PARCOURS project: **CRMcr** - a CIDOC-CRM extension for supporting semantic interoperability in the conservation and restoration domain

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LRMH Laboratoire de Recherche des Monuments Historiques
CRCC Centre de Recherche sur la Conservation des Collections (CRCC) USR3224 CRC
DAVID, Université de Versailles Saint-Quentin-en-Yvelines
IPANEMA
INP Institut national du patrimoine

12-13 September 2019, London, UK

Linked Conservation Data network: Modelling workshop

Thank you!

Inès Bannour (post-doc)

Cheikh Niang (post-doc)

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PARCOURS Project

- **PARCOURS**: Cultural Heritage and Conservation Restoration - an Ontology for the Use of a common Reference for different Data Sources
  `http://projet-parcours.eu/`
- Started in 2014 and supported by the Foundation of Heritage Sciences (PATRIMA Excellence Research Laboratory), France
- Partners:
  - French Museum's Research and Restoration Center (C2RMF)
  - Research Laboratory for Historical Monuments (LRMH)
  - ETIS Research Lab, Cergy-Pontoise (Paris area), France
  - Research Center on the Conservation of Collections (CRCC)
  - DAVID Research Lab, Université de Versailles Saint-Quentin-en-Yvelines
  - Laboratoire IPANEMA
  - Institut national du patrimoine (INP)
- Aims at providing users from different CH Institutions with enhanced **unified global access to data** related to studies, analysis, techniques, and preservation practices in **conservation processes**

Motivations

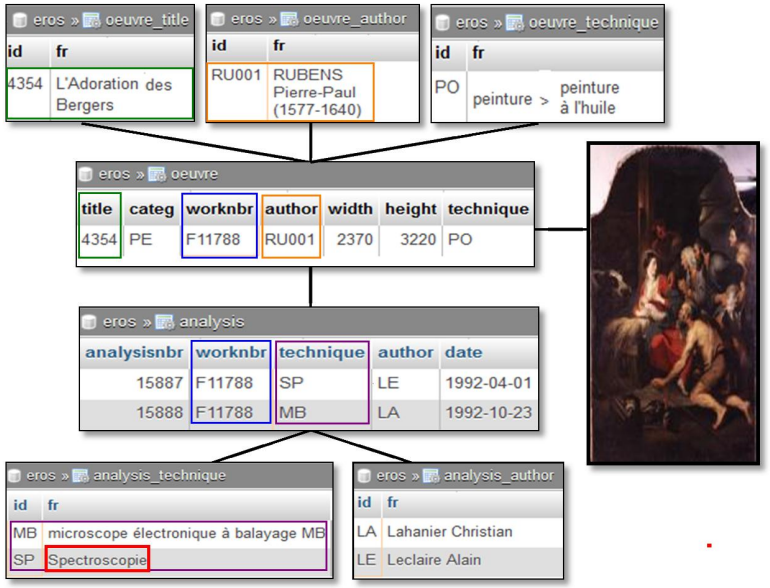
- Diversity of the data generated in the **conservation** field
- Difficulty to put together the overall information concerning the artworks' life cycle

⇒ Important to solve interoperability issues:

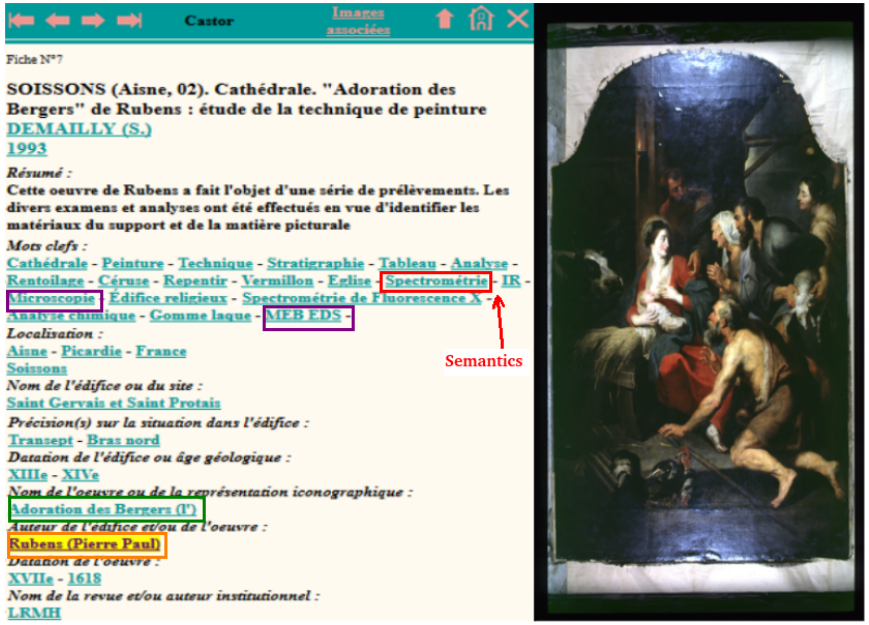
- **Distributed data:** isolated data due to restrictions
- **Databases heterogeneity:** relational, NoSql, bibliographic records...
- **Lack of semantic power:** data with implicit semantics
- **Terminology heterogeneity and ambiguity:** databases do not share the same meaning about the terms they use in conservation tasks

Motivation

- **C2RMF:** EROS: relational database

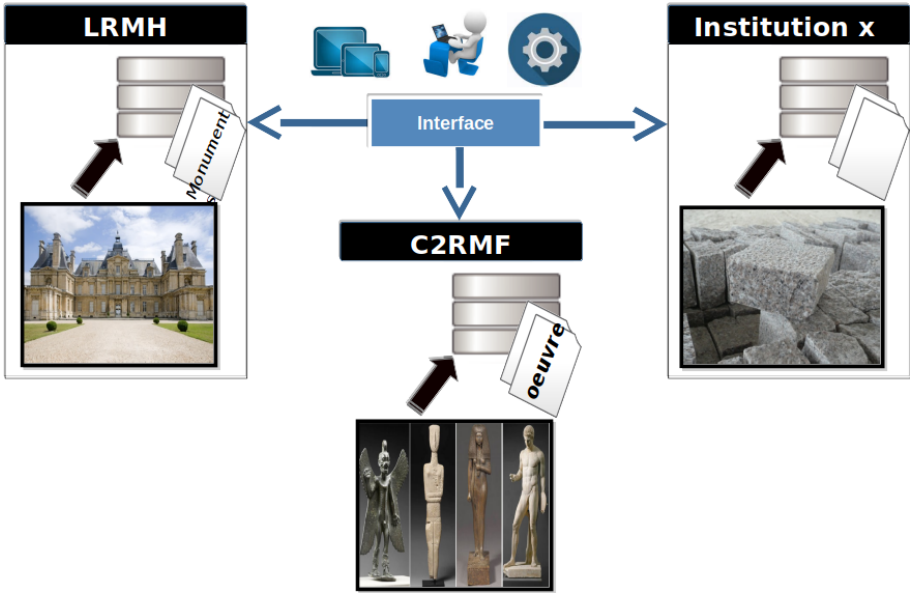


- **LRMH:** CASTOR: bibliographical NoSql database



PARCOURS' objective

- **Goal:** Query at the same time multiple data sources
- **Constraints:**
  - have a minimum of structure and of semantics in the databases
  - have a unique conceptualization of the data for interoperability
  - have queries that can query at the same time



PARCOURS' interoperability goals

- Provide a **common shared reference** for **distributed** and **heterogeneous** cultural heritage data
  - to have a common understanding
  - to have a common evaluation, etc.

  (1) A common conceptualization: a conceptual model
- Provide a **common unified global access** to data sources, based on their **meta-data**:
  - solve data incompleteness
  - enhance data complementarity
  - produce, diffuse, share and reuse efficiently data by stakeholders, etc.

  (2) An information system

Questions to fulfill the objectives

1. Is the database **semantically** ready to integrate a unified query system?
2. Are there any terminological **heterogeneity** and **ambiguity** problems in the data?
3. What constraints and steps to produce the **shared conceptual model**?
4. How to query the **heterogeneous** databases by using the shared conceptual model?
5. How to query **distributed** databases and which architecture for the query system?

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Is the database **semantically** ready to integrate a unified query system?

Lack of semantics in the database

Bibliographical base CASTOR

Issue:

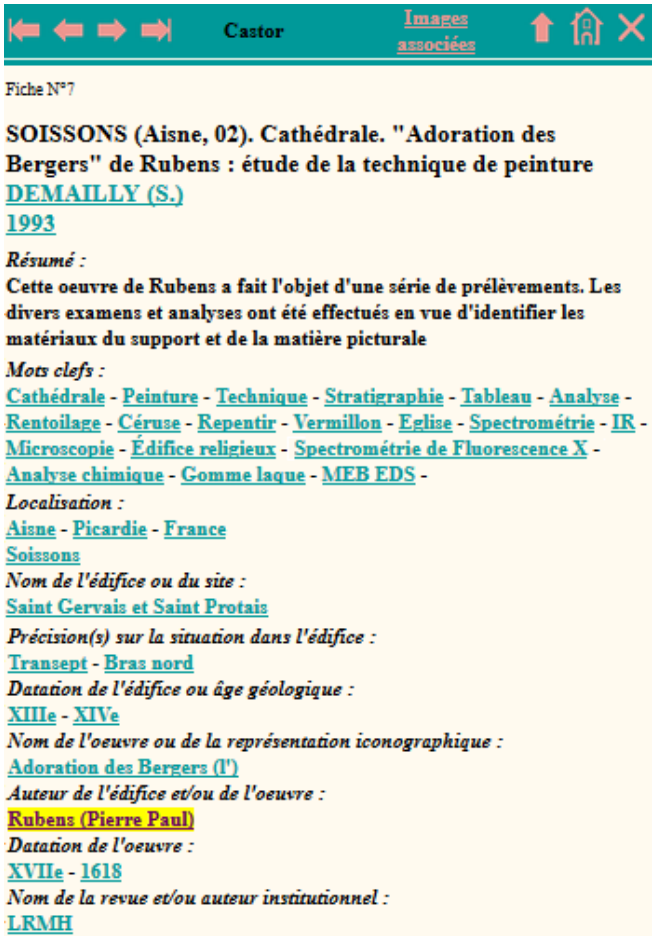
- The field *keywords* contains the knowledge concerning the conservation and restoration
- Impossible to know which keyword corresponds to: analyses, restorations, alterations, etc.

