

# ‘A puzzle in 4D’: integrating and archiving the resources of a long-term excavation project

Edeltraud Aspöck, Gerald Hiebel, Peter Andorfer, Matej Ďurčo  
DHA 2017, Innsbruck

# A puzzle in 4D:

## digital preservation and reconstruction of an Egyptian palace

### Digital long-term preservation of resources from Austrian excavations at Tell el-Daba (Egypt)

- Funding: Austrian Academy of Sciences digital long-term preservation program (ÖAW / ACDH Digital Humanities) & ARIADNE (FP7-313193)
- February 2015 – January 2020
- OREA & ACDH (Austrian Academy of Sciences)
- **Case study to develop archaeology data archive at the Austrian Academy of Sciences**

#### Cooperations with:

- Ludwig Boltzmann Institute ArchPro
- Chicago University
- Österreichisches Archäologisches Institut, Grabung Tell el Dab'a
- Archaeology Data Service
- PIN Scri - Polo Universitario "Città di Prato"



# Excavation

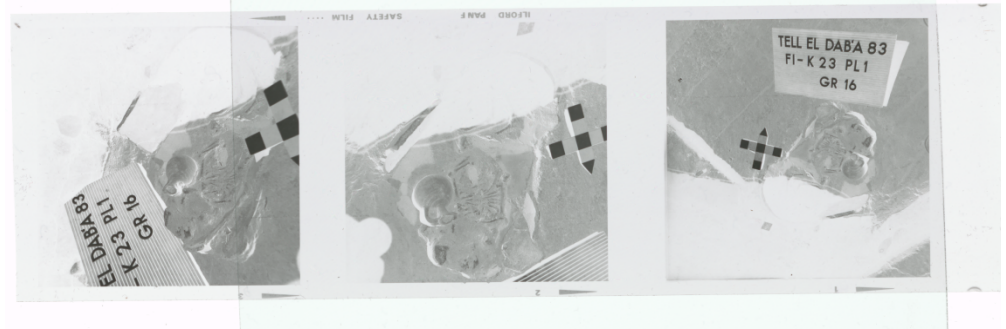
- Since 1966
- 8 excavation areas
- 88 fieldwork campaigns



# ANALOGUE documentation

## Photos

- 15 000 photos
- 200 000 photo negatives  
of which 1/3 are 6x6 negatives
- 45 000 slides



## Drawings

- find drawings: 15 200 pencil on cardboard  
+ 8000 ink on cardboard
- 35 000 field drawings (plana, sections, details): colour pencils on  
millimeter paper
- 4500 plans, nearly all DIN A2 or A1: ink on tracing paper

## Written documentation

- 5 folders of excavation protocols - 300 pages each
- Lists, find cards, etc.





## **DIGITAL resources**

### **TED Documentation Databases:**

- Since 2007: locus- & wall lists, inventory, protocols, wall painting fragments, stone tools, human remains, animal bones, botanic remains, seals

### **Photos**

- Photos: field- and finds-photos, since 2007

### **Drawings**

- AutoCAD Plans: fieldplans of some areas digitized
- Scans of finds drawings, since 2011 complete, before only occasionally

