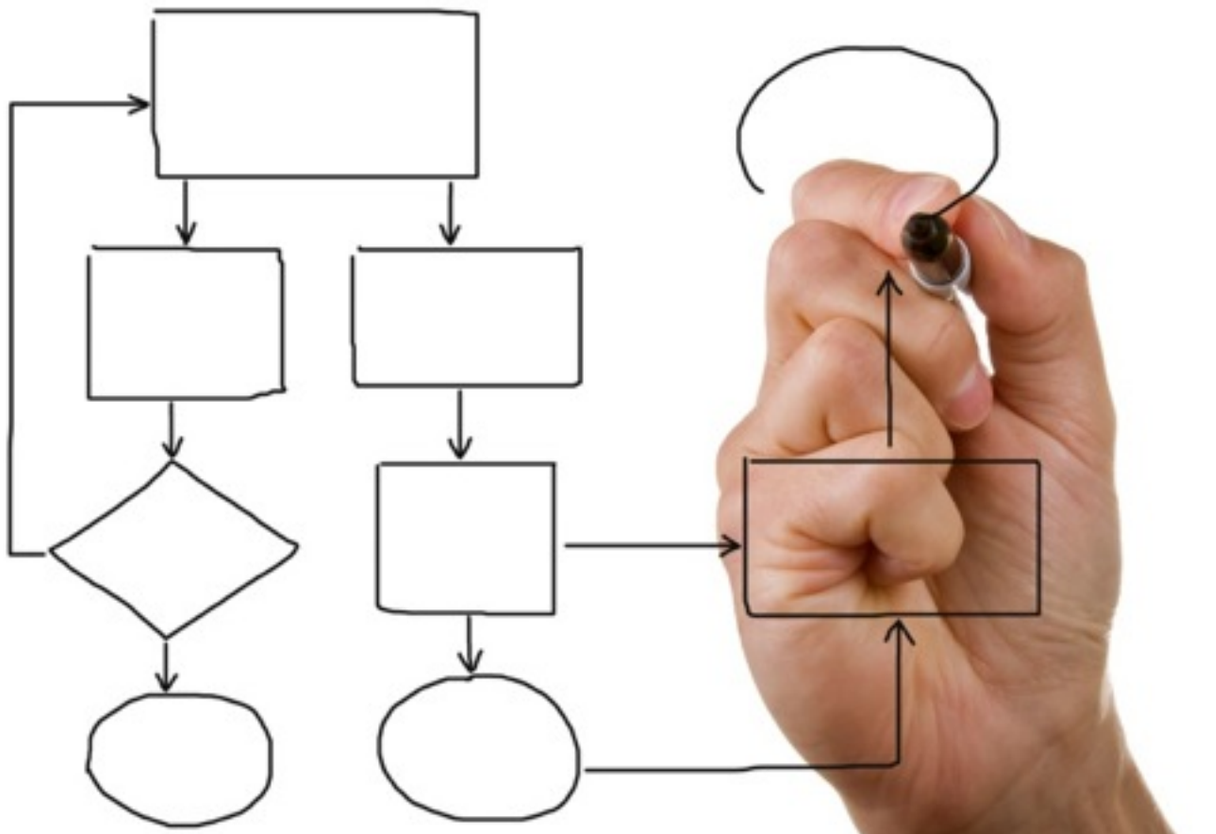
CAPS

Capturing and Managing Provenance Information in Scientific Workflows



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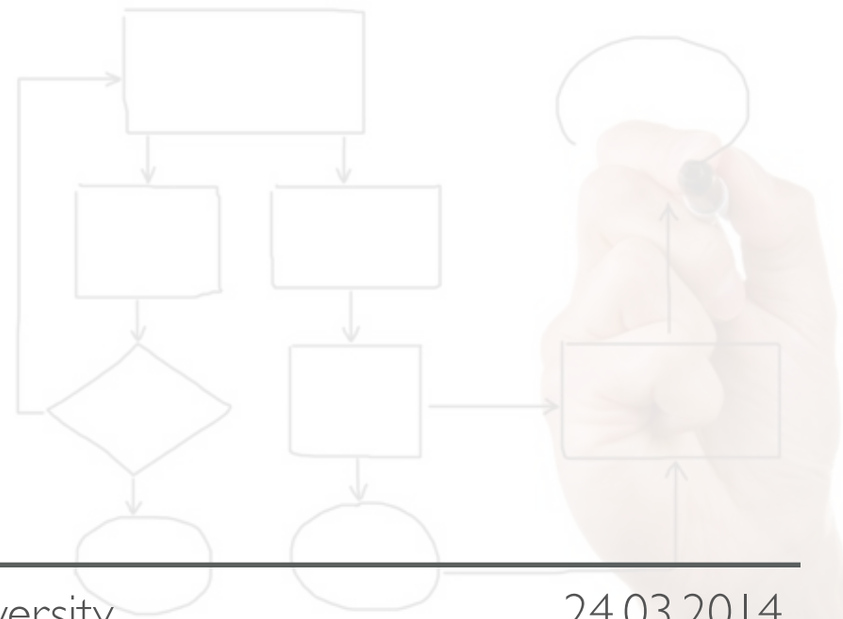
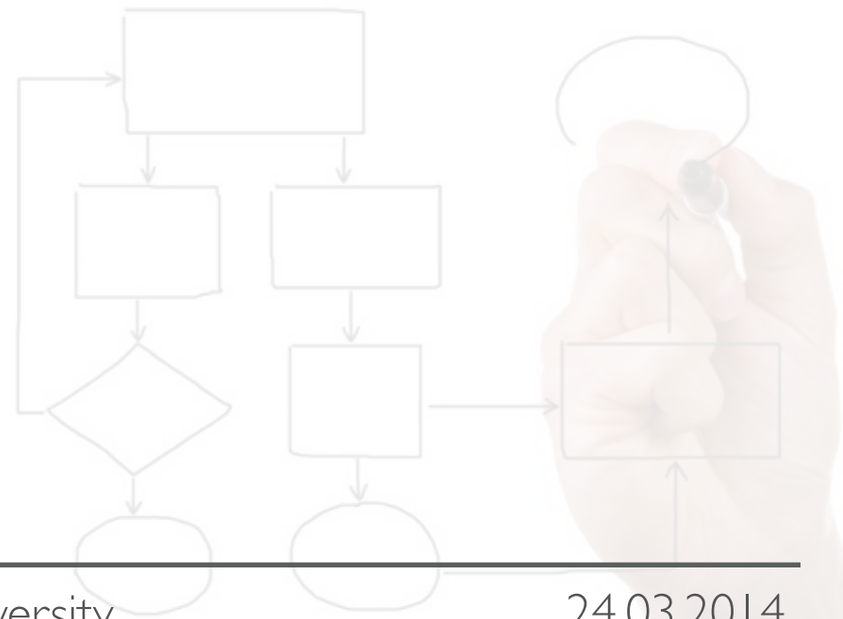
Hamburg, 24.03.2014

AGENDA

- Motivation
- Research Questions
- CAPS
- Evaluation



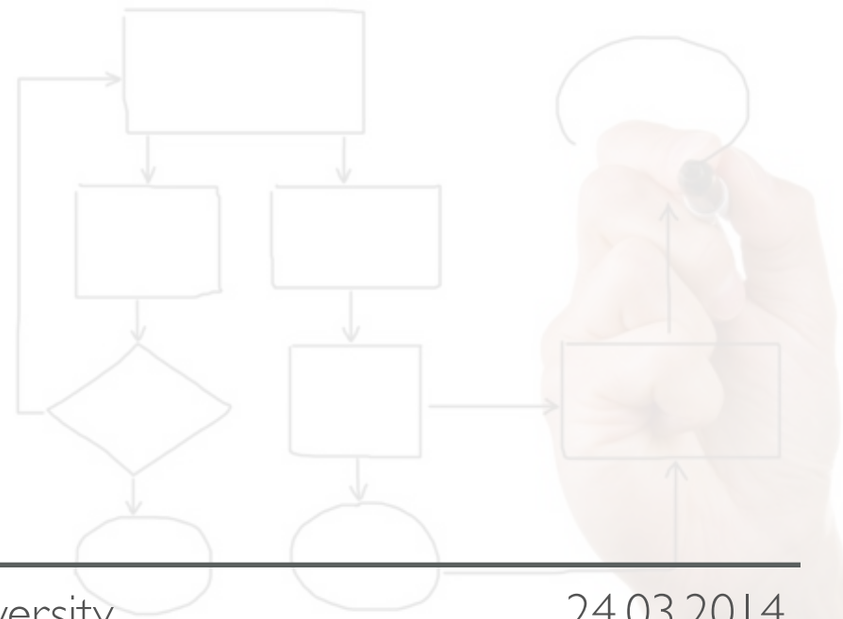
Motivation



MOTIVATION

Provenance

How was the scientific data I use
for my research created?



Coordinates

Position (RA):	9 0 12.02
Position (Dec):	-45° 57' 0.24"
Field of view:	33.16 x 33.16 arcminutes
Orientation:	Die Nordrichtung liegt 90.1° links zur Vertikale

Description

The oddly shaped Pencil Nebula (NGC 2736) is pictured in this image from ESO's La Silla Observatory in Chile. This nebula is a small part of a huge remnant left over after a supernova explosion that took place about 11 000 years ago. The image was produced by the Wide Field Imager on the MPG/ESO 2.2-metre telescope at ESO's La Silla Observatory in Chile

About

Name:	NGC 2736
Typ:	• Milky Way : Nebula : Type : Supernova Remnant • X - Nebulae
Distance:	800 Lightyears
Constellation:	Vela

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Type:	Observation
Release date:	12 September 2012, 12:00
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Size:	8357 x 8357 px

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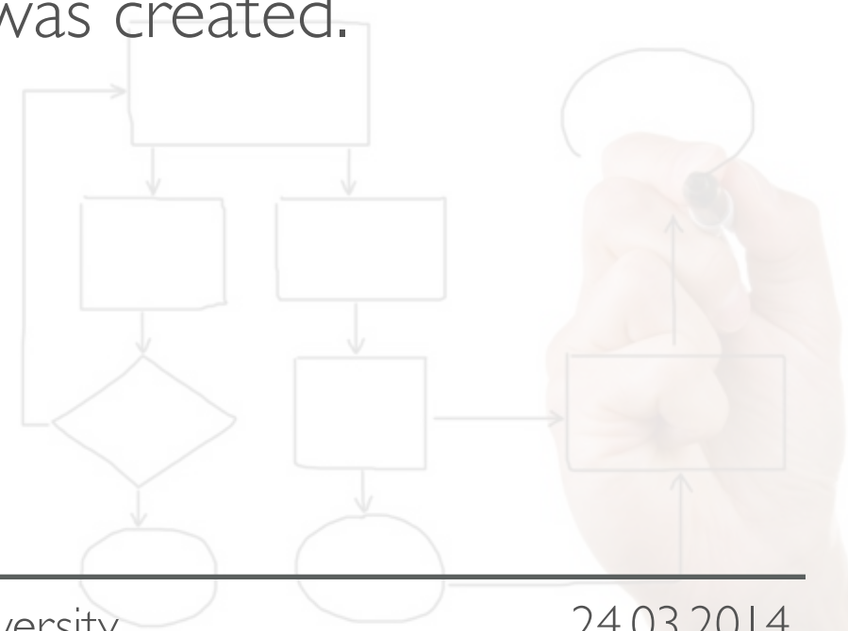
Provenance Information helps to assess (scientific) Data !

MOTIVATION

Definition Provenance

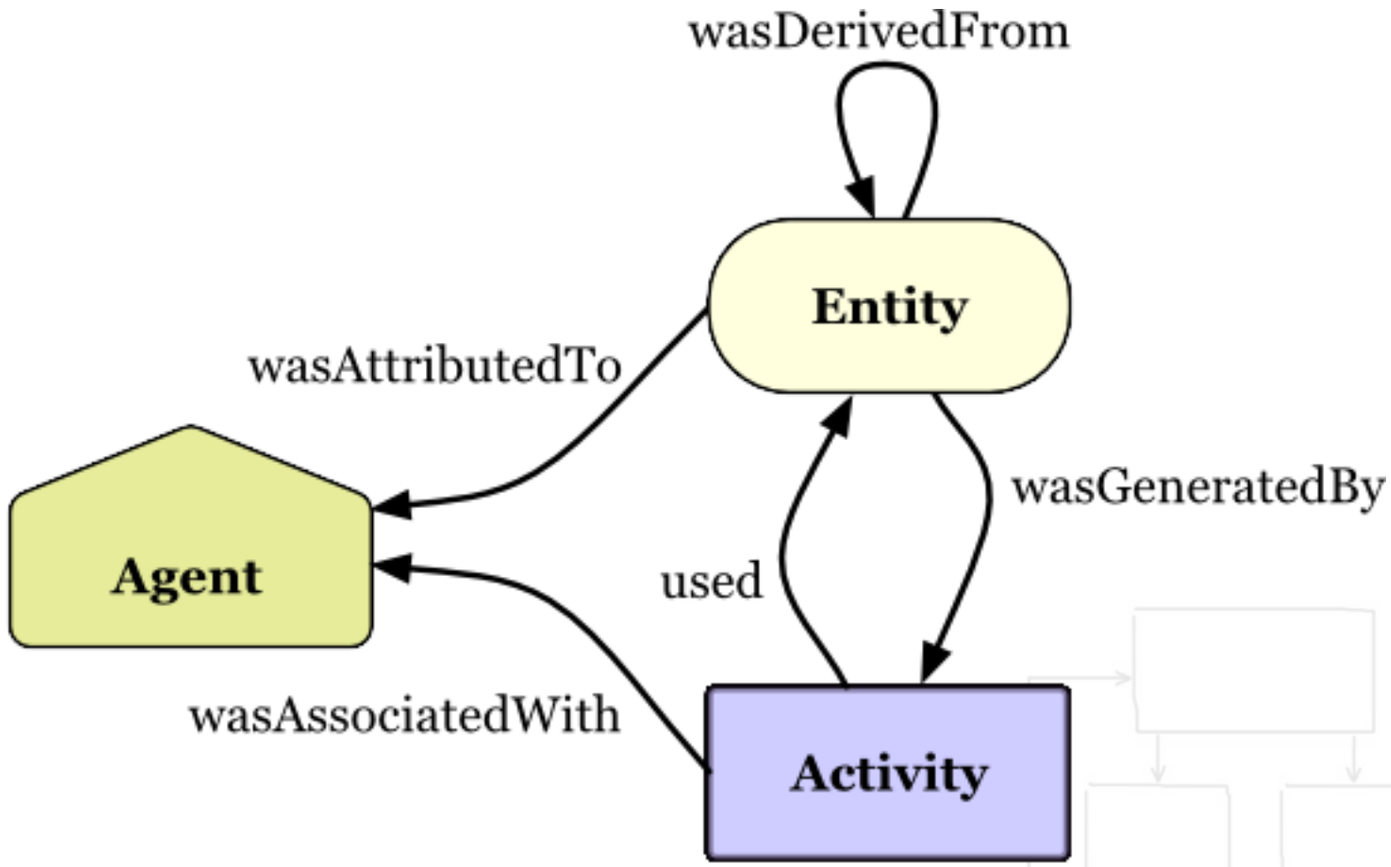
Provenance information describes how,

when, where and by whom data was created.