Goal:

- Class each keyword in a category: `Restoration` (*Rentoilage*), `Analysis` (*spectrometry, IR, microscopy, chimical analysis, MEB EDS*), `Type`(*Cathedral, Religious building, Church*)

Result:

- 7000/10.500 keywords classed in 12 categories



Castor | Images associées

Fiche N°7

SOISSONS (Aisne, 02). Cathédrale. "Adoration des Bergers" de Rubens : étude de la technique de peinture
DEMAILLY (S.)
1993

Résumé :
Cette oeuvre de Rubens a fait l'objet d'une série de prélèvements. Les divers examens et analyses ont été effectués en vue d'identifier les matériaux du support et de la matière picturale

Mots clefs :
Cathédrale - Peinture - Technique - Stratigraphie - Tableau - Analyse - Rentoilage - Céruse - Repentir - Vermillon - Eglise - Spectrométrie - IR - Microscopie - Édifice religieux - Spectrométrie de Fluorescence X - Analyse chimique - Gomme laque - MEB EDS -

Localisation :
Aisne - Picardie - France
Soissons

Nom de l'édifice ou du site :
Saint Gervais et Saint Protais

Précision(s) sur la situation dans l'édifice :
Transept - Bras nord

Datation de l'édifice ou âge géologique :
XIIIe - XIVe

Nom de l'oeuvre ou de la représentation iconographique :
Adoration des Bergers (l')

Auteur de l'édifice et/ou de l'oeuvre :
Rubens (Pierre Paul)

Datation de l'oeuvre :
XVIIe - 1618

Nom de la revue et/ou auteur institutionnel :
LRMH

Are there any terminological **heterogeneity** and **ambiguity** problems in the data?

Terminological heterogeneity and ambiguity

Issues:

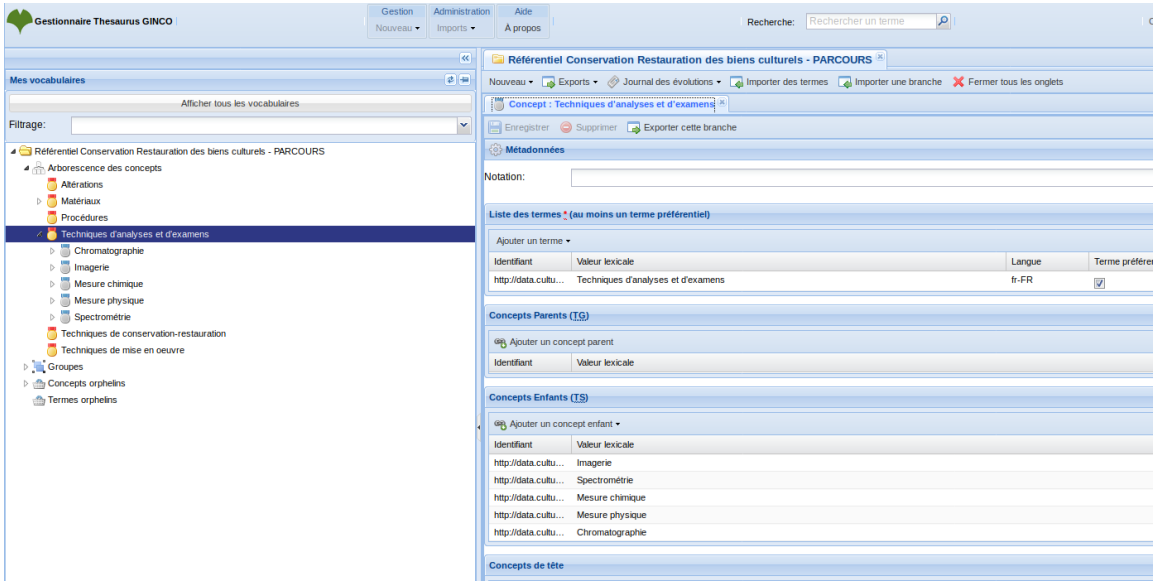
- Synonym terms and abbreviations of the terms: spectrometry/spectroscopy, etc.
- Polysemic terms: artificial aging (analysis technique) / natural aging (alteration of natural origin)
- Rich vocabulary: presence of generic terms and specific terms: MEB / MEB EDS, etc.

Objectives:

- Development of a set of thesauri

Thesauri: Common terminology

Reference software of the Ministry of Culture (France) : **GINCO**



- Thesaurus of alterations
- Thesaurus of manufacturing techniques
- **Thesaurus of analysis and examination techniques**
- Thesaurus of intervention techniques
- Thesaurus of materials

Example : Thesaurus of analysis and examination techniques

- **Top level concepts** :Chromatography, Scientific imagery, Chemical measurement, Physical measurement, Spectrometry

What constraints and steps to produce the **shared conceptual model**?

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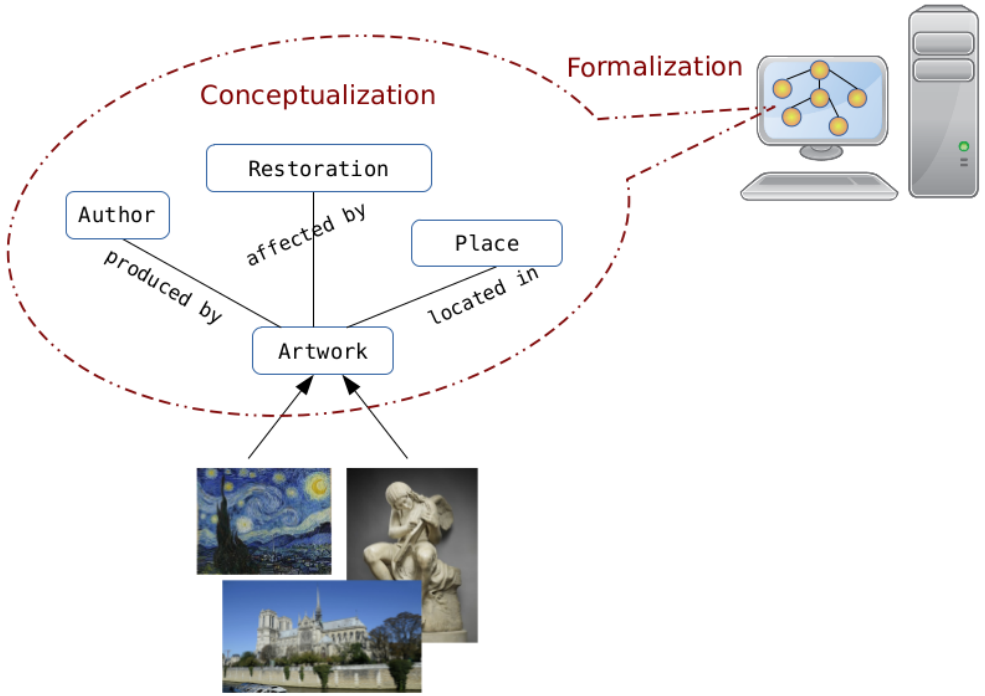
Definitions

Ontology:

- **Conceptualization :** produce an **abstract model** for the conservation field, by semantically classifying the domain concepts
- **Formalization :** make this conceptualization understandable and exploitable by information systems



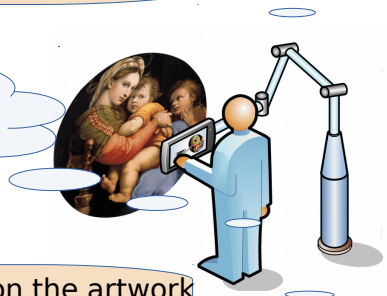
Requirements of the cultural institutions

What kind of **static information** could describe the artwork and its identity ?

identifiers, author, typology, form, dimensions, manufacturing material, location, owner...

What kind of **alterations** can affect an artwork and what do you need to keep about them ?

**Degradation, aging, attacks...*
**Origin, Nature, Factors, Area...*



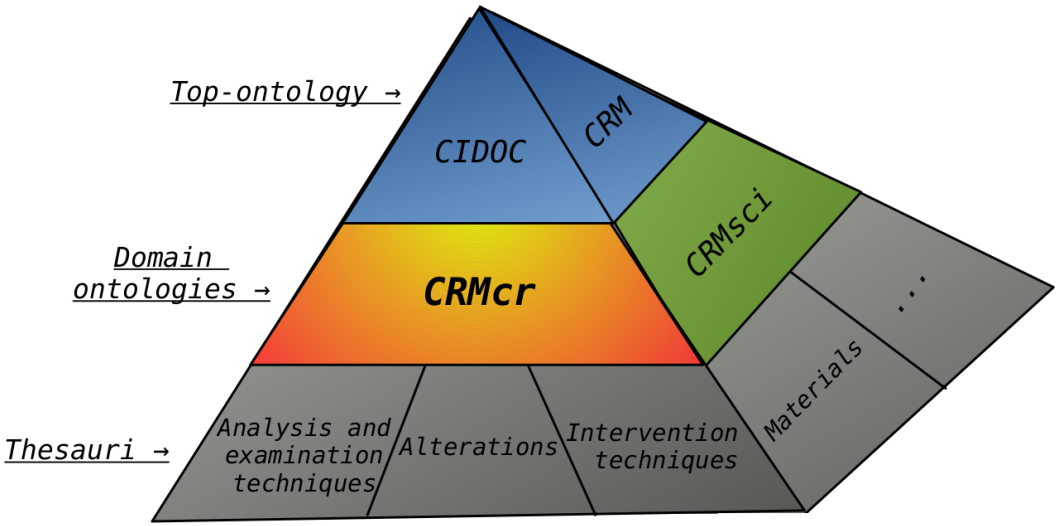
What kind **scientific studies** can be conducted on the artwork and what kind of **data** and **results** can be collected ?

