

The Application of IIR and LOD in Digital Humanities: A Case Study of the Dictionary of Wooden Slips

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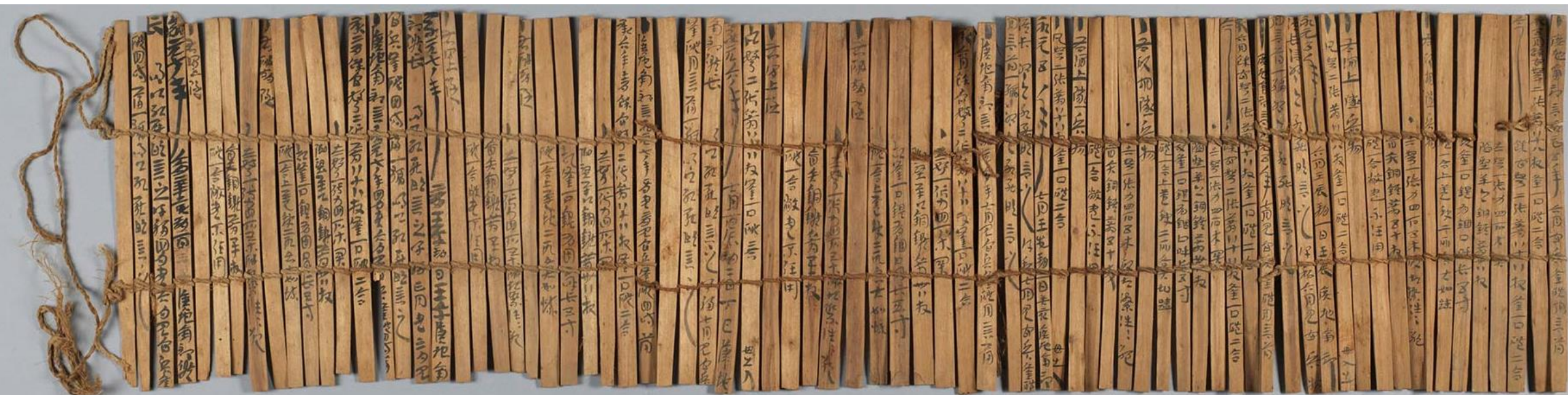
Academia Sinica Center for Digital Cultures (ASCDC)

December 02, 2022

SWIB 2022, the 14th Semantic Web in Libraries Conference, 28.11-02.12 2022

Research on the Juyan Han Wooden Slips

- The traditional writing medium in the Early Chinese Medieval period, especially in the Han Dynasty (206 BC-AD 220).
- Composed of woods or bamboos and binding together, the Chinese characters on the slips are living evidence to study the military and legal systems, educational practices, economy, beliefs, and everyday life of the society at that time.

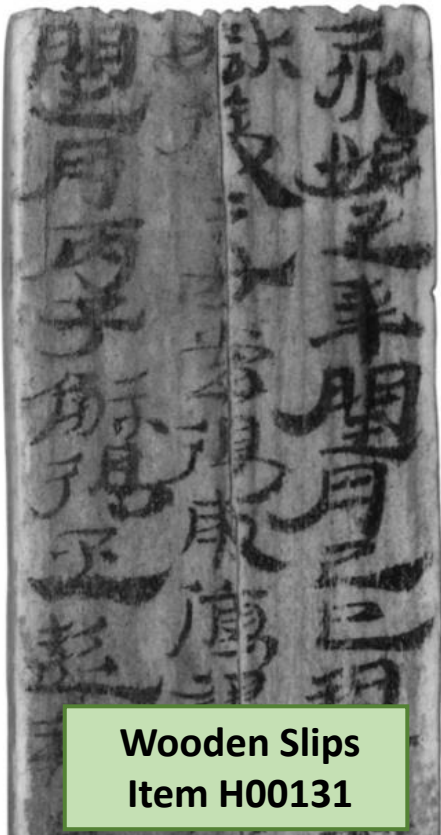


Monthly and Seasonal Records of Military Supplies from the Kuang-ti South Platoon in the Yung-yüan Era

廣地南部永元五年至七年官兵釜磴月言及四時簿, ca. AD 97, Item H00185

Research on the Juyan Han Wooden Slips

- Around 1930s, more than 10,000 Han wooden slips, called as Juyan Han Wooden Slips (居延漢簡), were excavated by the Chinese and Swedish scholars of the Sino-Swedish Scientific Expedition, in the watershed of the Edsen-Gol (額濟納河) of the Kansu Province (甘肅省), China.



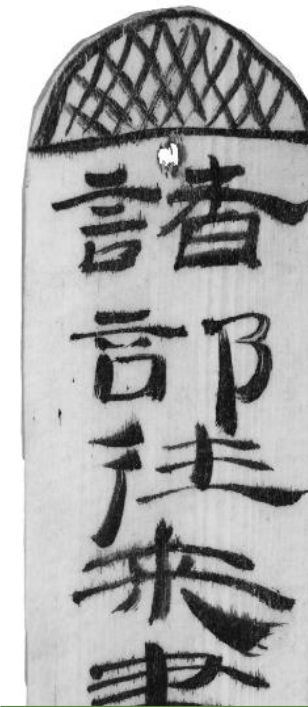
Wooden Slips
Item H00131



Wooden Slips
Item H13613



Wooden Slips
Item H07851



Wooden Slips
Item H02544



Wooden Slips
Item H01637

Digital Archive of the Han Wooden Slips

- To preserve these treasurable archaeological objects, the Institute of History and Philology in Academia Sinica has established Digital Archive of Han Wooden Slips since the 1990s.

漢代簡牘數位典藏

歷史語言研究所藏漢代簡牘資料庫

版權宣告

簡介 資料檢索 使用說明 木簡與木牘

上一筆 下一筆

Images of slip item

請選擇所需影像並填入其排列順序 (可複選)

影像縮圖	方向	全形/局部	影像類別	備註
	正面	全形	紅外線照片	
	背面	全形	紅外線照片	
	背面	全形	彩色照片	

Metadata of slip item

登錄號	H01637
簡號	057.001
品名	永光二年予候長鄭赦寧冊
年代	西漢 Western Han元帝永光二年三月壬戌朔己卯
遺址	A8 破城子
功能形制	冊
材質	木
尺寸	長23.2公分 寬3.0公分 厚0.34公分 重11.04公克

Share / Save

Interface of Digital Archive of Han Wooden Slips (Item H01637)
<http://rub.ihp.sinica.edu.tw/~wodslip/index.htm>

