DESIGNSAFE-CI

A NATURAL HAZARDS ENGINEERING COMMUNITY

The Next Generation CI for the Natural Hazards Community

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Natural Hazard Engineering Research Infrastructure (NHERI)

- National, shared-use research infrastructure to enable transformative research
  - Network Coordinating Office (NCO)
  - Cyberinfrastructure (CI)
  - Seven experimental facilities (EF)
  - Post-disaster, rapid response research facility (RAPID)
  - Computational Modeling and Simulation Center (SimCenter)
- Replaces similar program for earthquake engineering (NEES) but expanded to include windstorms and associated hazards

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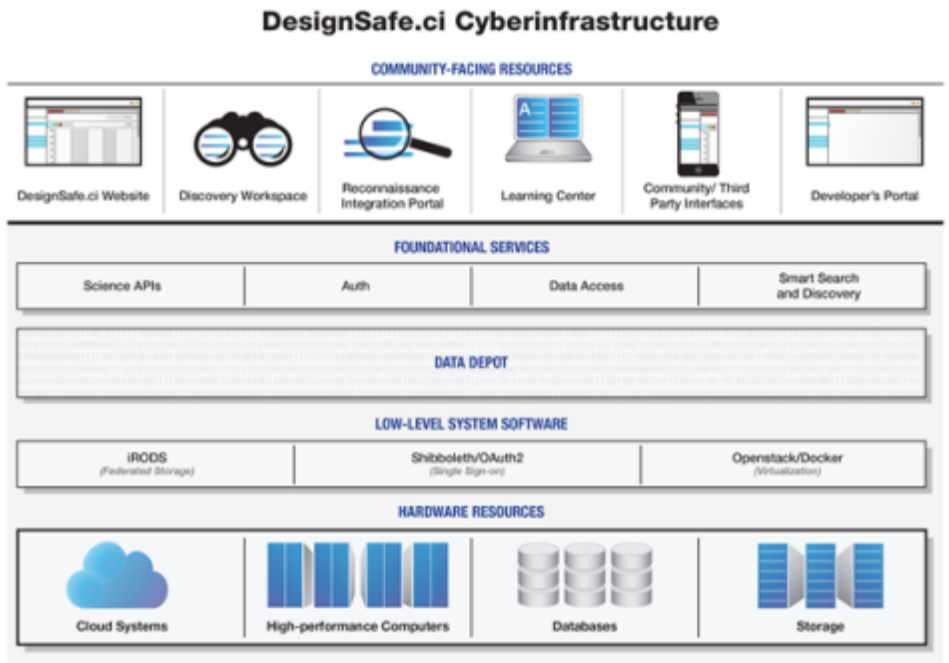
DesignSafe-ci Vision

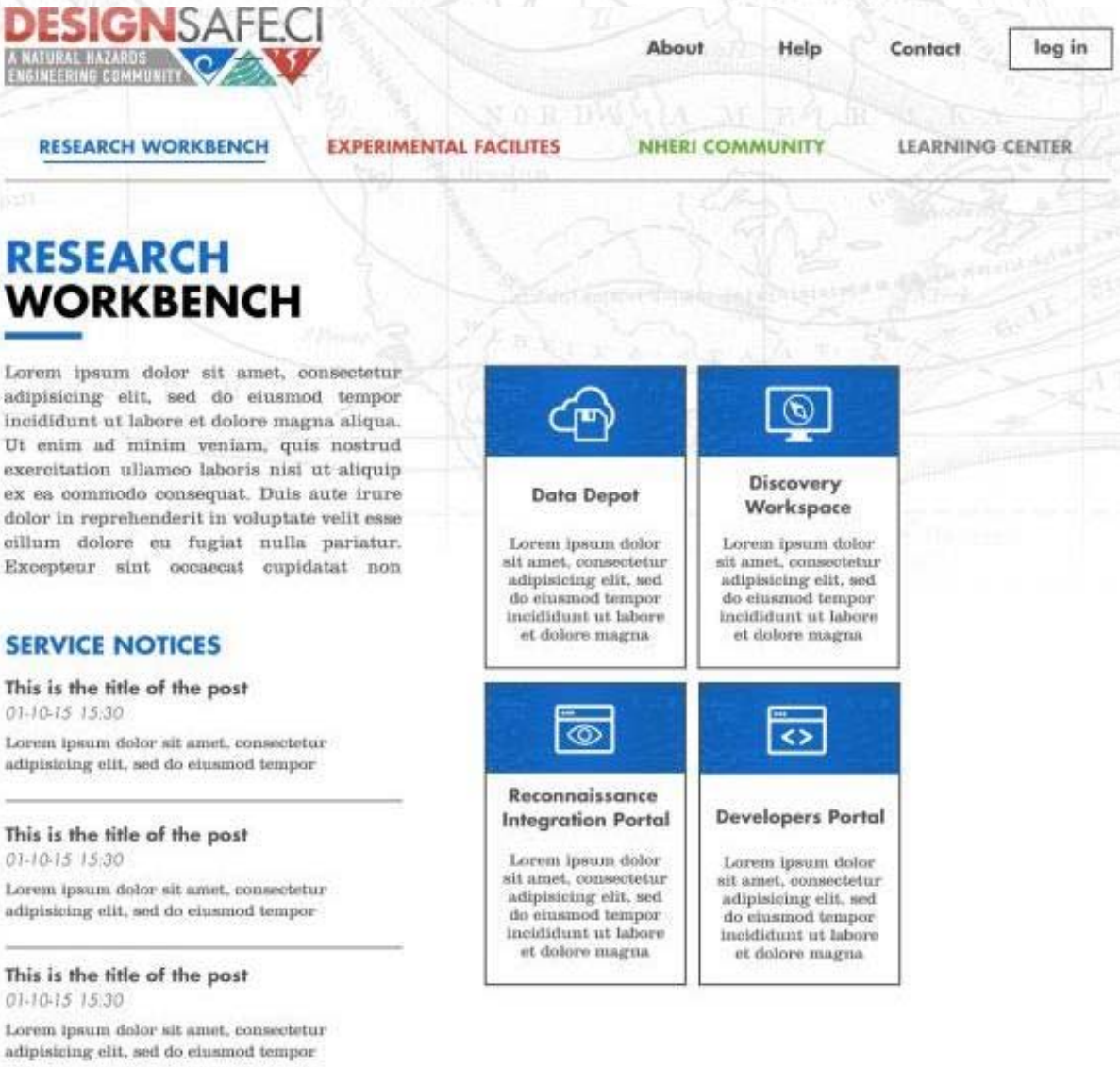
- Provide a CI that becomes an integral and dynamic part of research discovery
- Cloud-based tools that support the analysis, visualization, and integration of diverse data types
  - Key to unlocking the power of “big data”
- Support end-to-end research workflows and the full data lifecycle
- Enhance, amplify, and link the capabilities of the other NHERI components

DesignSafe-ci Components

- Web Portal
- Data Depot
- Discovery Workspace
- Reconnaissance Integration Portal
- Developer's Portal
- Learning Center



DesignSafe-ci Web Portal



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NHERI COMMUNITY

Find here the latest news and highlights on important natural hazards research discoveries and NHERI program announcements including upcoming meetings. Resources and collaboration tools for the NHERI community will also be provided here.

News & Features

NSF invests $40 million in research infrastructure for earthquake, wind and water hazards

09-24-15

Experimental facilities and cyberinfrastructure will offer opportunities for natural hazards research to bolster community resilience.

$13.7 Million NSF Grant Creates Natural Hazards Engineering Center at UT Austin

07-21-15

A new cyberinfrastructure effort funded by a $13.7M grant from the NSF will help engineers build safer structures that can better withstand natural hazards.

Cyberinfrastructure Description

A comprehensive environment for experimental, theoretical, and computational engineering and science.

Web Conferencing Service

DesignSafe provides Web Conferencing Services to facilitate your natural hazards engineering collaborations.

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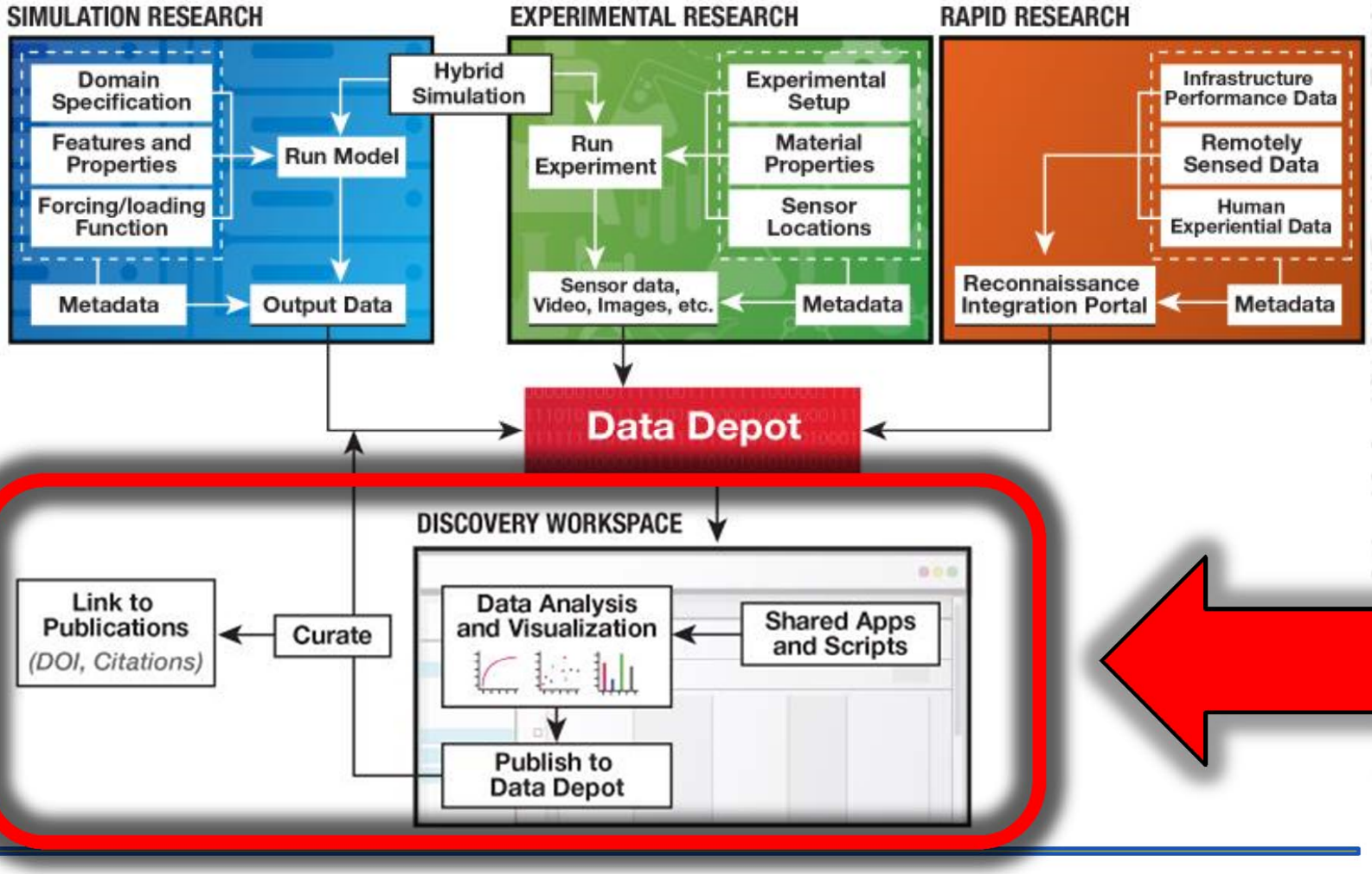
DesignSafe: Enabling Research