**Diagnosis, studies, sample taking, imagery...*
**Mesaurements, spectrums, interpretations, images...*

What kind of **interventions** can be undertaken on an artwork after possible analysis

restoration, preventive conservation, remedial Conservation...

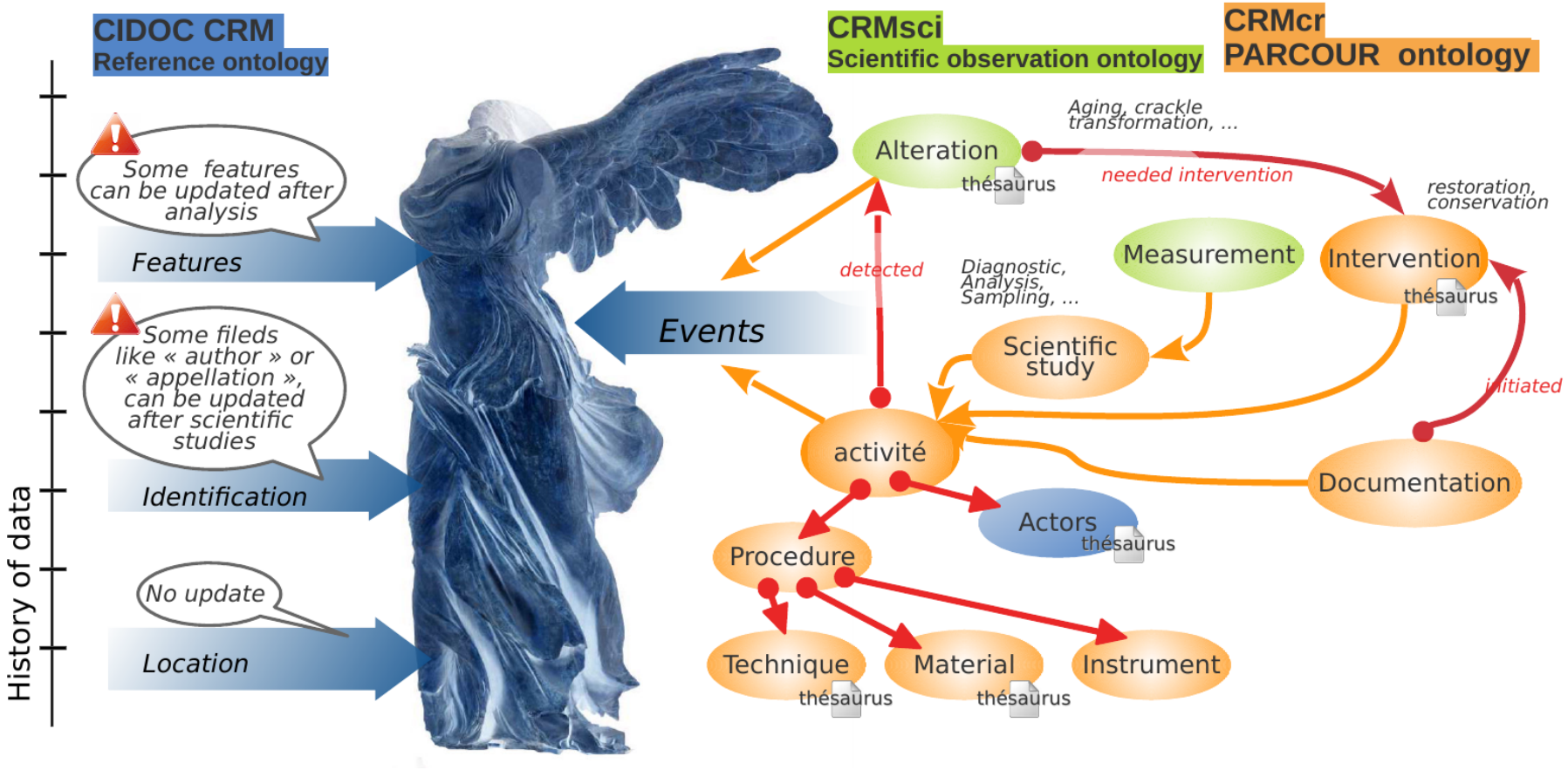
Conceptual architecture



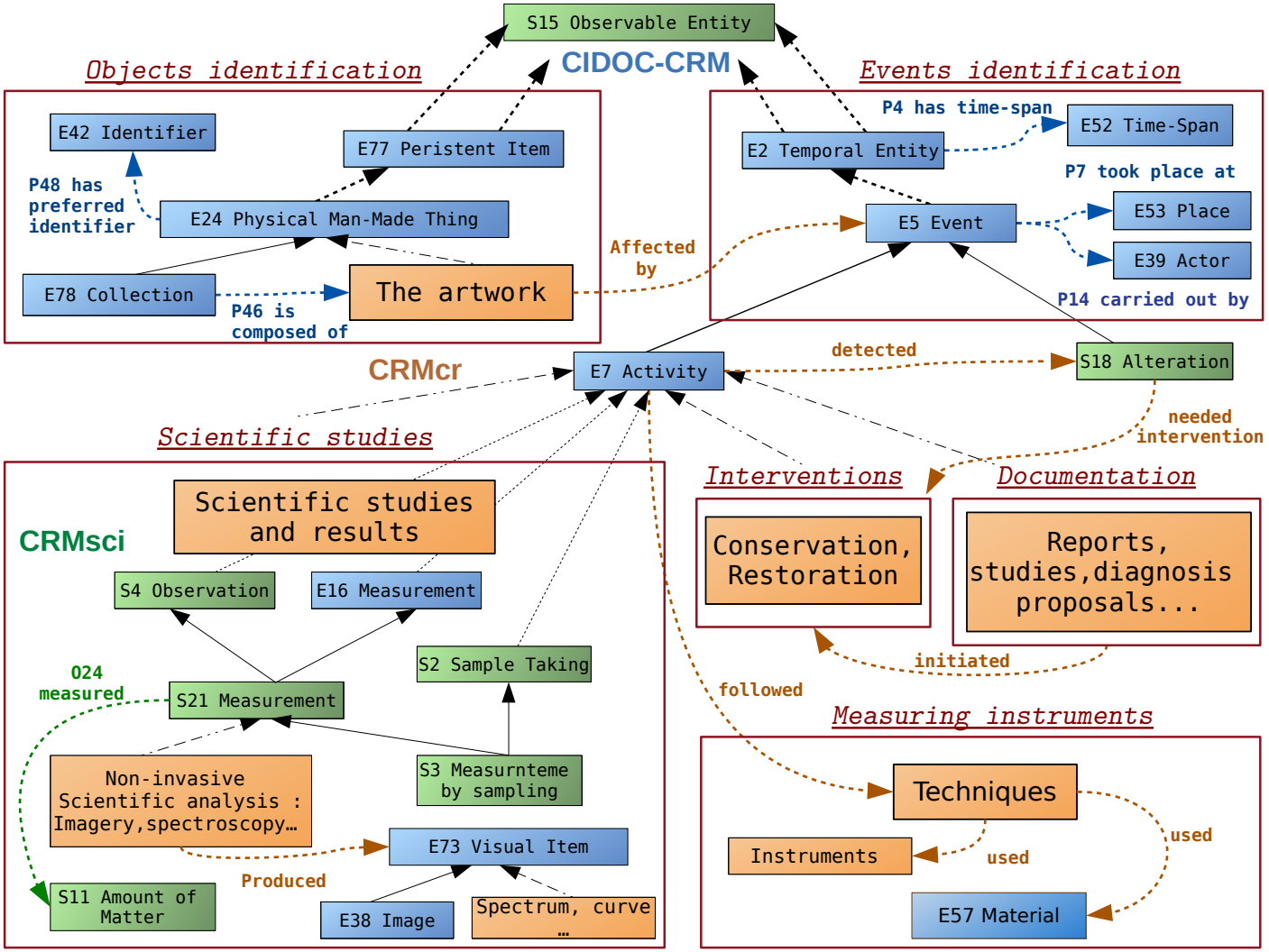
- **CIDOC-CRM (Conceptual Reference Model)**[1]**:** reference conceptual model for information related to cultural heritage [Class (**E**), Property (**P**), Blue]
- **CRMsci**[2]**:** extension of CIDOC-CRM for scientific observation [Class (**S**), Property (**O**), Green]
- **CRMcr:** proposed extension of CIDOC **CRM** for the **C**onservation-**R**estoration of cultural objects [Class (**C**), Property (**R**), Orange]