Challenges in traditional Database for Wooden Slips

- Restriction of the traditional database for DH study of the Han Wooden Slips

	Problems of the traditional database system	Solution methods
1	Database focused on the information of an entire wooden slips and can not provide information on the characters written on them	Enhancing the granularity for information retrieval methods embedded in system
2	Database established as an isolated silo, can not connect with other related data resources	Constructing RDF-formatted Linked Data for cross-database query
3	Textual content and Image can not be mapped to each other on the interface	Applying IIIF APIs combined with Linked Data-based image annotation function

Wooden Slips Character Dictionary (WCD)

- Content: 7,377 Objects of Wooden Slips, 8,491 IIF-based images, 65,736 data entries on annotated characters
- Core functions in WCD platform:
 - * **Information retrieval** by object and by character
 - * **Image research** on objects and characters
 - * **Image annotation** by classified categories
 - * **Cross-database query** for Chinese characters
- Structure of Metadata designed based on CIDOC-CRM in order to further apply as linked data



WCD Website: <https://wcd-ihp.ascdc.sinica.edu.tw/woodslip/index.php>

WCD: Information Retrieval

簡牘字典 史語所藏居延漢簡資料庫 操作說明 登入

簡牘檢索 甲渠

查詢結果 比較清單

簡牘檢索 / 查詢詞: 甲渠 / 25個符合的項目

排序 依簡號

			
簡號 111.007	簡號 157.011	簡號 227.008	簡號 004.029
<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單

			
簡號 006.008	簡號 017.032	簡號 028.021	簡號 033.028

Object-based retrieval

簡牘字典 史語所藏居延漢簡資料庫 操作說明 登入

單字檢索 渠

查詢結果 比較清單

單字檢索 / 查詢詞: 渠 / 31個符合的項目

排序 依簡號

				
簡號 033.028	簡號 046.005	簡號 057.001	簡號 101.017	簡號 101.033
<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單

				
簡號 103.005	簡號 145.013+104.008	簡號 104.036	簡號 160.015	簡號 133.003
<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單	<input type="checkbox"/> 加入比較清單

Character-based retrieval

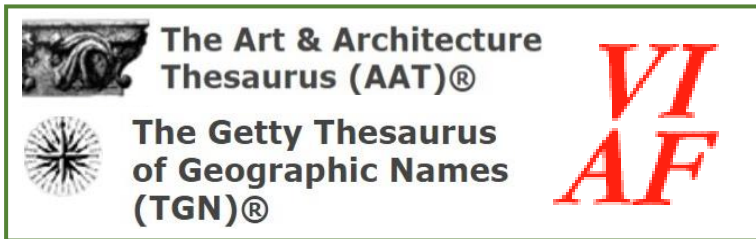
WCD: Image Research



- The IIF-based image viewer can make comparisons of the characters' writing styles and identify the possible writing contributor between related characters.

Data Model of WCD

- **CIDOC-CRM based** WCD-data model: Describing information on the cultural object of the Chinese wooden slips.
- Core structures in WCD data model:
 - * **23 classes** in object-based and event-based model (CIDOC-CRM)
 - * **47 properties** from 9 semantic vocabularies (ascdc, bmo, CIDOC-CRM, dcterms, owl, rdf, rdfs, schema, skos)
 - * **3 external resources** (AAT, TGN, VIAF) reused for data enrichment



Classes [23]

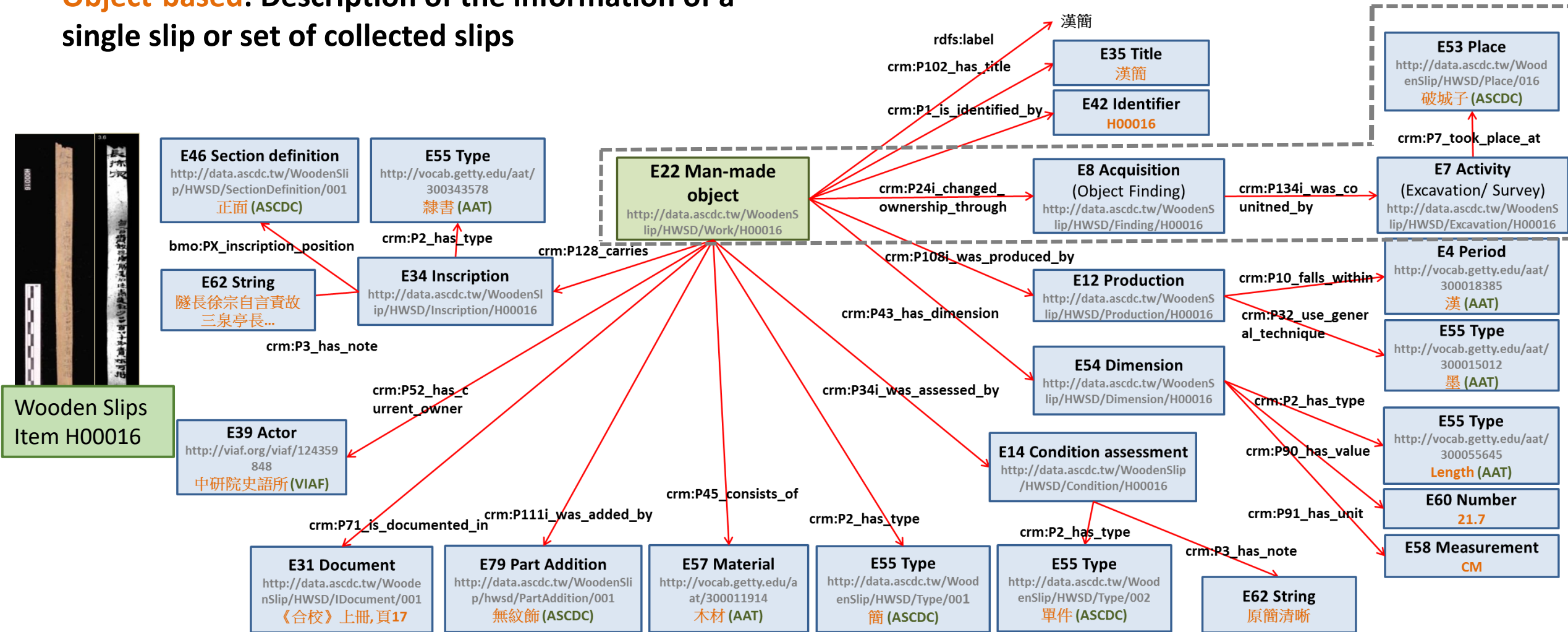
crm:E4_Period, crm:E7_Activity, crm:E8_Acquisition, crm:E12_Production, crm:E14_Condition_Assessment, crm:E22_Man-Made_Object, crm:E31_Document, crm:E33_Linguistic_Object, crm:E34_Inscription, crm:E35_Title, crm:E38_Image, crm:E39_Actor, crm:E42_Identifier, crm:E52_Time-Span, crm:E53_Place, crm:E54_Dimension, crm:E55_Type, crm:E57_Material, crm:E58_Measurement_Unit, crm:E60_Number, crm:E62_String, crm:E73_Information_Object, crm:E79_Part_Addition

