Workshop: Linked Data in Architecture and Construction
Wednesday 28 - Thursday 29 March, 2012
Organized by: SmartLab, Multimedia Lab
University of Ghent, Belgium

RESEARCH PROJECTS

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ARC Enginyeria i Arquitectura La Salle
Universitat Ramon Llull
Barcelona, Spain

Research group

ARC (Architecture Representation Computation) is a multidisciplinary research group integrated in the School of Engineering and Architecture La Salle founded in 1999

Members of the group are architects, computer scientists, multimedia engineers and graphic designers.

It is dedicated to the design, development and application of information and communication technologies (ICTs) to architecture in different areas, including education, design and construction.

Research lines

Architectural Design and Building

Computer-based design and construction processes, building information modeling (BIM), building component catalogues, modular buildings and industrial construction.

Pedagogy

Environments to support collaborative learning, repositories of educational resources and learning systems.

Information spaces

Interactive interface design, information visualization, concept mapping and data mining.

ARCHITECTURE REPRESENTATION COMPUTATION

ARC: Home

laSalle ARQ
Universidad Ramon Llull

ARC is a multidisciplinary group dedicated to the design, development and application of information technology and communication (ICT) architecture, in several areas: education, projects, and research. The group was founded in 1999 and in 2009 was officially recognized as research group by the Catalan Government. During this time it has conducted numerous educational and research projects, whose results have been published in journals and at international conferences.

Currently, the lines of research of the group are:

- Design and construction: building information modeling (BIM), modular construction and manufacturing, simulation, design and construction processes, and product modeling.
- Pedagogy: collaborative environments, digital repositories, and learning models.

Among the projects funded by national research programs in Europe stand out: coordination of the project BARCODE SYSTEM HOUSING (Spanish National R+D+I plan); coordination of the project RÉPENER(Spanish National R+D+I plan); coordination of the European project OIKODOMOS (Life Long Learning Program), as well as the participation in the FP7 project IntUBE.

Interactive PDF

[Printable version: 50Mb]

Featured Projects

SDR:NETWORKING [ESPACIO]

VRML environment that allows users to set relationships between spatial units, building a 3d model collaboratively. Awarded first prize in the category "Interface design" in the international competition "ACADIA Digital Design Exhibition, 2002",...

SDR:NETWORKING [TEXTO]

Web environment that allows a group of students to analyze texts by means of a semantic network.

BCNi-matges

BCNi-matgesWeb-based environment to visualize and send photographs and photomontages done in the theme IMAGE of the course "SDR, Sistemas de Representación".

SDR NETWORKING: INFO

SISTEMAS DE REPRESENTACIÓN, is a pedagogic project which integrates interdisciplinary content, collaborative working methods and information technology in an innovative manner. A web-based learning environment, named SDR NETWORKING, has been designed and implemented...

ILLA MYRURGIA

Web pedagogic environment to promote collaboration between citizens and architecture students in the urban analysis and transformation.

Conferences

ECAADE Conference
2011-10-10
The paper "OIKODOMOS Virtual Campus: Constructing learning processes in collaboration" was presented in the ECAADE conference, that took place Septmber 26 to 28, in Ljubljana, Slovenia.

CIB conference
2011-10-10
ARC will participate the CIB W078-W102 conference with the paper "Integration of an infrared-based monitoring system with an EIIP...." which presents some of the results obtained in the FP7 project INTUBE. The conference, organized by CSTB, will take place in Sophia Antipolis, 26 to 28th October.

OIKODOMOS International Conference
2011-07-12
The OIKODOMOS International Conference, "Innovating, Housing, Learning" will take place October 27-28th in Brussels, at W& K Sint-Lucas Architecture School.

CAAD Futures 2011
2011-07-12
A poster has been presented in the CAAD Futures conference, that took place in Liège, from the 4th to the 8th of July 2011, which summarizes the development of an integrated information platform to improve energy efficiency in the entire building lifecycle. The research work has been conducted in the project FP7 Intube and is continuing in the project REPENER, funded by the Spanish National RDI plan.

News

Workshop on ontology modelling
2011-12-29
The ontology modelling workshop, held in our institution this week on 27-28/12/2011, joined people from different countries (Spain, Belgium, Germany) with the idea of sharing knowledge and common issues about ontology design methodologies, linked data, ontology matching, data mining with ontologies,...

Research projects

OIKODOMOS (Long Life Learning Programme, 2007-2011)

A Virtual Campus to promote the study of dwelling in contemporary Europe

REPENER (Spanish National RDI plan, 2009-2012)

Control and improvement of buildings energy efficiency by means of repositories

SEMANCO (FP7 programme, 2011-2014)

Semantic Technologies for Carbon Reduction in Urban Planning

OIKODOMOS

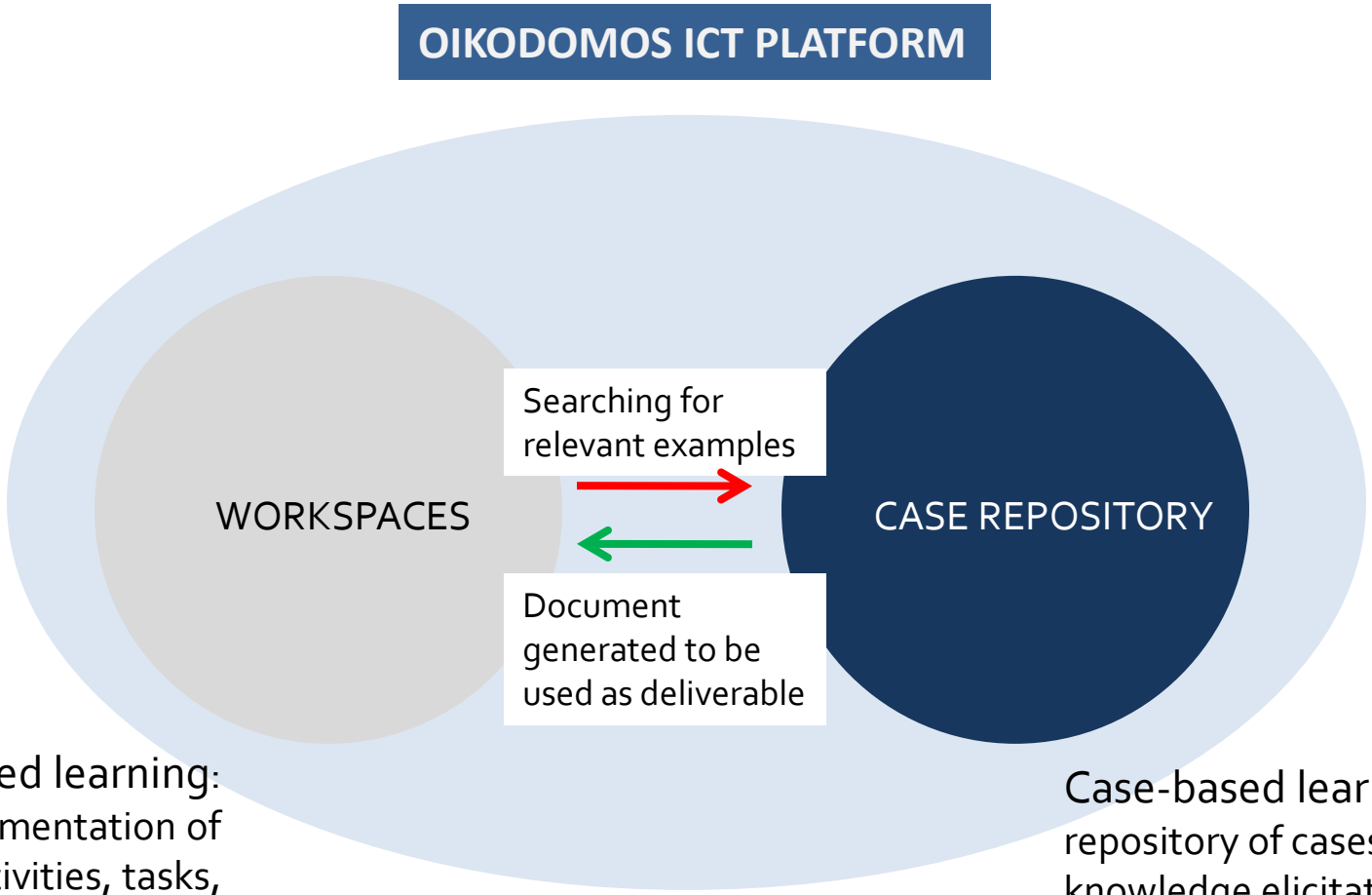
Long Life Learning Programme, 2007-2009, 2010-2011

OIKODOMOS Virtual Campus is a space of collaboration where schools of architecture and urban planning collaborate in the design and implementation of learning activities to study housing in an interdisciplinary way

It is a network of learners (teachers, students, adult learners) and activities, as opposed to an organization of schools with shared curriculum.

A digital platform has been specifically developed and implemented for the Oikodomos Virtual Campus to support a blended-learning pedagogic model. It consists of two environments: Workspaces and Case Repository.

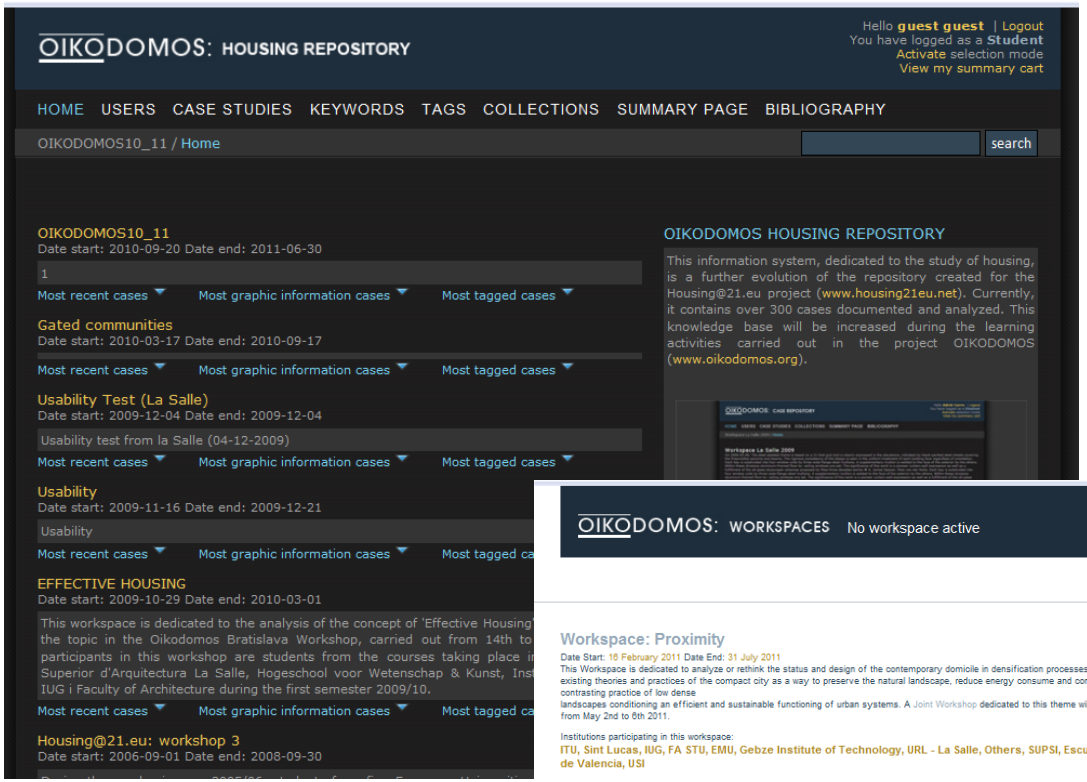
OIKODOMOS_digital platform



Project-based learning:
Design/implementation of learning activities, tasks, deliverables, evaluation