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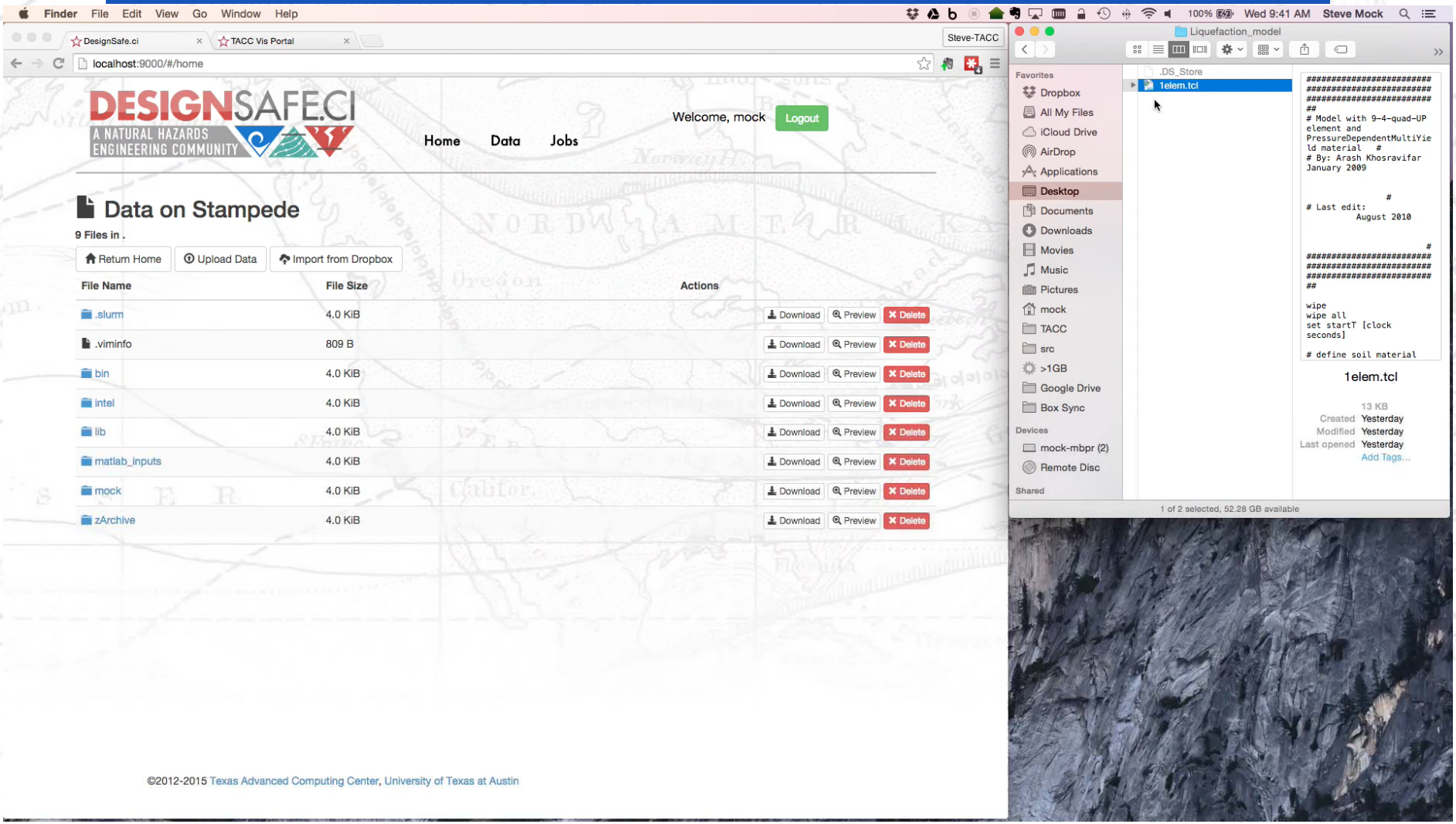

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DesignSafe-ci.org Leadership

Director
Ellen Rathje
Univ. of Texas

Simulation
Clint Dawson
Univ. of Texas

Data
Jean-Paul Pinelli
Florida Inst. Tech.

ECO
Jamie Padgett
Rice Univ.

CI
Dan Stanzione
Univ. of Texas
TACC

TACC
TEXAS ADVANCED COMPUTING CENTER

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TEXAS

TACC RICE Florida Tech

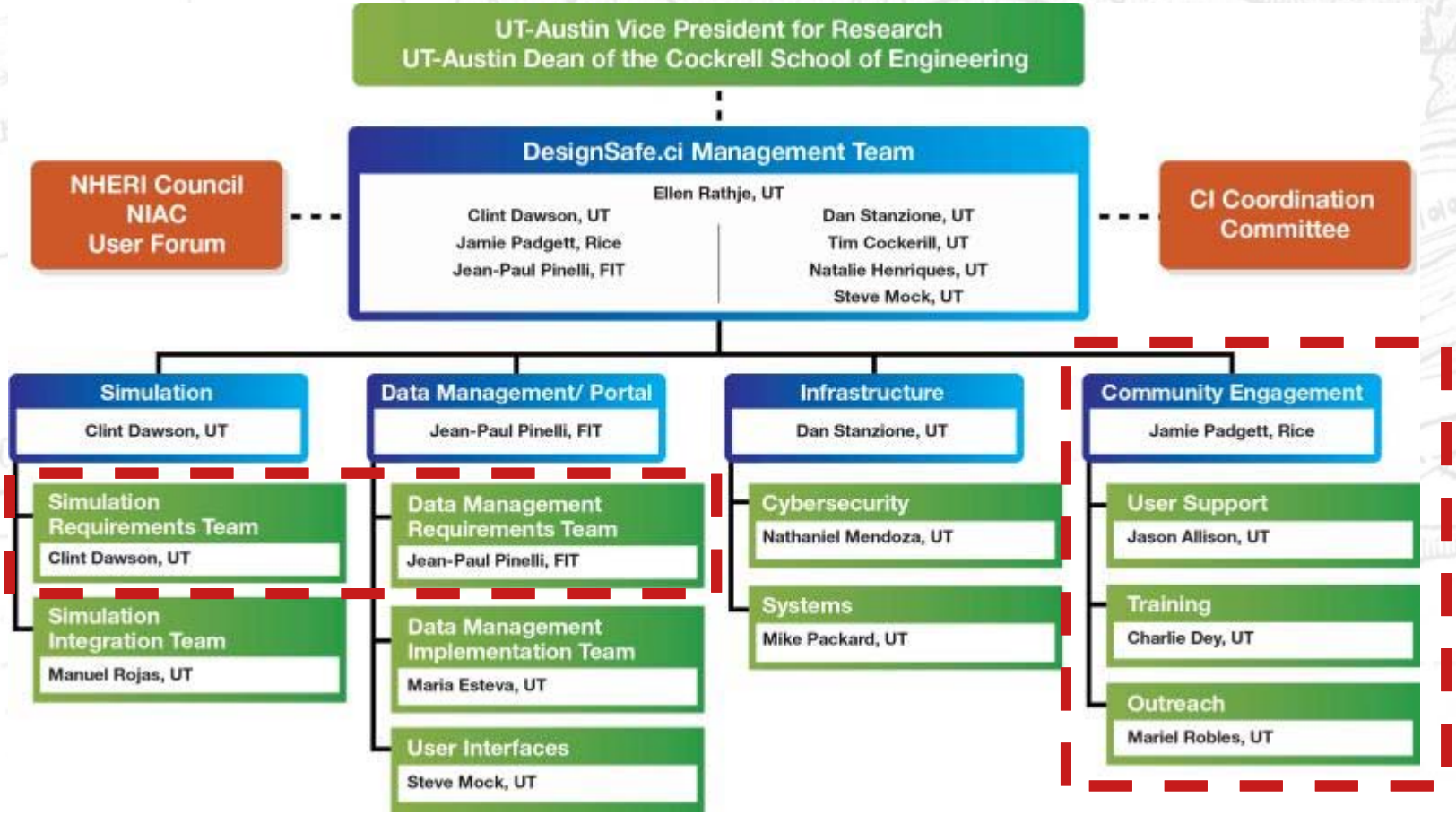
User Requirements

- ***Definition:*** user requirements describe what the **user** expects the software to be able to do
- Identify user requirements
  - Use cases: what do users want to do?
  - Requirements Gathering Workshop
  - Informal discussions
- Prioritize user requirements
- Software developers use the requirements to design the software

User Requirements

Req	User Requirement	DesignSafe.ci Component	Brief Description
1	Facilitate upload by simplifying the data model and the information provided	Data Depot	Flexible data model with enhanced data upload, metadata, etc. for diverse data types
2	Online software and tools for generating data products from raw data	Discovery Workspace	Cloud environment to invoke analytics, visualization, and collaboration tools.
3	More online simulation codes, both open source and commercial codes	Discovery Workspace	Cloud environment to invoke simulation tools.
4	Ability to use and access the data repository via remote software or services (expert user)	Developer's Portal	Information on DesignSafe.ci extensions/APIs, to allow construction of new interfaces and addition of new tools.

DesignSafe-ci Organization



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Simulation and Analytics

- ***Vision:*** Provide access to open source and commercial software within Discovery Workspace and provide a venue to share simulation/analysis results
- Simulation Requirements Team
  - Represents the broad natural hazards community
  - Interact with the larger community to identify user requirements
  - Prioritize user requirements

Simulation Requirements Team

Clint Dawson, Lead (UT) - Water
Pedro Arduino (U. Wash) - EQ
Ahsan Kareem (Notre Dame) - Wind
Laura Lowes (U. Wash) - EQ
Jamie Padgett (Rice) - EQ, Water

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Simulation and Analytics

- Identify initial simulation codes/tools to be deployed
- Access to commercial codes: “Bring Your Own License” (BYOL) approach
- Discovery Workspace will provide mechanism for users to share simulation codes/tools
- Application programming interfaces (APIs) will be available through the Developer’s Portal to develop additional interfaces
- *DesignSafe-ci* Extended Collaborative Support Services (ECSS) can assist users

Data

- ***Vision:*** Allow users to easily store, share, document, and publish the data associated with their research, supporting the full data lifecycle
- Data Requirements Team
  - Represents the broad natural hazards community
  - Interact with the larger community to identify user requirements
  - Prioritize user requirements

Data Management Requirements Team

Jean-Paul Pinelli, Lead (FIT) - Wind
Scott Brandenberg (UCLA) - EQ
Frederick Haan (Rose Hulman) - Wind
Gilberto Mosqueda (UCSD) - EQ
Lorraine Haricombe (UT) - Library Science

- NSF new Proposal Guide (Jan 2016) will require public access of data created as part of NSF projects

