured by the organization ontology...) and this navigation and access terminology, because we want to clearly **uncouple organization knowledge from the way/mode/technique to access it through the portal**

2. to **build indirectly navigation and access models by mapping domain information terminology to navigation and access terminology** via RDFS and OWL mapping terms (rdfs:subClassOf, rdfs:subPropertyOf, owl:equivalentClass, owl:equivalentProperty, etc.)

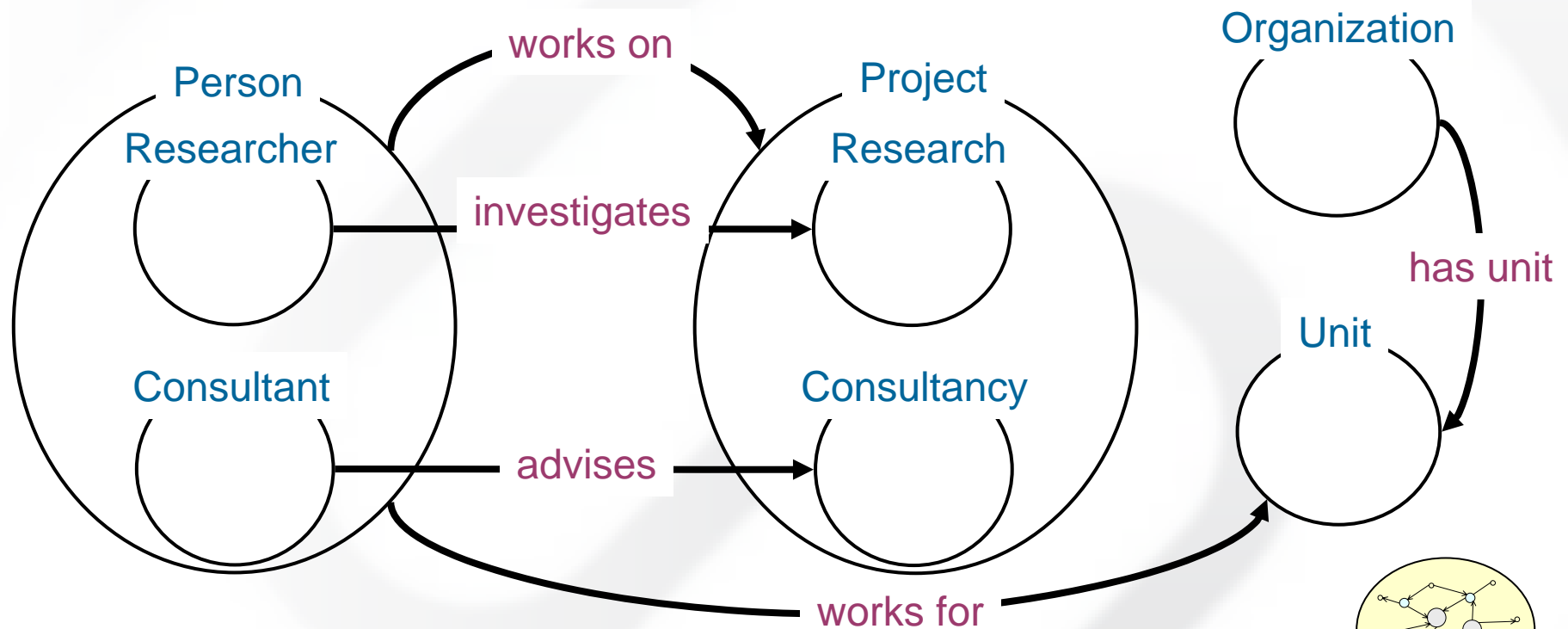


there's a substantial difference with WWWCM that model *directly* domain information, navigation and access, providing primitives to define these models

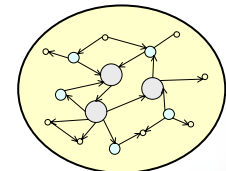
Moreover we do NOT assume **any “a priori” agreement**, except the use of a common set of knowledge modeling primitives (e.g. OWL), because the Semantic OIP is only one among many applications accessing the organizational knowledge

Example / CEFRIEL domain ontology definition

“CEFRIEL is an **organization**. Organizations are divided into **units**. **People works for** a unit **on** one or more projects. People can be divided into **researchers** and **consultants**. Projects can be split in **researches** and **consultancies**. In particular a researcher **investigates** in at least a research project and a consultant **advises** in at least a consultancy. [...]”