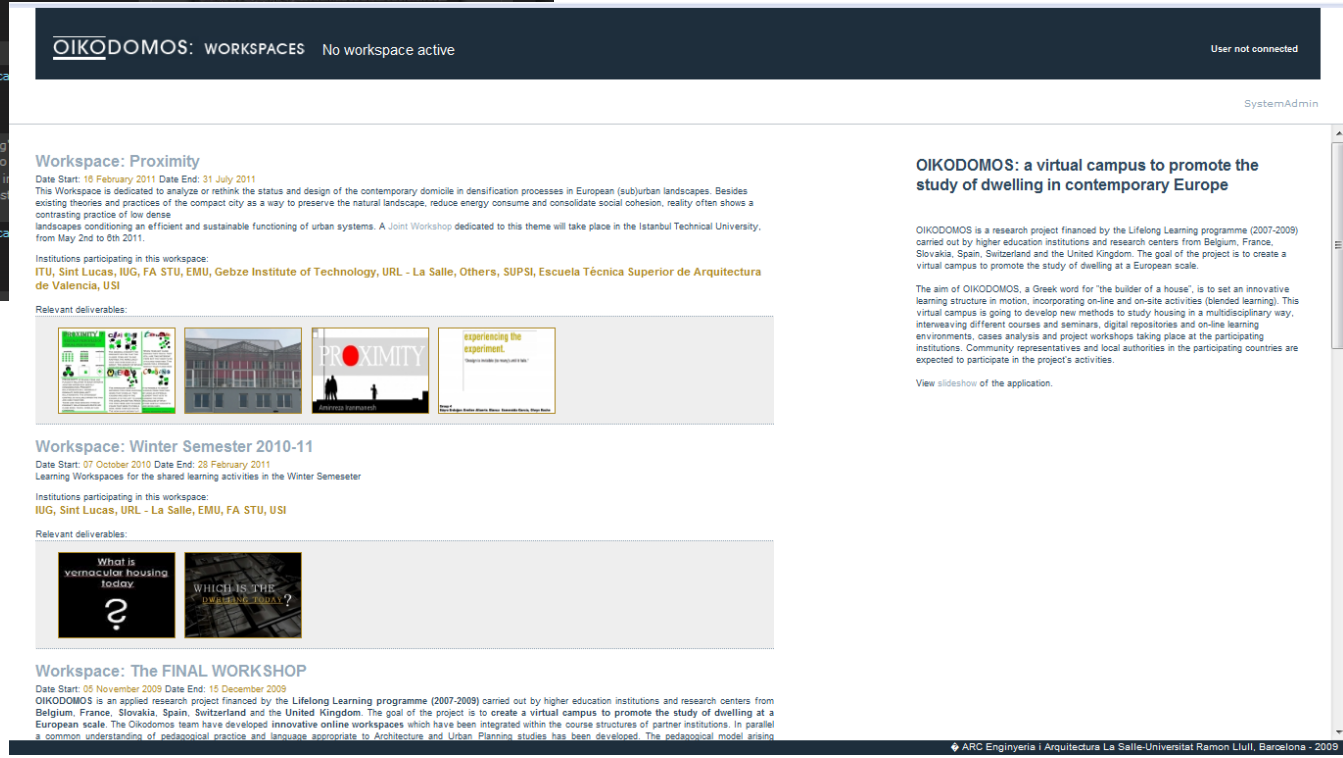
Case-based learning:
repository of cases, knowledge elicitation, collaborative analysis

OIKODOMOS_digital platform



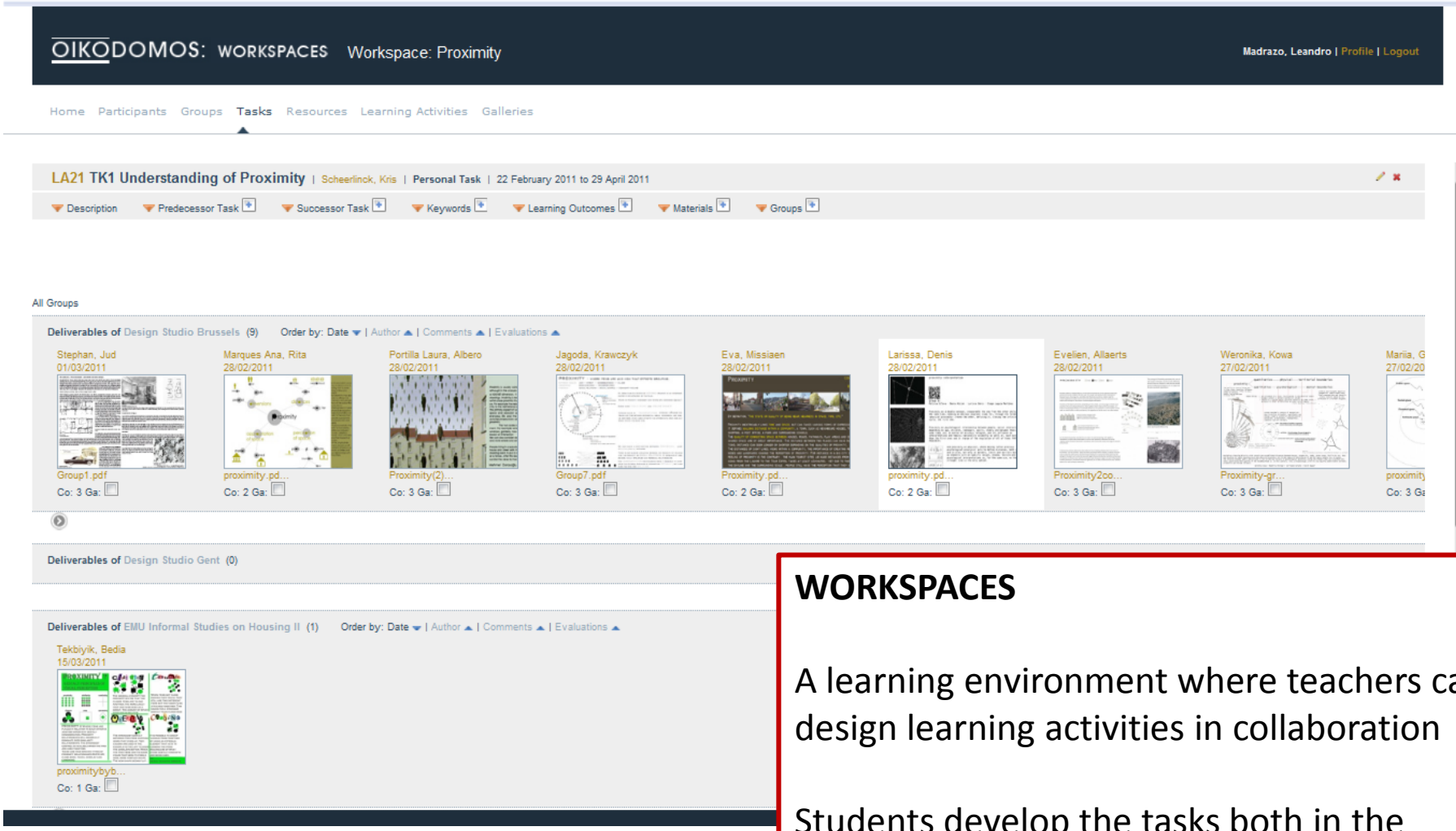
CASE REPOSITORY

WORKSPACES



www.oikodomos.org

OIKODOMOS_Workspaces

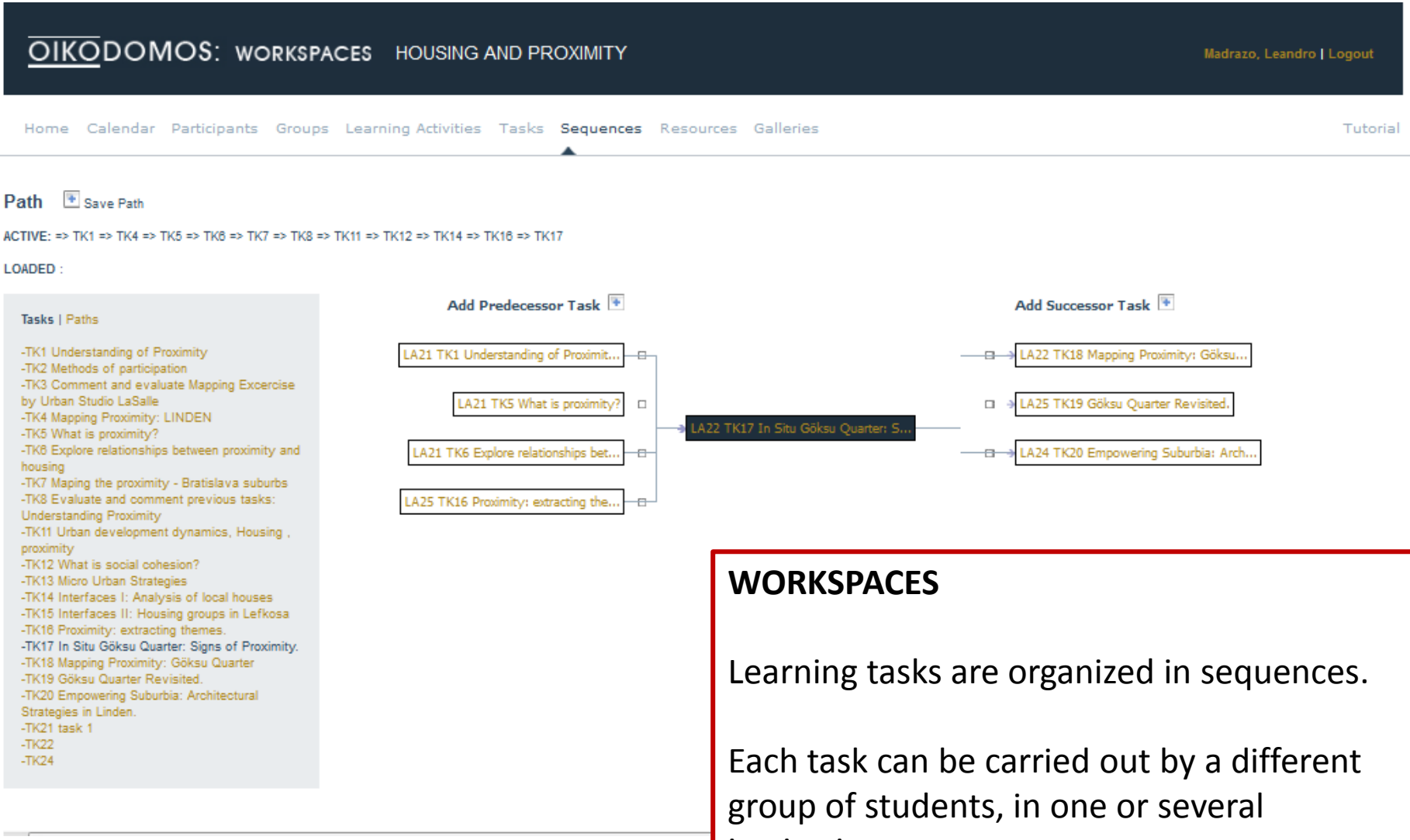


WORKSPACES

A learning environment where teachers can design learning activities in collaboration