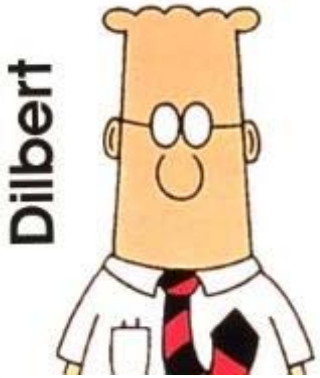
Data Management Philosophy

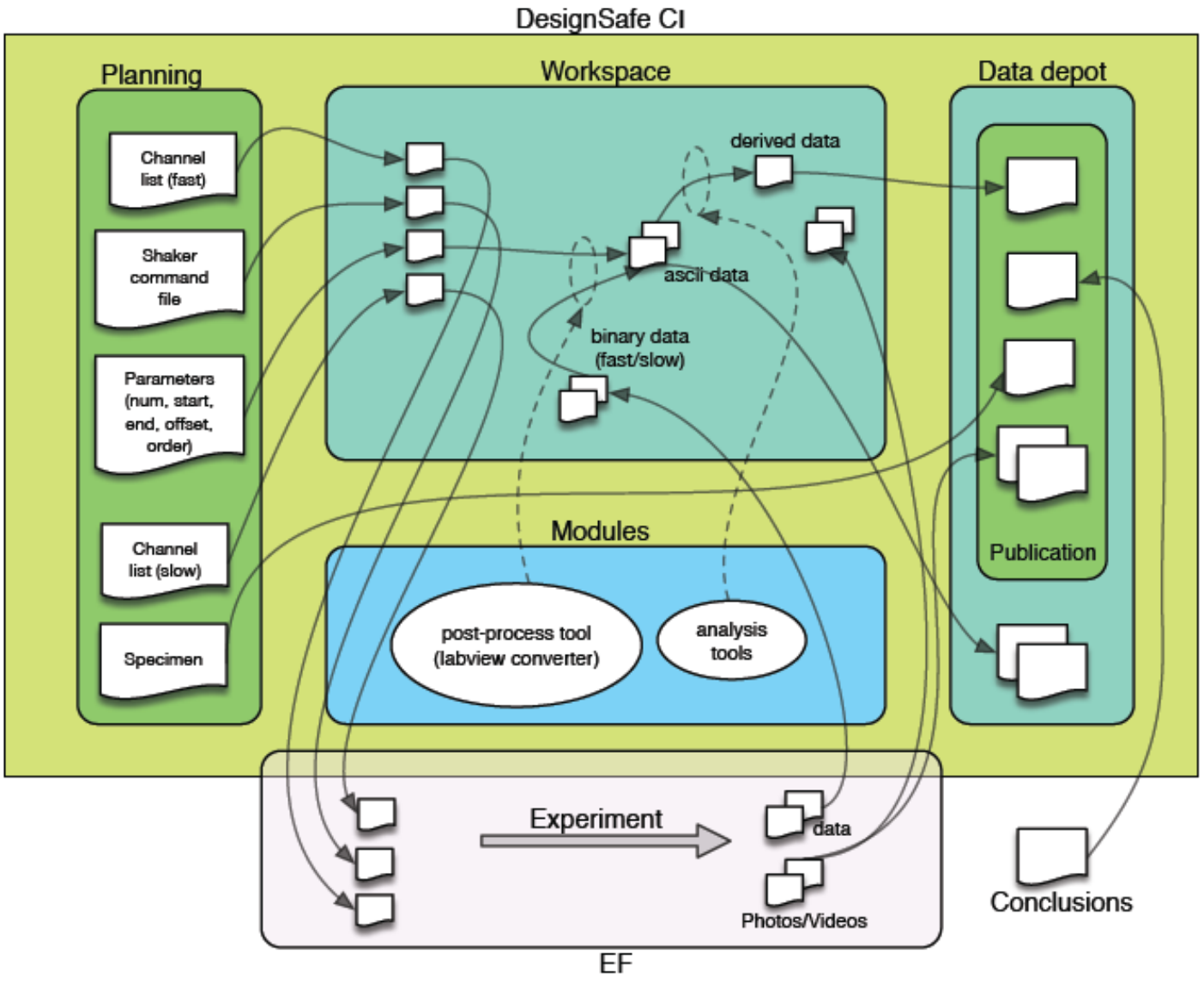
- Progressive curation, integrated with the research lifecycle
- Focus on achieving community's research goals
- Modular data model that supports how researchers organize their data
- Drag and drop upload and cloud import will encourage users to use the Data Depot throughout the data/research lifecycle
- Should not be a burden to researchers
- Work with NHERI awardees to gather data model/metadata requirements

Flexible Data Model

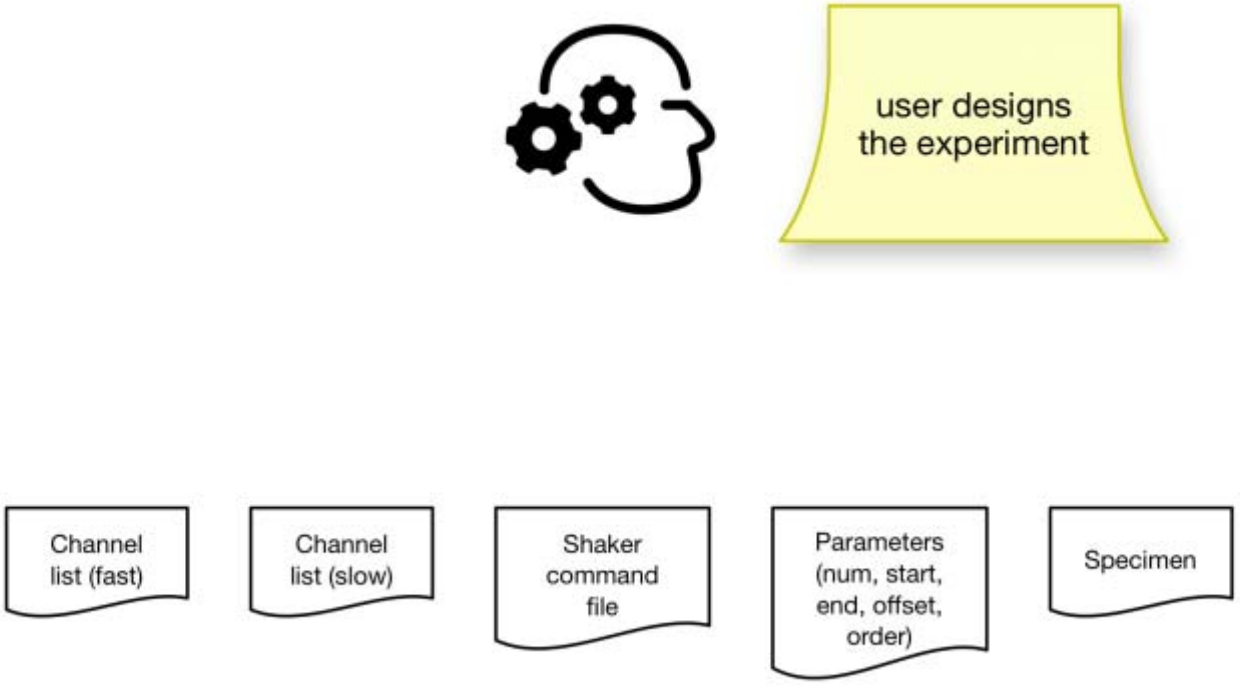
- Represent the structure of research and its functions
- Different metadata for different research functions and domain specific datasets
- With flexibility comes responsibility
  - EF defines standards for their site (data model, organization, metadata requirements) and helps users use the standards appropriately
  - Trust researchers to use the data model and provide the metadata required to document their experiments