MOTIVATION

W3C Prov-DM



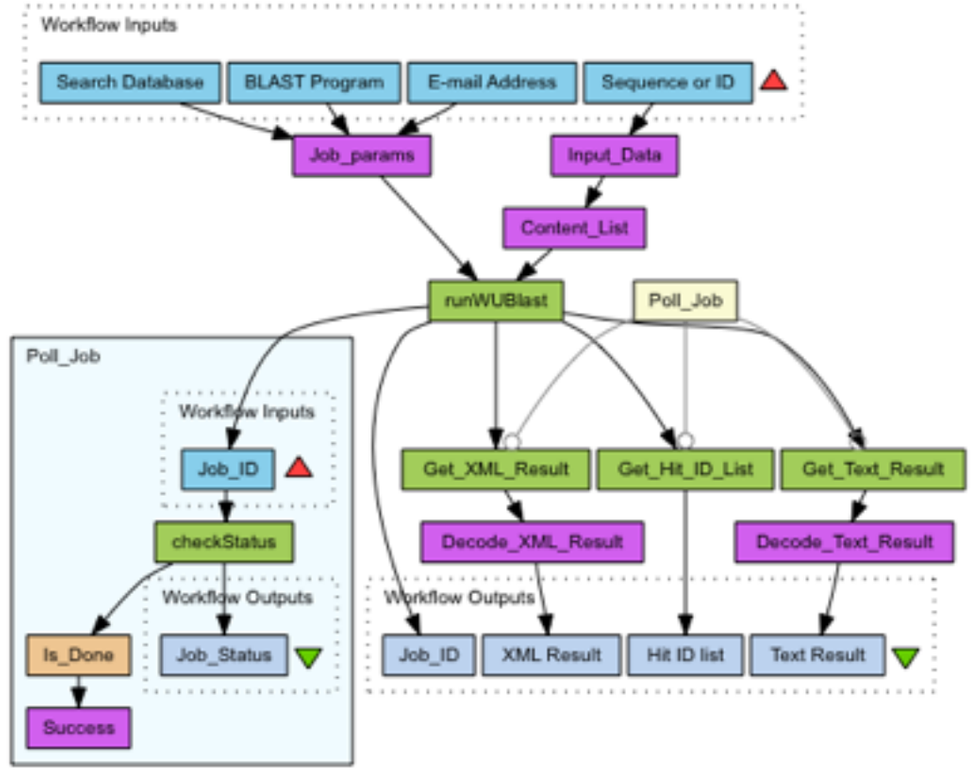
Source: http://www.w3.org/TR/2013/NOTE-prov-primer-20130430/

MOTIVATION

Scientific Workflows

Scientific Workflows …

- … automate recurrent tasks
- … are widely used in data intensive domains
- … orchestrate complex analysis or computations



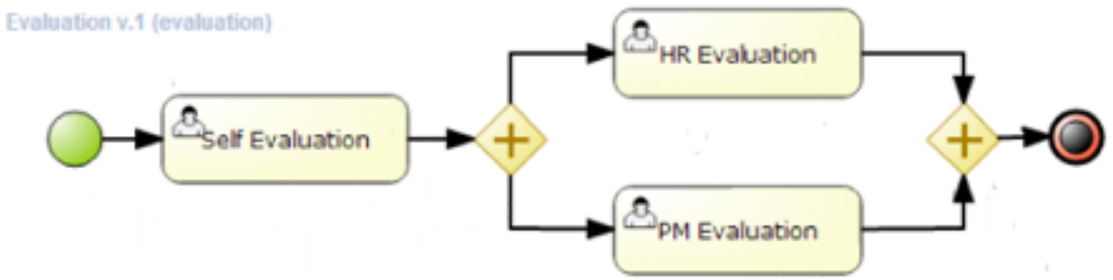
Source: www.myexperiment.org/workflows/197.html

MOTIVATION

Scientific Workflows

Scientific Workflows …

- … can have many different forms
- … consist mainly of Activities, Gateways and Events



Quelle: http://docs.jboss.org/jbpm/v6.0.1/userguide/images/Chapter-1-Overview/Overview.png

MOTIVATION

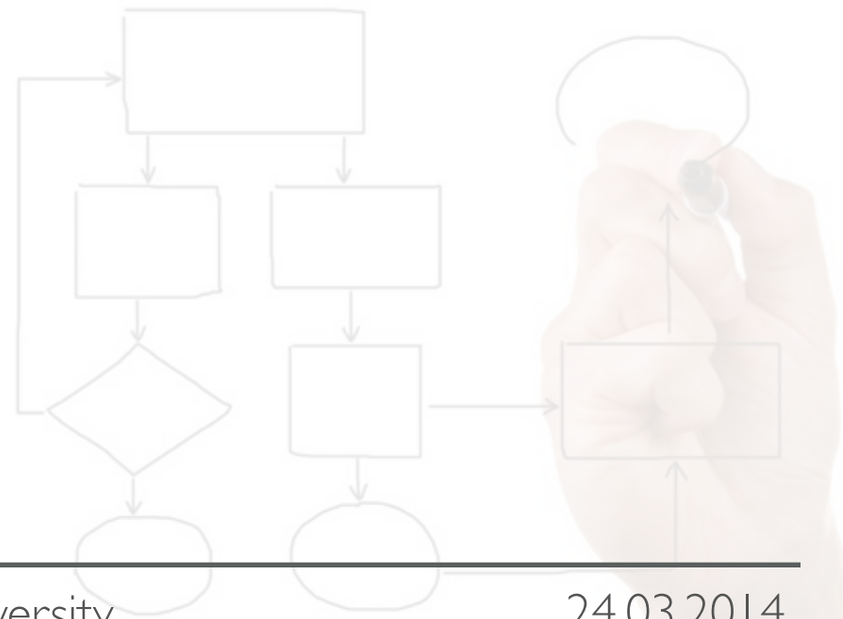
Problemstatement

- Scientific workflow engines are often domain specific and developed by small teams with less resources > only really needed functionality is implemented

- also business products are widely used

How to assure the capturing of provenance information in these systems ?

Research Question



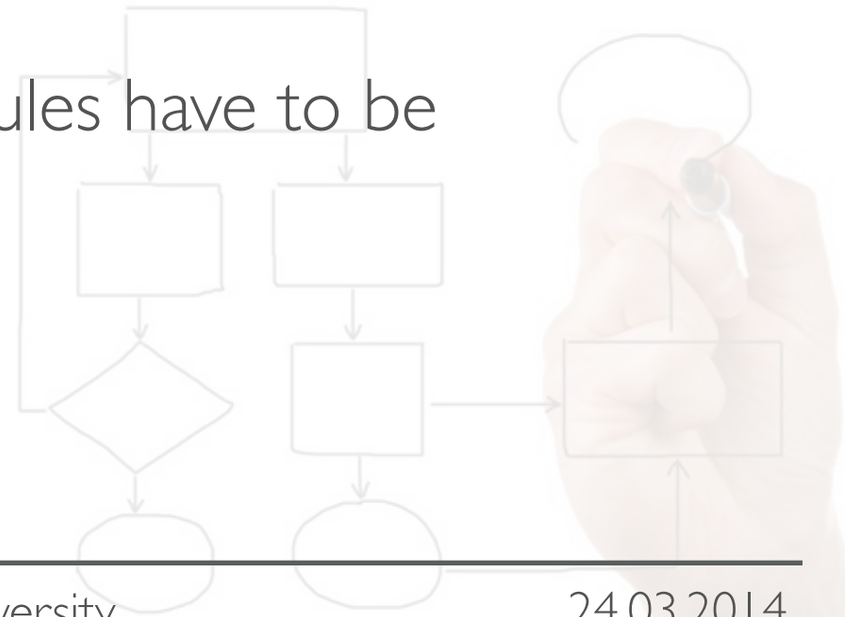
RESEARCH QUESTIONS

Aspect-Oriented Provenance Capturing

Data provenance as a cross-cutting concern

- Is it possible to use aspect-oriented programming techniques to acquire provenance information from a scientific software system?

- How to determine, which methods and modules have to be monitored?

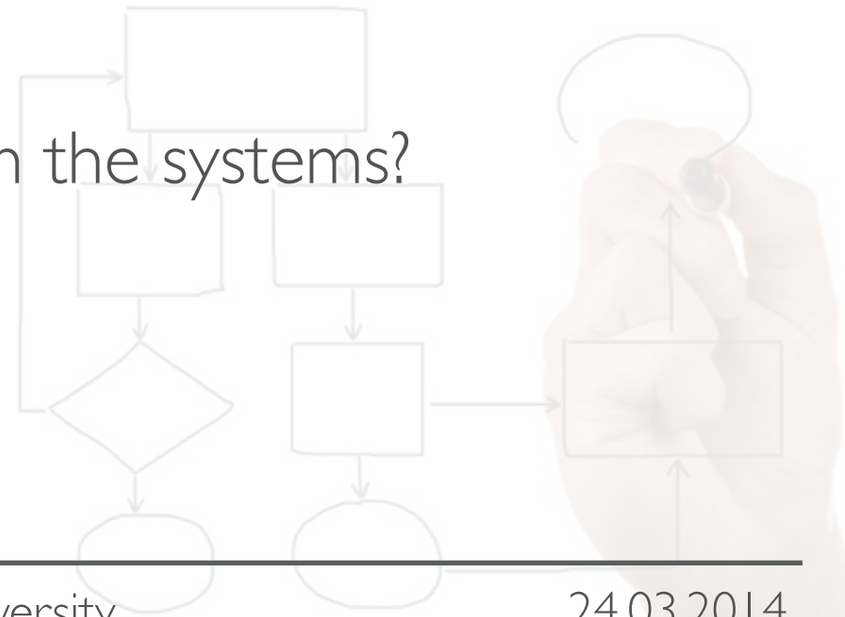


RESEARCH QUESTIONS

Scientific Workflows

Capturing Provenance Information in scientific workflows

- What are the demands for capturing provenance information in scientific workflows?
- Which informations have to be gathered from the systems?

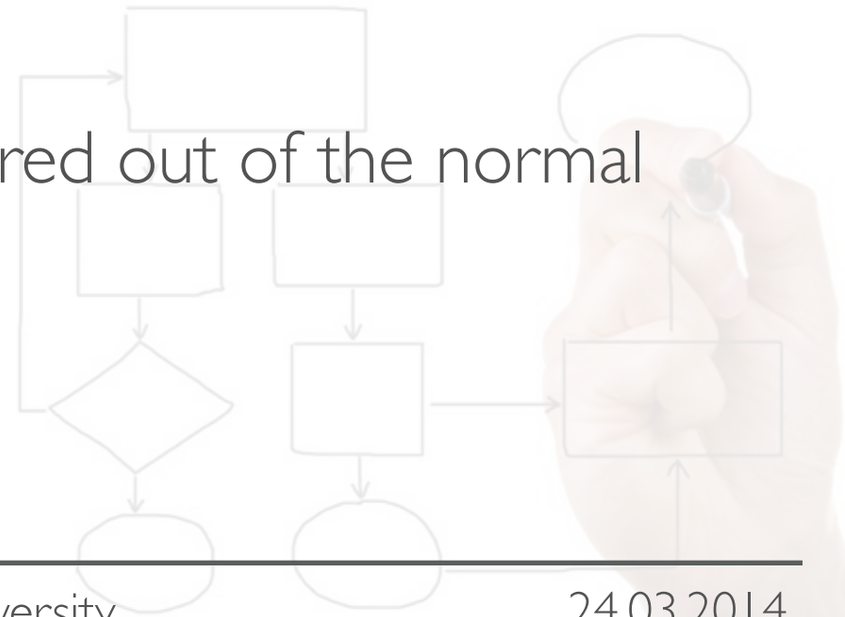


RESEARCH QUESTIONS

Provenance Information Reconstruction

Integrating provenance information from different systems and reconstruction the provenance graph

- What are the demands for constructing a provenance graph out of monitoring informations received from different software systems?
- How can the provenance information be filtered out of the normal monitoring records?



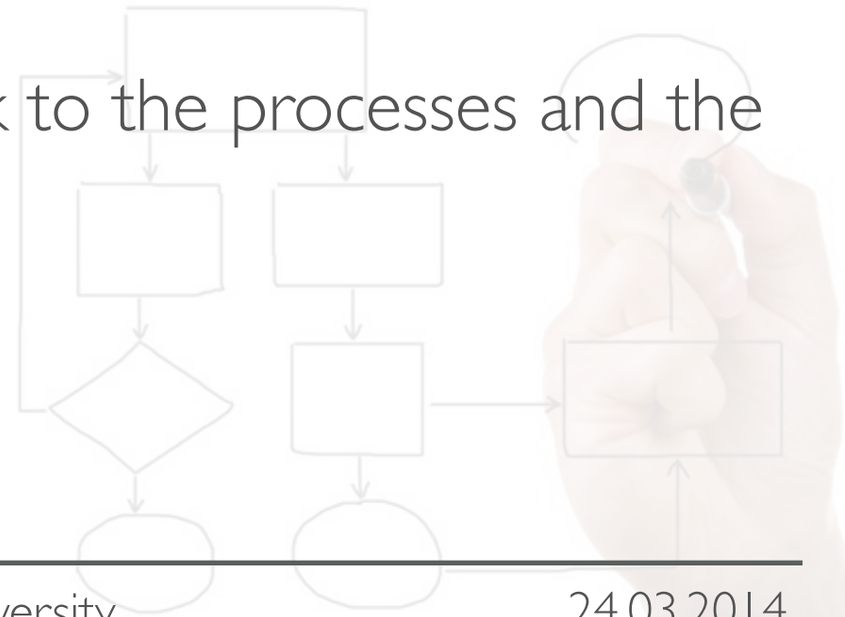
RESEARCH QUESTIONS

Provenance Information Archival

Archiving the provenance information

- How to store the provenance information, so it can be accessed by scientist and data managers to validate their data?

- How to link the provenance information back to the processes and the data it evolved of?