Students develop the tasks both in the digital environment in the classes

OIKODOMOS_Workspaces

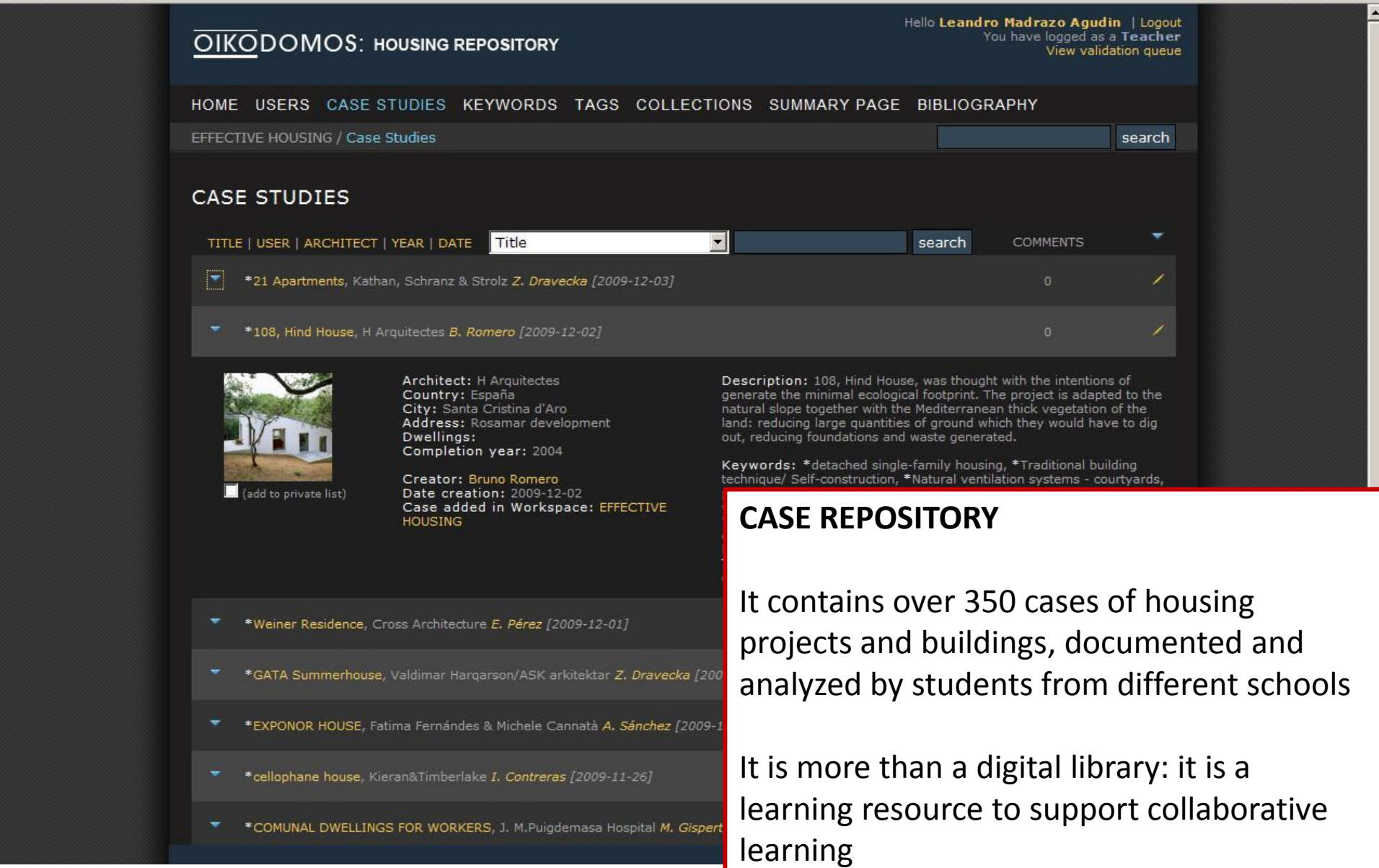


WORKSPACES

Learning tasks are organized in sequences.

Each task can be carried out by a different group of students, in one or several institutions

OIKODOMOS_Case Repository

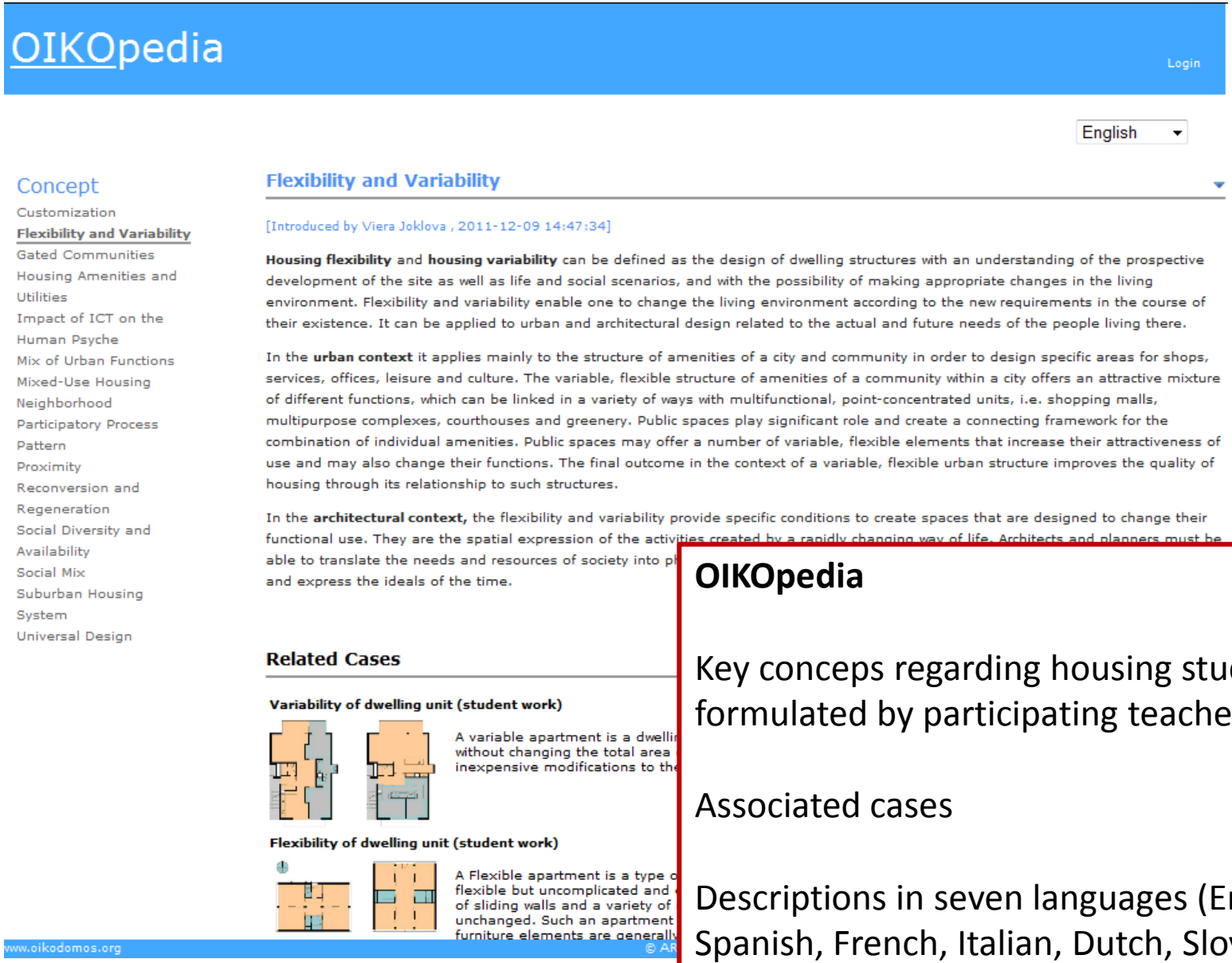


CASE REPOSITORY

It contains over 350 cases of housing projects and buildings, documented and analyzed by students from different schools

It is more than a digital library: it is a learning resource to support collaborative learning

OIKODOMOS_OIKOpedia



OIKOpedia

Key conceps regarding housing studies formulated by participating teachers

Associated cases

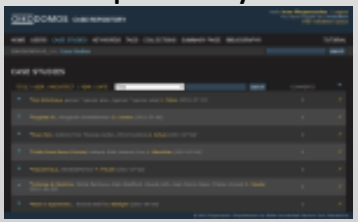
Descriptions in seven languages (English, Spanish, French, Italian, Dutch, Slovak and Turkish)

OIKODOMOS_ontologies

Data Bases | **RDF/OWL** | **Ontology Matching** | **Interface** | **Users**

Workspaces

Case Repository



Oikopedia

Workspaces Ontology

Case Repository Ontology

Oikopedia Ontology

PROBLEMS

Containt remains hidden in the repositories, it is difficult for new users to find “decontextualized” information

Potential relationships among databases are not visible

OIKODOMOS_ontologies_interface

Search Flexibility and Variability in all Repositories

Search

Context filters

Repositories	Concepts	Activities	Cases Studies
-All	-All	-All	-All
-CaseRepository	-Customization	-Analysis	-1 Centaur
-Oikopedia	-Flexibility	-Blended learn	
-Workspaces	-Impact of ICT	-Collecting	
	-Mixed-Used	-Defining	
	-Neighborhood	-Designing	
	-Pattern	-Developing	
	-Proximity	-Organizing	

Flexibility and Variability [21, *21], *B. Gonzàlez Ferrer-Vidal [2012-03-09]*

(add to private libraries)

Case study: Les Nids, Christophe Ouhayoun, Nicolas Ziesel, [KOZ architectes]
Private libraries: (no added in private libraries)
Defined by: [B. Gonzàlez Ferrer-Vidal] The white box is "pluged" into the living room without a pre-defined function.
Added in: Oikodomos_Ontology

Results

- **Flexibility and Variability** is a tag attached to case Les Nids in *Case Repository.*
- **Flexibility and Variability** is a Keyword attached to learning activity Reflections on Housing in *Workspaces.*
- Urban theoretical concepts is a task added to learning activity Reflections on Housing that has attached **Flexi**
- Today's apartment architecture
Variability in *Oikopedia*.

GOALS

To transform the interface in a space of interaction, with certain "depth"

The interface helps the user to construct knowledge; it is more than a search tool

REPENER

Spanish National RDI Plan, 2009-2012

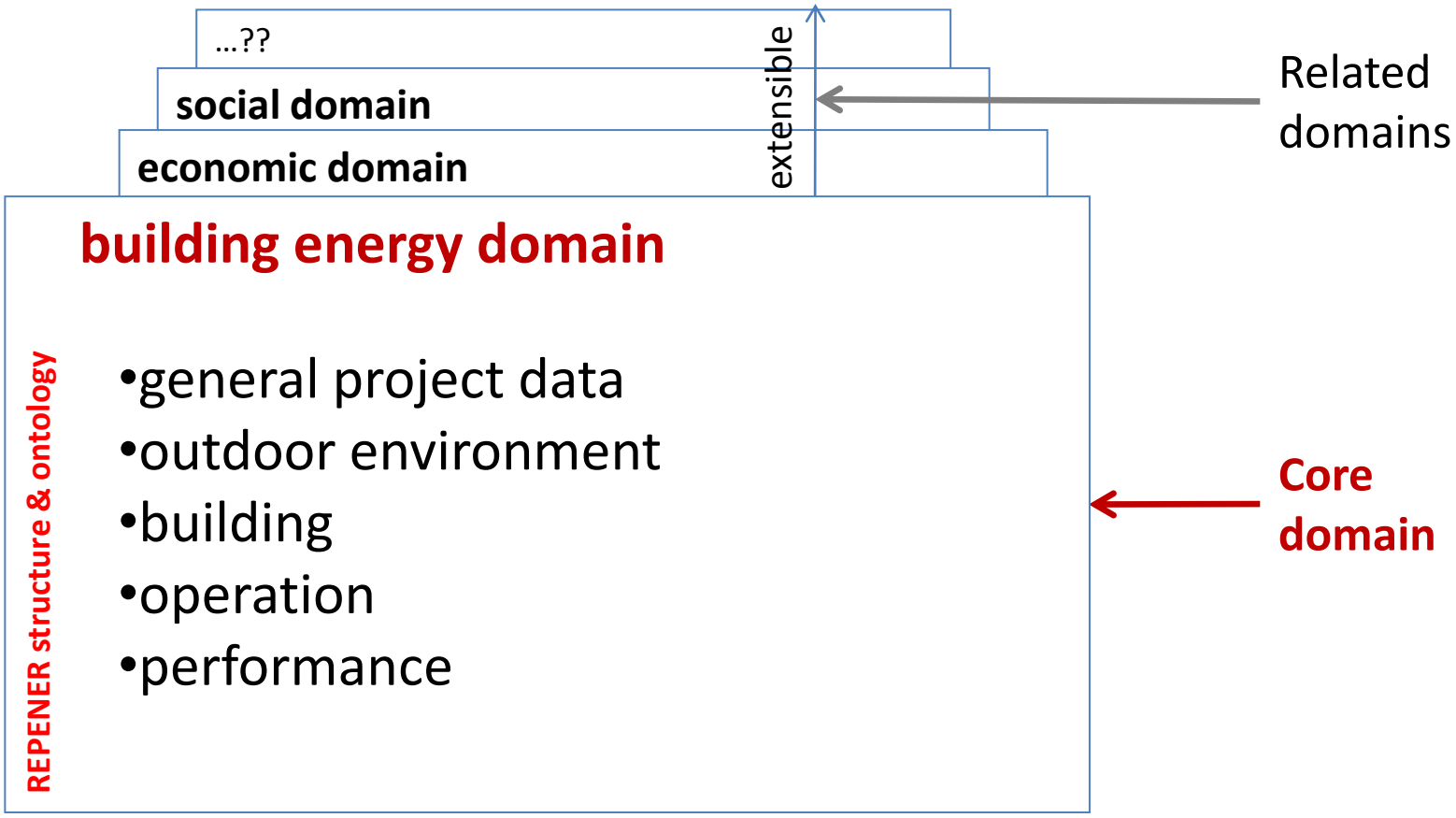
The purpose is to create a energy information system based on the model proposed by the initiative Linked Open Data

