Vincenzo Ferme, Cesare Pautasso | University of Lugano (USI)

Towards a Benchmark for BPMN Engines

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Nagarjuna Siddam

Tayyaba Azad

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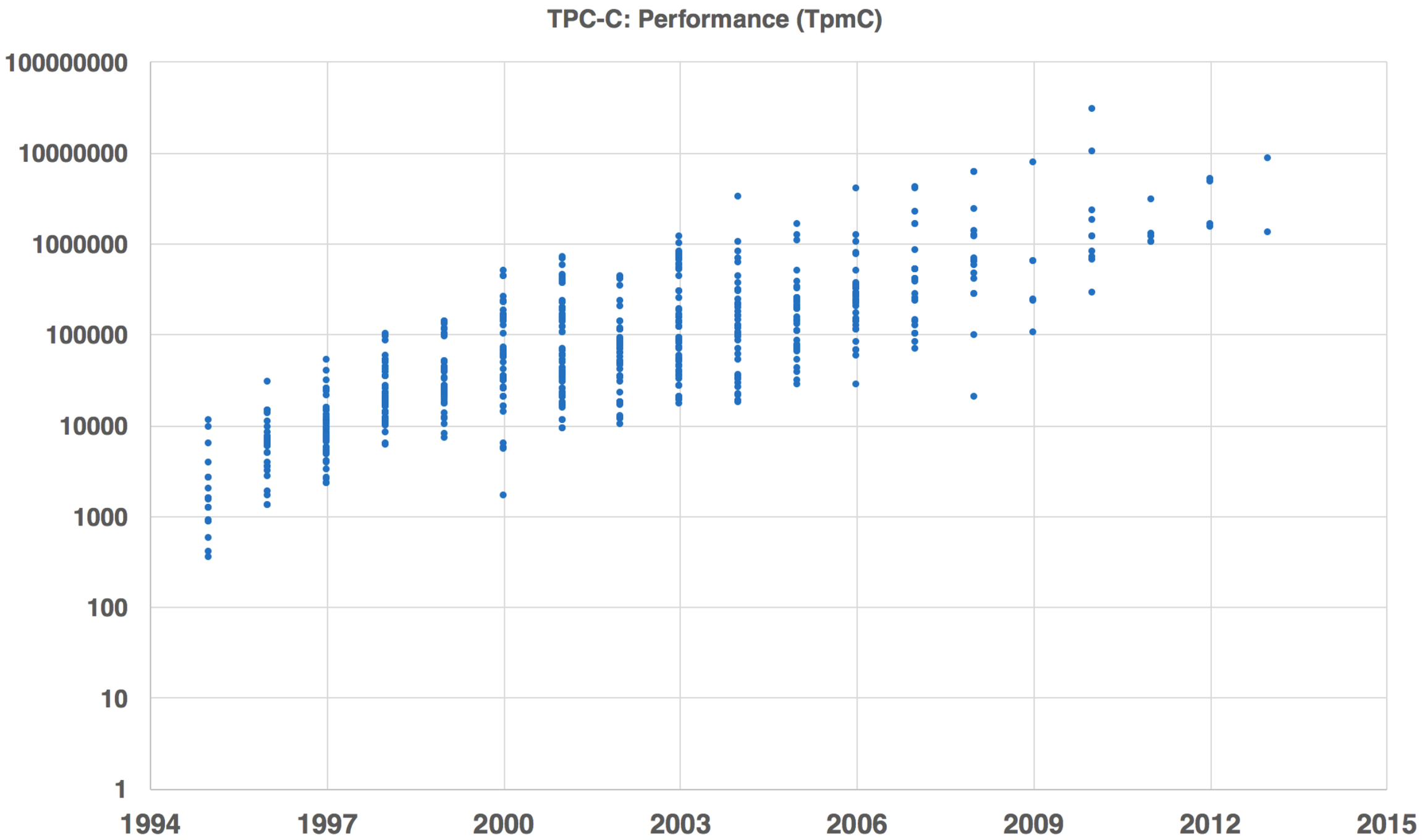
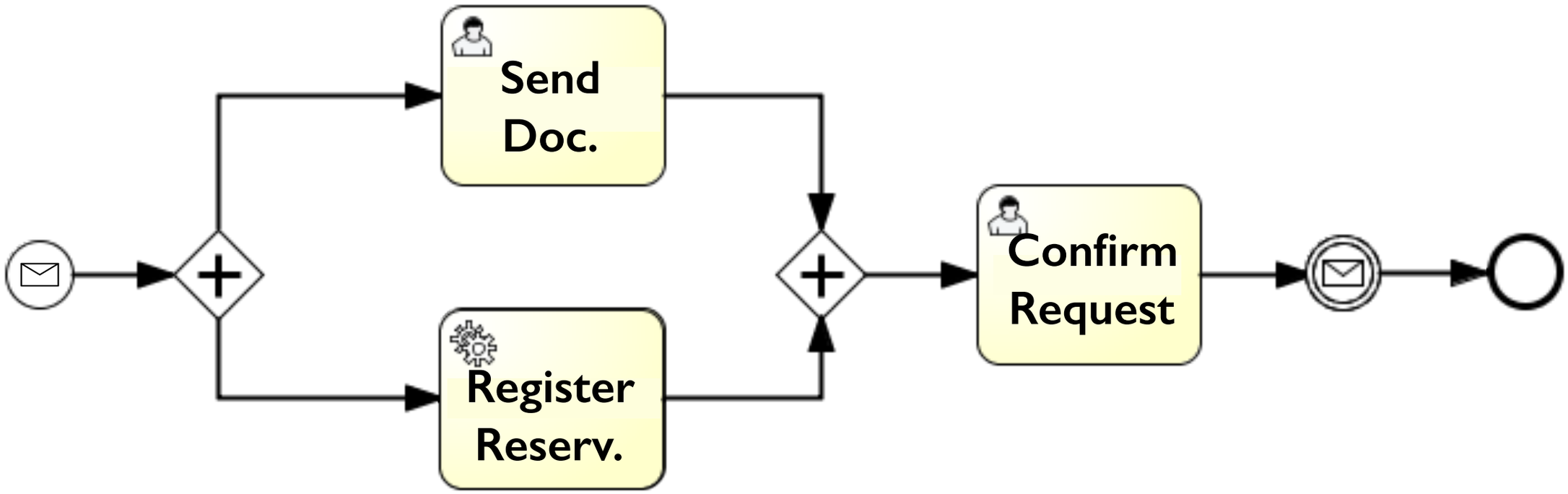
Germany

The Impact of TPC Benchmark on DBMS Performance



Source: http://www.tpc.org/tpcc/results/tpcc_results.asp

What is a Workflow?



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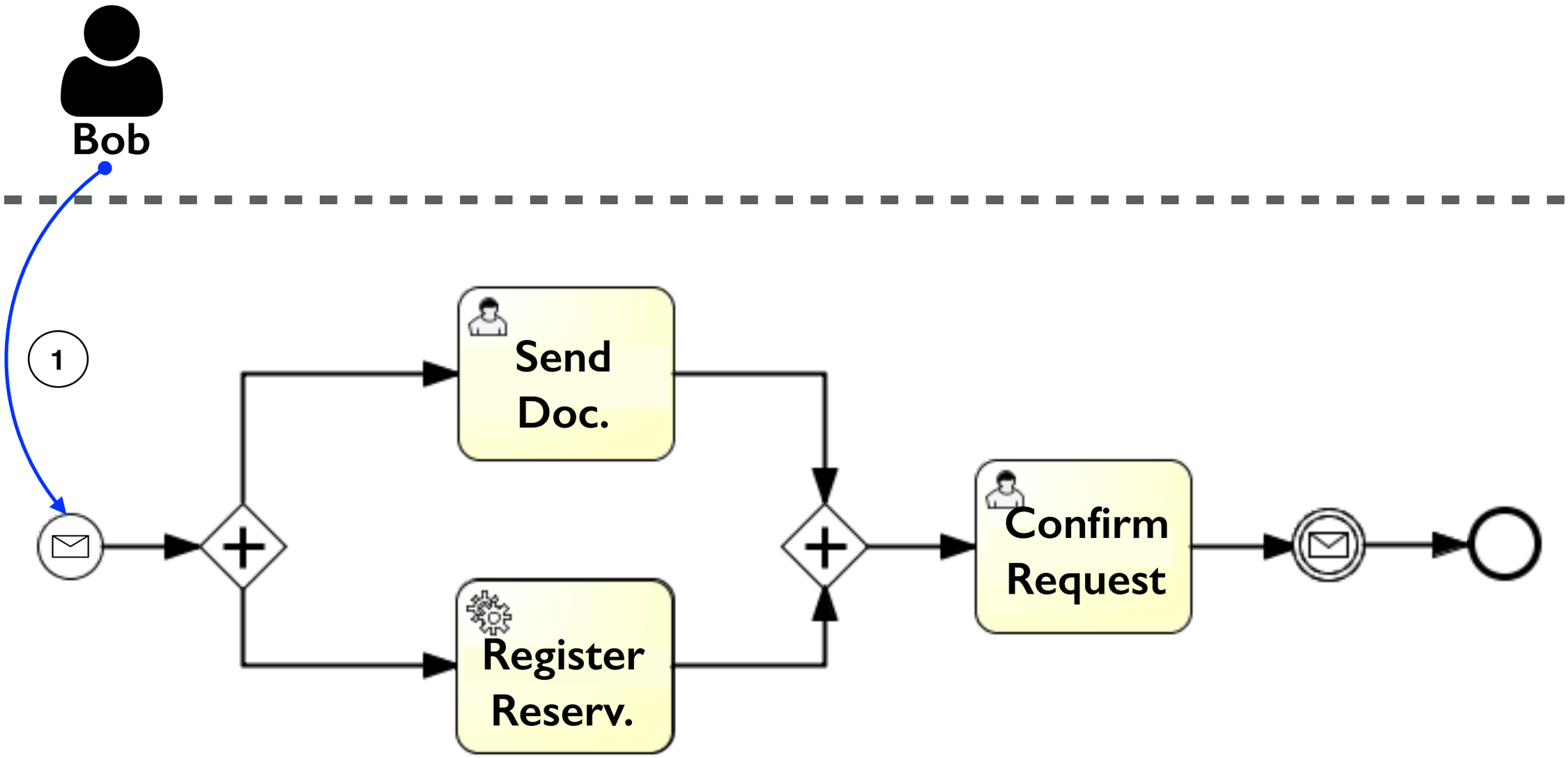

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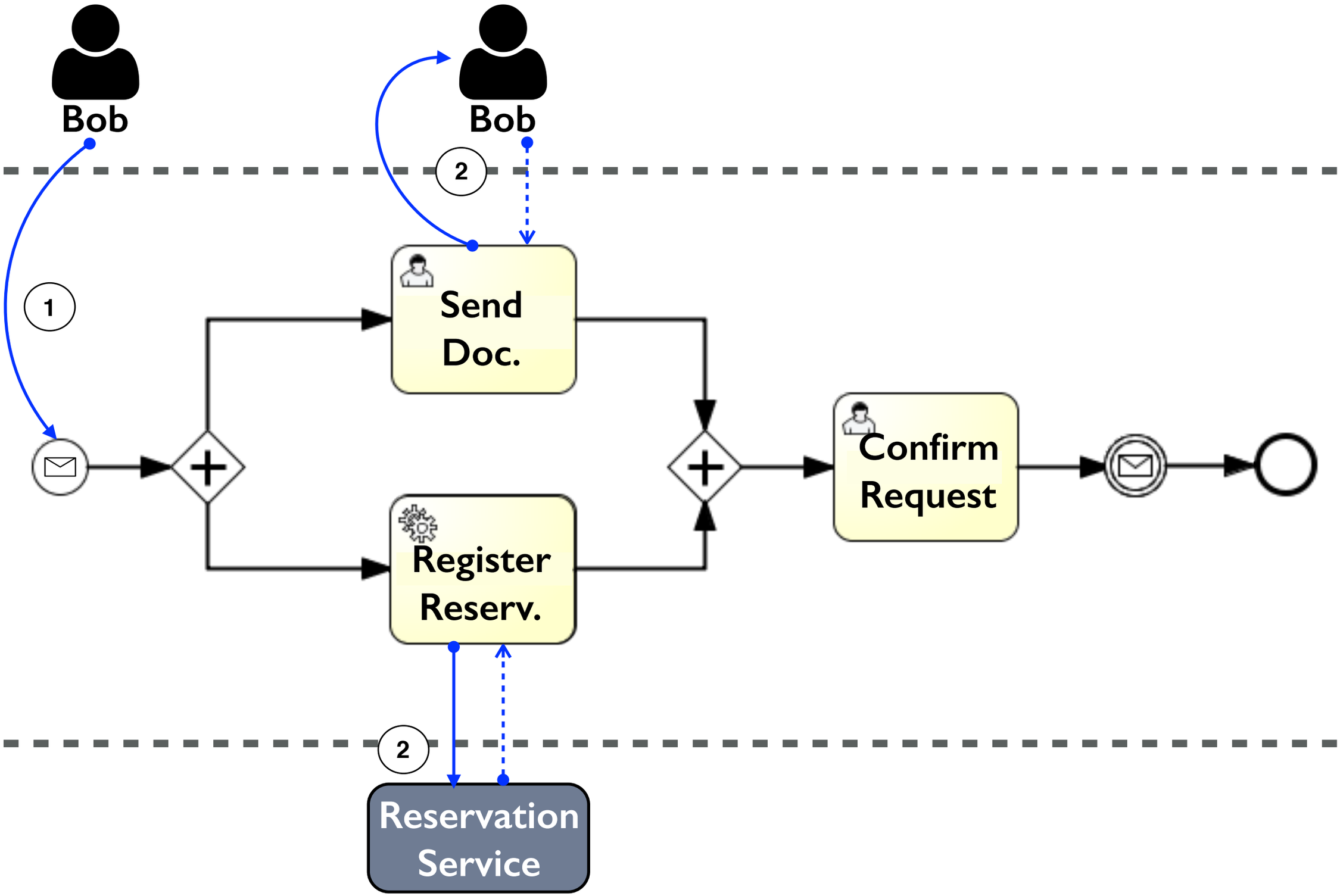

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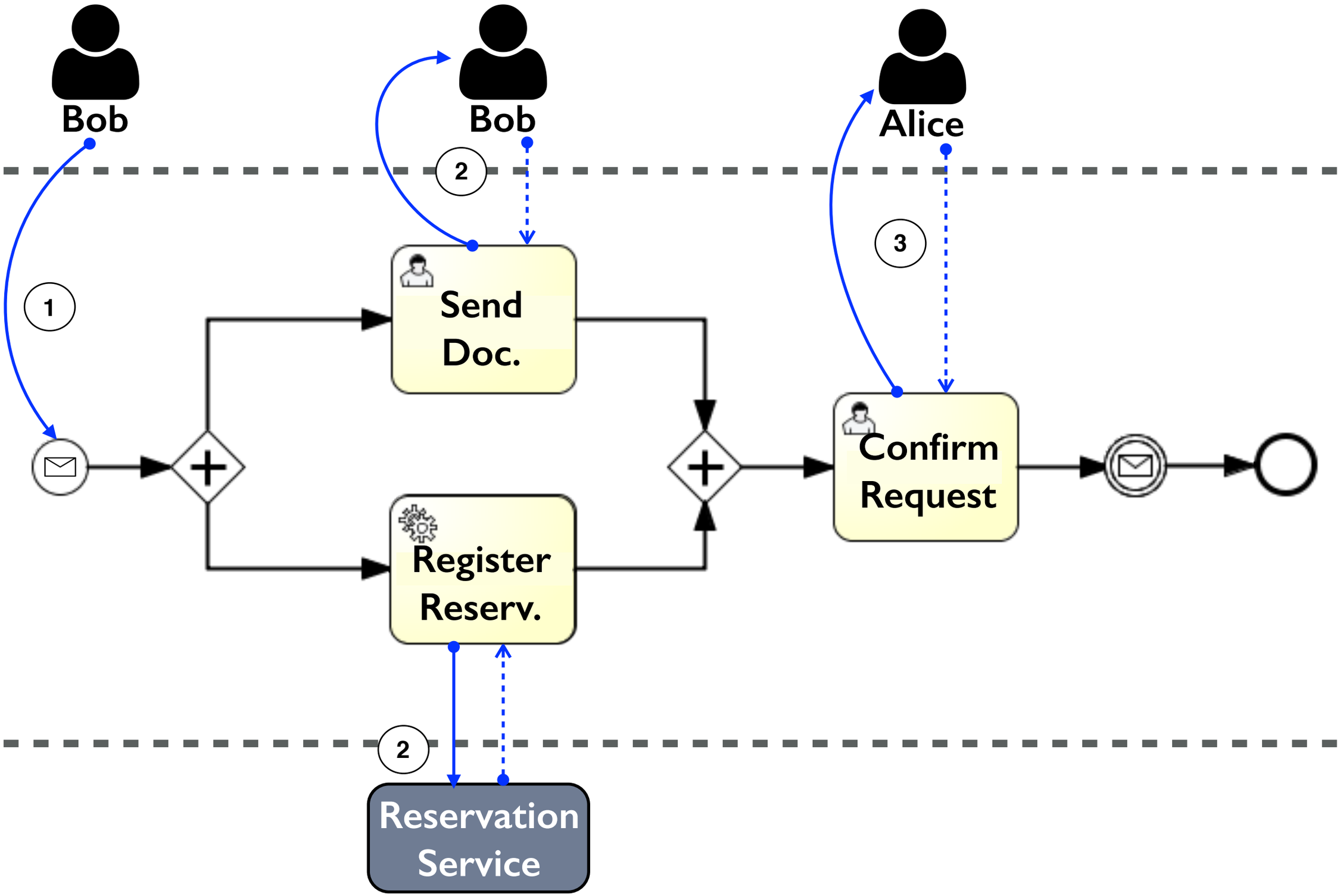

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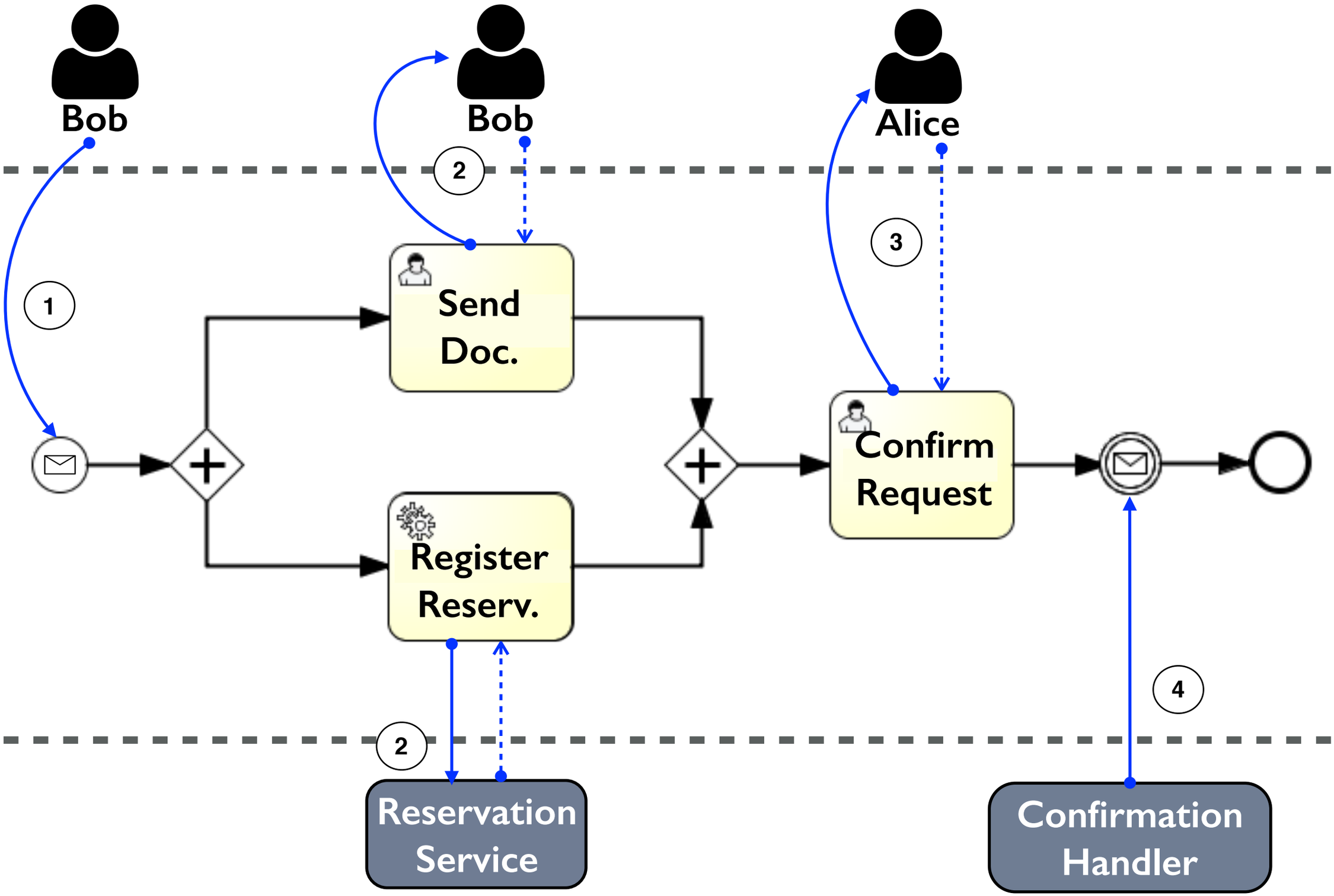

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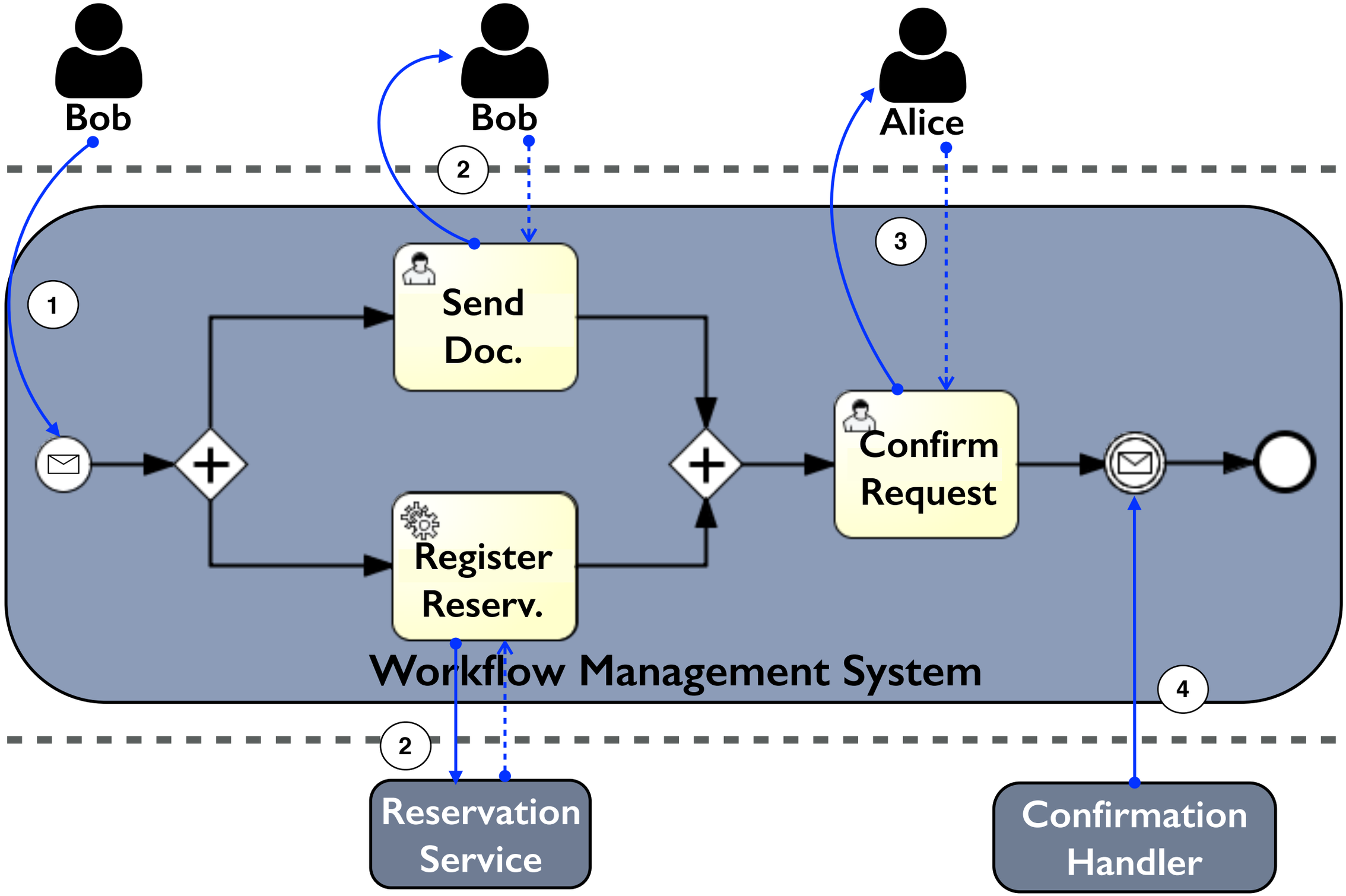
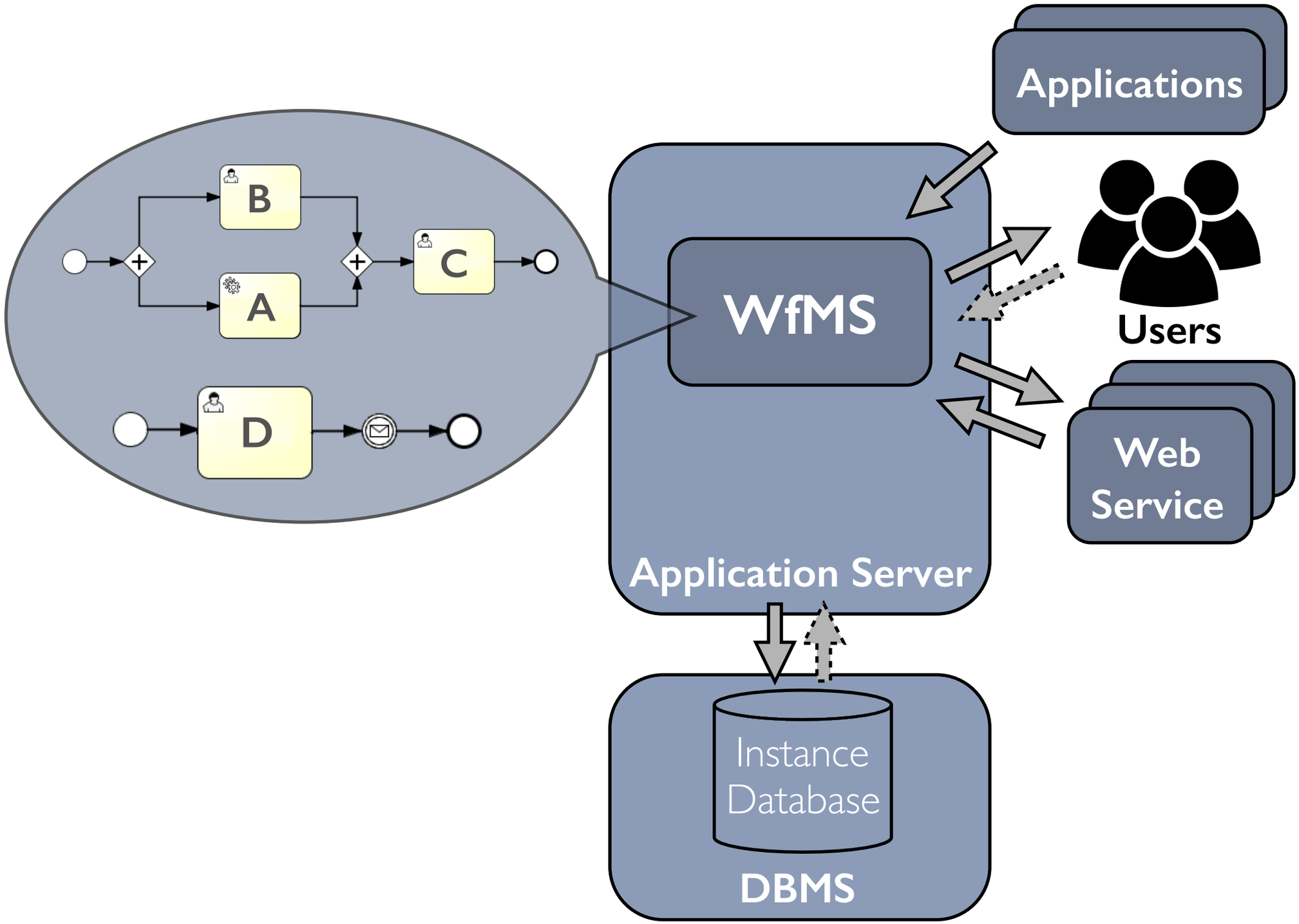
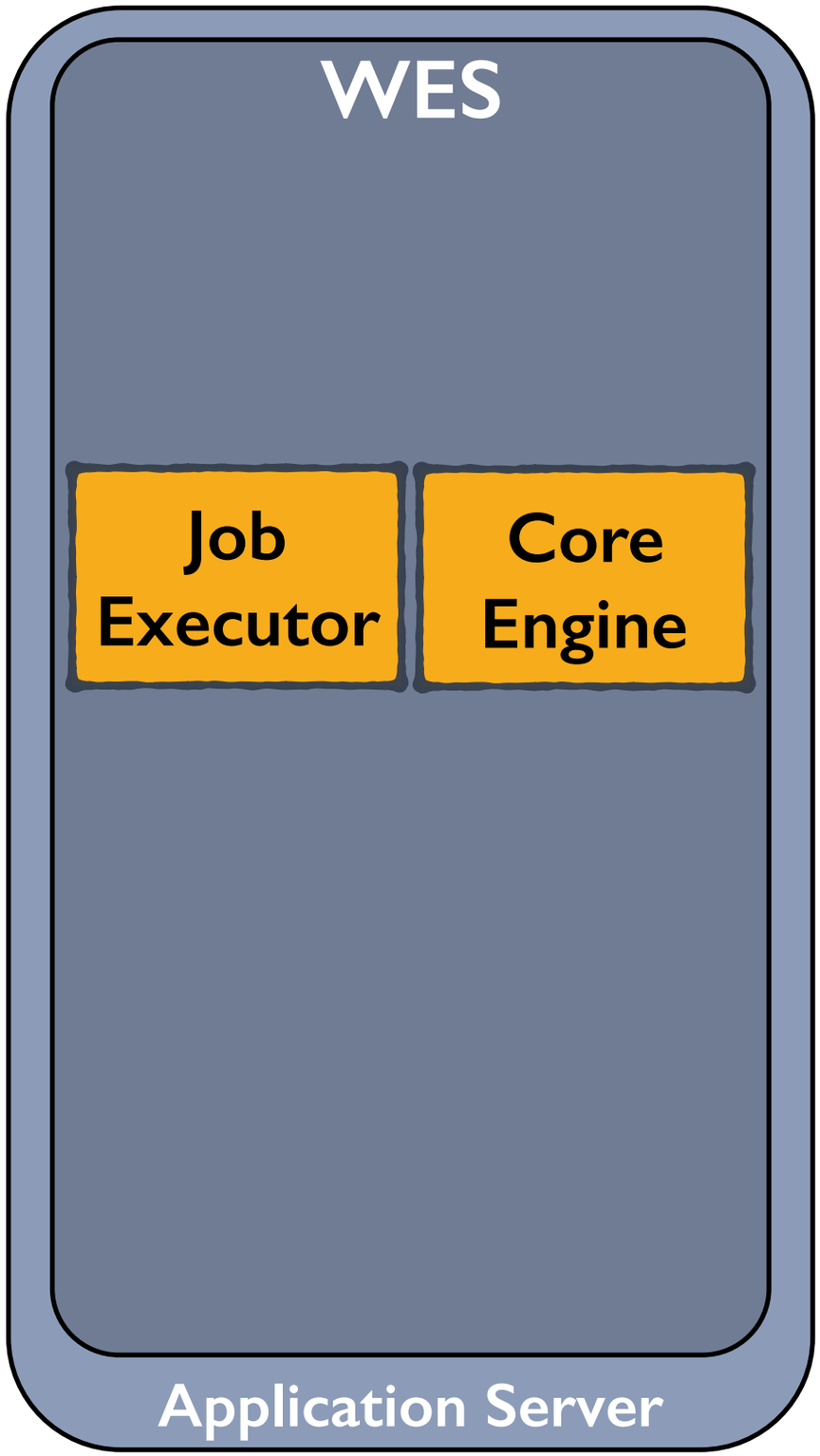


What is a Workflow Management System (WfMS)?



Workflow Management System's Main Components



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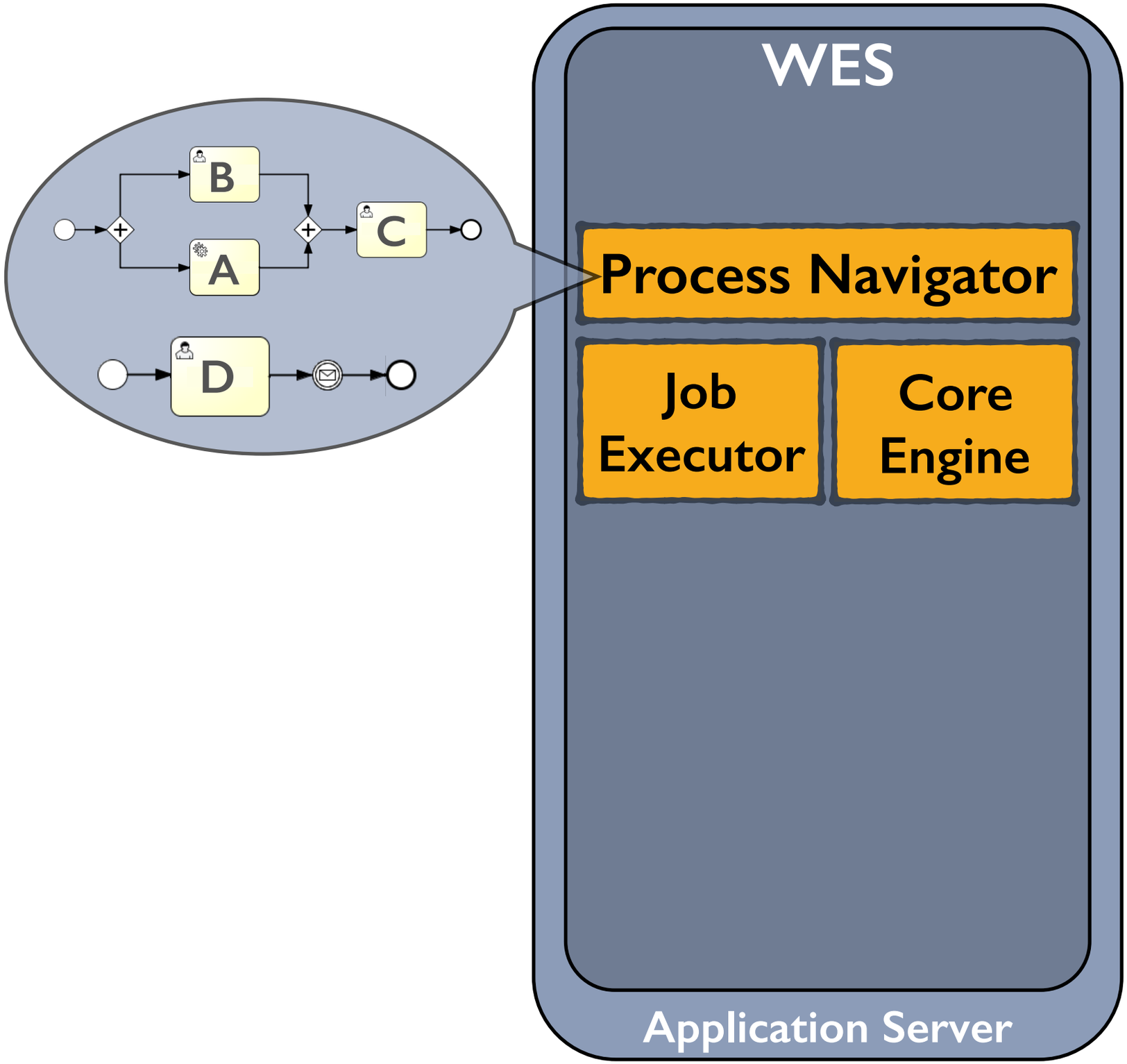

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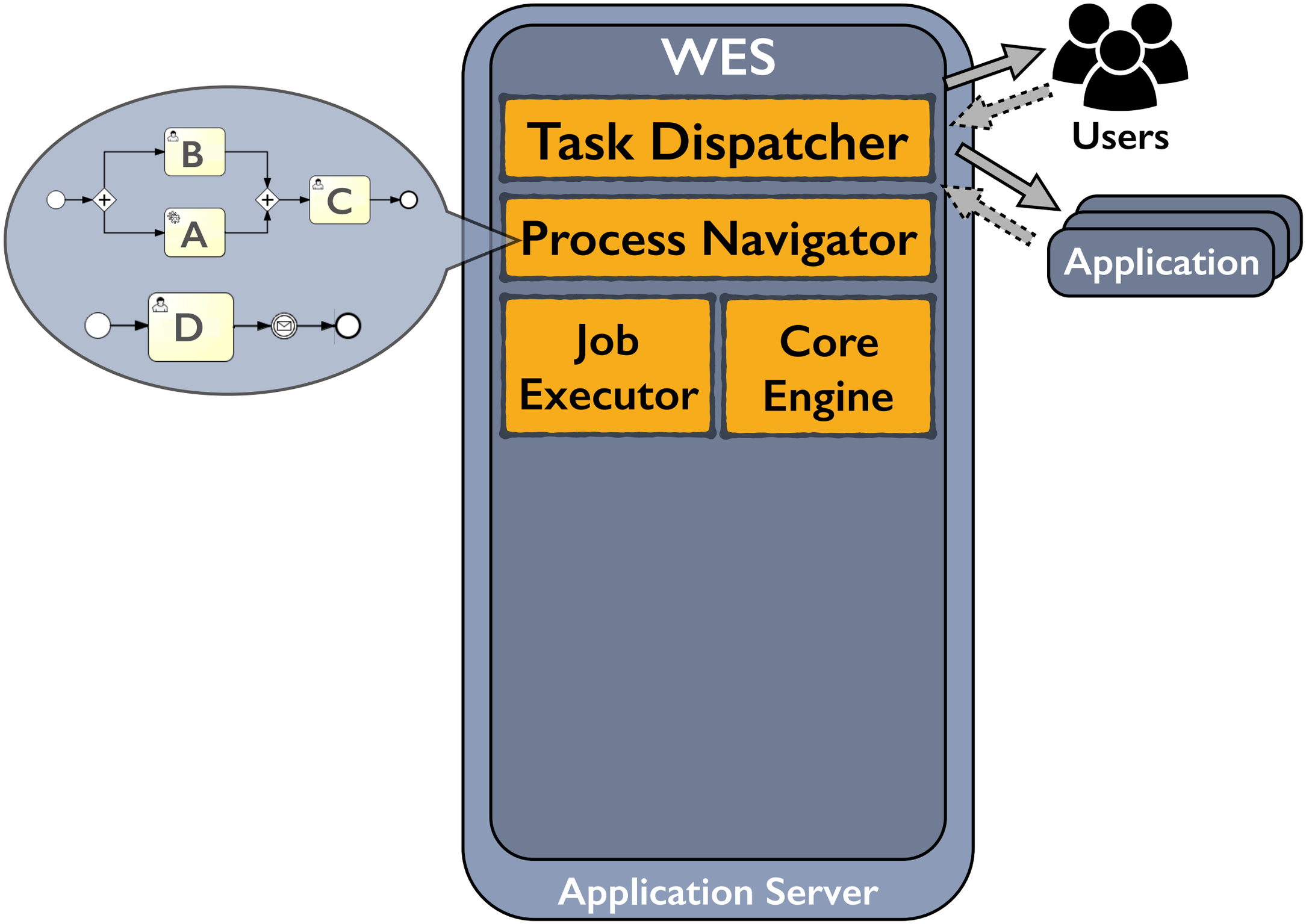

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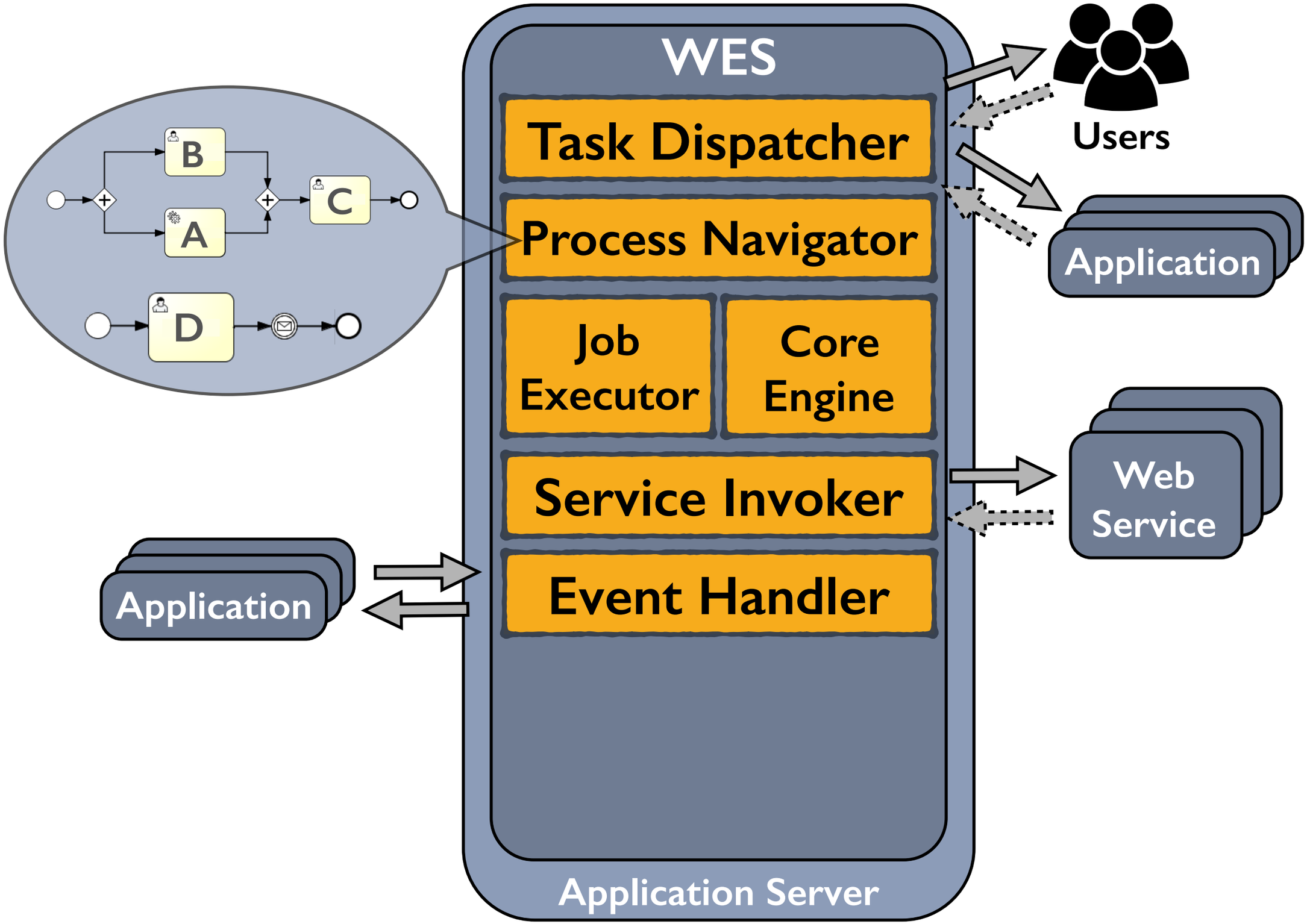

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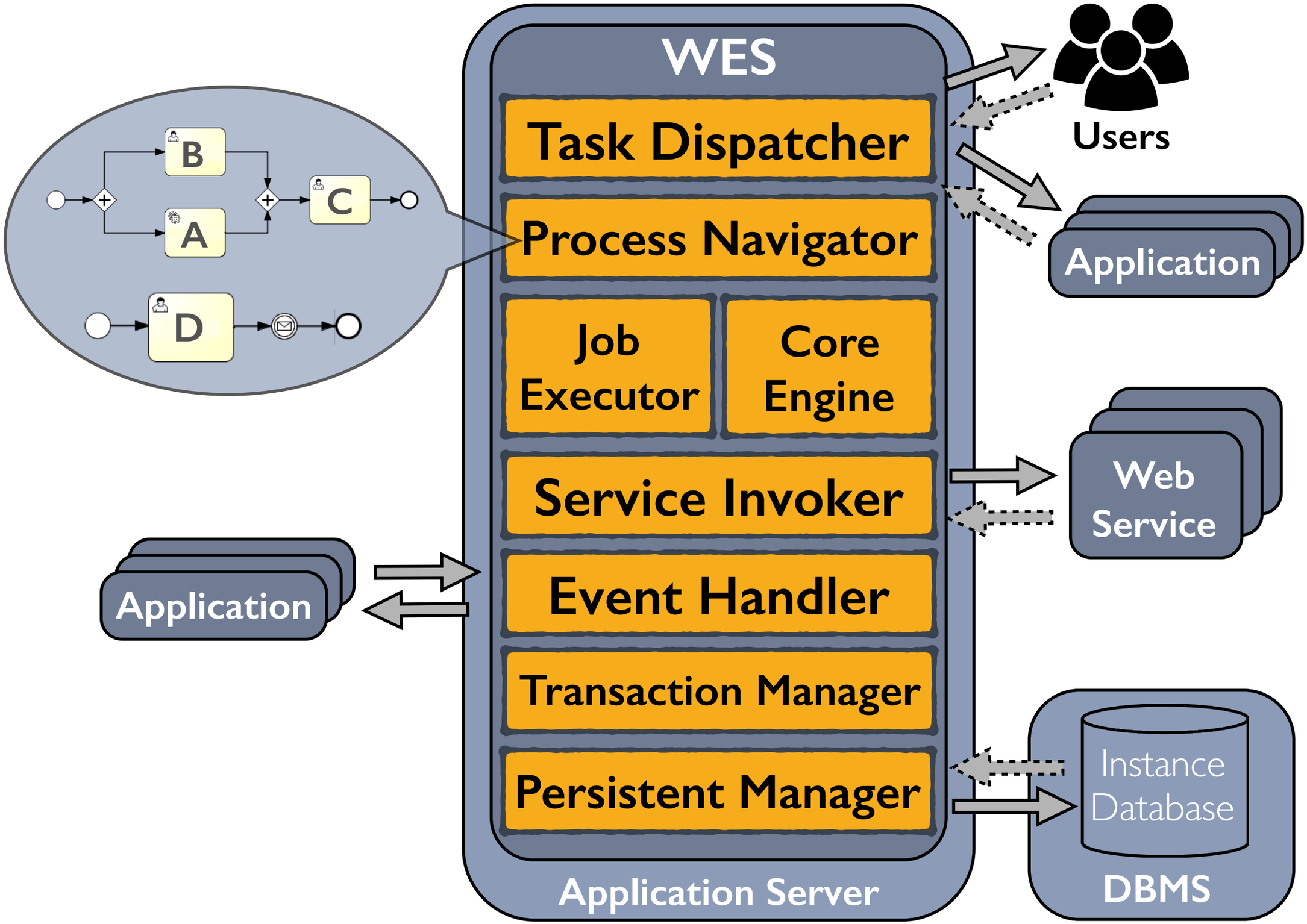