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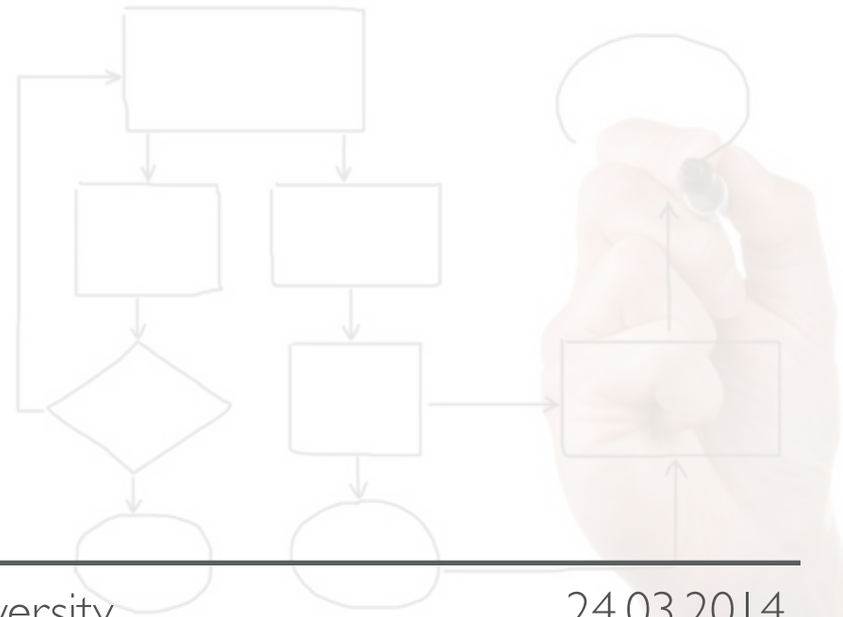

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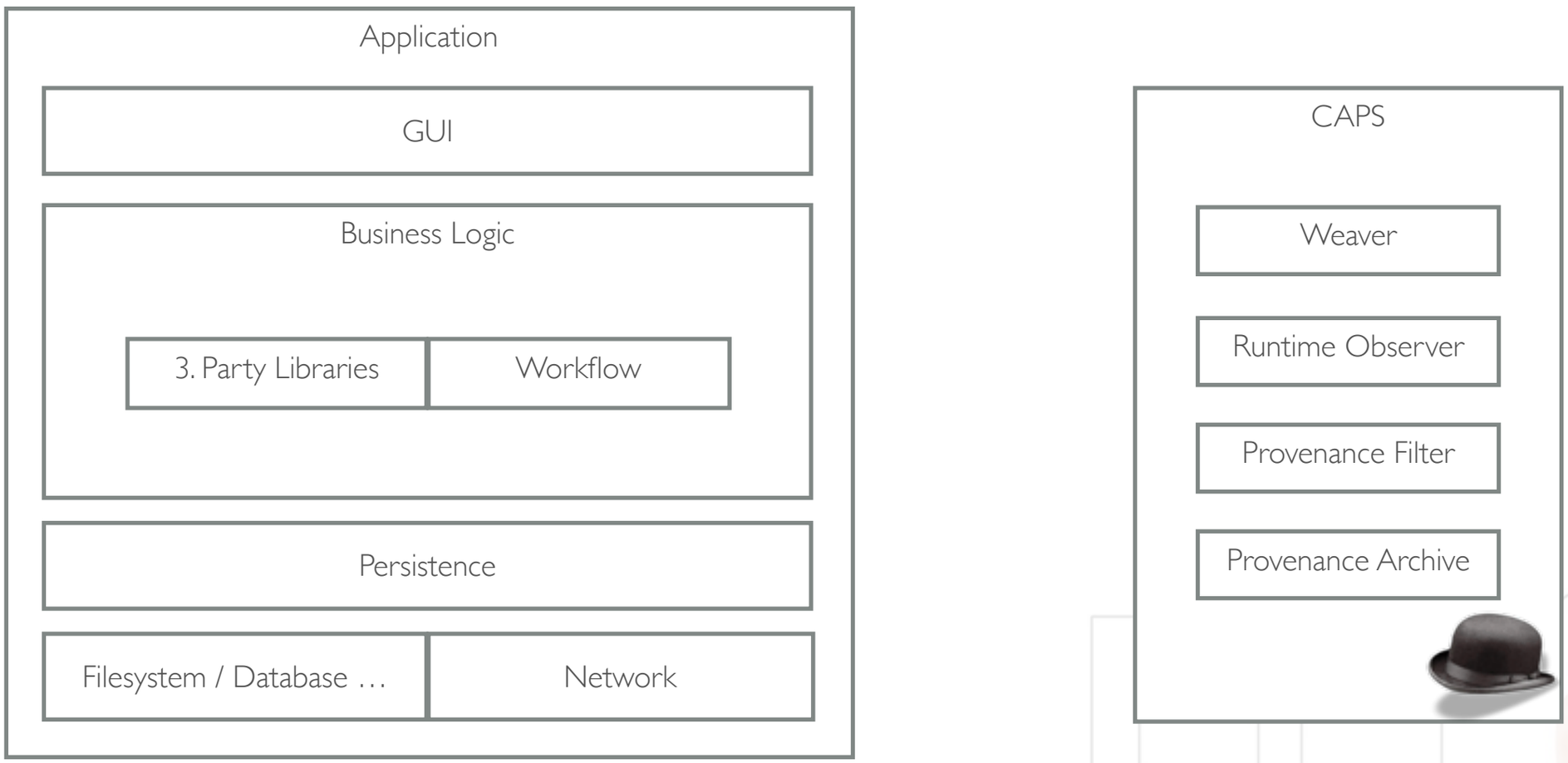
Integration in the Guest System



CAPS

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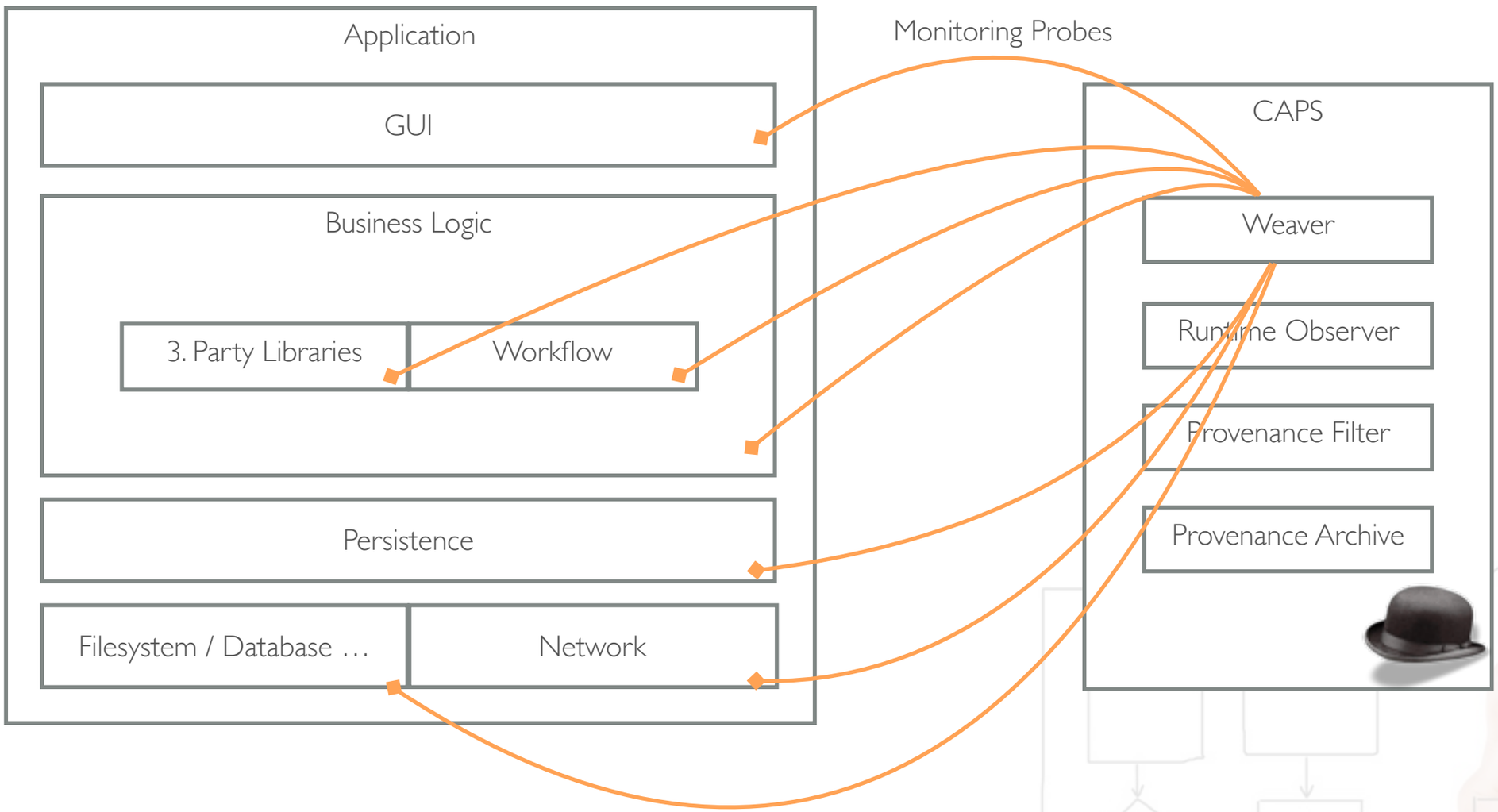
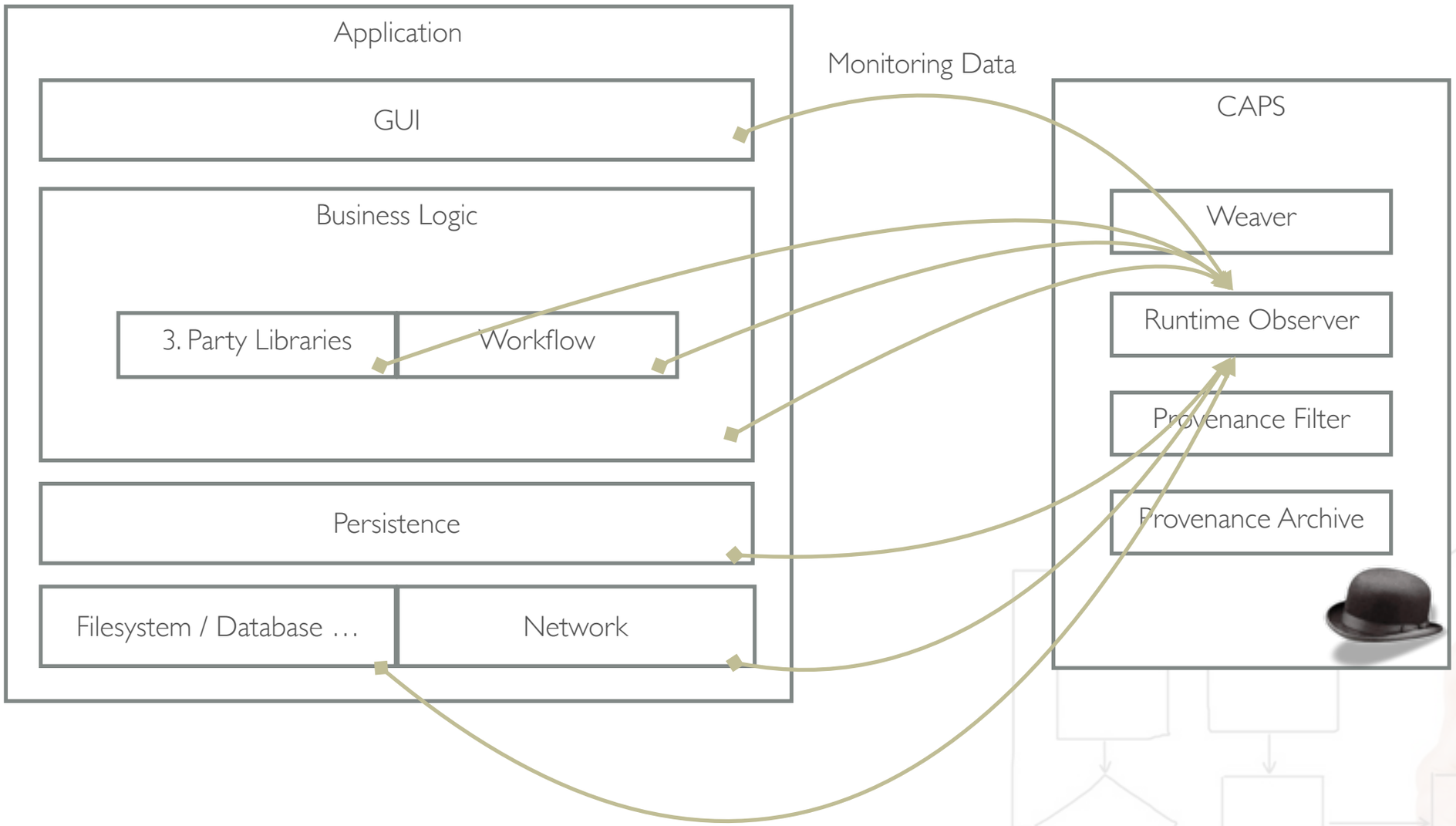