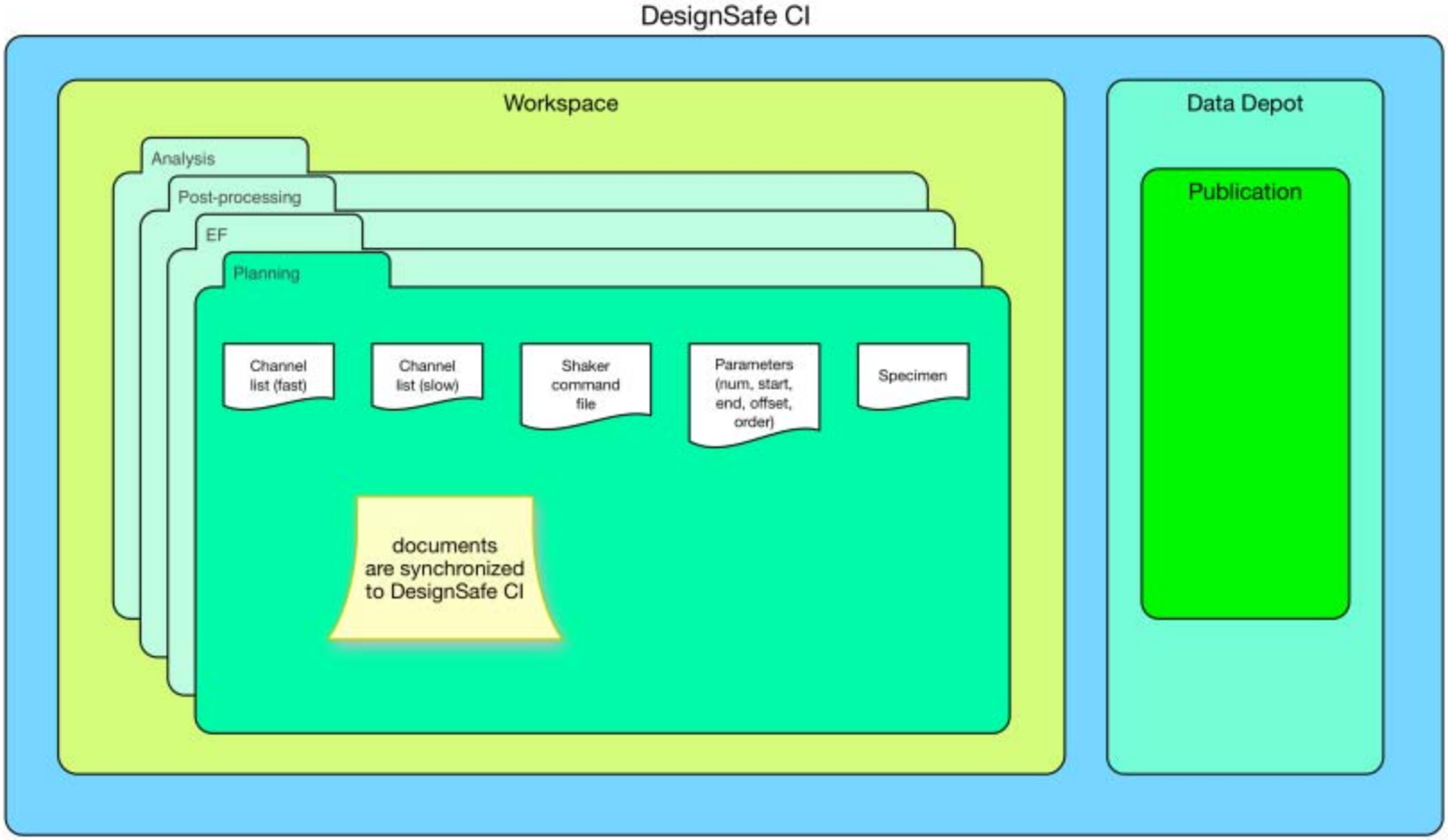
Data Workflow: Dilbert Diagram

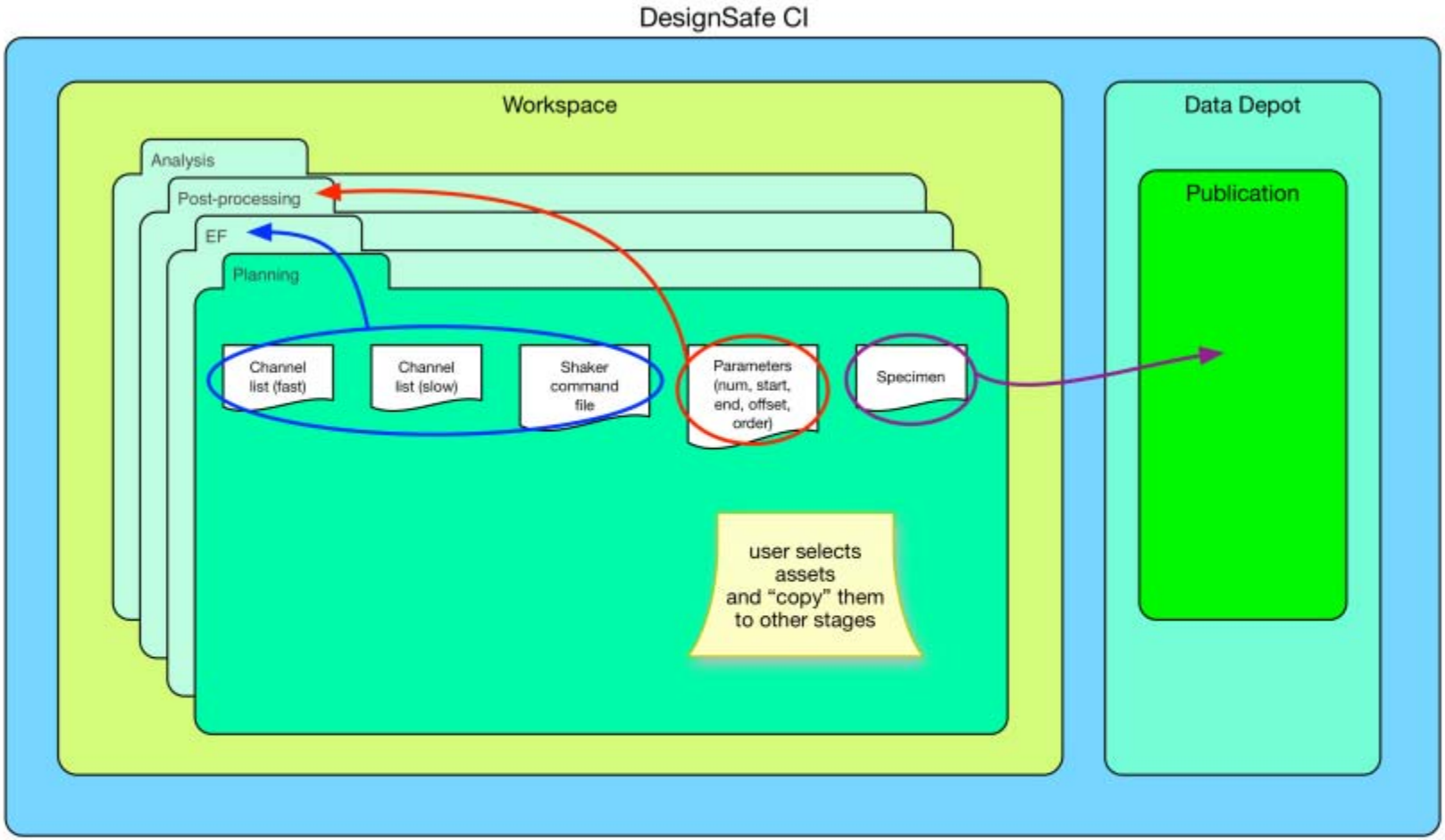


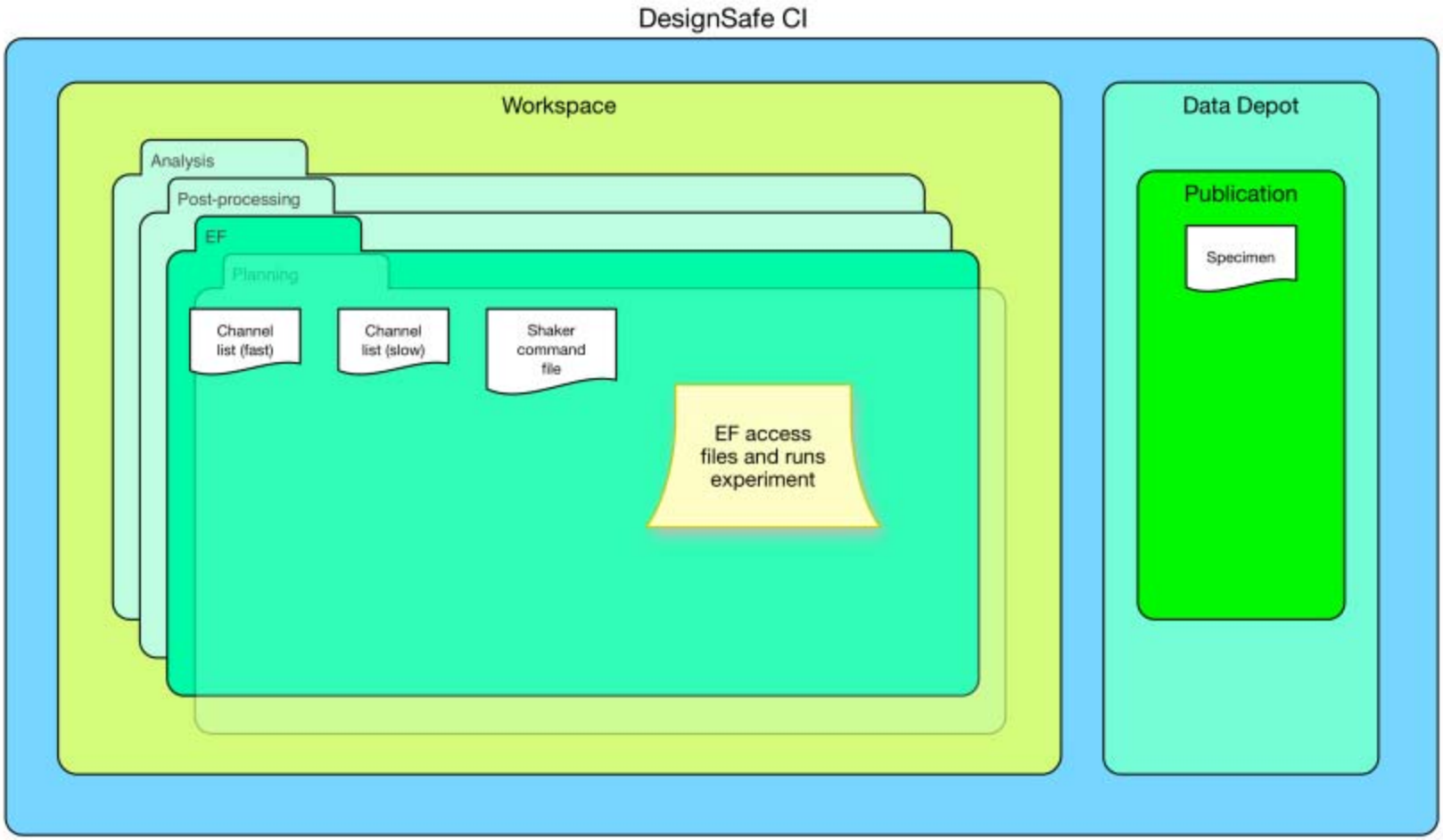


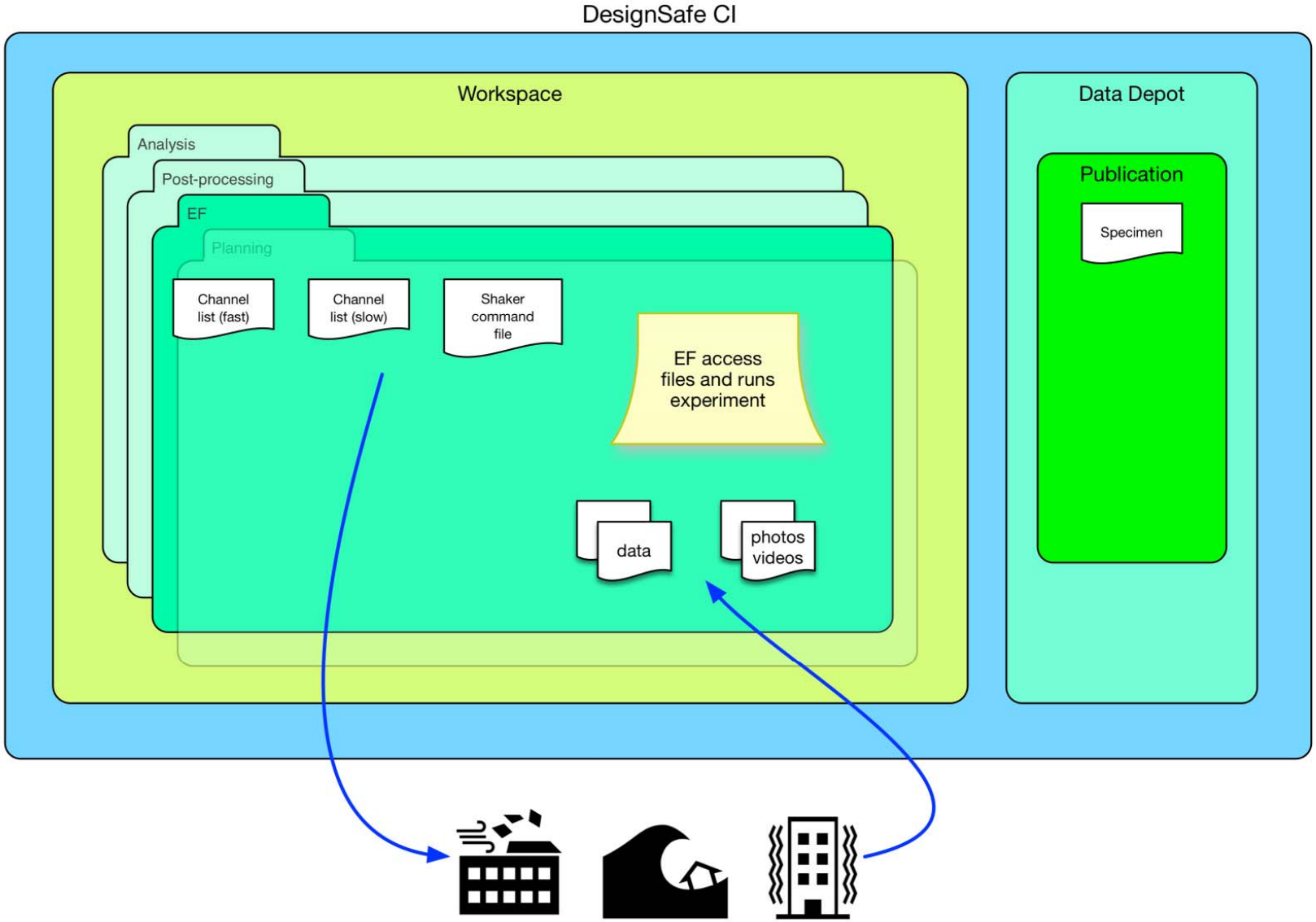
Step-by-step Workflow: Example




DesignSafe CI
Workspace
Analysis
Post-processing
EF
Planning
Channel list (fast)
Channel list (slow)
Shaker command file
Parameters (num, start, end, offset, order)
Specimen
documents are synchronized to DesignSafe CI
Data Depot
Publication


DesignSafe CI
Workspace
Analysis
Post-processing
EF
Planning
Channel list (fast)
Channel list (slow)
Shaker command file
Parameters (num, start, end, offset, order)
Specimen
user selects assets and "copy" them to other stages
Data Depot
Publication


DesignSafe CI
Workspace
Analysis
Post-processing
EF
Planning
Channel list (fast)
Channel list (slow)
Shaker command file
EF access files and runs experiment
Data Depot
Publication
Specimen