The energy model embraces two kinds of energy information:

- building information (building systems, consumption,…),
- contextual data (economics, climate,…)

The data sources are of two types: propietary and open. Both types of data sources have been interlinked by means of ontologies.

REPENER_energy model



To build-up the **energy model**, the knowledge of experts in building energy domain was formulated in terms of categories. These categories provide the starting point for the creation of a generic **data structure**.

REPENER_data structure

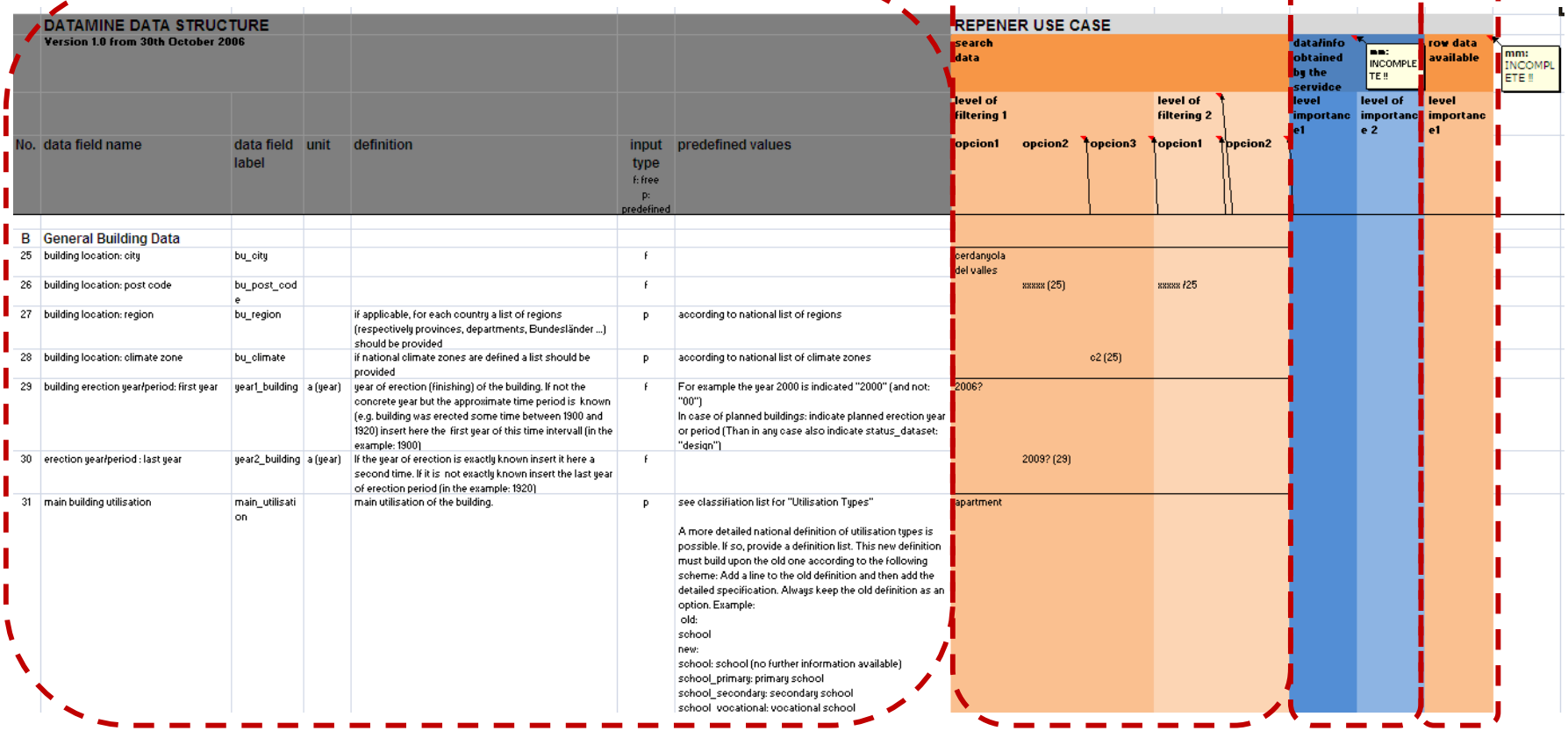
Use cases have been used to reduce the number of parameters (potentially an immense list!) included in the energy model **data structure**. **Energy parameters** have been analyzed and classified and **relationships** between them have been identified. Based on this study, an open and flexible **data structure** has been created jointly by **energy experts** and **ontology engineers**.

III. Datos base

II. Datos salida

I. Datos entrada

Definiciones datos (proyecto DATAMINE; ISO 13790:2008)



DATAMINE DATA STRUCTURE
Version 1.0 from 30th October 2006

REPENER USE CASE

search data

data/info obtained by the servidce

row data available

mm: INCOMPLETE !!

mm: INCOMPLETE !!

level of filtering 1

level of filtering 2

level importance1

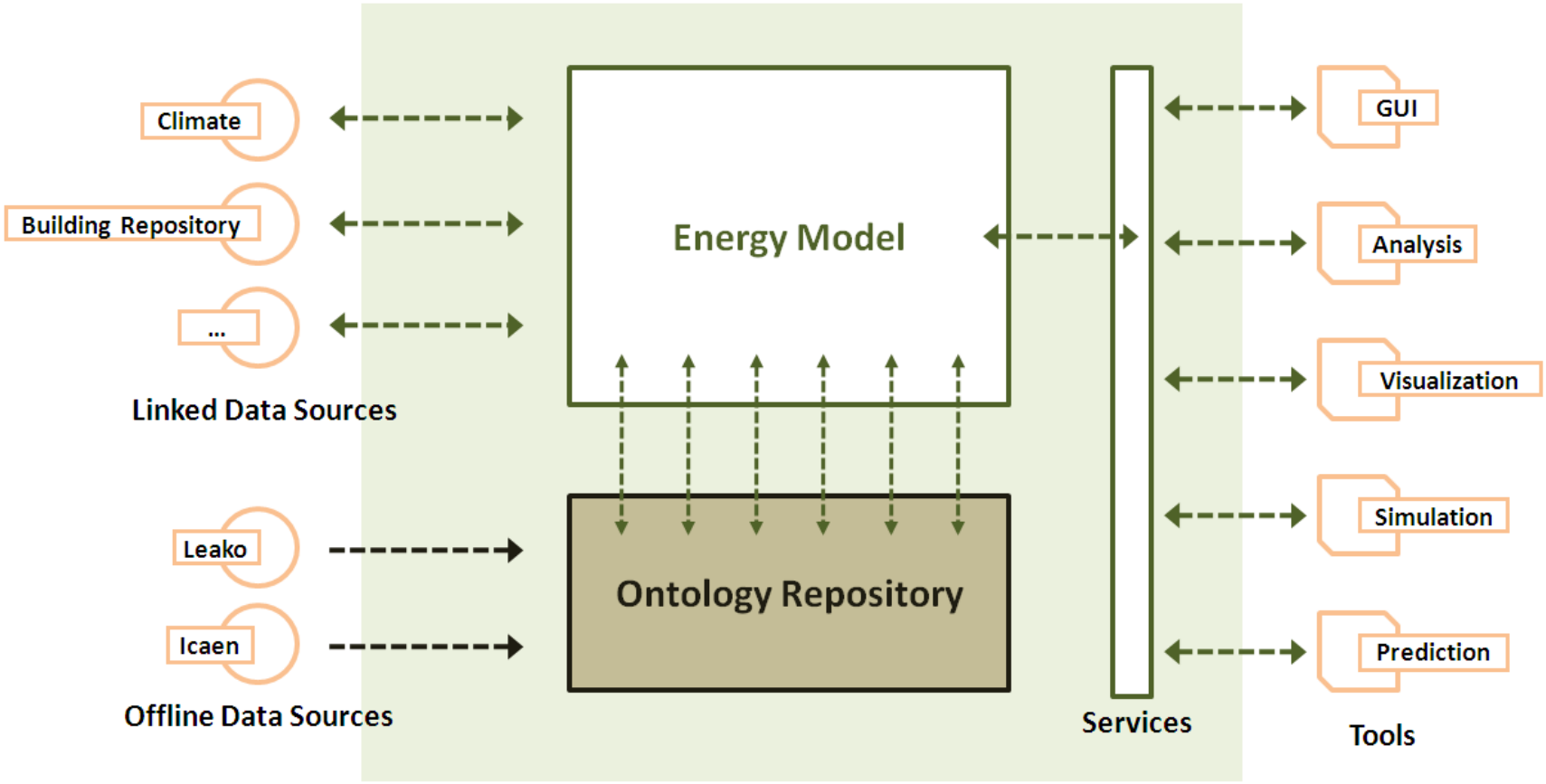
level of importance 2

level importance1

opcion1 opcion2 opcion3 opcion1 opcion2

No.	data field name	data field label	unit	definition	input type f: free p: predefined	predefined values	cerdanyola del valles	xxxxx (25)		xxxxx /25			
B	General Building Data												
25	building location: city	bu_city			f								
26	building location: post code	bu_post_code			f								
27	building location: region	bu_region		if applicable, for each country a list of regions (respectively provinces, departments, Bundesländer ...) should be provided	p	according to national list of regions							
28	building location: climate zone	bu_climate		if national climate zones are defined a list should be provided	p	according to national list of climate zones			c2 (25)				
29	building erection year/period: first year	year1_building	a (year)	year of erection (finishing) of the building. If not the concrete year but the approximate time period is known (e.g. building was erected some time between 1900 and 1920) insert here the first year of this time intervall (in the example: 1900)	f	For example the year 2000 is indicated "2000" (and not: "00") In case of planned buildings: indicate planned erection year or period (Than in any case also indicate status_dataset: "design")	2006?						
30	erection year/period : last year	year2_building	a (year)	If the year of erection is exactly known insert it here a second time. If it is not exactly known insert the last year of erection period (in the example: 1920)	f				2009? (29)				
31	main building utilisation	main_utilisation		main utilisation of the building.	p	see classifiation list for "Utilisation Types" A more detailed national definition of utilisation types is possible. If so, provide a definition list. This new definition must build upon the old one according to the following scheme: Add a line to the old definition and then add the detailed specification. Always keep the old definition as an option. Example: old: school new: school: school (no further information available) school_primary: primary school school_secondary: secondary school school_vocational: vocational school	apartment						