Workflow Management Systems' Diversity

Functionality

- Dynamic handling of Workflows
- Integration capabilities

System's Architecture

- Distributed workflow support
- Migrating workflow objects support
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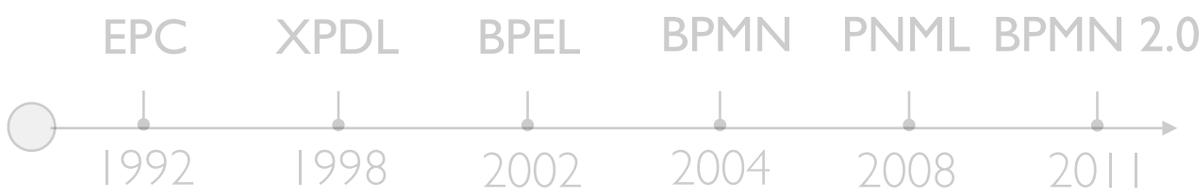
Deployment Infrastructure

- Standalone
- Cluster deployment
- Cloud deployment
- Mobile deployment

Supported Languages

- BPMN, BPEL, Petri-Nets, …



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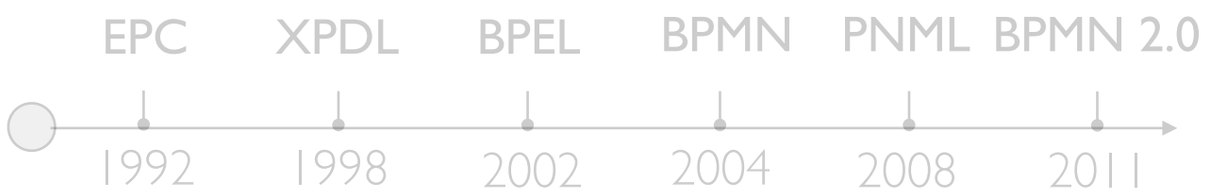

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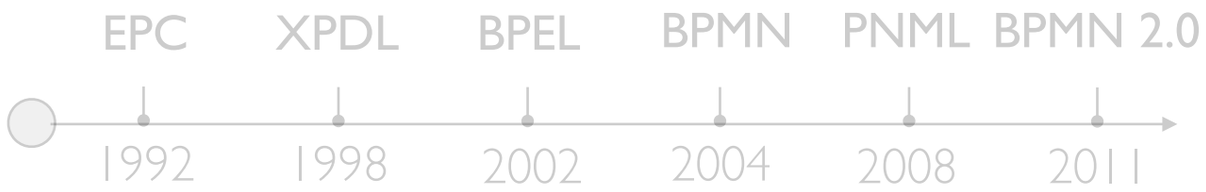

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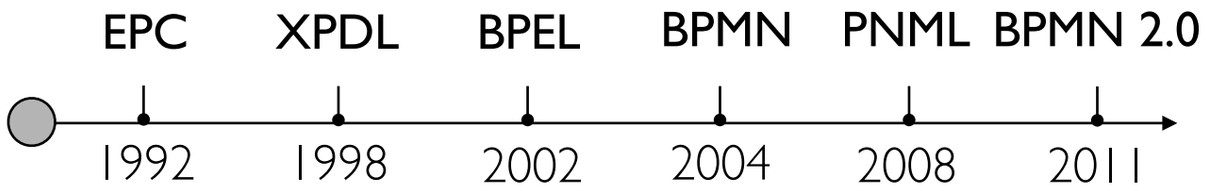
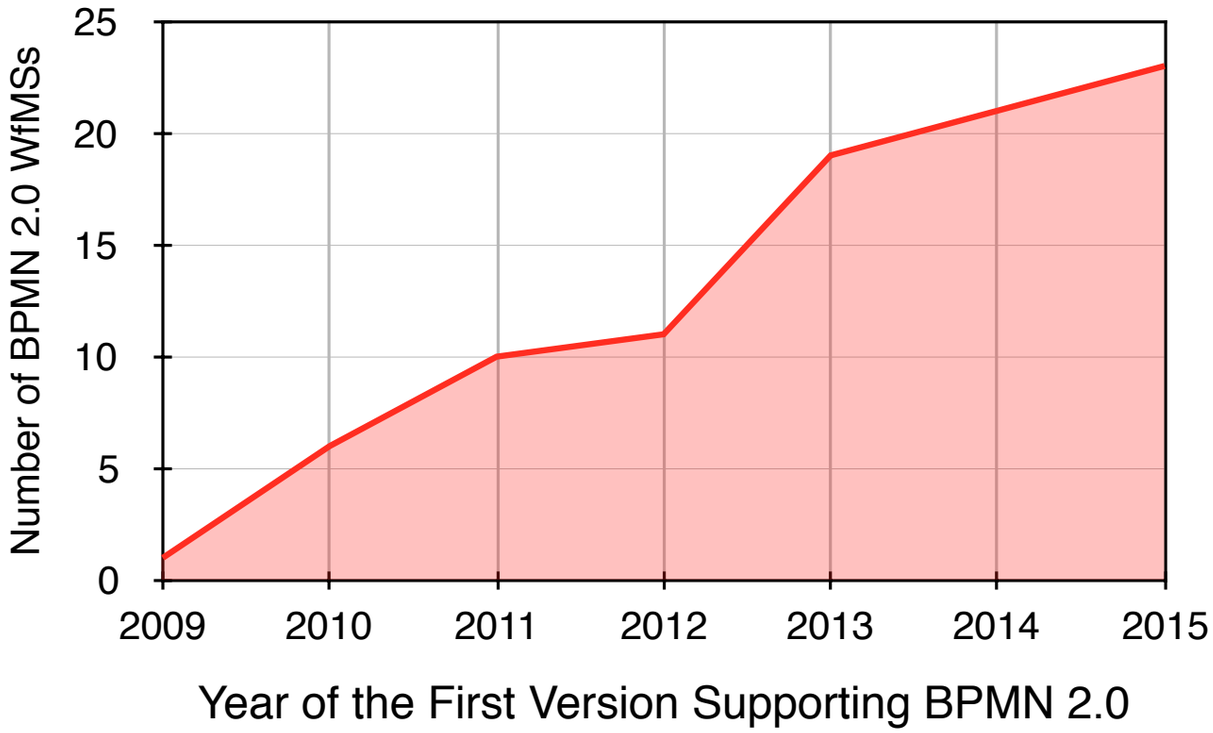
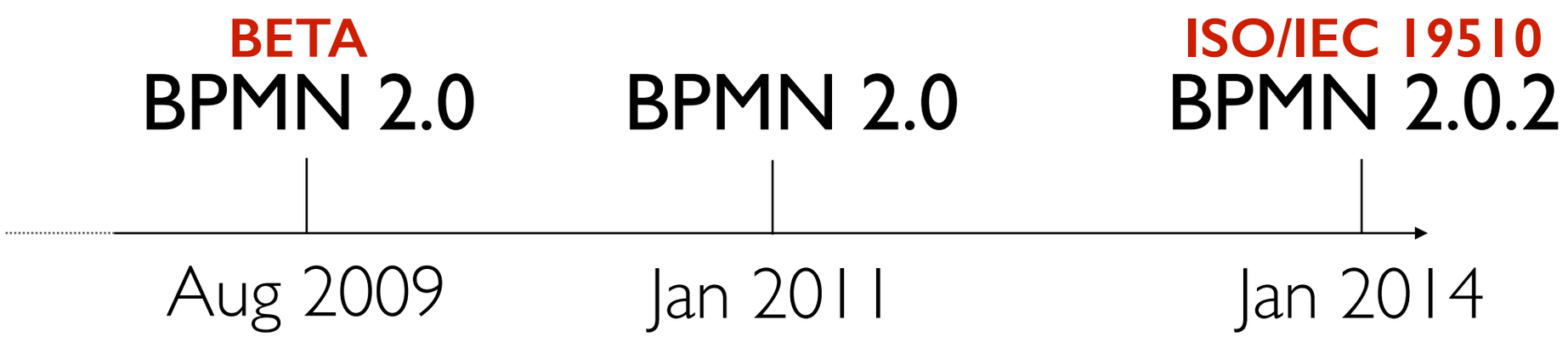


BPMN 2.0: A Widely Adopted Standard (?)



https://en.wikipedia.org/wiki/List_of_BPMN_2.0_engines



BPMN 2.0

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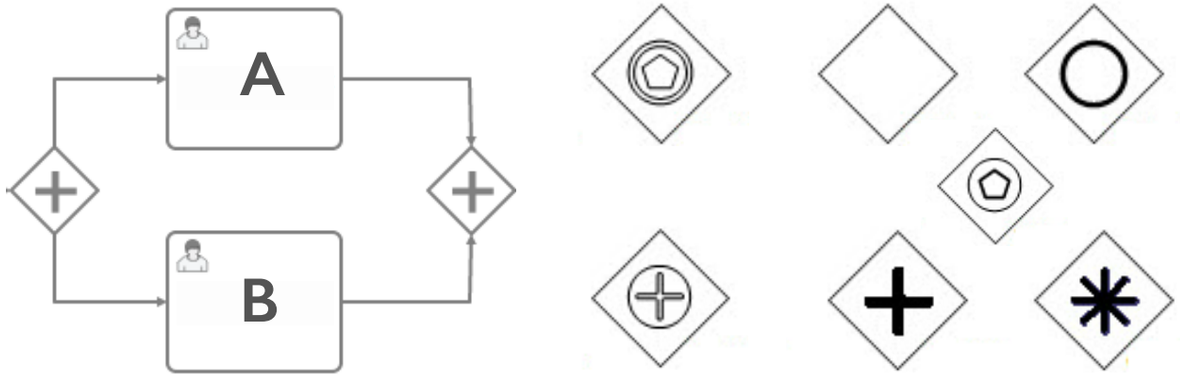
Control Flow



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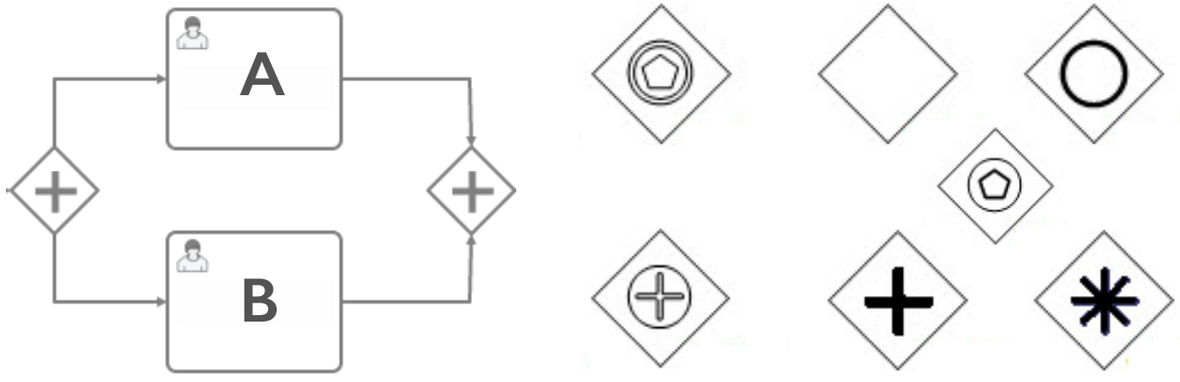
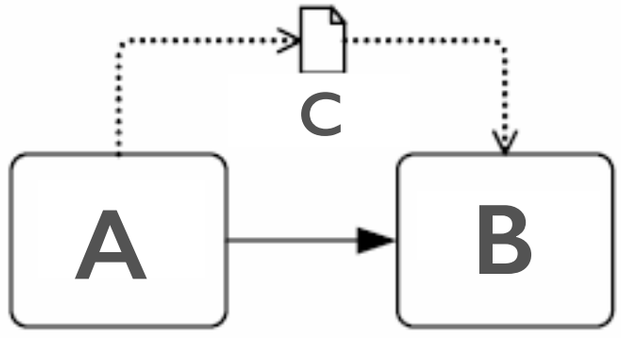
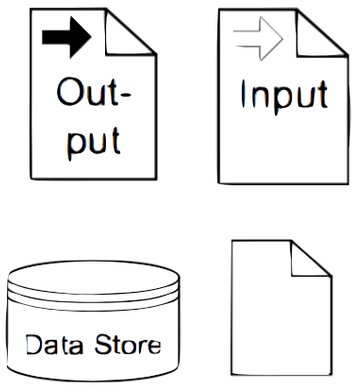


Data Flow





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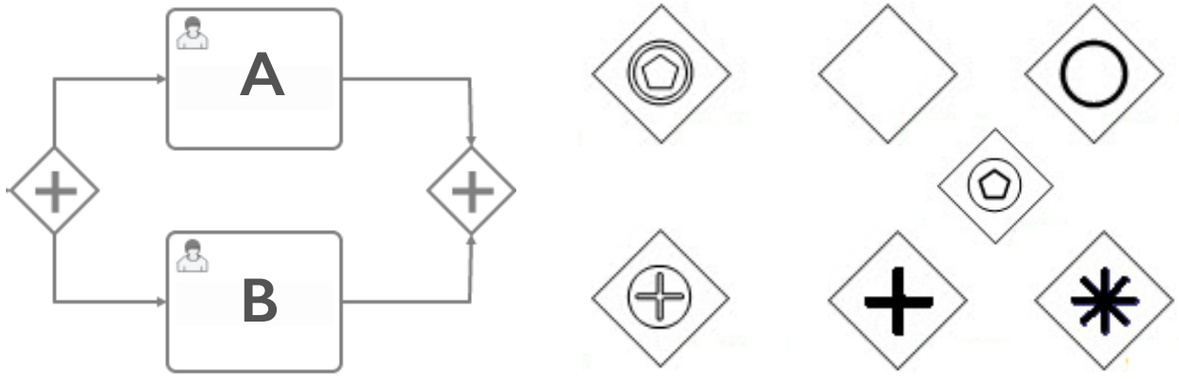

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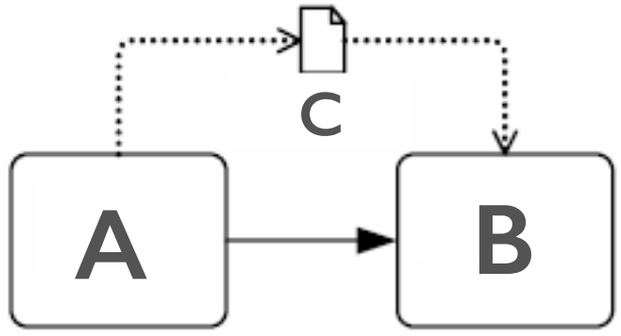
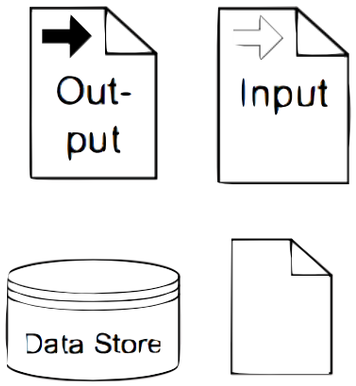
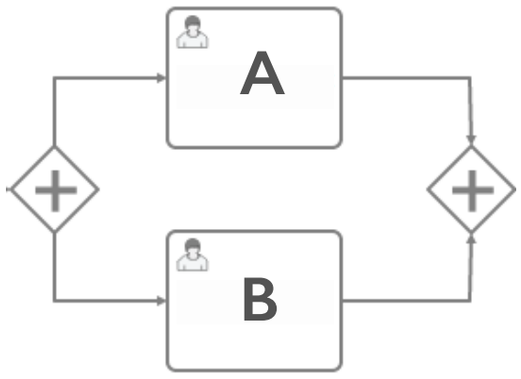


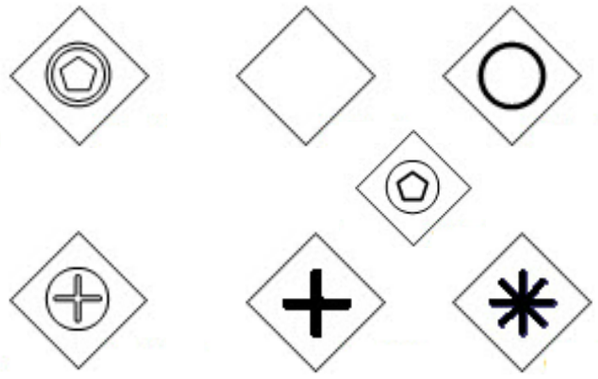


Events

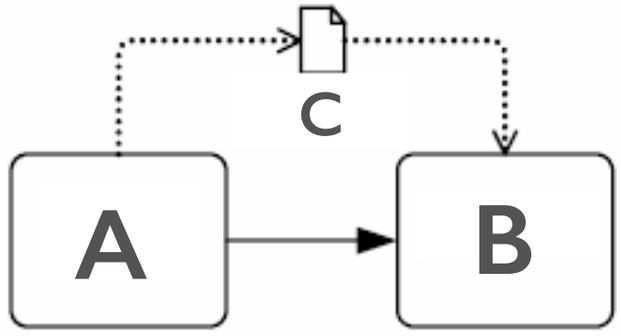
BPMN 2.0

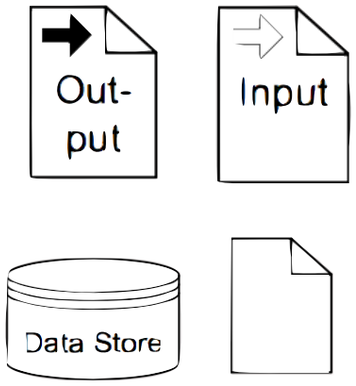
Control Flow





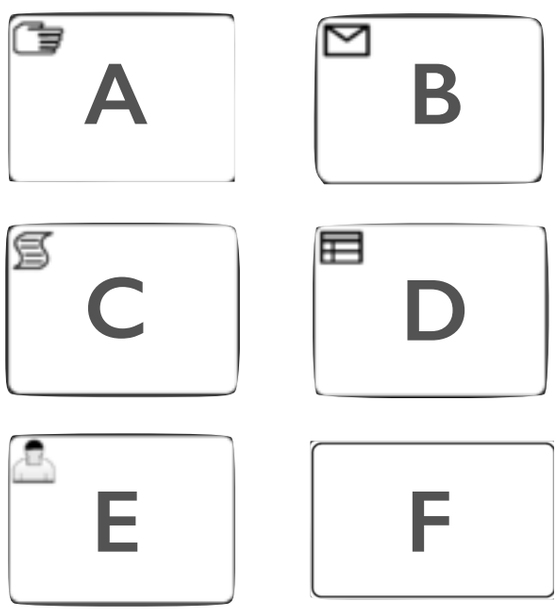
Data Flow



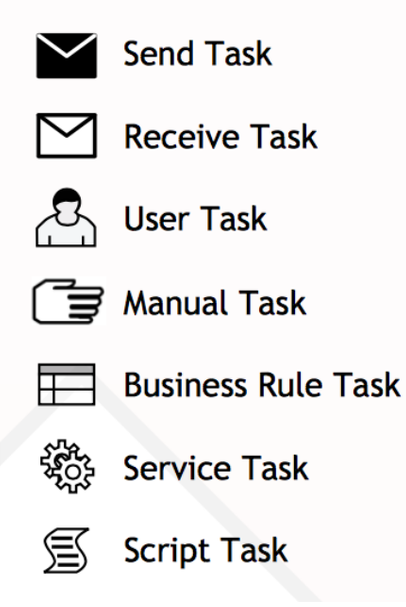


Events

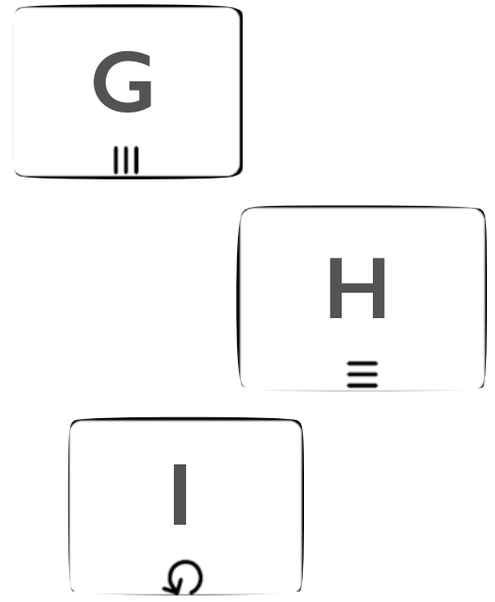
Activities



Task Types



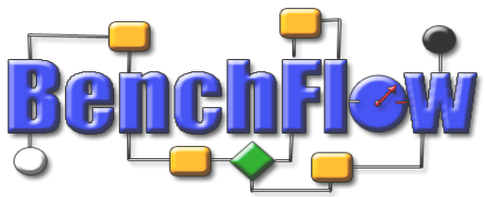
Execution Behaviour



BenchFlow Project

the goal

"Design and implement the first **benchmark** to assess and compare the **performance of WfMSs** that are compliant with Business Process Model and Notation 2.0 standard."



http://benchflow.inf.usi.ch

Why do we Need a Benchmark?

end-users, vendors, developers

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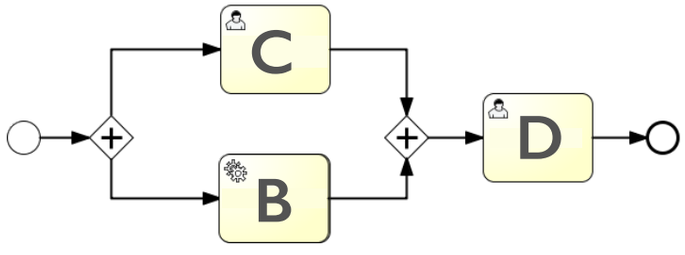
1. How to choose the best WfMS in accordance with the company's technical requirements?

2. How to choose the best WfMS in accordance with the company's business process models (workflows)?



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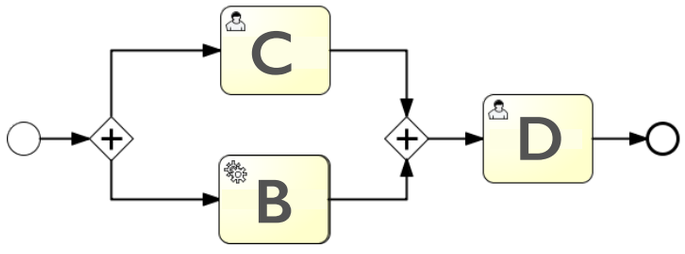
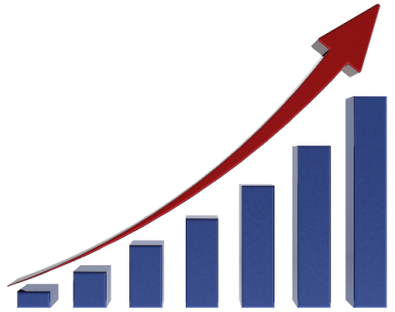
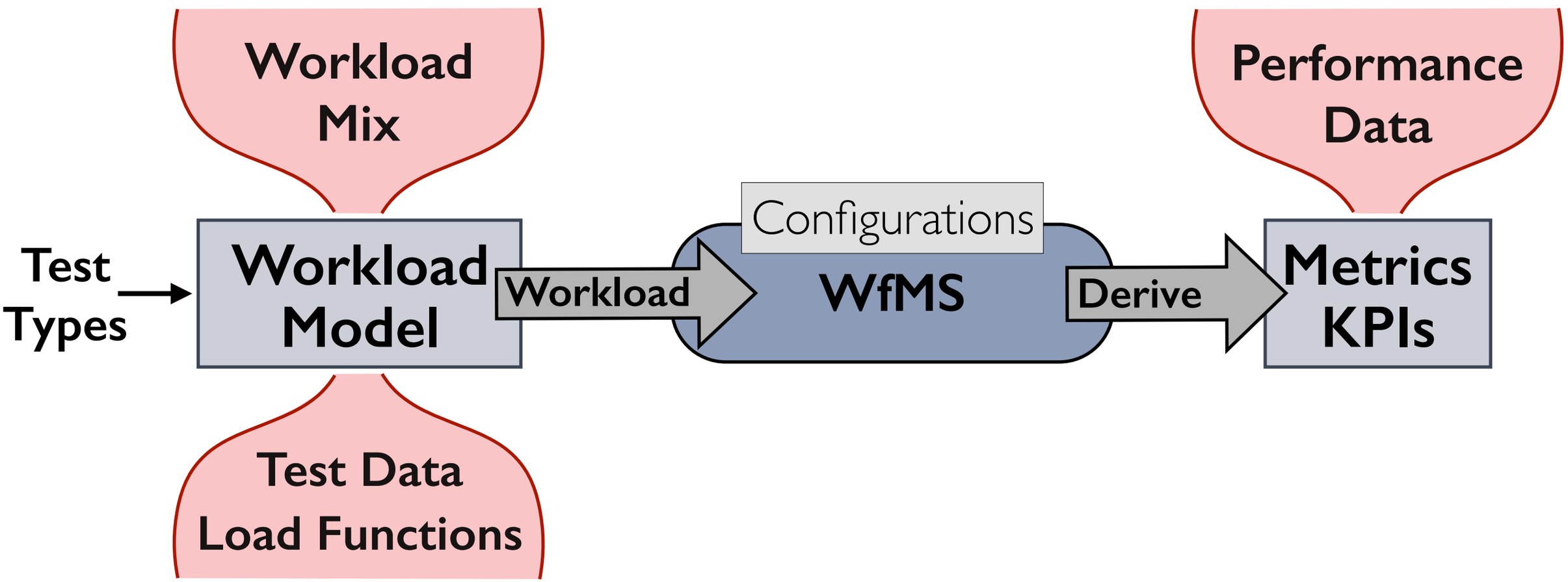


3. How to evaluate performance improvements during WfMS's development?



4. How to identify WfMS's bottlenecks?

Benchmark Elements for BenchFlow



State of the Art Limitations (BPEL WfMS)

Benchmark Element	Limitations
Test Types	Load Test, Stress Test

Röck et al.
[SEKE '14]

State of the Art Limitations (BPEL WfMS)

	Benchmark Element	Limitations
Workload Model	Test Types	Load Test, Stress Test
	Workload Mix	Unclear Definition
	Load Functions	Simplistic
	Test Data	Not Realistic

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	WfMS Configurations	Not Extensive
Analyses	Metrics	Too General
	KPIs	Too General

Röck et al. [SEKE '14]

Benchmarking Requirements

- Relevant
- Representative
- Portable
- Scalable
- Simple
- Repeatable
- Vendor-neutral
- Accessible
- Efficient
- Affordable

References:

- K. Huppler, **The art of building a good benchmark**, 2009
- J. Gray, **The Benchmark Handbook for Database and Transaction Systems**, 1993
- S. E. Sim, S. Easterbrook et al., **Using benchmarking to advance research: A challenge to software engineering**, 2003

Main Challenges in Benchmarking BPMN 2.0 WfMSs

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WORKLOAD MODEL

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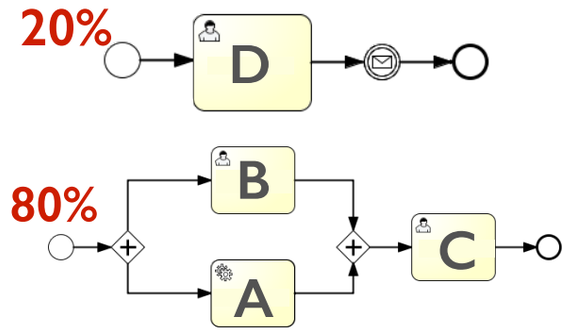

Workload Mix

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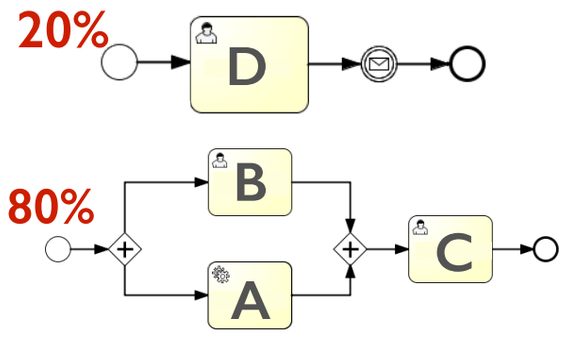

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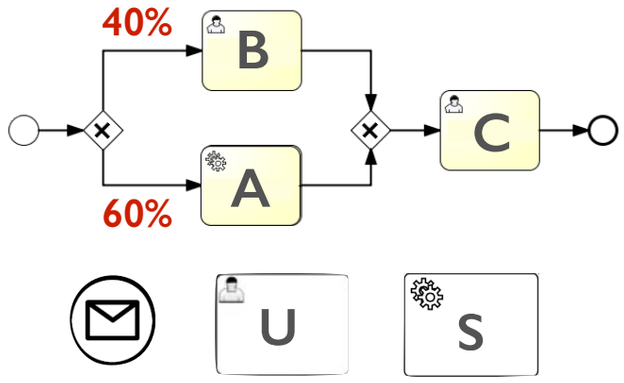

Test Data

WORKLOAD MODEL

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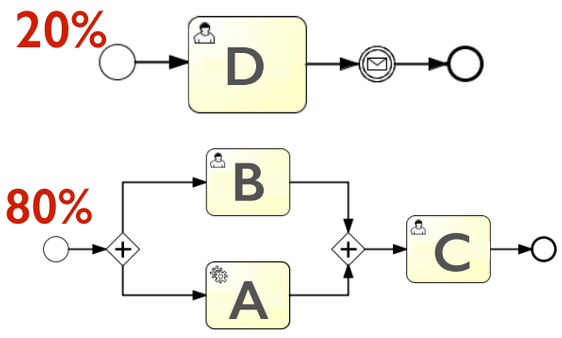

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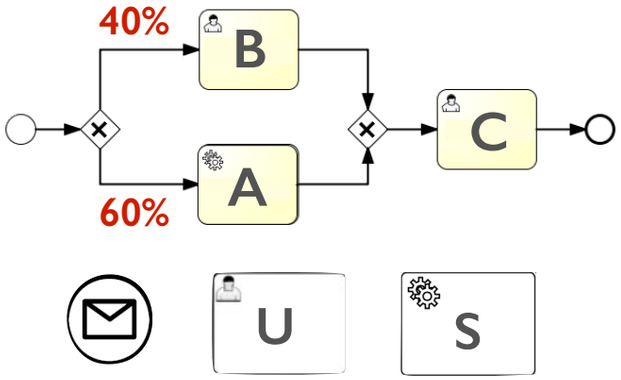

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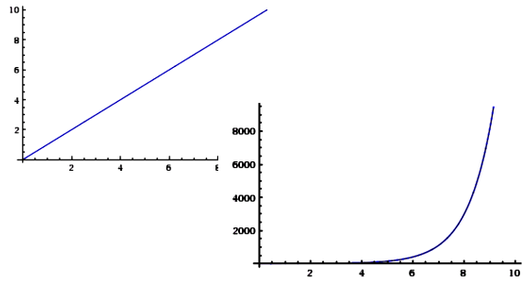

Load Functions

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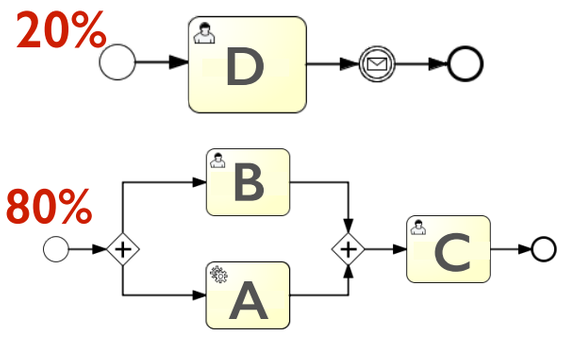

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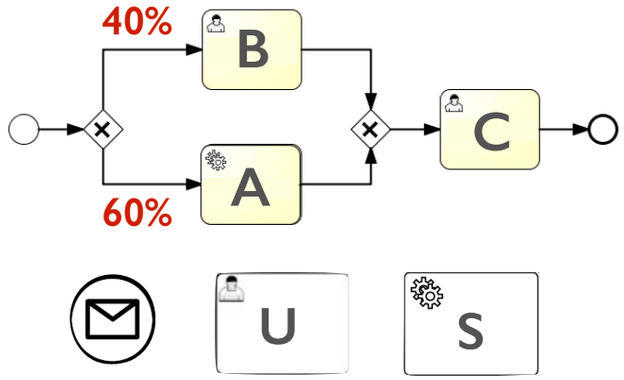

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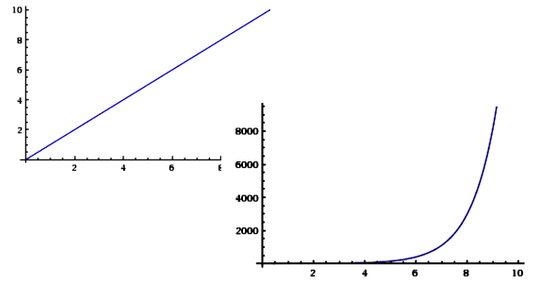

Load Functions

WORKLOAD MODEL

BENCHMARK EXECUTION

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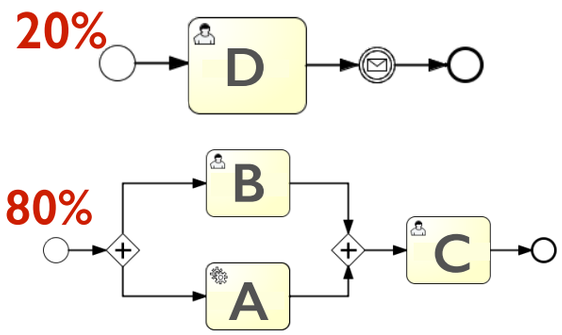

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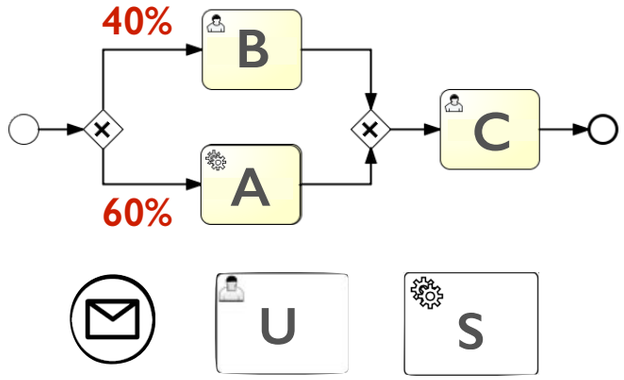

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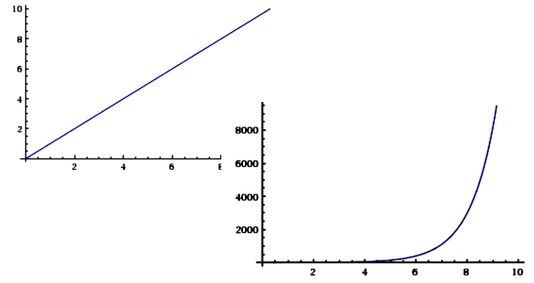
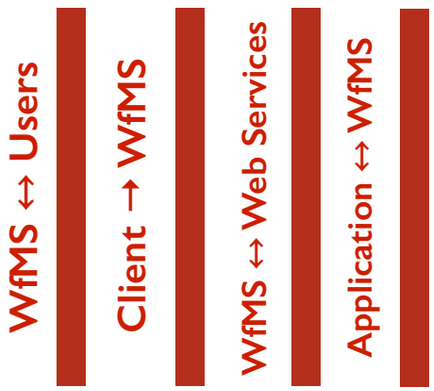


Load Functions

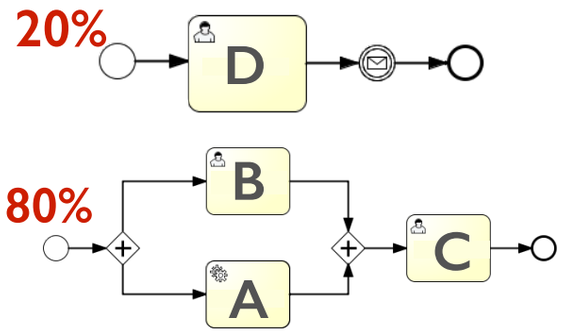
WORKLOAD MODEL



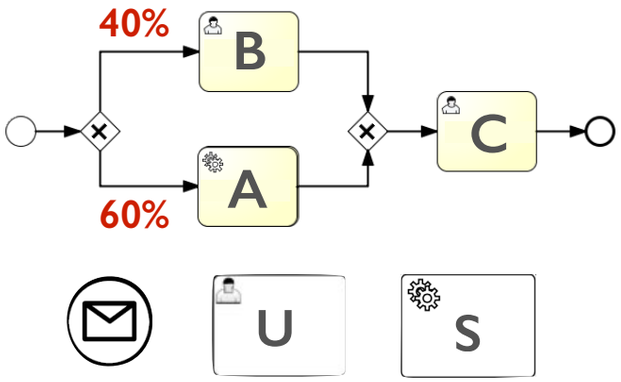
WfMS-specific APIs
and BPMN 2.0 Customisations

BENCHMARK EXECUTION

Main Challenges in Benchmarking BPMN 2.0 WfMSs



Workload Mix



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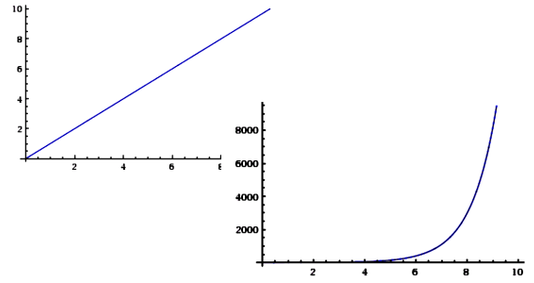

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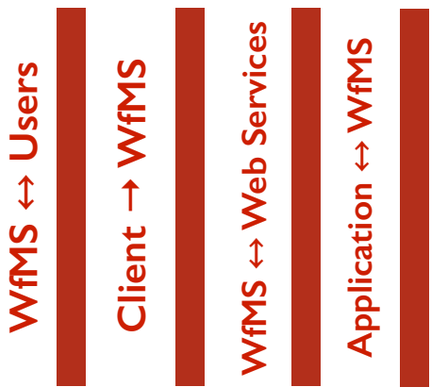
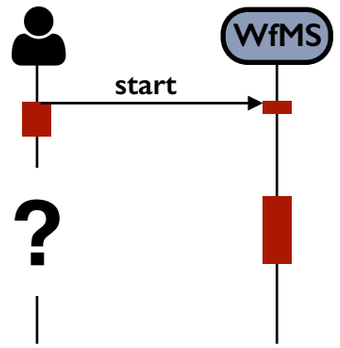


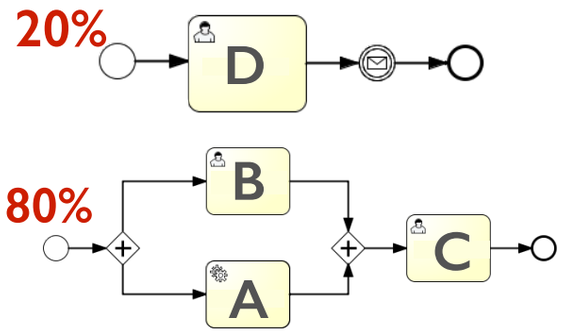
WfMS-specific APIs and BPMN 2.0 Customisations



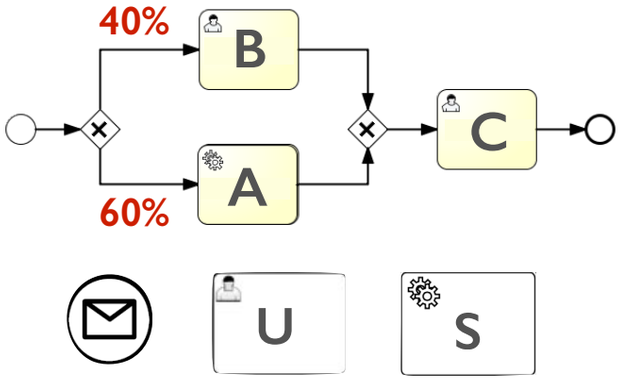
Asynchronous Execution of Workflows

BENCHMARK EXECUTION

Main Challenges in Benchmarking BPMN 2.0 WfMSs



Workload Mix



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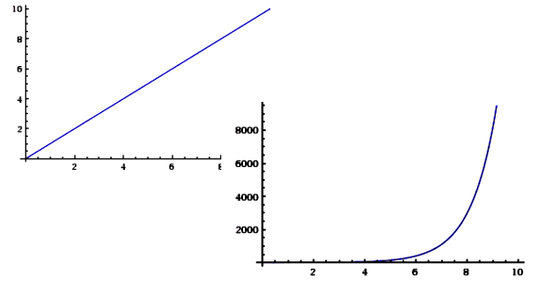
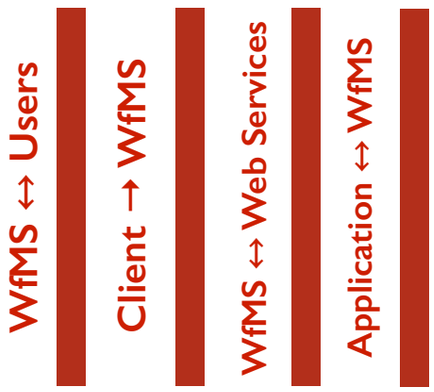
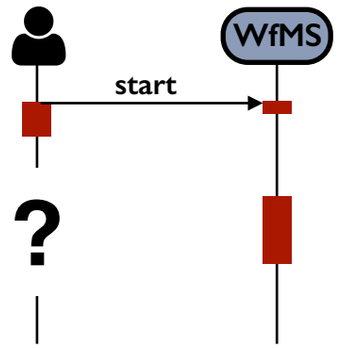


Load Functions

WORKLOAD MODEL



WfMS-specific APIs and BPMN 2.0 Customisations

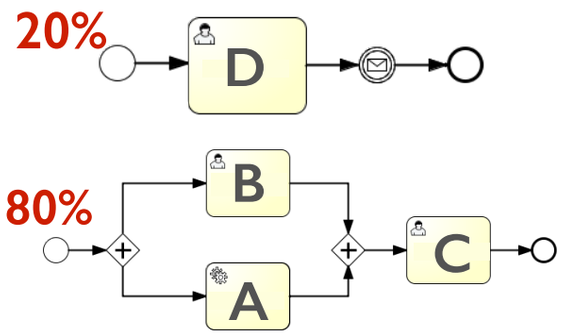


Asynchronous Execution of Workflows

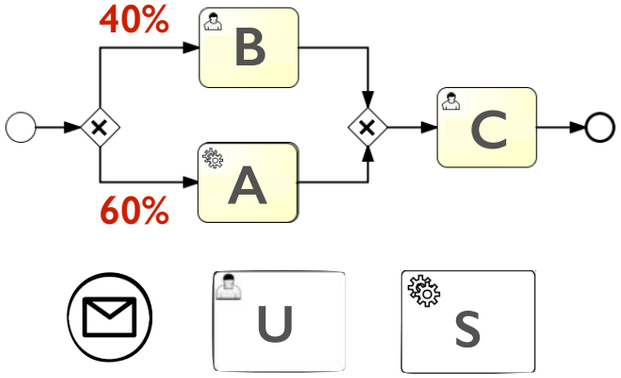
BENCHMARK EXECUTION

ANALYSES

Main Challenges in Benchmarking BPMN 2.0 WfMSs



Workload Mix



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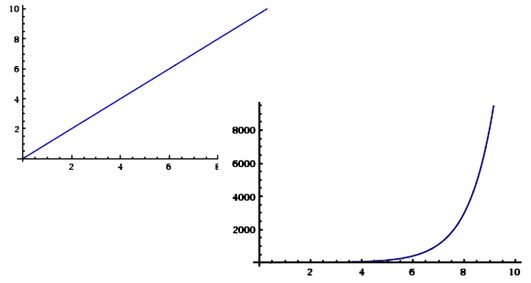

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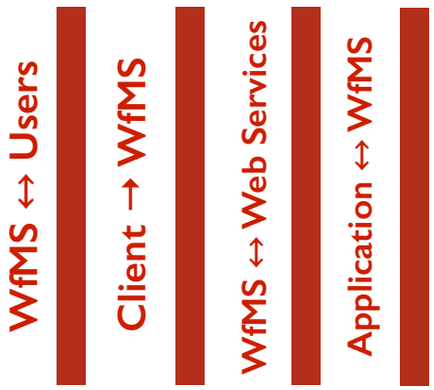

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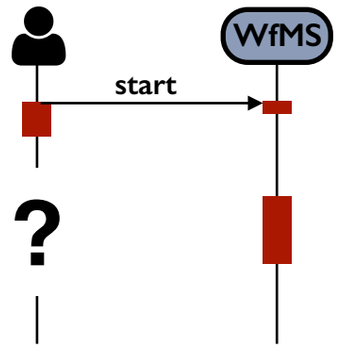

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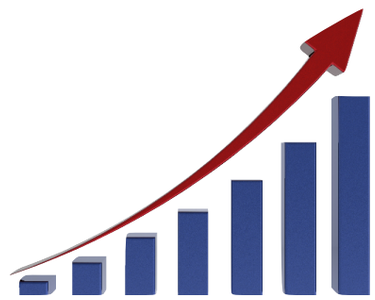