[1] http://www.cidoc-crm.org/
[2] http://www.cidoc-crm.org/crmsci/

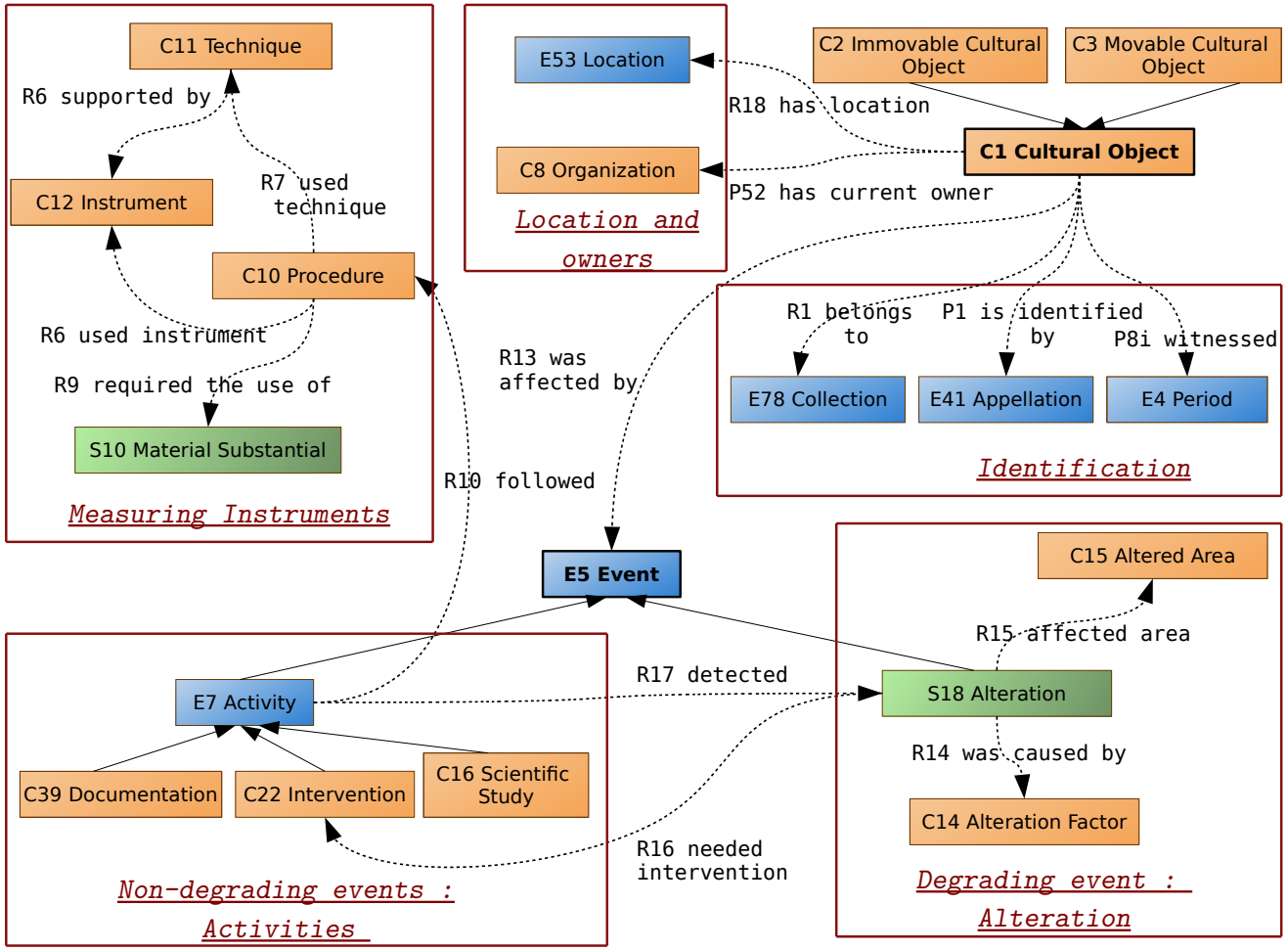
Requirements' validation



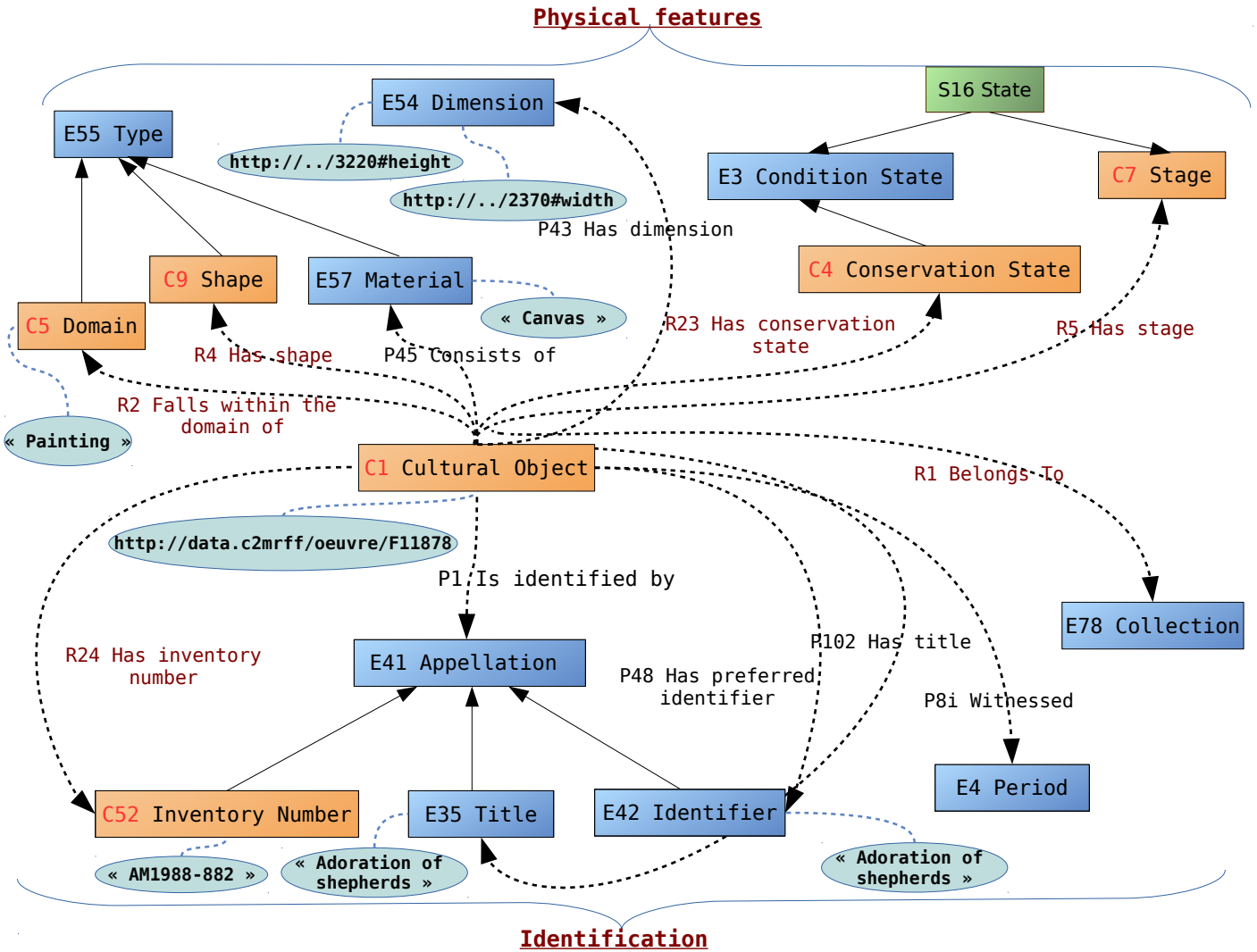
Join institutions' requirements



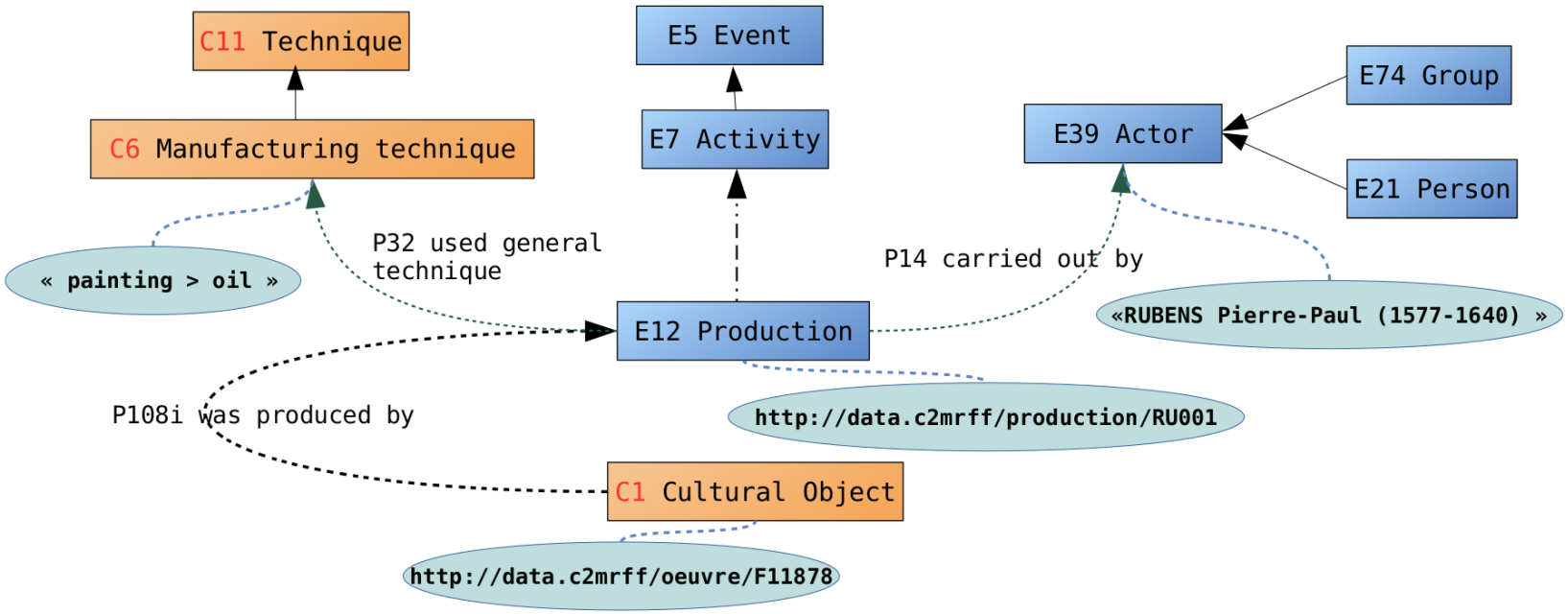
CRMcr: overview of the main concepts



Identification and physical features: Simple paths

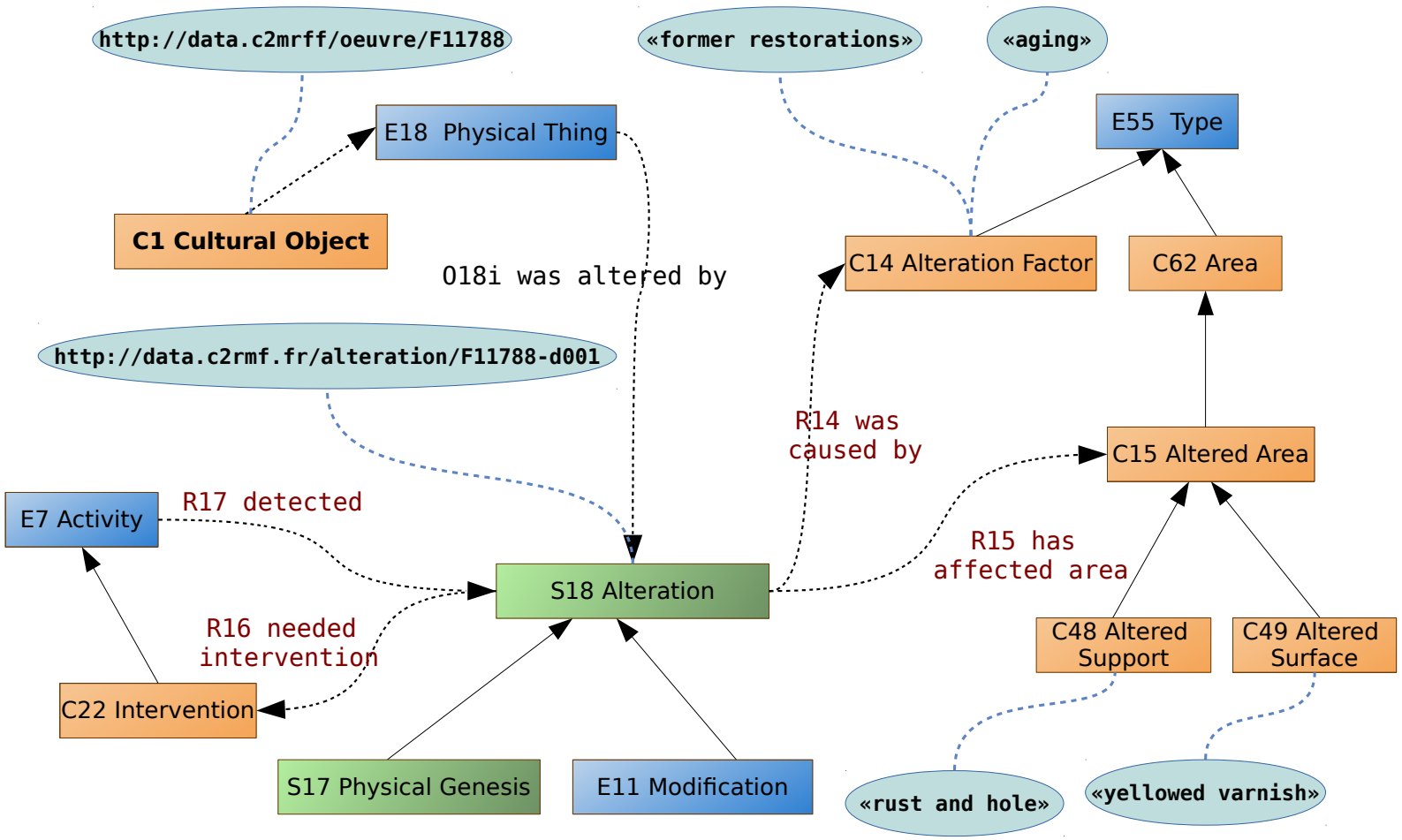