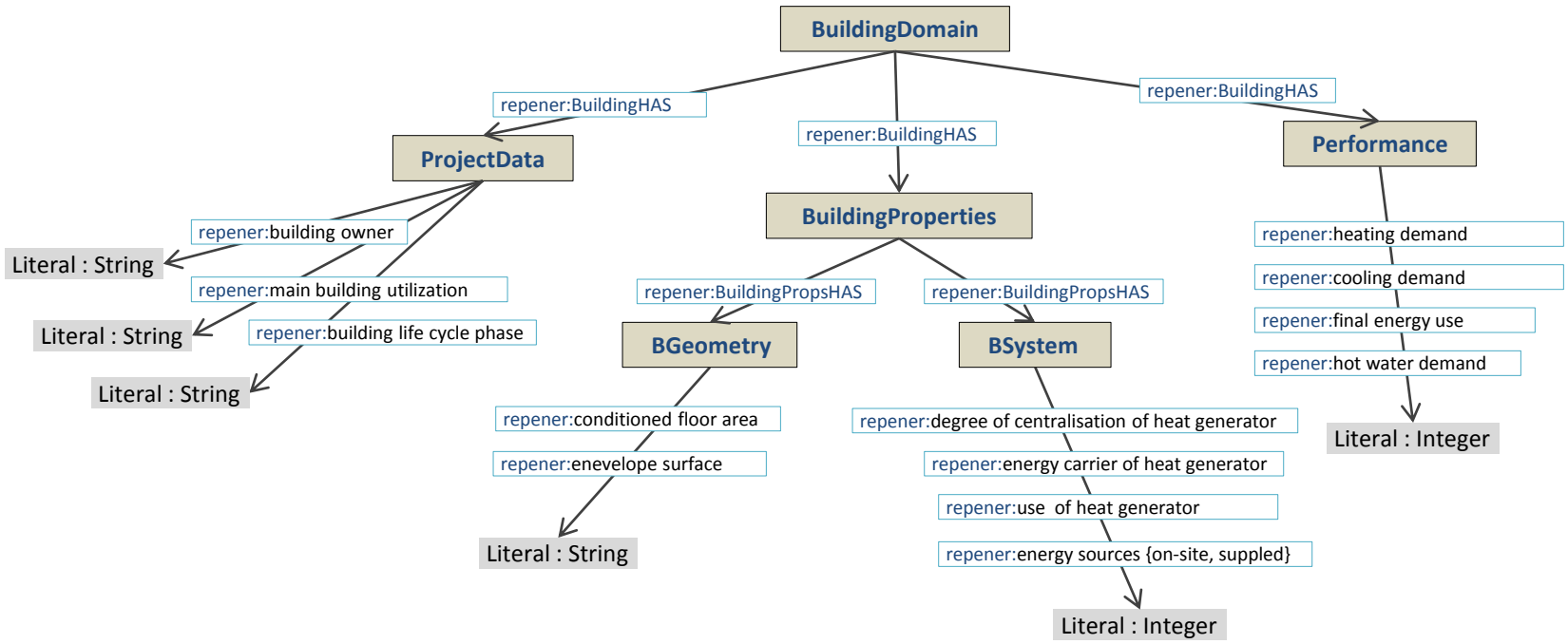
REPENER_ontologies



The core of the information system is the energy model which contains descriptions of terms, relations, types and units which are present in all of the data sources.

The energy model is implemented as a global ontology which is the union of the sets of terms from all data sources.

REPENER_ontologies



- Local ontologies have been designed for each data source using the OWL.
- An ETL process has been applied to translate relational databases into RDF.
- D2RQ mapping language has been used to obtain RDF dumps which have been uploaded to a RDF server (Virtuoso server).

REPENER_ontologies_interface

REPENER - Control and improvement of energy efficiency in buildings through the use of repositories

Welcome to REPENER !
Introduce yourself and REPENER can bring you the information you need

I'm a

- building user
- building owner
- **architect**
- engineer
- facility manager
- public administrator
- researcher

[type other]

see more

I'm involved in a

- project of a new building
- project of building retrofit
- feasibility study
- energy certification
- research

[type other]

see more

I'd like to know

- typical solutions
- building examples
- typical performances

[type other]

see more

REPENER_ontologies_interface

REPENER - Control and improvement of energy efficiency in buildings through the use of repositories

building location Cerdanyola del Valles

map advanced search

Main building utilisation residential advanced search

Passive Systems [mark items √]

- ☐ orientation
- ☐ insulation
- ☐ envelope
- ☐ solar control
- ☐ inertia
- ☐ natural ventilation

Active Systems [mark items √]

- ☑ heating — Less details

  Energy Carrier
  - ☐ gas
  - ☐ oil
  - ☐ biomass
  - ☐ electricity
  - ☐ renewable

  Degree of centralisation
  - ☐ district heating
  - ☐ central system for building
  - ☐ system for apartment
  - ☐ other

- ☐ cooling
- ☐ hot water
- ☐ lighting

See the 137 building examples found !

SEMANCO

FP7 STREP Project, ICT Systems for energy efficiency, 2011-2014

CO_2 emissions reduction is a systemic problem that must be addressed at multiple geographical, social and economic scales. This approach to carbon reduction in urban environments can be fostered by exploiting ICTs and the application of semantic energy data modeling.

SEMANCO's purpose is to provide semantic tools to different stakeholders involved in urban planning (architects, engineers, building managers, local administrators, citizens and policy makers) to help them make informed decisions about how to reduce CO_2 emissions in cities.

SEMANCO

WP8

CO_2 emissions reduction!

WP6

Enabling scenarios for stakeholders

Application domains

Regulations | Planning strategies | Urban Developments | Building Operations

Stakeholders

Policy Makers | Planners | Designers/Engineers | Building Managers | Citizens

Building stock energy modelling tool | Advanced energy information analysis tools | Energy simulation and trade-off tool | Interactive design tool

WP5

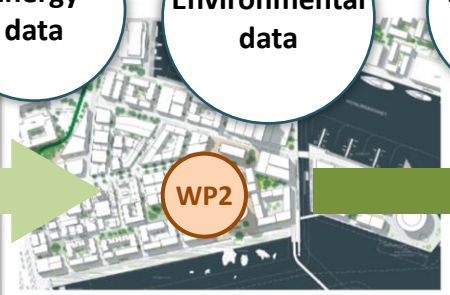
Technological Platform

SEMANTIC ENERGY INFORMATION FRAMEWORK (SEIF)

WP4

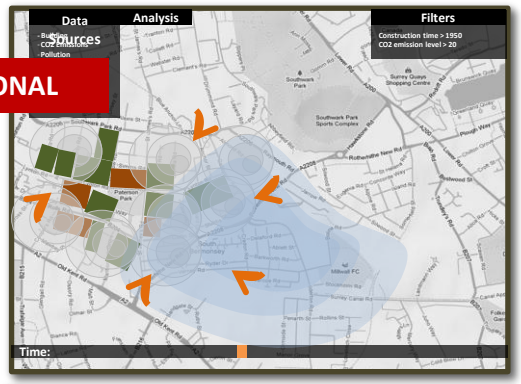
Building repositories | Energy data | Environmental data | Economic data

WP3

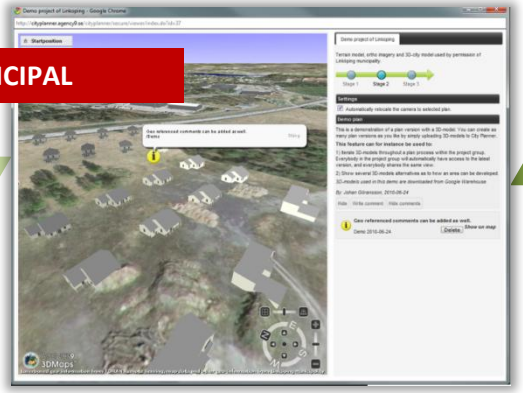


WP2

SEMANCO



REGIONAL



MUNICIPAL

NEIGHBORHOOD

TOOLS: (visualization, analysis, simulation)

ACCESS TO SEMANTICALLY MODELLED ENERGY DATA

OUTCOMES FROM TOOLS IMPROVE ENERGY MODEL

Interfaces with external tools

ENERGY PROFILES ASSOCIATED TO BUILDINGS TYPES CALCULATED BY TOOLS

RETRIEVING DATA ACROSS DIFFERENT GEOGRAPHIC SCALES

Ontology Repository

Energy Model

Mapping tool

Exploration interfaces

SEIF: Semantic Energy Information Framework

Off-line data

Building repositories

Monitoring data

Open Linked Data

Environmental data

Economic data

Energy data

DATA: Distributed repositories of energy related information

www.salleurl.edu/arc

BARCODE HOUSING SYSTEM

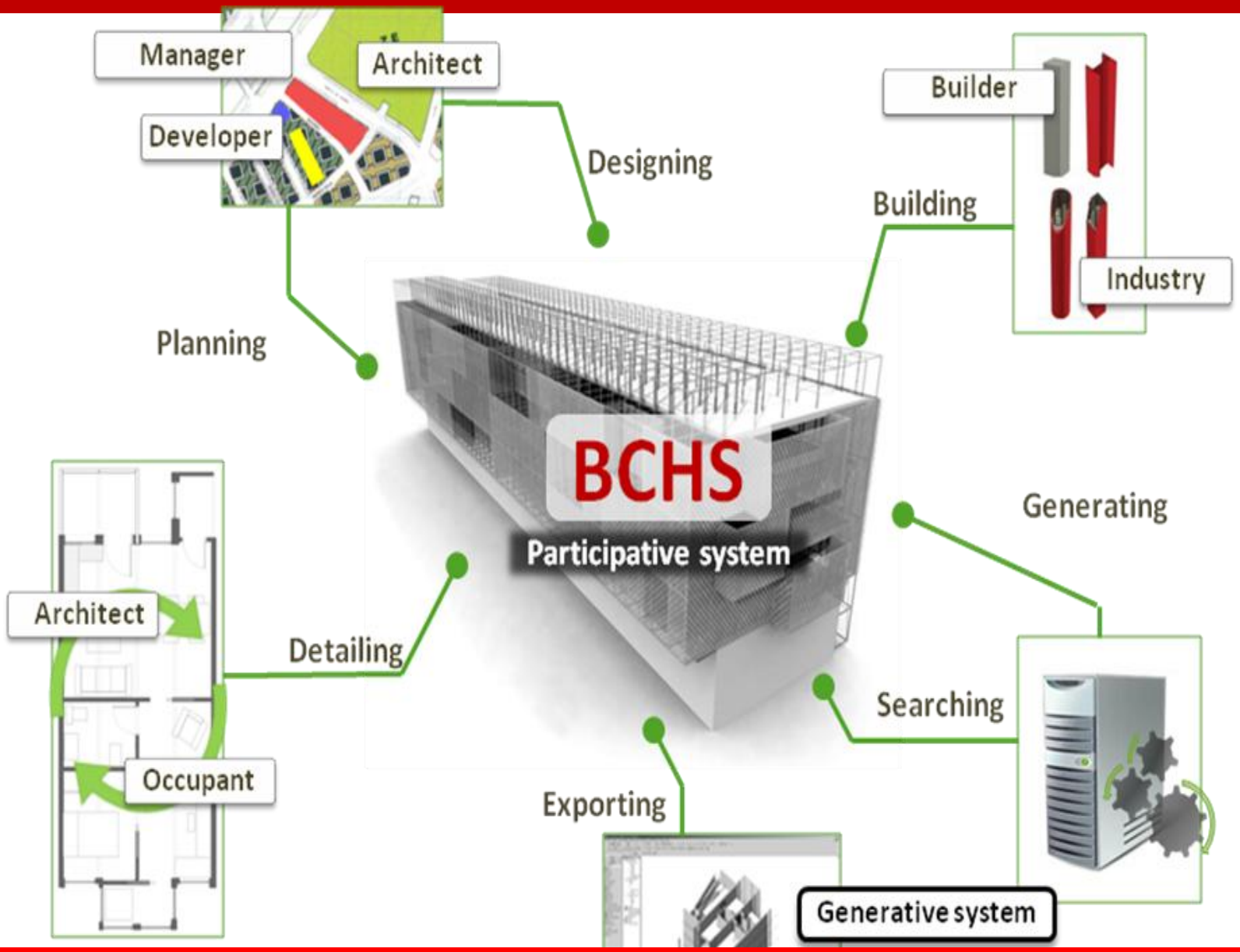
Spanish National RDI plan, 2005-2009

2002-2005, development of a stand-alone prototype system

2005-2009, development of a environment which supports the design and construction of housing blocks with flexible dwellings, using industrial components and assembled according to the principles of open prefabrication.