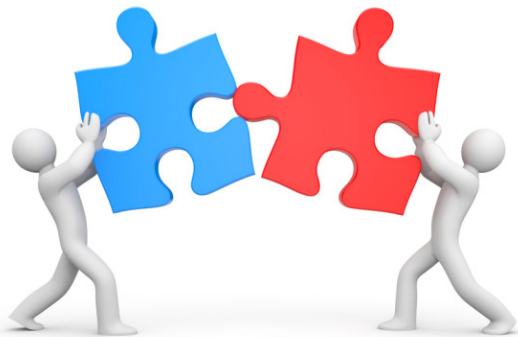
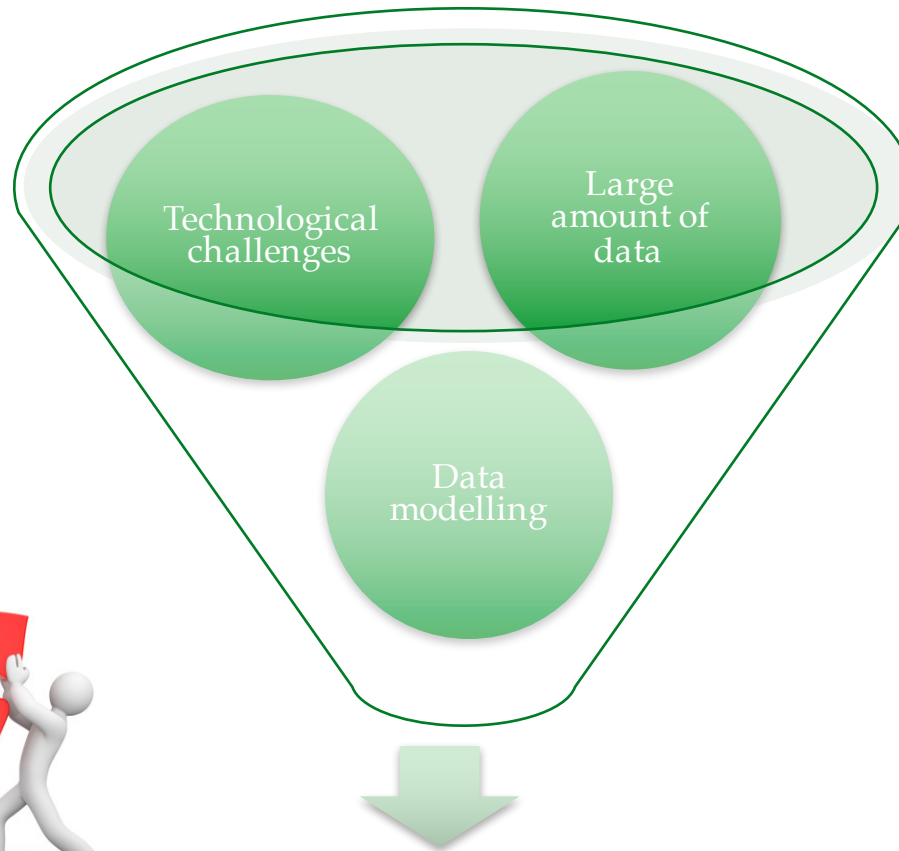
### **Written documentation**

- TED Documentation access database, since 2007 (protocol-, locus- & wall lists)
- Scans of inventories of Pottery and small finds (complete)

### **Other**

- Spreadsheets: C14 measurements
- Geophysical surveys (geo-magnetic and geo-physics)
- GPS-plans
- Various maps
- Illustrator files: reconstruction drawings