Analyze Application & Integrate Provenance Awareness

CAPS

Integration in the Guest System



Collect Provenance Information

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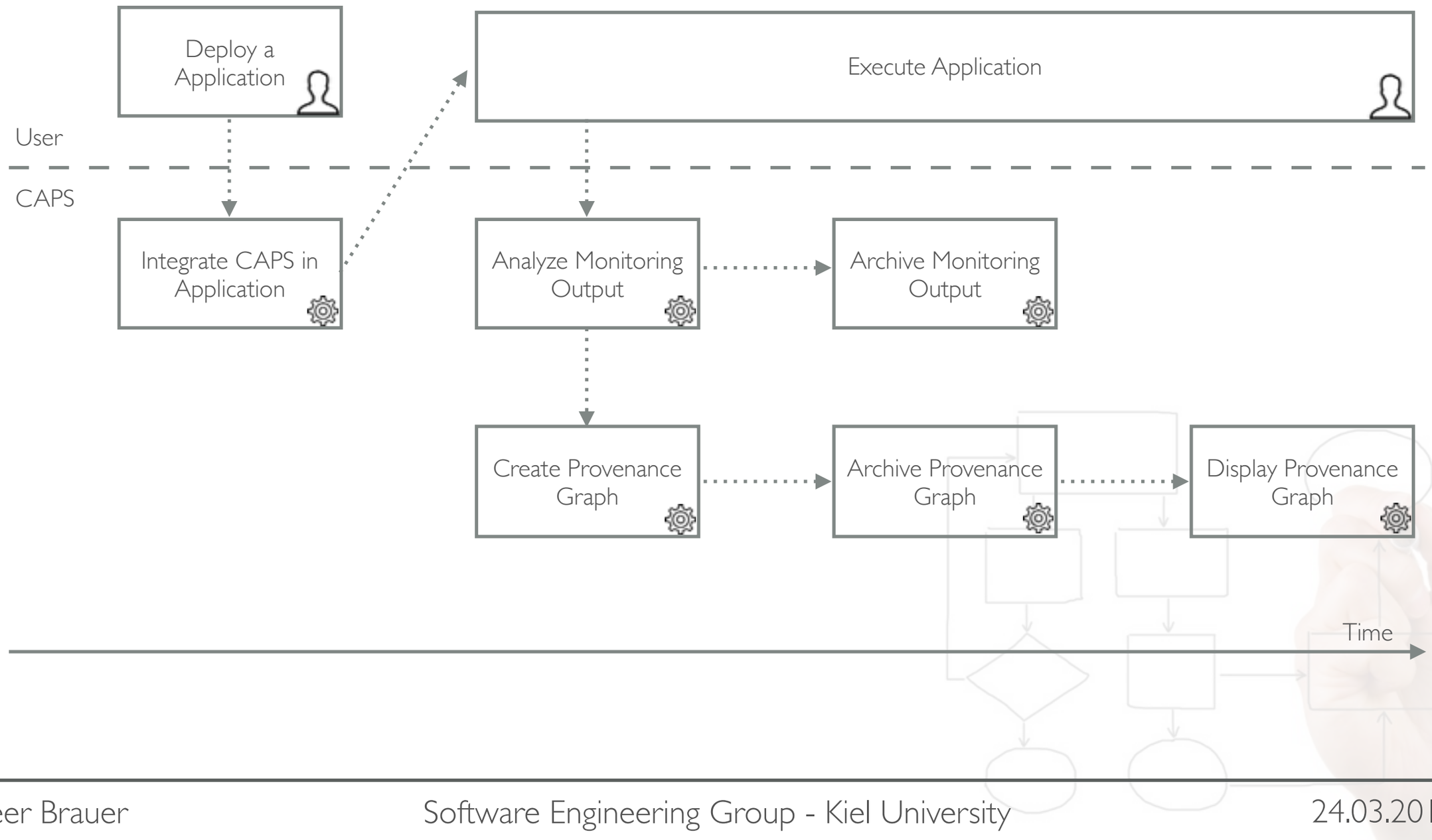
Basic Workflow



CAPS

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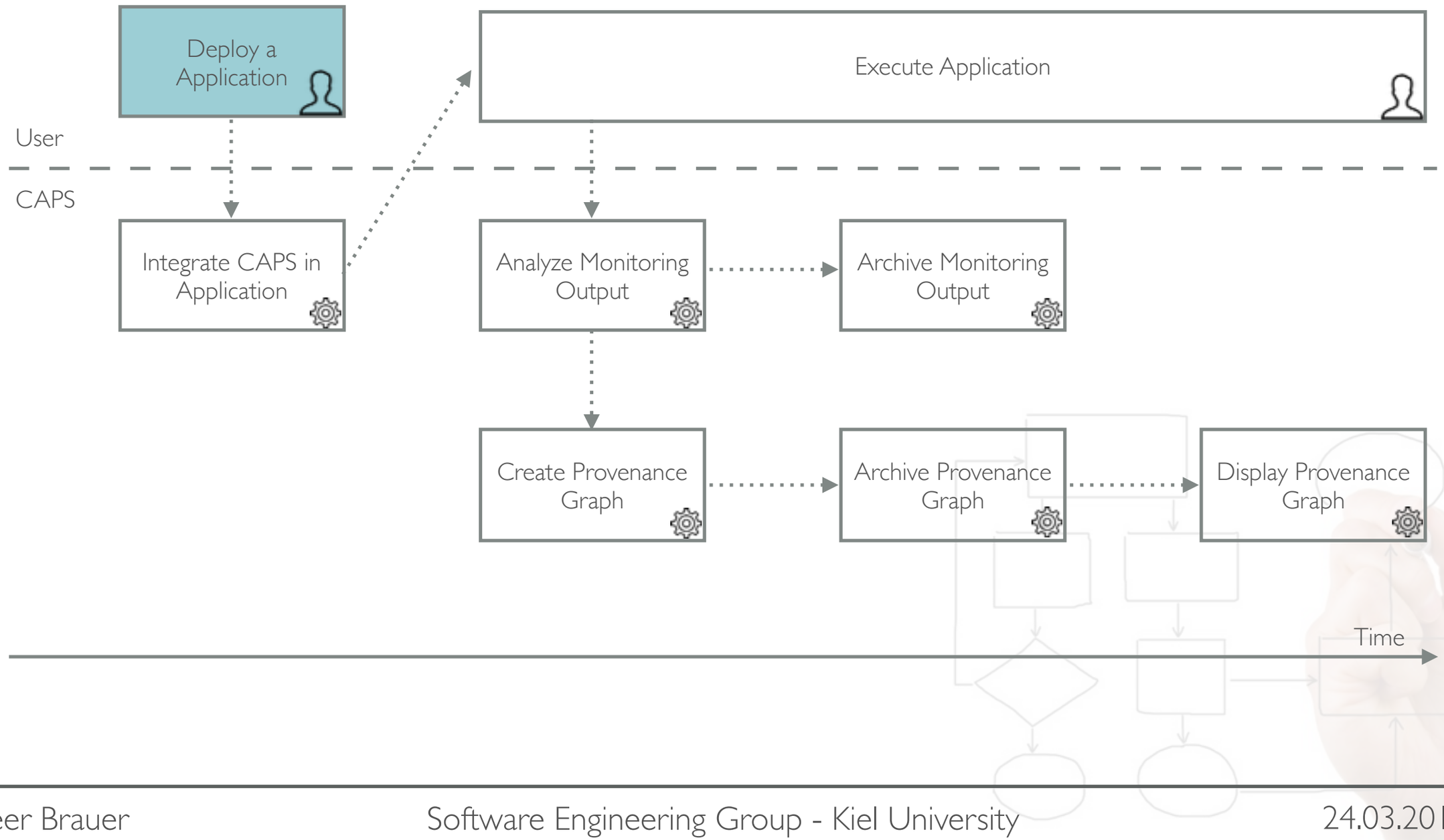

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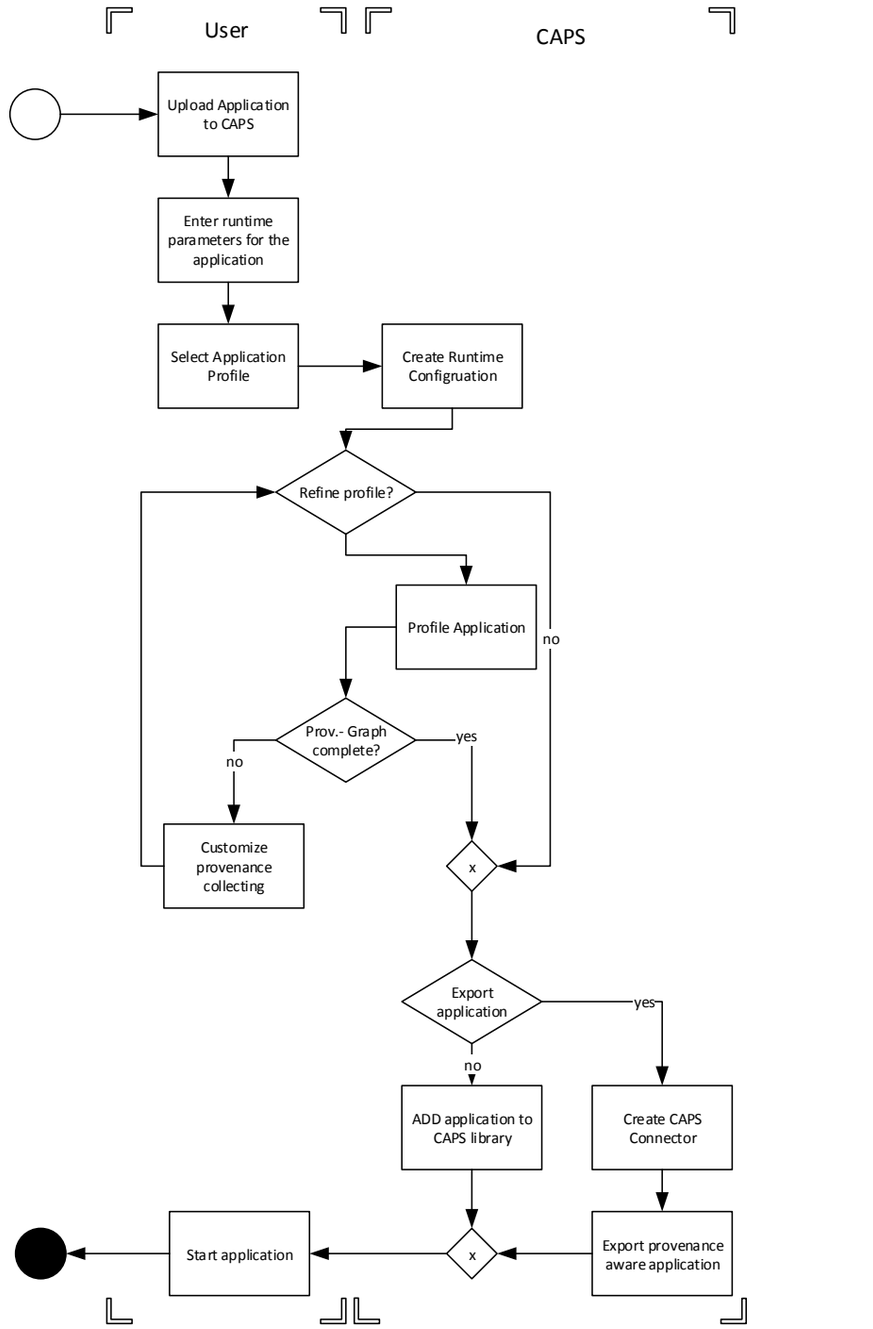
Deploying an Application

- Upload an application to CAPS
- Choose an application profile
- Create a runtime configuration
- Create an application wrapper



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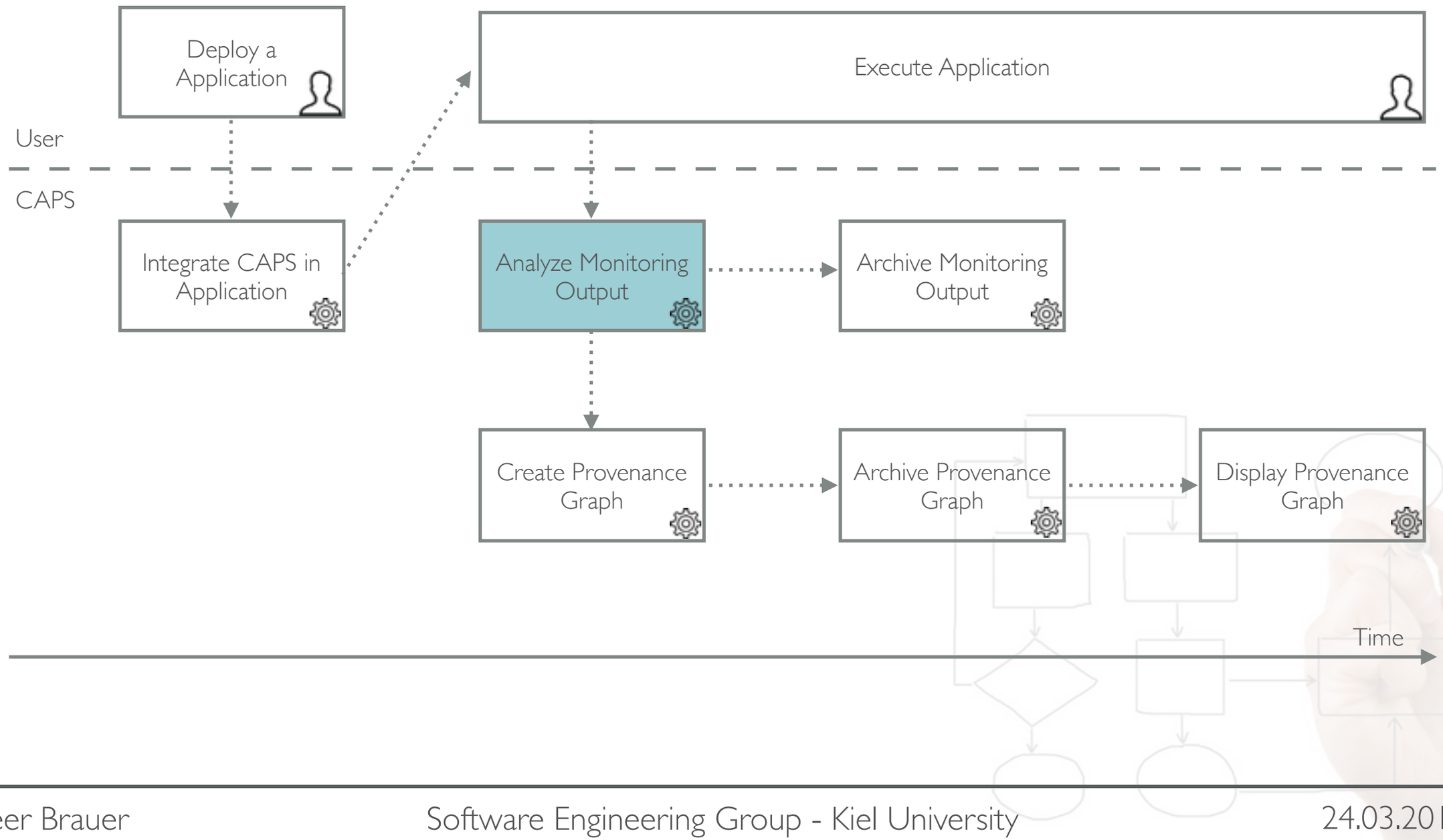
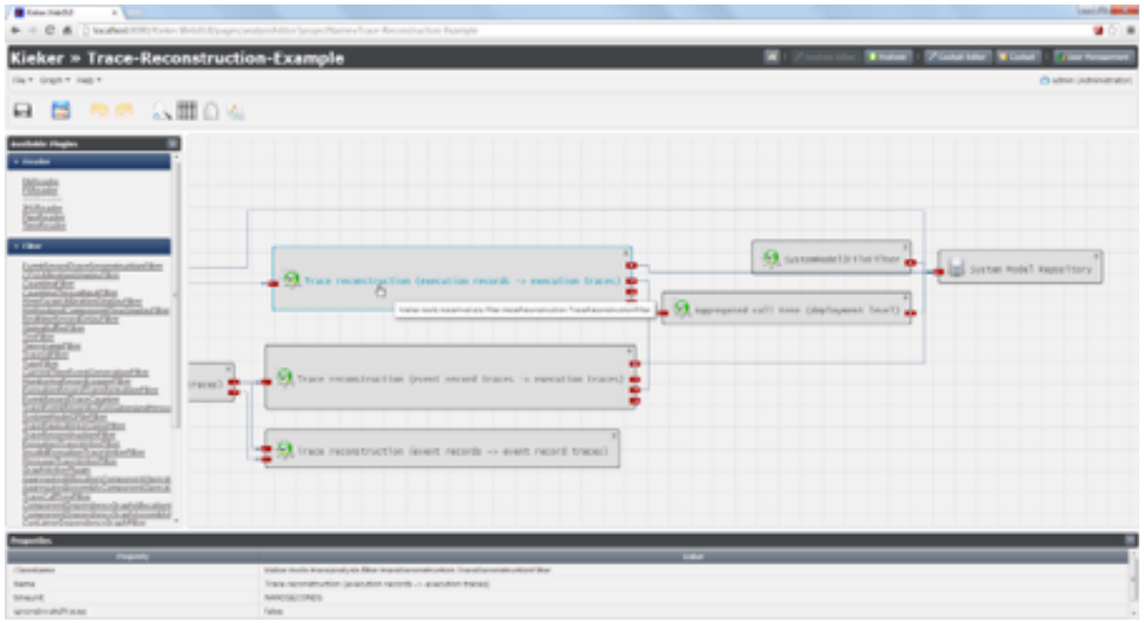