Properties [47]

ascdc:type, bmo:PX_inscription_position, crm:P1_is_identified_by, crm:P2_has_type, crm:P3_has_note, crm:P4_has_time-span, crm:P7_took_place_at, crm:P10_falls_within, crm:P14_carried_out_by, crm:P24i_changed_ownership_through, crm:P32_use_general_technique, crm:P33_use_specific_technique, crm:P34i_was_assessed_by, crm:P43_has_dimension, crm:P45_consists_of, crm:P48_has_preferred_identifier, crm:P50_has_current_keeper, crm:P52_has_current_owner, crm:P65_shows_visual_item, crm:P67_refers_to, crm:P70i_is_documented_in, crm:P90_has_value, crm:P91_has_unit, crm:P102_has_title, crm:P108i_was_produced_by, crm:P111i_was_added_by, crm:P115_finishes, crm:P116_starts, crm:P127_has_broader_term, crm:P128_carries, crm:P129i_is_subject_of, crm:P134i_was_continued_by, crm:P137_exemplifies, crm:P139_has_alternative_form, dcterms:identifier, dcterms:isPartOf, dcterms:type, owl:sameAs, rdf:type, rdfs:label, rdfs:seeAlso, schema:endDate, schema:identifier, schema:startDate, skos:altLabel, skos:broadMatch, skos:related

WCD Data Model: Object-based Design

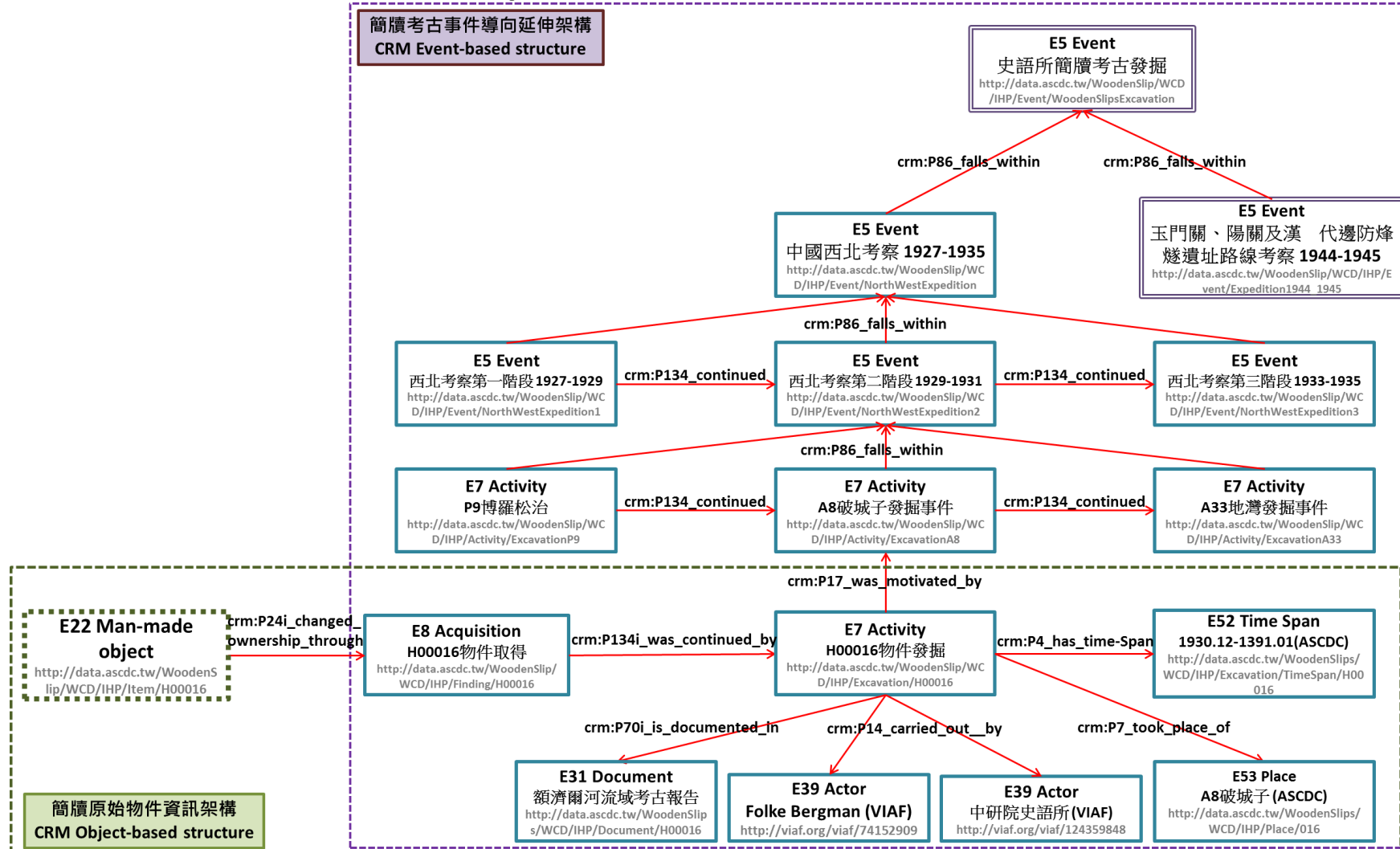
- Object-based:** Description of the information of a single slip or set of collected slips



Event-based: information on archaeological events

WCD Data Model: Event-based Design

- **Event-based:** Description of the hierarchical, archaeological events, in which the slips are excavated during the Sino-Swedish Scientific Expedition in the 1930s