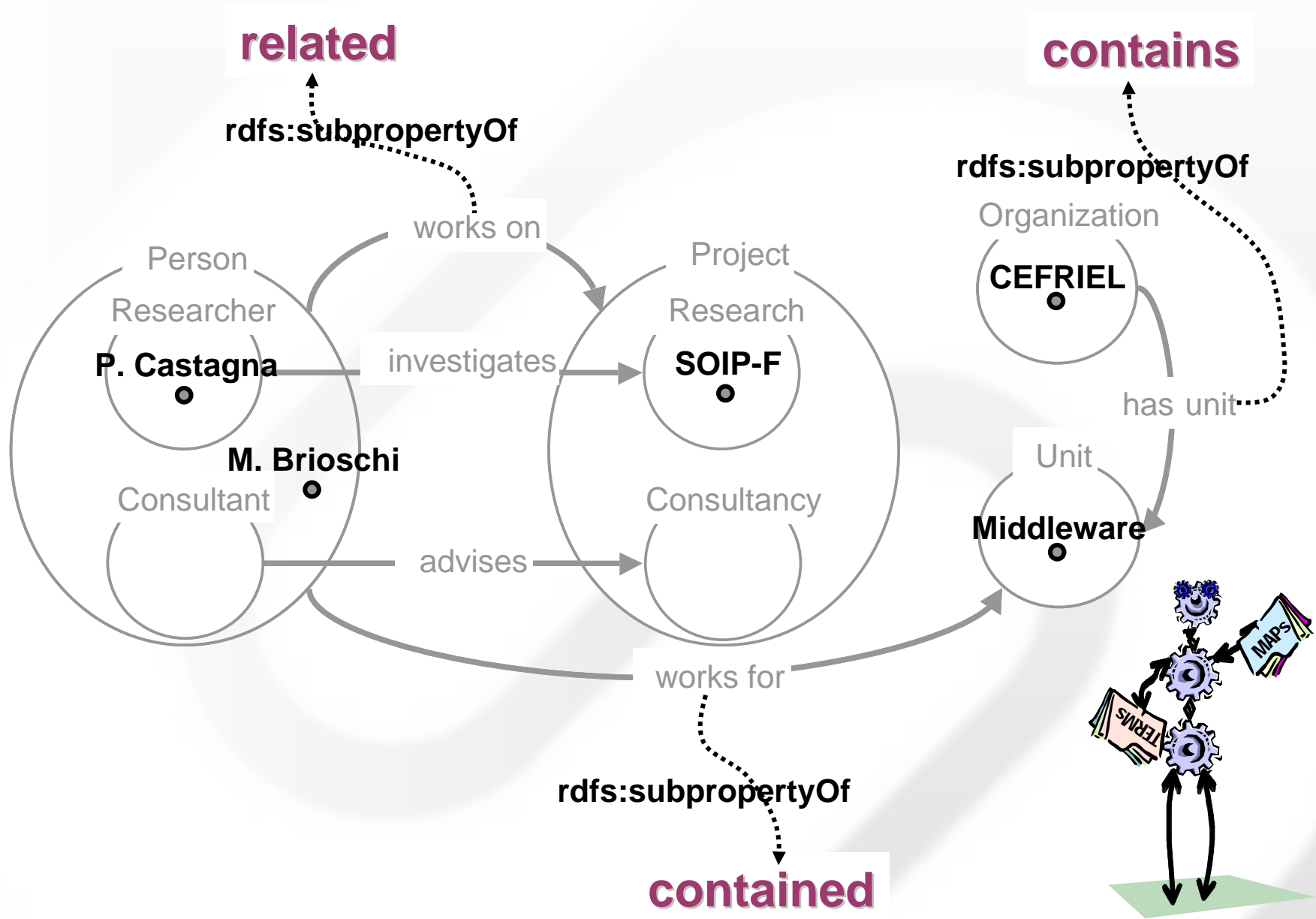


It is a **shared understanding** of the information in the organization knowledge that **doesn't change**, or changes slowly, over the time. Its design is completely decoupled from the semantic OIP design. Therefore the **semantic OIP cannot assume any “a priori” agreement** except the use of OWL primitives