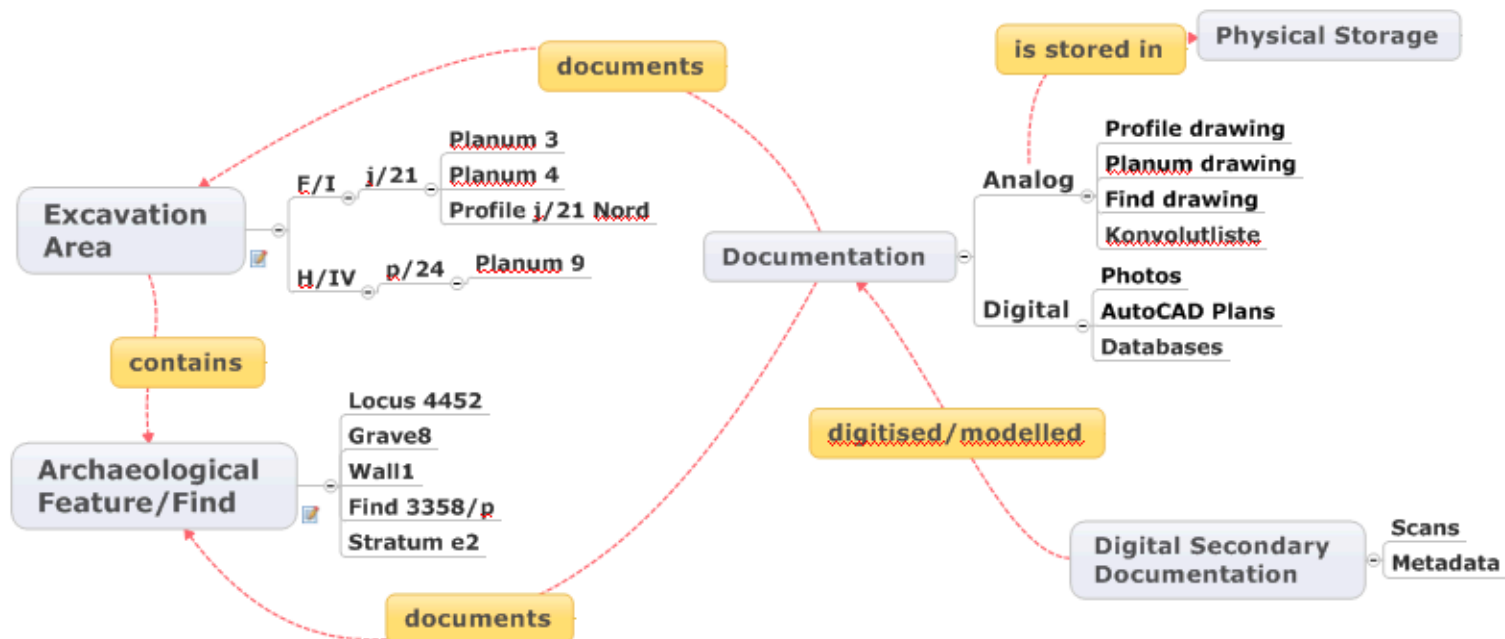
# Challenges



**Homogeneous documentation**

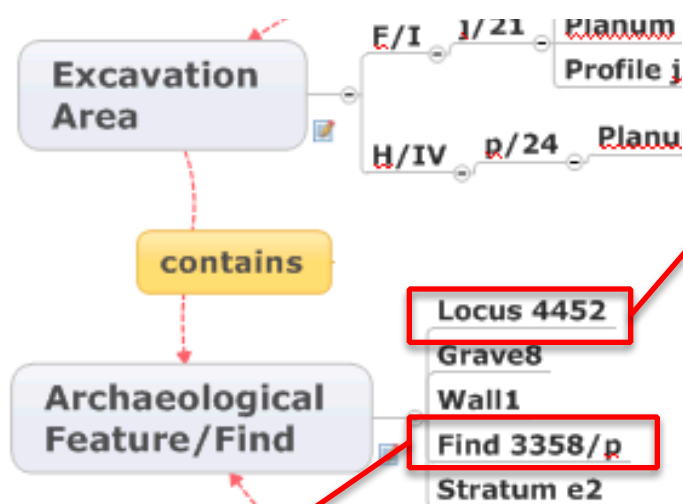
# Data model: CIDOC CRM

- What questions do we want to answer with Metadata created from analog sources?
  - All documents of a specific **excavation area** – or **archaeological feature/find types** (grave, wall, vase, ....) – or specific **archaeological features/finds** (e.g. grave 5 in area Area F/1)
  - All **archaeological features/finds** of a specific **type** in an **excavation area** (all graves



# Integration of Digital Sources

## Locus Databases



Locus ID	Type	Description
Nummer	Kategorie	Beschreibung
L6153	Schicht	Sandschicht, darauf Steinsplitter, ver
L6154	Schicht	Füllschutt, Lehmziegel, in Innenraum
L6155	Grube	flache Grube, schneidet in L6035 ein,
L6156	Grube	Grube, tief, mit Lehm gefüllt, Tonsch
L6157	Grube	Grube gerundet rechteckig, NNO-SS
L6159	Treppe	Gestuckte Treppe, führte von L6106
L6160	Raum	Gestuckter Boden, nördlich der Trep

## Inventory Database

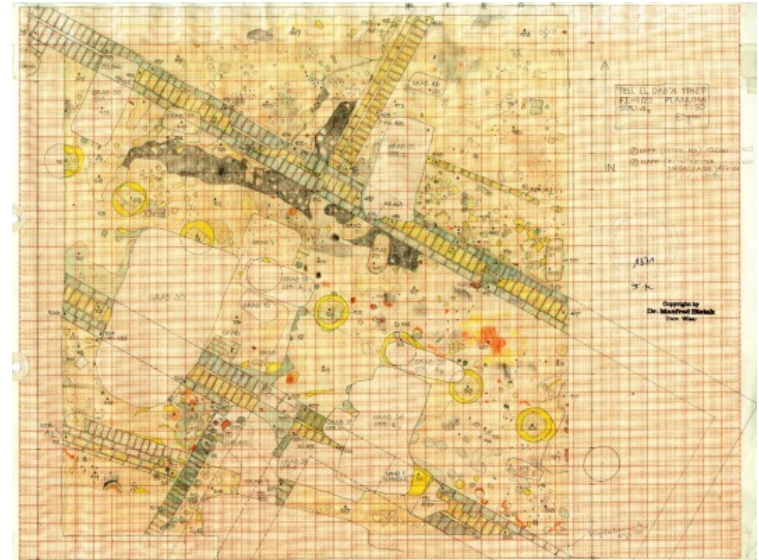
INVNR	PHOTO	AREA	PL	GL	FINDNR	DA1	TYPE	ZN	WA	FAB	FEINI	TECH	BODEI	BR	HA	MI	HD
0178	2783/05	AII-I12		2	bur 3	E1	TEY krug	66/034	SPI	Id	f	W2	W gef	re	3	2.8	1.2
0179		AII-I12		2	bur 3	E1	TEY krug	66/036	SPI	Id	f	W2	W gef	re	3	2.7	1.2
0180	2783/06	AII-I12		2	bur 3	E1	TEY krug	66/034	SPI	Id	vf	W2	W gef	re	3	2.7	1.3
0181	2783/07	AII-I12		2	bur 3	E1	TEY krug	66/034	SPI	Id	f	W2	W gef	re	3	2.8	1.3
0182	2783/08	AII-I12		2	bur 3	E1	TEY krug	66/034	SPI	Id	f	W2	W gef	re	3	2.8	1.3
0183	2783/09	AII-I12		2	bur 3	E1	TEY krug	66/034	SPI	Id	vf	W2	W gef	re	3	2.7	1.4
0184	2783/10	AII-I12		2	bur 3	E1	TEY krug	66/039	SPI	Id	f	W2	W gef	re	3	2.75	1.2