It is an open, participatory, modular system that facilitates the interaction of the different actors (architects, builders, manufacturers, occupants, facilities managers) involved in the design, construction and use of housing.

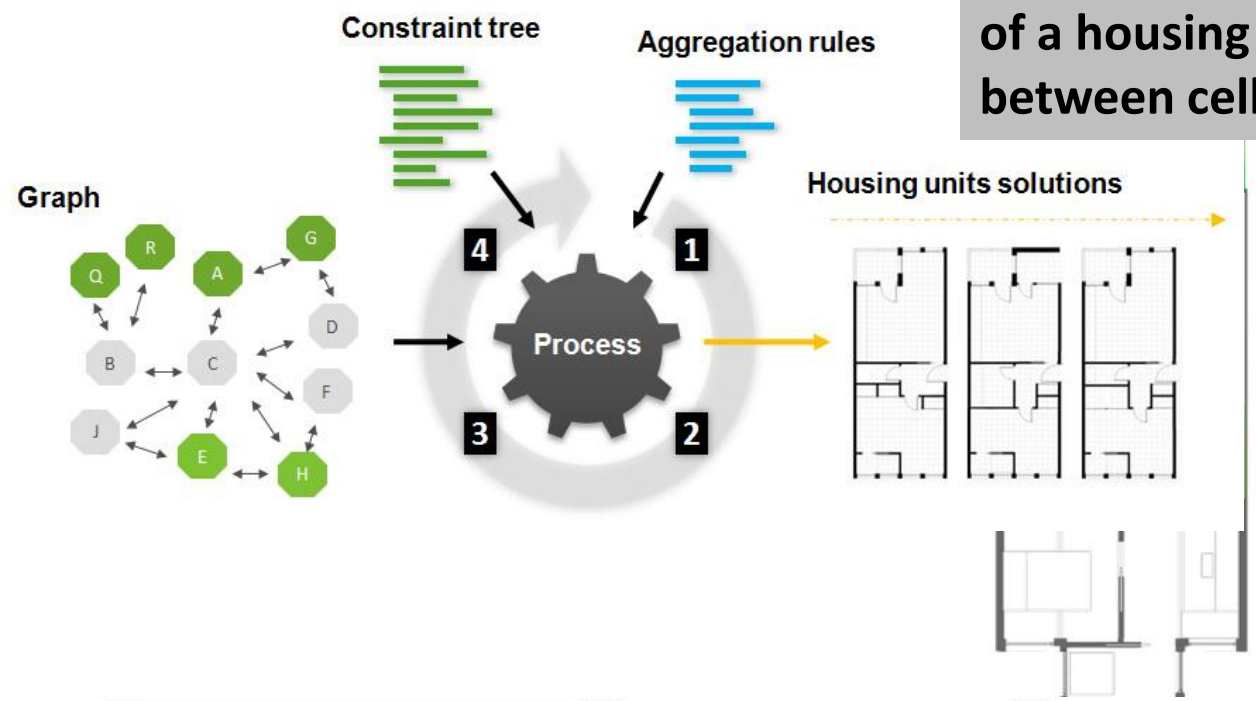
BARCODE HOUSING SYSTEM_environment

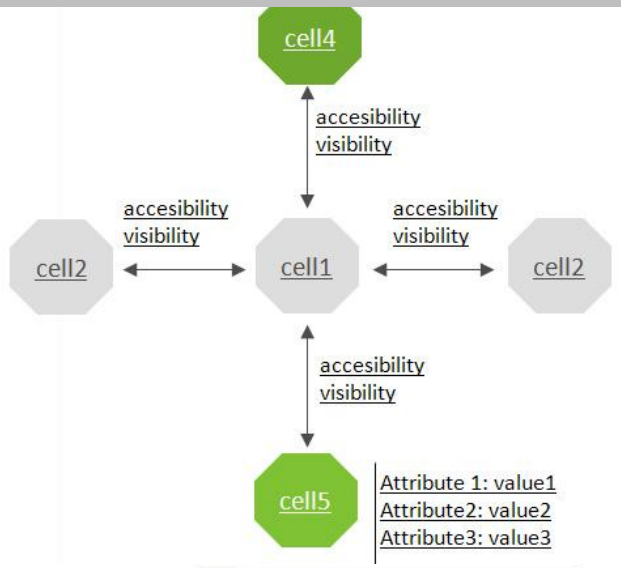


In this project we have buildt our own data model, it is not using BIM. Because of this, we could integrate a building model with a product catalogue; we could define assembly rules for spaces as well as for building components. This integration of the different environments worked because we had control on the whole environment. To achieve such level of integration using BIM software we would need to use of semantic technologies.

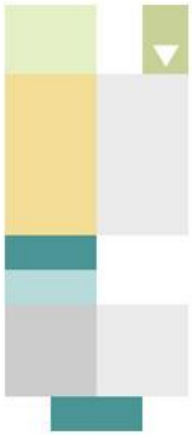
BARCODE HOUSING SYSTEM_environment

A graph represents the spatial structure of a housing unit in terms of relations between cells

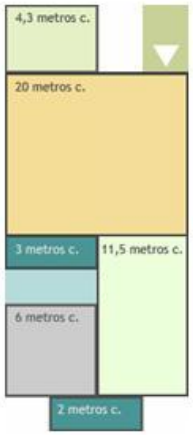




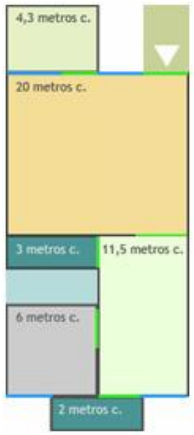
1 DIMENSIONLESS PHASE | **2 SPATIAL PHASE** | **3 CIRCULATION PHASE** | **4 DEFINITION PHASE**