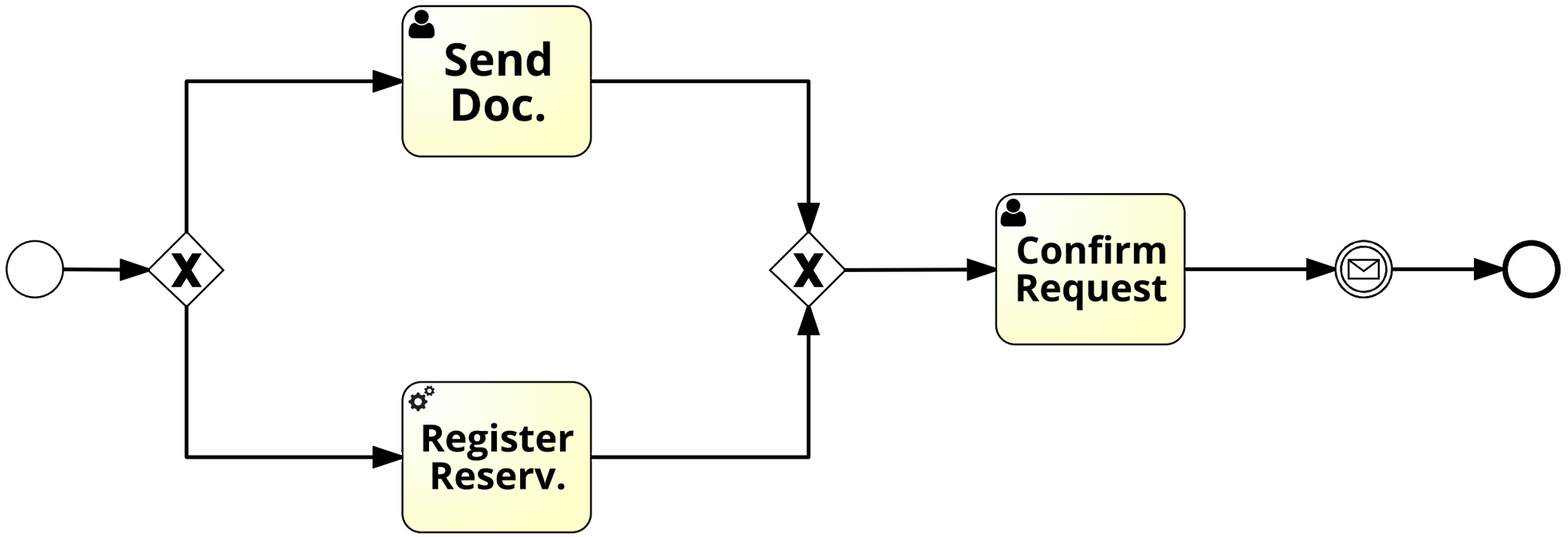
Performance Metrics and KPIs

BENCHMARK EXECUTION

ANALYSES

Define the Workload Mix

based on real-world BPMN 2.0 process models



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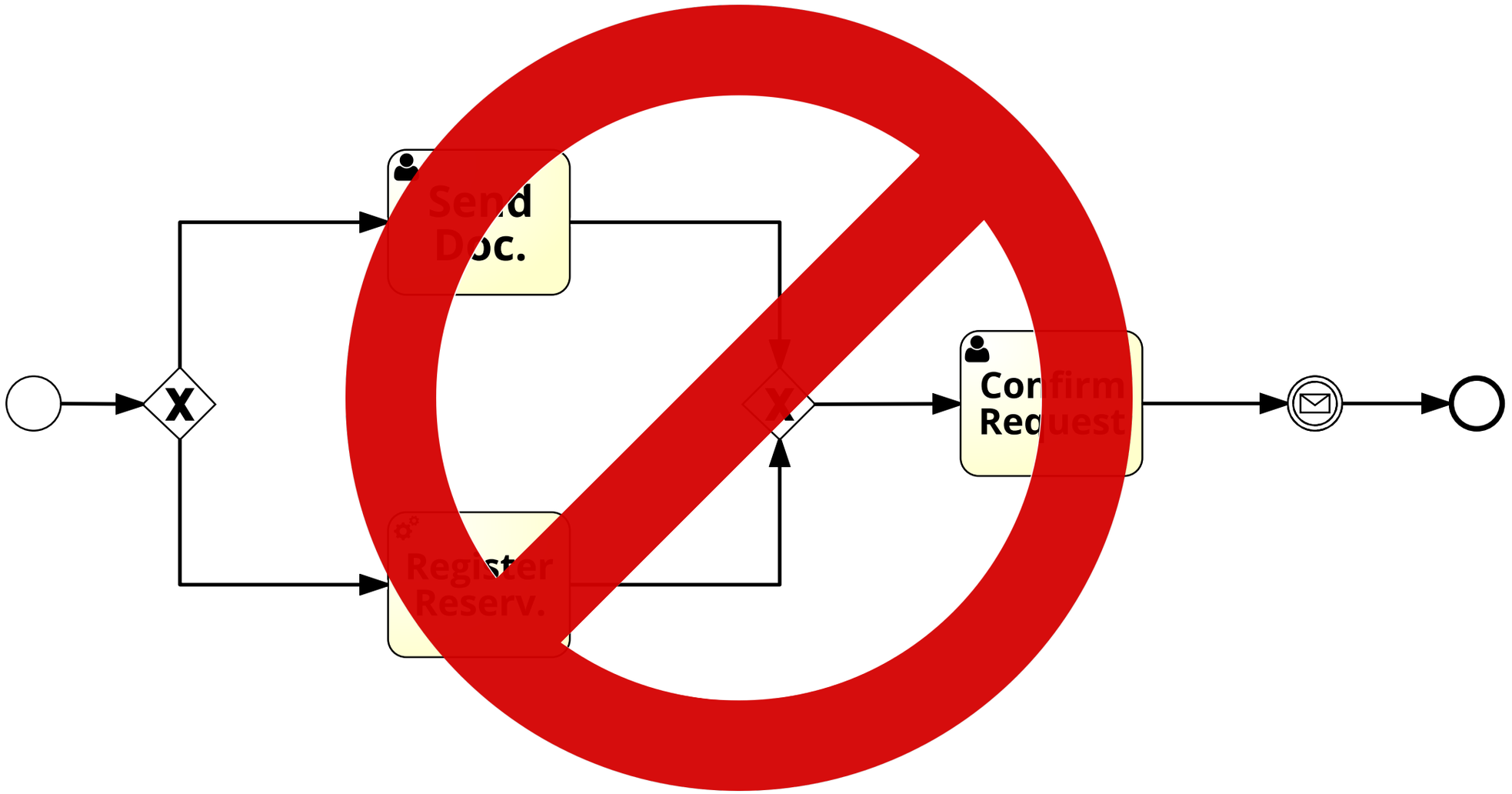

MAIN CHALLENGE:

Obtain Real-World BPMN 2.0 Process Models

Define the Workload Mix

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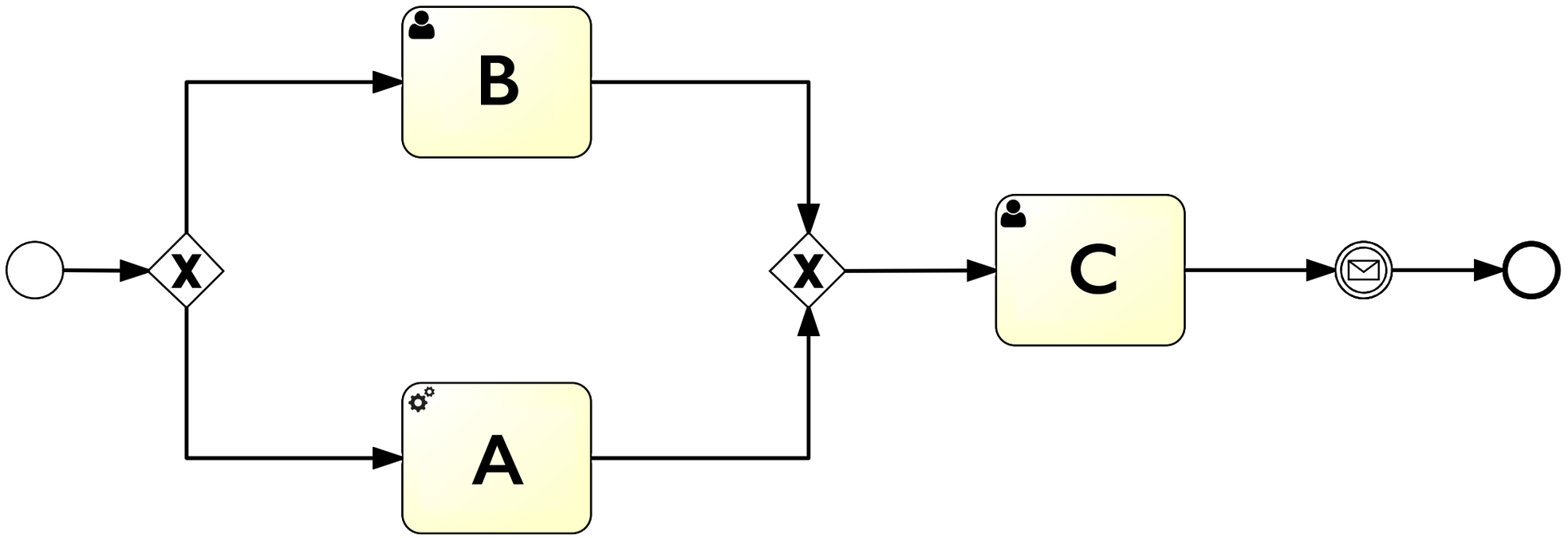


MAIN CHALLENGE:

Obtain Real-World BPMN 2.0 Process Models

Define the Workload Mix

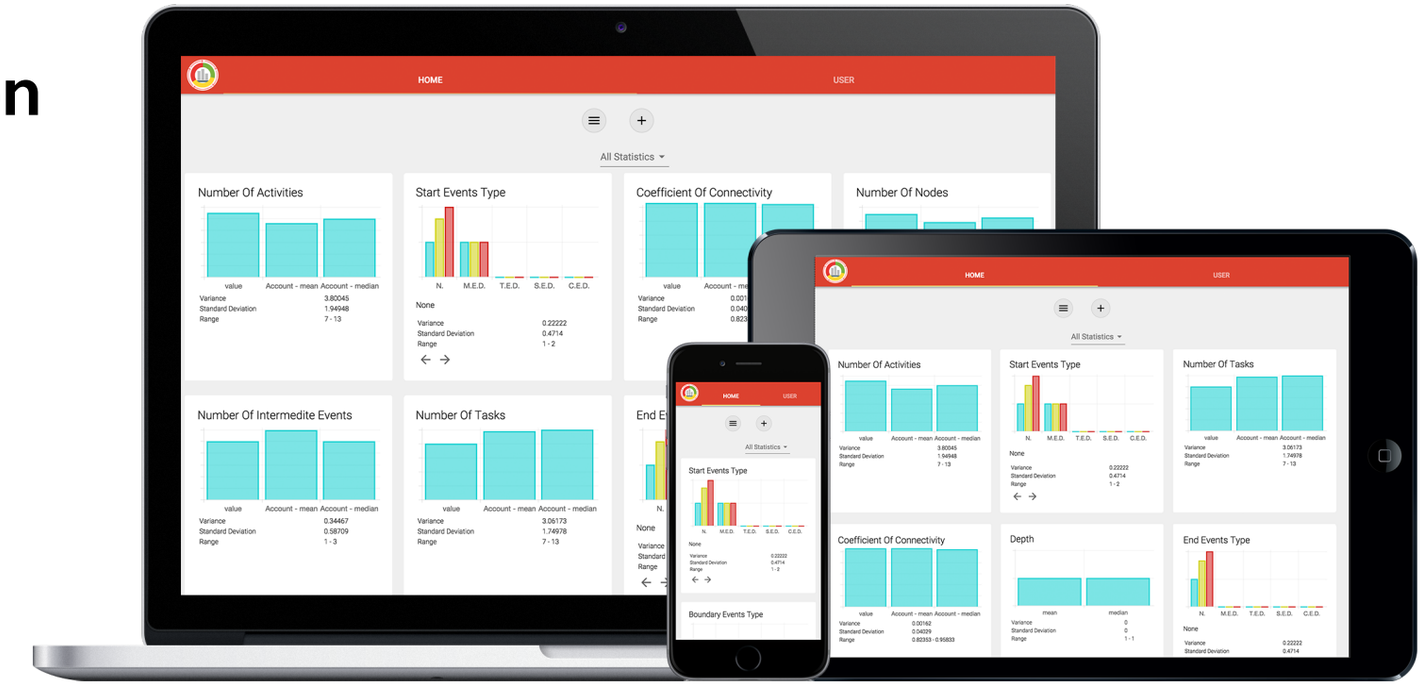
characterise real-world BPMN 2.0 process models collections

BPMeter:

Web Service and application for static analysis of BPMN 2.0 collections

> 100 METRICS:

Size, Structure, External Interaction, Data Handling, Complexity



http://benchflow.inf.usi.ch/bpmeter

Define the Workload Mix

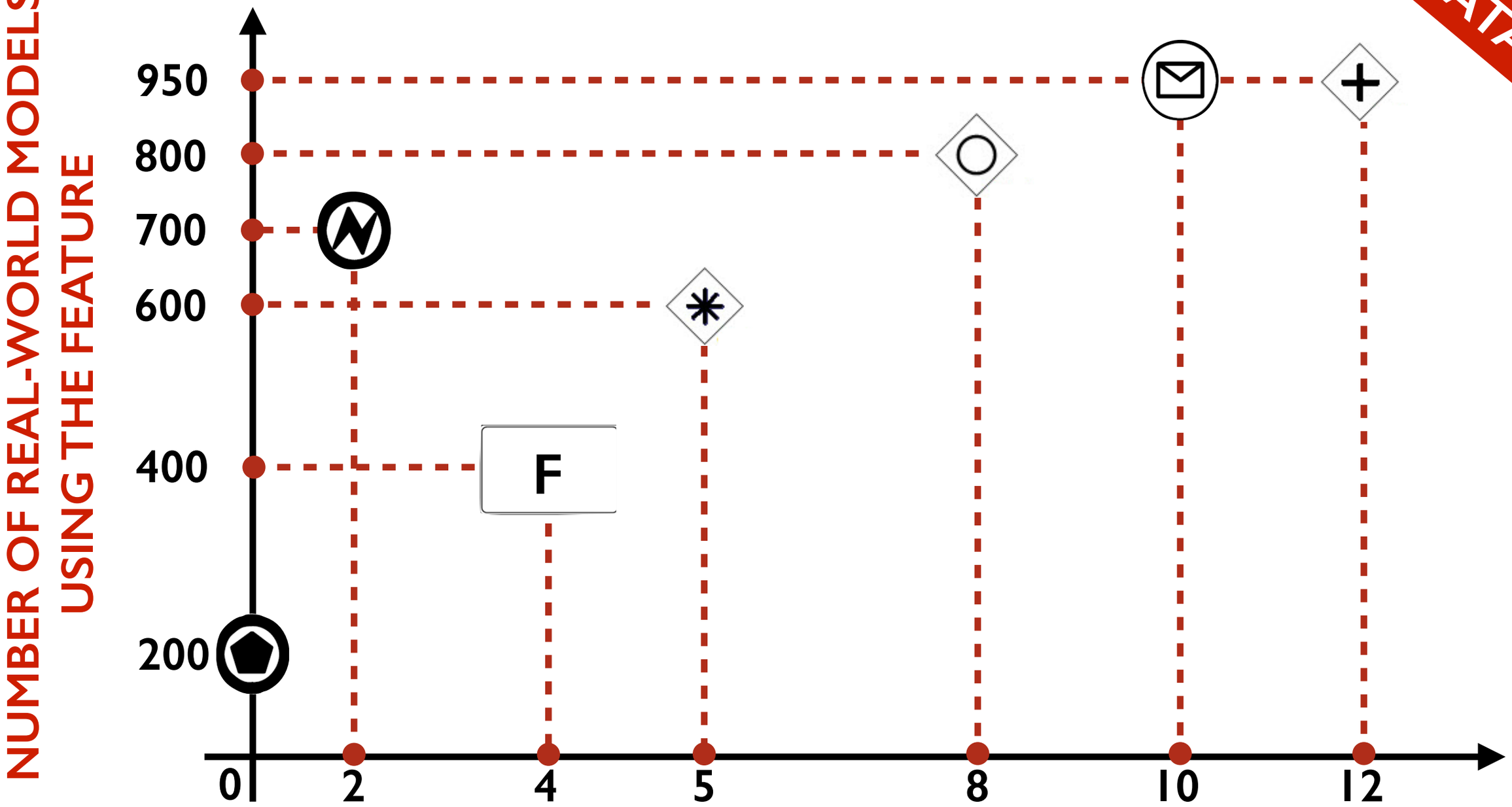
heterogeneous usage and support of BPMN 2.0

MOCK DATA

Define the Workload Mix

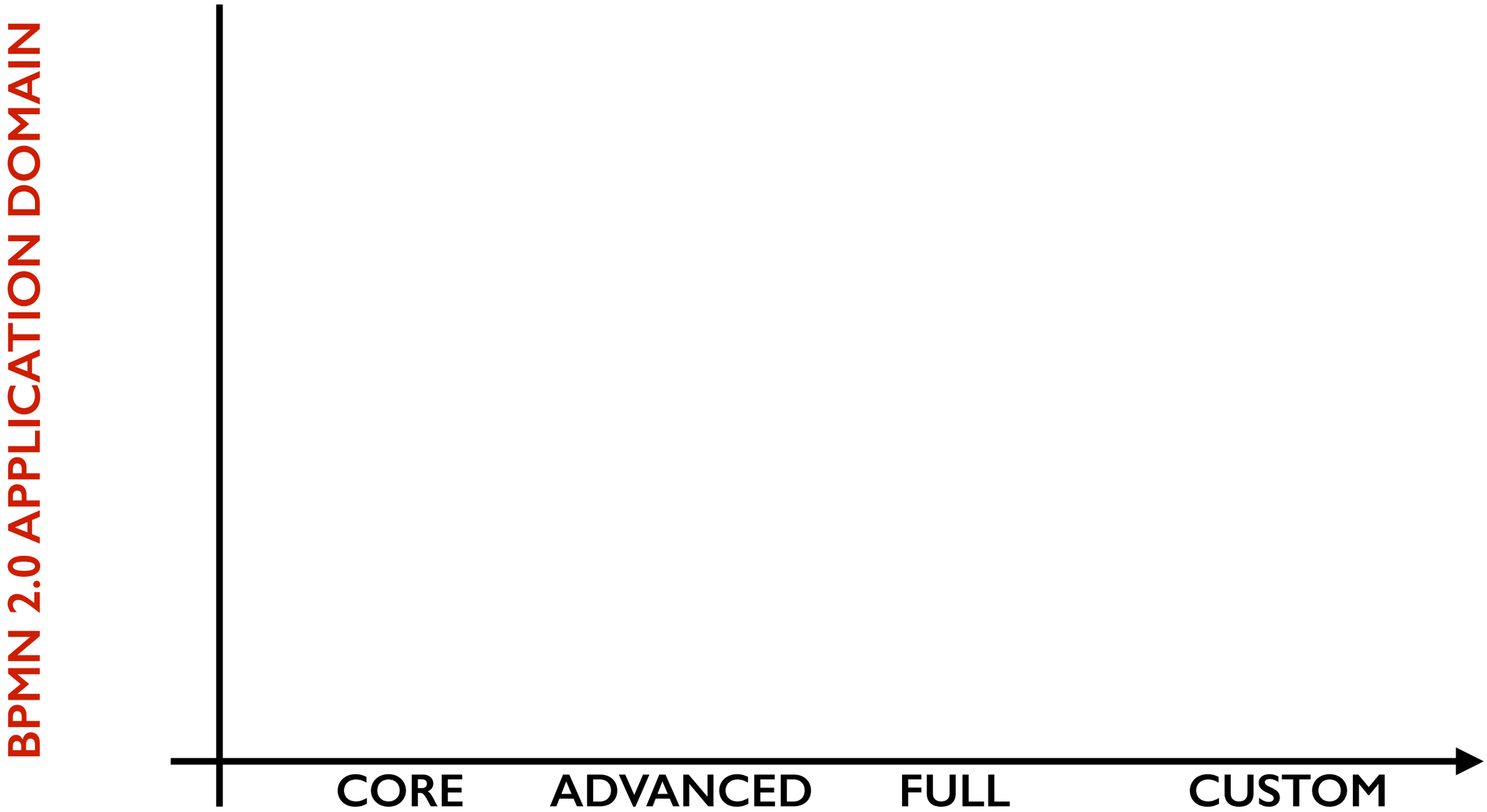
heterogeneous usage and support of BPMN 2.0

MOCK DATA



Different Types of Benchmarks

core, advanced, full, custom



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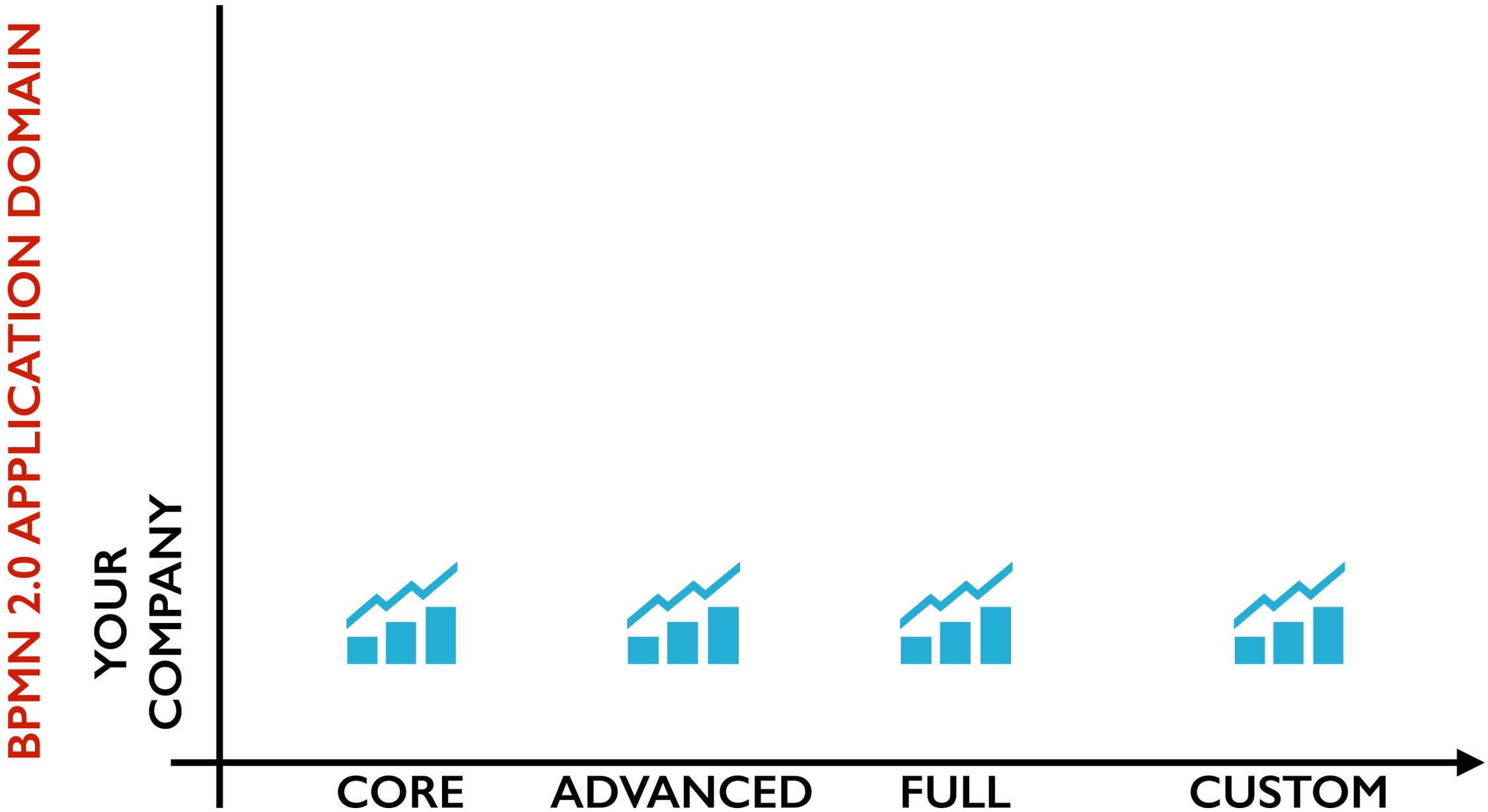

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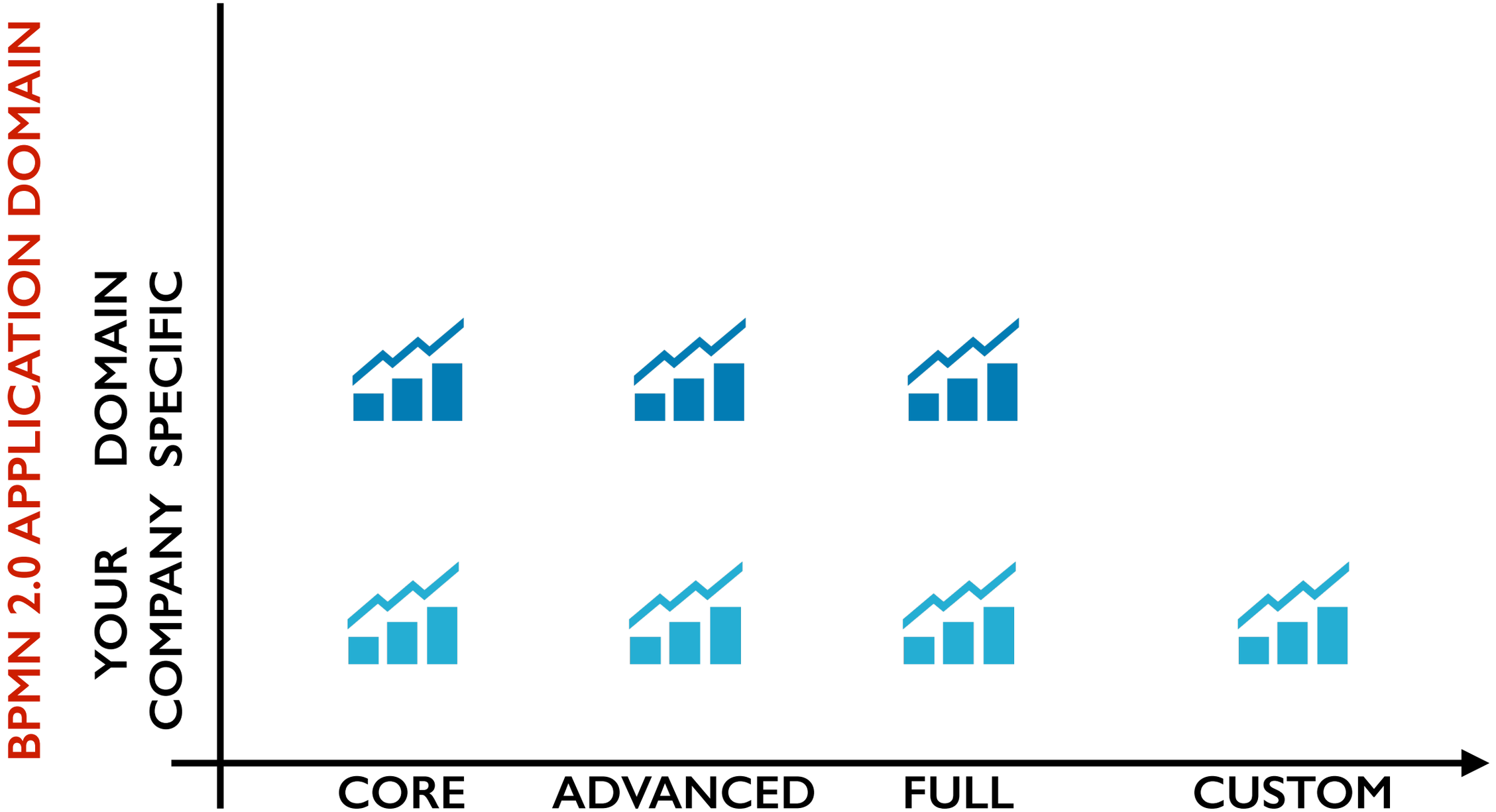

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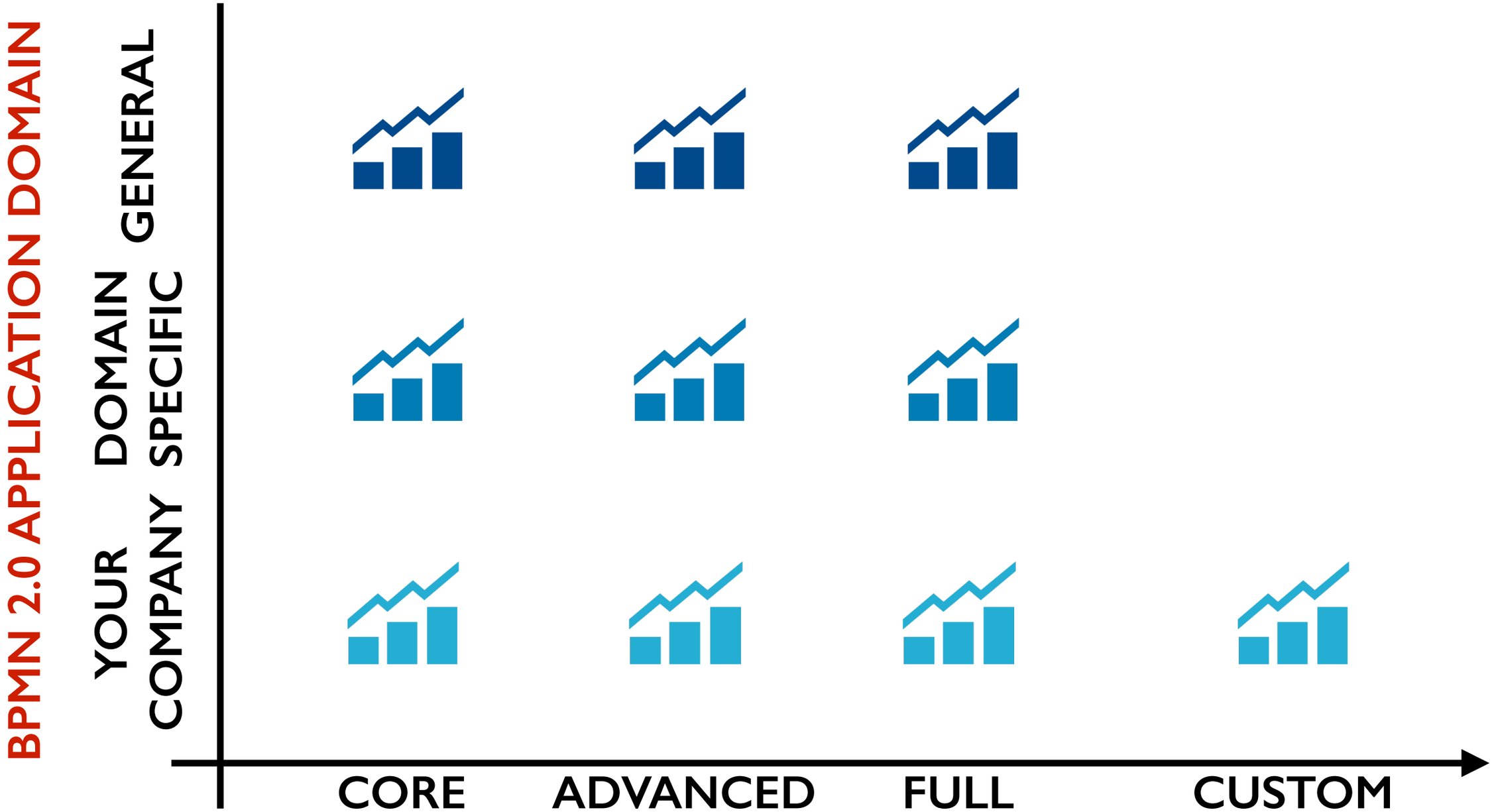
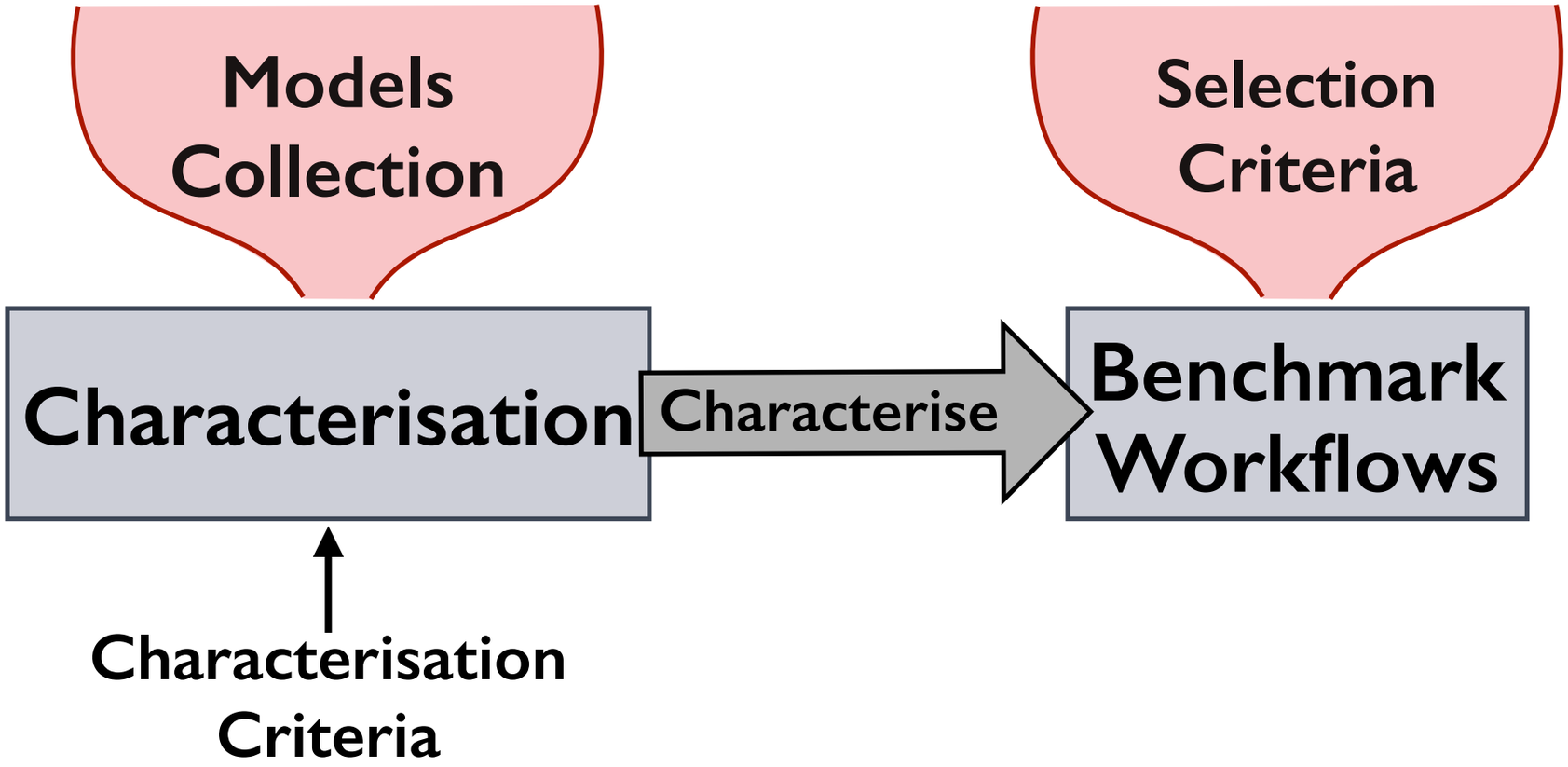


BPMN 2.0 SUPPORTED ELEMENTS

Workload Mix Characterisation Overview



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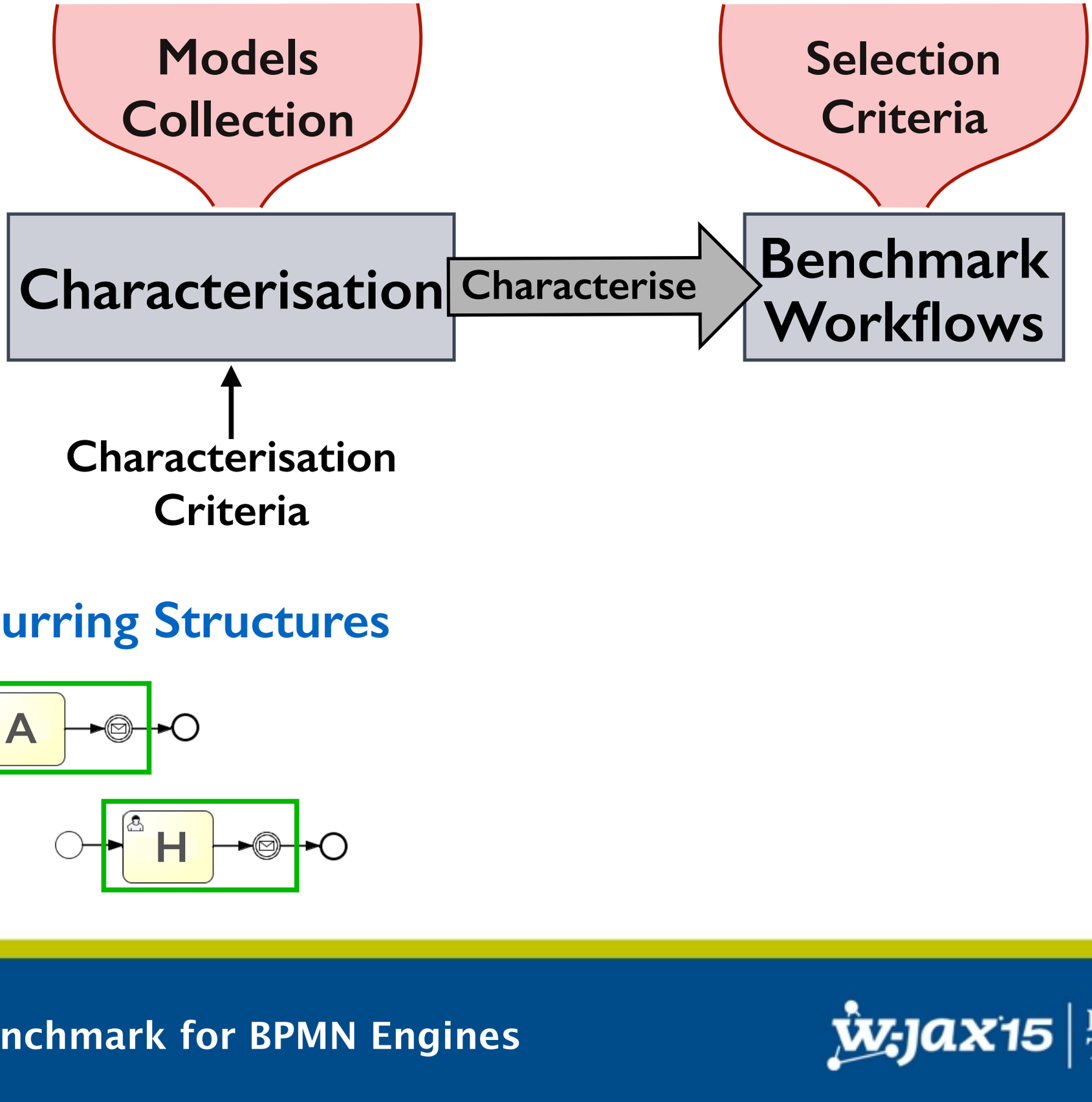
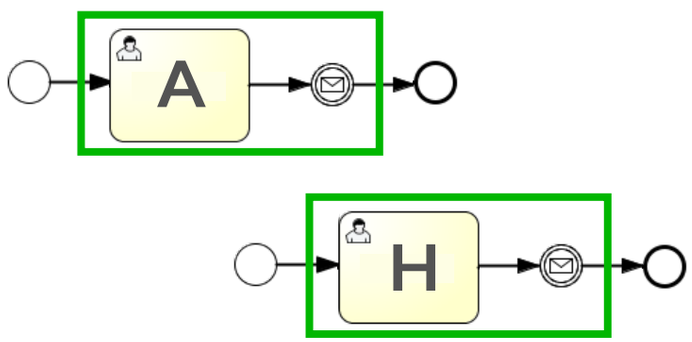


Reoccurring Structures



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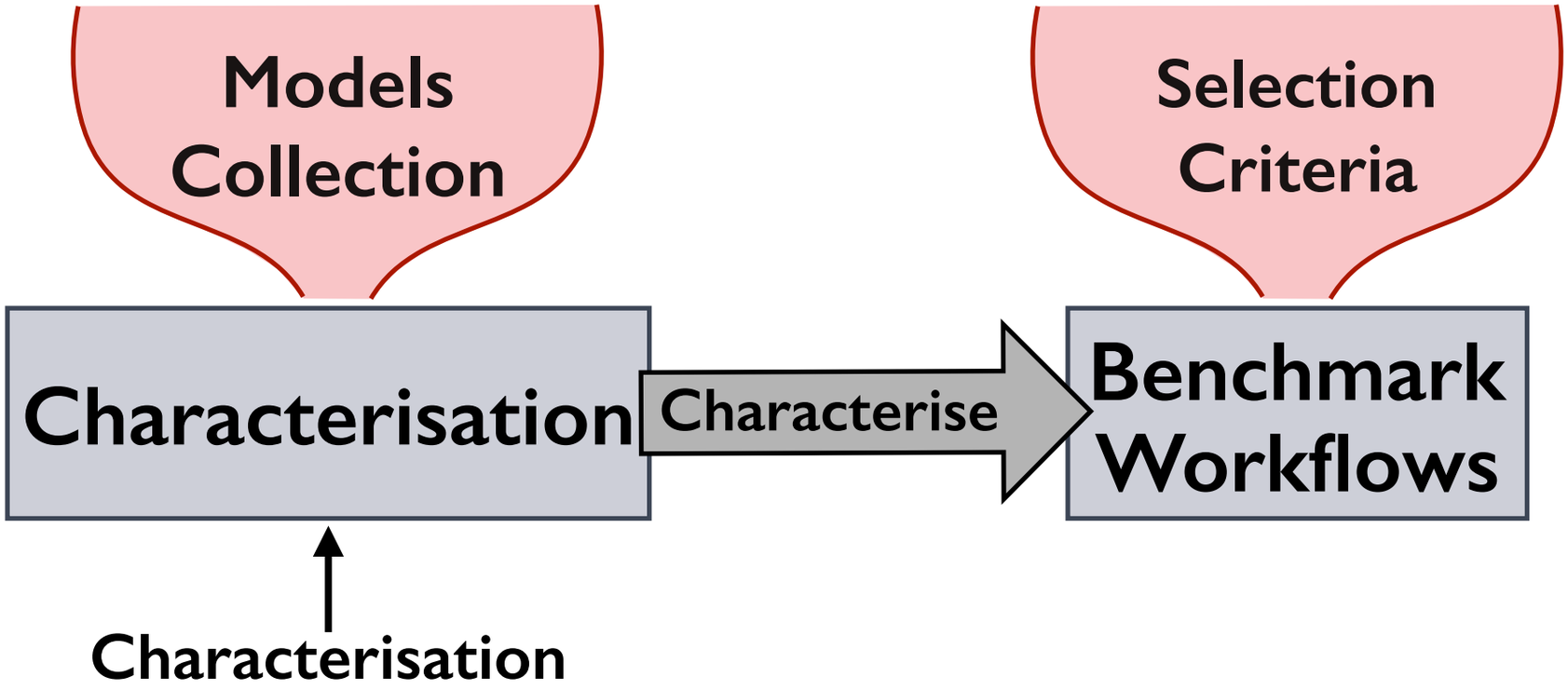

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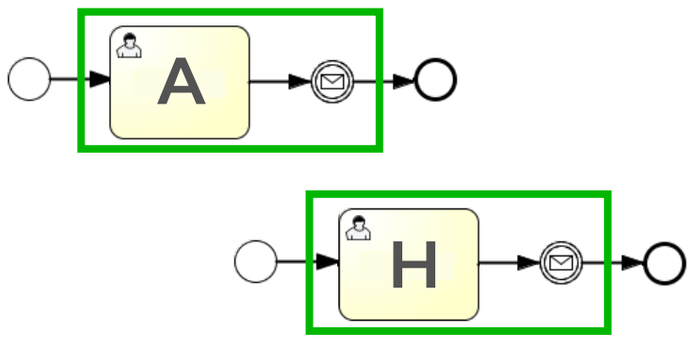
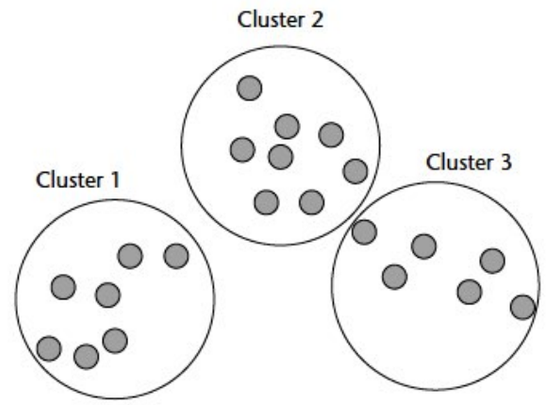
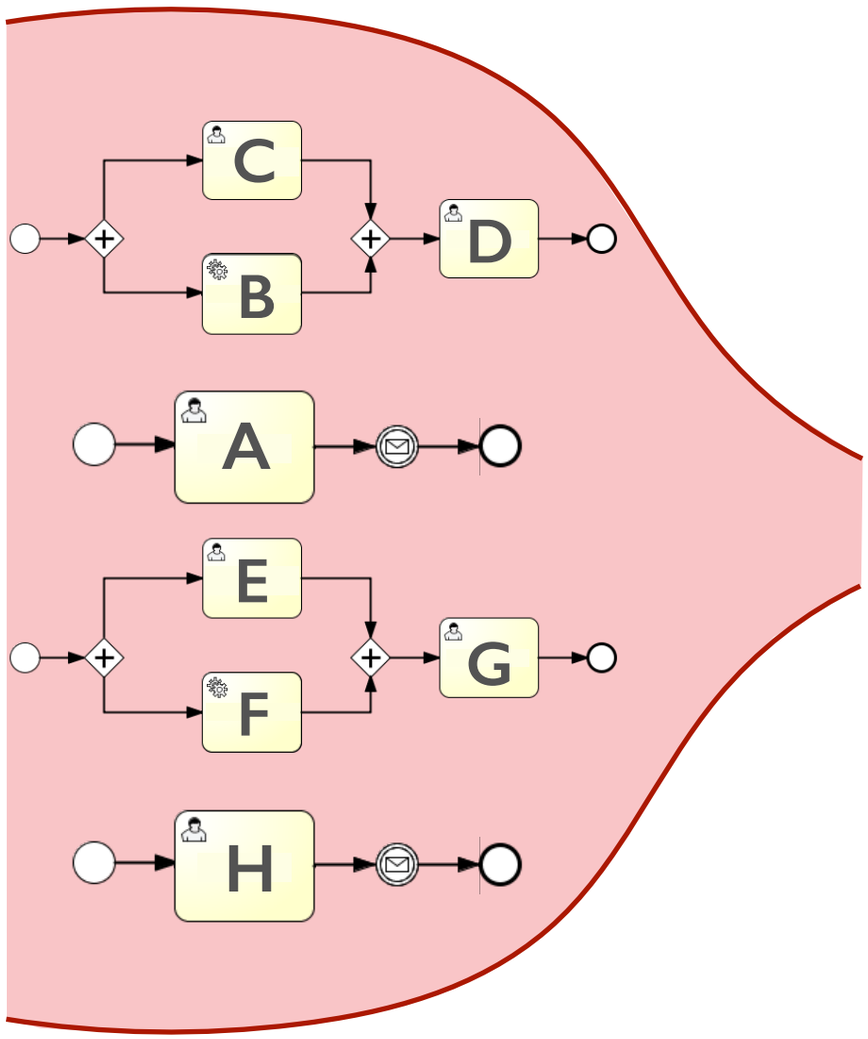