Identification and physical features: Complex paths

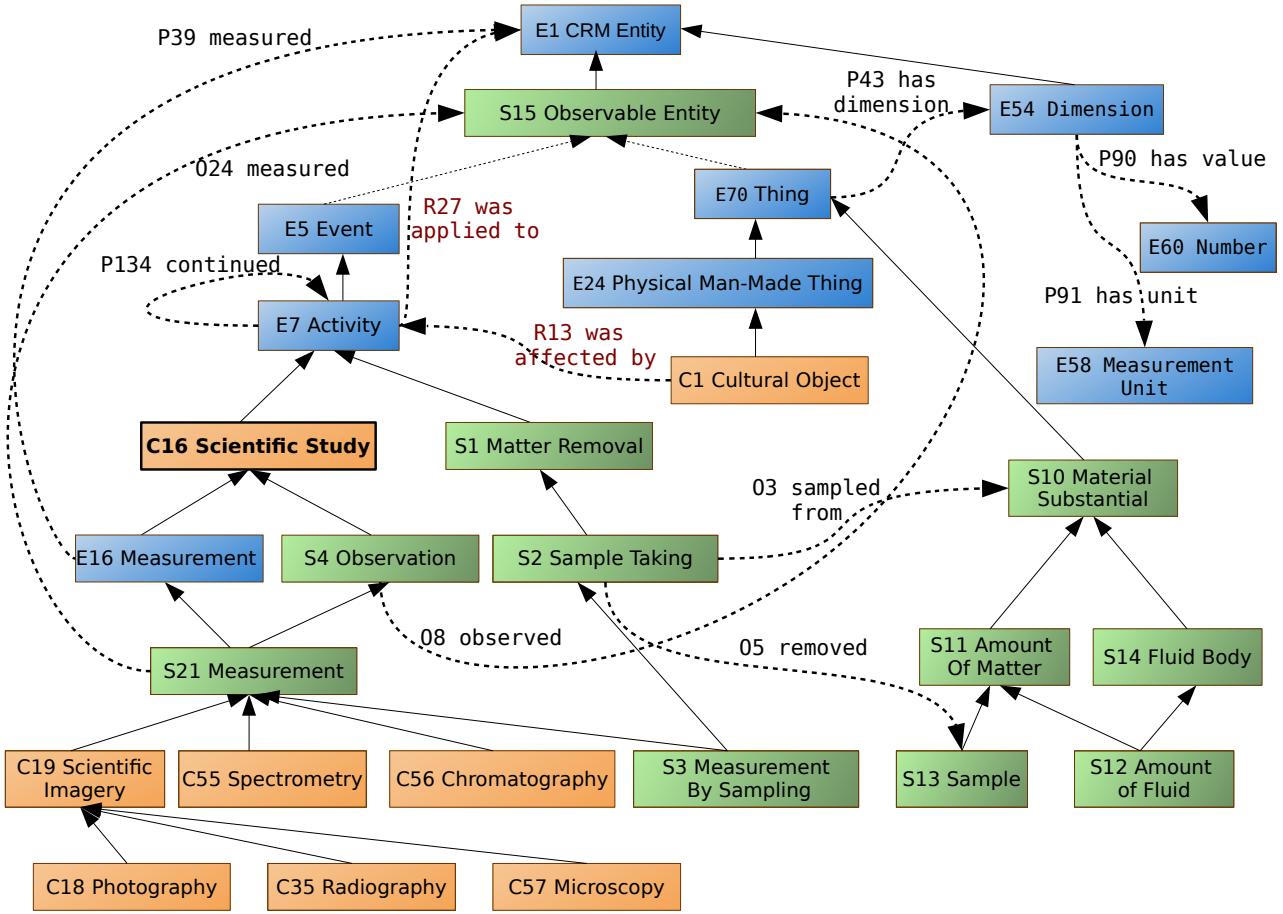


- **The author :**
  C1 Cultural Object → P108i was produced by → E12 Production
  E12 Production → P14 Carried Out By → E39 Actor
- **The manufacturing technique:**
  C1 Cultural Object → P108i Was Produced By → E12 Production
  E12 Production → P32 Used General Technique → C7 Manufacturing Technique