Spatial agregation

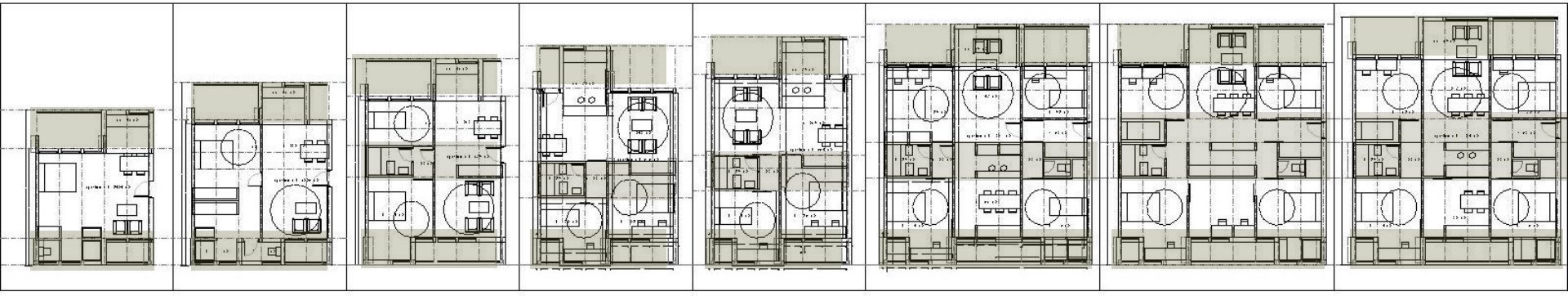


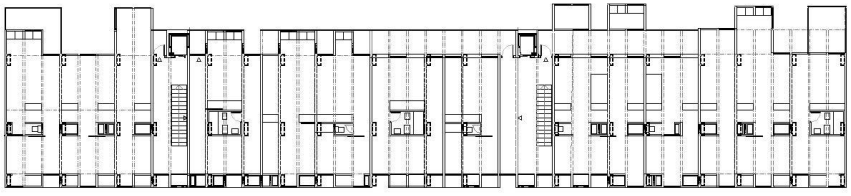
Inter-spatial connectivity

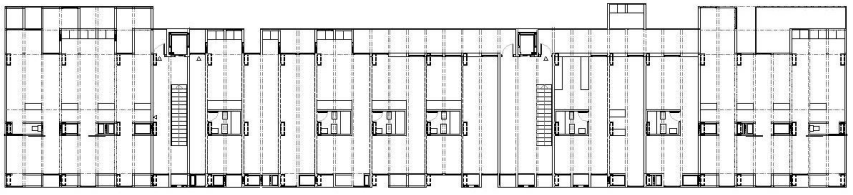


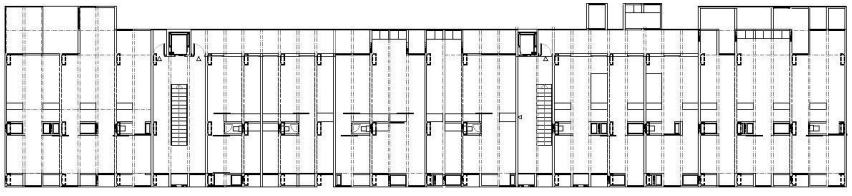
Architecture grid

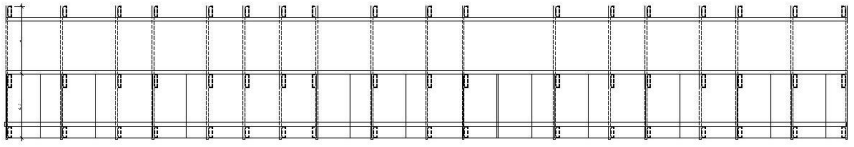
BARCODE HOUSING SYSTEM_environment

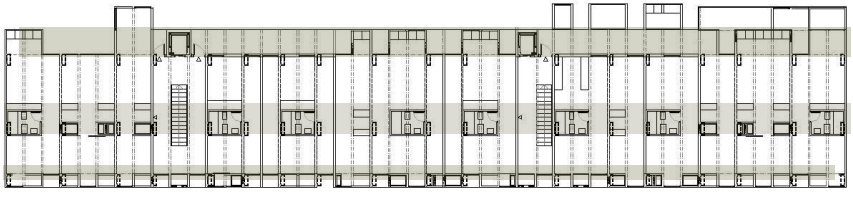


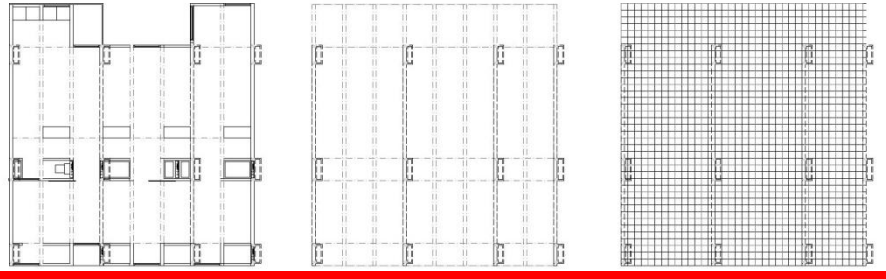






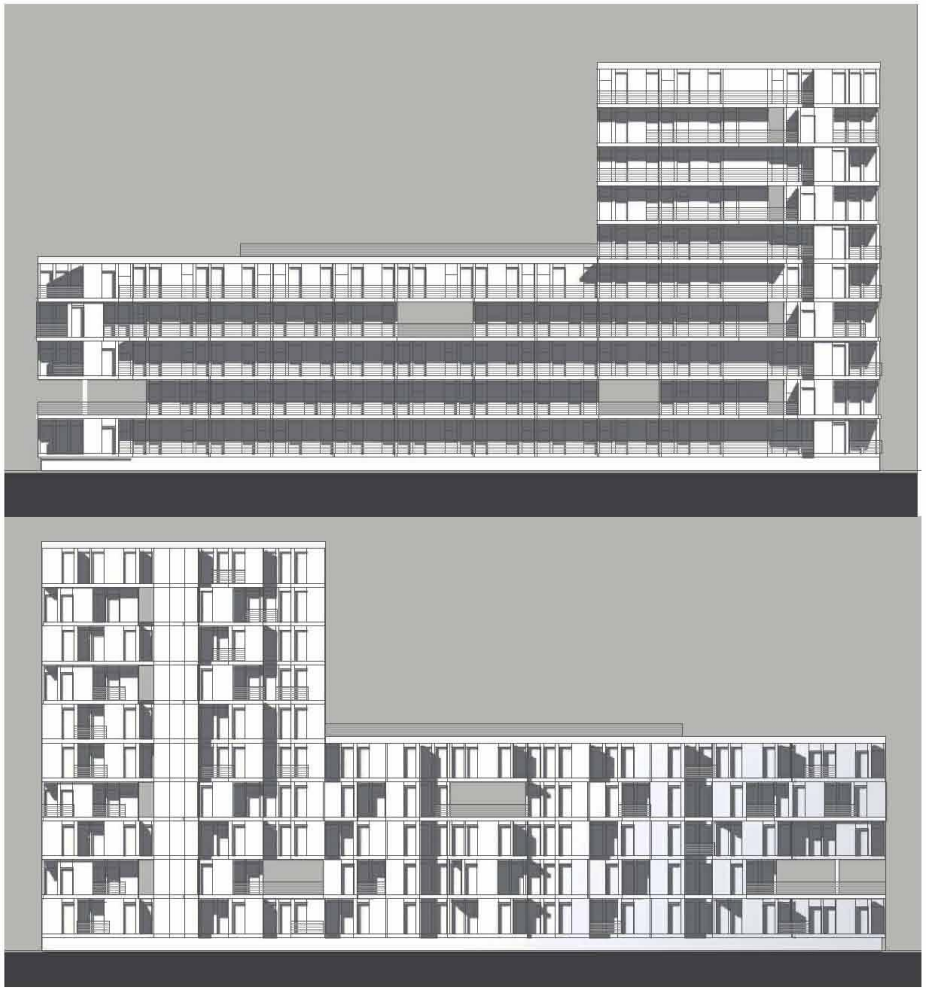






These are the floor-plans generated by the rule-base system

BARCODE HOUSING SYSTEM_environment



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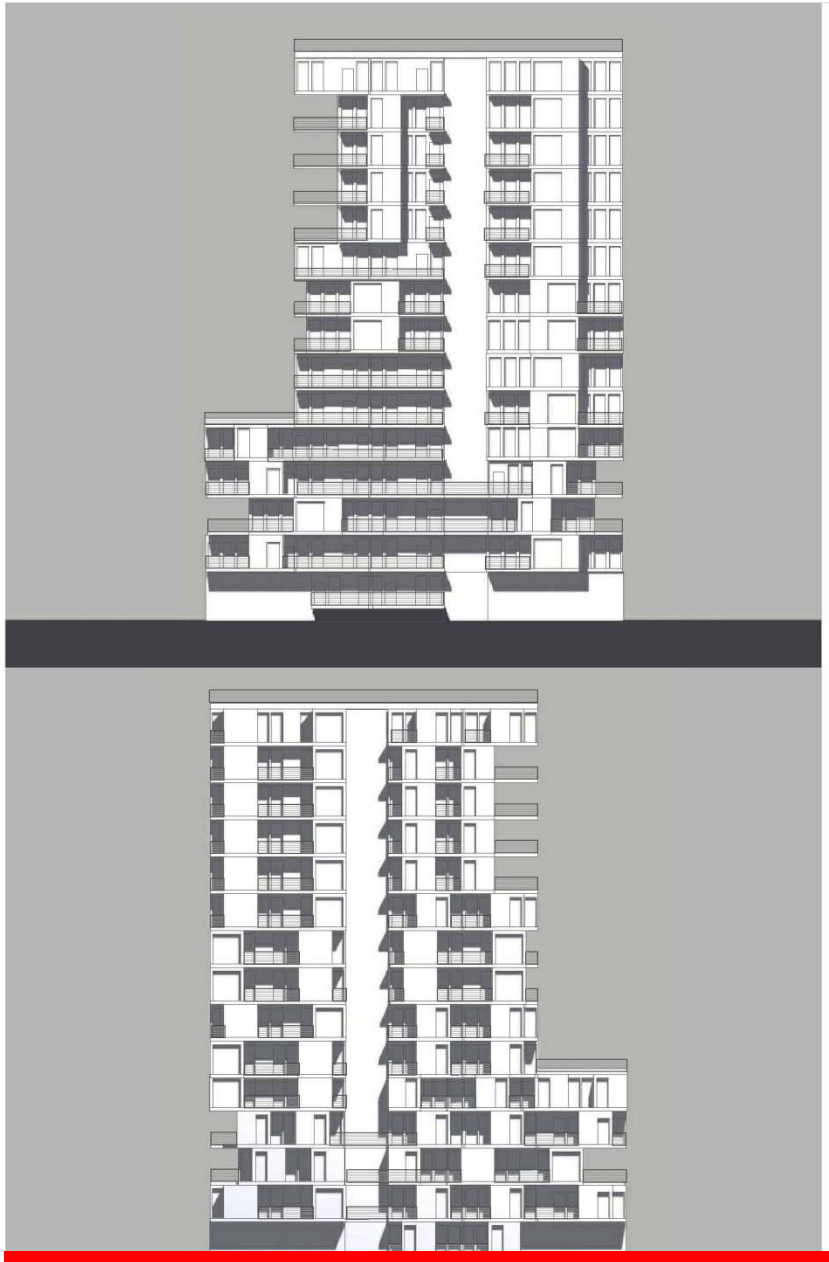

These are examples of the kind of housing blocks that can be generated by assembling the housing units. The

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The architectural attributes extracted in the last stage of the generative process are used to cluster housing units

The architect seeks in the system the most appropriate housing units for a specific program requirements. The search is done with clustering techniques.

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Matching support and infill

The housing units retrieved in the previous interface are used to generate the block. In the process to create a housing blocks, the housing units (infill) and support structure (e.g. the rules governing the position of building sytems, structure,…) need to conform to each other. The final block is the solution of the interaction between both systems, infill and support.

CONNECTORS

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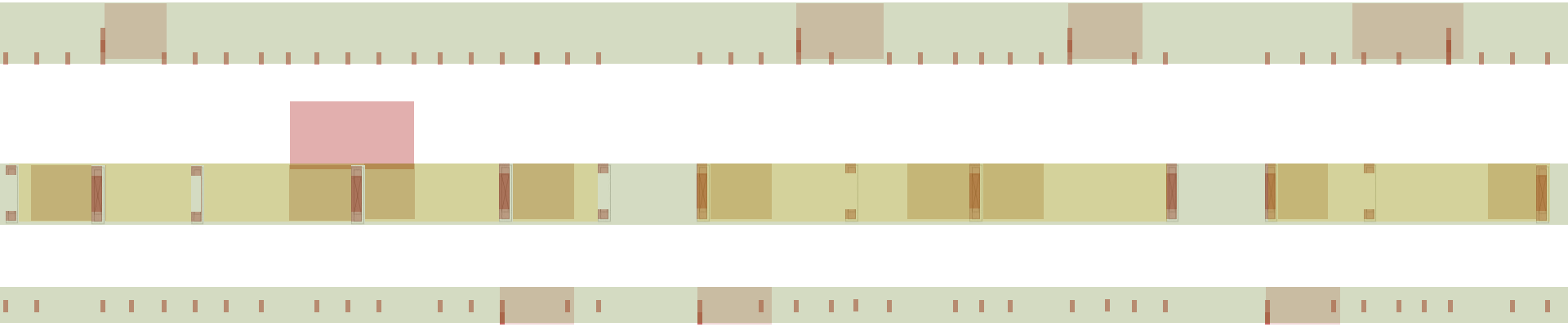

Support and infill: The underlying support structure which holds a variable combination of housing units

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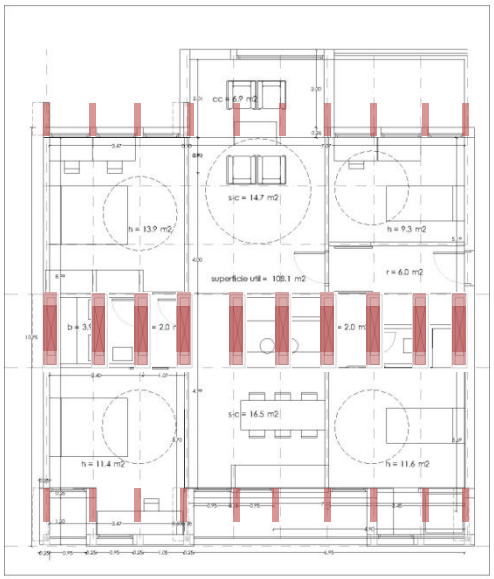

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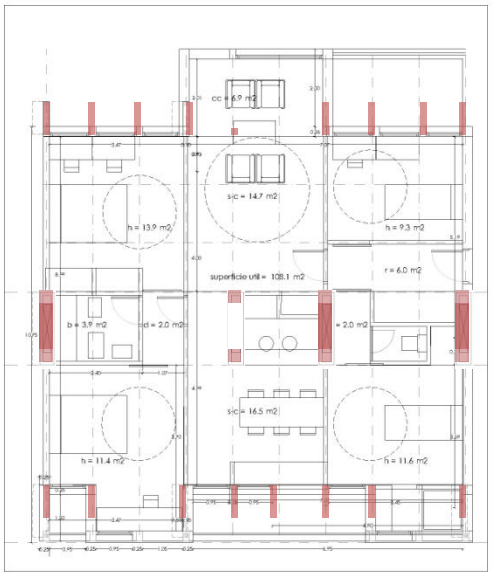
In the process to create a housing blocks, the housing units (infill) and support structure (e.g. the rules governing the position of building sytems, structure,…) need to conform to each other. Connectors sare the nexus between the rules of the support system and the rules of the infill system

BARCODE HOUSING SYSTEM_environment



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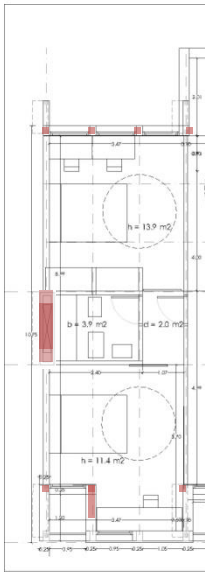