Clusters of Models



Define the Workload Mix

discover reoccurring structural patterns

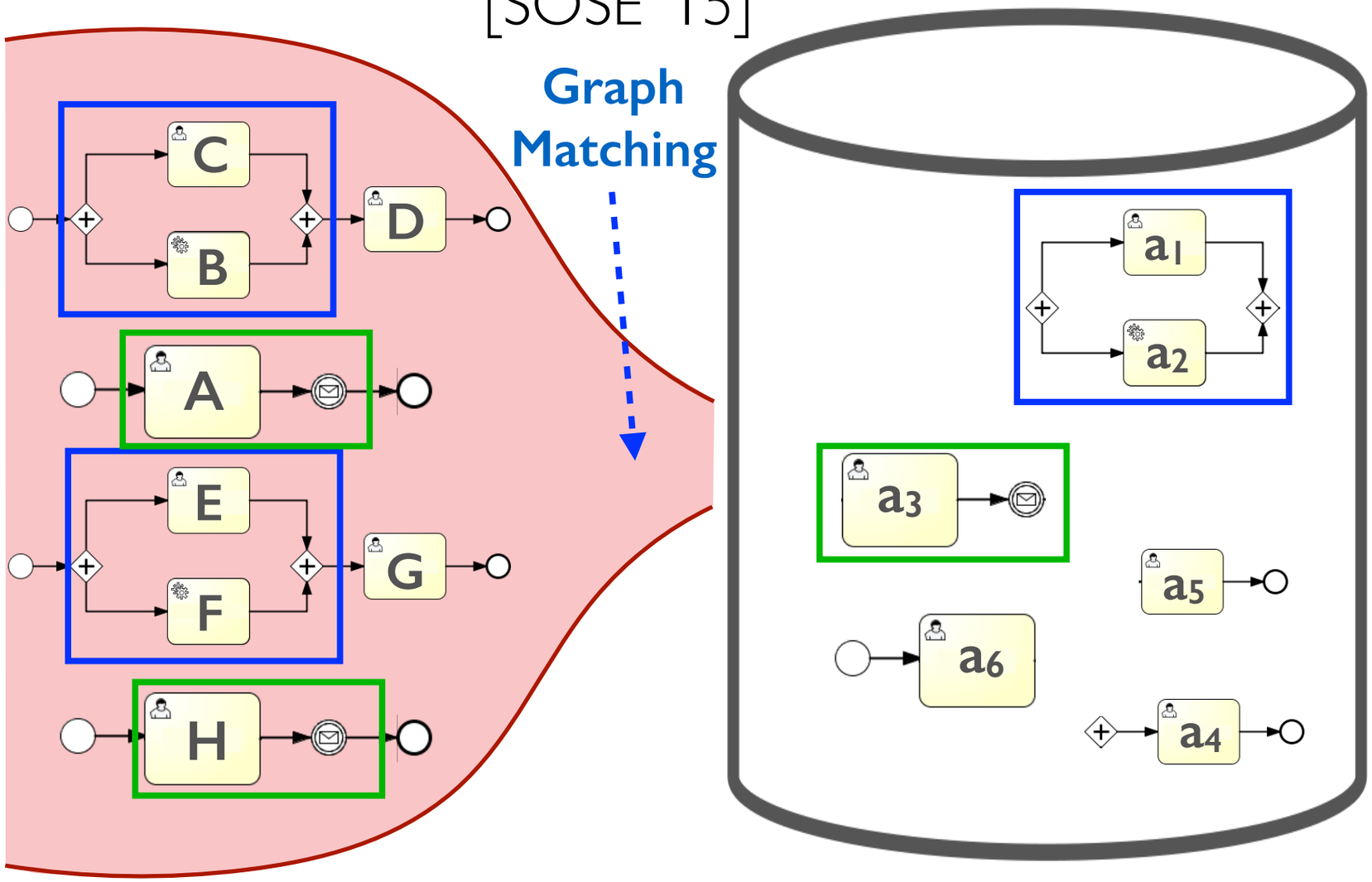


REAL-WORLD PROCESSES

Define the Workload Mix

discover reoccurring structural patterns

Skouradaki et al.
[SOSE '15]



REAL-WORLD PROCESSES

REOCCURRING STRUCTURES

Define the Workload Mix

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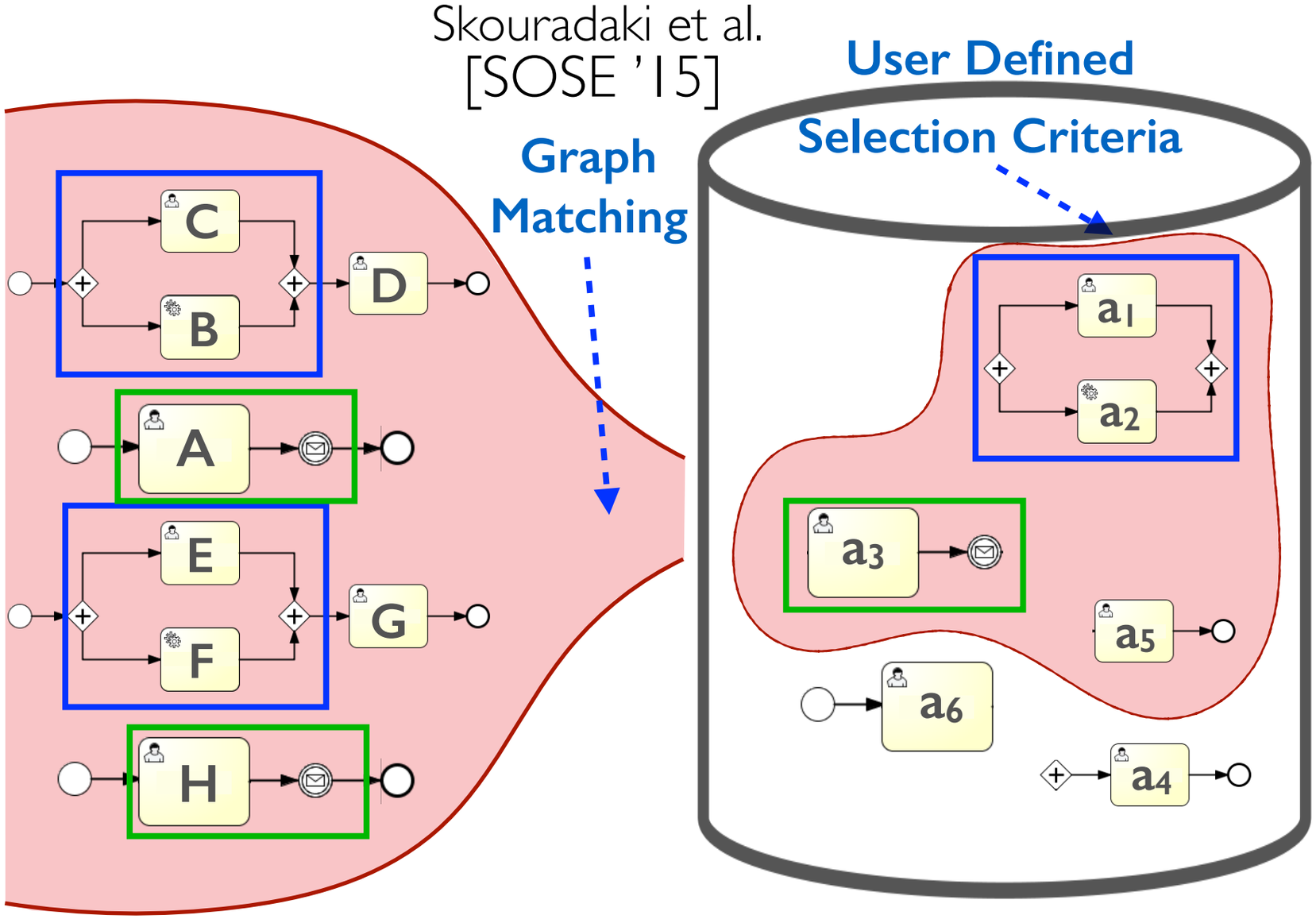


REAL-WORLD PROCESSES

REOCCURRING STRUCTURES

Define the Workload Mix

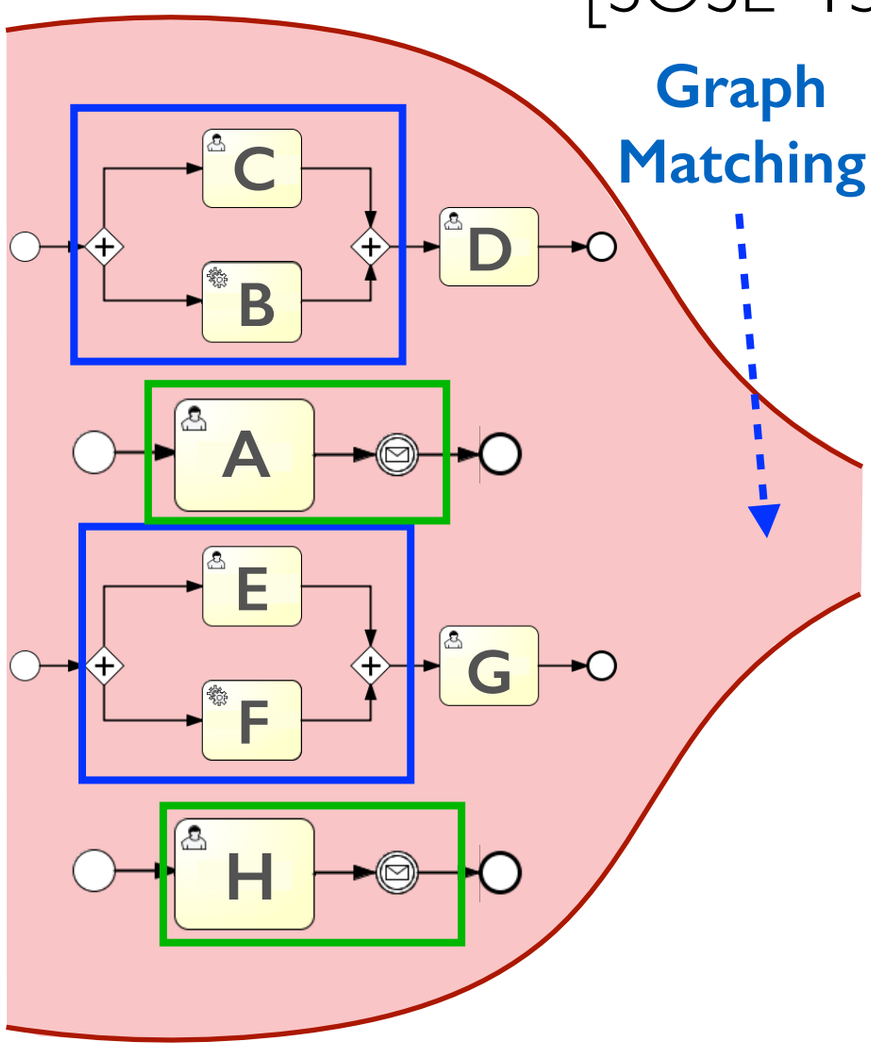
discover reoccurring structural patterns

Skouradaki et al.
[SOSE '15]

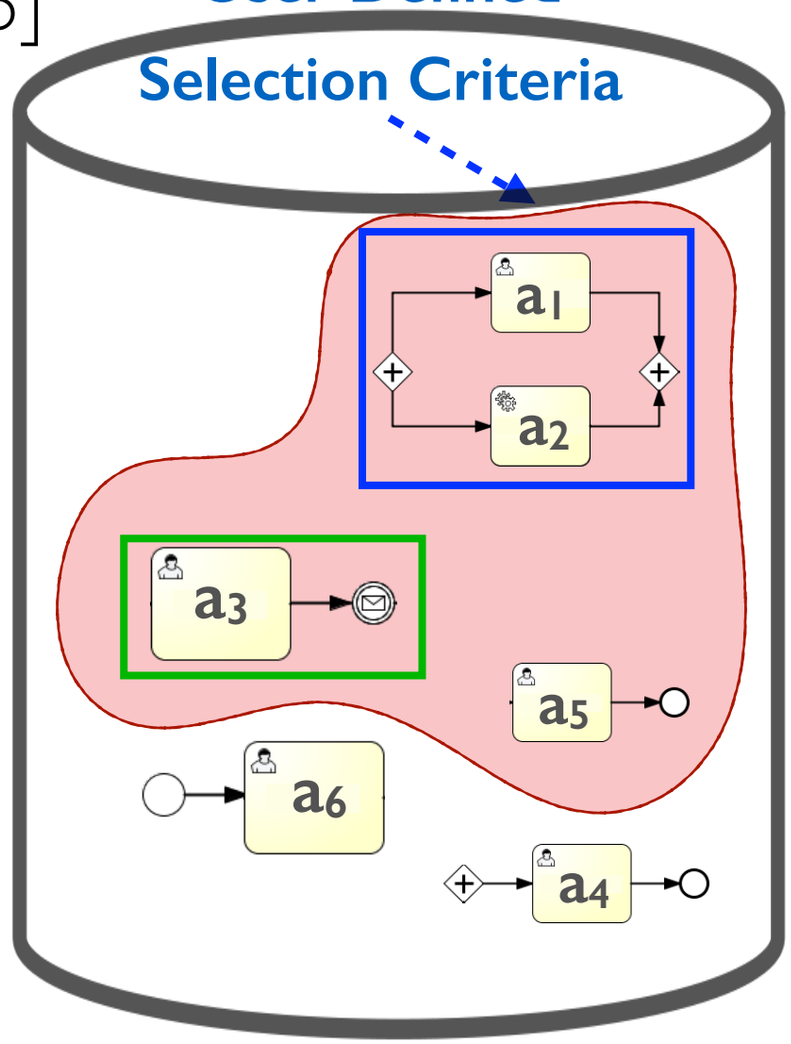
Graph Matching

User Defined Selection Criteria

Composition Criteria



REAL-WORLD PROCESSES



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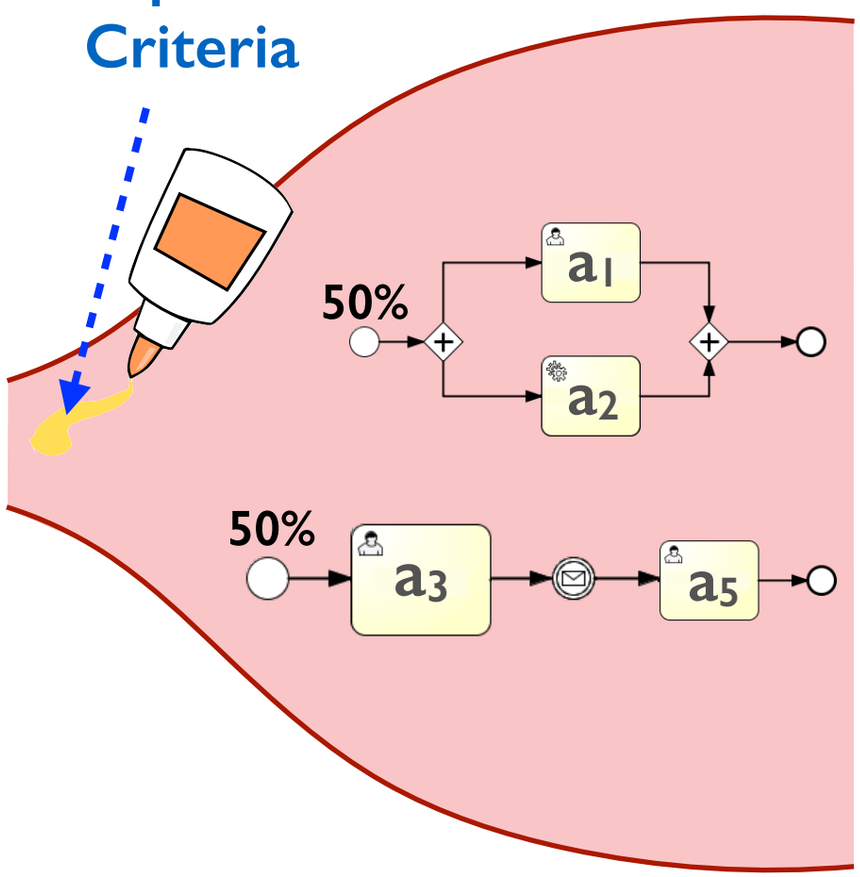
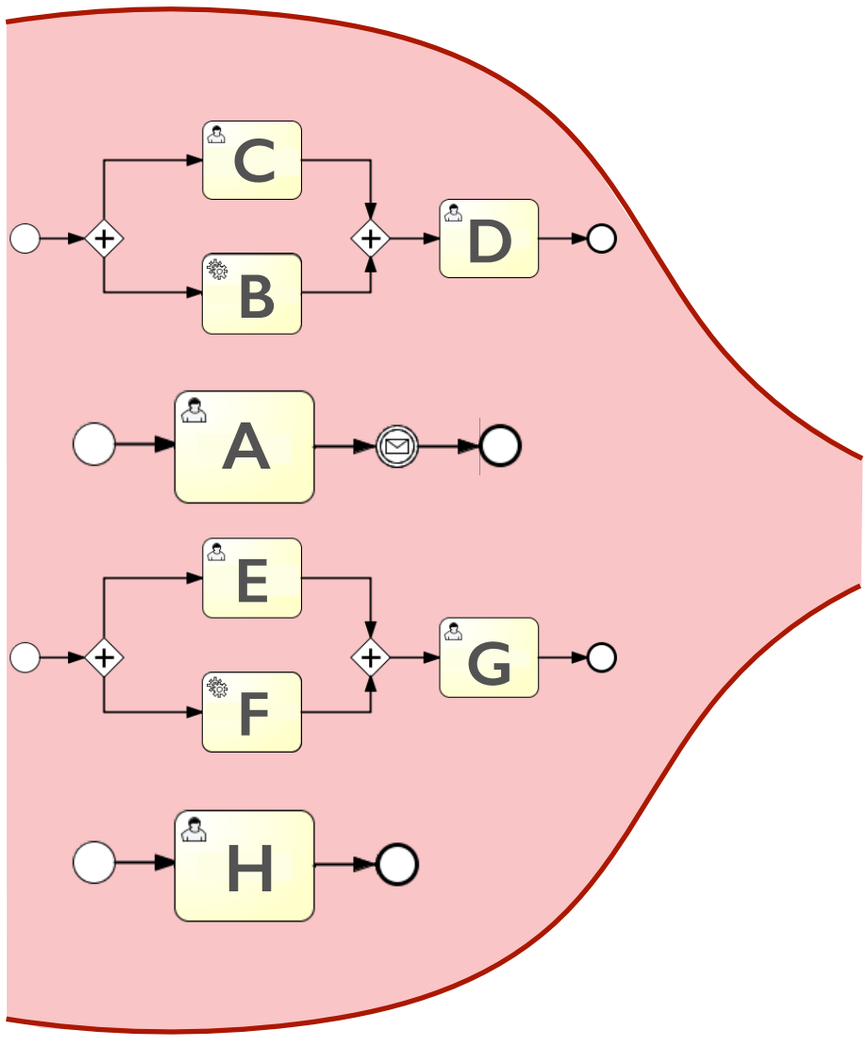


WORKLOAD MIX

Define the Workload Mix

discover clusters of models



REAL-WORLD PROCESSES

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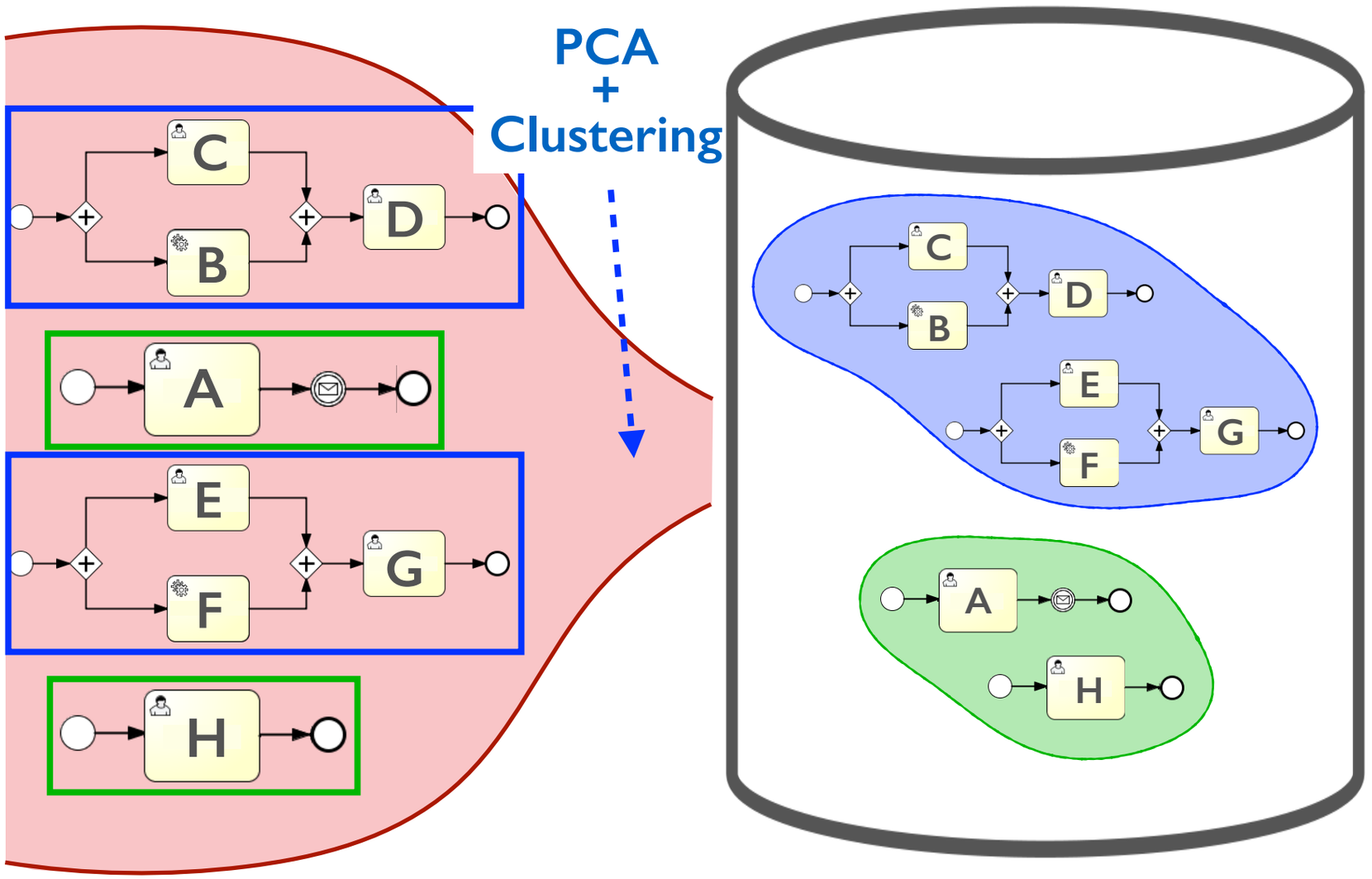


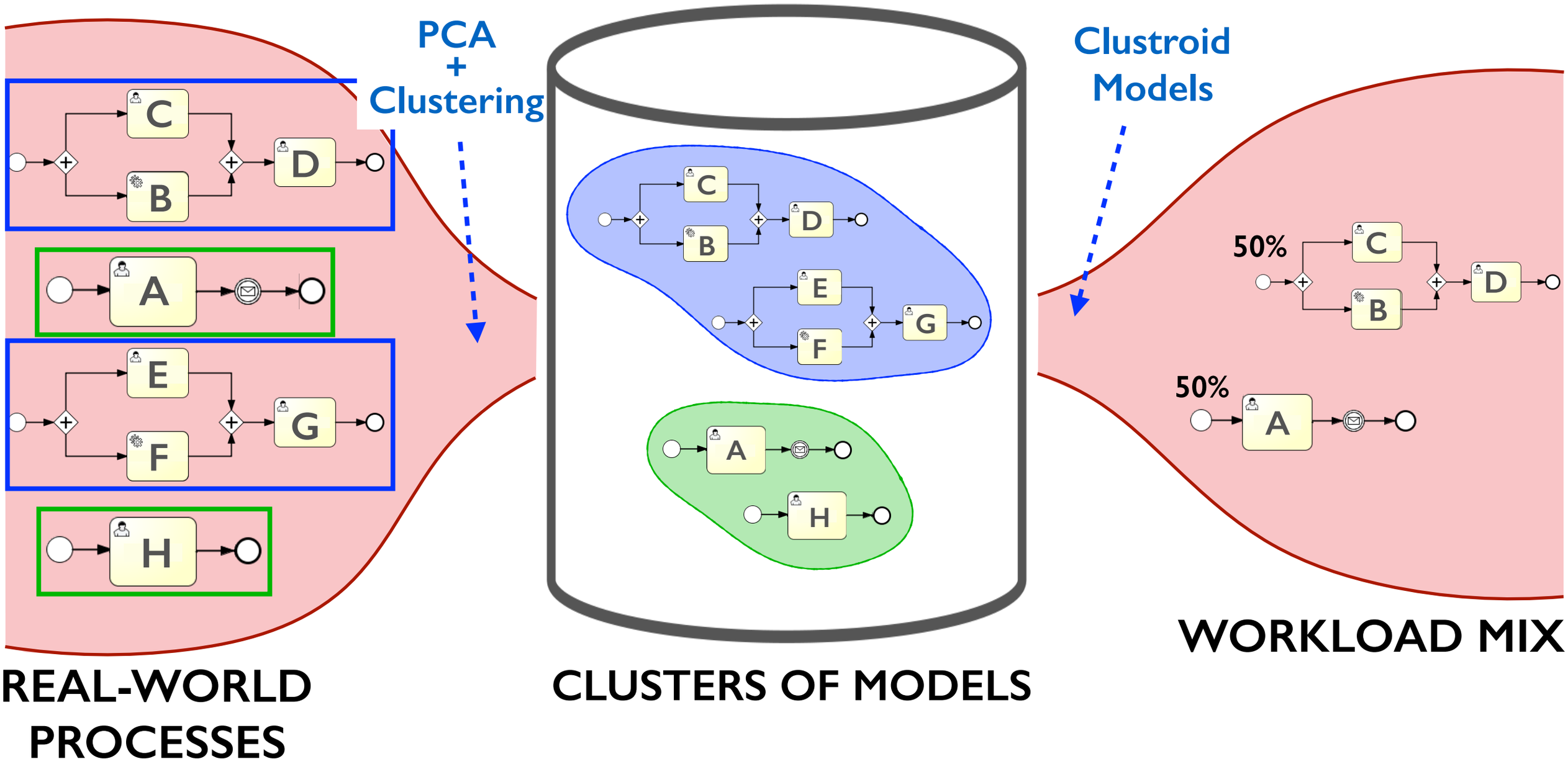
REAL-WORLD PROCESSES

CLUSTERS OF MODELS

> 100 METRICS: Size, Structure, External Interaction, Data Handling, Complexity

Define the Workload Mix

discover clusters of models



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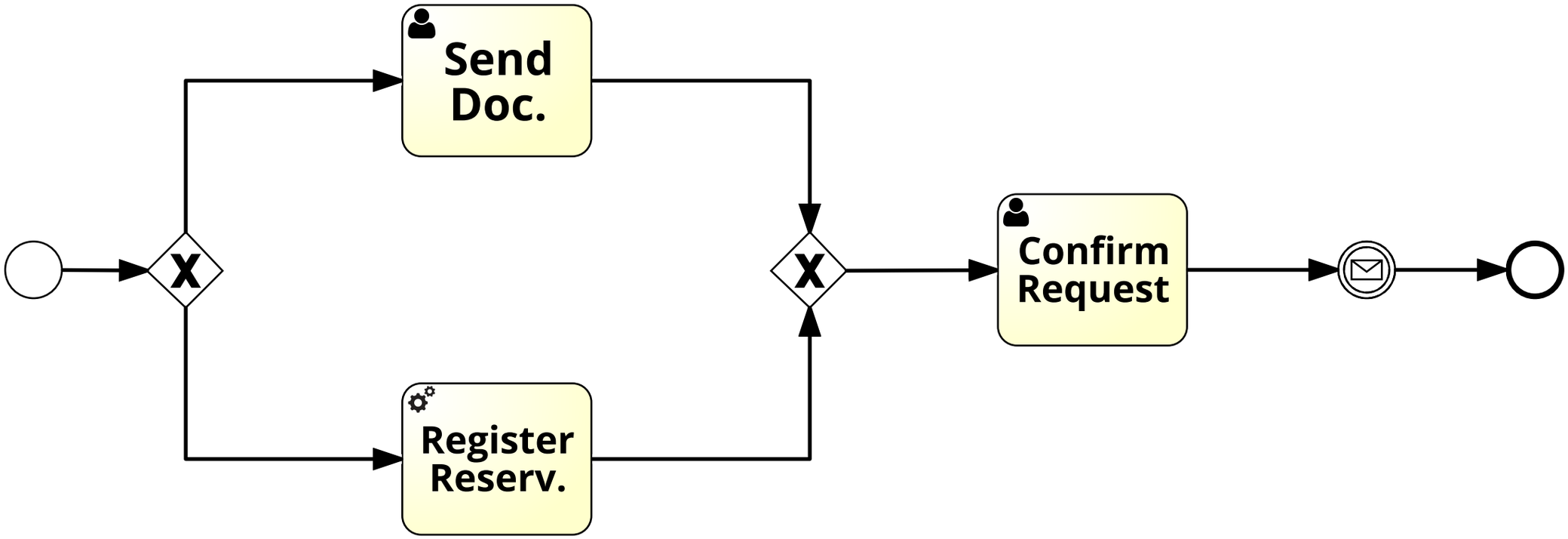
Define the Test Data

different types of test data



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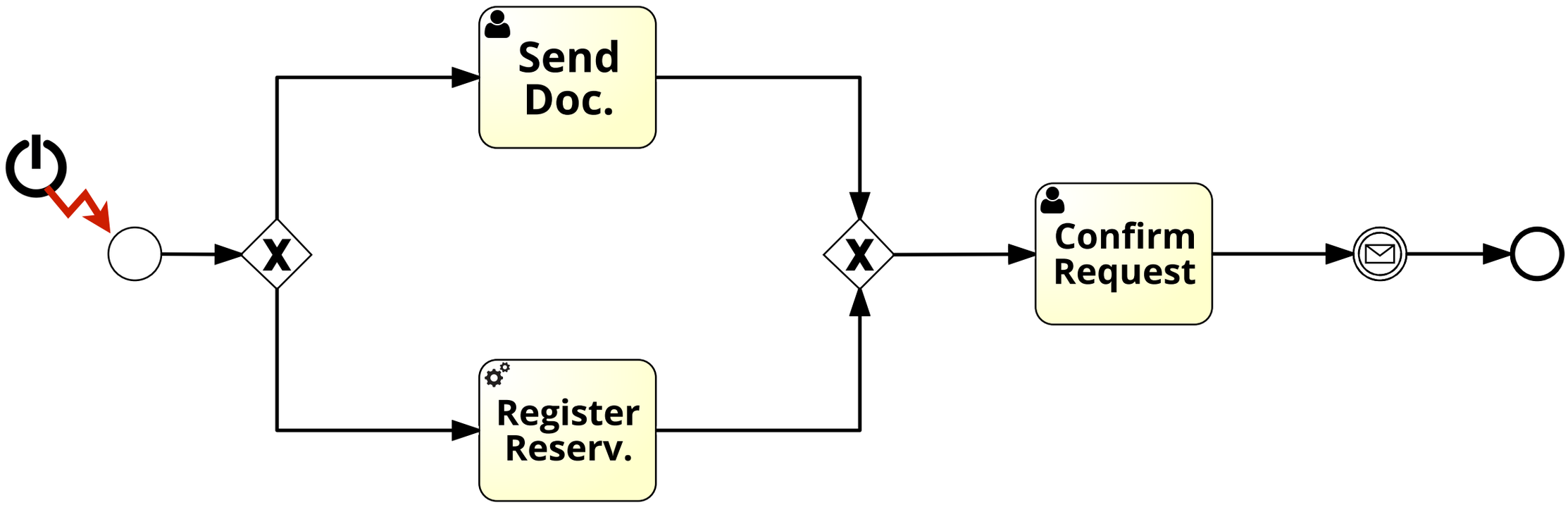

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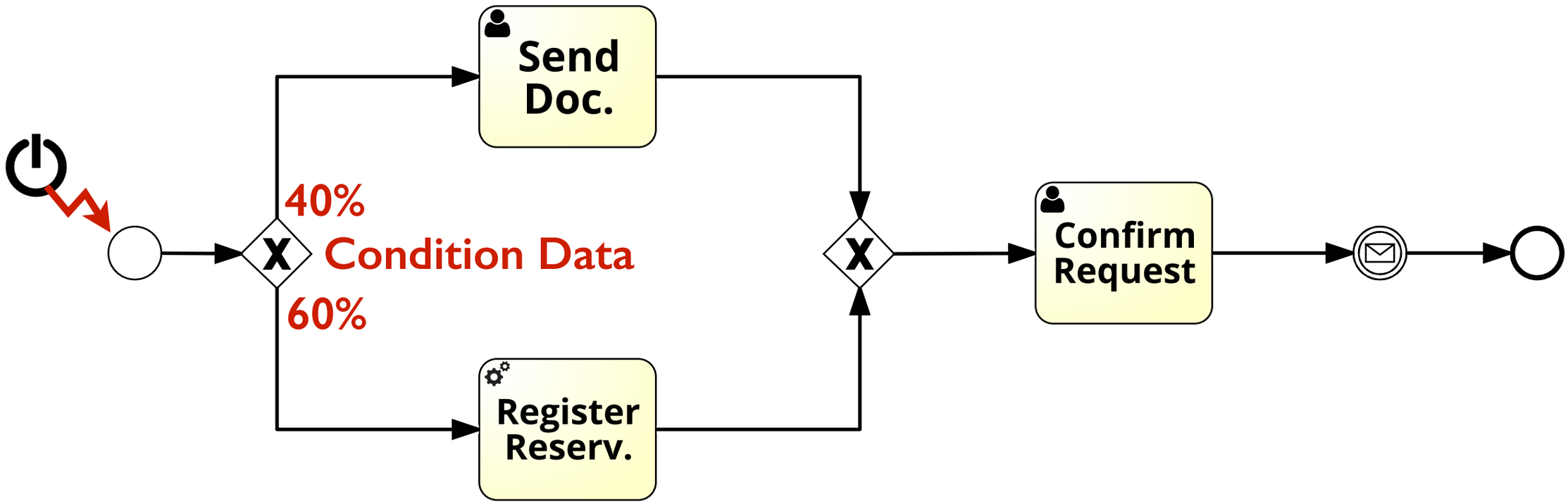

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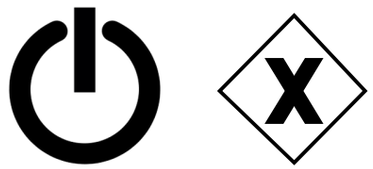

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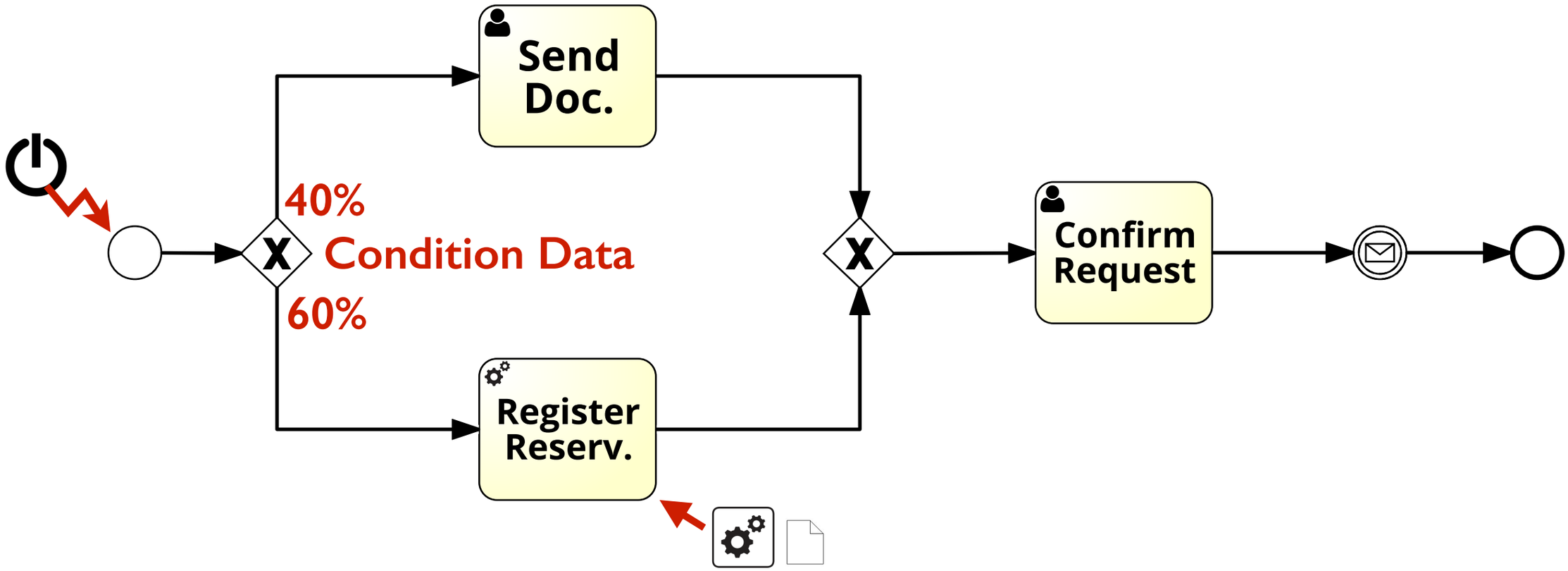

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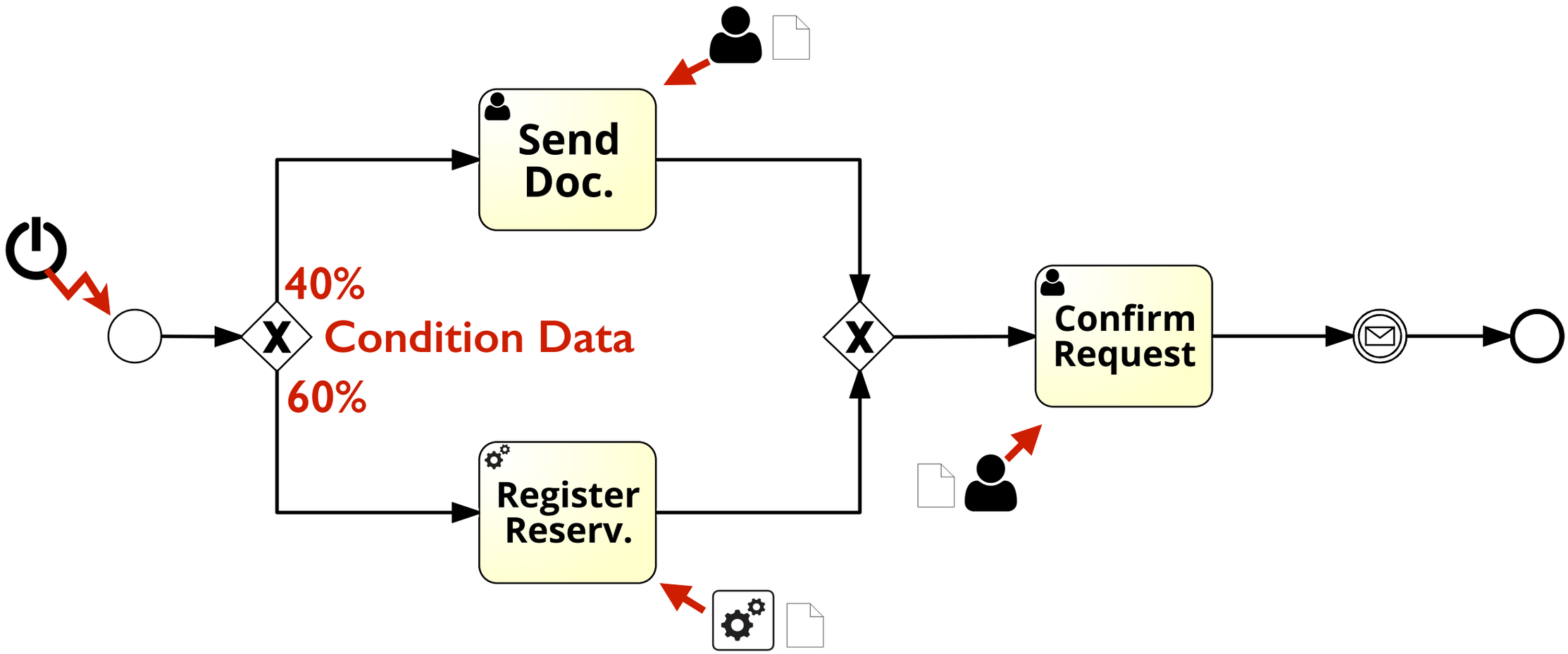

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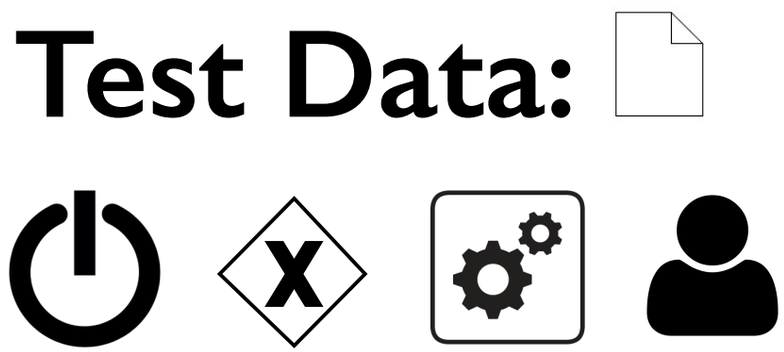

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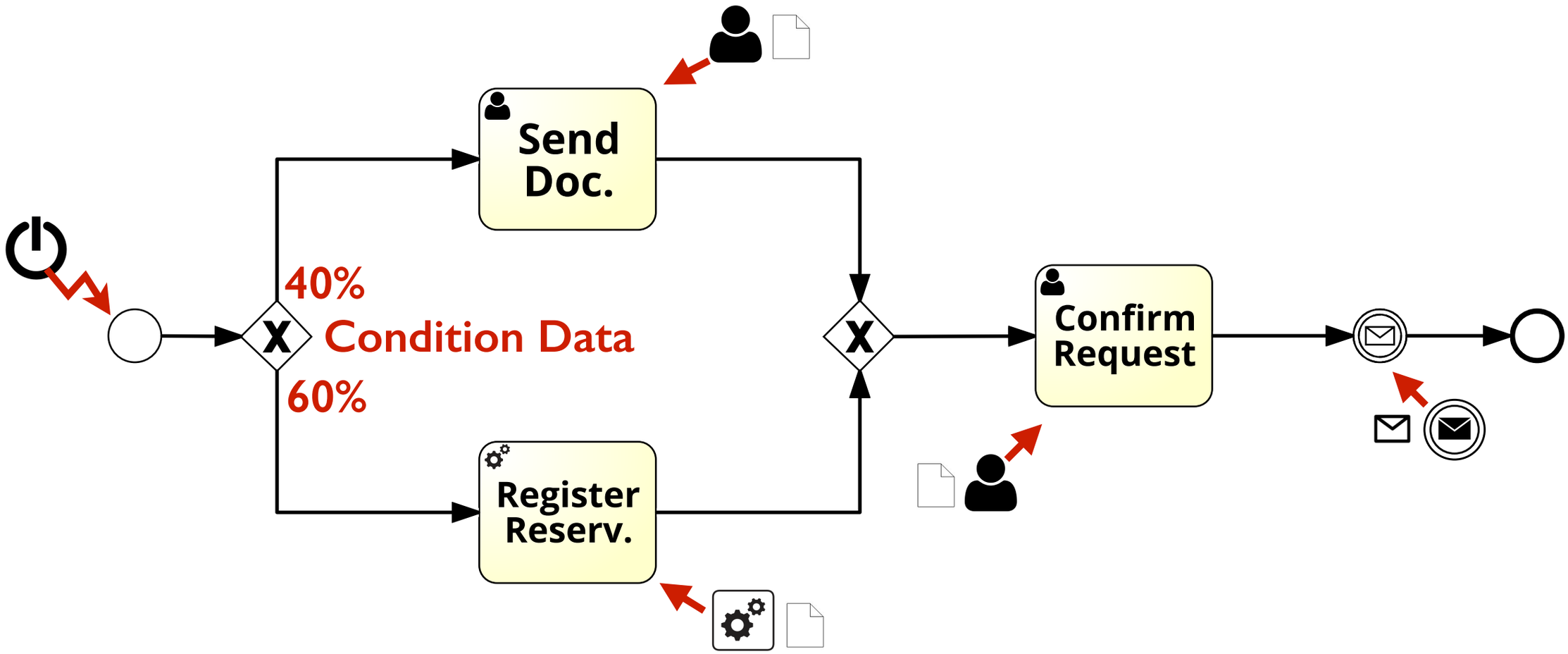
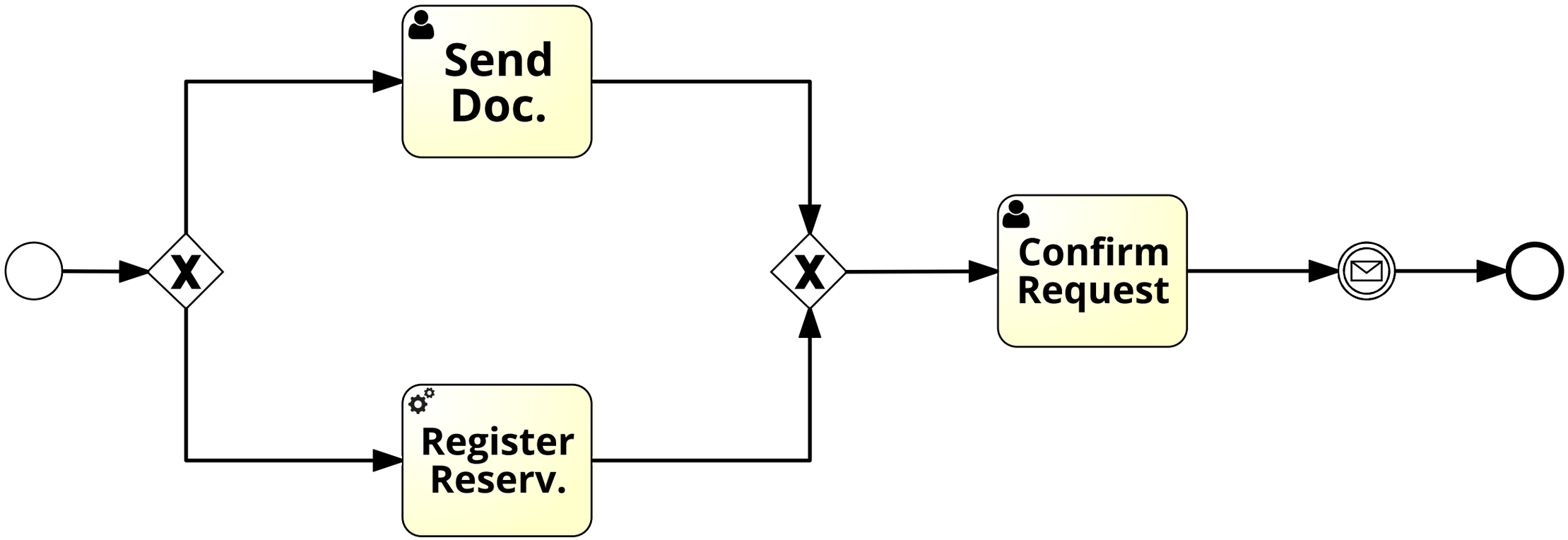