Degrading events: alterations

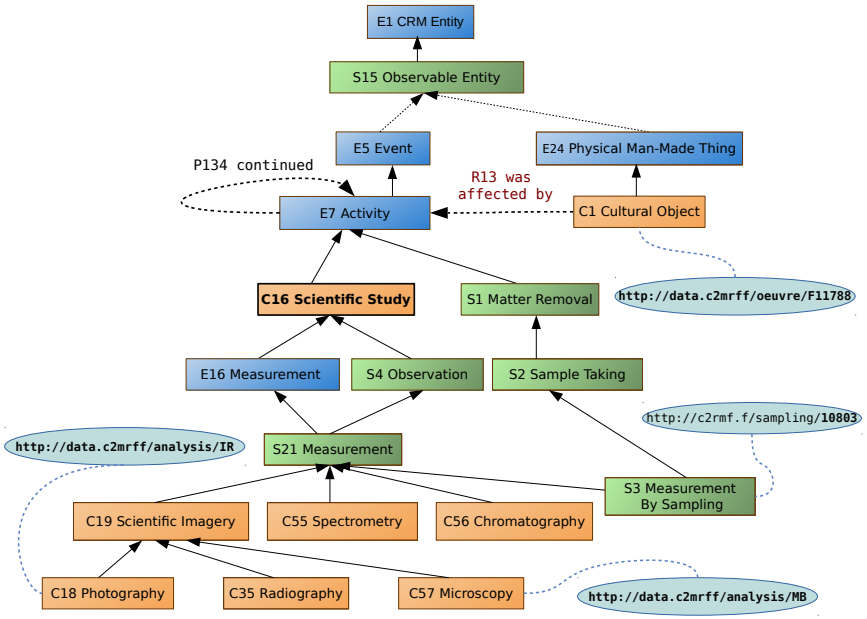


Non-degrading events: activities

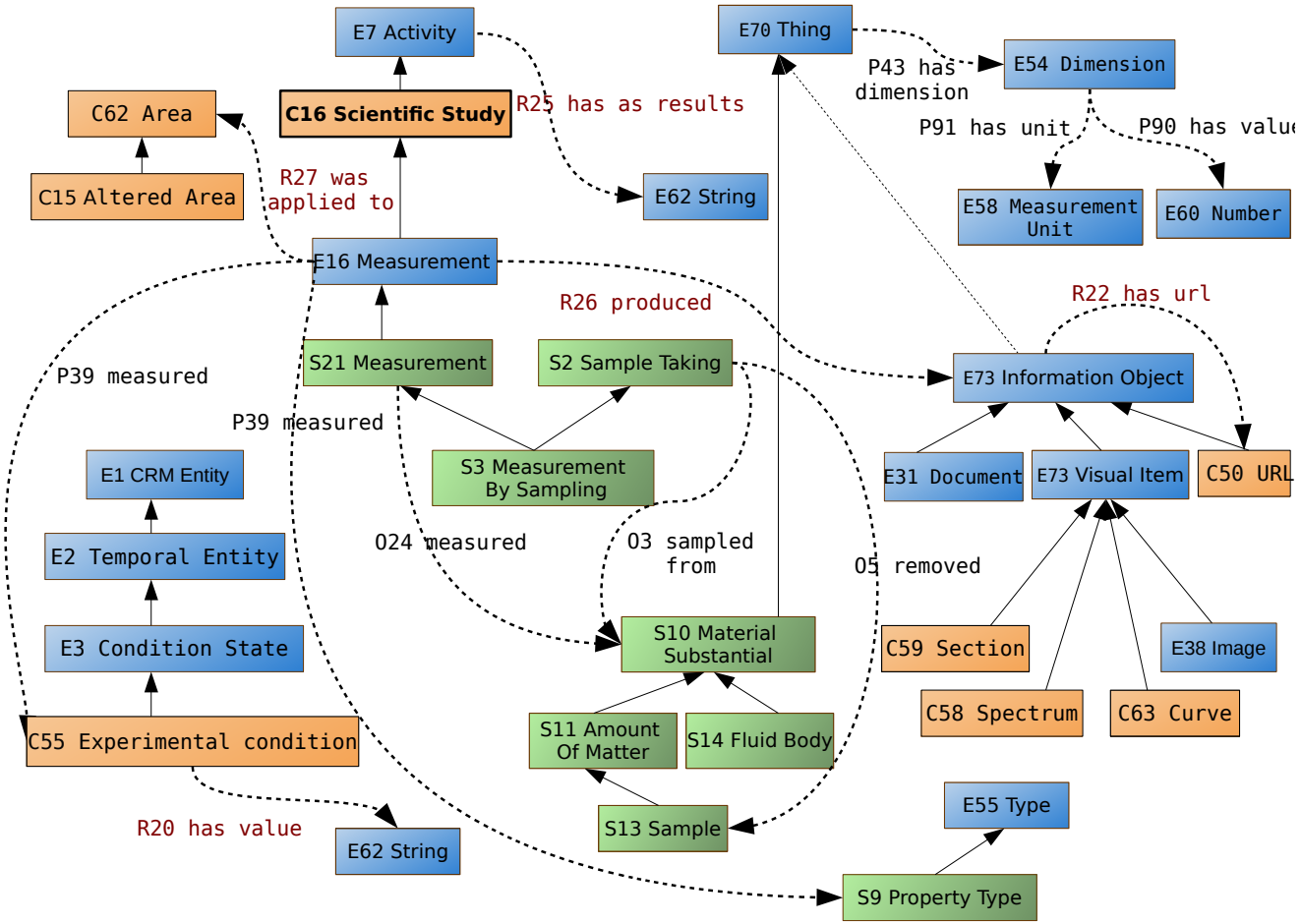


Non-degrading events: activities

- *(1) C16 Scientific Study:* classification of analysis
  - S4 Observation: observing a cultural object
  - E16 Measurement: taking measurement by doing some experimental analysis
    - **Invasive analysis:** S3 Measurement By Sampling
    - **Non-invasive analysis:** C19 Scientific Imagery, C55 Spectrometry
    - **Chemical analysis:** C18 Chromatography
    - **Physical analysis:** C55 Spectrometry