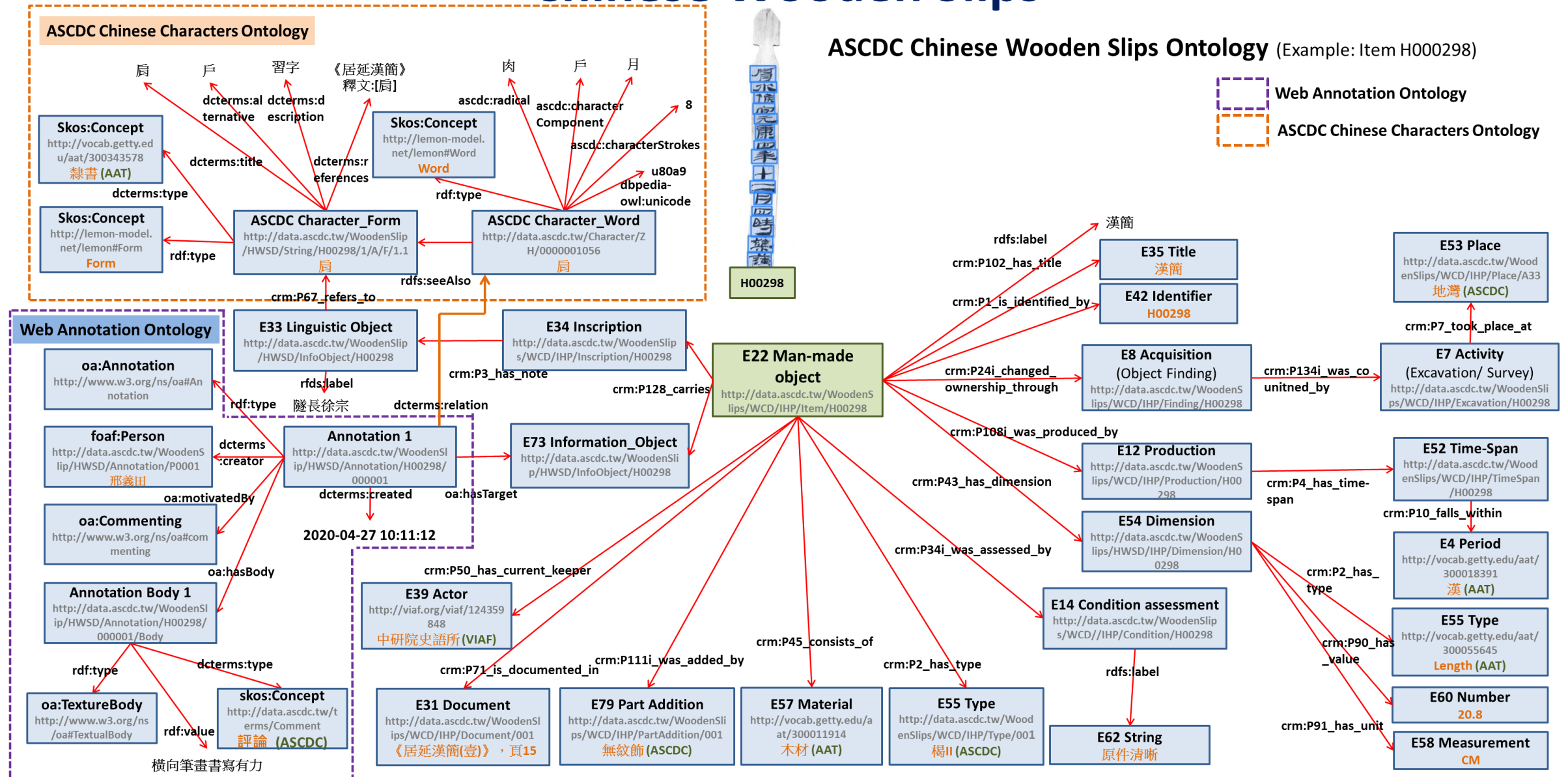


The Integrative Ontological Design of the Chinese Wooden Slips

- Purpose: Integration of the classified text information of IIF-based image annotation with LOD-based metadata of Han Wooden Slips to enhance the interoperability of IIF JSON-LD files with LOD data resources and exchange the researcher's opinion between domain experts.
- The current integrative ontological design for Chinese wooden slips contains:

	Ontology type	Purpose for design	Model base
1	簡牘知識本體 Chinese wooden slips ontology	To describe entire metadata information of each wooden slip	CIDOC-CRM
2	漢字知識本體 ASCDC Chinese characters ontology	To describe information of each Chinese character written on the wooden slips	N/A
3	標註知識本體 Web annotation ontology	To describe annotated information on each wooden slip and characters written on it to classify different type of annotation and transform the annotated text into linked data	Web Annotation Data Model

The Integrative Ontological Design of the Chinese Wooden Slips



LOD Dataset of the WCD

- Based on this integrative data model design, metadata of the wooden slips and characters on the slips are converted into LOD dataset; Released in the websites of ASCDC's LODdatasets, datahub.io and Linked Open Data Cloud

```
1 <?xml version="1.0" encoding="utf-8" ?>
2 <rdf:RDF
3   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
4   xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
5   xmlns:owl="http://www.w3.org/2002/07/owl#"
6   xmlns:ns3="http://www.cidoc-crm.org/cidoc-crm/"
7   xmlns:ns4="http://schema.org/"
8   xmlns:ns5="http://purl.org/dc/terms/"
9   xmlns:skos="http://www.w3.org/2004/02/skos/core#"
10  xmlns:ns7="http://data.ascdc.tw/property/" >
11  <rdf:Description rdf:about="http://data.ascdc.tw/woodenslips/WCD/IHP/Item/H00185">
12    <rdf:type rdf:resource="http://www.cidoc-crm.org/cidoc-crm/E22_Man-Made_Object" />
13    <rdfs:label xml:lang="zh">廣地南部永元五年至七年官兵釜礎簿</rdfs:label>
14    <rdfs:seeAlso rdf:resource="http://ndweb.iis.sinica.edu.tw/woodslip_public/system/Search/view_Frame.
15    <owl:sameAs rdf:resource="https://wcd-ihp.ascdc.sinica.edu.tw/woodslip/item.php?id1=H00185" />
16    <ns3:P43_has_dimension rdf:resource="http://data.ascdc.tw/woodenslips/WCD/IHP/Dimension/Length/H0018
17    <ns3:P43_has_dimension rdf:resource="http://data.ascdc.tw/woodenslips/WCD/IHP/Dimension/Thickness/H0
18    <ns3:P43_has_dimension rdf:resource="http://data.ascdc.tw/woodenslips/WCD/IHP/Dimension/Weight/H0018
19    <ns3:P43_has_dimension rdf:resource="http://data.ascdc.tw/woodenslips/WCD/IHP/Dimension/Width/H00185
20    <ns3:P102_has_title rdf:resource="http://data.ascdc.tw/woodenslips/WCD/IHP/Title/H00185" />
21    <ns3:P1_is_identified_by rdf:resource="http://data.ascdc.tw/woodenslips/WCD/IHP/Identifier/ItemID/H0
22    <ns3:P2_has_type rdf:resource="http://data.ascdc.tw/woodenslips/WCD/IHP/FormatType/003" />
23    <ns4:identifier xml:lang="zh">128.001</ns4:identifier>
24    <ns3:P137_exemplifies>http://data.ascdc.tw/woodenslips/WCD/IHP/AssessmentType/Single</ns3:P137_exemp
25    <ns3:P45_consists_of rdf:resource="http://data.ascdc.tw/woodenslips/WCD/IHP/Material/001" />
26    <ns3:P24i_changed_ownership_through rdf:resource="http://data.ascdc.tw/woodenslips/WCD/IHP/ObjectFin
27    <ns3:P50_has_current_keeper rdf:resource="http://data.ascdc.
28    <ns5:type rdf:resource="http://purl.org/dc/dcmitype/Physical
29    <ns5:type rdf:resource="http://vocab.getty.edu/aat/300234110
30    <ns5:identifier xml:lang="zh">H00185</ns5:identifier>
31    <skos:altLabel xml:lang="zh">居延漢簡</skos:altLabel>
```

WCD data record in RDF
Example: Item H00185

datahub
The easy way to get, use and share data

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/ Organizations / Academia Sinica Center for ... / Dataset of Wooden Slips ...