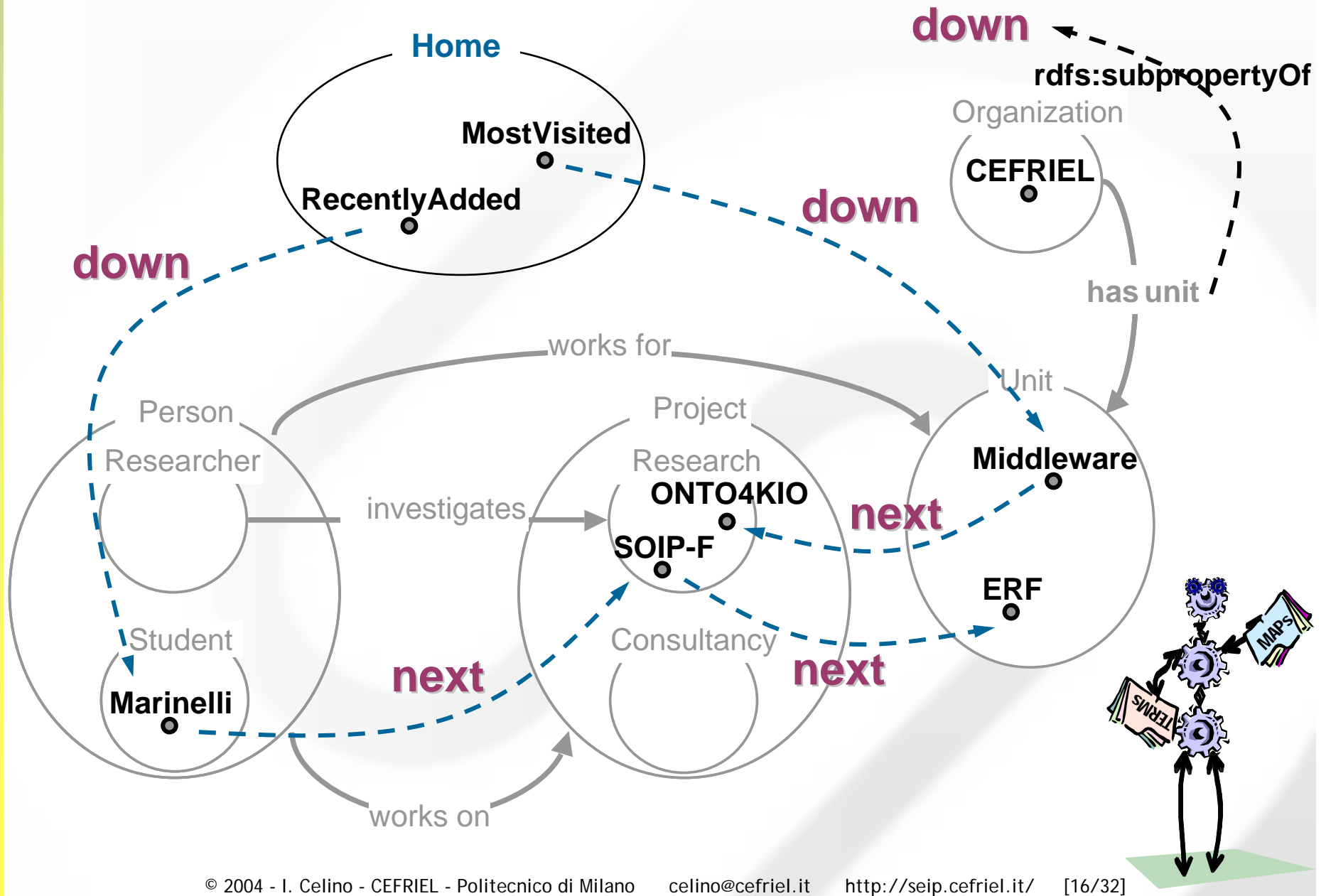


CEFRIEL
organization
ontology

Example / Mapping a navigation model



Example / Mapping an access model



Concept step 2 / Interacting with SOIP

Different “actors” benefit from SOIP approach:

- ❑ **Users**, whose navigation through heterogeneous resources is simplified offering them **homogeneous paths** and **landmarks** to get easily oriented
- ❑ **Shapers**, that write navigation and access models **mapping** information space terminology to navigation and access terminology **without affecting resources** in organization knowledge
- ❑ **Editors**, whose **editing task** is **distributed and independent** from portal structure; the only constraint for them is to add (a few) metadata to resources with respect to organization ontology: this way a **reasoning service** can infer all useful information/knowledge about resources