CAPS

Analyzing and Filtering the Results

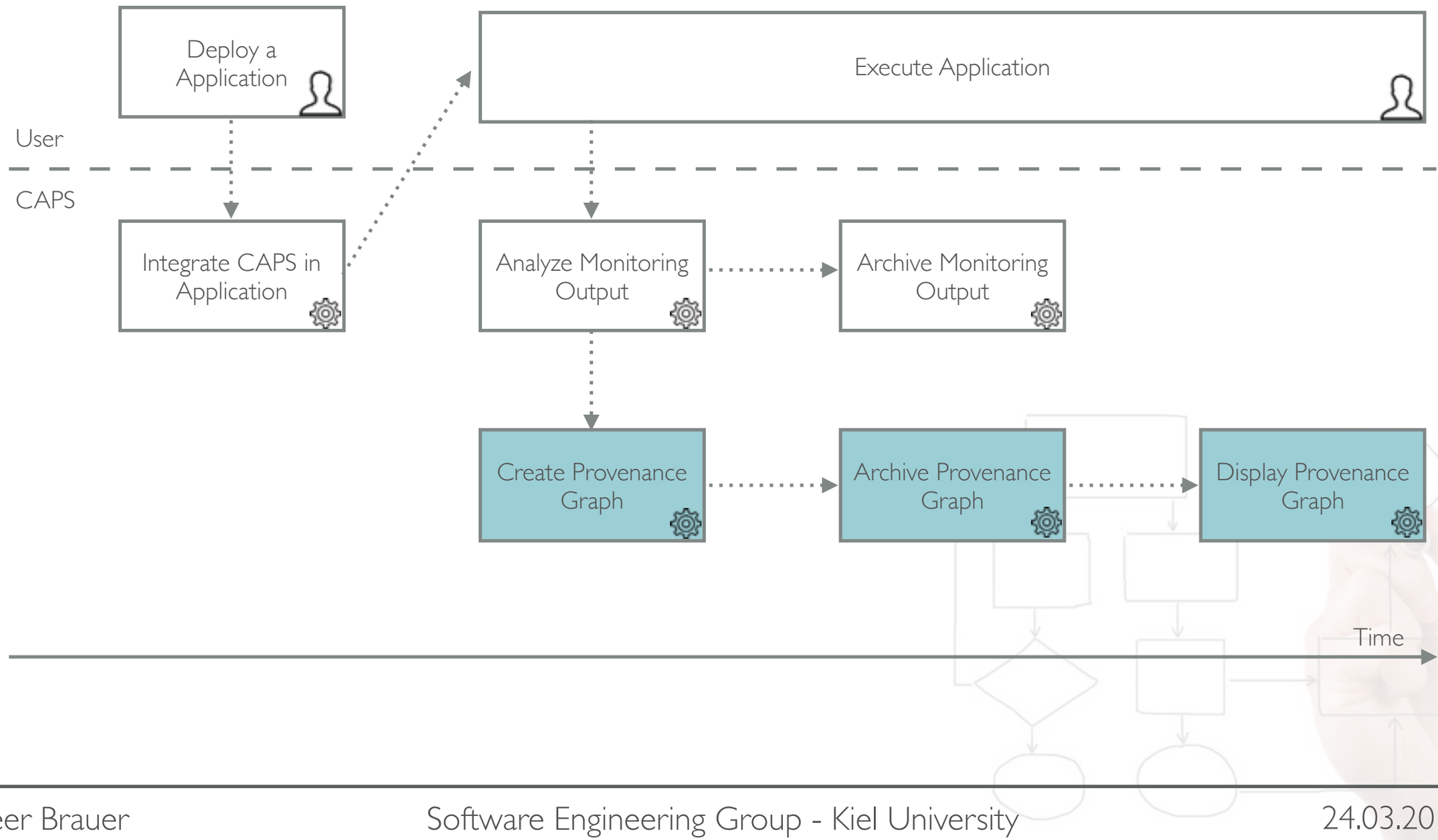
- Observation data analysis is build upon Kieker Webgui
- Data is processed by an integrated pipe and filter analysis framework
- Dedicated provenance filter reconstruct the provenance graph, workflow
- Additional information can be processed (Memory usage, CPU time, …)
- Own filters and analysis plugins can be added



Source: http://kieker-monitoring.net/features/webgui/attachment/kieker-webgui-02/

CAPS

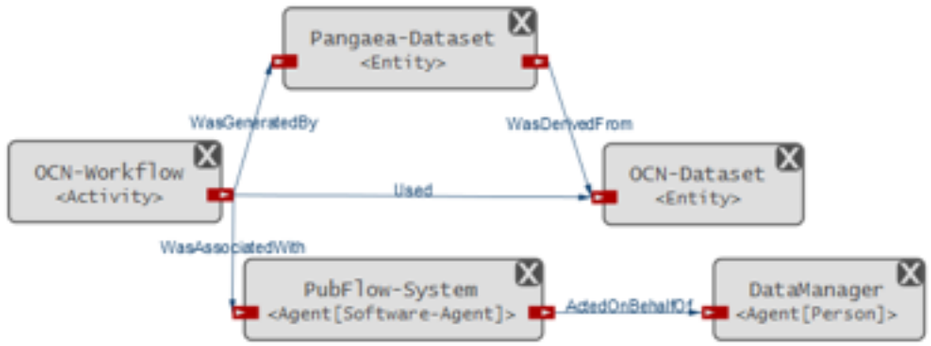
Basic Workflow



CAPS

Archiving the Provenance Data

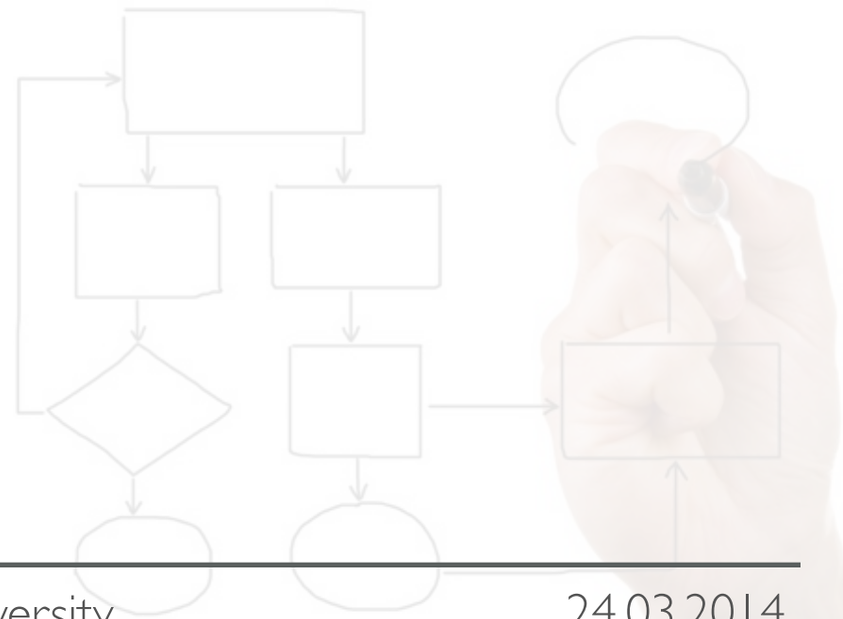
- Provenance archive build upon Neo4J, EMF and Prov-DM



- API, Webservice and WebGUI for accessing the provenance information

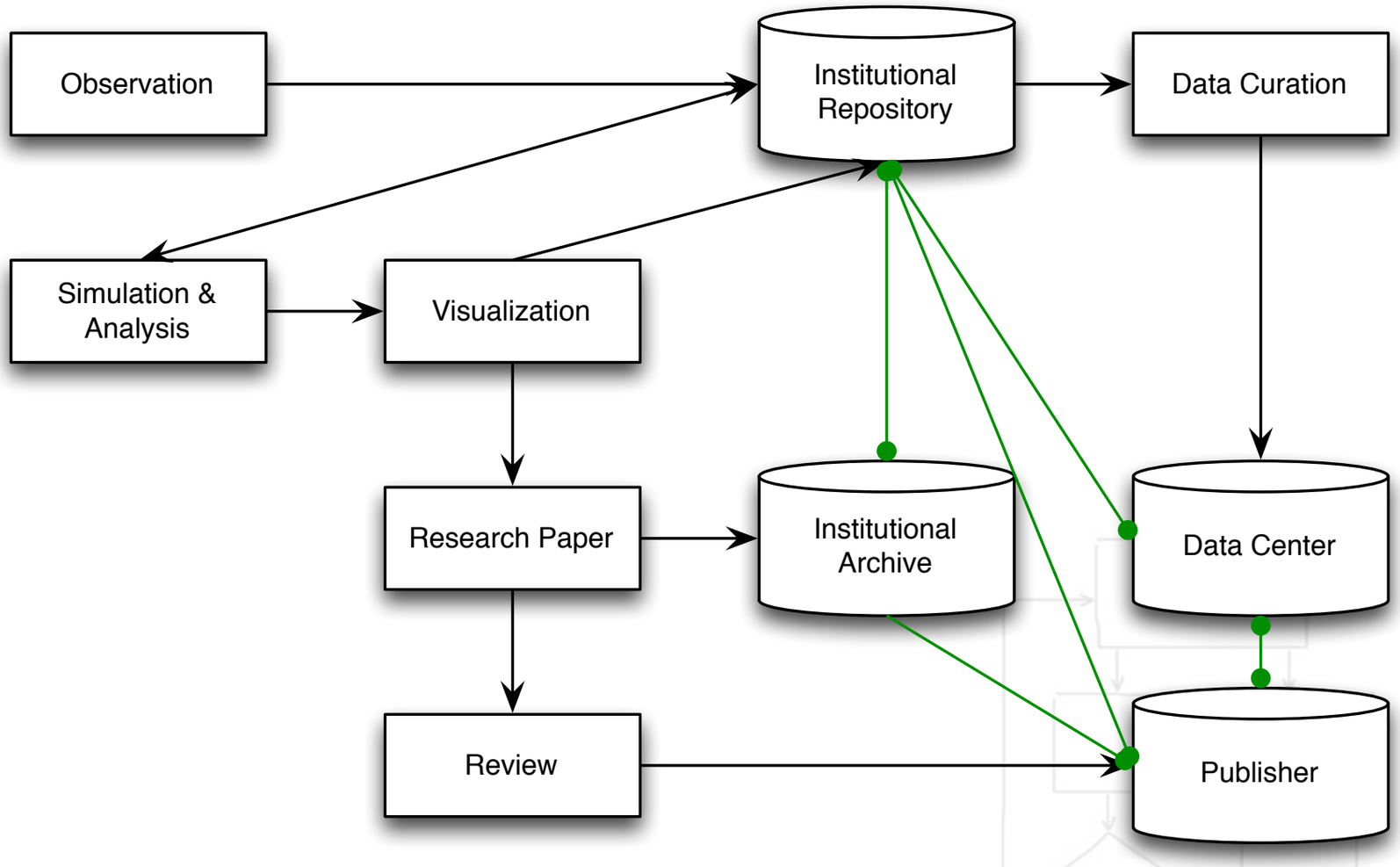
- Export of the provenance data to data centers (i.e. Zenodo)