Test Data:

Define the Load Functions

different types of load functions



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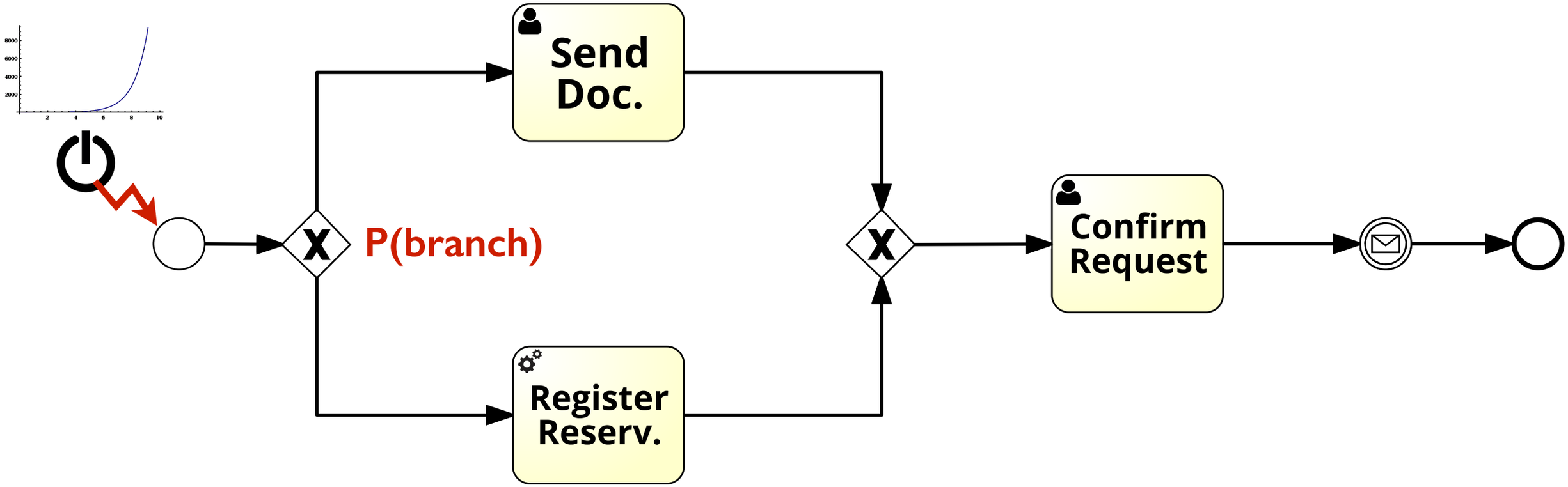

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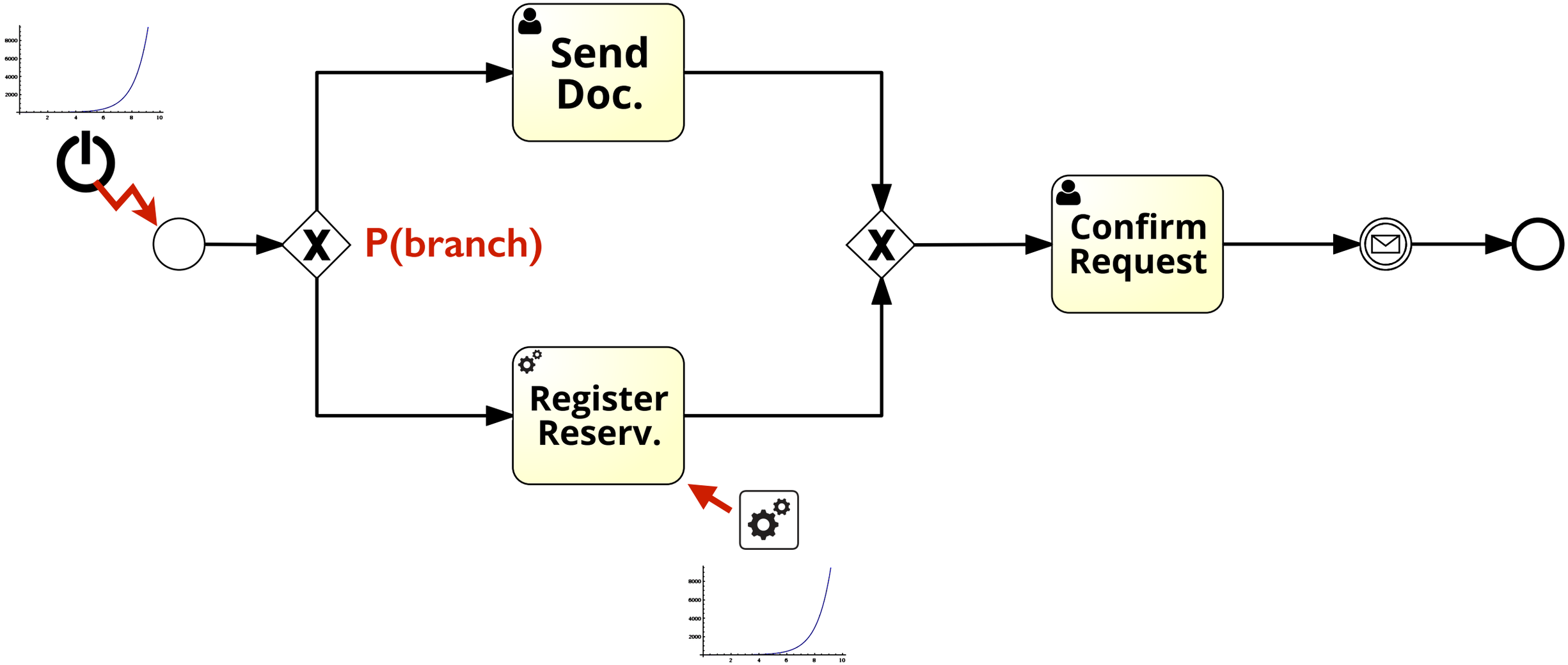

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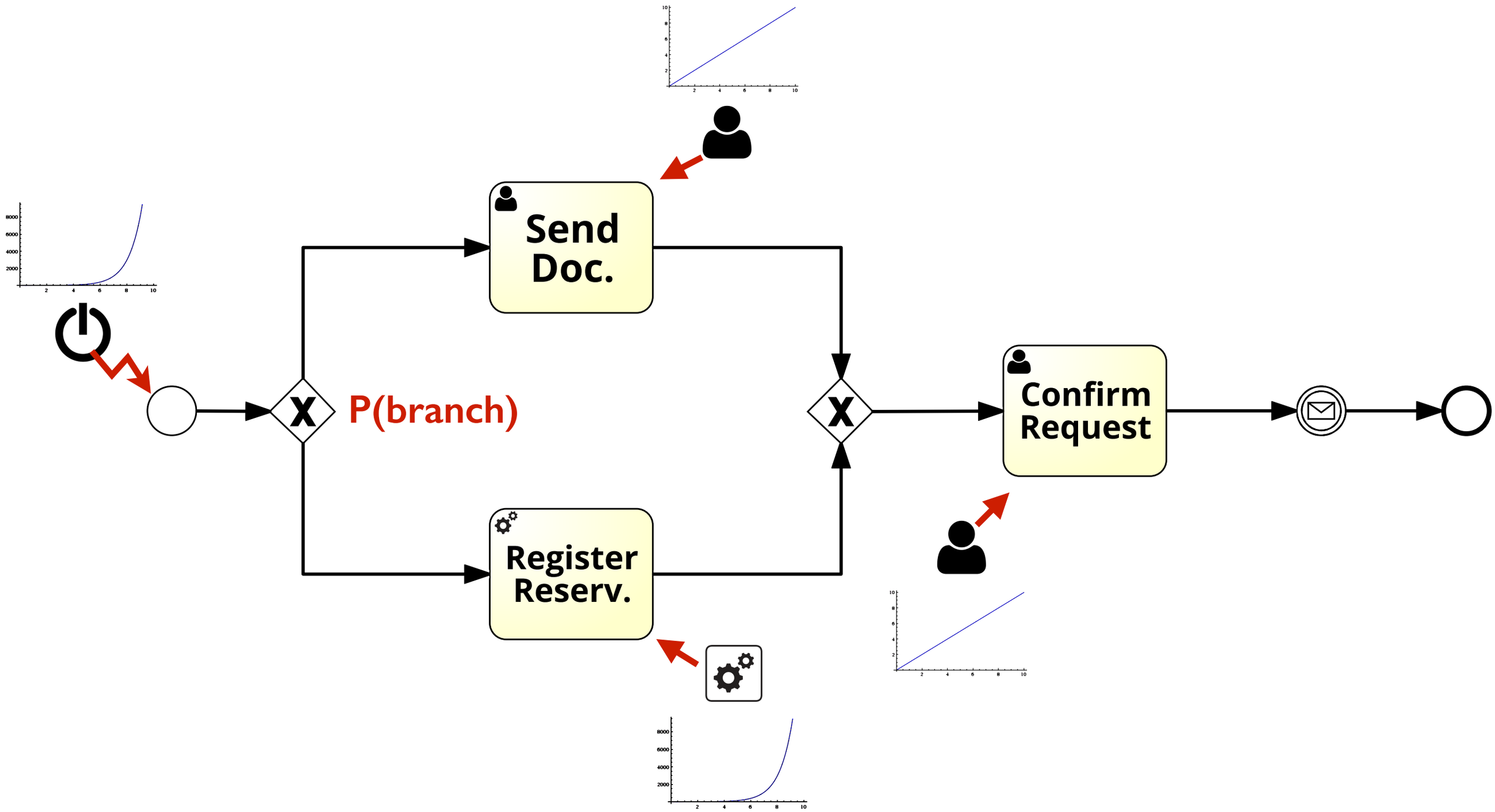
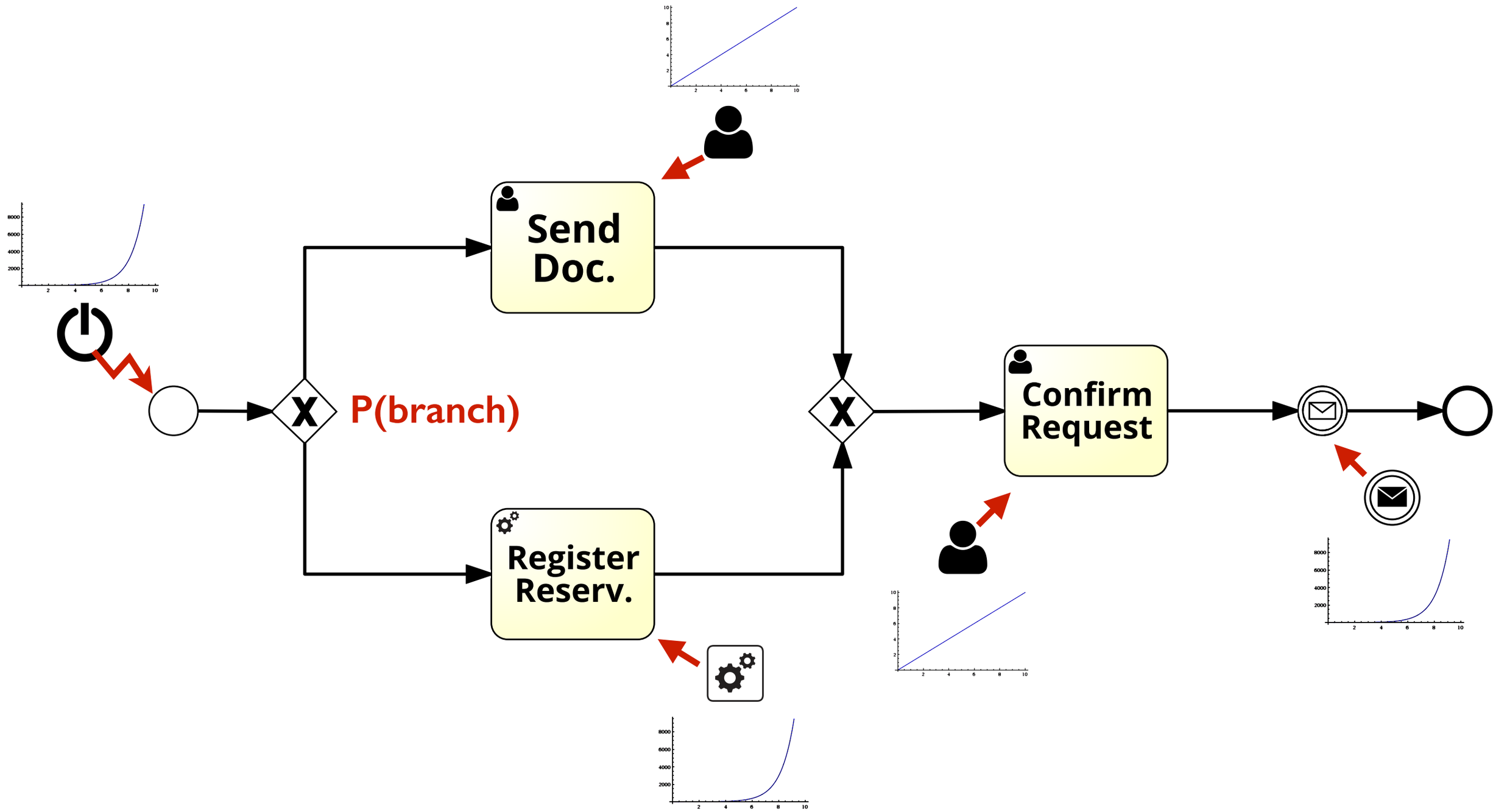


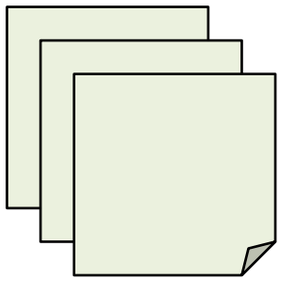
Define the Load Functions

different types of load functions

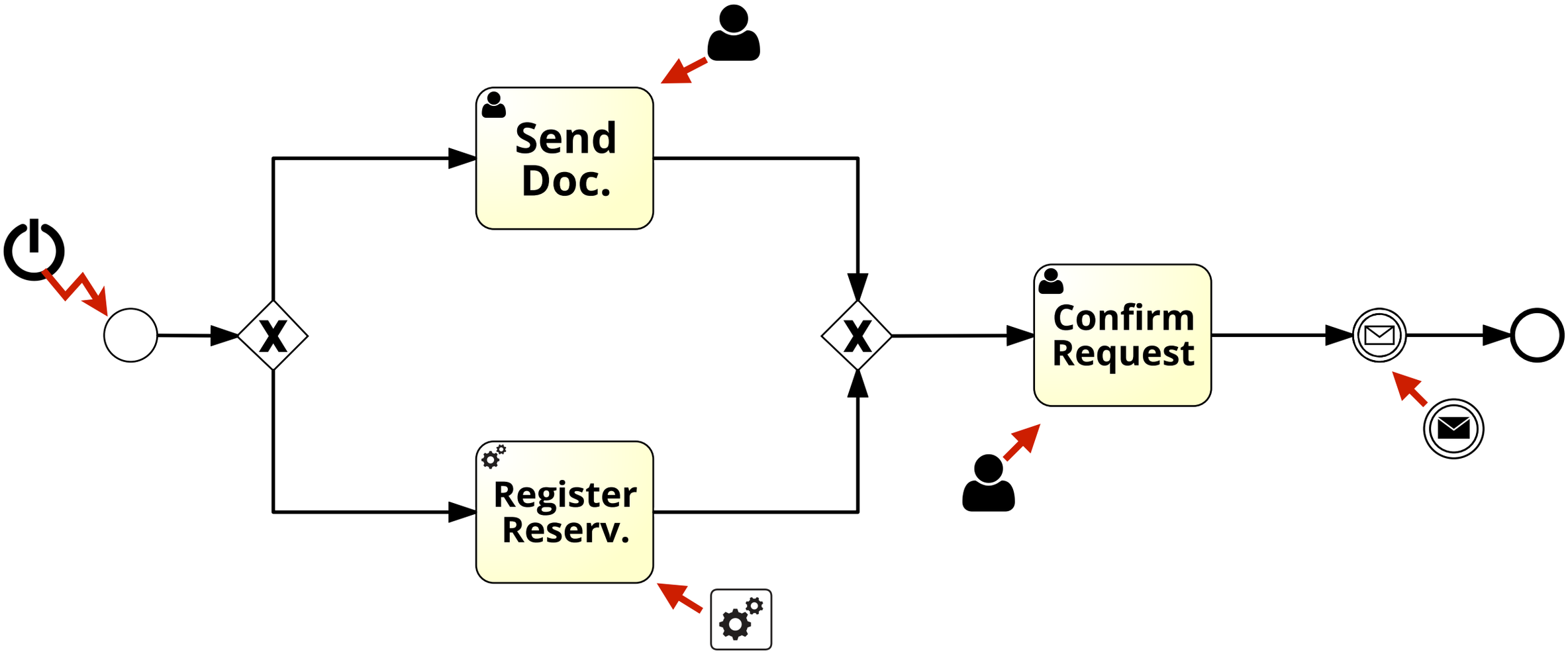


Define the Load Functions

process logs, experts' opinion

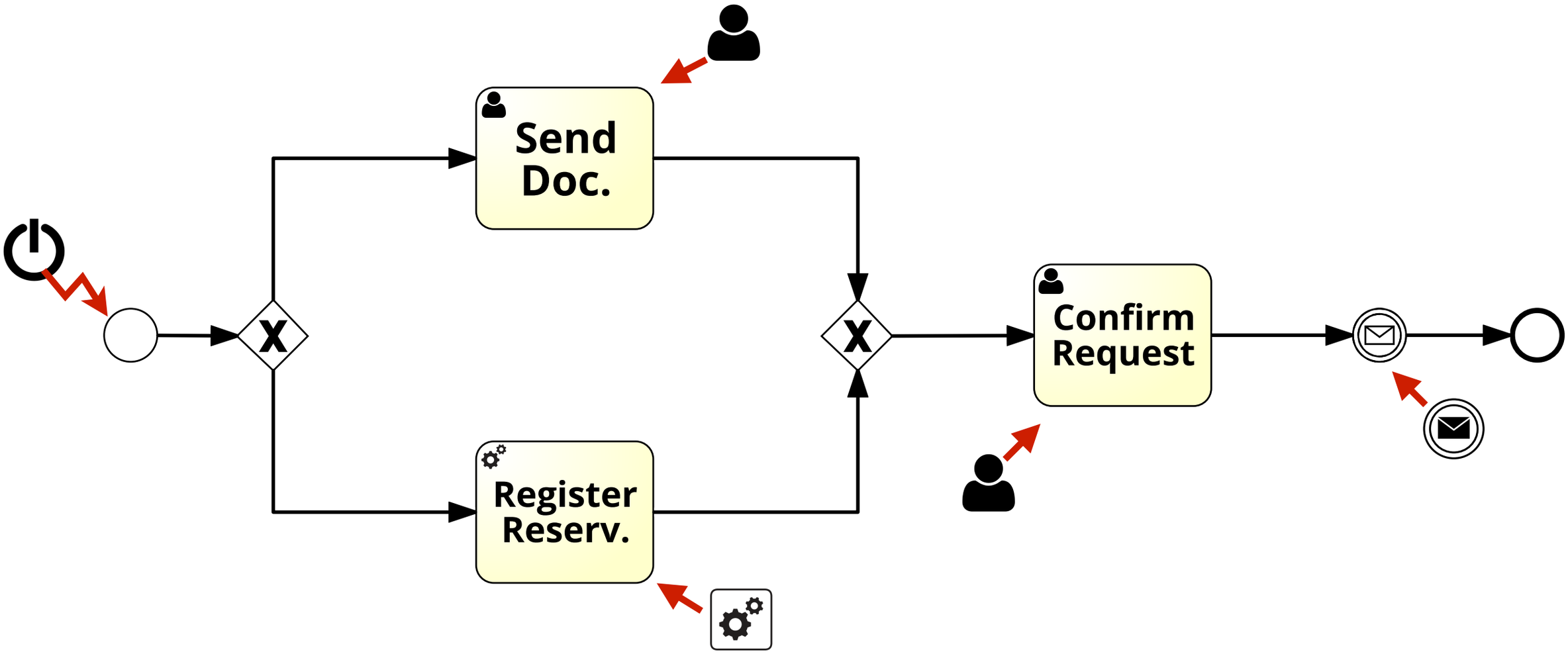


Process Logs



Define the Load Functions

process logs, experts' opinion



Define the Load Functions

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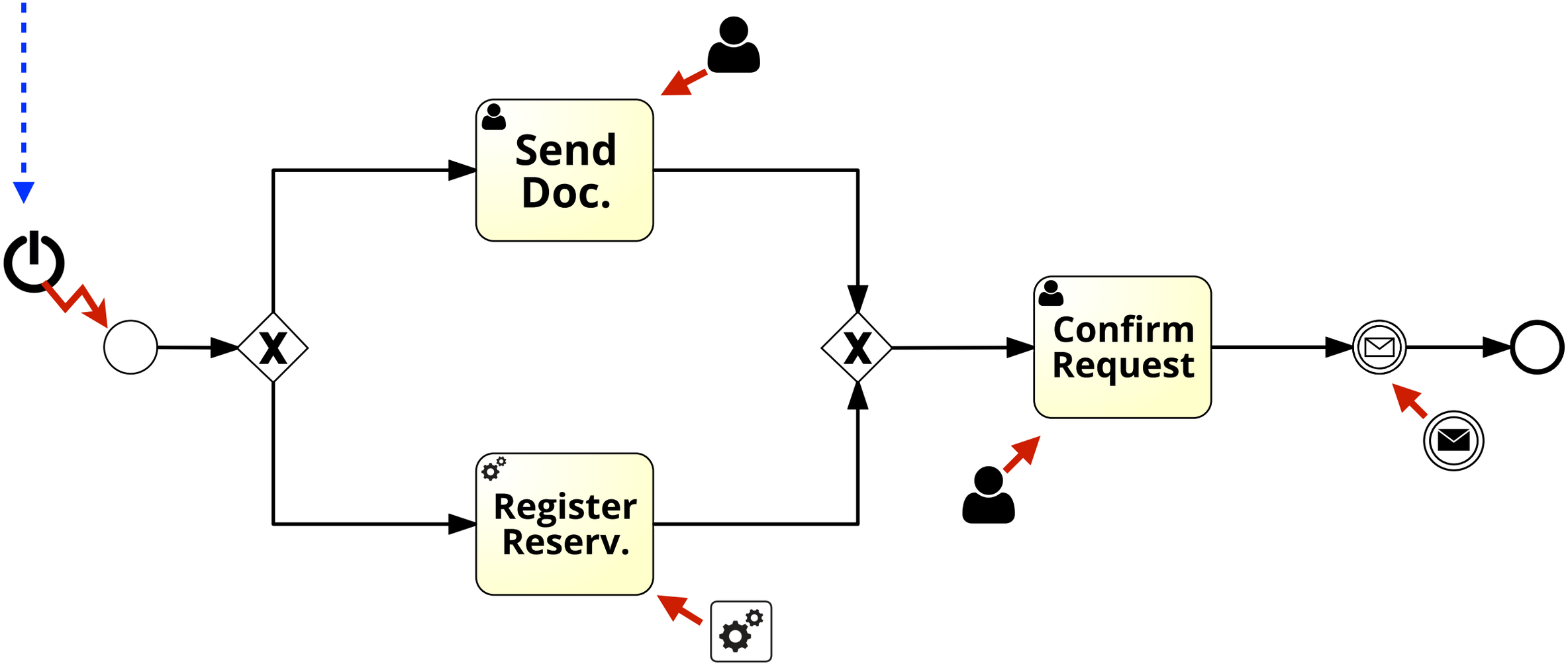
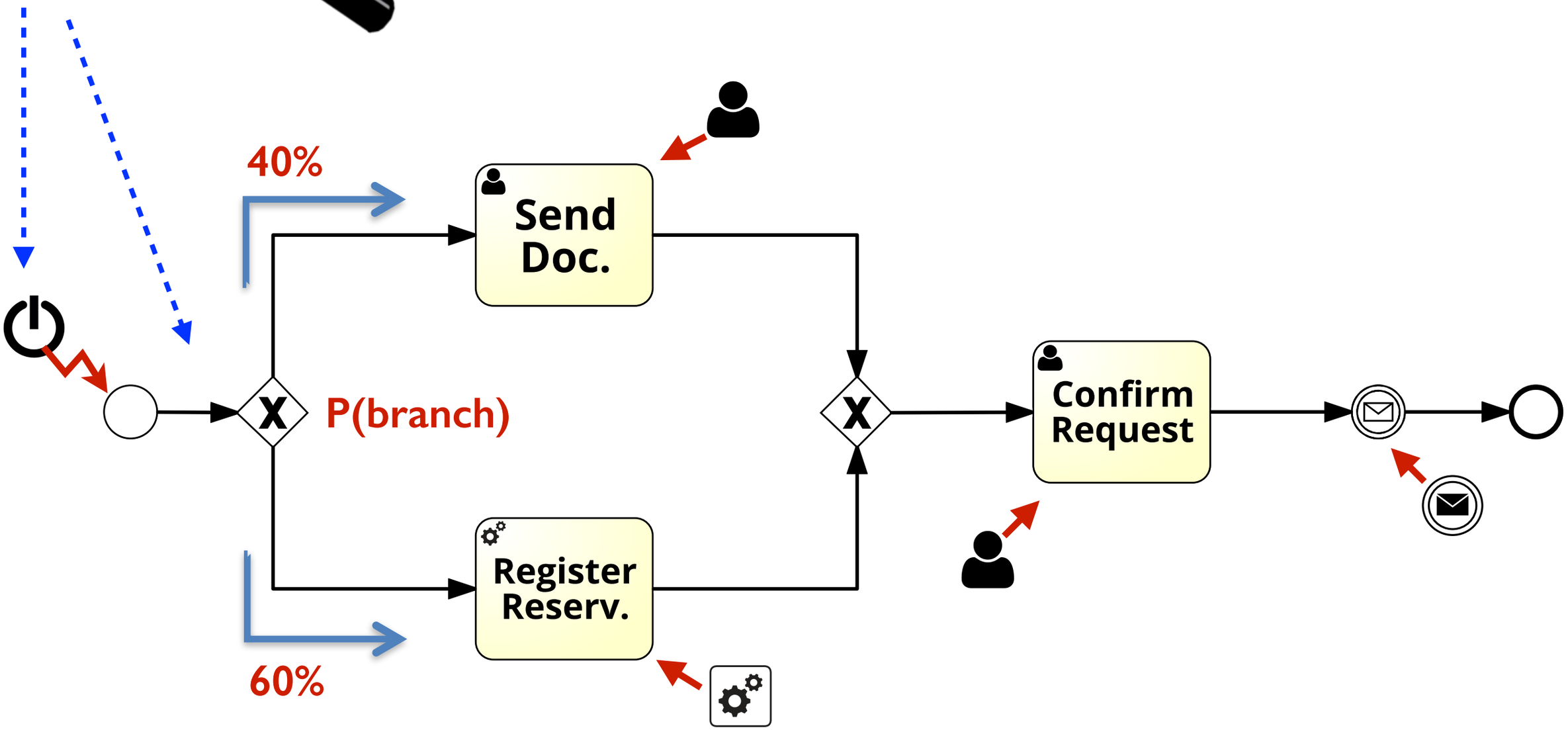


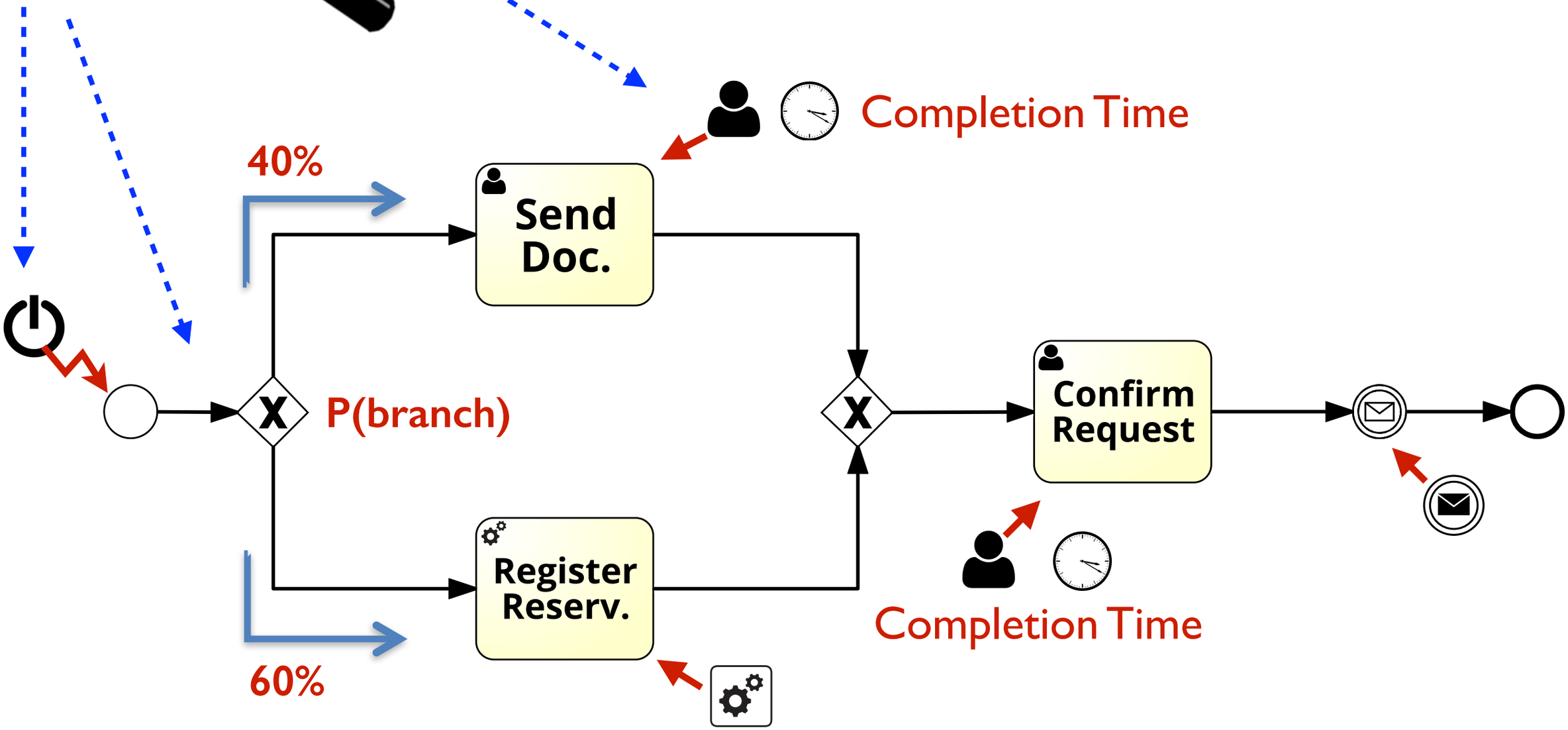
Define the Load Functions

process logs, experts' opinion



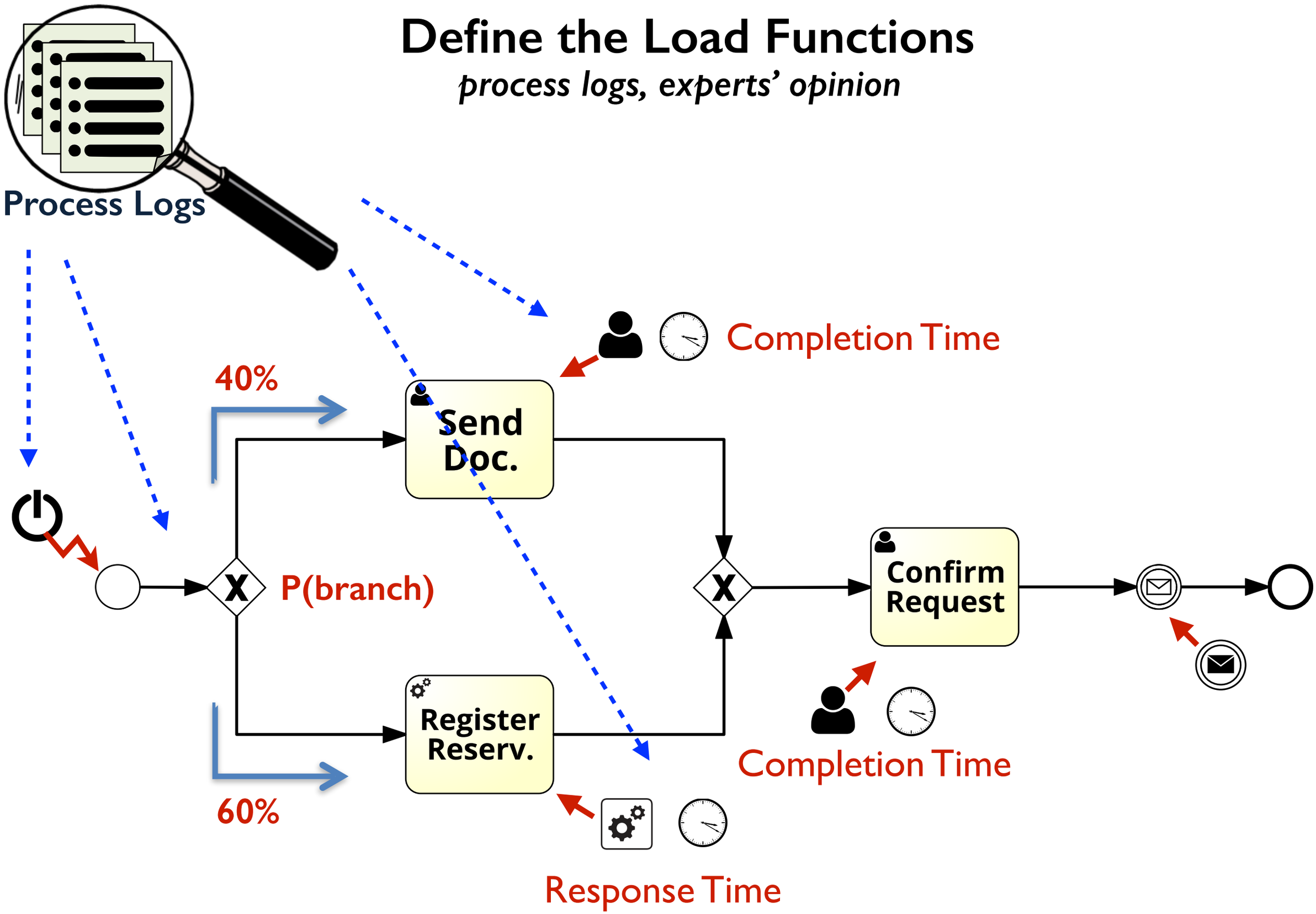
Define the Load Functions

process logs, experts' opinion



Define the Load Functions

process logs, experts' opinion



Define the Load Functions

process logs, experts' opinion

Completion Time

40%

Send Doc.

P(branch)

Confirm Request

Requests Rate

Completion Time

Register Reserv.

60%

Response Time

Define the Load Functions

process logs, experts' opinion

Completion Time

40%

Send Doc.

P(branch)

Confirm Request

Requests Rate

Completion Time

Register Reserv.

60%

Response Time

Test Types and the Workload Model

Performance Test Types

- Load testing
- Stress testing
- Soak testing
- Spike testing
- Scalability testing
- Capacity testing
- Configuration testing
- Isolation testing
- …

Workload Model

Test Types and the Workload Model

Performance Test Types

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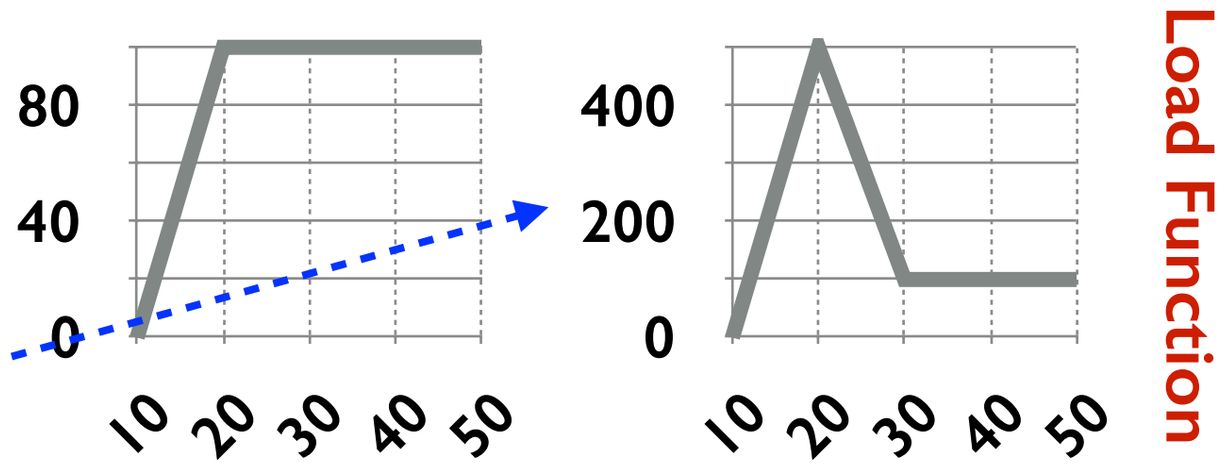
Workload Model



Test Types and the Workload Model

Performance Test Types

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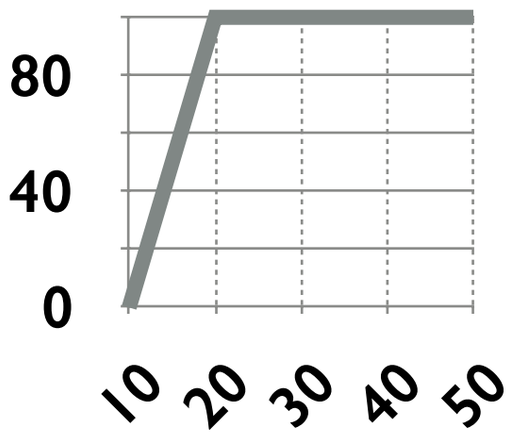
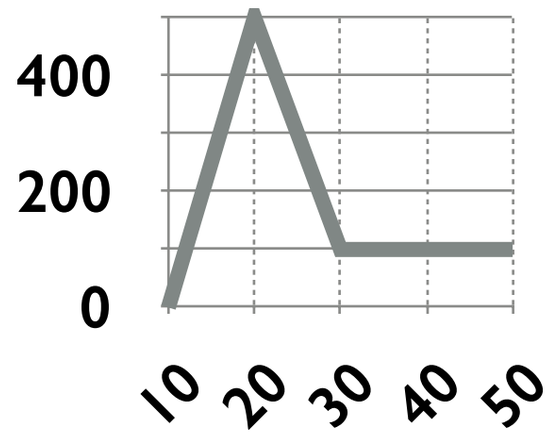
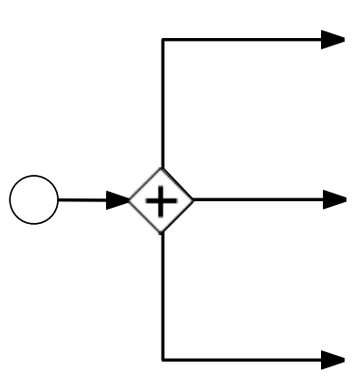
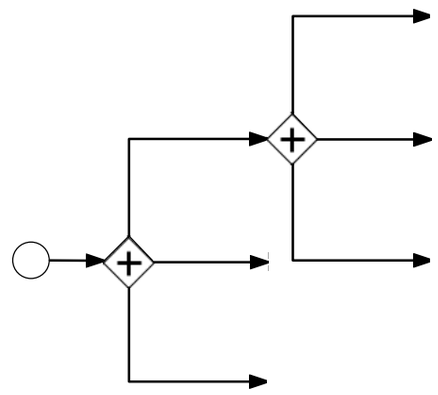
Workload Model





Load Function





Workload Mix

Test Types and the Workload Model

Performance Test Types

- Load testing
- Stress testing
- Soak testing
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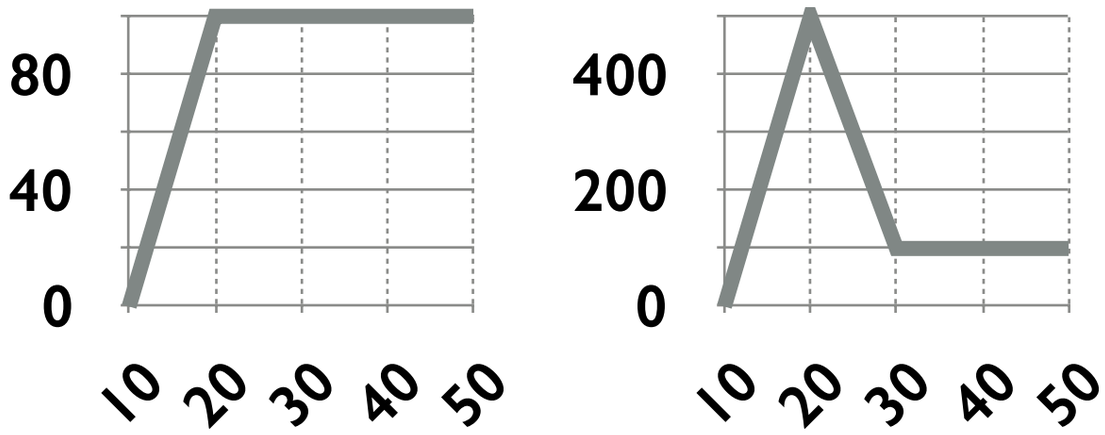
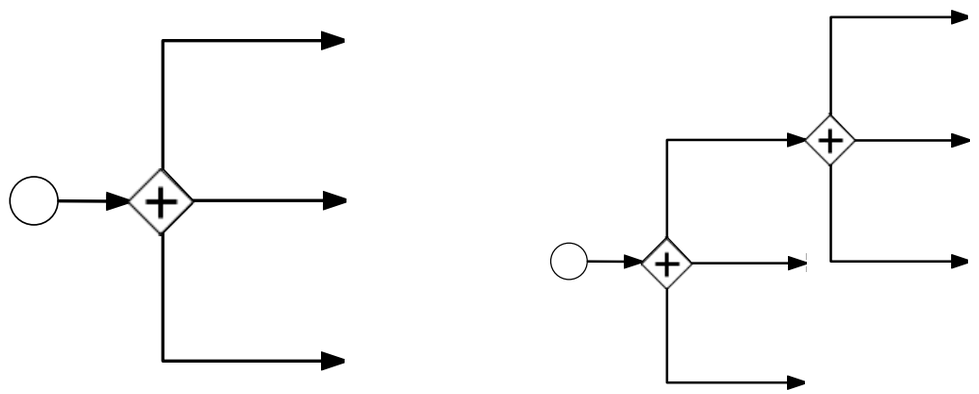
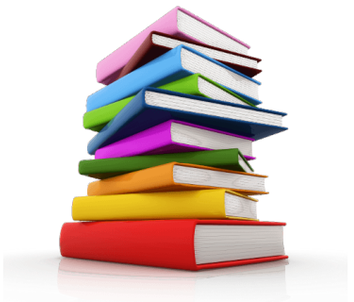
- Configuration testing
- Isolation testing
- …