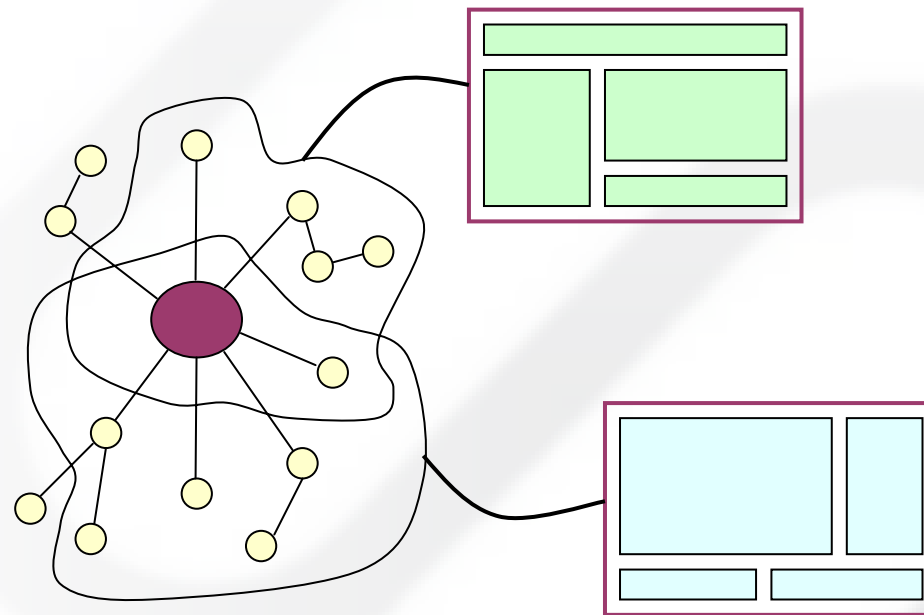


- OIP users are **organization members** that interact with the portal in order to find information to support their job within the organization
- But **different users need different information** because they:
 - ▶ have different profiles
 - ▶ follow different aims
 - ▶ are in different moments of their travel
- Therefore, we need to define **different views on organization knowledge** to face these different information needs
- A **view** centered on a resource is made up of (at least) two components:
 1. **Presentation** of a heterogeneous but coherent subset of all available information
 2. **Navigation** from/to other resources, supporting moving through organization knowledge



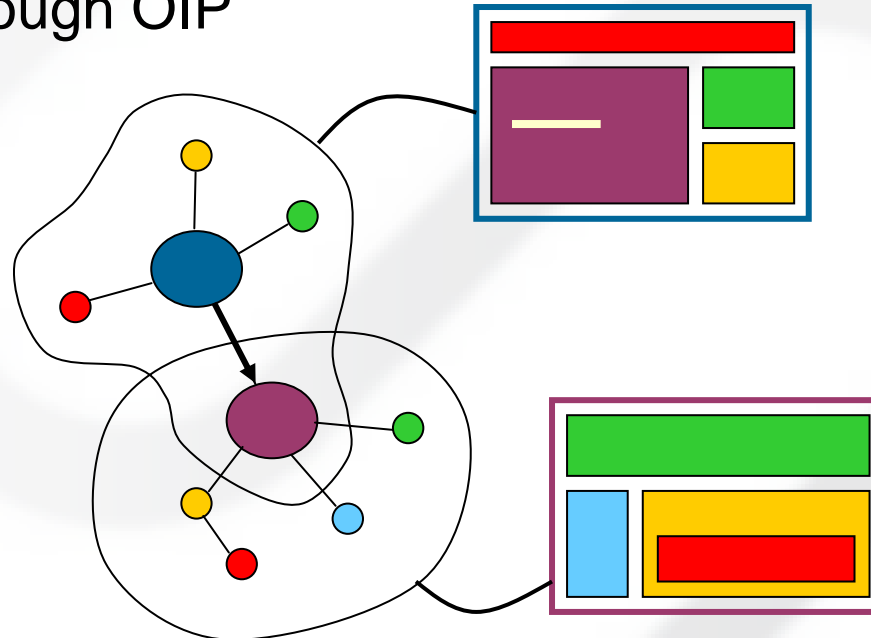
1. **Presentation** of a heterogeneous but coherent subset of all available information

- we can divide all knowledge about a particular item in “**travel objects**”, i.e. atomic bunches of information, elementary “bricks” that can be composed together to build a view



2. **Navigation** from/to other resources, supporting moving through organization knowledge

→ we want to suggest **different paths** to cross information, that can be related to the specific **surfing modality** (navigation oriented to get an overview on available information vs. deepen searching for detailed information) or to the particular **phase of the travel** (starting activity of getting oriented vs. aware navigation in a limited environment); thus, we offer different “vehicles” to travel through OIP