# Metadata entry

## Excel Sheets

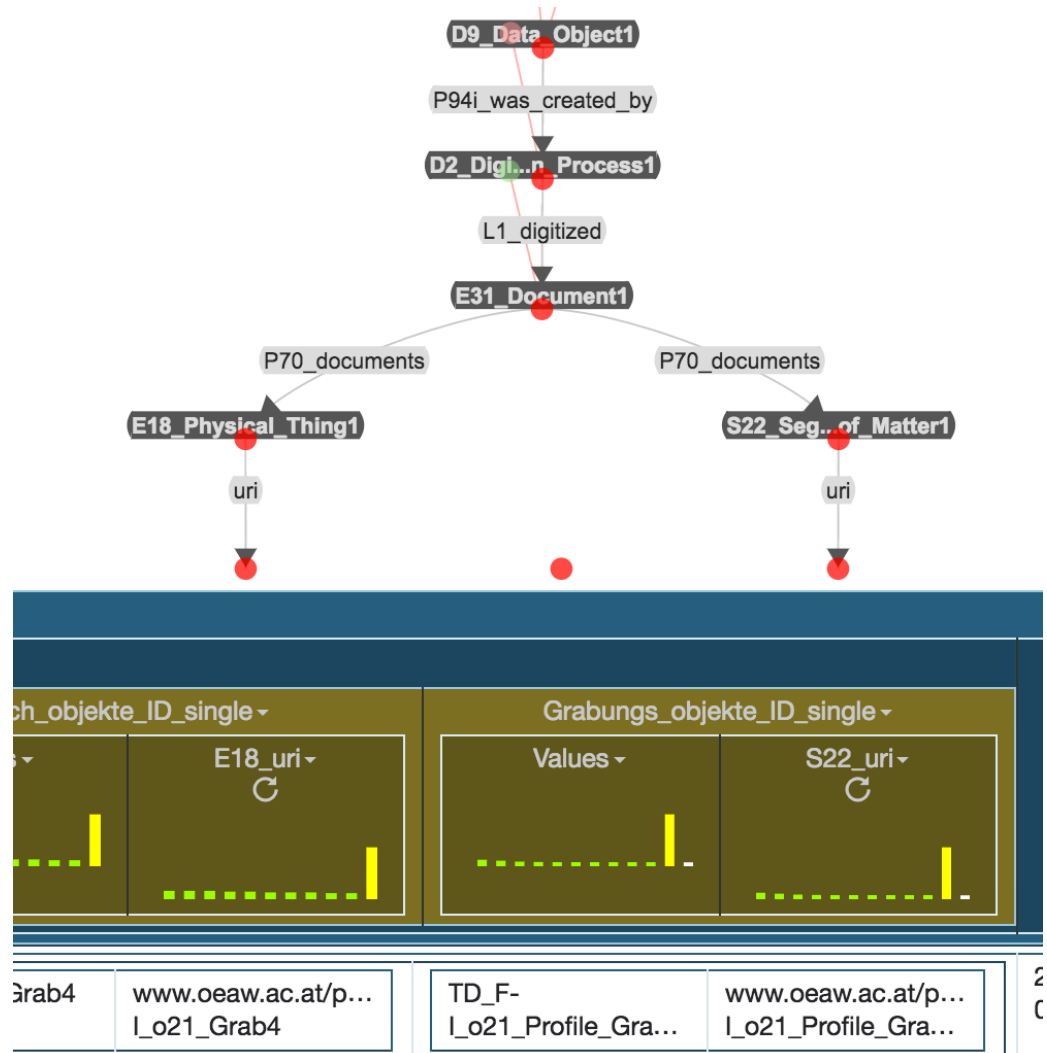
- Excel with workflow to allow 1:n relations
- Controlled vocabularies (Identifiers & Terms)
- Field drawings, photos
- Identifiers, hierarchies, terms for Excavation Areas
- Identifiers & terms Archaeological Features/ Finds