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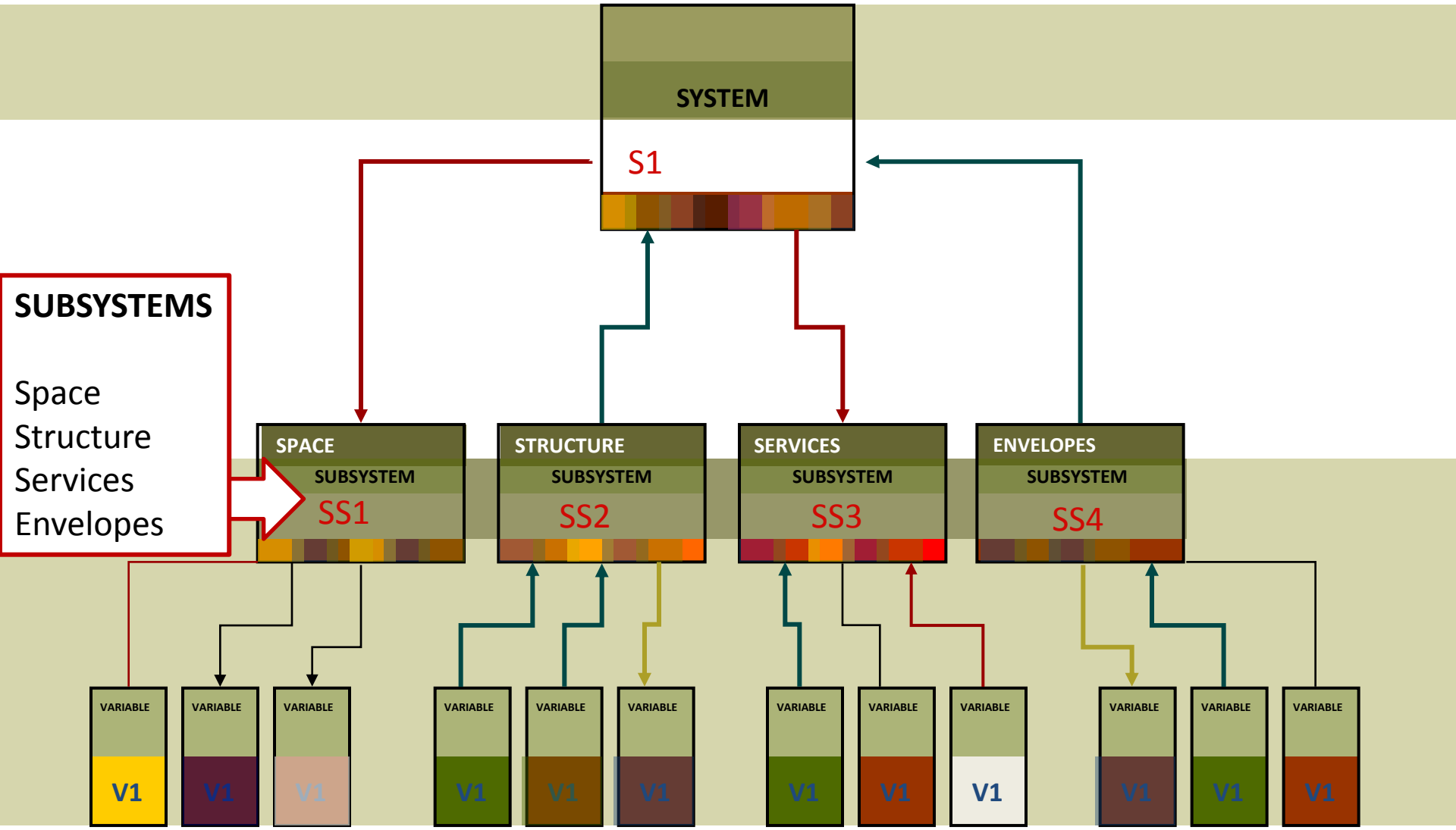

The building model is though of a system made up of four subsystesms. Each subsystem is made up of the components defined at the lowest level. The realtionship between levels is in both directions, from top down and from bottom up. Thus, the selection of a particular component for structure migh determined the spatial composition. (bottom up), while the selection of a particular subsystem (e.g. steel structure) determines the lower level componentes.

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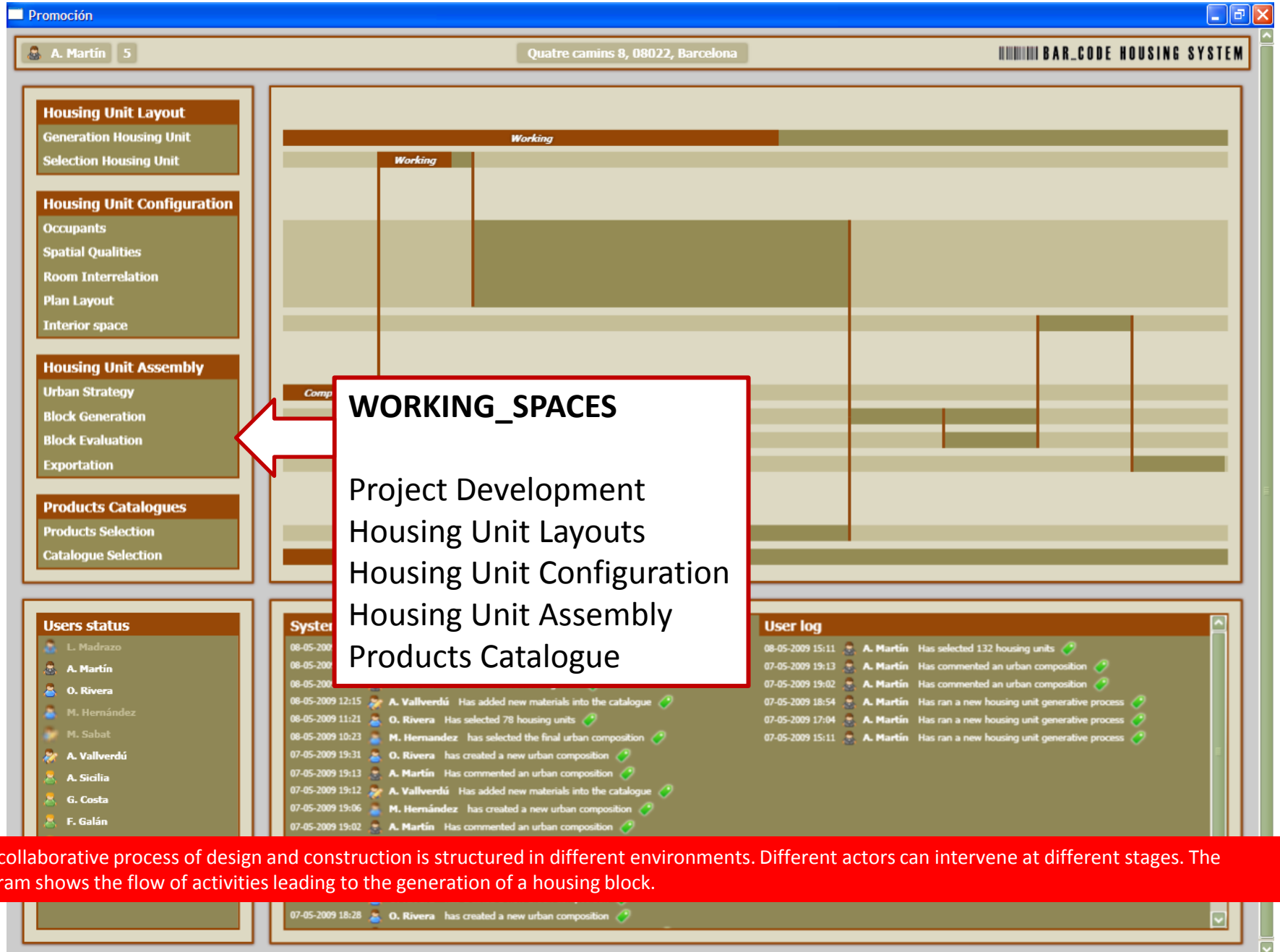

The collaborative process of design and construction is structured in different environments. Different actors can intervene at different stages. The diagram shows the flow of activities leading to the generation of a housing block.

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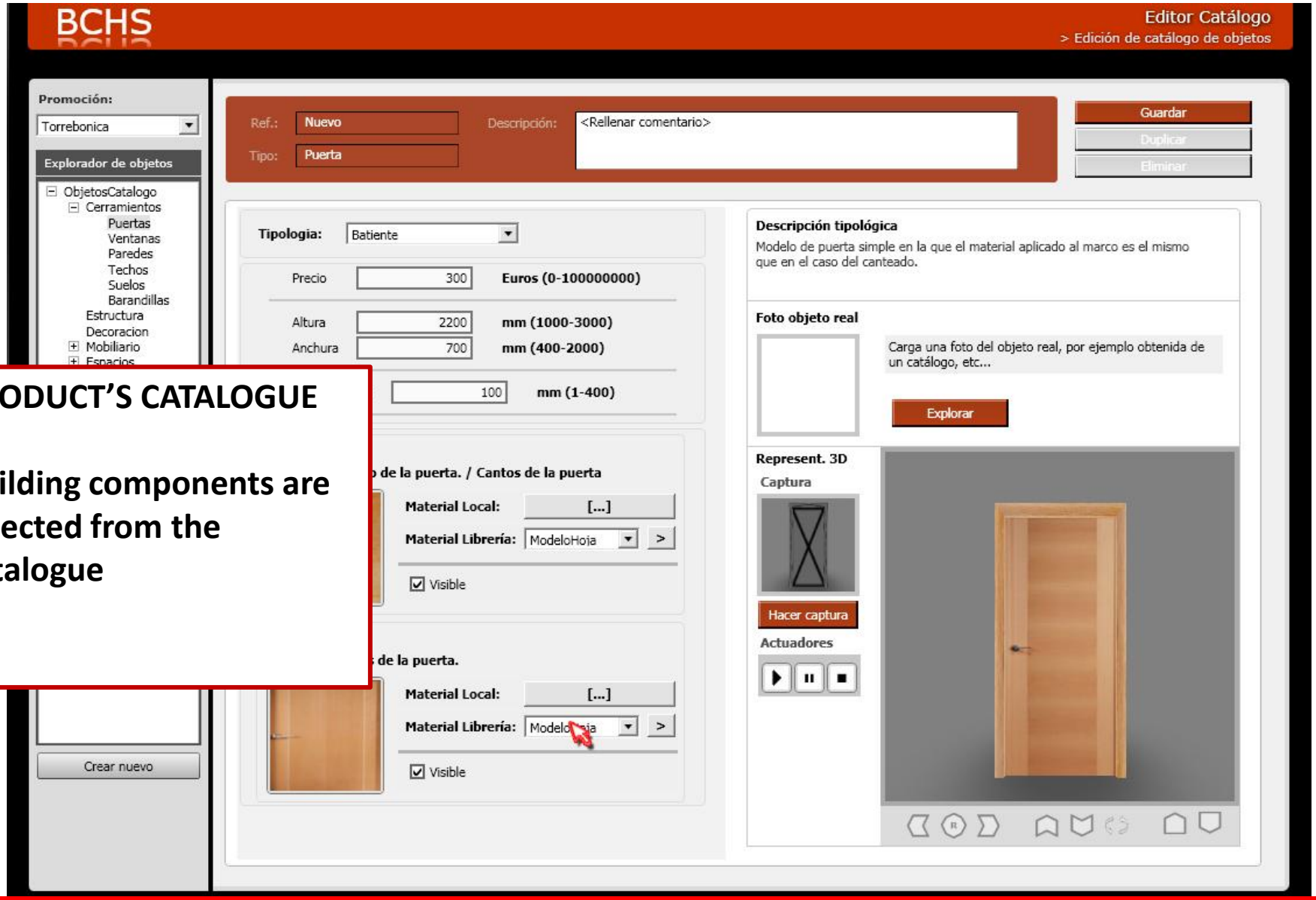

PRODUCT'S CATALOGUE

Building components are selected from the catalogue

This is a product catalogue open to external providers but only used by the BCHS model. A research topic could be to developed product catalogues using semantic technologies which can interoperate with