Concept step 3 / Browsing via multiple vehicles

- Our concept accomplishes the objective **to offer users different views related to their needs**, **binding resource presentation to the “semantics” provided by metadata** (linking visualization to concepts and relations in organization ontology via mapping)
- The **rational** behind is straight forward:
 - ▶ **A view is defined by the composition of a certain number and type of travel objects**, choosing them among the available ones for each information item; “*understanding*” the meaning of metadata and knowing concepts hierarchy, **SOIP can infer what set of elements** is to be visualized for each resource asked by the user
 - ▶ **Different compositions of travel objects constitutes different views** on the same information space

Concept step 3 / Our approach in modeling

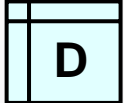
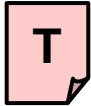
To support multiple views building we choose:

1. to **define a presentation terminology**, known by the portal and used to define unitary “travel objects” to build views
2. to **build indirectly presentation models** by **mapping domain information terminology to presentation terminology**

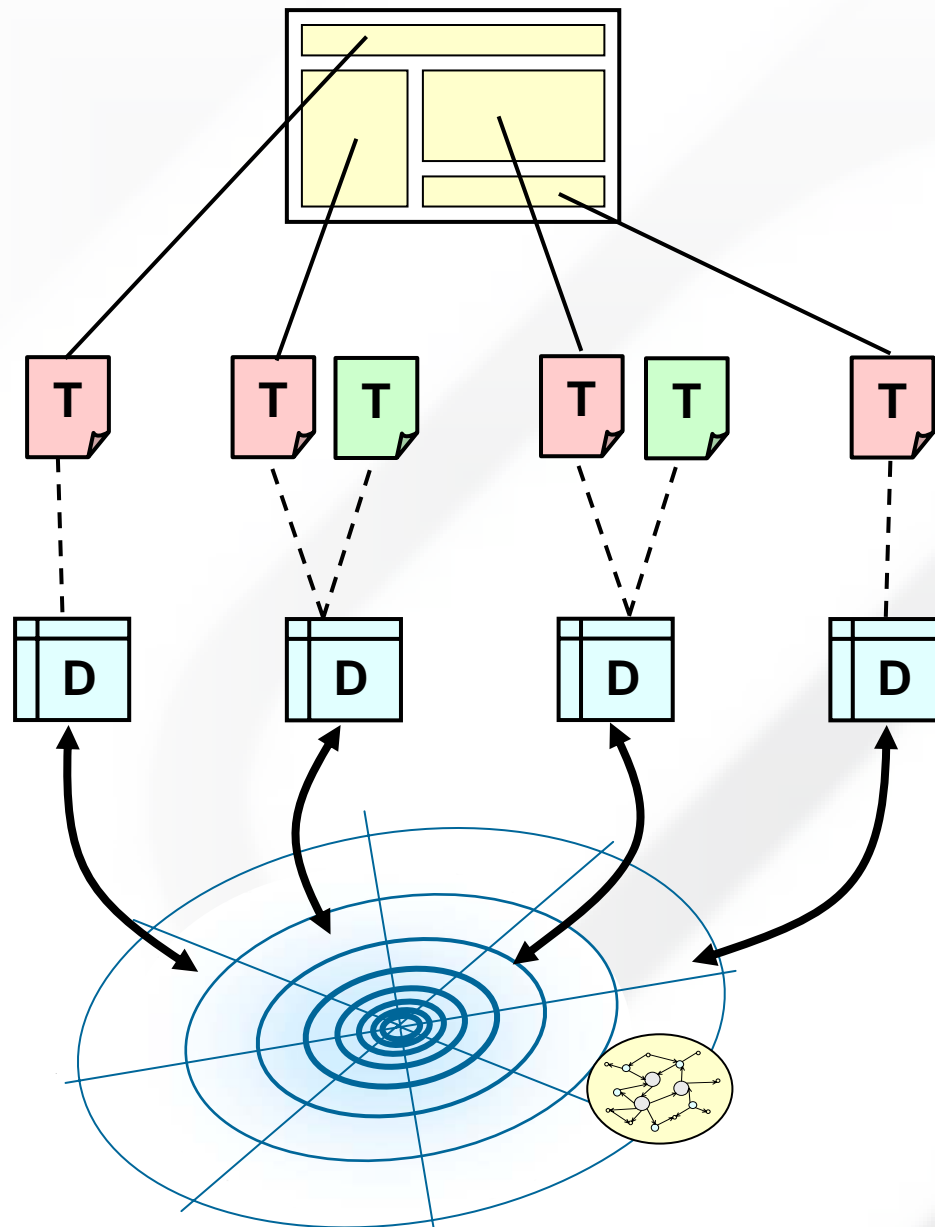
Notes:

- A **vehicle** to cross organization space is then made up of the **combination of navigation, access and presentation mappings**
- Moreover, since a SOIP is based on a reasoner to make **inference**, when we define (through mapping) a presentation for a concept of organization ontology, we assign by default the same presentation to all sub-concepts and instances of that concept
- According to MVC design pattern, visualization of resources is managed by a **template engine**: in presentation mapping we can then insert even the specific template to present information
- We still do NOT assume any binding between domain information model and presentation terminology, that is to say that there is a **clear decoupling between organization resources and portal terms**

Concept step 3 / Our prototype 1/2

- To implement travel object idea, we apply **Decorator design pattern**:
 - ▶ **each decorator corresponds to a travel object** and is responsible for selecting and structuring a part of the available information about a resource 
 - ▶ **each presentation mapping links domain terms to** (all and only) **the decorators** implementing those travel objects that compose a coherent view on information space
- Then, to manage resources visualization, we exploit a **template engine**:
 - ▶ **each travel object** (bunch of information) **can have one or more templates** to be presented (from a web-design point of view) 
 - ▶ **each presentation mapping links decorators to** correspondent **templates** that best visualize information in a particular view of resources

Concept step 3 / Our prototype 2/2



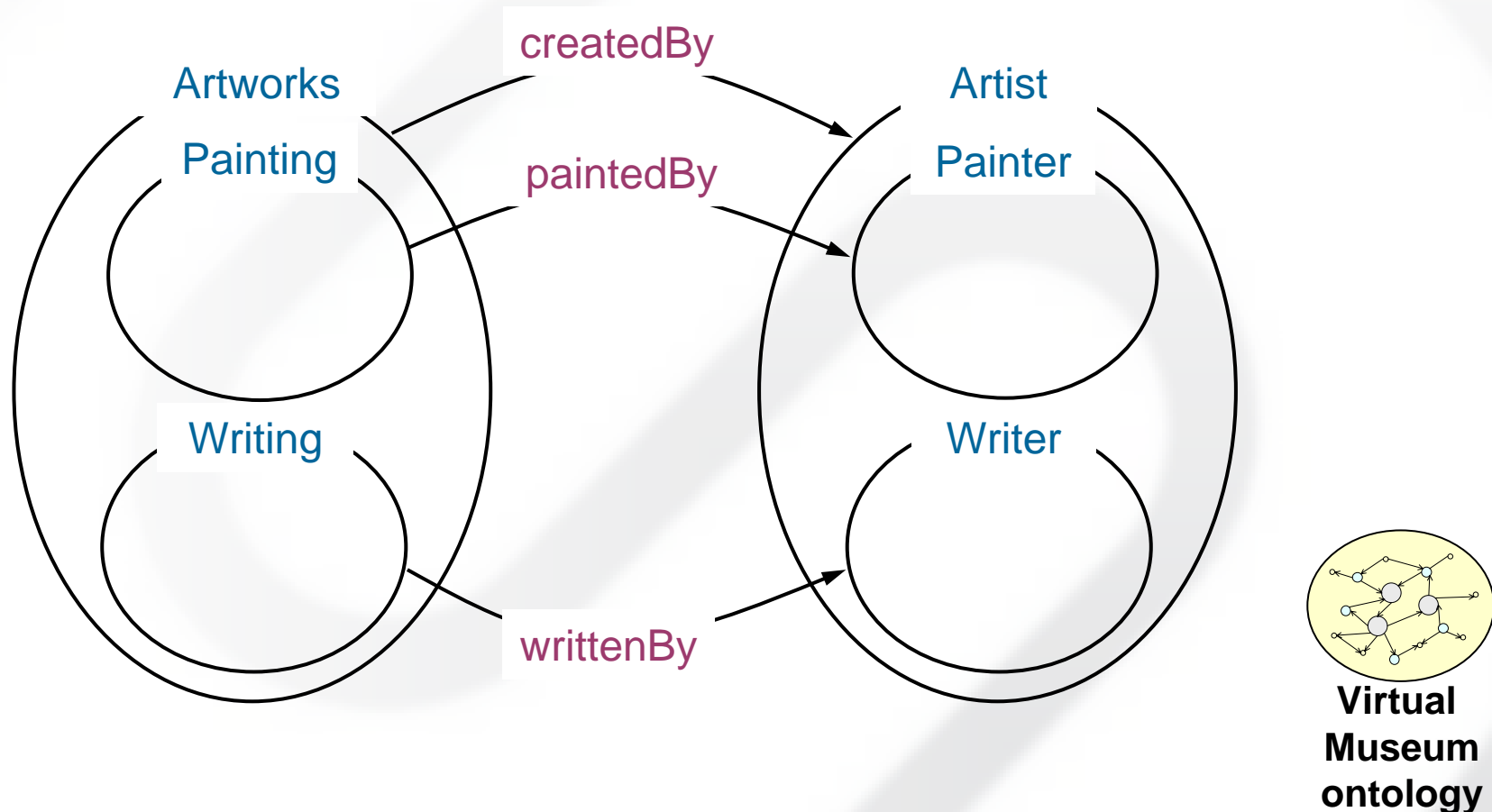
knowledge-item
composed by a set
of travel objects