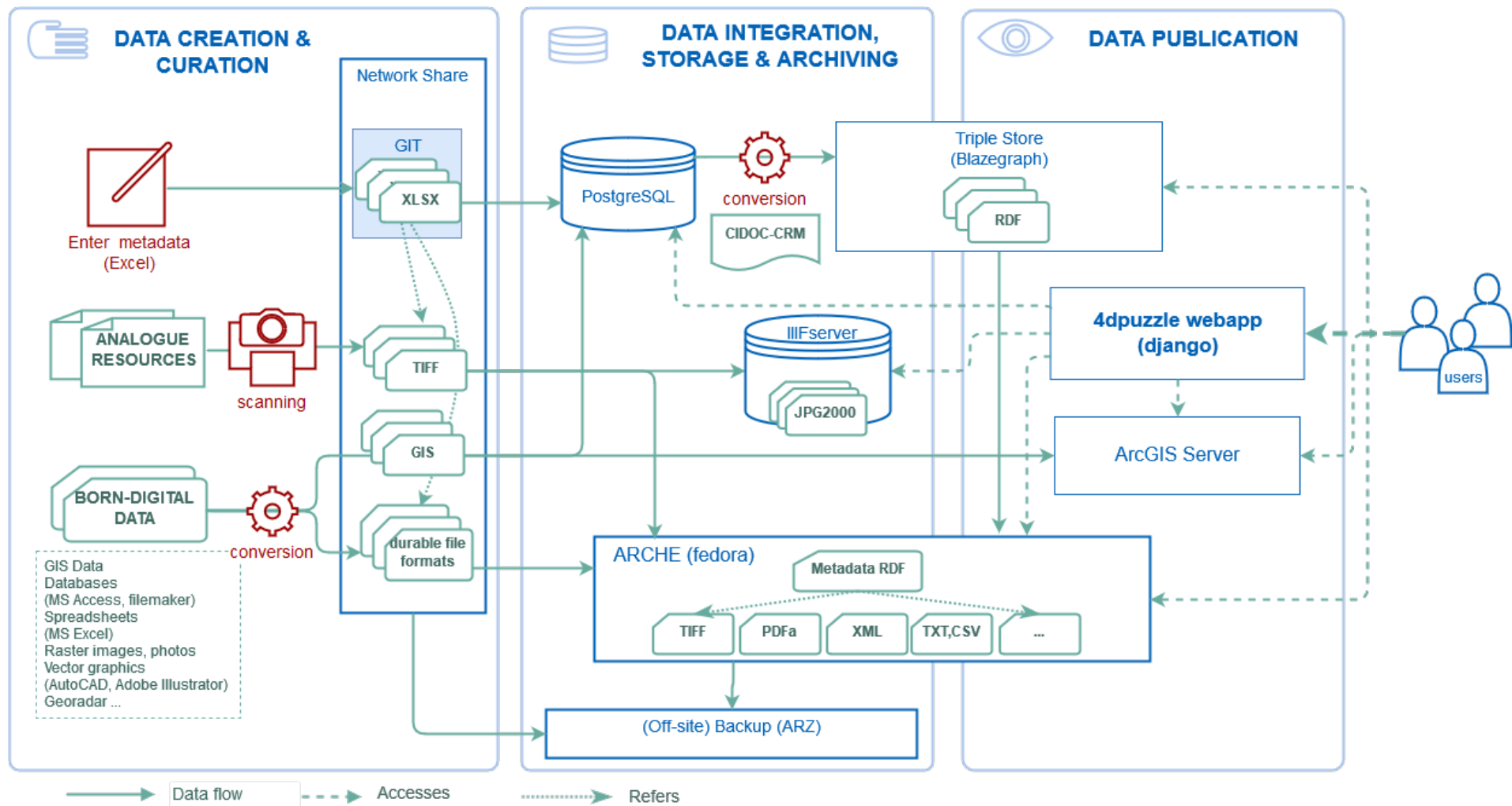
Filename	Document_ID	Excavation_area_ID	Arch_object_ID
TD_FZ_1030__TD_F-I_j;TD_FZ_1030			TD_F-I_j21_Grab4
TD_FZ_1029__TD_F-I_j;TD_FZ_1029		TD_F-I_j21_Planum2_1979 TD_F-I	TD_F-I_j21_Grab8
TD_FZ_1070__TD_F-I_j;TD_FZ_1070		TD_F-I_j21_Planum2_1979 TD_F-I	TD_F-I_j21_Grab8
TD_FZ_1083__TD_F-I_j;TD_FZ_1083		TD_F-I_j21_Planum2_1979 TD_F-I	TD_F-I_j21_Grab8
TD_FZ_1071__TD_F-I_j;TD_FZ_1071		TD_F-I_j21_Planum3_1980	TD_F-I_j21_Grab9 TD_F-