DesignSafe CI
Workspace
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Post-processing
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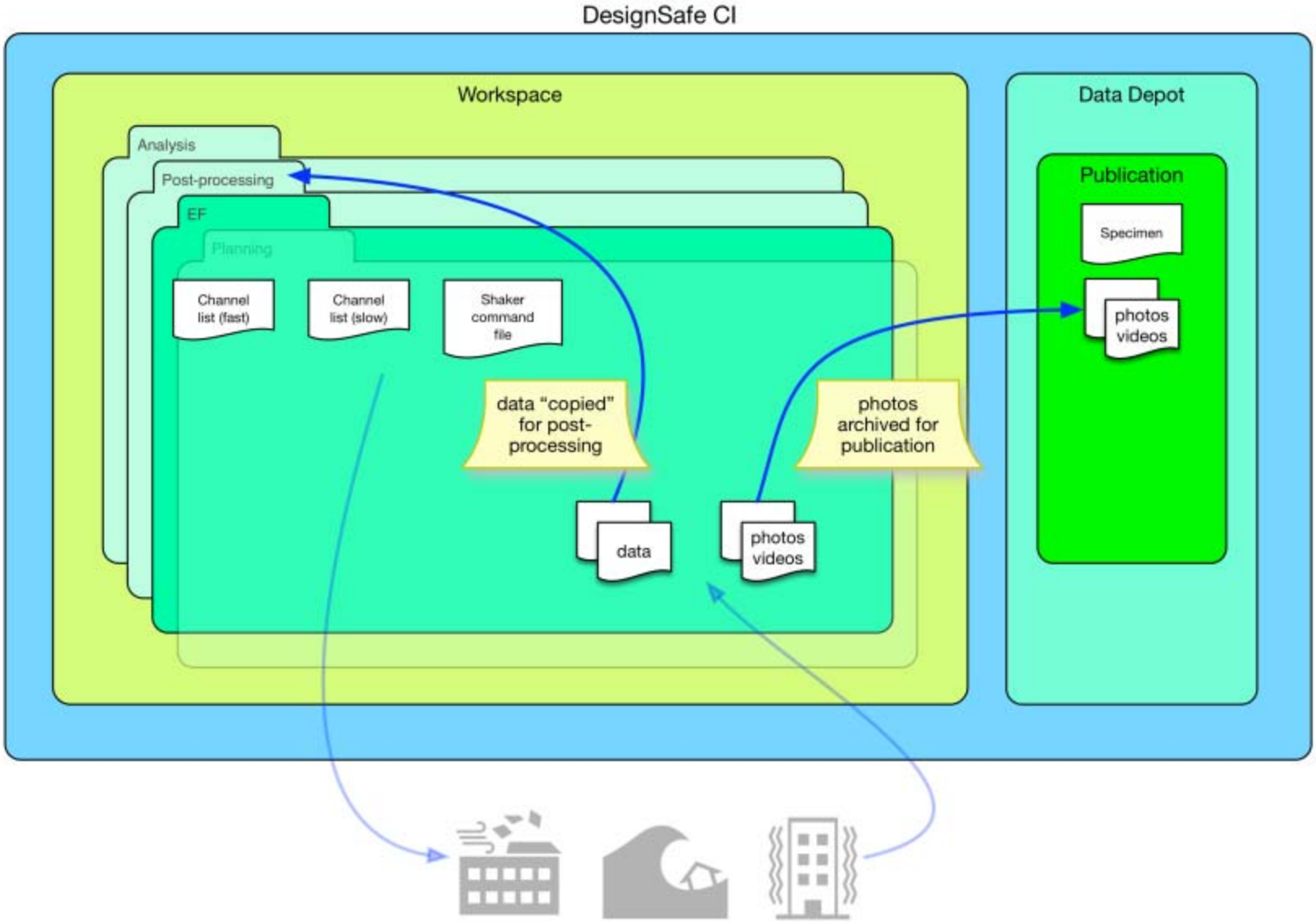
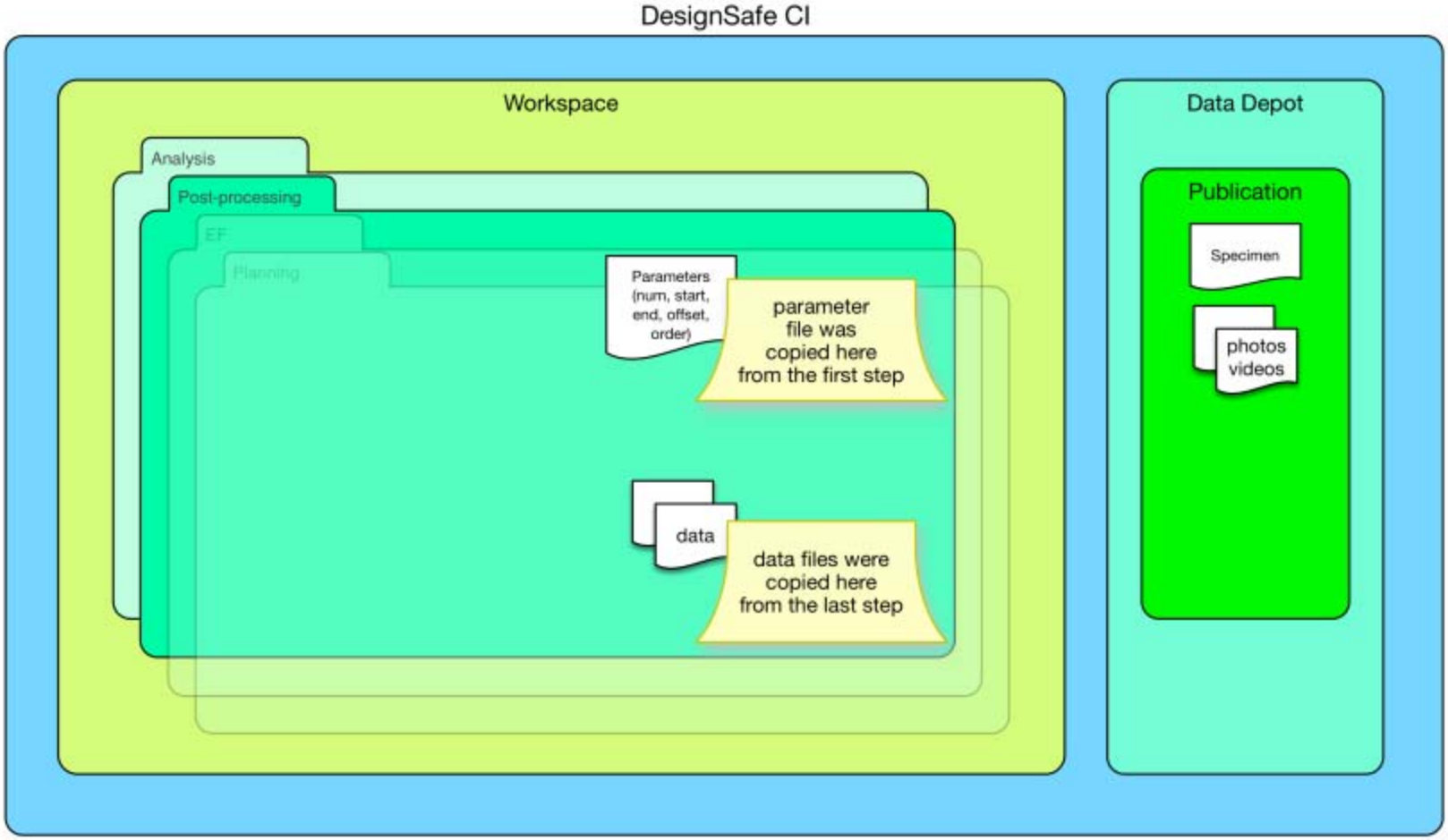
Planning
Channel list (fast)
Channel list (slow)
Shaker command file
EF access files and runs experiment
data
photos videos
Data Depot
Publication
Specimen


DesignSafe CI
Workspace
Analysis
Post-processing
EF
Planning
Channel list (fast)
Channel list (slow)
Shaker command file
data "copied" for post-processing
data
photos videos
photos archived for publication
Data Depot
Publication
Specimen
photos videos


DesignSafe CI
Workspace
Analysis
Post-processing
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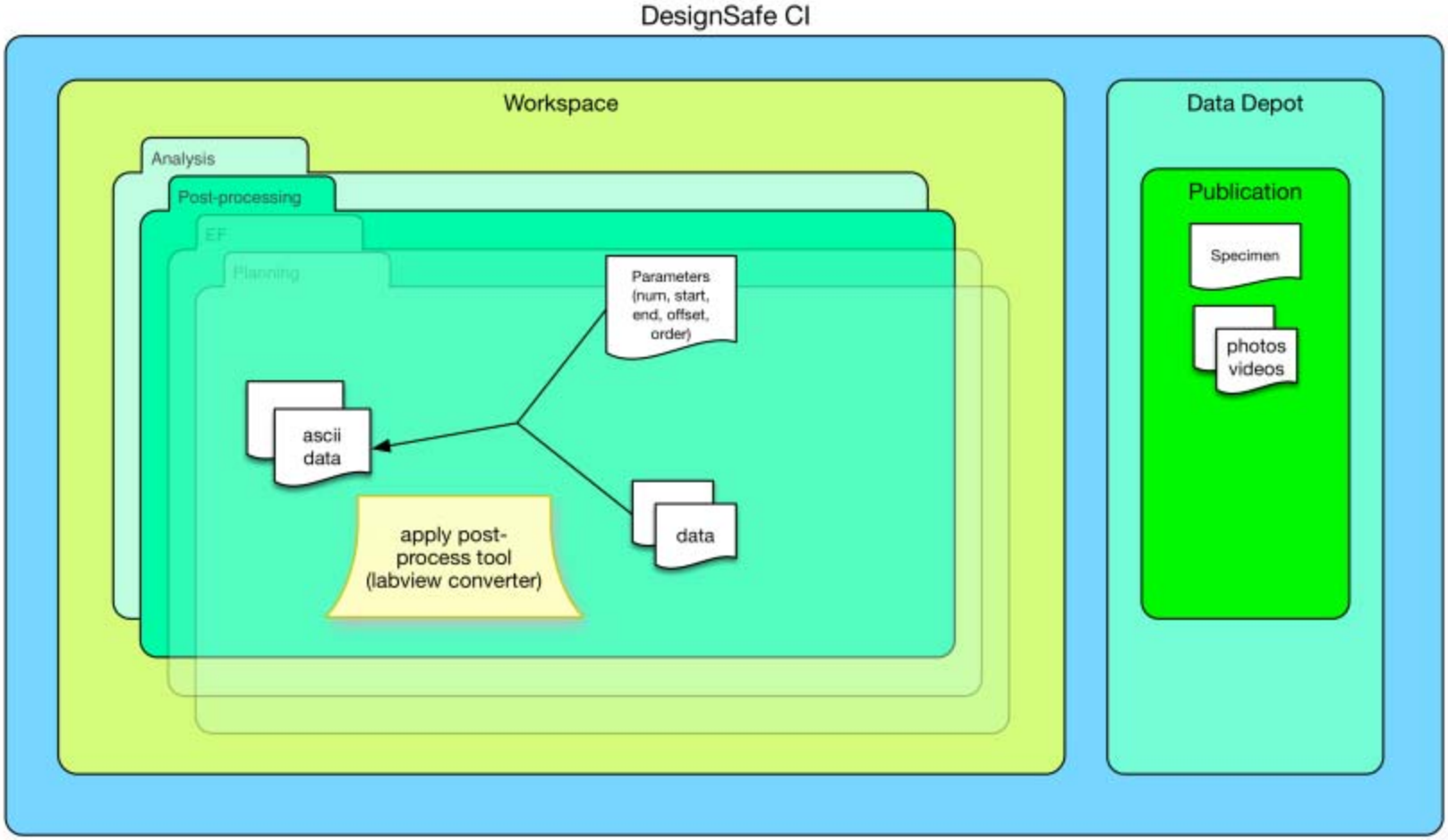
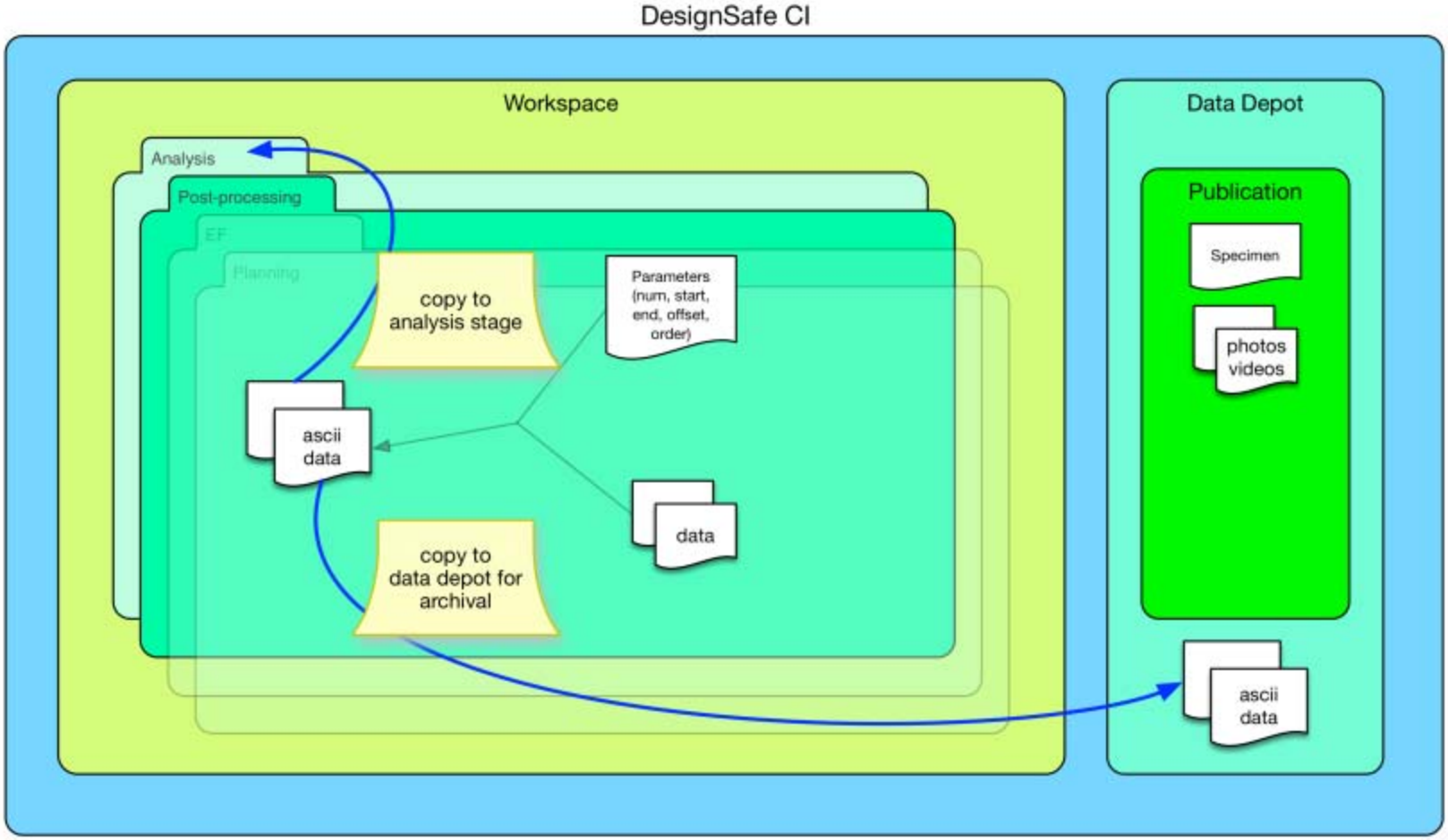
Planning
Parameters (num, start, end, offset, order)
parameter file was copied here from the first step
data
data files were copied here from the last step
Data Depot
Publication
Specimen
photos videos