templates }
travel
objects }
decorators }

Organization
Semantic Web
(with organization ontology)

Example / Virtual museum of contemporary art

- An organization wants to build a portal about contemporary art, letting users to navigate across information like they were visiting a sort of virtual museum
- The portal arises from the aggregation of contents provided by several sources that are distributed, heterogeneous and autonomous but that share a specific domain ontology to describe their resources



Example / Two different vehicles

- 1) The Virtual Museum offers some **thematic trails** to those users that want to navigate across resources without a definite purpose in mind, just following recommended paths to get generic/contextual information
 - ▶ This **thematic trail vehicle** offers a **generic view on information** without entering into the smallest details, but letting users to have a **guided journey**
- 2) The Virtual Museum offers even the possibility to **explore single resources in details**, foreseeing the needs of (thinking about) those users that propose themselves to achieve a definite purpose through navigation and that don't need generic or contextual information
 - ▶ This **detailed investigation vehicle** offers a **specific view** on information entering into the smallest details and letting users to **deepen their knowledge** about single resources



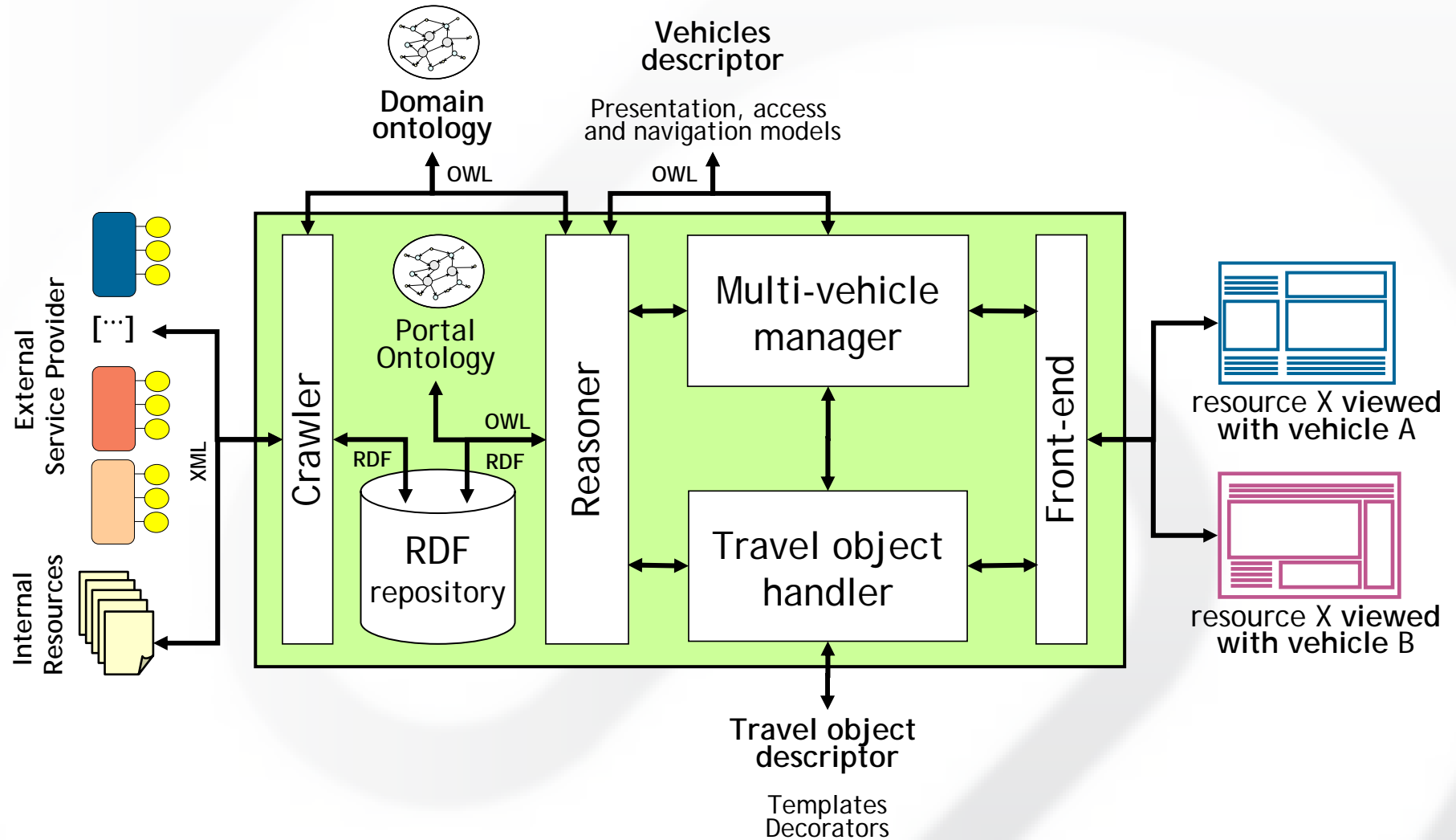
Concept step 3 / Interacting with SOIP

Different “actors” benefit from SOIP approach:

- ❑ **Users**, that interact with the portal, **supported in their browsing by a vehicle** (a view) that takes in account their needs and their navigation’s features (surfing modality or phase of the travel)
- ❑ **Shapers**, that write presentation models **mapping** information space terminology to presentation terminology and **choosing** which **travel objects** compose each view/vehicle, still **without affecting resources** in organization knowledge



SOIP-F general architecture



Demonstrative sites

- ❑ Cefriel organization portal
- ❑ Virtual Museum of contemporary art
- ❑ Semantic Web virtual lesson:
 - putting together different lessons to offer a coherent and homogeneous path through heterogeneous resources
- ❑ Catalogue of Semantic Web Services articles:
 - classifying different bibliographic references about Semantic Web Services in order to systematize their collection

Future evolutions/developments

- ❑ Improvement of **searching** feature by semantic-based resource discovering
- ❑ Implementation of user-**bookmarking** feature by personal access modeling