# Metadata/digital data conversion

- Transform Excel / digital data(databases) to CIDOC CRM and extensions using Karma tool
- Integrate data of different sources (Field Drawings, Fotos, Controlled Vocabularies, Archiving System,...)
- Ingest into **triple store** and / or to the **repository**



# Architecture



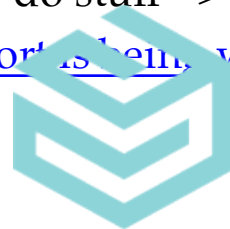
# Repository - ARCHE

<https://arche.acdh.oeaw.ac.at>

- Based on Fedora 4
- Major changes between Fedora 3 and 4

**Functionality** (See also [Features list](#), especially [External Content](#))

- Restful API on Resource URIs (Paths)
- (Create / Read / Update / Delete) = LDP
- Tombstones (Deleted resources keep their PATHS)
- Versioning (/fcr:versions) and Memento to come
- Authorization - WebACL
- Atomic Batch Operations = TX (start / do stuff --> commit / rollback)
- No native user interface ([Islandora port system worked on](#))



**ARCHE**  
*beta*



# Frontend prototype

<https://4dpuzzle.orea.oeaw.ac.at>



## Online GIS

### A Puzzle in 4D - Tell el-Daba

The project A Puzzle in 4D aims to provide digital long-term preservation for the rich archaeological resources of the Austria Egypt. Since 1966, Austrian excavations took place at Tell el-Daba (TD) in Egypt, an archaeological site revealing evidence from of the eastern Mediterranean dating to the 12th to 18th dynasties (early second millennium BC). After 50 years of fieldwork (Austrian Academy of Sciences) contains a huge and heterogeneous resource of digital and non-digital photographs, plans,



In the A Puzzle in 4D project we prepare excavations for digital long-term preservation analysis based on international standards made available open access online for >

The project is a case study for the archaeological data at the ÖAW ACDH (Austrian Center for Digital Humanities)

On this website you will find Information



## Operationale Layer

☒ TD\_FI\_j21\_Phases ...☒ Phase\_TD\_A ...☒ Phase\_TD\_E1-D2 ...☒ Phase\_TD\_E2 ...☒ Phase\_TD\_E3 ...☒ Phase\_TD\_F ...☒ Phase\_TD\_G3-1 ...☒ Phase\_TD\_G4 ...☒ Phase\_TD\_H ...☒ Phase\_TD\_N ...☐ TD\_FI\_j21\_Photoshopped\_areas ...☒ TD\_FI\_Excavation\_objects ...☐ TD\_FI\_j21\_digitised\_Archaeological\_features ...☒ TD\_FI\_j21\_Field\_drawings ...☒ World Topographic Map ...☐ Satellite image view

(1 von 14)

## Information\_points\_TD\_E3

## Oven

During this phase a series of ovens were constructed against the eastern wall of an earlier "Totenhaus." It was constructed of mud and protected at the outside with mud bricks and mud-brick fragments to preserve the heat. The inner mud core was fired due to cooking activities. A small bench to its south was maybe used as a work or storage surface. Finds of bronze moulds close by indicate that these ovens occasionally were also used as smelting furnaces.

Phase\_ID TD\_E3  
Stratum\_ID TD\_F-I\_b2

[Zoomen auf](#)

0 1 2m

31,818 30,788 Grad

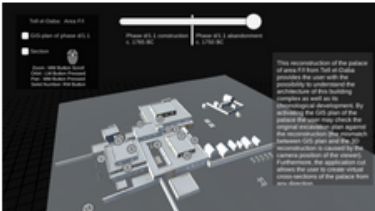
## Wooden reconstruction of Tell el-Daba F/I palace



This scan shows a wooden model of the palace of area F/I, which was produced for the exhibition "Pharaonen und Fremde" at the Vienna city hall in 1994. The model is based on the field documentation of this building, which was excavated between 1979 and 1989. It shows the palace of area F/I in its final stage, just before this building was abandoned.