Dataset of Wooden Slips Character Dictionary (WCD)

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Organization

Academia Sinica Center for Digital Cultures

Established in 2013, the Academia Sinica Center for Digital Cultures (ASCDC,

Dataset of Wooden Slips Character Dictionary (WCD)

The LOD-based dataset of the "ASCDC Dataset of the Han Wooden Slips Character Dictionary (WCD)" is created by the Academia Sinica Center for Digital Cultures (ASCDC) and based on the metadata from the online database of the "Wooden Slips Character Dictionary" (簡牘字典—史語所藏居延漢簡資料庫, <https://wcd-ihp.ascdc.sinica.edu.tw/woodslip/index.php>). The database is established and maintained by the Institute of History and Philology, Academia Sinica, Taipei, Taiwan (ROC). The WCD dataset contains information of more than 200 Han wooden slips, which are excavated by the expedition group of the Academia Sinica and the Swedish archaeologist Folke Bergman (1902-1946) around the 1930s and in Inner Mongolia and Gansu Province. Containing 3,235 data records (from 207 items) and 15,346 triples, the dataset is downloadable in ttl format. The released textual content of the WCD dataset is licensed with CC0 by the Creative Commons Attribution.

Data and Resources

LOD Dataset of the WCD
The LOD-based dataset

WCD dataset in datahub.io
<https://datahub.ckan.io/dataset/dataset-of-wooden-slips-character-dictionary-wcd>

Template-based LOD SPARQL Query Examples

According to the focus of research, the template-based LOD SPARQL queries are designed in discussion with domain experts to satisfy the researcher's needs and to offer a user-friendly interface to retrieve the data content.

	Query examples for WCD dataset	Related research focuses
1	What is the list of Han wooden slips inscribed with "zhuan" (傳), and what are their excavation sites, calligraphic styles, and time periods?	1) Interpretation of Chinese characters 2) Comparative study on writing styles
2	What is the list of Han wooden slips decorated with perforations, and what are their excavation sites?	1) Study on the administrative History and official documents in Han Dynasty
3	What is the list of Han wooden slips with pictures, and what are their formats?	1) Comparative study on writing styles
4	What is the list of characters used as "practice characters" (習字) on Han wooden slips, and what are the formats of those slips?	1) Interpretation of Chinese characters 2) Comparative study on writing styles
5	What is the list of Han wooden slips with the human-face talisman format, that include color photographs?	1) Comparative study on writing styles
6	What is the list of Han wooden slips with a calligraphic style of "clerical script" (隸書) and a format of "two rows"?	1) Interpretation of Chinese characters 2) Manuscript restoration between slips
7	What is the list of Han wooden slips inscribed with "yue" (月), "shi" (石), "dou" (斗), or "sheng" (升), and excavated from the "A8 City Ruins" (A8破城子)?	1) Interpretation of Chinese characters 2) Manuscript restoration between slips
8	What is the list of Han wooden slips inscribed with the place of origin "lingshichong" (令史充), and the proximate time periods of wooden slips in the same numbered bundle?	1) Interpretation of Chinese characters 2) Study on the career development of frontier officers in Han Dynasty
9	What is the list of Han wooden slips inscribed with “zhuan” (專), with a calligraphic style of “clerical script” (隸書)?	1) Interpretation of Chinese characters 2) Comparative study on writing styles

Template-based LOD SPARQL Query Examples

Query Example: What is the list of Han wooden slips decorated with **perforations**, and what are their excavation sites?
列舉出漢代簡牘中物件中，具**穿孔**之裝飾特色的簡牘物件類型及其出土遺址地點？

LOD Datasets

LOD Lab 中文/EN

Data Queries

SPARQL Queries

Download Datasets

Example cases

Category	Query examples	(2) SPARQL query reasoning
Han Wooden Slips	<div><div>5 SELECT ?Item ?ID ?Decoration ?FormatType ?Place</div><div>6 FROM <http://data.ascdc.tw/WoodenSlips/WCD/IHP/></div><div>7 WHERE{</div><div>8 ?Item crm:P111i_was_added_by/rdfs:label ?Decoration.</div><div>9 FILTER (str(?Decoration) = '穿孔').</div></div>	<div>1. For records in the Wooden Slips Database, set S as the wood</div> <div>"perforation" (穿孔) and set the "decoration" (紋飾特徵) data f</div> <div>rdfs:label.</div> <div>2. Set S as the wooden slip URIs from step 1, then query the da</div> <div>set O as the formats.</div>
EX1. What is the list of Han wooden slips with a format of "two rows," and what is each slip's excavation site, dynasty of origin, length, and width?		
EX2. What is the list of Han wooden slips decorated with perforations, and what are their excavation sites?		
EX3. What is the list of Han wooden slips inscribed with "zhuan" (傳), and what are their excavation sites, calligraphic styles, and time periods?		
EX4. What is the list of Han wooden slips with burn marks, and what are their excavation sites?		
EX5. What is the list of Han wooden slips with pictures, and what are their formats?		
EX6. What is the list of characters used as "practice characters" (習字) on Han wooden slips, and what are the formats of those slips?		
EX7. What is the list of Han wooden slips with the human-face talisman format, that include color photographs?		

Triples

Map

Chart

(5)