- ❑ **Personalization of views** according to user profile or preferences and automatic matching with user context; runtime creation of mappings and vehicles
- ❑ Realization of a set of tools that allows shapers to define navigation, access and presentation mappings, to implement decorators or to write templates via a **graphical interface**
- ❑ Improvement and simplification of **authorization management**; e.g. administrators could give permissions to users letting them to navigate resources via a specific vehicle, binding access privileges to the semantics of resources (what information is “reachable” with a particular view) and to navigation features



Conclusions

- We believe that **Semantic Web technologies** in the next few years will break through **as the technology change** that developers of OIP frameworks require for moving a step further in the direction of a better trade off between simplicity and flexibility
- Adopting Semantic Web technologies:
 - ▶ a portal will **give a unified view of the information present in the organizational knowledge**
 - ▶ organizations can keep developing **distributed and autonomous systems** on an ad-hoc basis (as required by contingency plans)
 - ▶ singular **parts of the organization can keep their degree of autonomy** in managing such systems
- **Our framework** for Semantic OIPs **brings many innovations** in OIP development because:
 - ▶ **imposes no restriction** but the **use of RDF and OWL over the design of the domain information model**, which is the possibly already present organizational ontology
 - ▶ **enables information reuse** because it doesn't require the information carried by the metadata to be coded in any particular way
 - ▶ **enables** both **resources and metadata management in a distributed and, when necessary, autonomous way**
 - ▶ **offers a homogeneous navigation experience among heterogeneous resources** distributed over an organizational semantic web through mapping of corporate terminology to the portal terminology.

Credits

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- Research projects:
 - ▶ MAIS project (Multichannel Adaptive Information System)
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- Conception and development:
 - ▶ Lara Marinelli
 - ▶ Irene Celino
 - ▶ Paolo Castagna
 - ▶ Emanuele Della Valle
 - ▶ Maurizio Brioschi

Publications

- E. Della Valle, M. Brioschi, “*Towards a Semantic Enterprise Information Portal*”, In proceedings of Workshop on Knowledge Management and the Semantic Web at K-CAP'03, 2003
- E. Della Valle and M. Brioschi, “*Toward a framework for Semantic Organizational Information Portal*” In proceedings of first European Semantic Web Symposium, J. Davies et al. (Eds.): ESWS2004, LNCS 3053, pp. 402-416, 2004