Evaluation



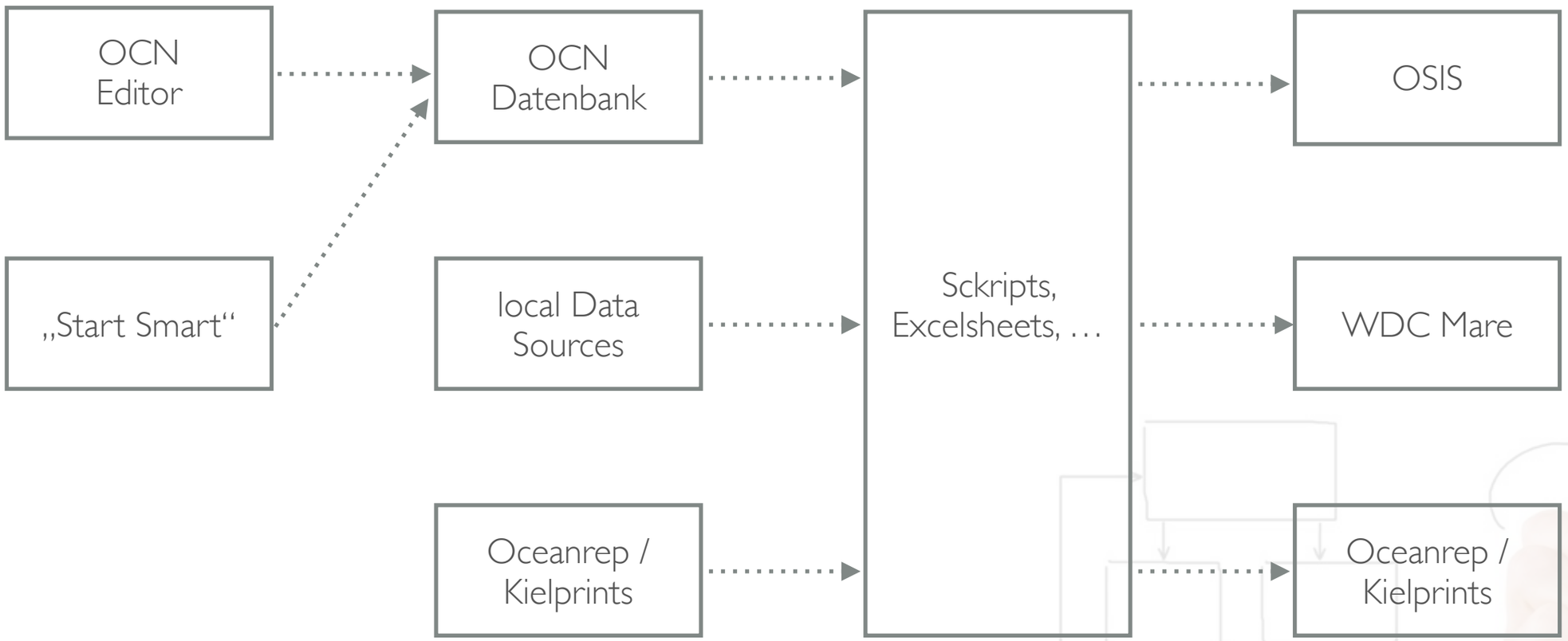
EVALUATION

PubFlow



EVALUATION

System Landscape



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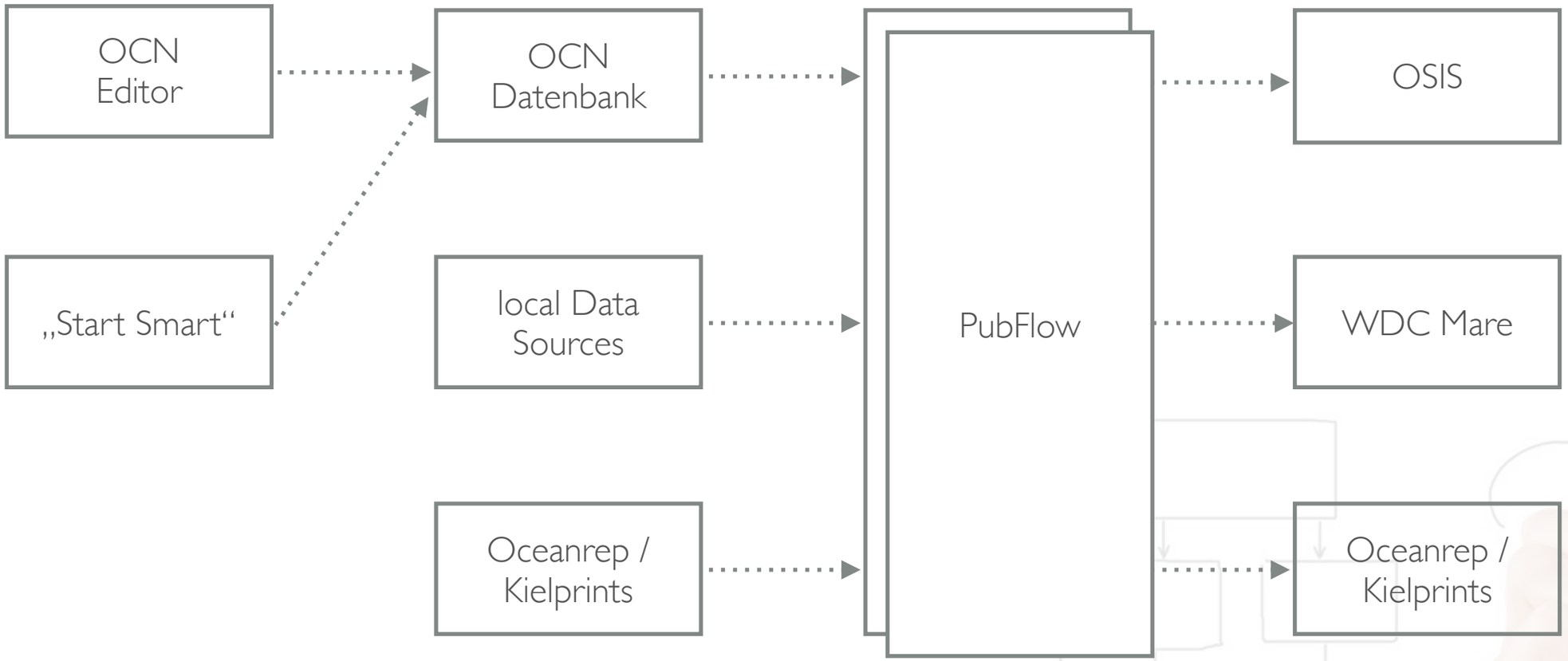
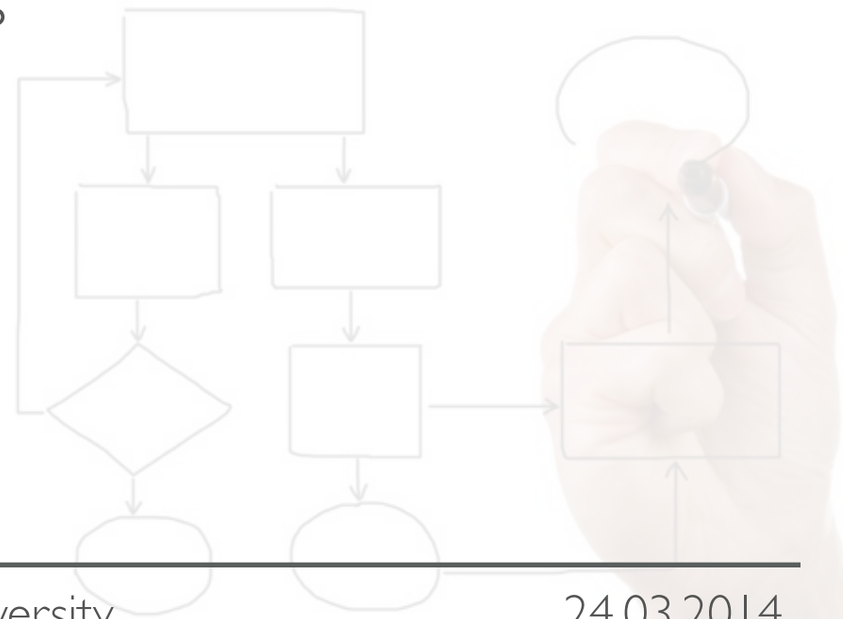


EVALUATION

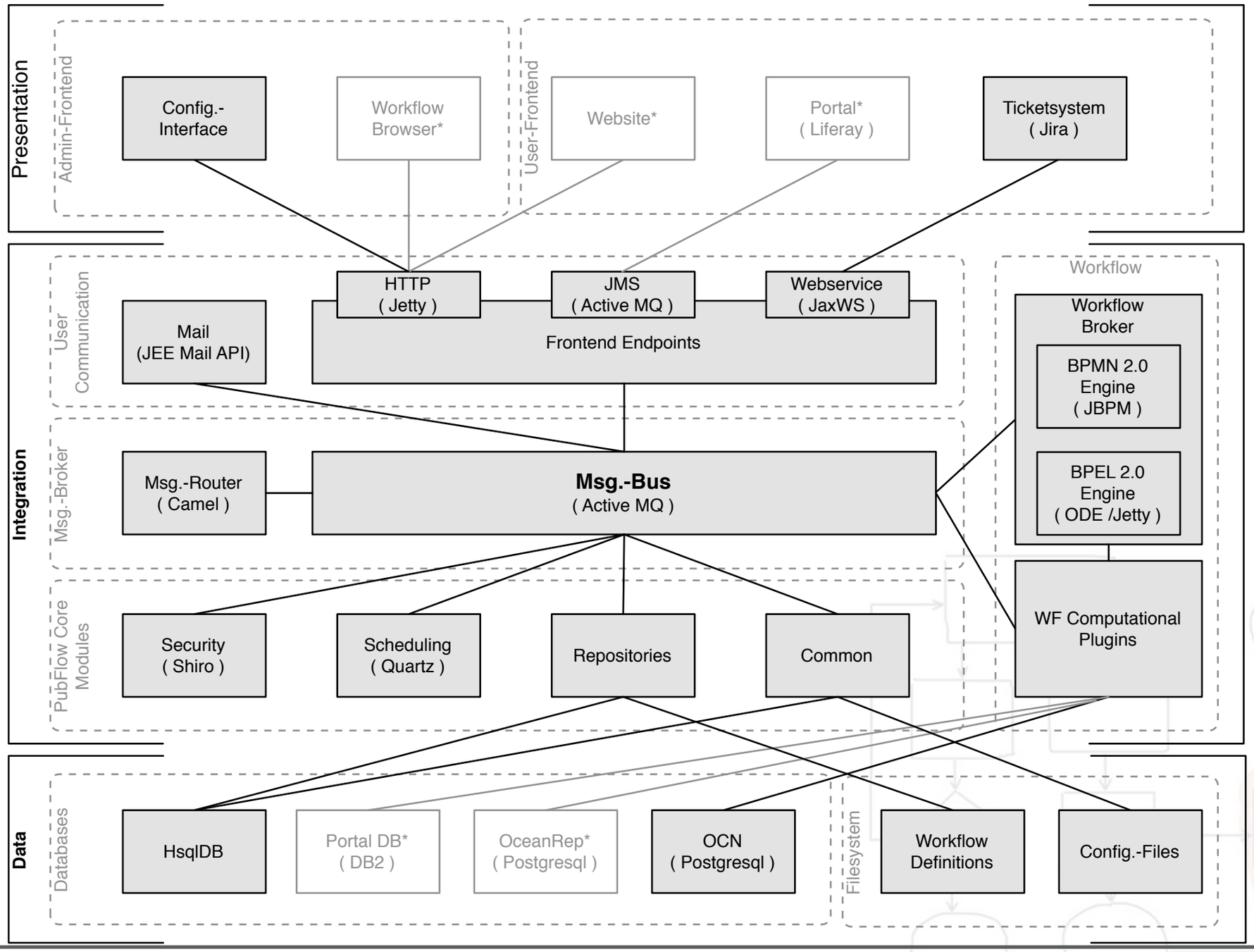
PubFlow : Goals

- Development of a workflow based tool for data publication
- Integration of PubFlow in the existing systems



EVALUATION

PubFlow



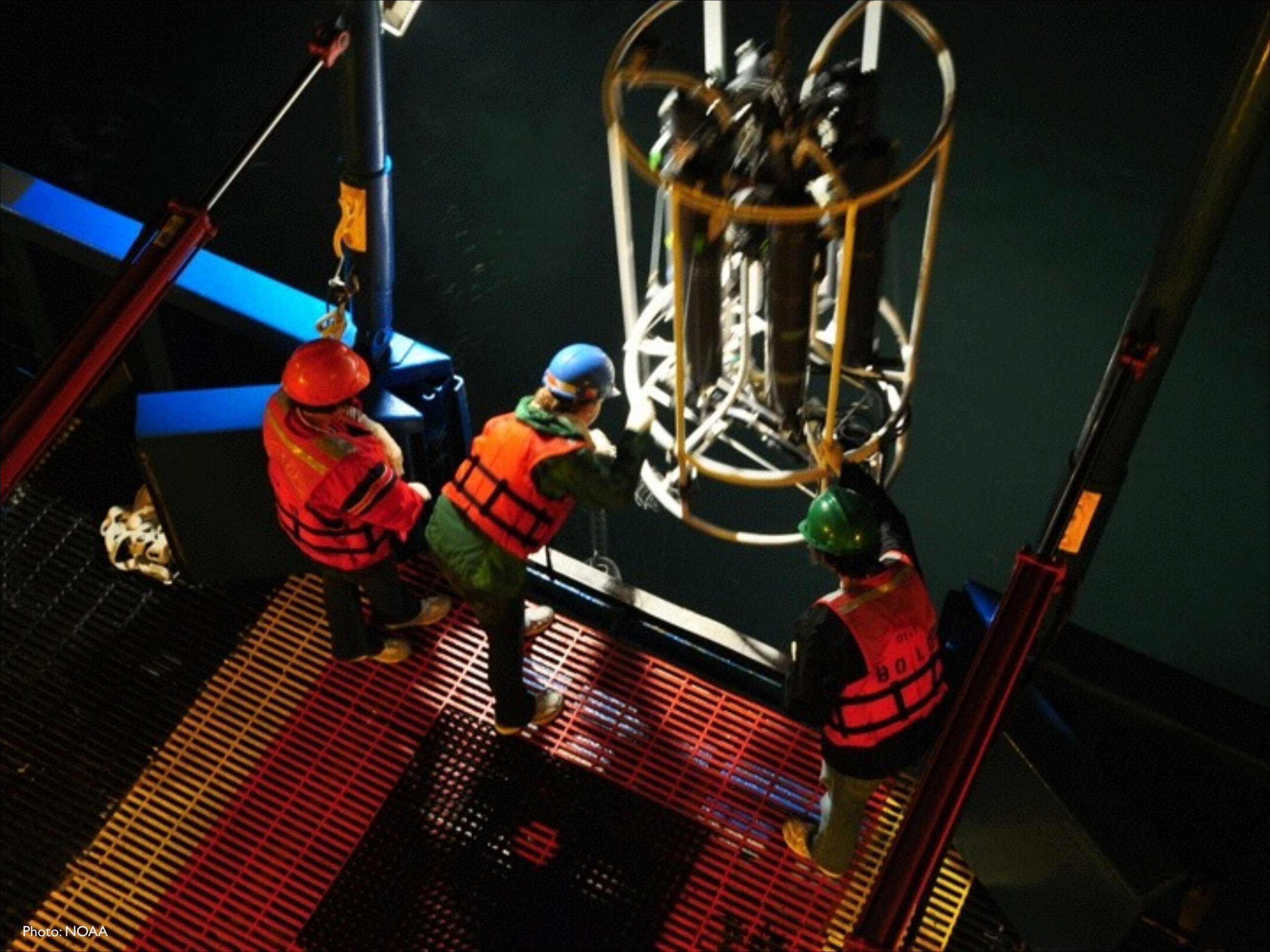
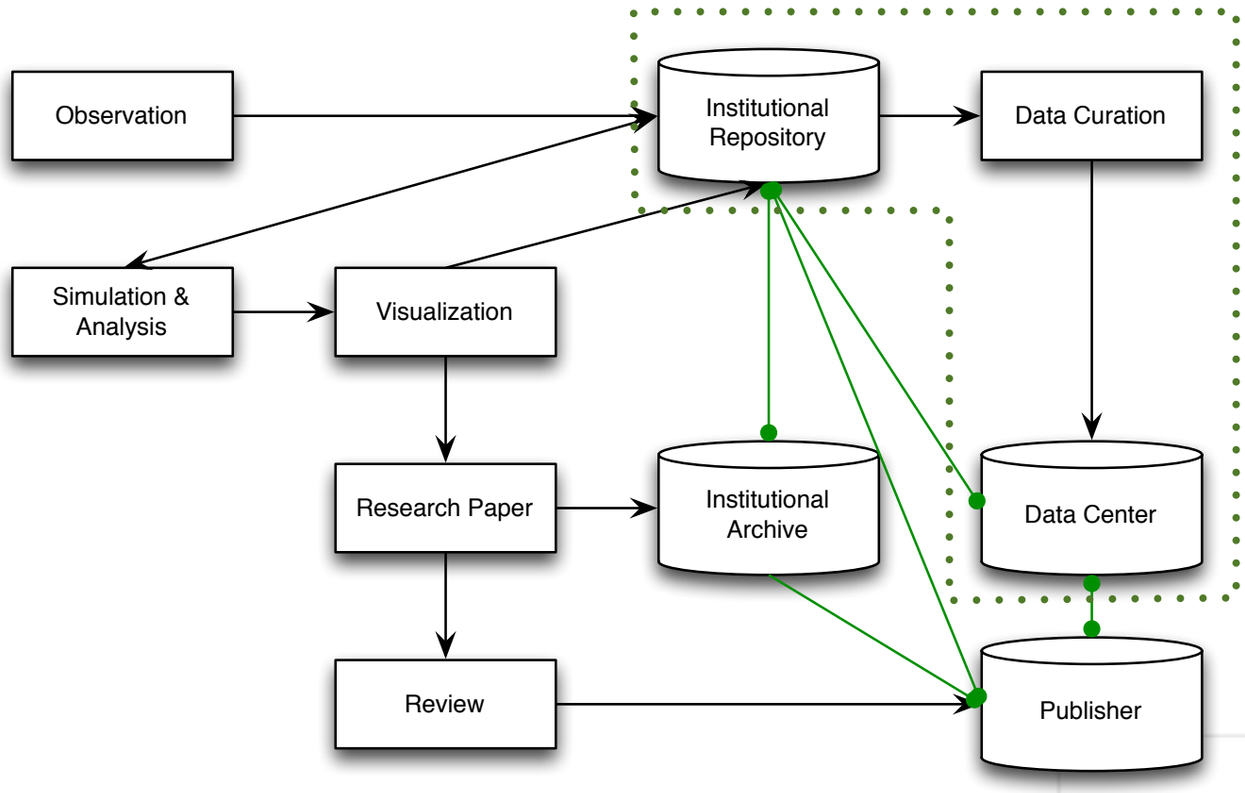