Explore More

## Phase Model of Tell el-Daba F/I palace



Loading the application could take a few minutes, depending on your internet access. If your browser has not enough memory, please close all other tabs of your browser, restart it and reload the application.

Internet Explorer is not supported.

This reconstruction of the palace of area F/I from Tell el-Daba provides the user with the possibility to understand the architecture of this building complex as well as its chronological development.

Explore More

## Walkthrough Tell el-Daba F/I palace



Loading the application could take a few minutes, depending on your internet access. If your browser has not enough memory, please close all other tabs of your browser, restart it and reload the application.

Internet Explorer is not supported.

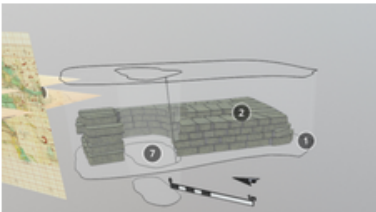
**Navigation**  
**First Person Mode:** Navigate with the arrow keys or the letter keys W, S, A, D to move and use the mouse to look around.

**Fly Mode:** Use the left mouse button to orbit and the mouse wheel to zoom in and out.

**Flood Terrain:** Click to see the Nile flood.

Explore More

## Virtual reconstructions of tombs and a cellar

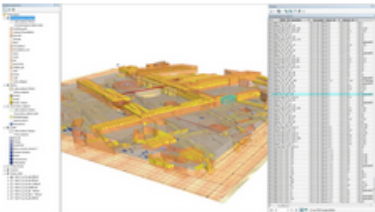


The 3d models will be completed October 2017.

Two tombs and a cellar have been reconstructed using field drawings, protocols and photos. Each reconstruction shows the field documentation, a reconstruction of the in situ evidence (i.e. how it looked like when found at excavation) and an idealised reconstruction (how it may originally have looked like).

Explore More

## 3D GIS online

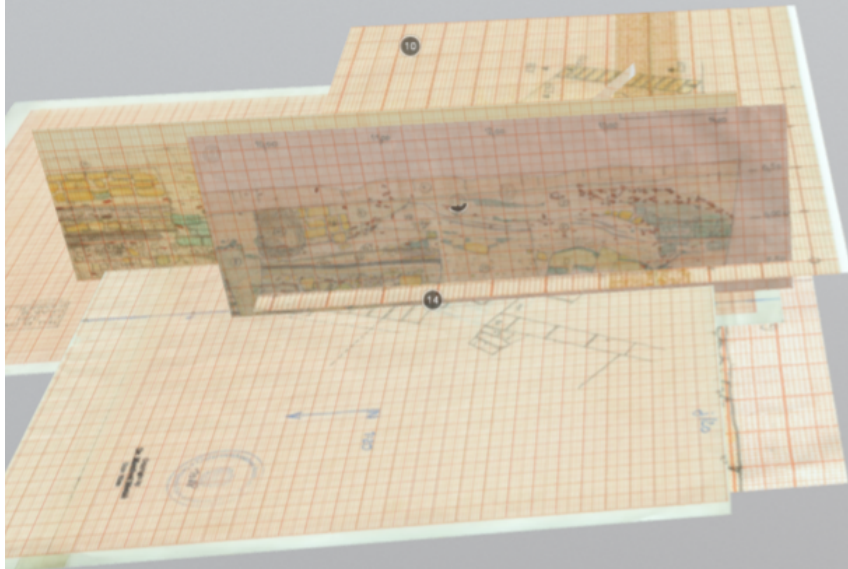


The 3D GIS will be completed January 2018.

The 3D GIS will show a reconstruction of the complex layers of archaeological objects of area F/I, square trench j/12.

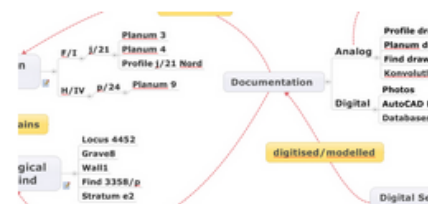
Explore More



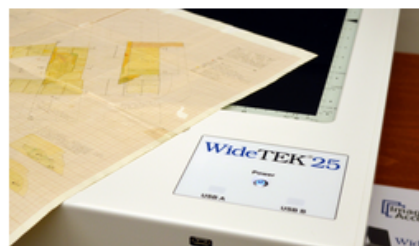




## Creation of the digital archive



**Figure 1:** Main categories of physical reality, documentation and digitizing processes.



**Figure 2:** Scanning over-sized plans. (© copyright ÖAW/ACDH)

The TD archive at OREA holds a large quantity of analogue and digital resources which document the process of archaeological fieldwork and the archaeological discoveries that were made. For the digital archiving of these resources, we had to create a data model that represents the relationships between the information in the analogue and digital documentation, the actual archaeological evidence, the process of excavating this evidence and, of course, of us digitizing and processing the resources (**Fig 1**). We have used an ontology to represent this complex network of information.