DesignSafe CI
Workspace
Analysis
Post-processing
EF
Planning
Parameters (num, start, end, offset, order)
ascii data
apply post-process tool (labview converter)
data
Data Depot
Publication
Specimen
photos videos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Workspace
Analysis
Post-processing
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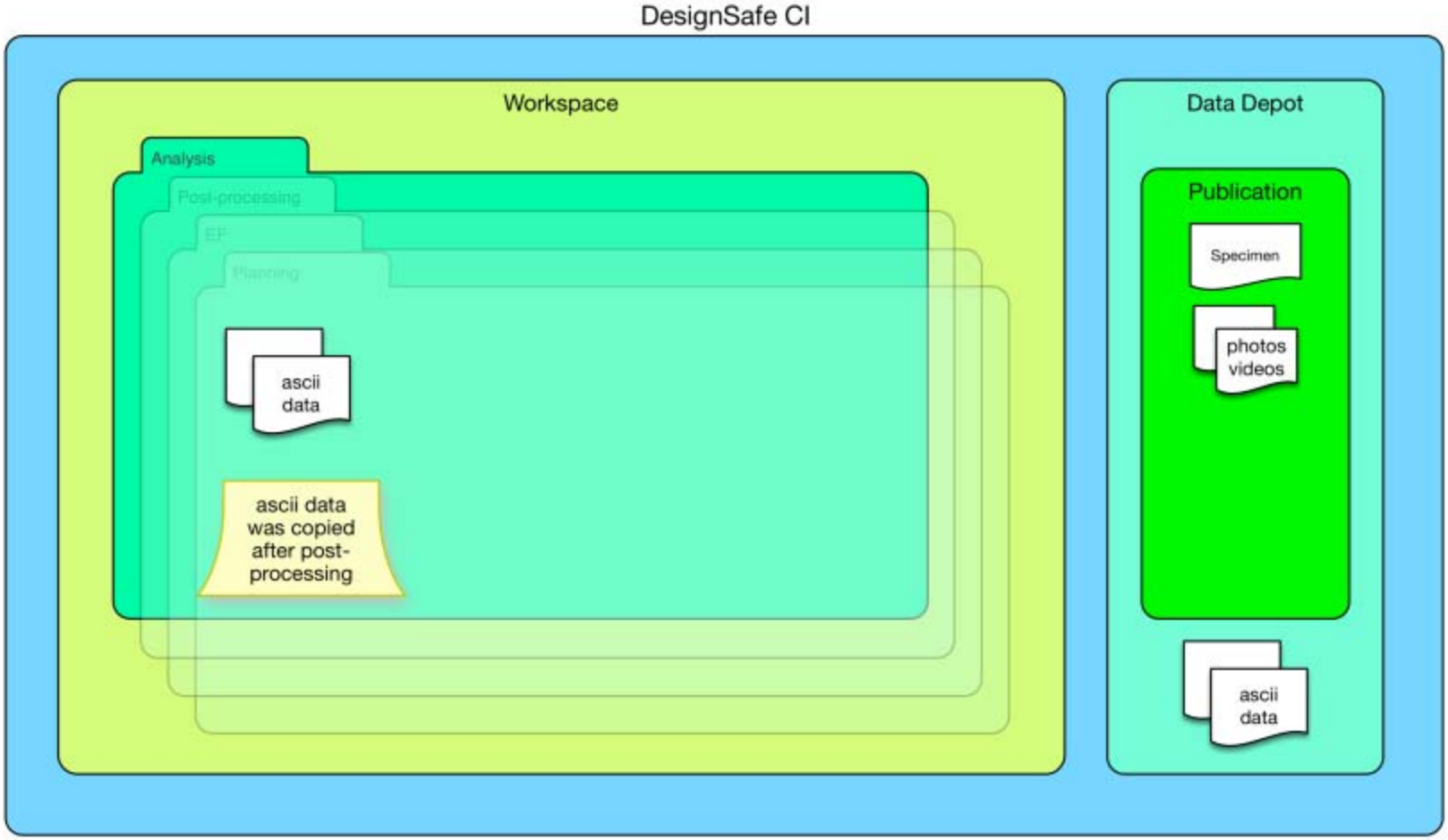
Planning
copy to analysis stage
Parameters (num, start, end, offset, order)
ascii data
data
copy to data depot for archival
Data Depot
Publication
Specimen
photos videos
ascii data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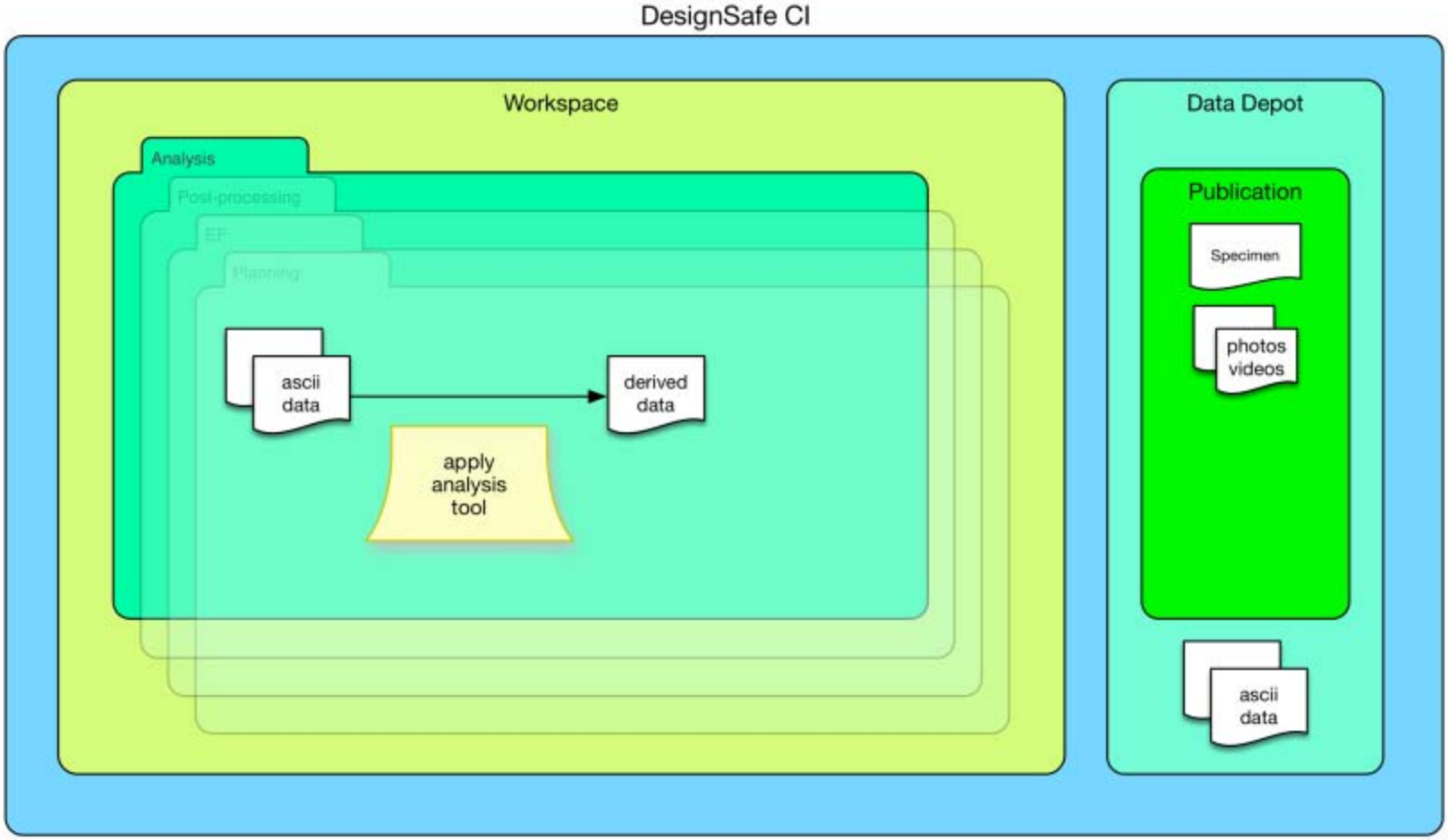
ascii data was copied after post-processing
Data Depot
Publication
Specimen
photos videos
ascii data


DesignSafe CI
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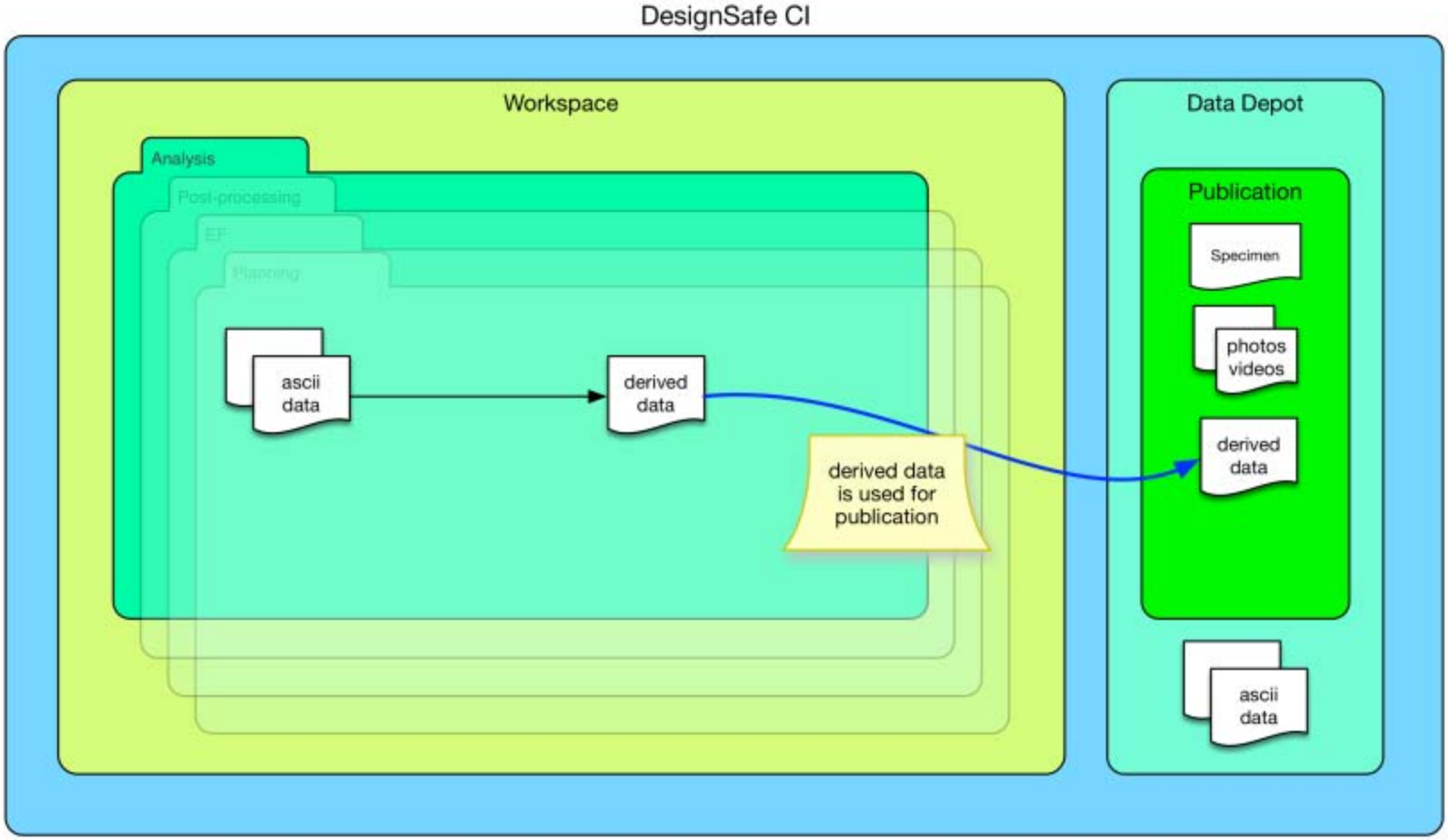
derived data
apply analysis tool
Data Depot
Publication
Specimen
photos videos
ascii data