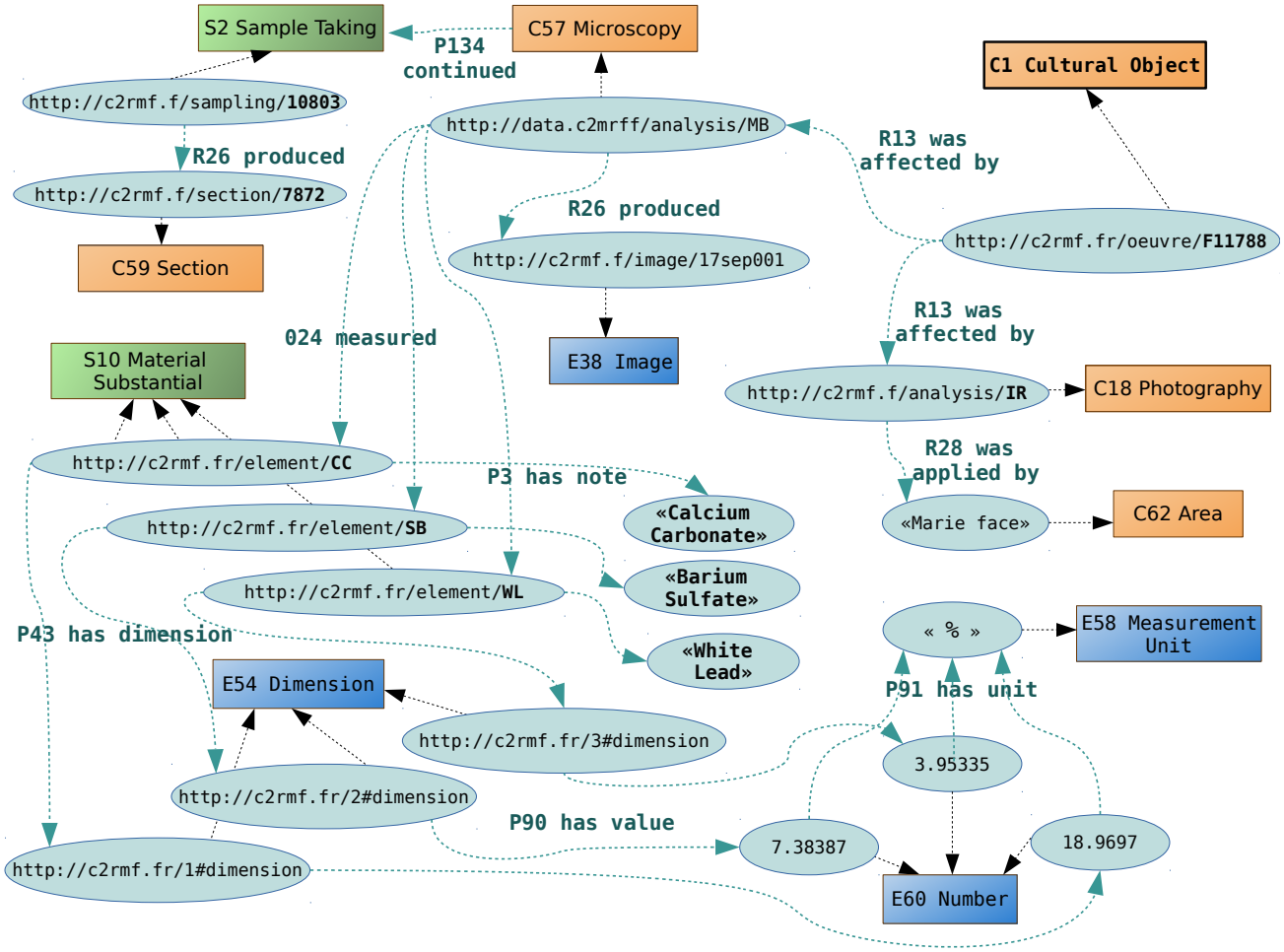


Non-degrading events: activities' results



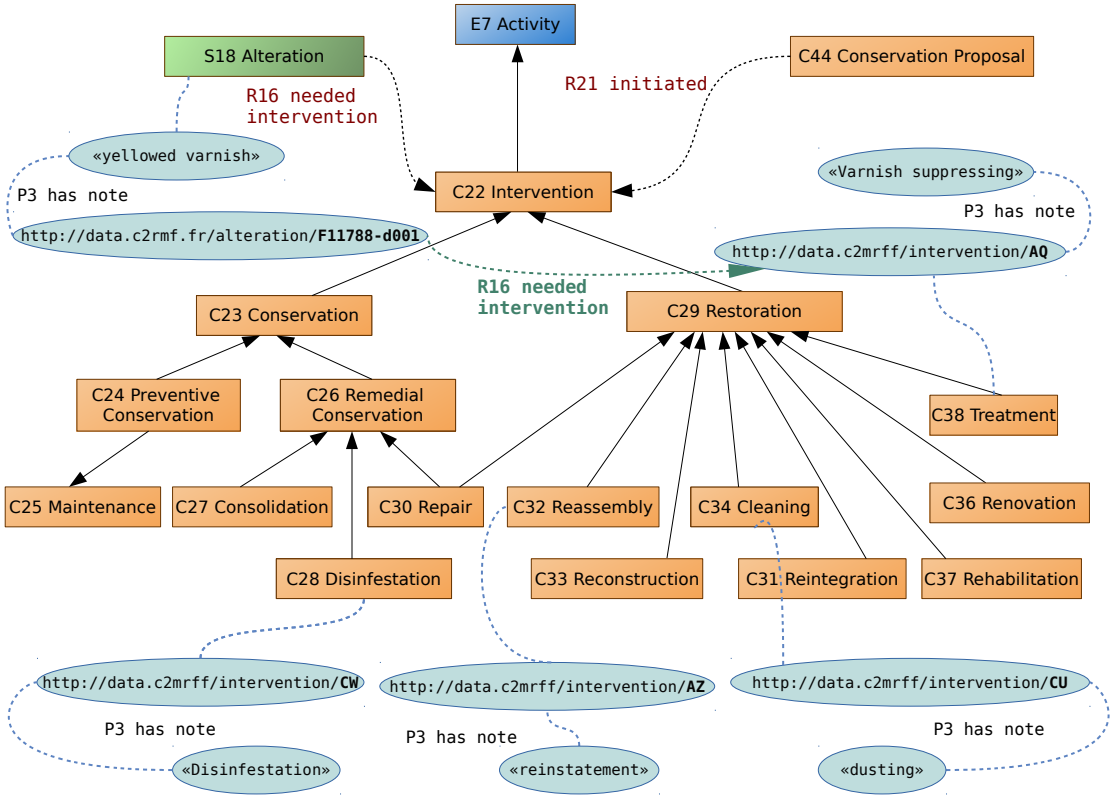
Non-degrading events: activities' results

- *(1) C16 Scientific Study*: an example of analysis results

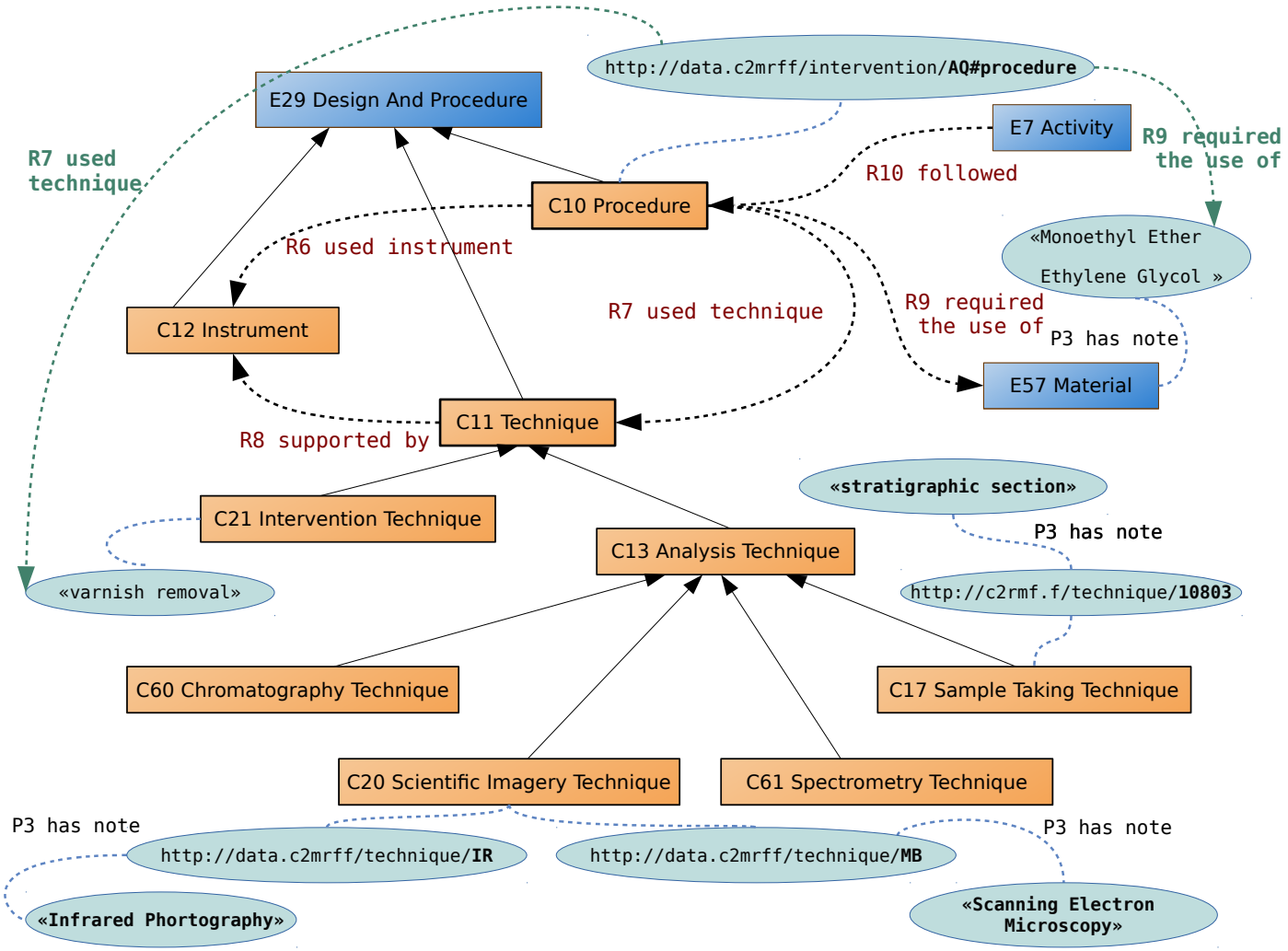


Non-degrading events: activities

- *(2) C22 Intervention*: classification of interventions : International Council of Museums - Committee for Conservation



Analysis techniques



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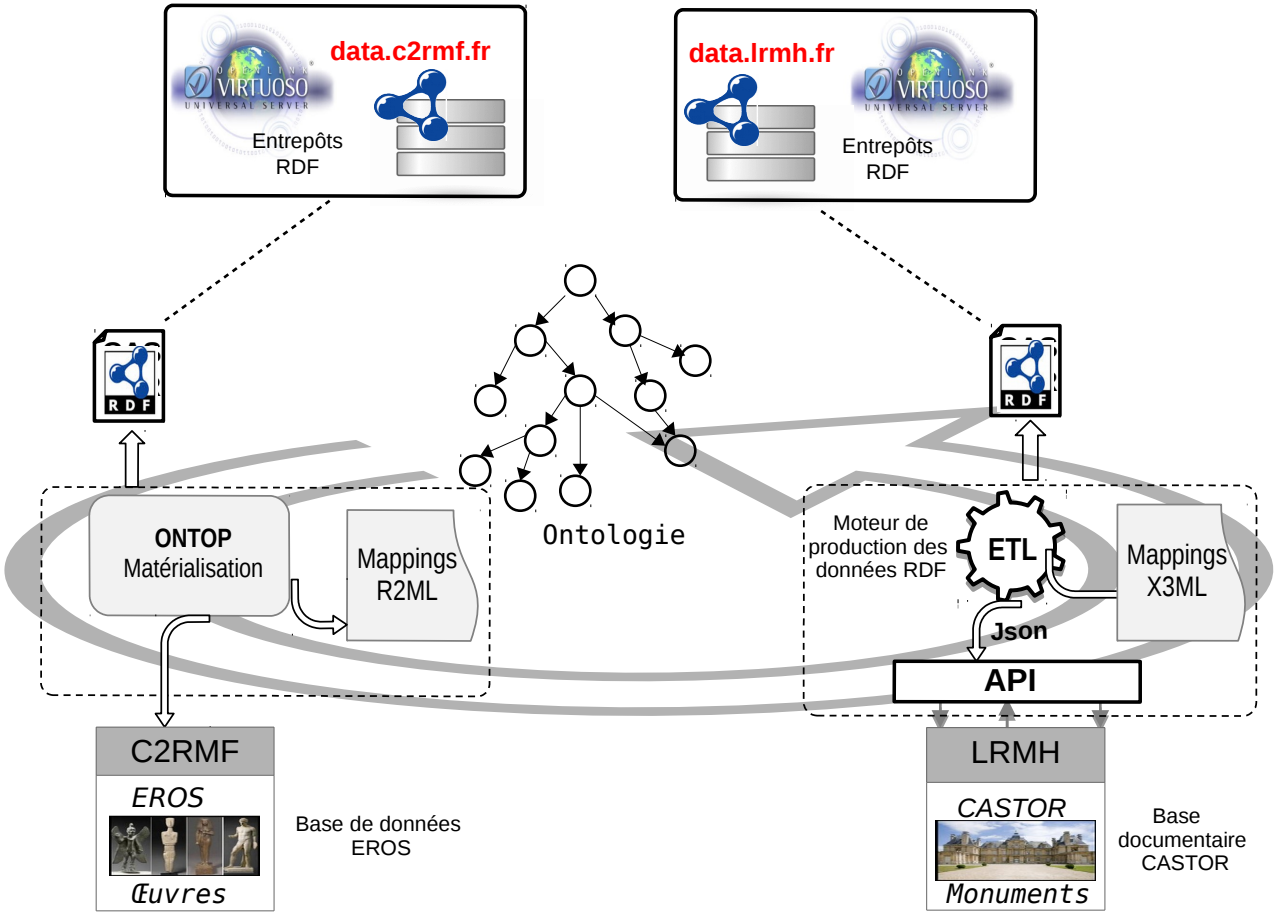
How to query the **heterogeneous** databases by using the shared conceptual model?