Photo: NOAA

EVALUATION

PubFlow : The Workflow



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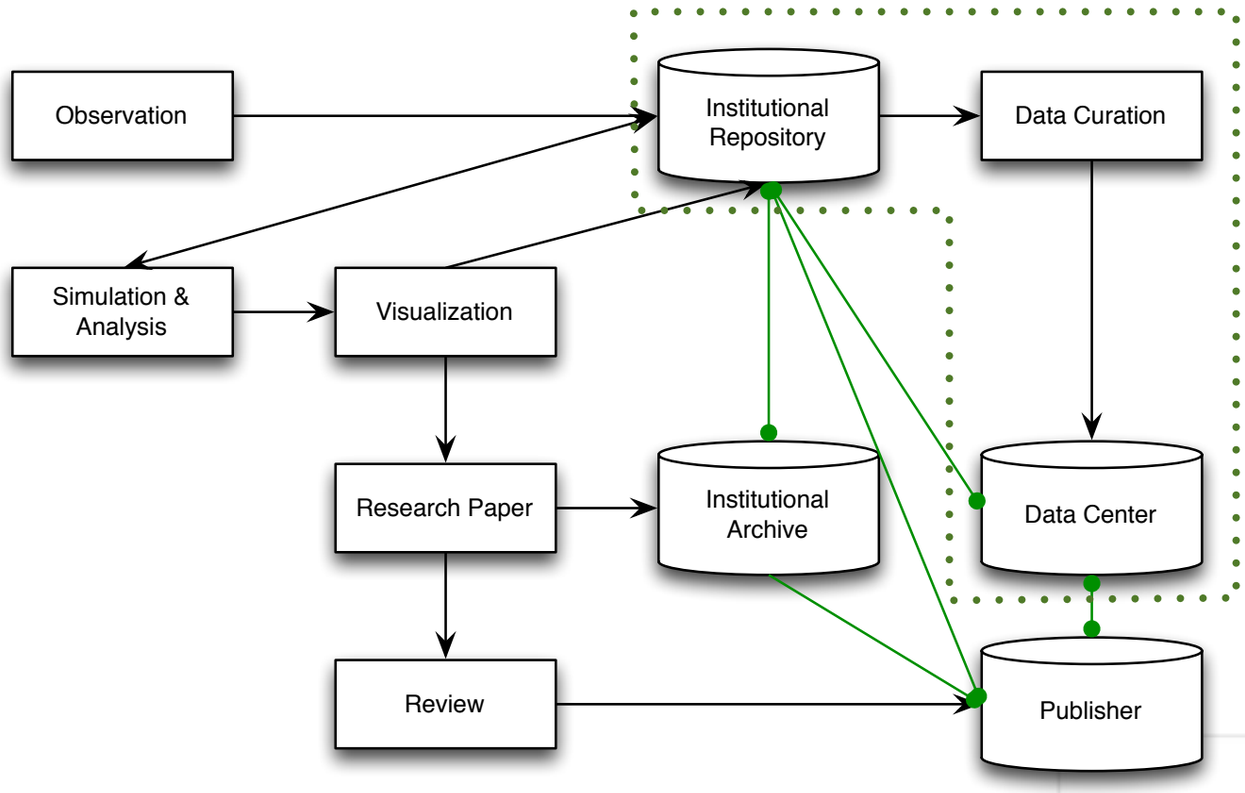

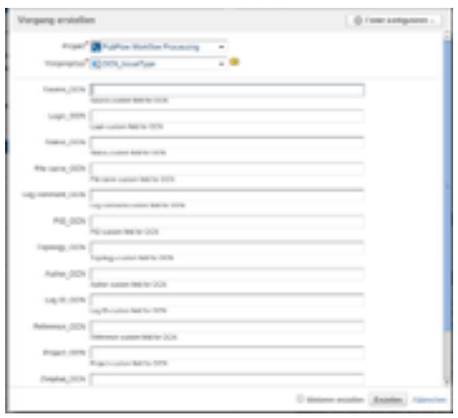

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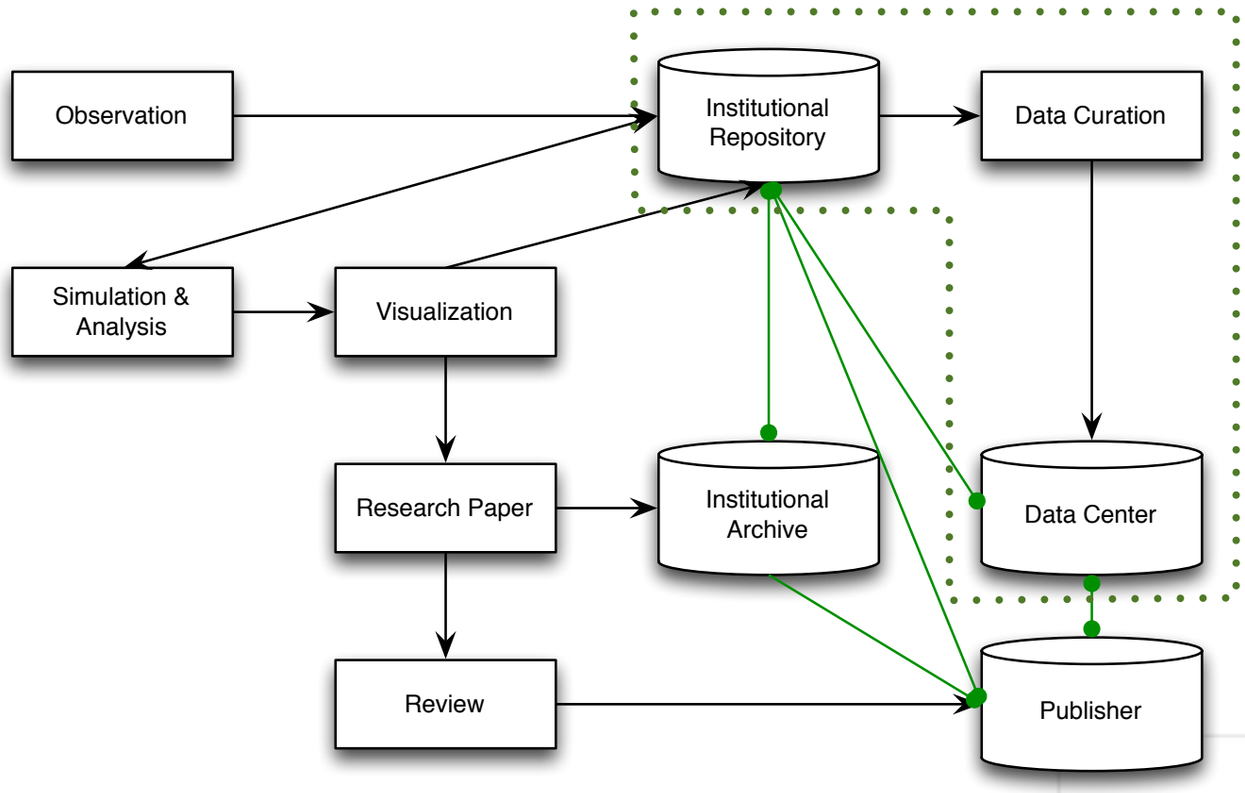
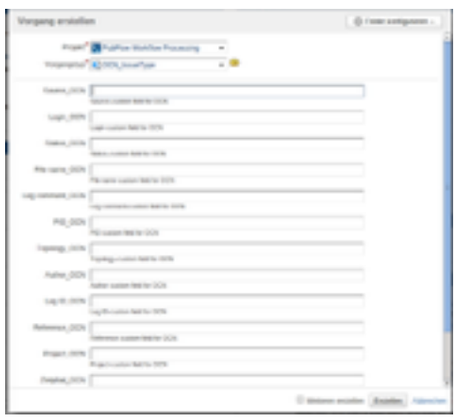
PubFlow : The Workflow