DesignSafe CI
Workspace
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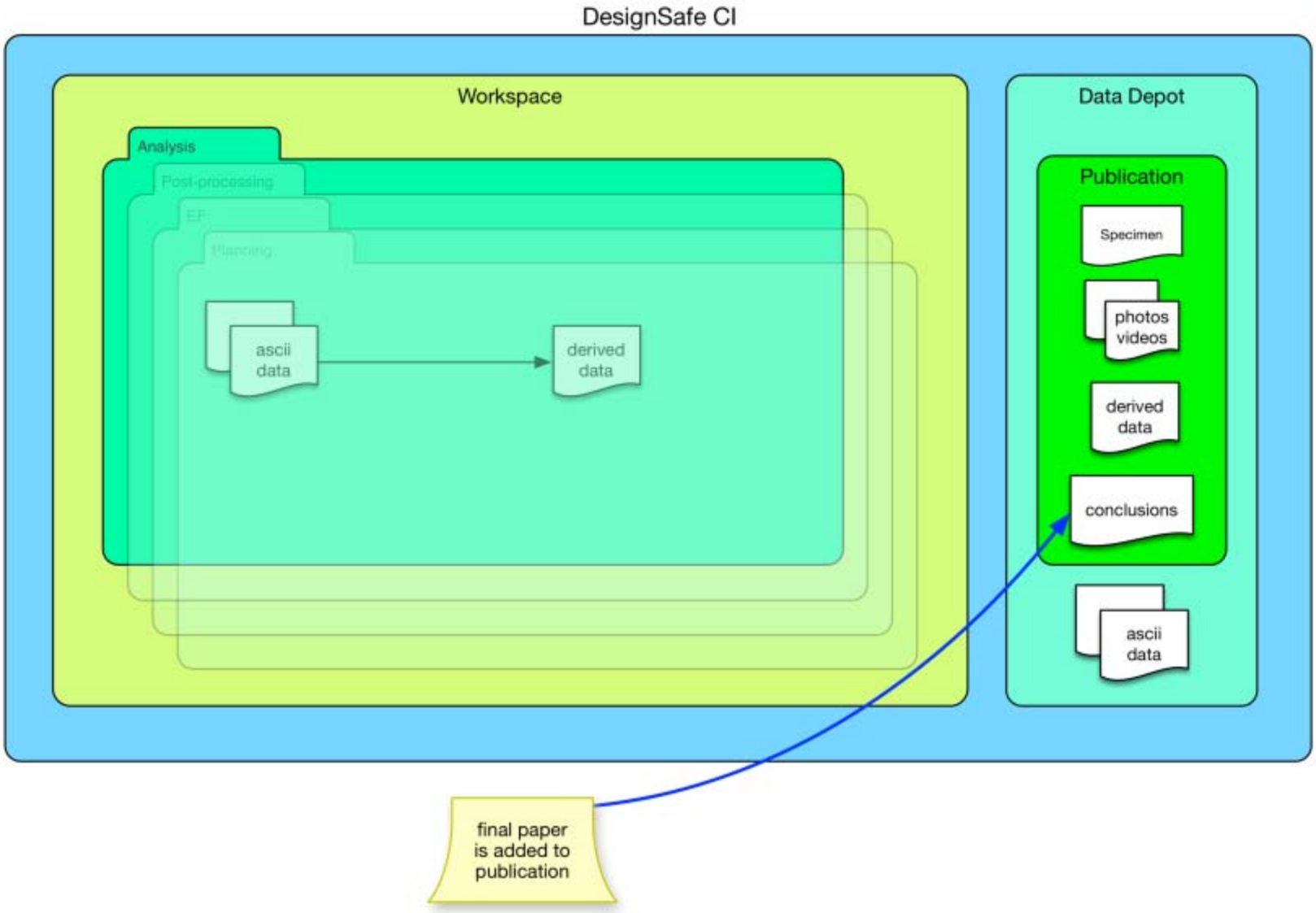
ascii data
derived data
derived data is used for publication
Data Depot
Publication
Specimen
photos videos
derived data
ascii data


DesignSafe CI
Workspace
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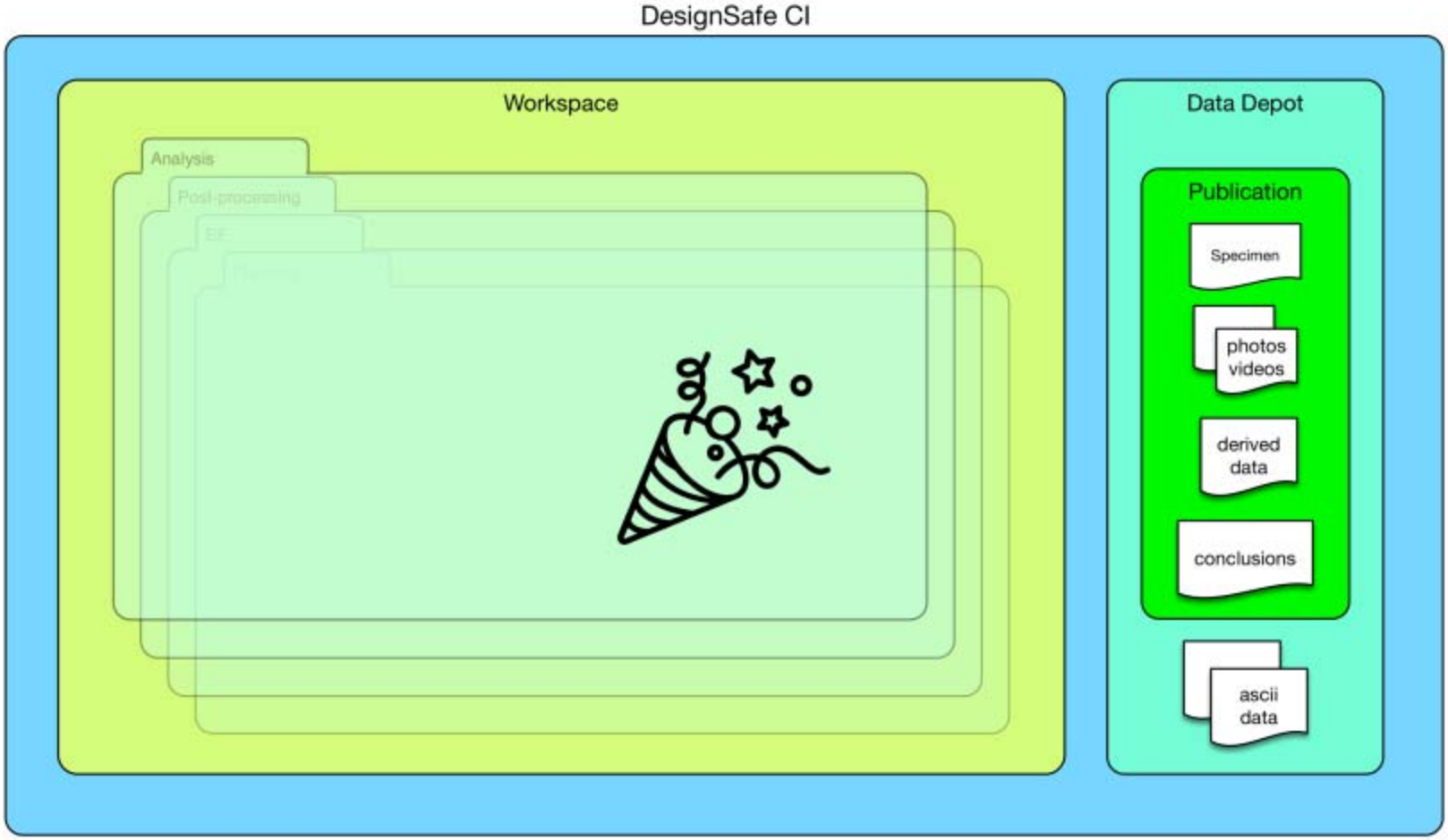
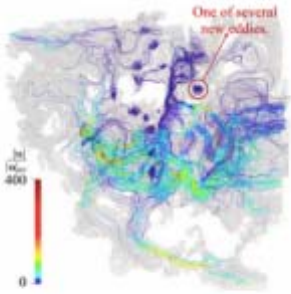
Data Depot
Publication
Specimen
photos videos
derived data
conclusions
ascii data
final paper is added to publication


DesignSafe CI
Workspace
Analysis
Post-processing
Data Depot
Publication
Specimen
photos
videos
derived
data
conclusions
ascii
data

Public View of Data: Flexible

Estaillades Carbonate

Project | Publications



Description

The effect of pore-scale heterogeneity on non-Darcy flow behaviour is investigated by means of direct flow simulations on 3-D images of Estaillades carbonate. The critical Reynolds number indicating the cessation of the creeping Darcy flow regime in Estaillades carbonate is two orders of magnitude smaller than in Bentheimer sandstone, and is three orders of magnitude smaller than in the beadpack. It is inferred from the examination of flow field features that the emergence of steady eddies in pore space of Estaillades at elevated fluid velocities accounts for the early transition away from the Darcy flow regime.

Further details can be found in Muljadi et al., Advances in Water Resources (2015), URL:http://dx.doi.org/10.1016/j.advwatres.2015.05.019

Author
Bagus Putra Muljadi (Imperial College London)

Created
Sept. 28, 2015

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Cite this project
http://dx.doi.org/10.17612/P73W2C

Datasets

- Sample: Estaillades Carbonate
  - Origin Data: Estaillades image (version 1)
  - Origin Data: Estaillades image (version 2)
    - Analysis Data: Velocity in X — Forchheimer regime
    - Analysis Data: Velocity in Y — Forchheimer regime
    - Analysis Data: Velocity in Z — Forchheimer regime

Digital Rocks Portal
https://pep-dev.tacc.utexas.edu

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DesignSafe for Data Publishing

- Researchers may not want to/be able to develop their own interface to share their data
- Easy-to-use data management interface will encourage broad use of DesignSafe across natural hazards engineering to share data
- Ability to aggregate data from different sources
- Creators of data linked with their data
- Digital Object Identifiers (DOI) assigned to data with authors, title, citation language, etc.