Workload Model

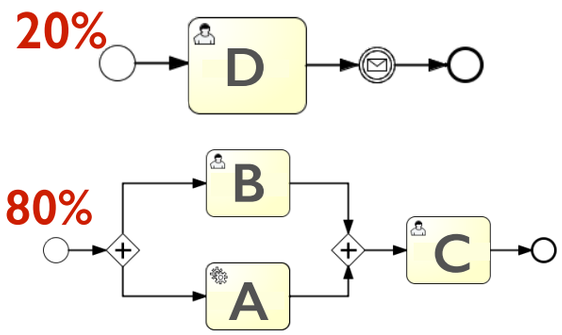




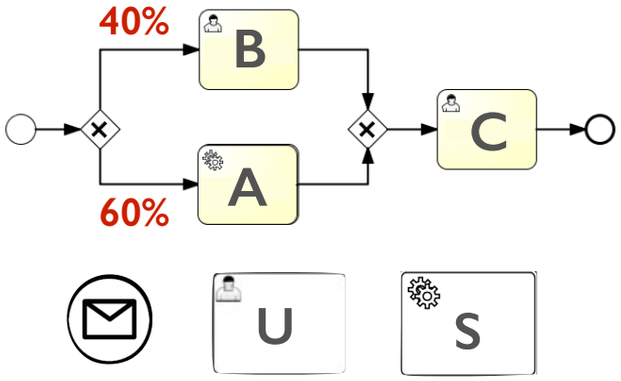


Load Function Workload Mix Test Data

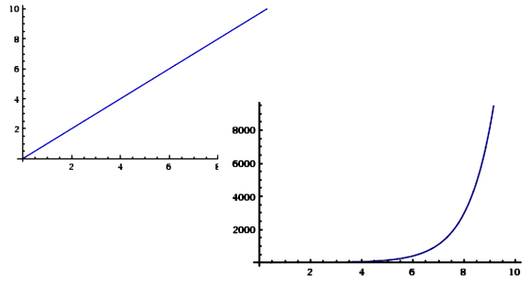
Main Challenges in Benchmarking BPMN 2.0 WfMSs



Workload Mix



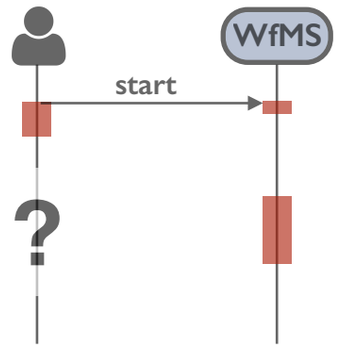
Test Data



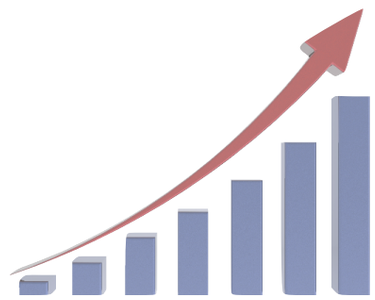
Load Functions

WORKLOAD MODEL

WfMS-specific APIs and BPMN 2.0 Customisations



Asynchronous Execution of Workflows

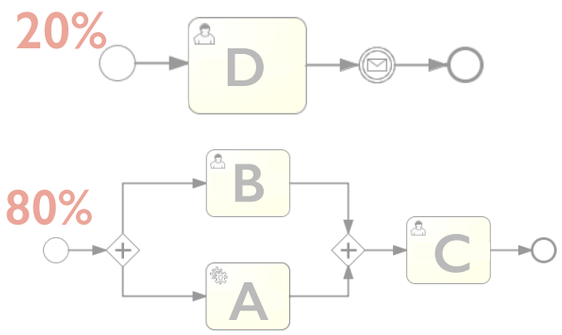


Performance Metrics and KPIs

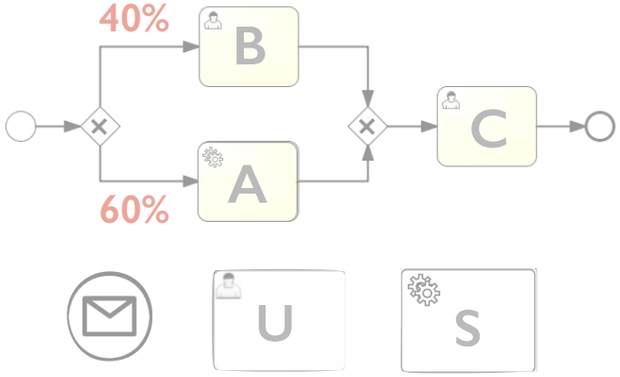
BENCHMARK EXECUTION

ANALYSES

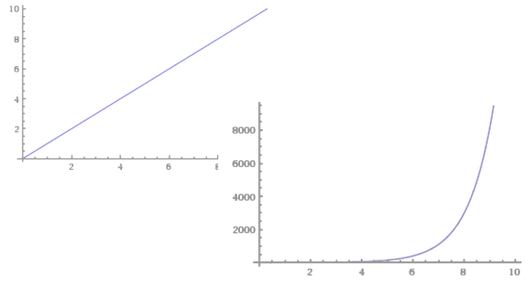
Main Challenges in Benchmarking BPMN 2.0 WfMSs



Workload Mix

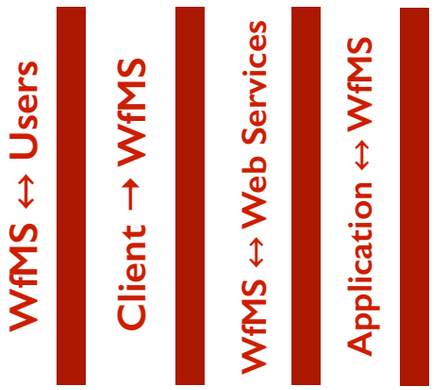


Test Data

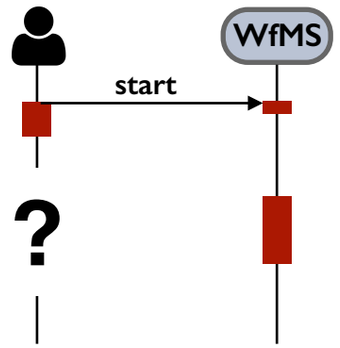


Load Functions

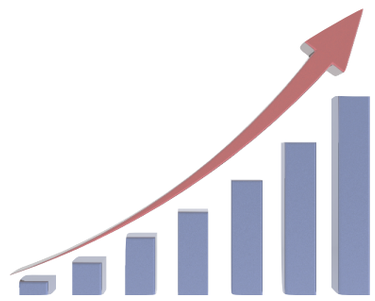
WORKLOAD MODEL



WfMS-specific APIs and BPMN 2.0 Customisations



Asynchronous Execution of Workflows



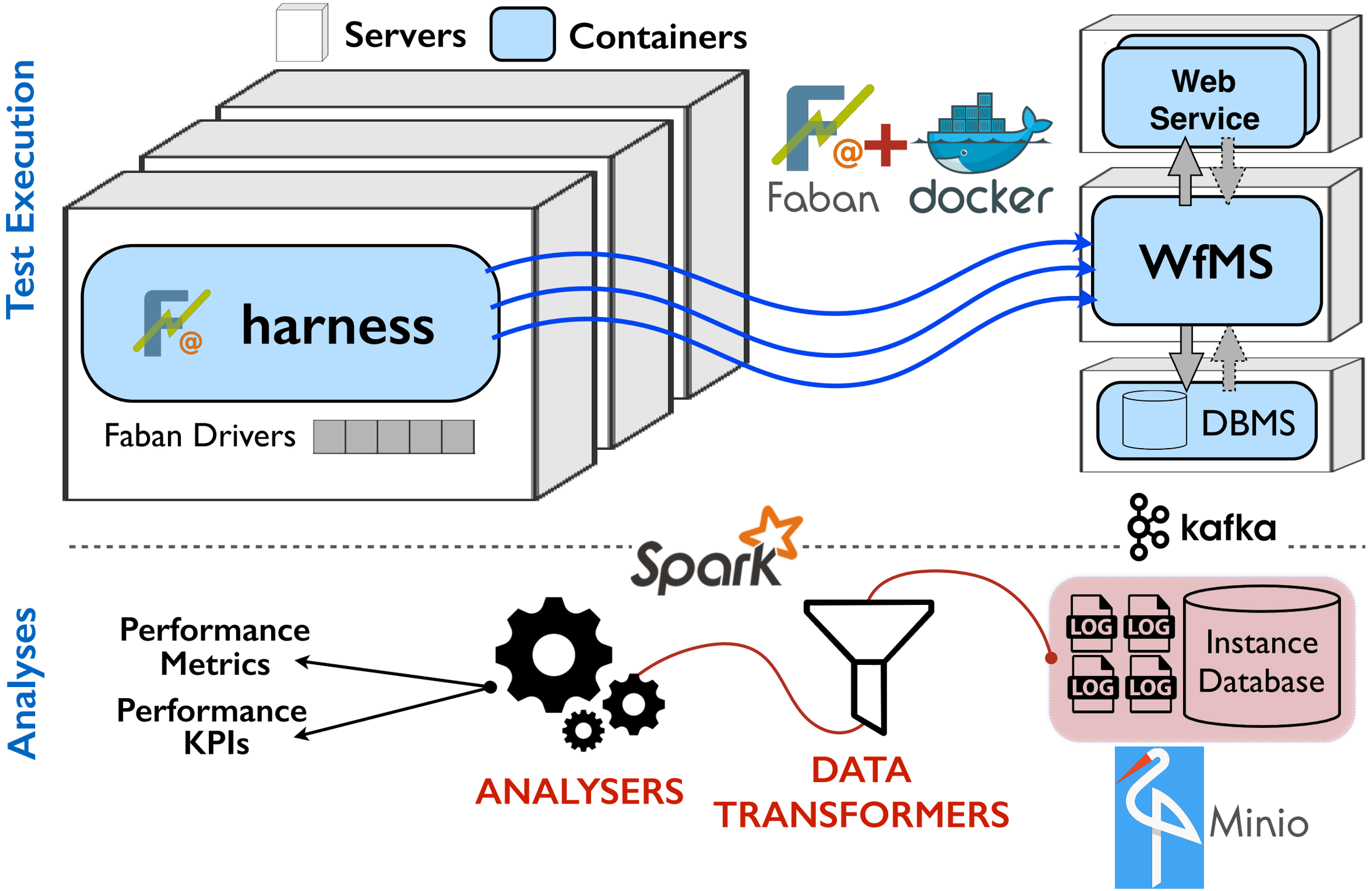
Performance Metrics and KPIs

BENCHMARK EXECUTION

ANALYSES

Enabling the Benchmark Execution and Analyses

BenchFlow framework



BenchFlow Framework

core requirements & functionalities

System Under Test (SUT)

Performance Benchmark

BenchFlow Framework

core requirements & functionalities

System Under Test (SUT)

- Automate the SUT deployment
- Simplify the SUT's deployment configuration

Performance Benchmark

BenchFlow Framework

core requirements & functionalities

System Under Test (SUT)

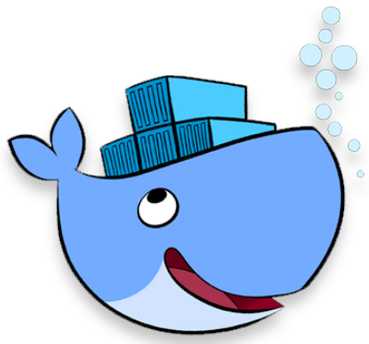
- Automate the SUT deployment
- Simplify the SUT's deployment configuration

Performance Benchmark

- Manage the benchmark lifecycle
- Simulate the entities interacting with the WfMS
- Accommodate and automate different kinds of performance tests
- Ensure reliable execution
- Ensure repeatability

BenchFlow Framework

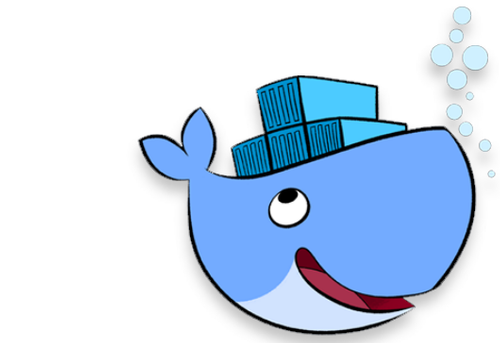
system under test



Docker Engine

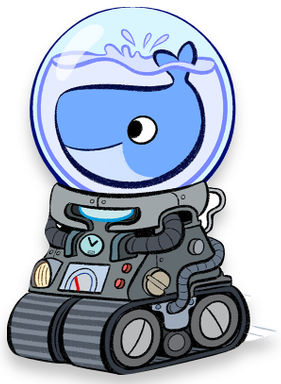
BenchFlow Framework

system under test



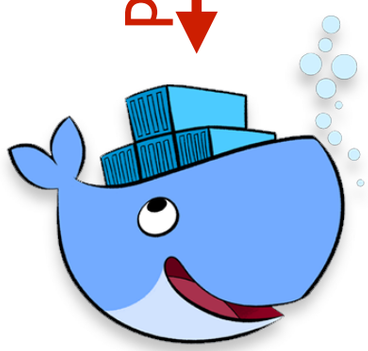
BenchFlow Framework

system under test

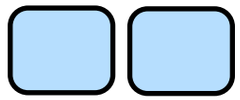


Docker Machine

provides



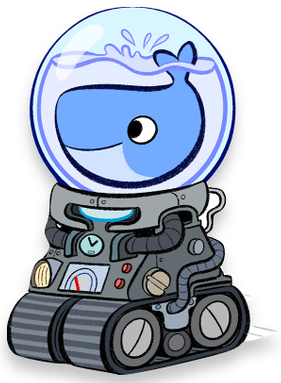
Docker Engine



Containers

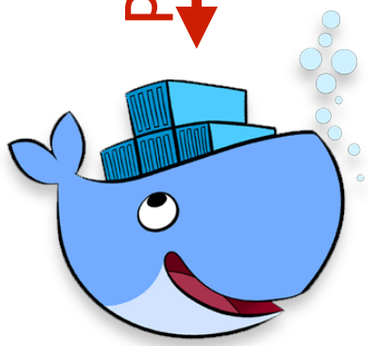
BenchFlow Framework

system under test



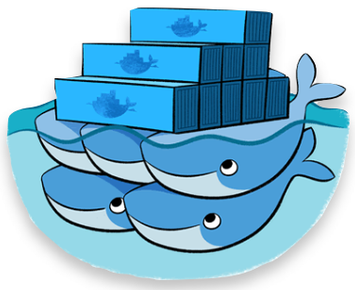
Docker Machine

provides



Docker Engine

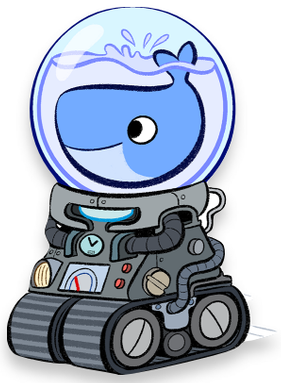
Containers



Docker Swarm

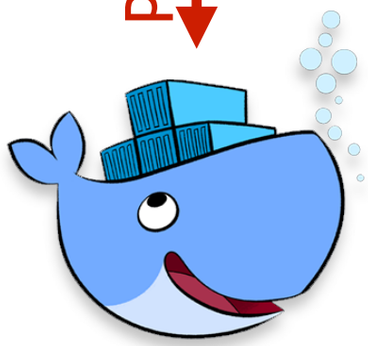
BenchFlow Framework

system under test



Docker Machine

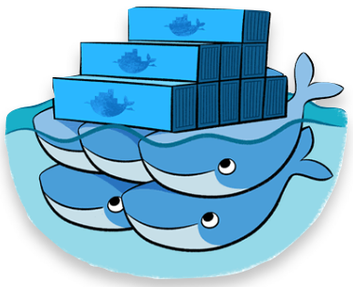
provides



Docker Engine

Containers

manages

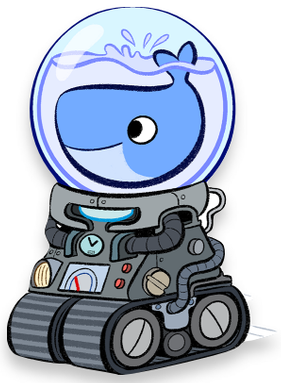


Docker Swarm

Servers

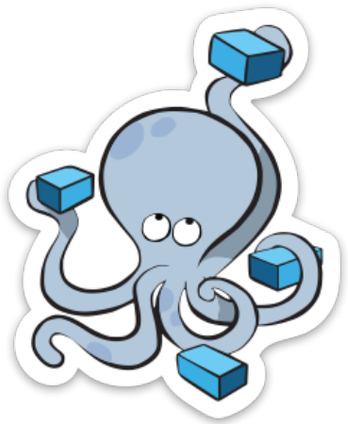
BenchFlow Framework

system under test

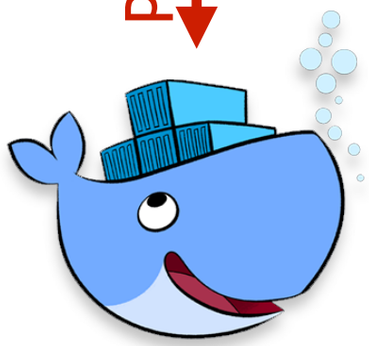


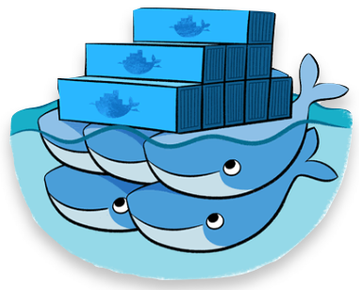
Docker Machine

provides



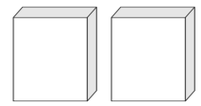
Docker Compose





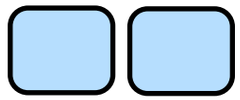
Docker Swarm

manages



Servers

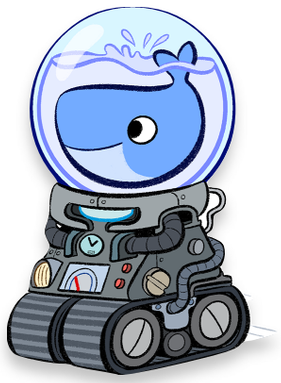
Docker Engine



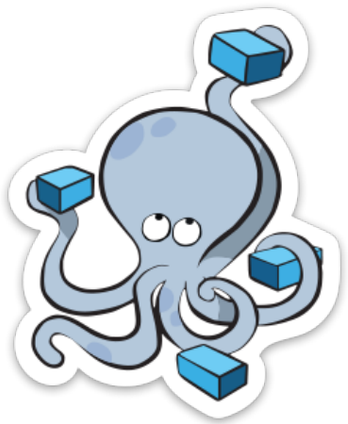
Containers

BenchFlow Framework

system under test



Docker Machine

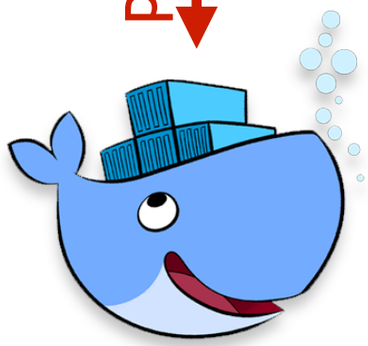


Docker Compose

SUT's Deployment Conf.

deploys

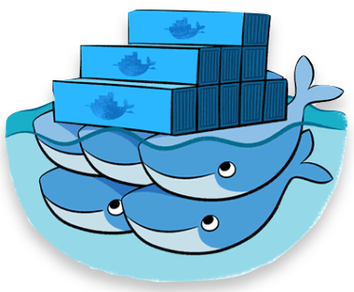
provides



Docker Engine

Containers

manages

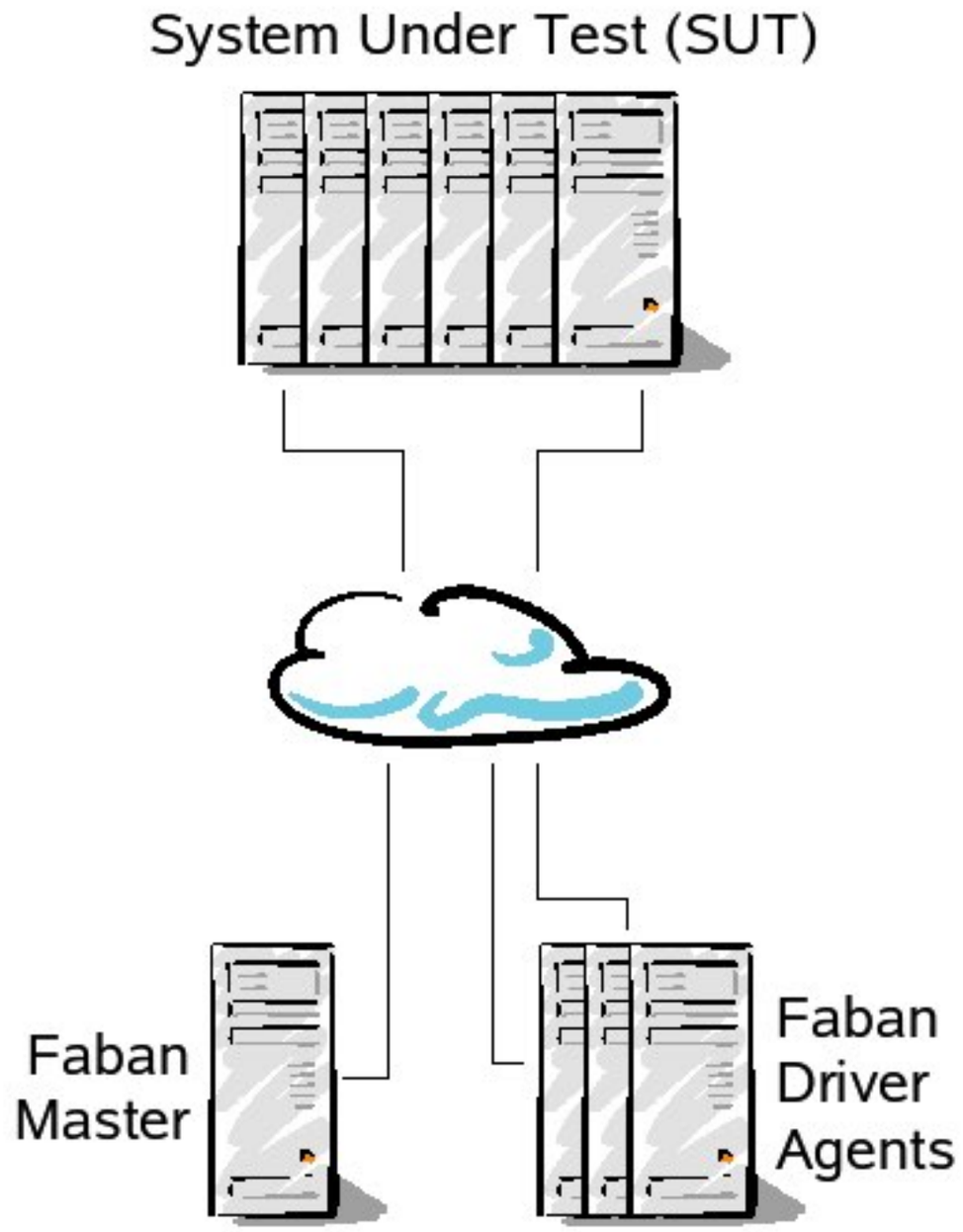


Docker Swarm

Servers

BenchFlow Framework

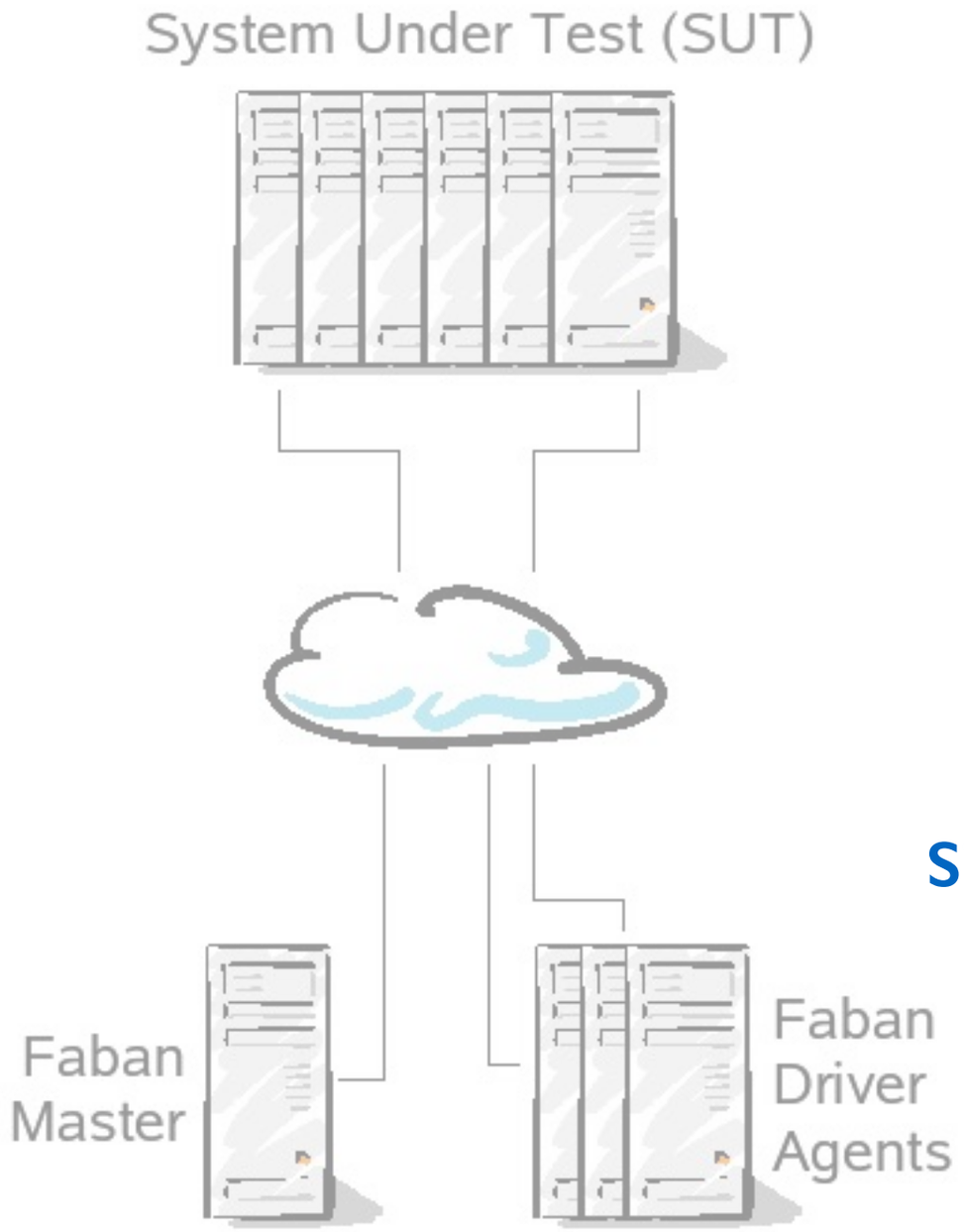
performance benchmark



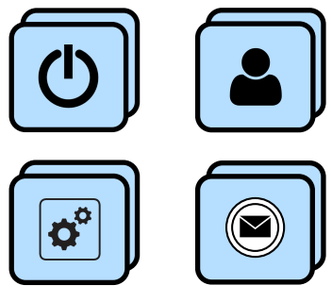
Manages the Benchmark Lifecycle

BenchFlow Framework

performance benchmark



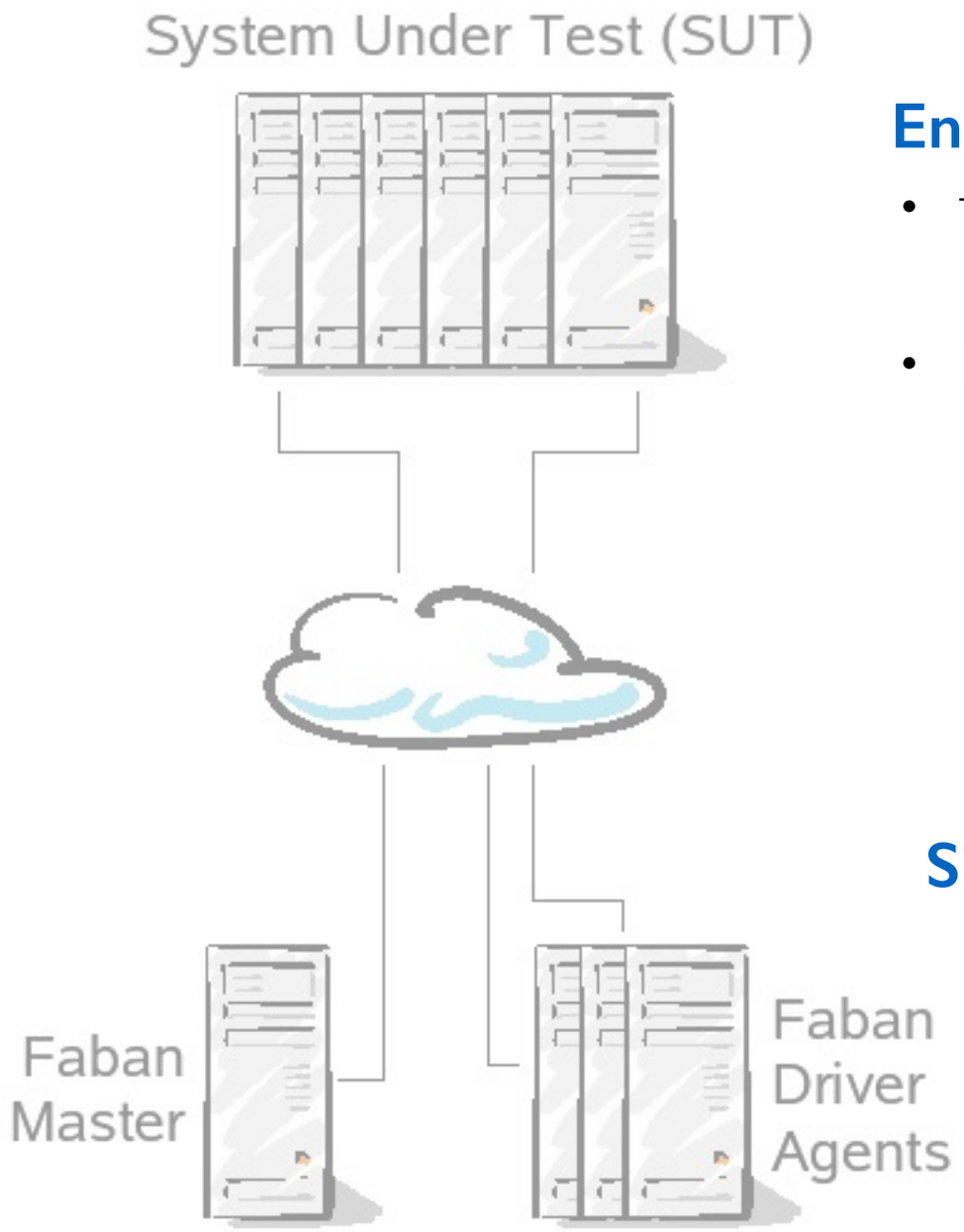
Simulates interacting entities



Manages the Benchmark Lifecycle

BenchFlow Framework

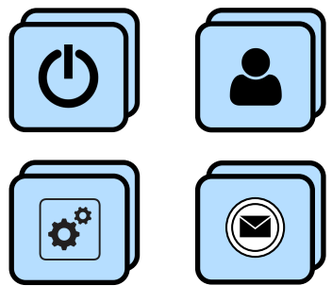
performance benchmark



Ensures repeatability

- the behaviour of a load driver is described using code
- load drivers can be released

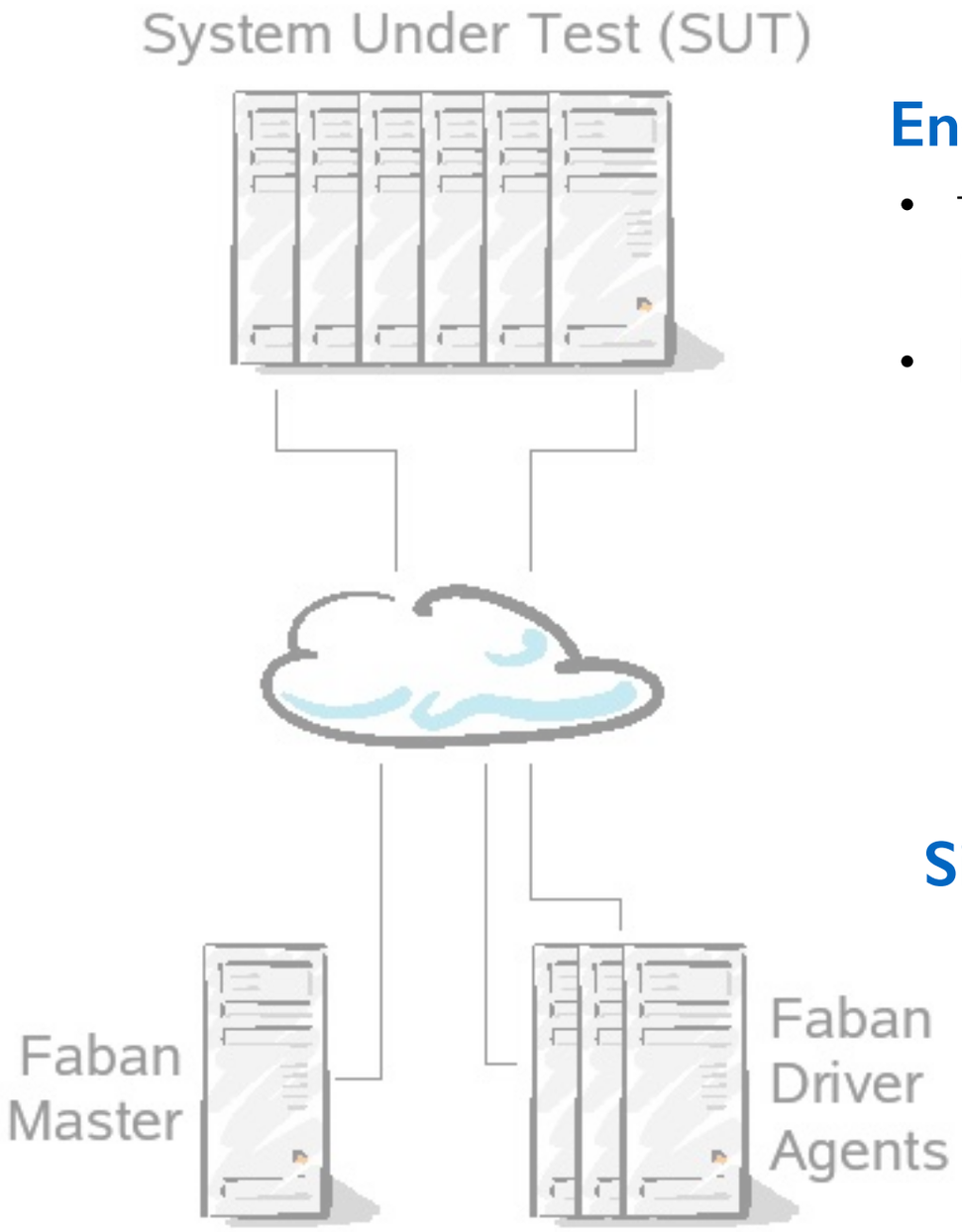
Simulates interacting entities



Manages the Benchmark Lifecycle

BenchFlow Framework

performance benchmark



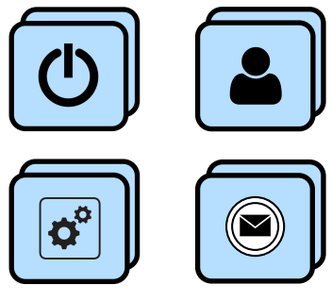
Ensures repeatability

- the behaviour of a load driver is described using code
- load drivers can be released

→ **paired with Docker:**

SUT's initial state is frozen in the container

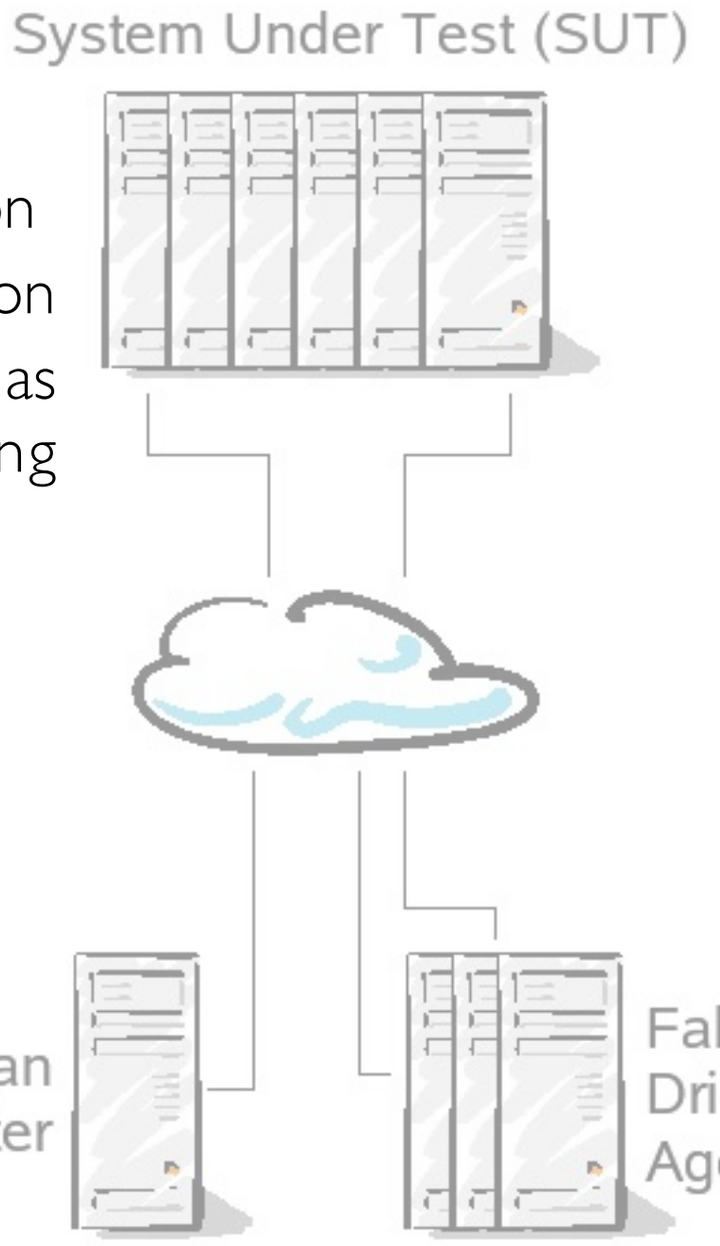
Simulates interacting entities



Manages the Benchmark Lifecycle

BenchFlow Framework

performance benchmark



Ensures reliable execution

- checks the environment condition
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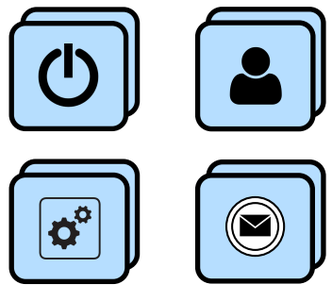
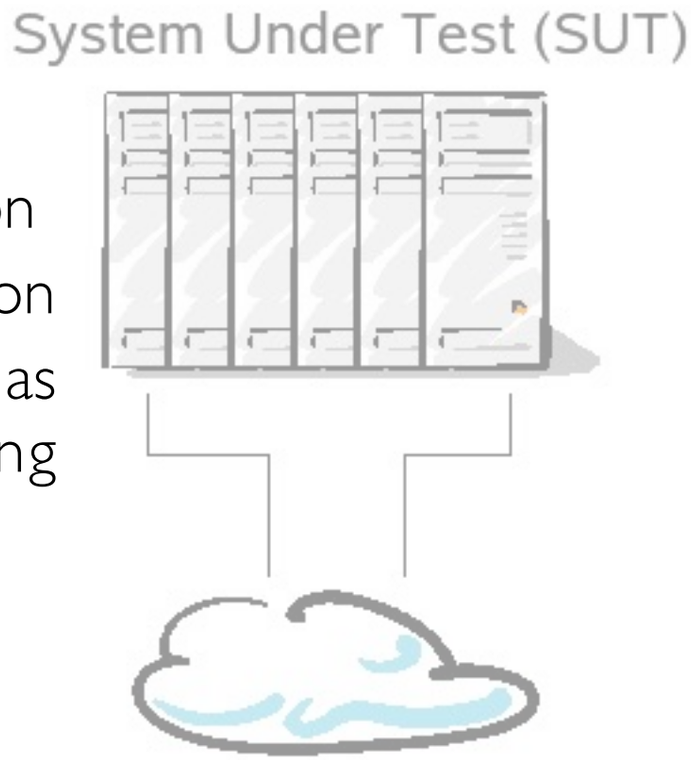


Manages the Benchmark Lifecycle

BenchFlow Framework

performance benchmark



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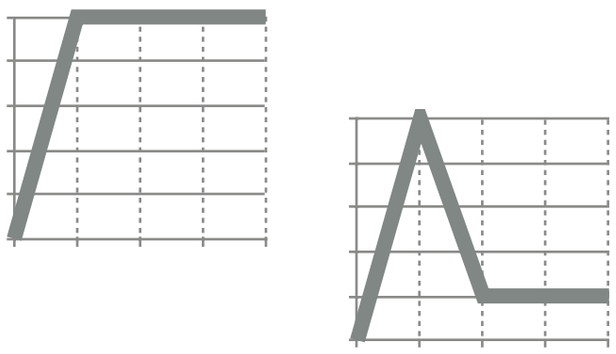
Automates performance tests



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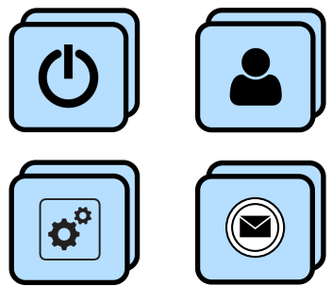
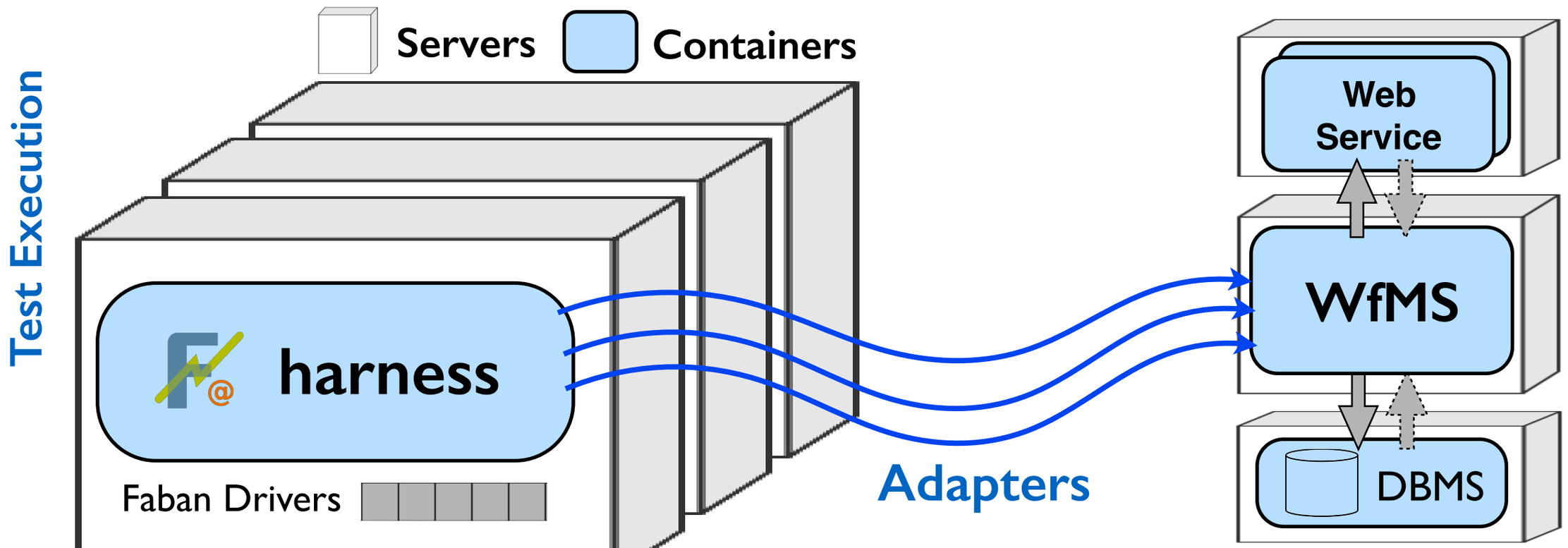


Manages the Benchmark Lifecycle

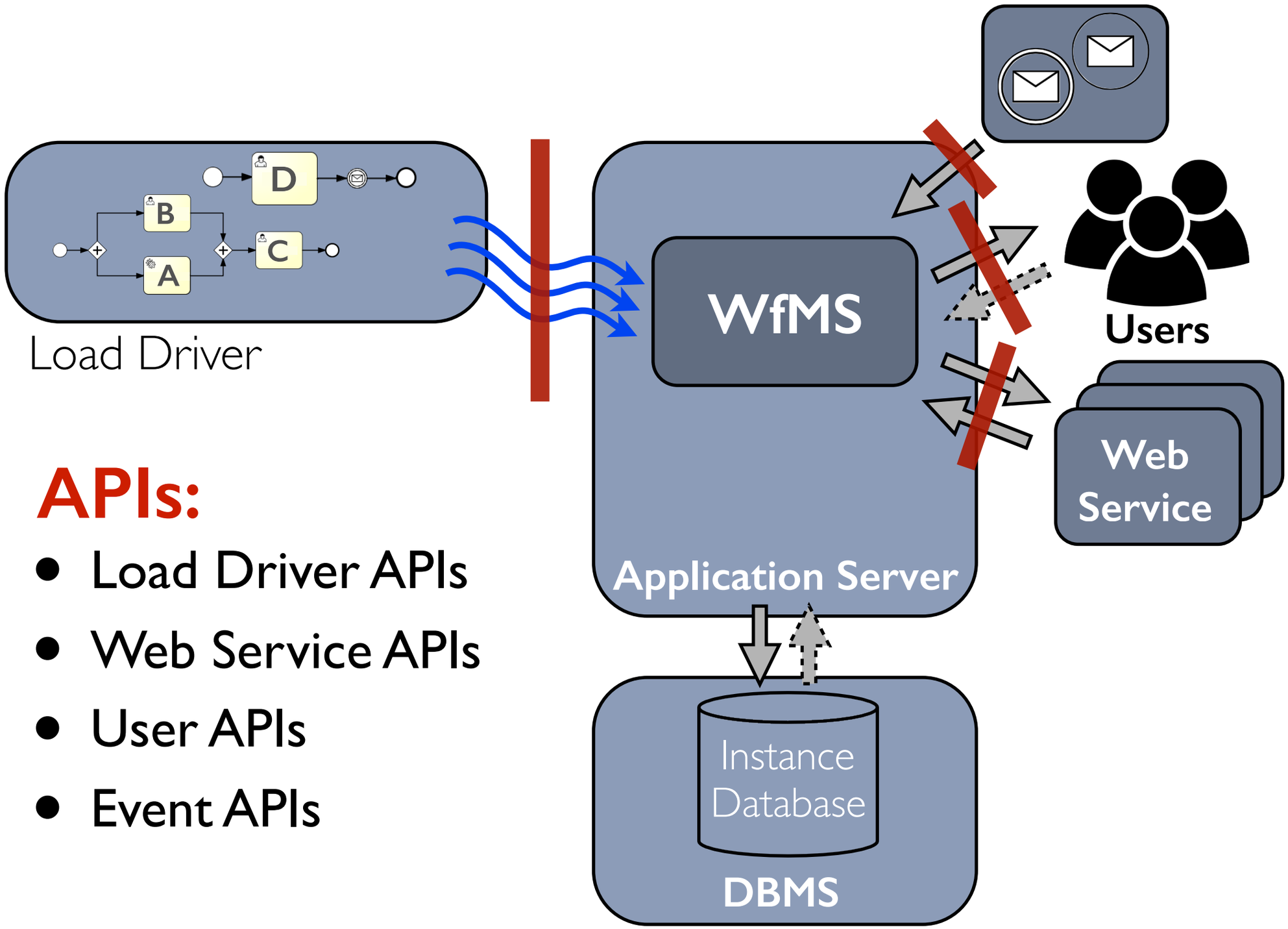
WfMS-specific APIs

software adapters



WfMS-specific APIs

custom APIs



APIs:

- Load Driver APIs
- Web Service APIs
- User APIs
- Event APIs

WfMS-specific APIs

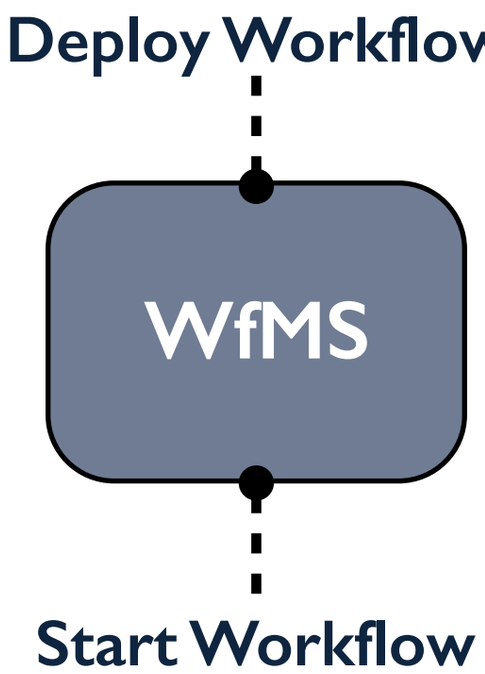
requirements from the WfMS

CORE | ADVANCED | FULL

WfMS-specific APIs

requirements from the WfMS

Load Driver APIs



CORE

ADVANCED

FULL

WfMS-specific APIs

requirements from the WfMS

Load Driver APIs

Deploy Workflow

WfMS

Start Workflow

User and Web Service APIs

Create User

Create Group

Pending User Tasks

WfMS

Invoke WS

Claim Task

Complete Task

CORE

ADVANCED

FULL

WfMS-specific APIs

requirements from the WfMS

Load Driver APIs

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WfMS

Start Workflow

CORE

+

User and Web Service APIs

Create User

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ADVANCED

+

Event APIs

Pending Event Tasks

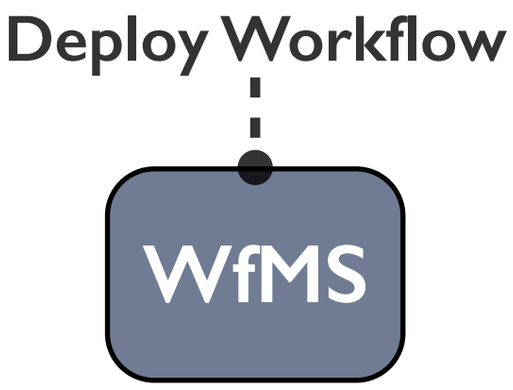
WfMS

Issue Event

FULL

BPMN 2.0 Customisations

models deployment version



BPMN 2.0 Customisations

models deployment version

Deploy Workflow

BPMN 2.0 Standard
XML Serialisation

WfMS A
BPMN 2.0
Serialisation

WfMS B
BPMN 2.0
Serialisation

BPMN 2.0 Customisations

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Deploy Workflow

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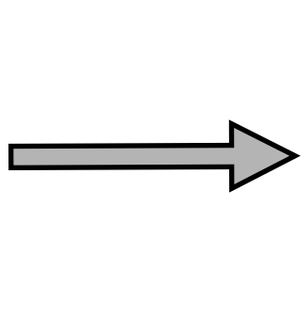

WfMS A
BPMN 2.0
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WfMS

XML

BPMN 2.0 Standard
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XML Processor

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<xsl:include href="
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WfMS A

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WfMS B

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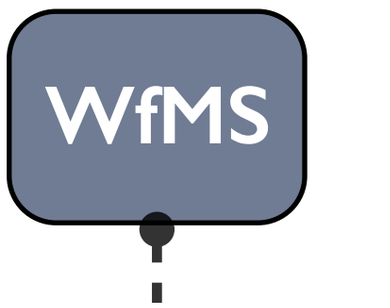
WfMS B

+

Customised Test Data Formatting

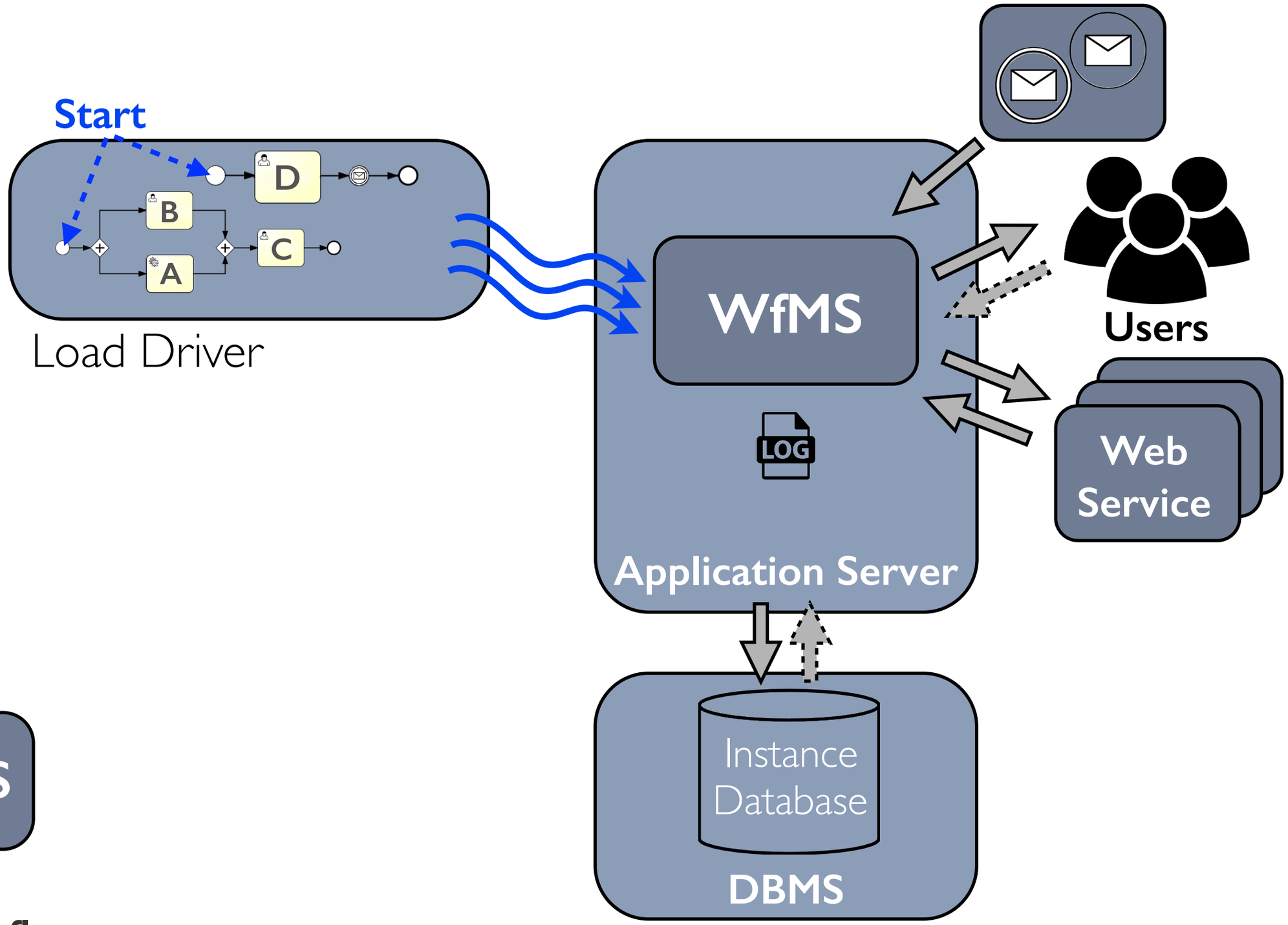
Asynchronous Execution of Workflows

overview



Asynchronous Execution of Workflows

overview



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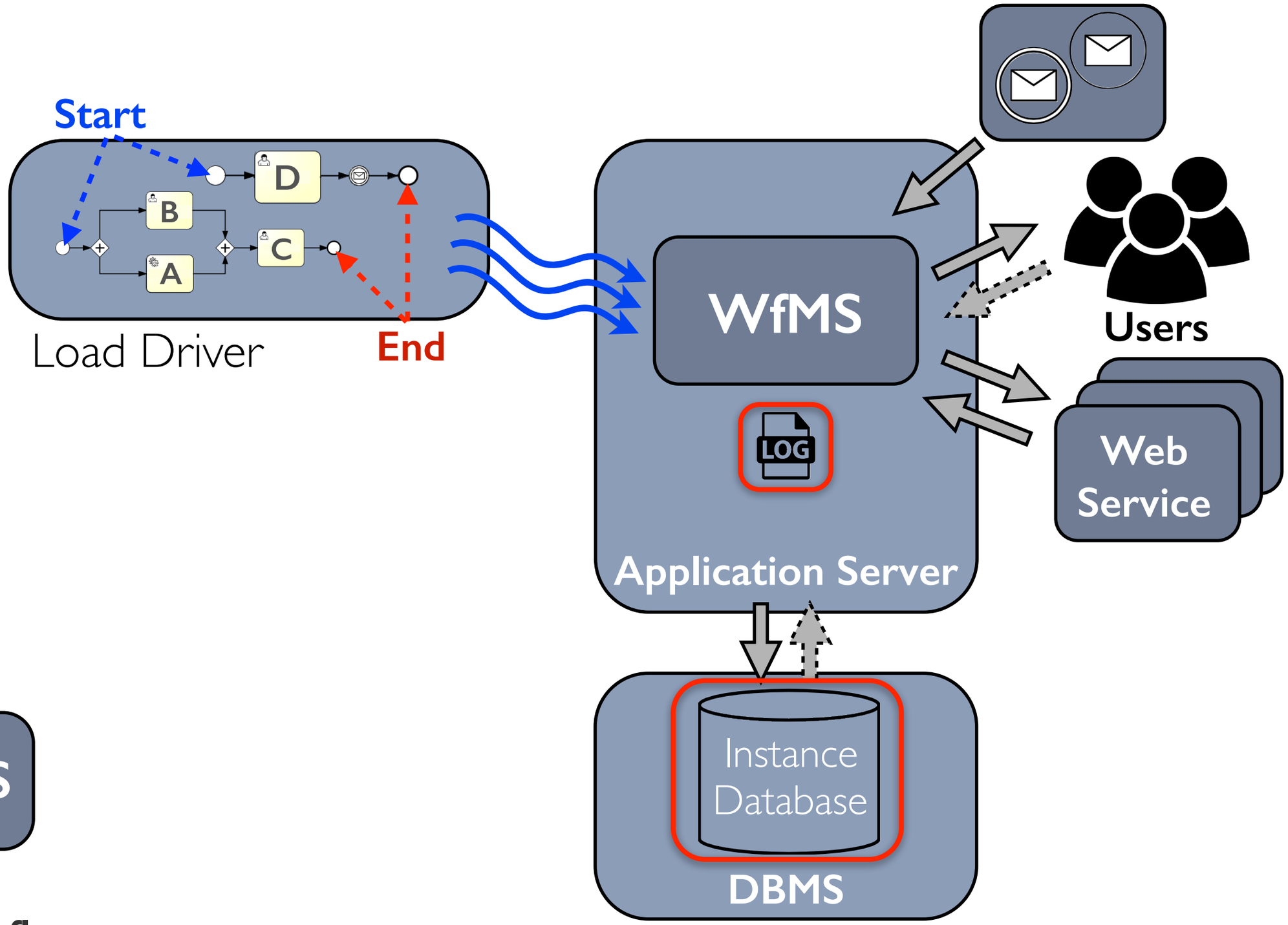
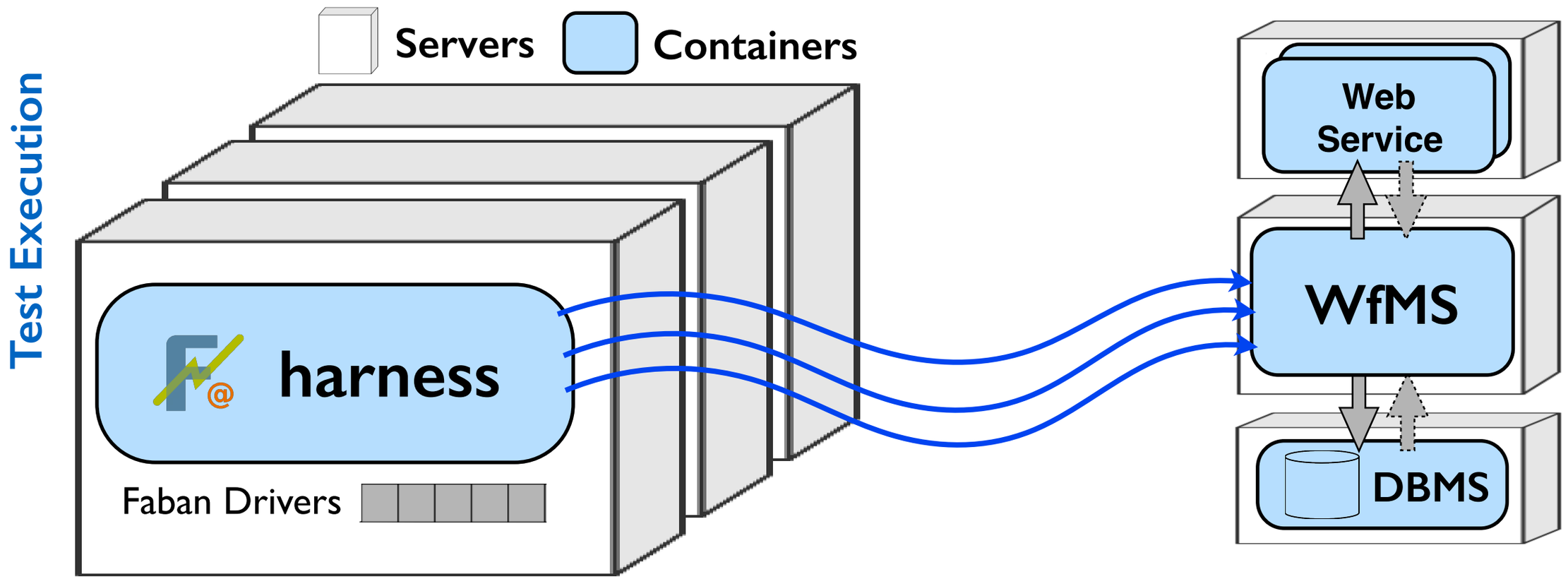


Asynchronous Execution of Workflows

monitors



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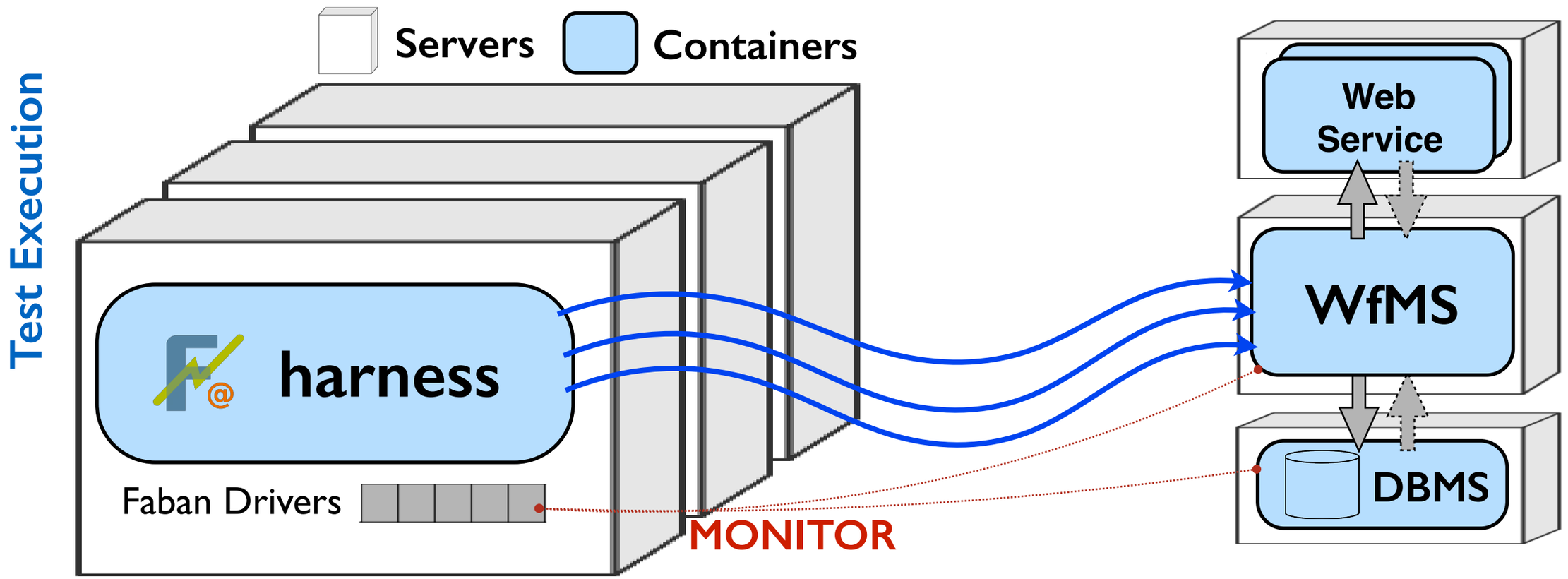

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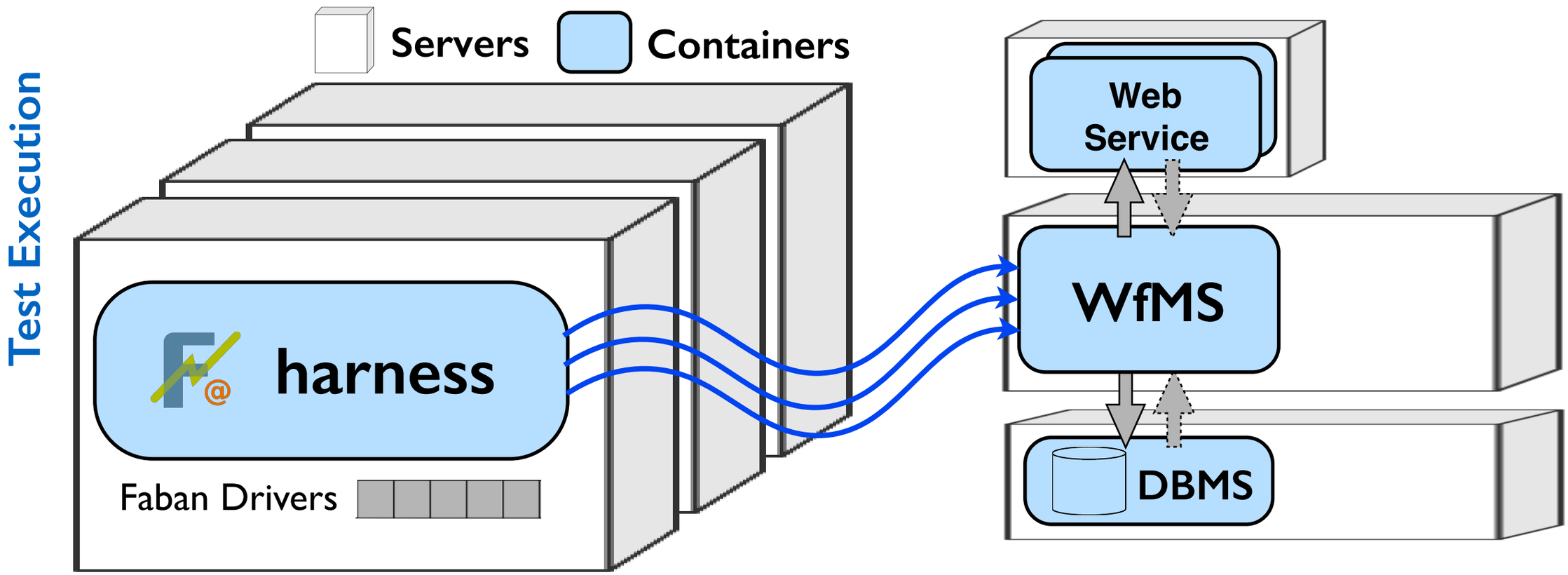


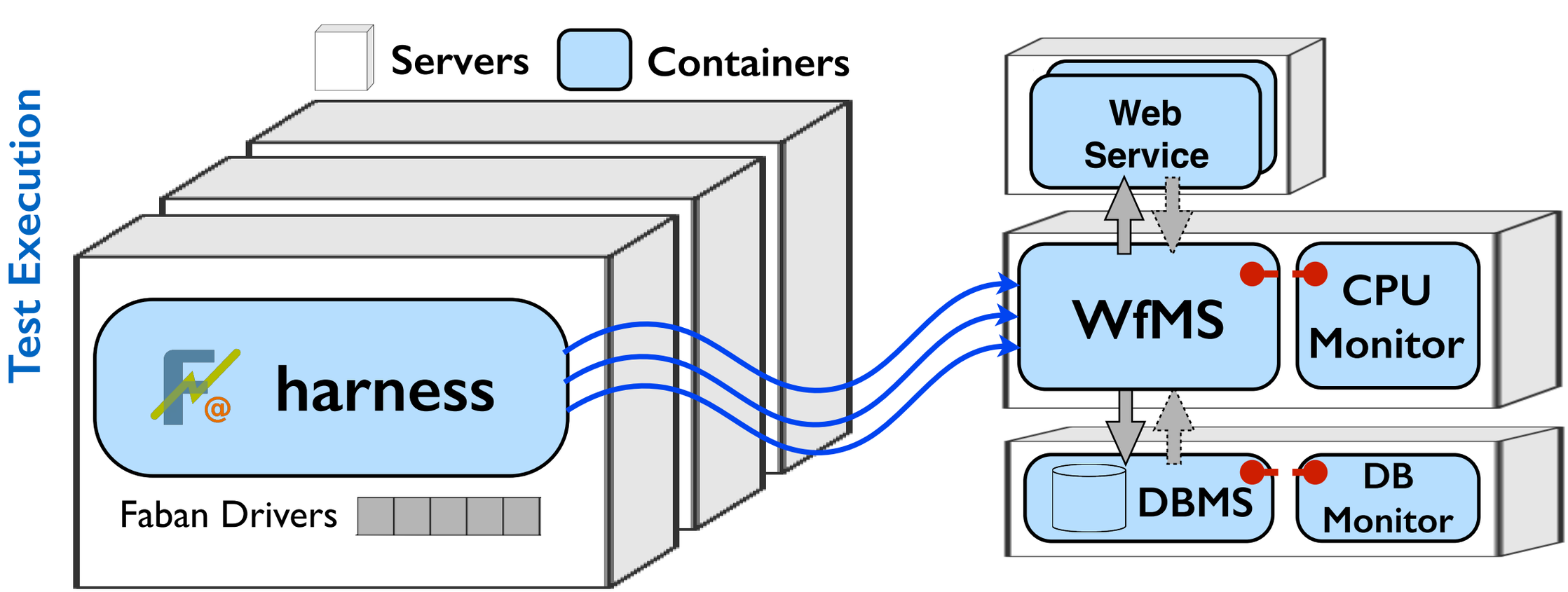
Monitors' Characteristics:

- Microservices
- Lightweight (written in Go)
- As less invasive on the SUT as possible
- Expose REST APIs towards the Drivers

Examples of Monitors:

- CPU usage
- Database state

Asynchronous Execution of Workflows



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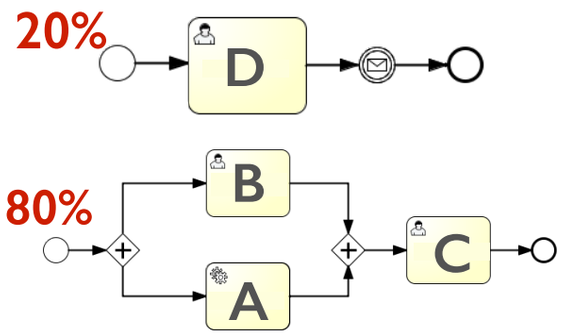
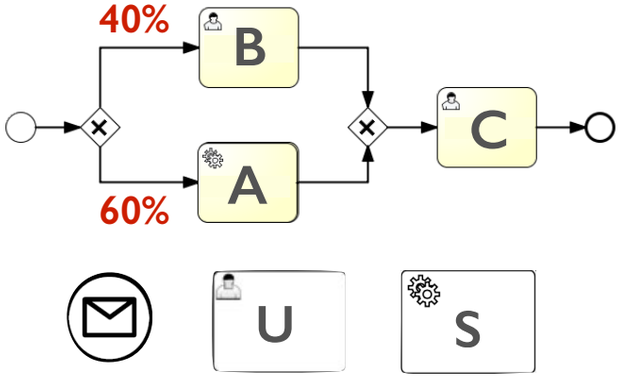
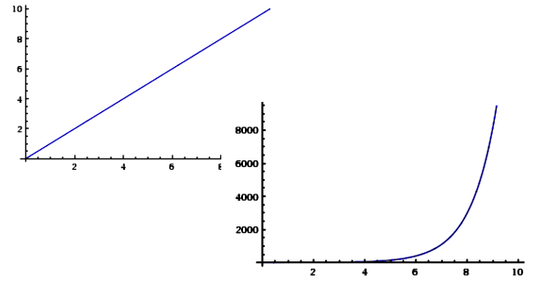
Main Challenges in Benchmarking BPMN 2.0 WfMSs



Workload Mix

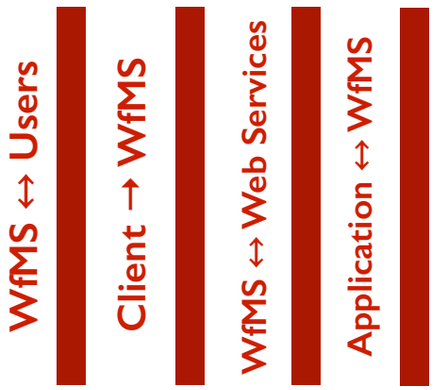


Test Data

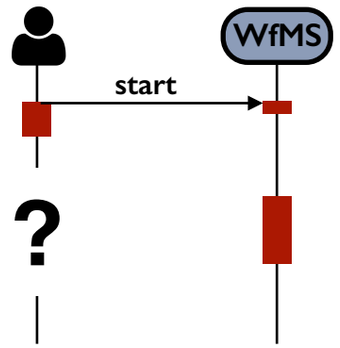


Load Functions

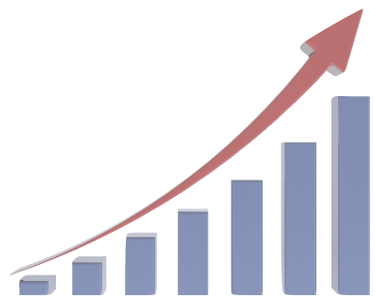
WORKLOAD MODEL



WfMS-specific APIs and BPMN 2.0 Customisations



Asynchronous Execution of Workflows

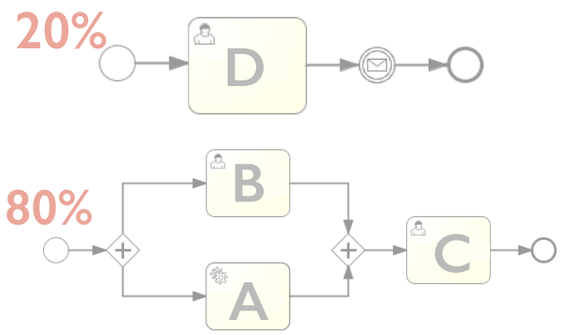


Performance Metrics and KPIs

BENCHMARK EXECUTION

ANALYSES

Main Challenges in Benchmarking BPMN 2.0 WfMSs



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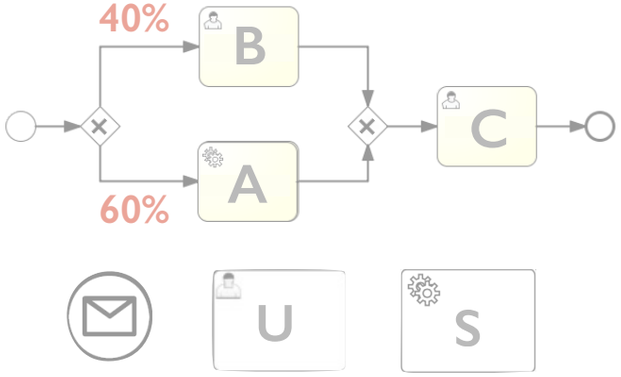

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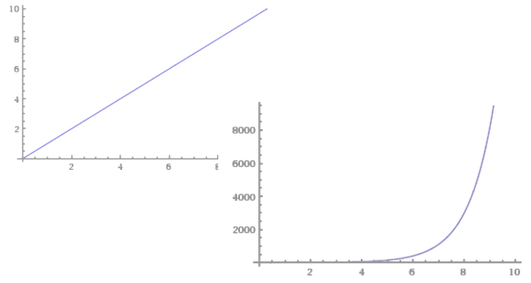
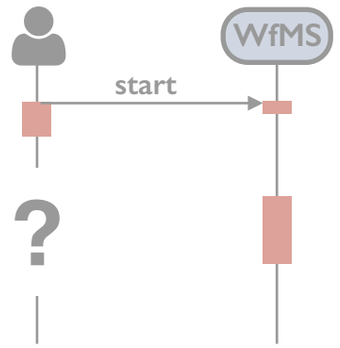