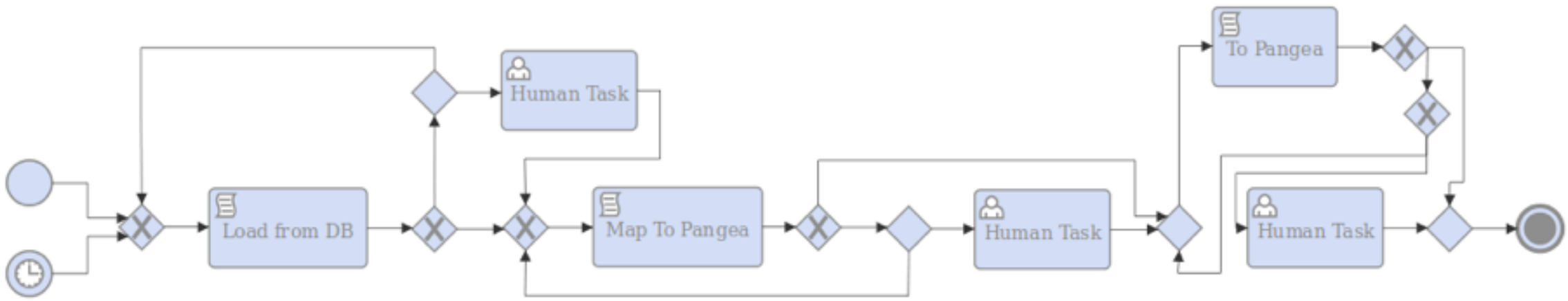




EVALUATION

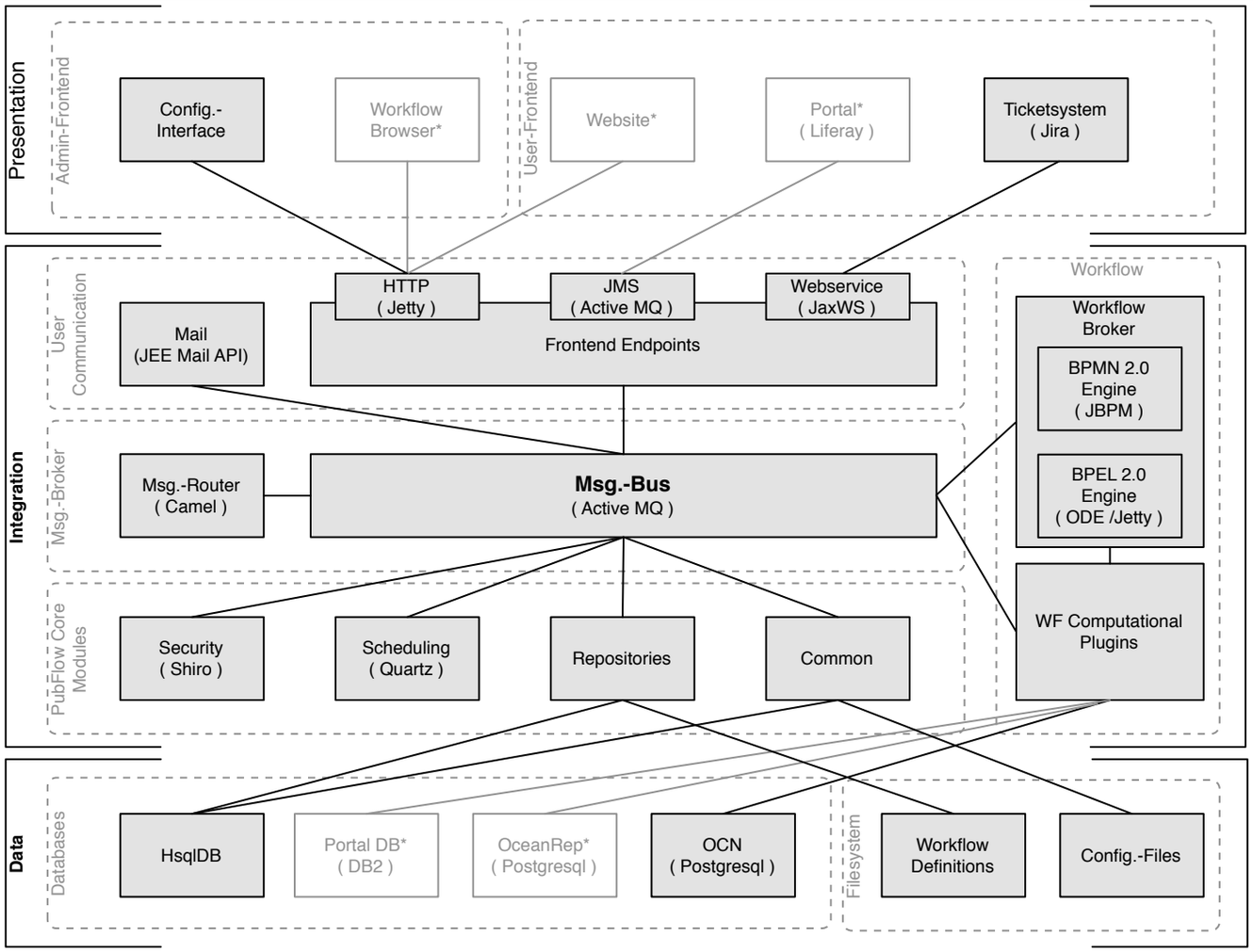
PubFlow : The Workflow

- Loading the Data
- Transformation
- Export the Data to the WDC



EVALUATION

PubFlow



EVALUATION

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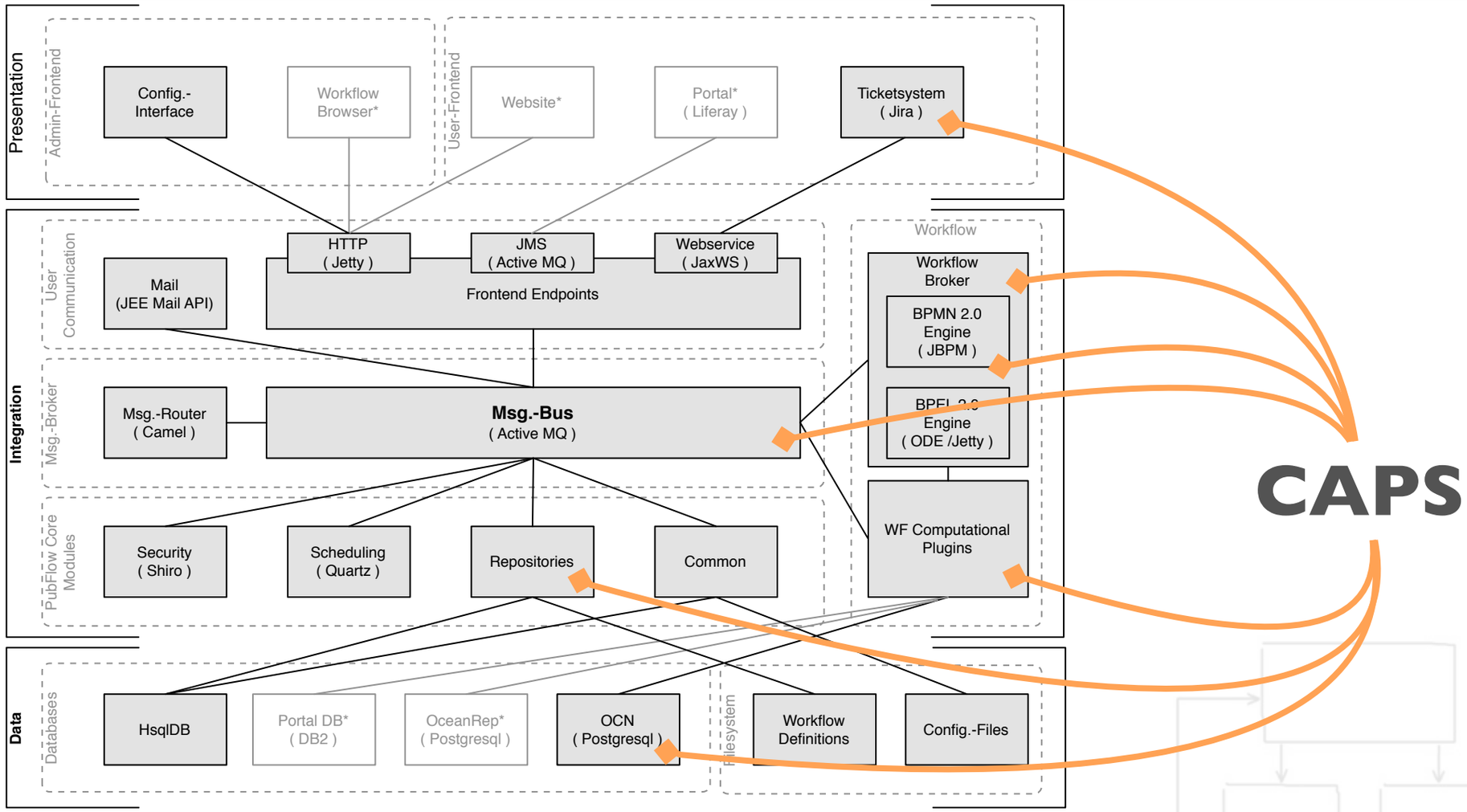

EVALUATION

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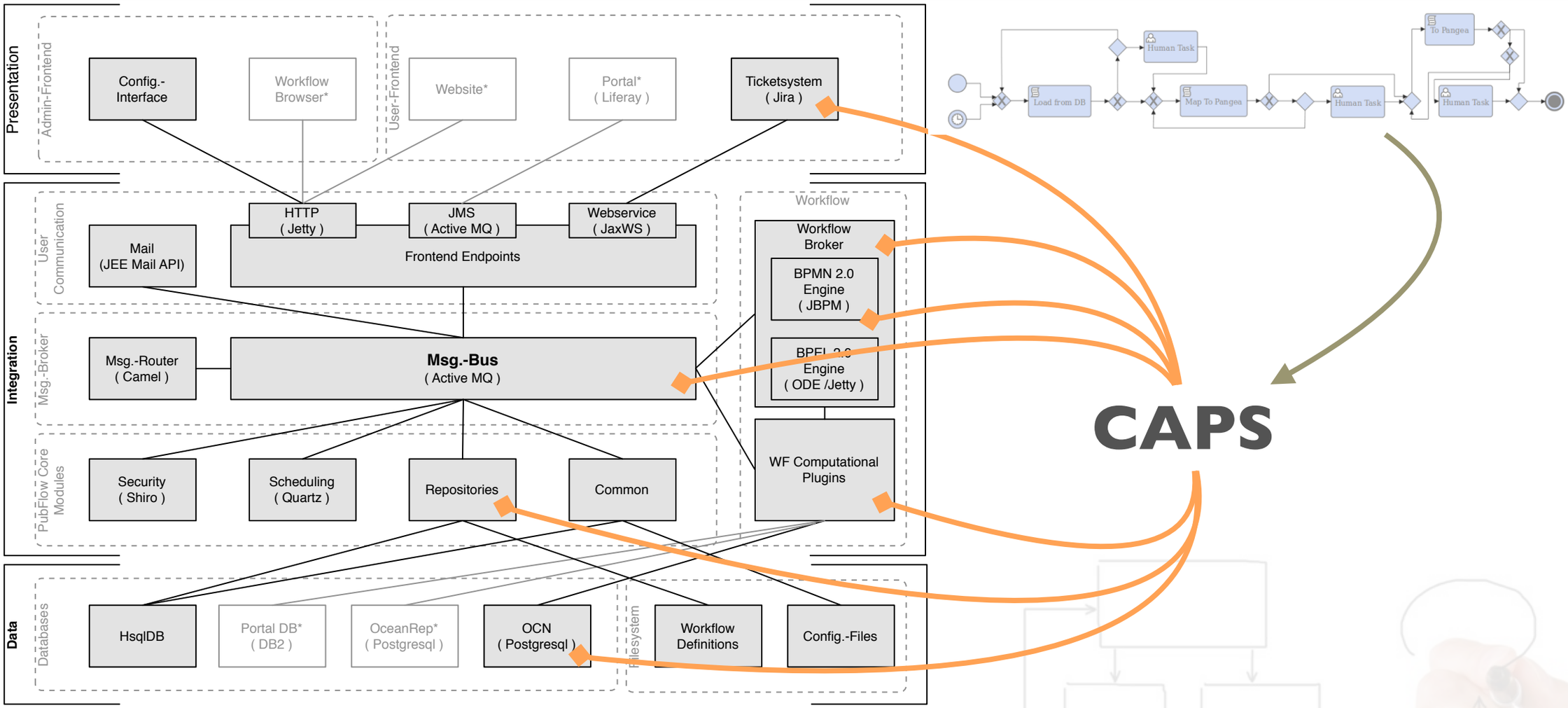

EVALUATION

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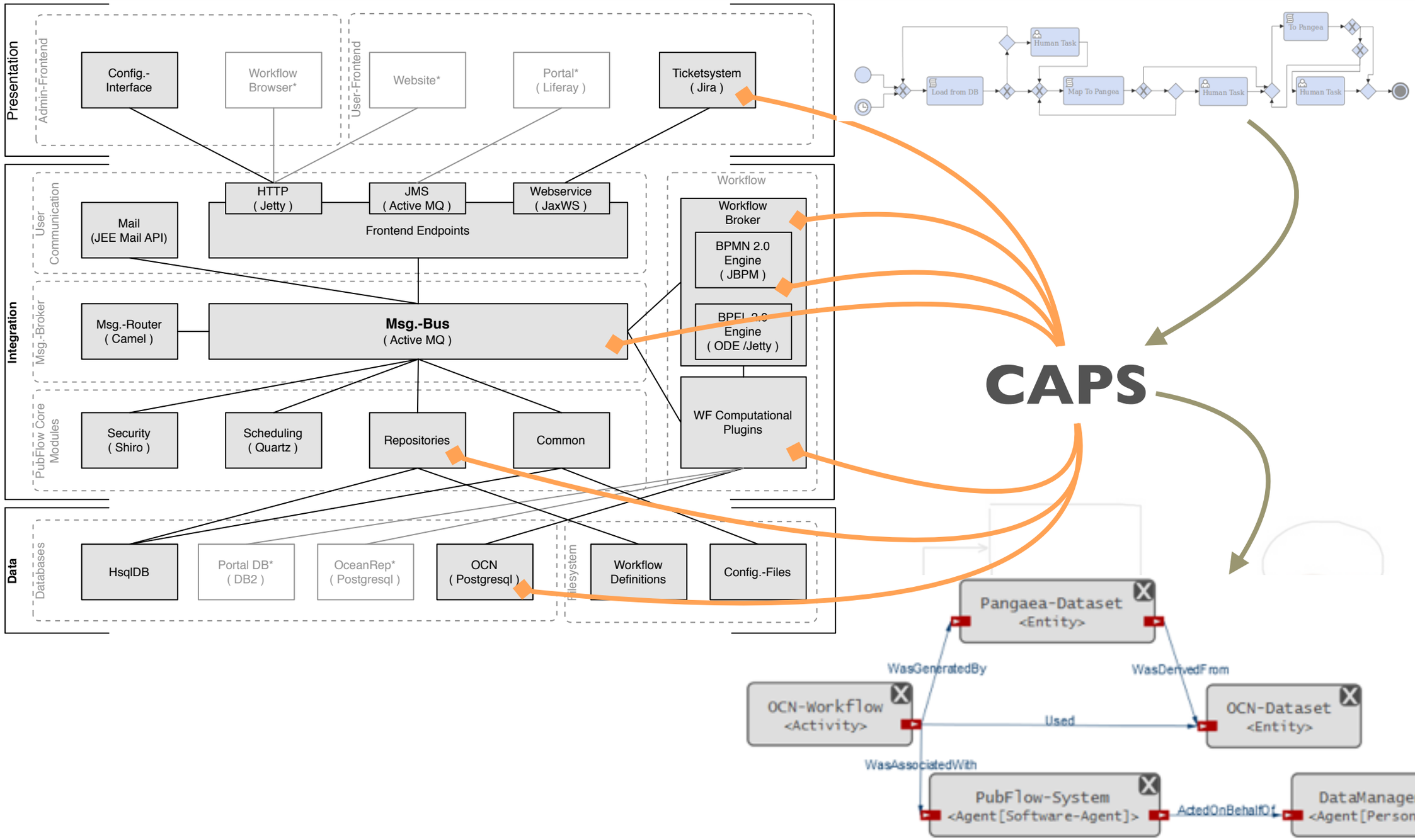
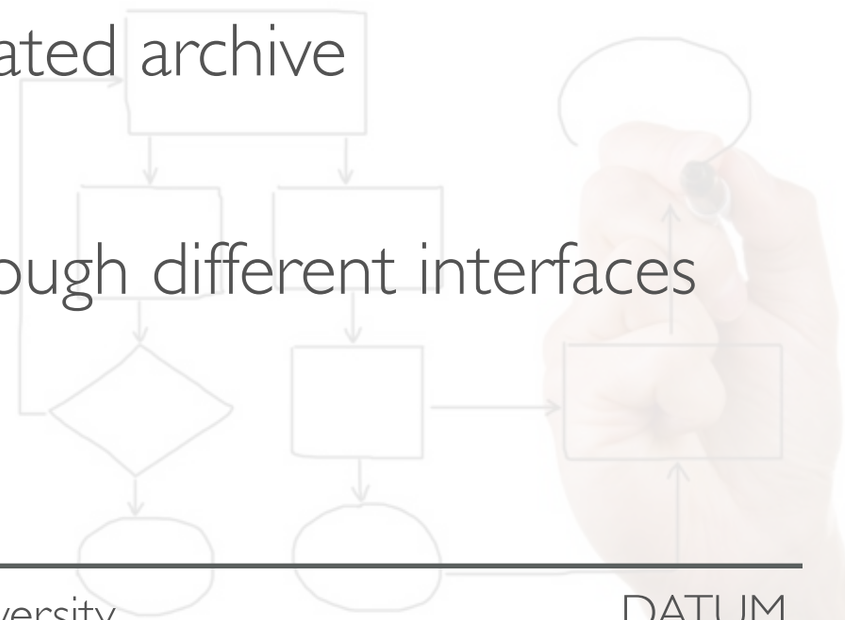


CONCLUSION

- CAPS captures provenance information using AspectJ and workflow monitoring
- Uses proven technologie like Kieker, Neo4J, Emf, GWT, …
- Archives provenance information in an integrated archive
- Makes provenance information accessible through different interfaces



CONCLUSION

Thanks for your attention !