RESULTS

JSON

XML

TTL

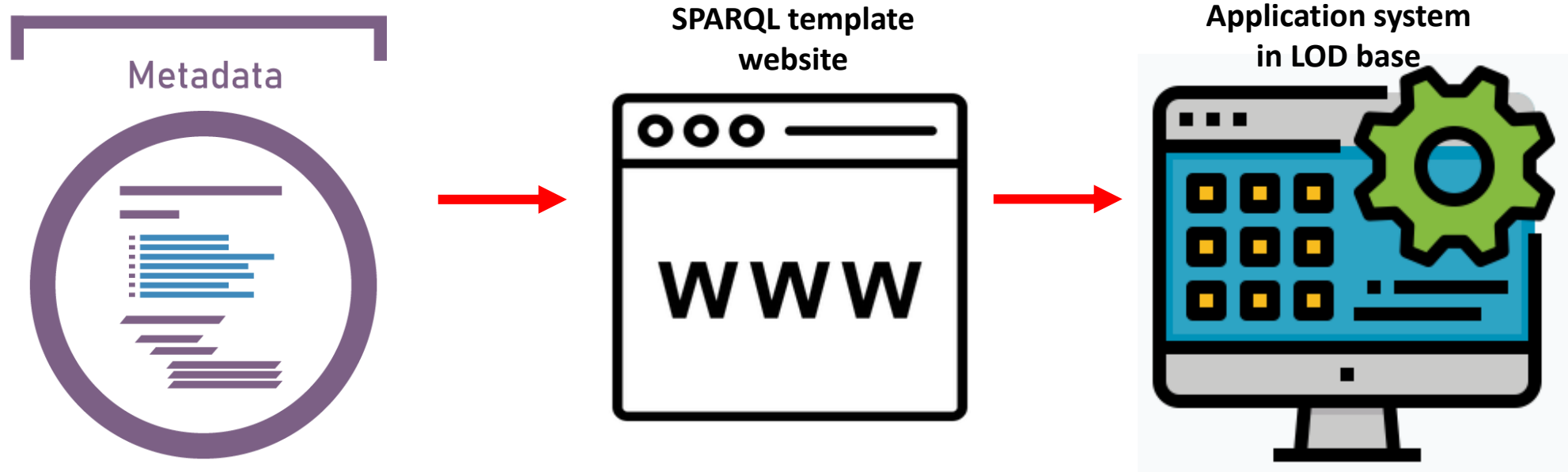
CSV

(7)

Item	ID	Decoration	FormatType	Place
(6) http://data.ascdc.tw/WoodenSlips/WCD/IHP/Item/H00135	065.009	穿孔	符券	A33 地灣
http://data.ascdc.tw/WoodenSlips/WCD/IHP/Item/H00134	065.007	穿孔	符券	
http://data.ascdc.tw/WoodenSlips/WCD/IHP/Item/H00235	082.018	穿孔	褐I	
http://data.ascdc.tw/WoodenSlips/WCD/IHP/Item/H13625	288.001	穿孔	褐I	
http://data.ascdc.tw/WoodenSlips/WCD/IHP/Item/H00379	008.001	穿孔	褐I	

- (1) Selection of query example
- (2) PARQL query reasoning
- (3) SPARQL query language
- (4) Submit
- (5) Selection of visualization modulus
- (6) Results in triples
- (7) Selection of download format

Template-based Queries to Application System

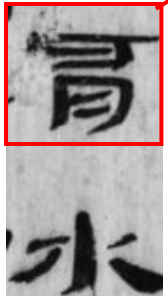


Template-based Design as Support for Study of Wooden Slips

- **Interpretation of Chinese characters:** to identify the written character and written style of a single character.
- **Manuscript Restoration:** to re-discovering the correct sequence or related group of slips by finding the similar contextual meaning or written patterns.



Is a Chinese character
“jien”(肩) or “mao”(冒)?



Wooden Slips
Item H00035



Wooden Slips
Item H00041



Wooden Slips
Item H00042



Wooden Slips
Item H00348

jien

jien

mao



Wooden Slips
Item H00103



Wooden Slips
Item H00109

Character “shi” (石)

Character “dou” (斗)

Character “sheng” (升)

Application of IIIF APIs on the WCD Platform

- Image presentation in the WCD database functions based on the IIIF standard, especially in application of the **IIIF Presentation API**, **IIIF Image API** and **IIIF Content Search API**.



	API type	Purpose of application	Application
1	IIIF Presentation API	Present an image or series of images in IIIF viewer by its correct image sequence, structure and layout based on the linked data and web page structure principles.	Image presentation, Image sharing, Structured retrieval system of WCD
2	IIIF Image API	Formulate an image's URI design, parameter specification, and attribution for data management to achieve static image retrieval and delivery.	Image zooming, Image comparison, Viewing form definition
3	IIIF Content Search API	Provides a content retrieval service mechanism to retrieve the annotation information embedded in the IIIF manifest JSON-LD file or information structured in the IIIF presentation API.	Character retrievals, Structured image annotation

WCD: Image Annotation

- Images of objects and characters can be annotated under different motivations and sub-categories as an extension to IIF APIs.
- The method of classified annotation in different sub-categories makes the annotated text more reusable for scholars' needs by recording object data or interpreting the form and meaning of the characters.
- The annotated information will be recorded in the IIF manifest and be reusable, exchangeable as linked data.
- Images can be researched by crowdsourcing.



簡牘字典 史語所藏居延漢簡資料庫 操作說明

標記選項：釋讀(確定) (1)
甲
描述選項：部首 (2)
田
評論選項：書寫特徵 (3)
工整
分類選項：書體 (4)
隸書
調和選項：面向順序
正面
save cancel

Motivation types
(1) Tagging
(2) Describing
(3) Commenting
(4) Classifying

The character “Jia” (甲) can be annotated under different motivations such as tagging, describing, commenting, or classifying (Item H04737)

WCD: Image Annotation

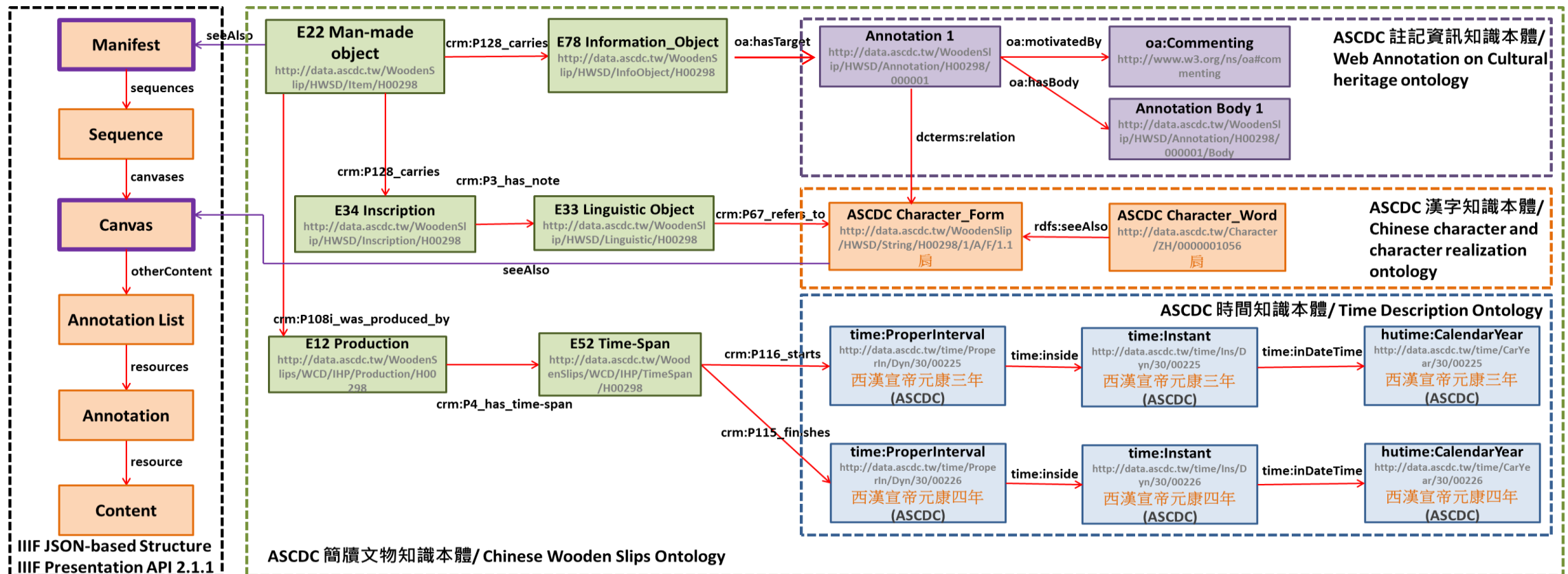
- The extension of the current IIF annotation function is made based on W3C's **Web Annotation Data Model** (WADM).
- The current structure of faceted annotation contains WADM's motivations, "**Tagging**", "**Describing**", "**Commenting**", and "**Classifying**", for different annotation purposes.
- When annotating the images, the property **oa:motivation** is applied to distinguish different motives, while **dcterms:type** is reused to specify the sub-type of annotation within a motivation.