The CIDOC CRM ontology is an ISO standard for cultural heritage documentation. Using this ontology does not only allow us to create the complex relationships that we need for our data model, but it also enables the data to be encoded in a machine-readable format. This is important if other computers want to access the information from the TD archive.

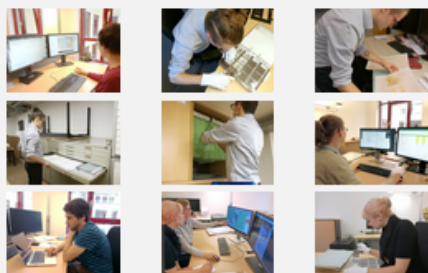
The preparation of the analogue resources for digital long-term preservation includes the digitization of resources, for example the scanning of paper records such as field drawings and the creation of metadata for the scan (**Fig 2**). Metadata can be information about the content depicted or described on the analogue resources, characteristics of the information carriers and/or information on the digitisation process. Depending on the future use of the digitised resources a set of Metadata is defined and presented in a standardized way, in our case the organisation of the metadata follows the standards set by the CIDOC CRM ontology. Typical metadata records in the A Puzzle in 4D for a digitised photo of a find are for example the inventory number of the find, the date when the photo was made and information about the scanning. The metadata about the finds include information about the type of find, the dating of the find and the find spot. The relationships that we have created between the different types of metadata allow a complex querying of the archive.

When the files are ready for long-term preservation, they will be imported into the data repository ARCHE. ARCHE is the data archive that is currently set up at the ÖAW ACDH.

For more information on our data model, the use of CIDOC CRM, the digitization workflow and the system architecture please continue reading here:

- [Metadata and semantic enrichment](#)
- [Digitisation of Tell el-Daba resources](#)
- [Data integration, storage, archiving and open access](#)

### Image Gallery



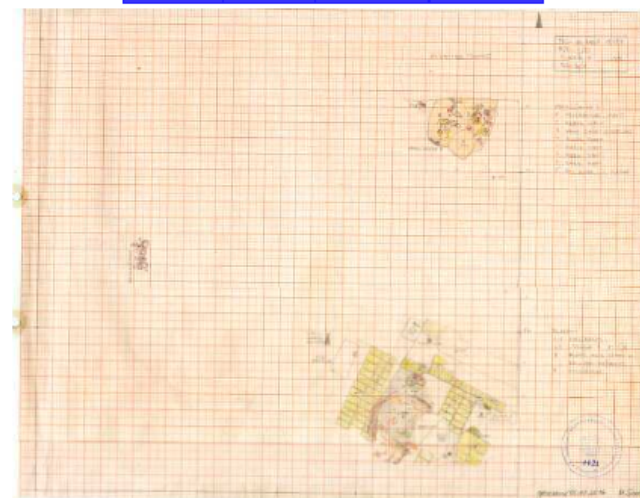


## field drawing: TD\_FZ\_1026



document id ⓘ	TD_FZ_1026
document type ⓘ	Feldzeichnung
document subtype ⓘ	Planum
scan	<a href="https://4dpuzzle-iiif.acdh.oeaw.ac.at/TD_FZ_1026__TD_F-I_j21_Planum1/info.json">https://4dpuzzle-iiif.acdh.oeaw.ac.at/TD_FZ_1026__TD_F-I_j21_Planum1/info.json</a>
site ⓘ	TD
area ⓘ	F-I
square trench ⓘ	j21
planum ⓘ	1
perspective of drawing	
stratum comment ⓘ	
drawn by	
year	1979
season	H
month	
scale	1:50
paper type	Millimeterpapier
archaeological object ⓘ	
excavation object ⓘ	<a href="#">TD_F-I_j21_Planum1</a>

Zoom In Default Zoom Out Full Screen



download





## Next Steps

- **Analysis and modelling of digital resources**
- **Monitoring of digitisation workflow for selection/prioritisation of analog resources to digitise**
- **Quality control**
- **Further develop front end user interface to include more resources and enhance query capabilities**
- **Create online 3D viewer**

**Thank you for your attention!**