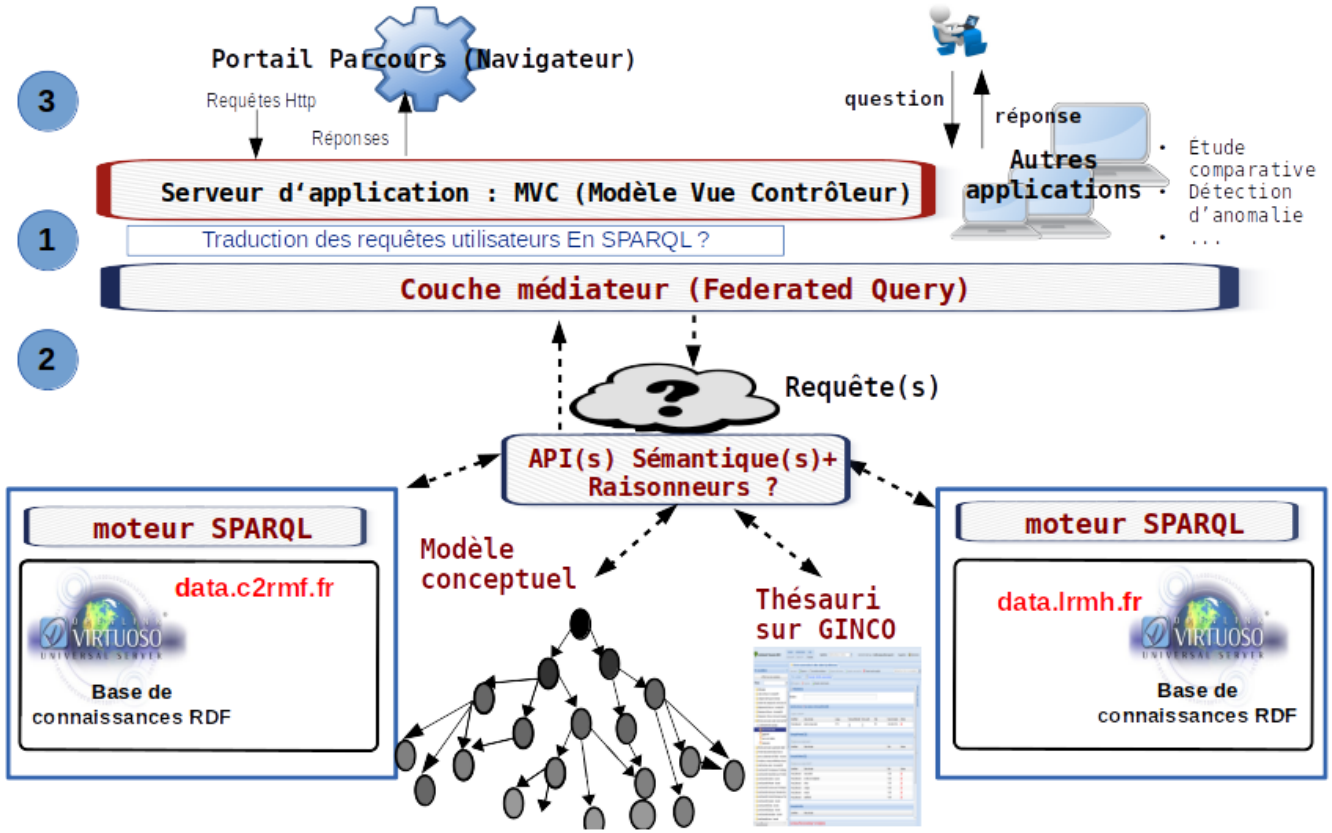
Knowledge base development



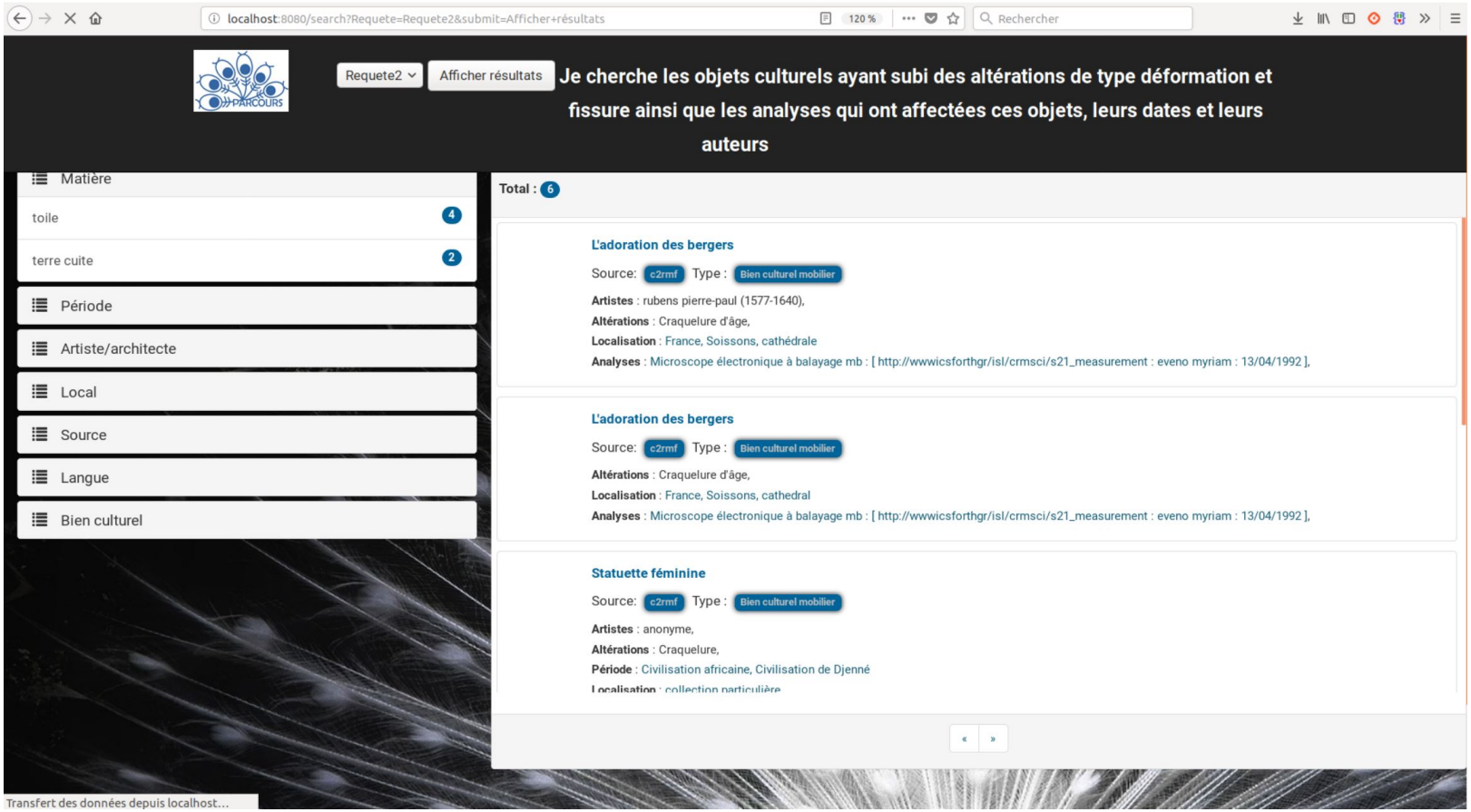
How to query **distributed** databases and which architecture for the query system?

Information system development

- Translation of user queries from natural language to SPARQL
- **Send the queries to knowledge bases (mediator)**
- **Send back the answers to the user**



Information system



Conclusion et perspectives

Conclusions:

- Semantization of CASTOR base
- Production and integration of thesauri
- Production, validation et documentation of the CRMcr ontology
- *Mappings* building
- Knowledge bases building
- Test and implementation of different reasoners
- Implementation of the information system

Conclusion et perspectives

Perspectives:

- Validate the CRMcr ontology by the CIDOC-CRM consortium
- Natural language queries processing
- Query optimization
- Development of a tool for online knwoledge data production under the PARCOURS format (ongoing - we just got the funding!)

THANK YOU FOR YOUR ATTENTION!

http://projet-parcours.eu

Lack of semantics in the database

Bibliographical base CASTOR
Méthodologie - sémantisation :

- Mise en place d'un outil permettant d'annoter sémantiquement (affecter des classes) les **mots-clés** en se basant sur :
  - les thesauri du domaine culturel ou des branches de ces thesauri existants sur GINCO ou dans la base EROS
  - les catégories existantes dans la conceptualisation mises en place pour la restauration-conservation.
- Si un mot-clé est classé dans plusieurs classes, mise en place d'un système de classement (*ranking*) ou choix arbitraire de la ou des catégories correspondantes

Réalisation :

- Mots-clés à classer : $\cong$ 10 500 mots-clés
- Classes :
  - .TAE : Techniques d'analyse et d'examen
  - .AL : Altérations
  - .IN : Interventions
  - .MMO : Matière de mise en oeuvre
  - .TMO : Technique de mise en oeuvre
  - .DHA : Domaine ou Histoire de l'art
  - .MODEN : Dénomination des objets culturels mobiliers
  - .IMODEN : Dénomination des objets culturels immobiliers
  - .CEC : Composition en élément chimique (résultats d'analyses)
  - .ECON : État de conservation
  - .MI : Marque/inscription
  - .EAR : Élément architectural
- Mots-clés classés : $\cong$ 7000 mots
- Mots-clés non classés : $\cong$ 3500 mots
- Production d'une copie de la base de données avec les nouvelles classes créées pour éclater le champ *Mots-Clés* de CASTOR

Example : Thesaurus of analysis and examination techniques