	Motivation types oa:motivation	Sub-types @zh	Sub-types @en dcterms:type
1	Tagging 標記	釋讀(確定)	InterpretationEnsured
		釋讀(不確定)	InterpretationUnsecured
		不區分/其他	TaggingOthers
2	Describing 描述	部首	Radical
		部件	Component
		不區分/其他	DescribingOthers
3	Commenting 評論	書寫特徵	WritingCharacteristic
		參考資料	References
		參考物件	RelatedItem
		備註	Note
		評論內容	Comment
		不區分/其他	CommentingOthers
4	Classifying 分類	書體	ScriptType
		不區分/其他	ClassifyingOthers

Structure of faceted annotation (motivations and sub-types)

Data Linkage between LOD and IIIF

- Using a **linking property** such as **seeAlso** as regulated in IIIF Presentation API to link the LOD-based **descriptive metadata** of an object or a Chinese character **with its image data embedded in the IIIF manifest** and further enhance data distribution and reusability of WCD's LOD



Manifest Joint between a single slip's LOD and IIIF manifest

Canvas Joint between a character's LOD and IIIF manifest

Data Linkage between LOD and IIIF: An Example

```
{
  @id: "https://wcd-ihp.ascdc.sinica.edu.tw/api/GET/43/manifest",
  - logo: {
    @id: "https://wcd-ihp.ascdc.sinica.edu.tw/woodslip/web.png",
    @type: "dctypes:Image",
    width: 170,
    height: 90
  },
  @type: "sc:Manifest",
  label: "永光二年予候長鄭赦寧冊",
  license: "https://creativecommons.org/licenses/by-nc-nd/3.0/tw/",
  navDate: "2017-09-14T00:00:00Z",
  - seeAlso: {
    @id: "http://data.ascdc.tw/WoodenSlips/WCD/IHP/Item/H01637",
    format: "rdf"
  },
  @context: "http://iiif.io/api/presentation/2/context.json",
  - metadata: [
    - {
      label: "Published",
      - value: [
        - {
          @value: "Institute of History and Philology, Academia Sinica",
          @language: "en"
        },
        - {
          @value: "中央研究院歷史語言研究所 | 中央研究院數位文化中心",
          @language: "zh-TW"
        }
      ]
    }
  ]
}
```

Manifest JSON-LD (H01637)

永光二年予候長鄭赦寧冊

Title	居延漢簡
Registration ID	H01637
Item ID	057.001
Type	冊
Broader Type	簡牘及竹木器
Material	木/ Wood
Date	西漢元帝永光二年
Place	A8 破城子
Item Owner	中央研究院歷史語言研究所/ IHP

Report on the bereavement leave of the officer Zheng She due to his father's death.



AAT



VIAF



Links to external resources (as AAT, VIAT)

LOD (H01637)

seeAlso as key property to integrate IIIF Manifest JSON-LD with LOD-based descriptive data

IIIF-based Union Catalog of WCD

歷史文字資料庫統合檢索系統

The screenshot displays the WCD Union Catalog interface. At the top, there is a search bar with the text '查詢文字：甲' (Search text: Jia). Below the search bar, there is a section for 'Academia Sinica, R.O.C.' with 41 results. Below that, there is a section for 'Nara Research Institute, Japan' with 12 results. Below that, there is a section for 'University of Tokyo, Japan' with 7 results. Each result is shown as a thumbnail with a '詳細' (Details) button. A red box highlights the '詳細' button for the first result in the University of Tokyo section. A red arrow points from this button to the 'Display on Mirador' label in the legend at the bottom. The legend also includes 'Character in original database' and 'Display in IIIF Manifest JSON-LD'.

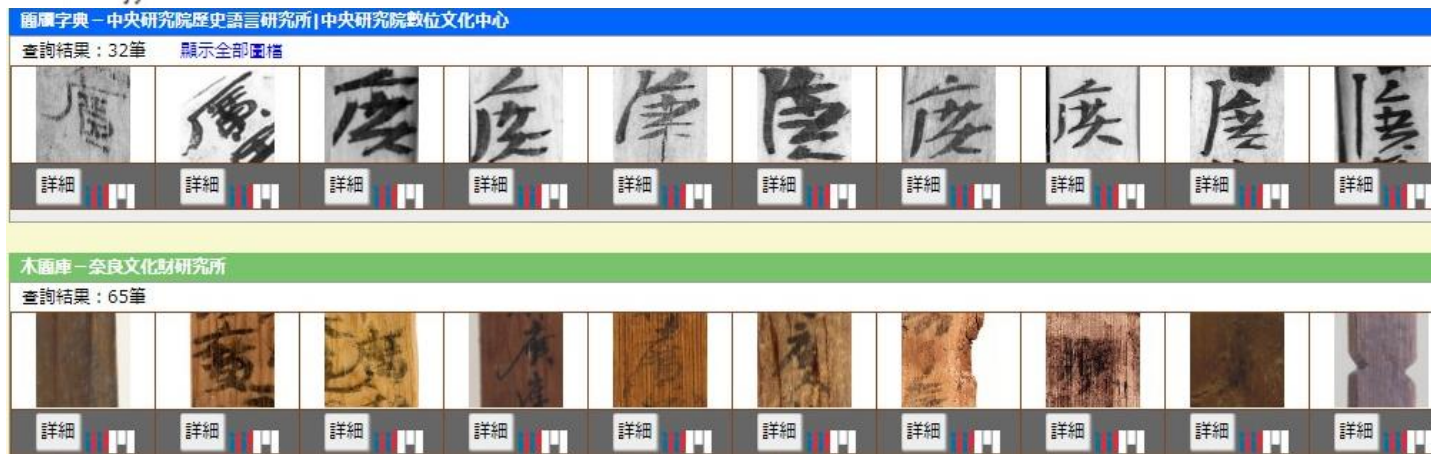
- Images of WCD characters are further interoperable and retrievable in the “**Union Catalog**” for searching historical Chinese Characters in cooperation with international research communities, such as the Nara National Research Institute for Cultural Properties, Historiographical Institute of the University of Tokyo, National Institute of Japanese Literature, National Institute for Japanese Language and Linguistics, and Institute for Research in Humanities at Kyoto University in Japan.
- Functions of WCD’s Union Catalog
 - * **Character retrieval across institutes**
 - * Redirection to original database
 - * Access to the IIIF Manifest structure of retrieved characters
 - * Presentation of retrieved characters in Mirador viewer
- System functions based on **IIIF APIs** and **customized API for sharing of the search results**