Datasets Interoperable with DesignSafe

- Creators/collectors of data want to maintain ownership of data
- Data easily discoverable from existing data repository through DesignSafe search or developed “App”
- Examples
  - Use App within DesignSafe to search PEER ground motion database to identify input motions for analysis
  - Search for data from centrifuge or shaking table facilities located across the globe
  - Collecting use cases for “killer apps” from community

Data Re-use

- Sharing well-documented and valuable data sets for re-use by others must be recognized by academic community as scholarly work
- Data needs a permanent, digital location (DOI) similar to journal article, not just a URL
  - List curated data sets on your CV
- Promote available data via Data Papers (e.g., EERI Earthquake Spectra) or Data Journals
- Users of data must cite it using DOI, citation language

Tracking Data Re-use

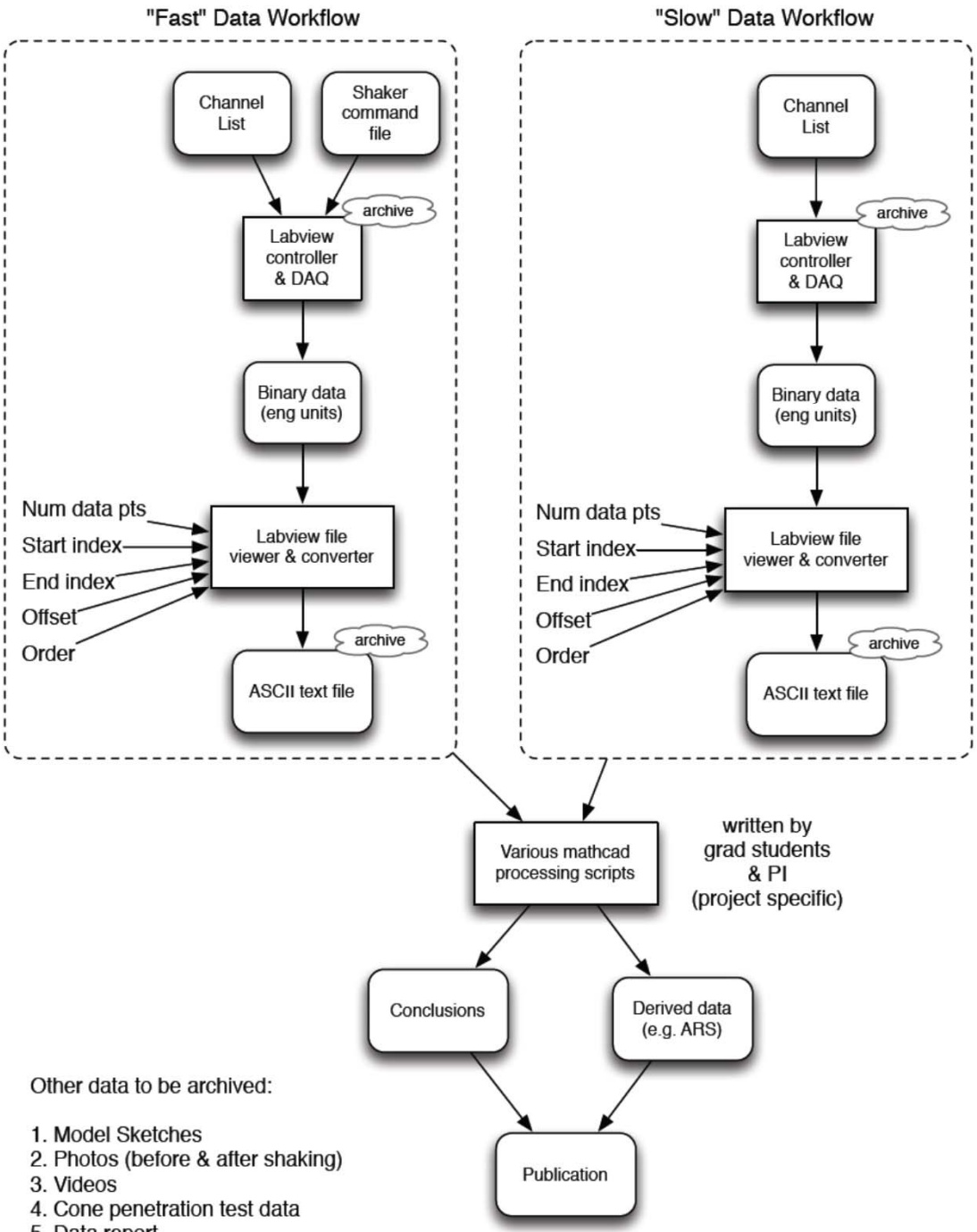
- Papers that cite data using DOI, citation language
  - Make our data DOIs discoverable by Google Scholar
  - Thomson and Reuters Data Citation Index tracks data DOIs, but it is a service separate from Web of Science
- Tracking Re-Use within DesignSafe
  - Data processing/analysis in the cloud will allow us to directly track re-use within the CI
- Citations to the DesignSafe “marker” paper
  - Description of DesignSafe CI published in journal paper
  - To track meaningful use of the CI, researchers will be asked to cite this “marker” paper

Important Schedule Milestones

- September 30, 2015: NEEShub transitioned to UT/TACC
- September 30, 2015: Initial DesignSafe website released (www.designsafe-ci.org)
- Fall/Winter 2015: Visit with each Experimental Facility
- January 2016: Community User Requirements Workshop (Austin, TX)
  - October 2015: Community User Requirements Webinars
- **Spring 2016:** DesignSafe-ci Release 1 including Discovery Workspace and Data Depot

User Requirements Workshop: What do you do now?

- Learn about your research workflows and how DesignSafe can improve/enhance them
  - Document your research workflow to share at workshop (narrative and sketch)
  - What tools/codes do you use?
  - Describe data types, file sizes, etc.
  - Explain data organization, considering the need to share the data


"Fast" Data Workflow
Channel List
Shaker command file
archive
Labview controller & DAQ
Binary data (eng units)
Num data pts
Start index
End index
Offset
Order
Labview file viewer & converter
archive
ASCII text file
"Slow" Data Workflow
Channel List
archive
Labview controller & DAQ
Binary data (eng units)
Num data pts
Start index
End index
Offset
Order
Labview file viewer & converter
archive
ASCII text file
Various mathcad processing scripts
written by grad students & PI (project specific)
Conclusions
Derived data (e.g. ARS)
Publication
Other data to be archived:
1. Model Sketches
2. Photos (before & after shaking)
3. Videos
4. Cone penetration test data
5. Data report

1) I generate a set of bridge parameters.
Software - matlab
input - range of parameter values (matlab script file - .m)
process - Latin hypercube sampling
output - text file containing parameter combinations (ascii)

2) Generate bridge models to perform eigen analysis for determining parameters for contact elements
Software - opensees
input - text file with bridge parameters
process - for each parameter combination (bridge) in the text file, 1000 tcl files are generated with variation contact penalty parameters
output - tcl files containing bridge models

3) Eigen value analysis
software - opensees
input - tcl files generated in previous step
process - eigen analysis
output - text files (ascii) with eigen values and deck displacement

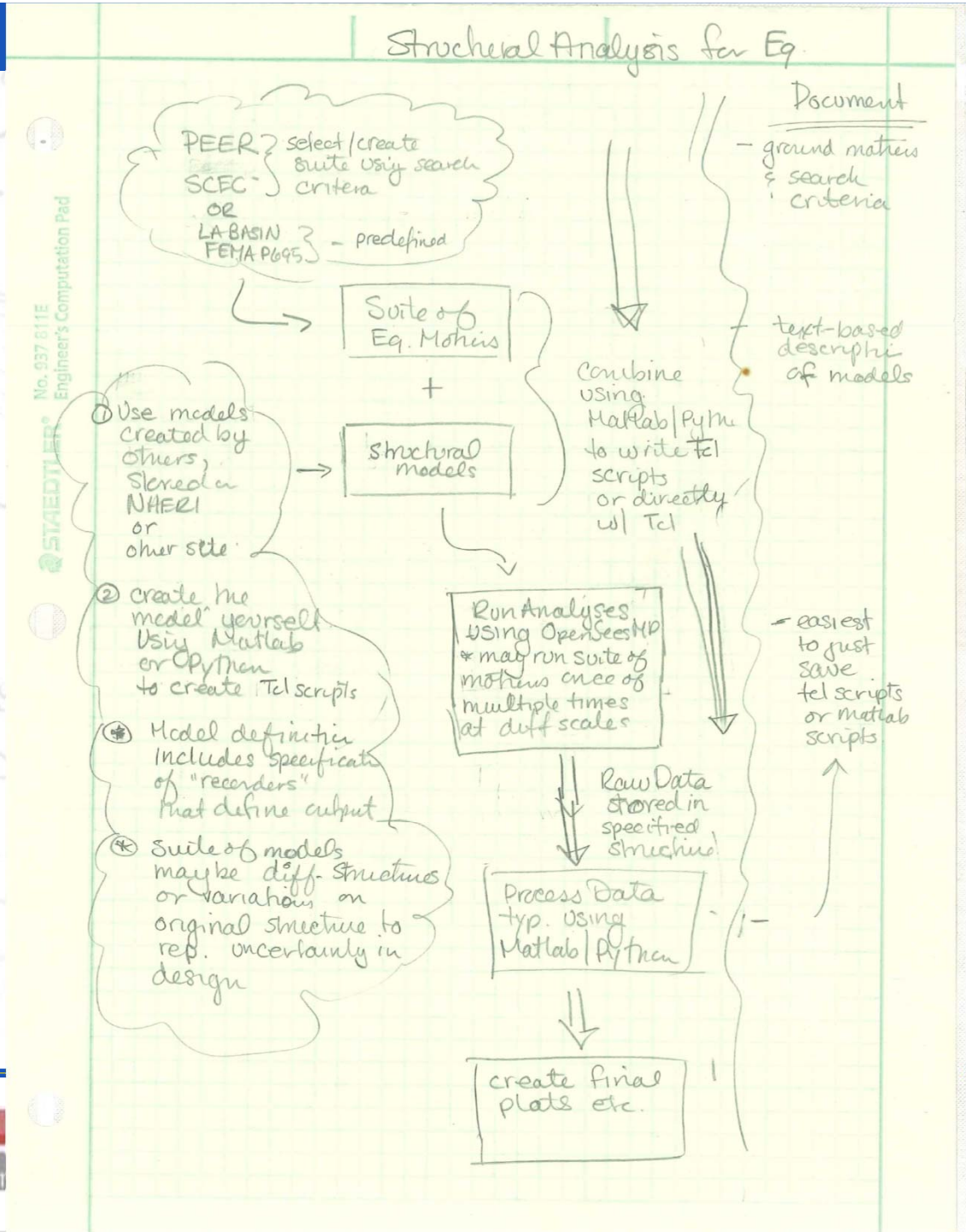
4) Select contact parameters
software - opensees
input - results from eigen analysis (text files)
process - read all the eigen values and deck displacement for all contact parameters and select appropriate contact parameters; repeat for each bridge (parameter combination obtained in step 1)
output - a modified text file (ascii), similar to the one in step one, with additional information on contact parameters

5) Generate tcl files and simulate hurricane response
software - opensees
input - text file from step 4
process - for each parameter combination, a tcl script is generated and response of the bridge is simulated
output - for each parameter combination, tcl files for bridge models and text files for bridge component response

6) Post processing
software - matlab
input - text files containing component responses for each bridge
process - for each bridge, read component responses from text files
output - matlab data file (.mat) containing response of each bridge for each component

7) Fragility and risk analysis
software - matlab
input - matlab files (.mat) containing component response
process - logistic regression and integration for risk
output - matlab data files (.mat) to save fragilities and risk data, and matlab figures (.fig) and corresponding image files

Please let me know if you need anything else.



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User Requirements Workshop: What do you want to do in the future?

- What do you want the CI to enable for your work?
  - Search
  - How do you want to present and organize your data?
  - Integrated visualization
  - Publication support
  - New interfaces

Action Items

- Send us your documented workflows
- Suggested break out session topics
- Please send information to Natalie Henriques
  - natalie@tacc.utexas.edu