WCD Union Catalog : <https://wcd-ihp.ascdc.sinica.edu.tw/union/>

Design of Interoperable API for Character Retrievals

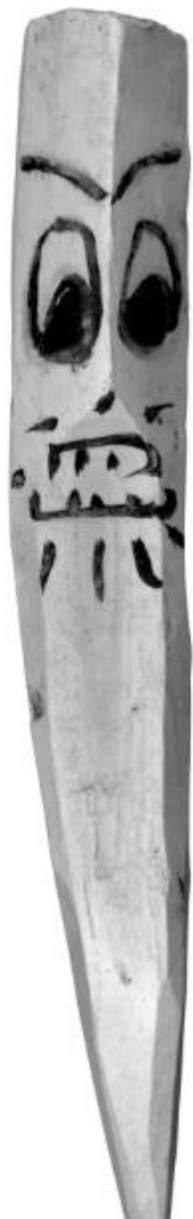
- In cooperation with 6 research institutes in Japan, an **API for sharing query results** was developed to enable **query of a single character across different institute databases** and enhance data interoperability.
- API is structured based on JSON format.
- **15 elements** are regulated in the WCD-Union query API: status code, search results, list, identifier, id, **title**, delegate, unicode, source, thumbnail url, manifest url, subject, creator, rights, rights url.

```
(1) status_code: "200",
(2) search_results: "32",
(3)- list: [
  (4) identifier: "http://wcd-ihp.ascdc.sinica.edu.tw/api/GET/anno/mysql/body\_55\_215",
  (5) id: "H00185",
  (6) title: "廣",
  (7) delegate: "1",
  (8) unicode: "5ee3",
  (9) source: {
    general_name: "居延漢簡",
    site: "A27 查科爾帖",
    time_Chinese: "東漢",
    time_CE: "25 ~ 220",
    material: "木"
  },
  (10) thumbnail_url: "https://wcd-ihp.ascdc.sinica.edu.tw/parser/IIIF/H00185BIWA-6/9318,393,77,94/full/0/default.jpg",
  (11) manifest_url: "https://wcd-ihp.ascdc.sinica.edu.tw/api/GET/55/manifest",
  (12) subject: "簡牘字典—史語所藏居延漢簡資料庫",
  (13) creator: "中央研究院歷史語言研究所 | 中央研究院數位文化中心",
  (14) rights: "",
  (15) rights_url: "https://wcd-ihp.ascdc.sinica.edu.tw/woodslip/terms.html"
],
```



Closing Remarks

- **Linked data** is a method to make results of DH study more reusable, accessible, and enhance data retrieval across different datasets or institutes. It can also integrate with heterogeneous databases or IIIF-based image resources.
- Based on the shared **linked data-structure of LOD dataset and IIIF manifest**, both can be connected using semantic properties. Thus, a model to support DH studies, both on their descriptive component and image component, is possible.

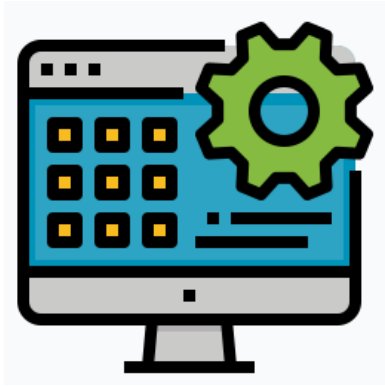


Wooden Slip with
human-faced image
Item H00053



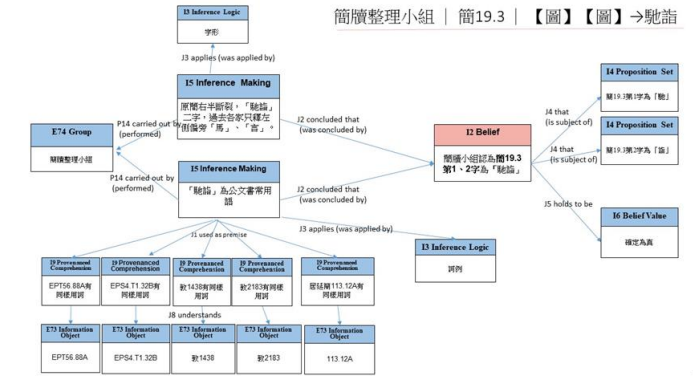
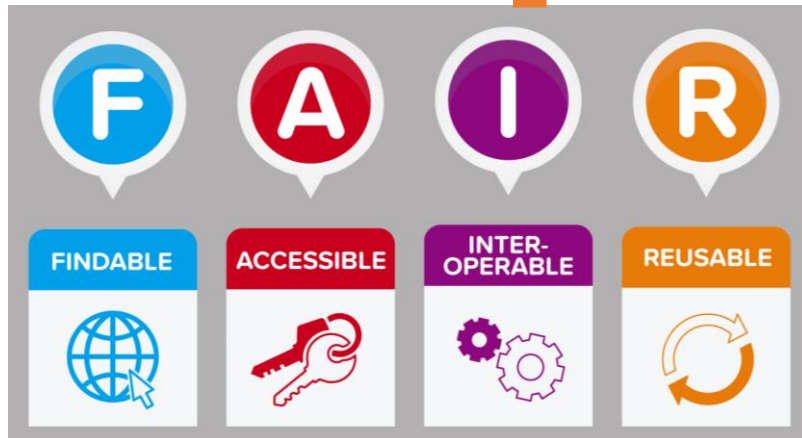
Wooden Slip with
human-faced image
Item H00052

Future Works



Implementing linked data-based Application system

Introducing the FAIR Principles



Introducing the CRMinf Model for Argumentation

Integrating into the Wikidata



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ASCD C



Thanks for your Listening