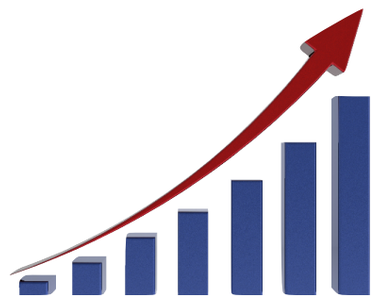
Load Functions

WORKLOAD MODEL

WfMS-specific APIs and BPMN 2.0 Customisations



Asynchronous Execution of Workflows



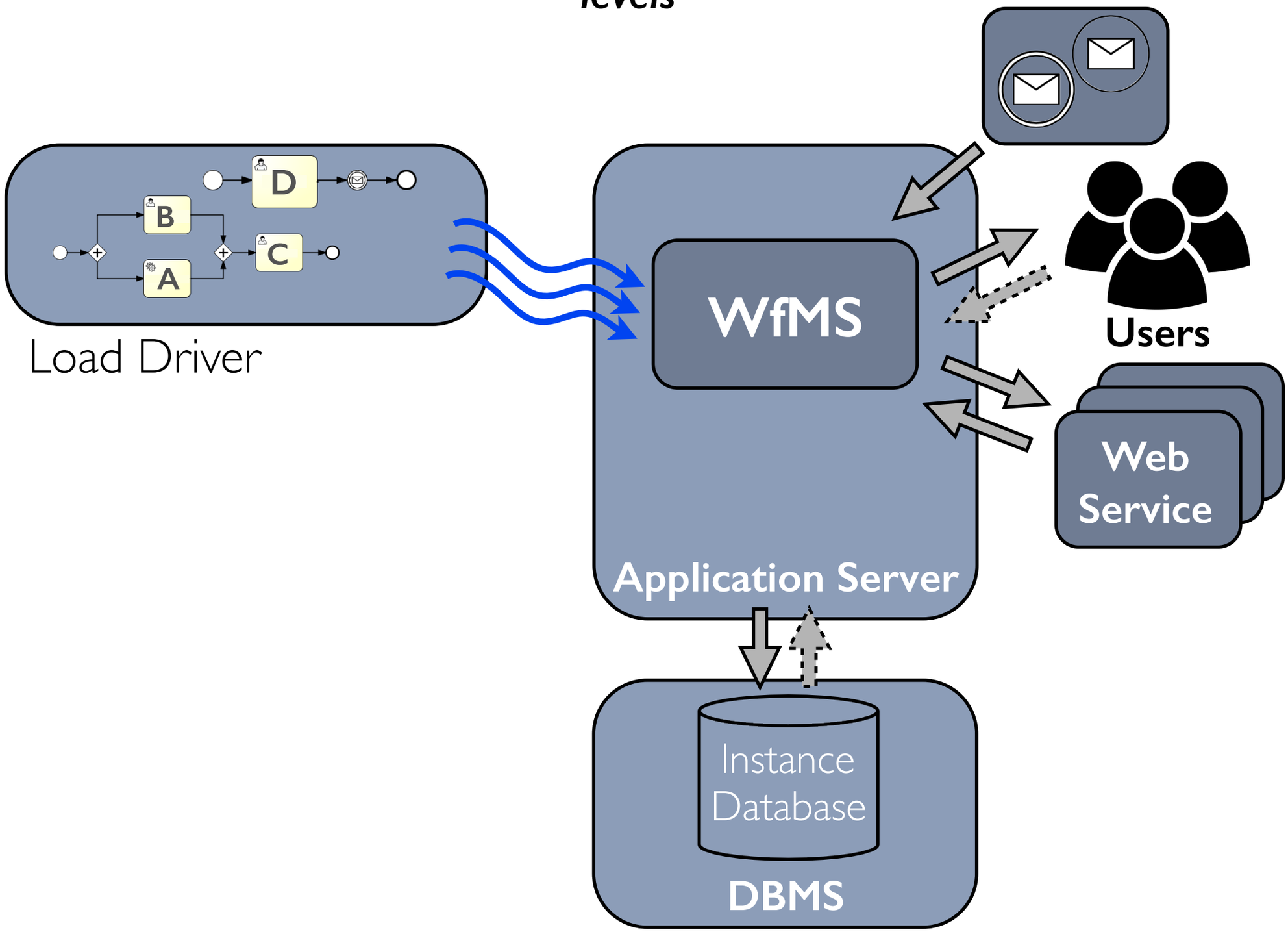
Performance Metrics and KPIs

BENCHMARK EXECUTION

ANALYSES

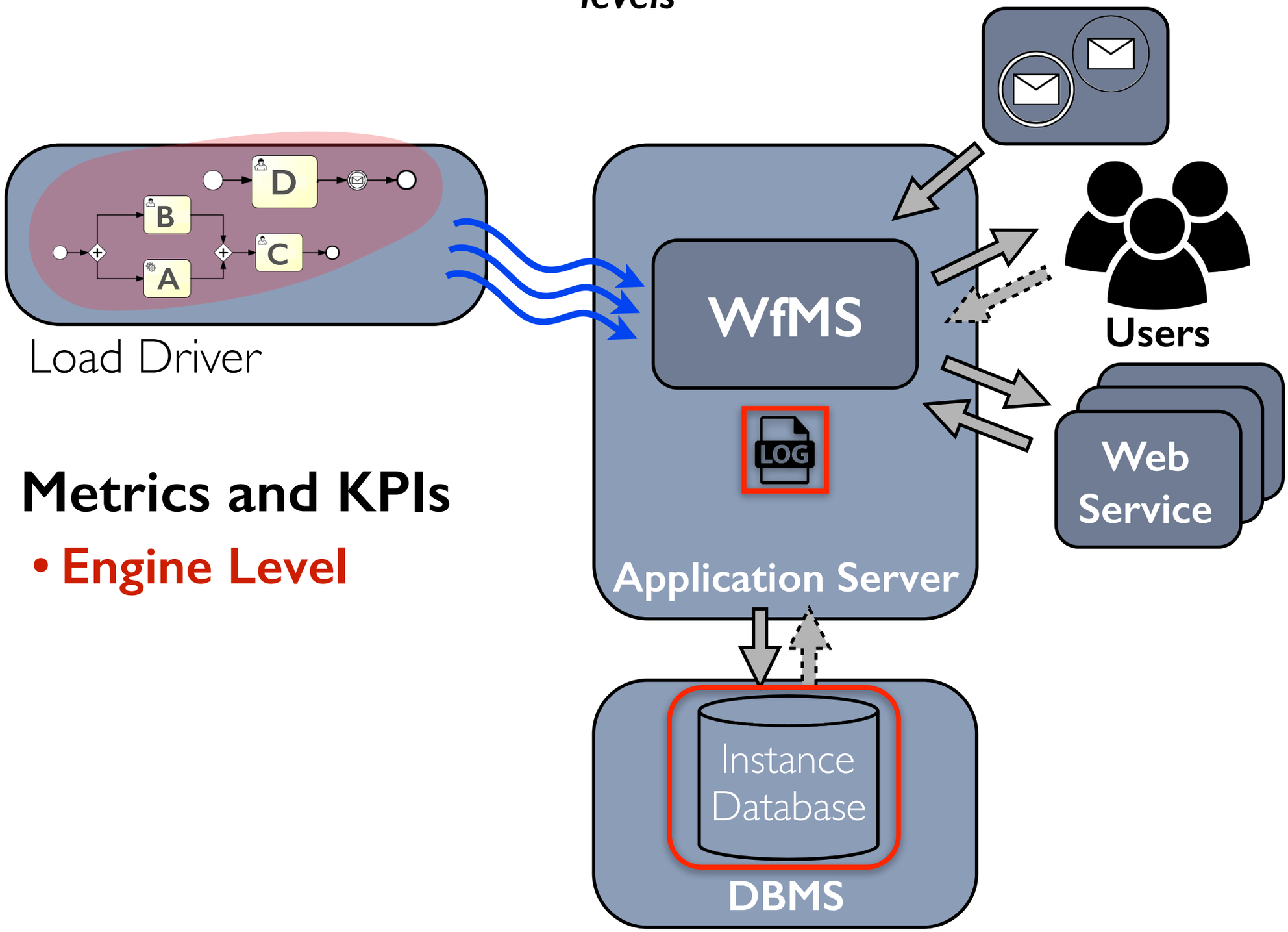
Performance Metrics and KPIs

levels



Performance Metrics and KPIs

levels

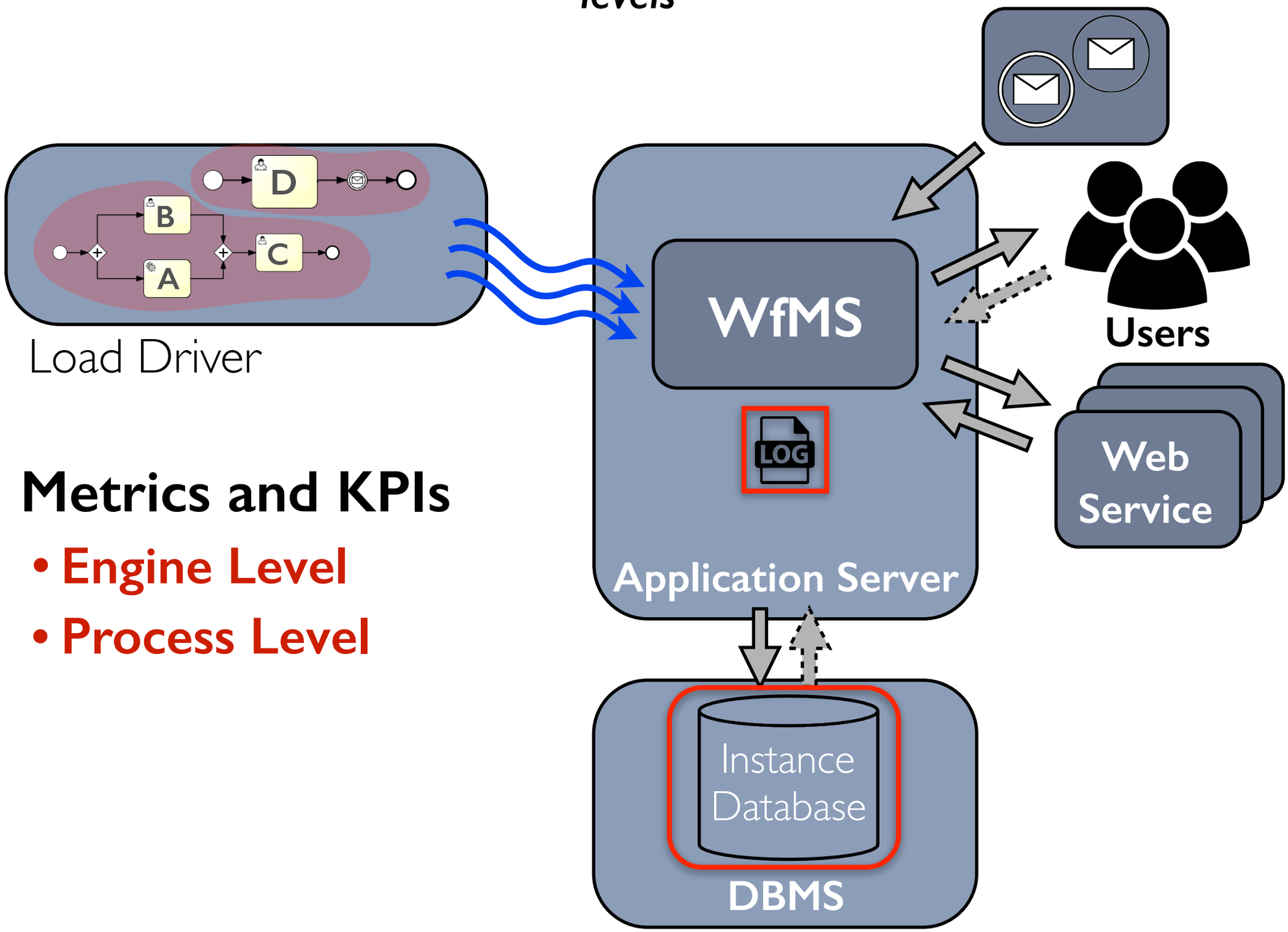


Metrics and KPIs

- **Engine Level**

Performance Metrics and KPIs

levels

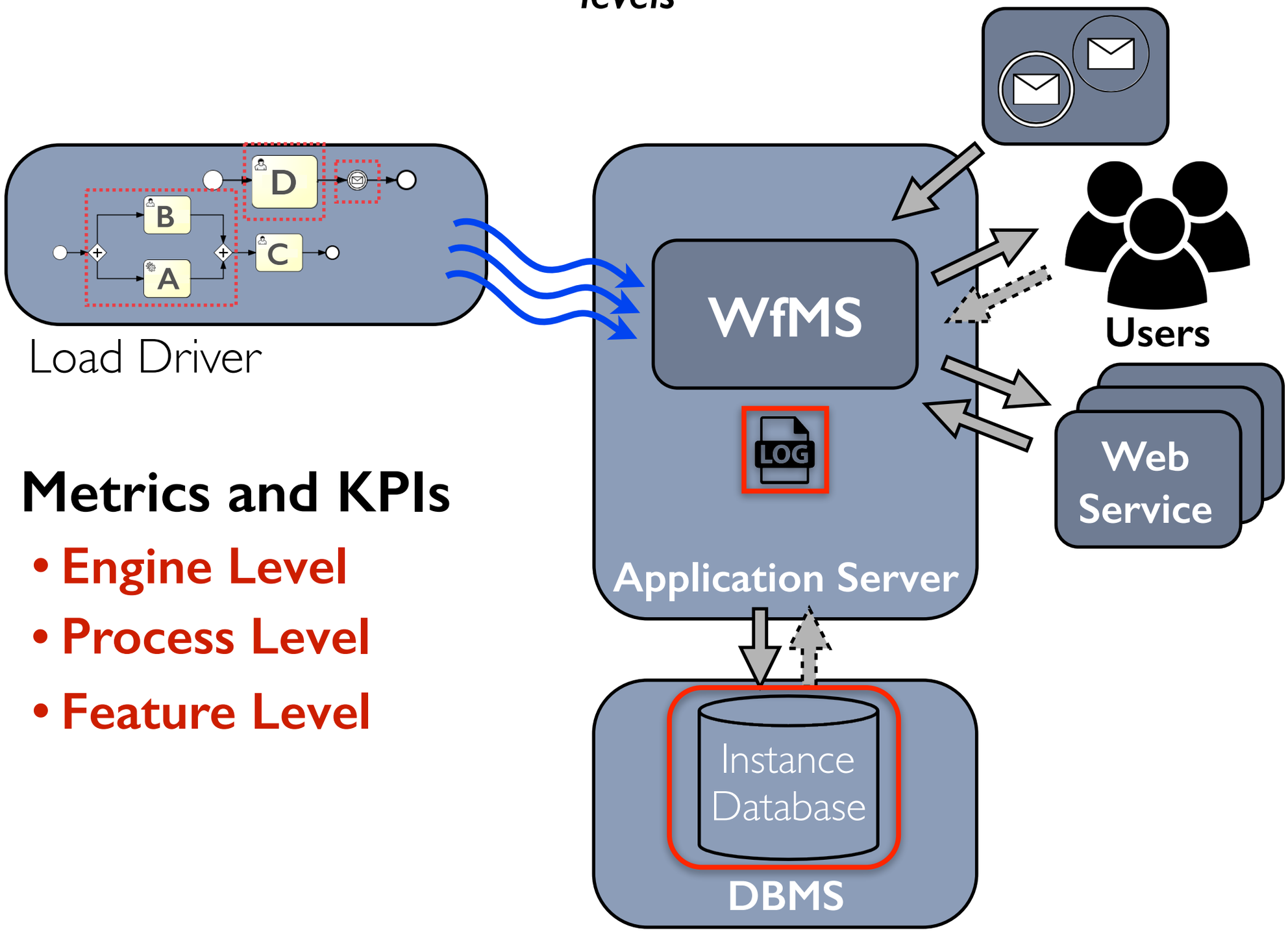


Metrics and KPIs

- Engine Level
- Process Level

Performance Metrics and KPIs

levels

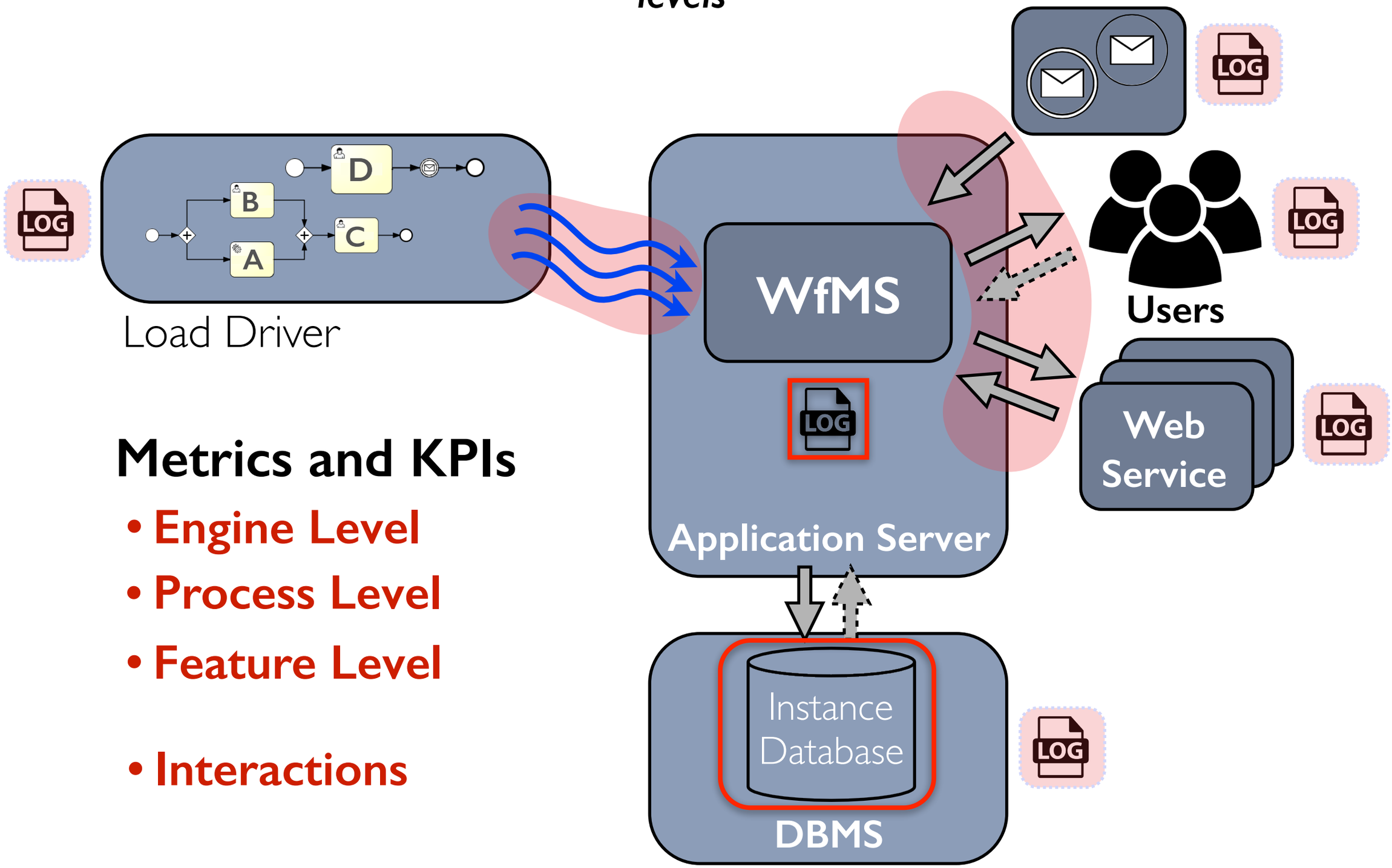


Metrics and KPIs

- Engine Level
- Process Level
- Feature Level

Performance Metrics and KPIs

levels



Metrics and KPIs

- Engine Level
- Process Level
- Feature Level

- Interactions

Performance Metrics and KPIs

examples and relevant users

Performance Metrics and KPIs

examples and relevant users

ENGINE LEVEL

PROCESS LEVEL

FEATURE LEVEL

Performance Metrics and KPIs

examples and relevant users

ENGINE LEVEL

- Capacity
- Flexibility to Spike
- Throughput
- Response Time
- Latency

PROCESS LEVEL

FEATURE LEVEL

Performance Metrics and KPIs

examples and relevant users

ENGINE LEVEL

Capacity

Flexibility to Spike

Throughput

Response Time

Latency

PROCESS LEVEL

Duration of Process

CPU Usage

RAM Usage

FEATURE LEVEL

Performance Metrics and KPIs

examples and relevant users

ENGINE LEVEL

- Capacity
- Flexibility to Spike
- Throughput
- Response Time
- Latency

PROCESS LEVEL

- Duration of Process
- CPU Usage
- RAM Usage

FEATURE LEVEL

- Duration of Message Event
- Delay of Timer Event
- Space Used by a Data Input

Performance Metrics and KPIs

examples and relevant users

ENGINE LEVEL

Capacity

Flexibility to Spike

Throughput

Response Time

Latency

PROCESS LEVEL

Duration of Process

CPU Usage

RAM Usage

FEATURE LEVEL

Duration of Message Event

Delay of Timer Event

Space Used by a Data Input

END-USERS

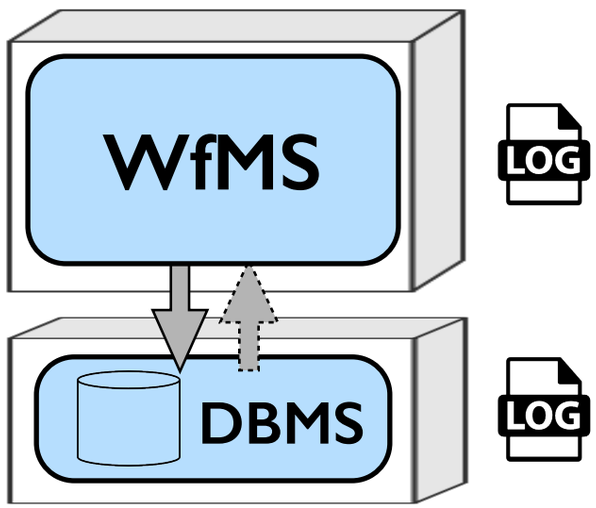
VENDORS

DEVELOPERS

Performance Metrics and KPIs

minimal data requirements

Accessibility of the Data



Performance Metrics and KPIs

minimal data requirements

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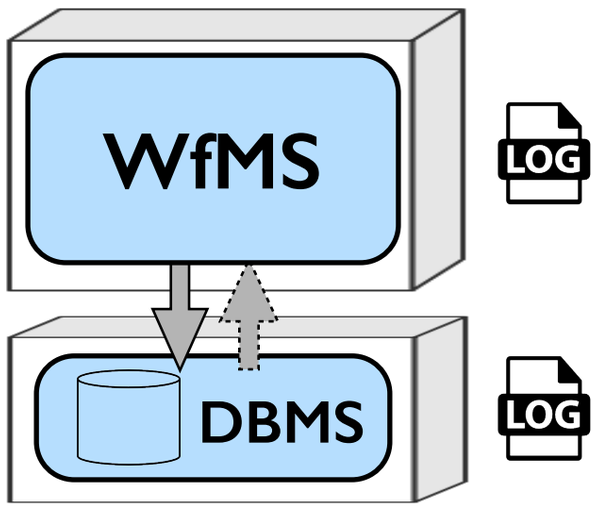

Availability of Timing Data

- Workflow & Construct:
  - Start Time
  - End Time
  - [Duration]

Performance Metrics and KPIs

minimal data requirements

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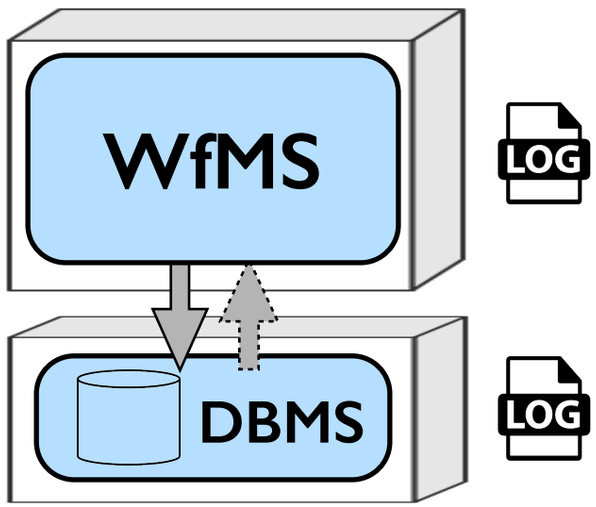

Availability of Timing Data

- Workflow & Construct:
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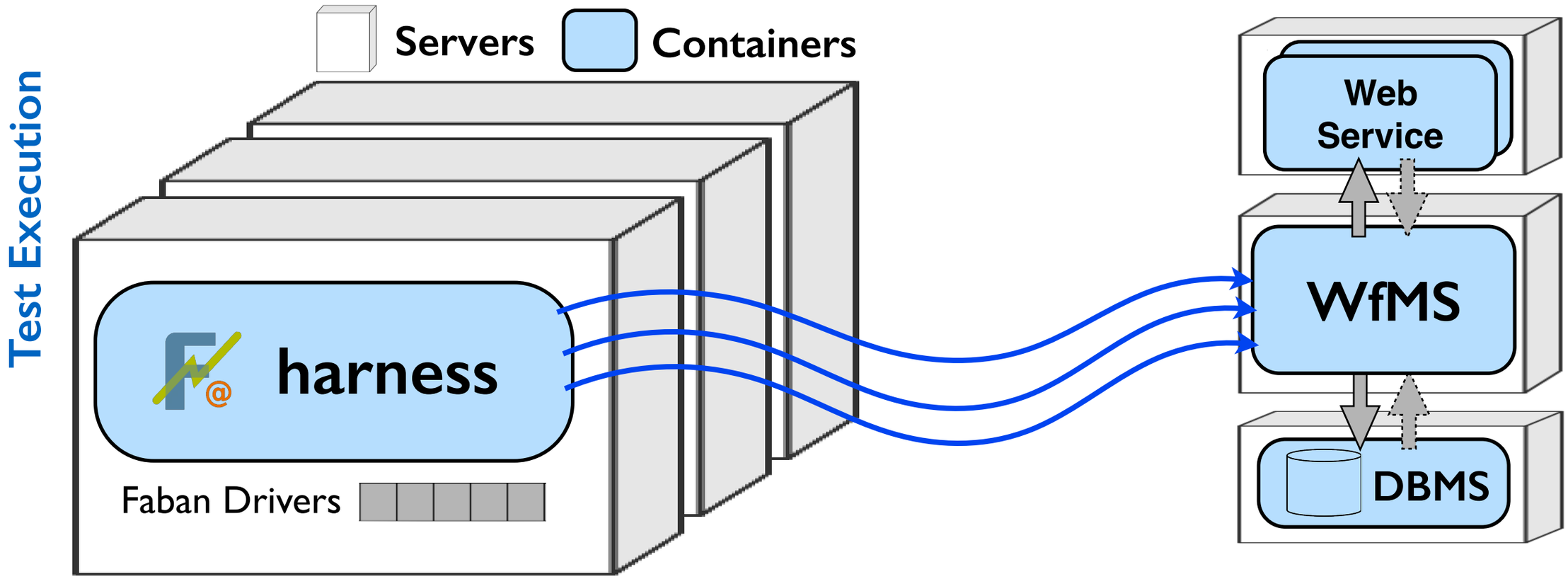
Availability of Execution State

State of the workflow execution. E.g., running, completed, error

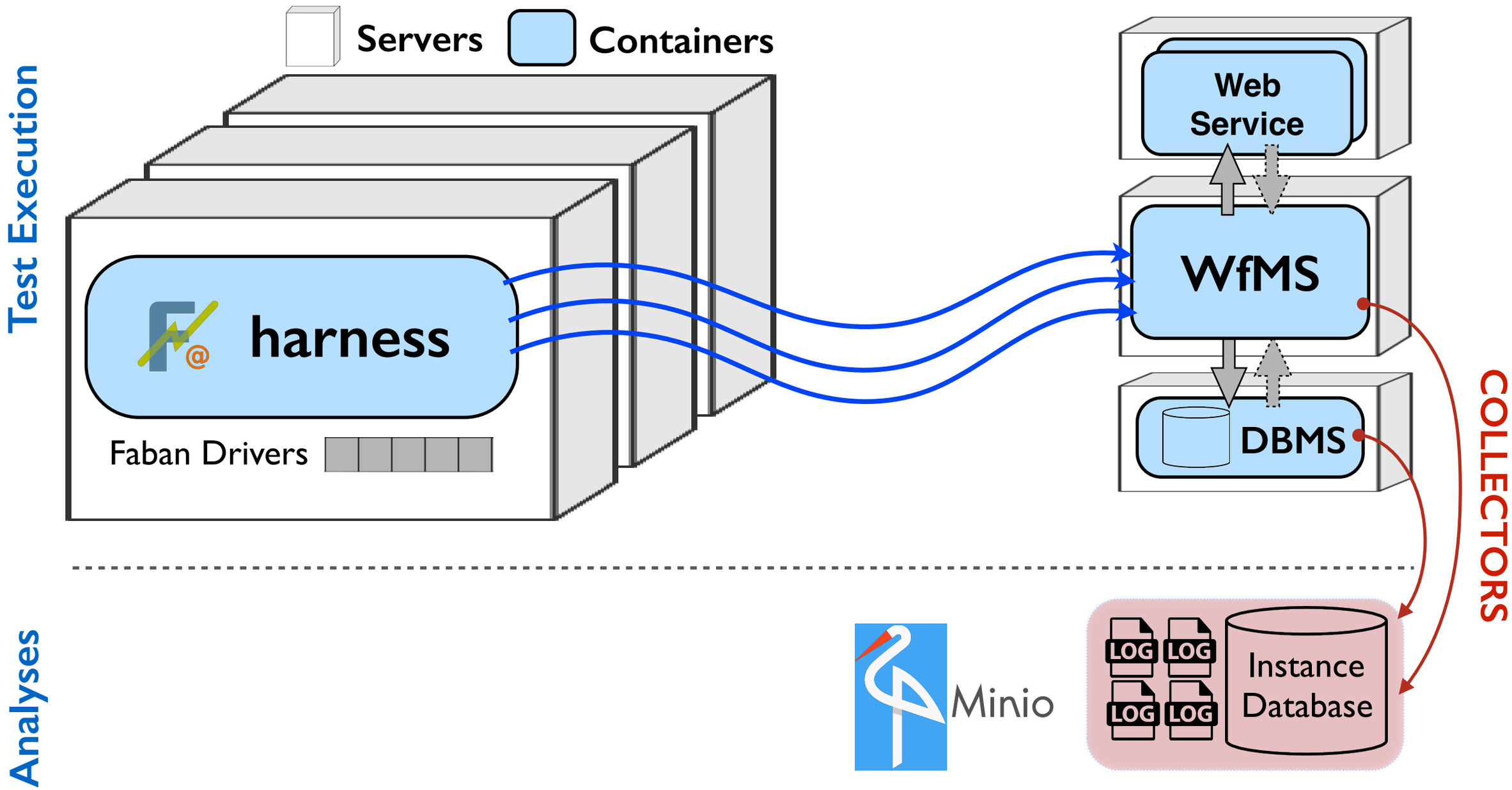
Performance Metrics and KPIs

collect data



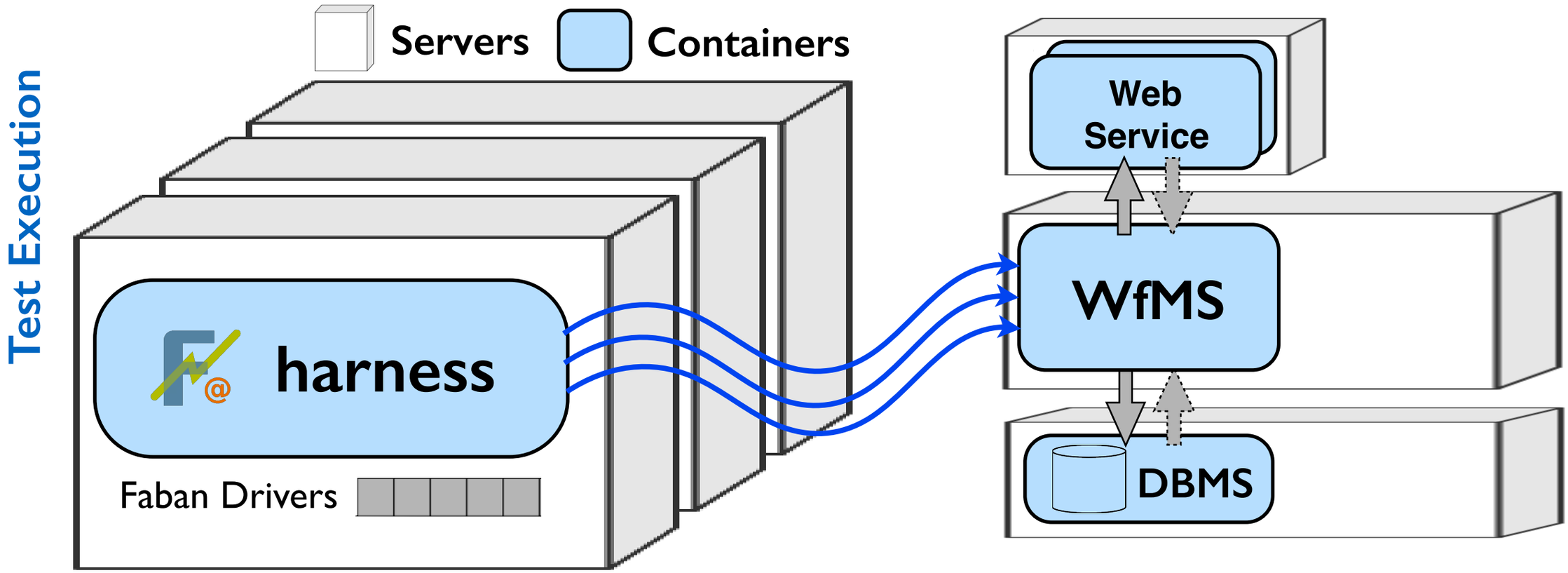
Performance Metrics and KPIs

collect data



Performance Metrics and KPIs

collect data



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- Two types: online and offline
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Examples of Collectors:

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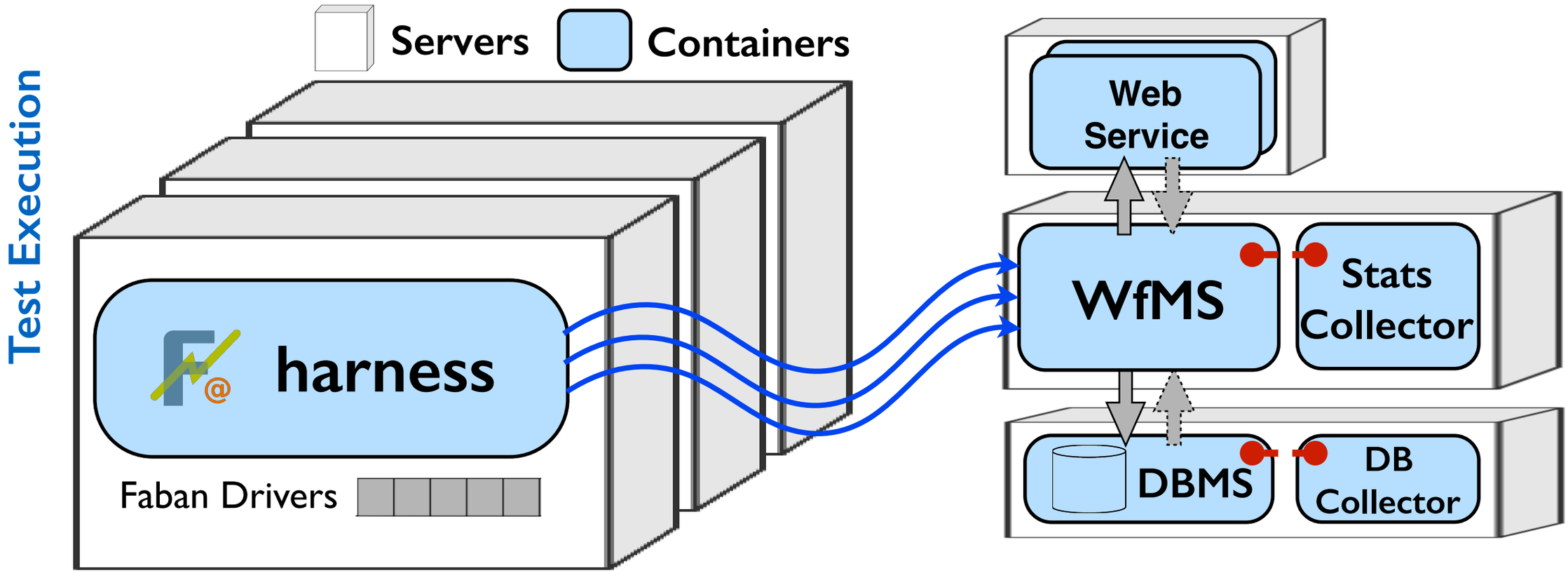
- Database dump
- Applications Logs

Performance Metrics and KPIs

collect data



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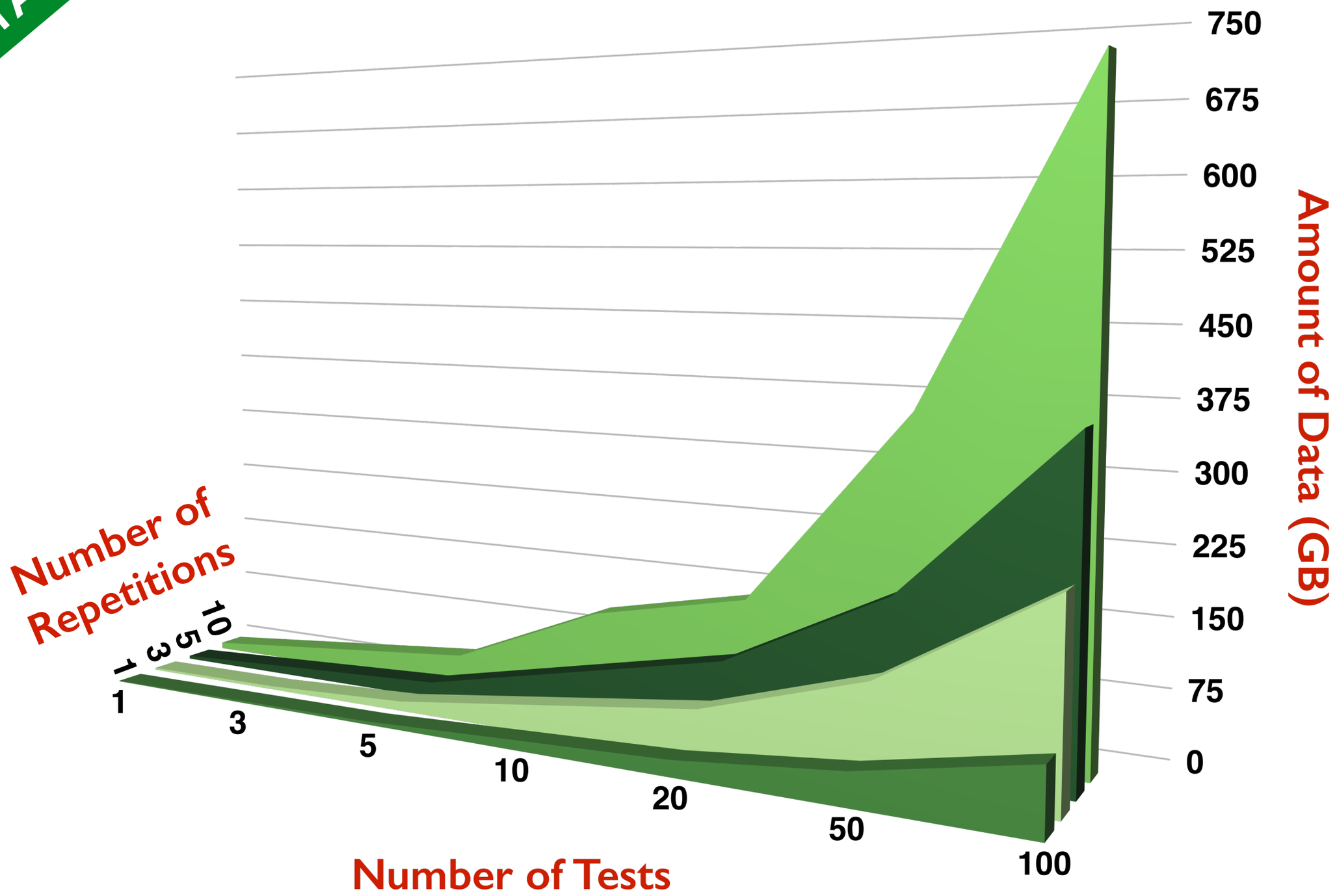
REALISTIC DATA

Performance Metrics and KPIs

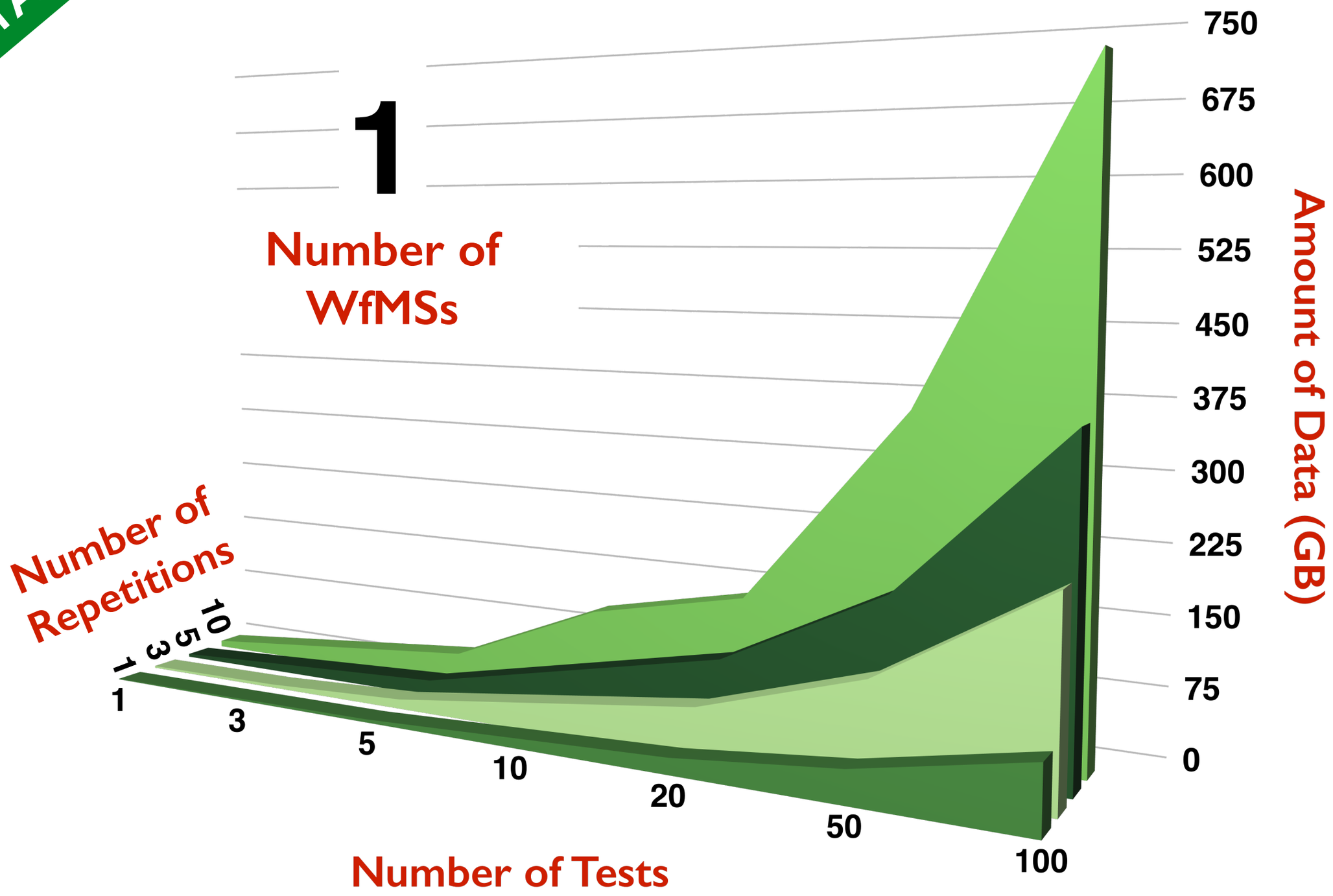
amount of data



REALISTIC DATA

Performance Metrics and KPIs

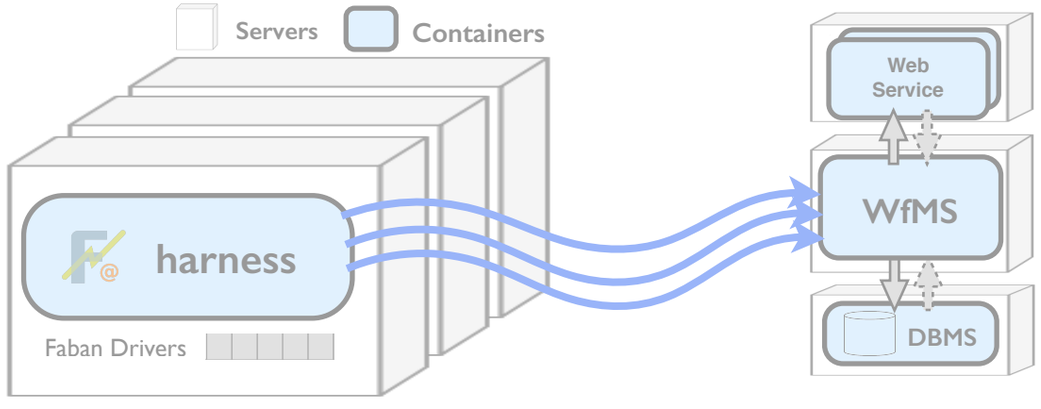
amount of data



Performance Metrics and KPIs

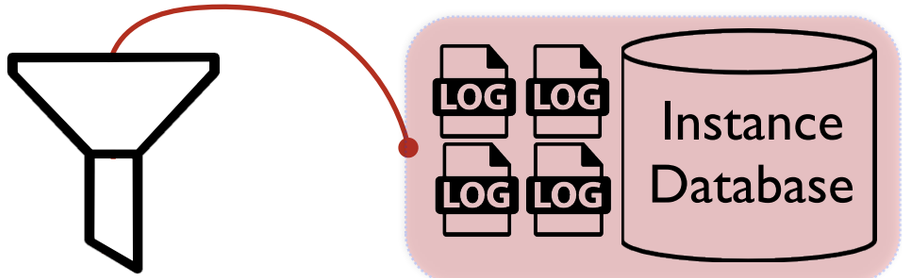
transform data

Test Execution



Data Mappers

Analyses

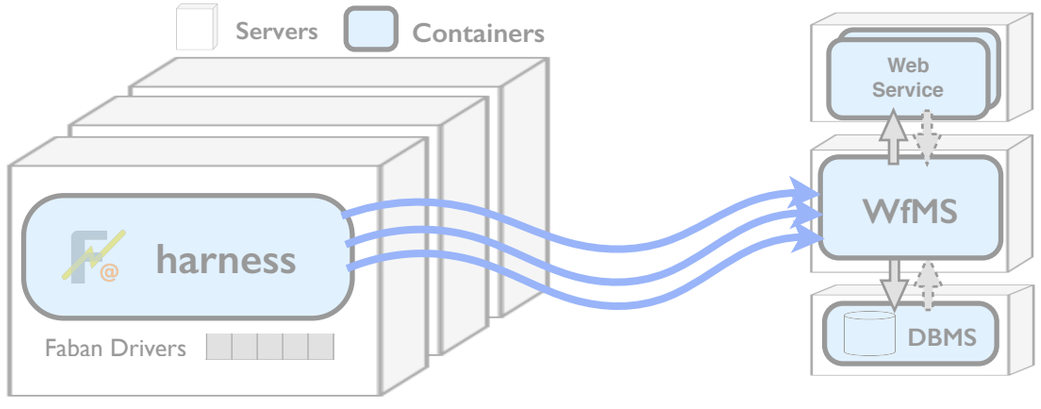


DATA TRANSFORMERS

Performance Metrics and KPIs

transform data

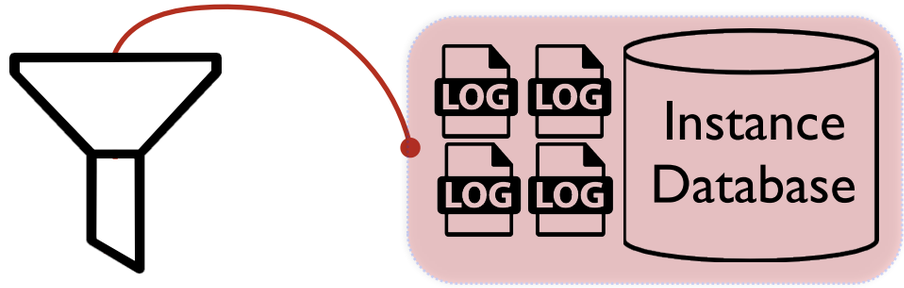
Test Execution



Data Mappers

Analyses

- custom DB format
- unstructured logs
- …

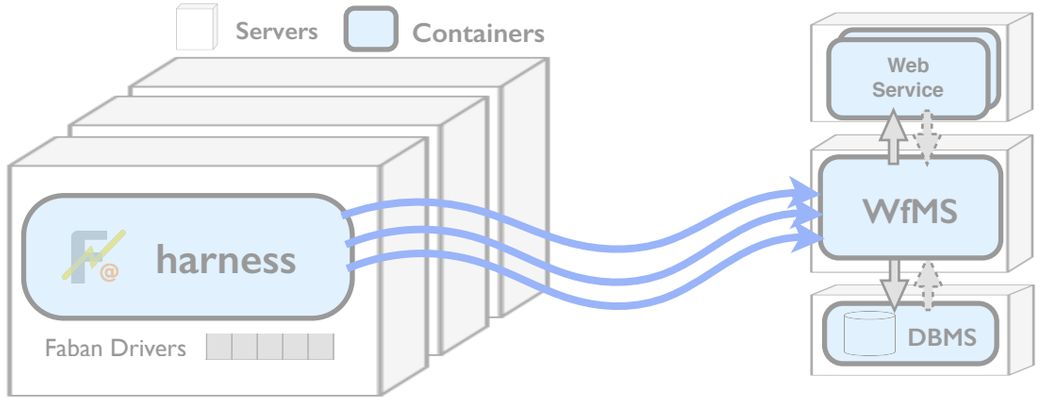


DATA TRANSFORMERS

Performance Metrics and KPIs

transform data

Test Execution



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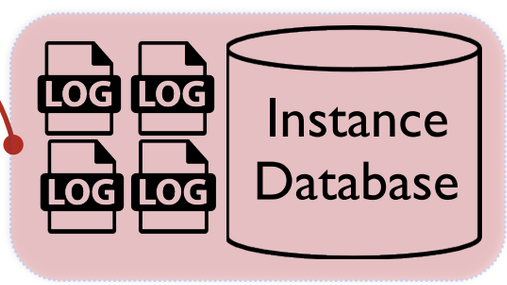
ETL Process

Spark

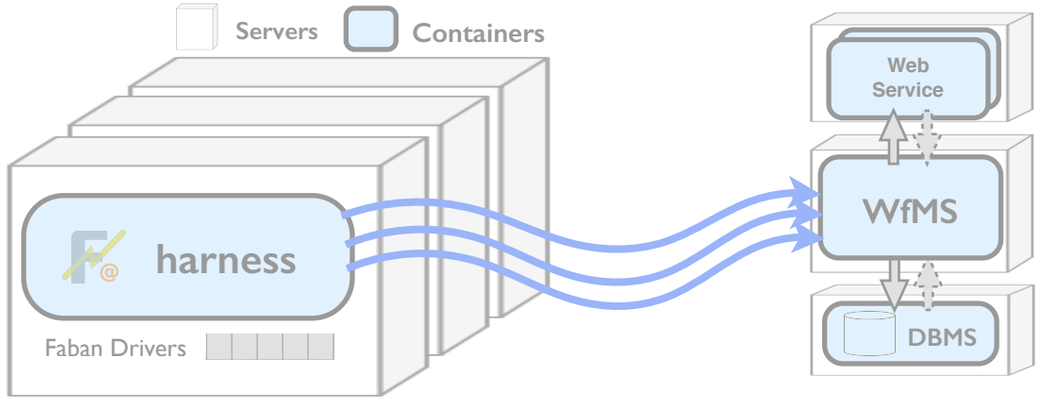
DATA TRANSFORMERS



Performance Metrics and KPIs

transform data

Test Execution

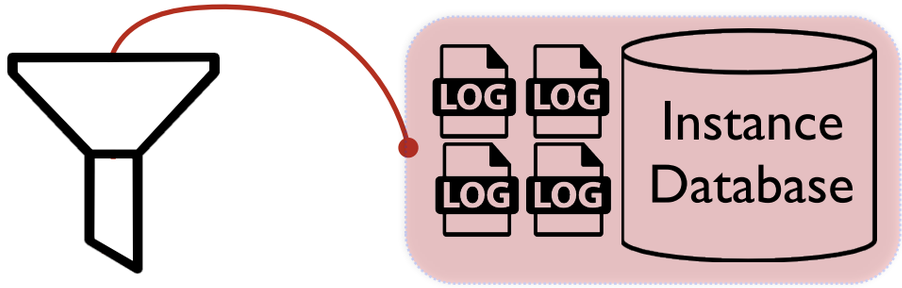


Data Mappers

Analyses

Spark

fast and general engine for large-scale data processing

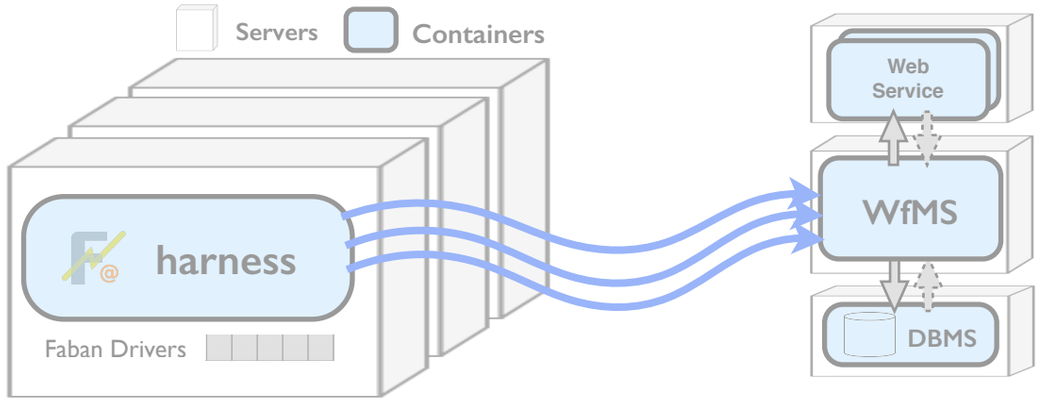


DATA TRANSFORMERS

Performance Metrics and KPIs

analyse data

Test Execution



Data Mappers

Analyses

Performance Metrics

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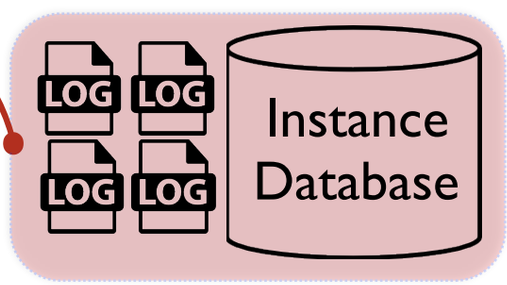
ANALYSERS

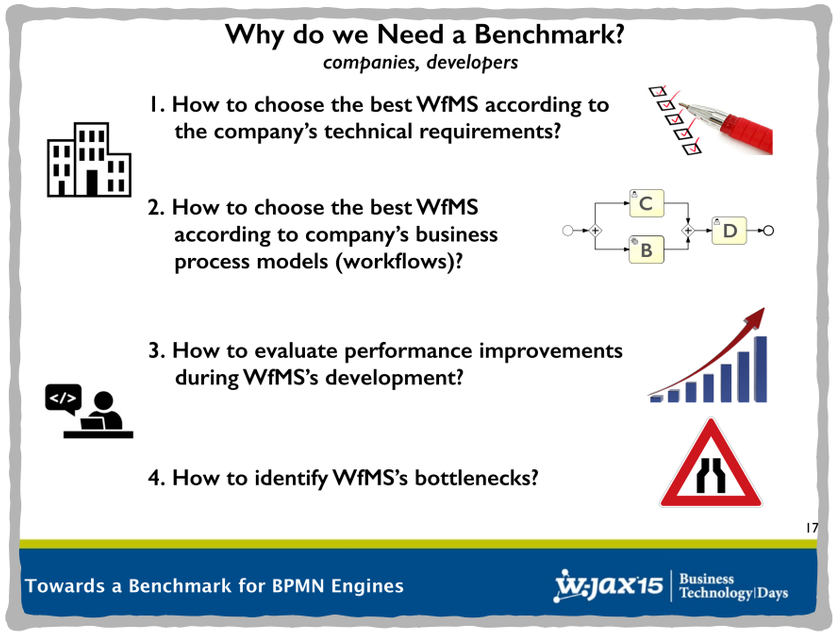
DATA TRANSFORMERS



Spark

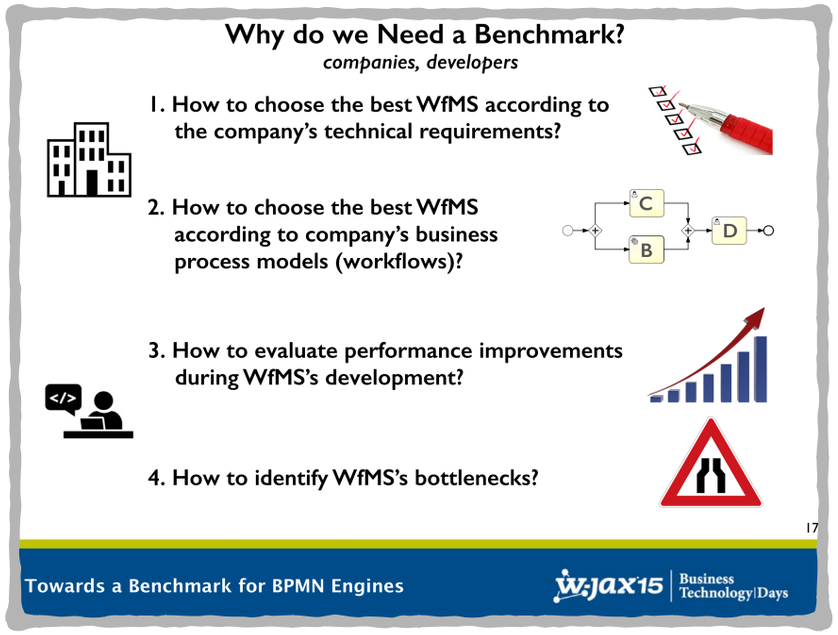
Highlights

Highlights



Why a Benchmark for WfMSs

Highlights



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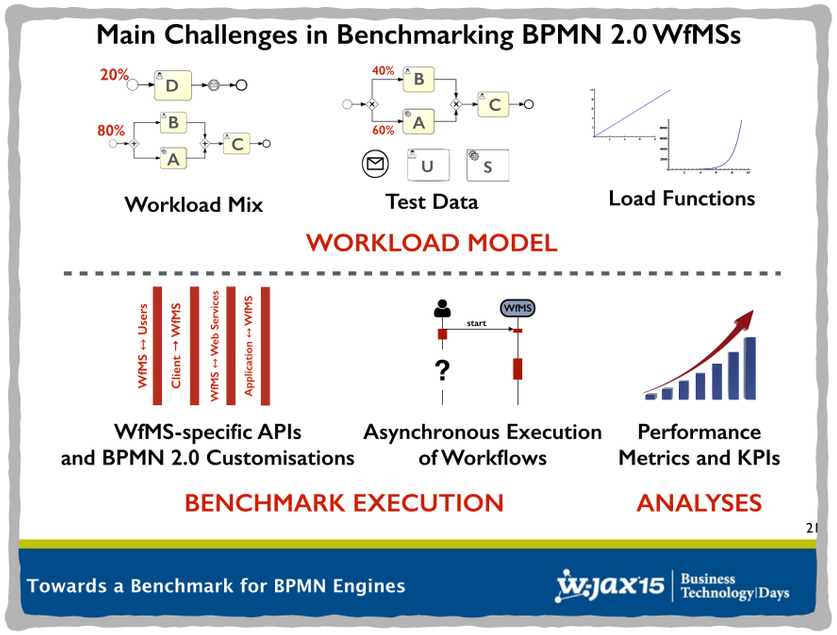
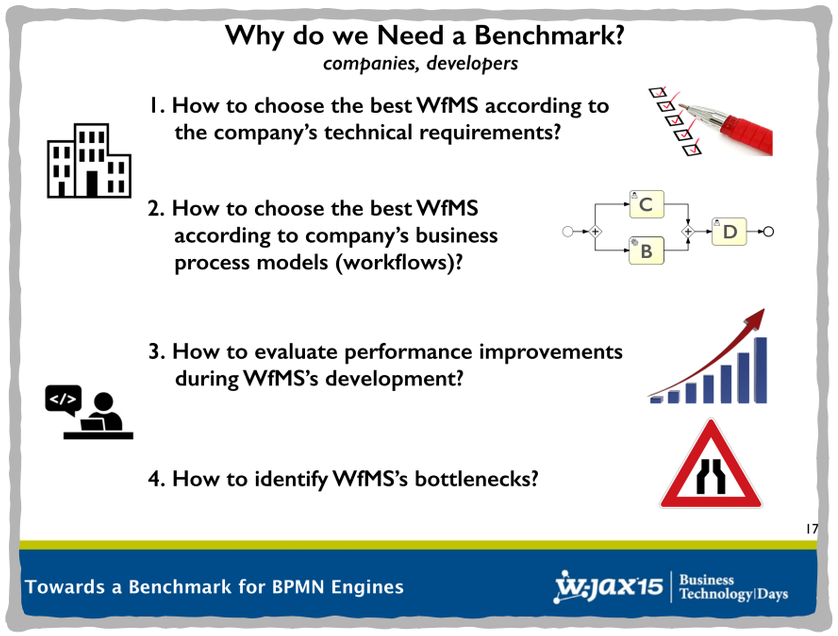


Benchmark's Main Challenges

Highlights



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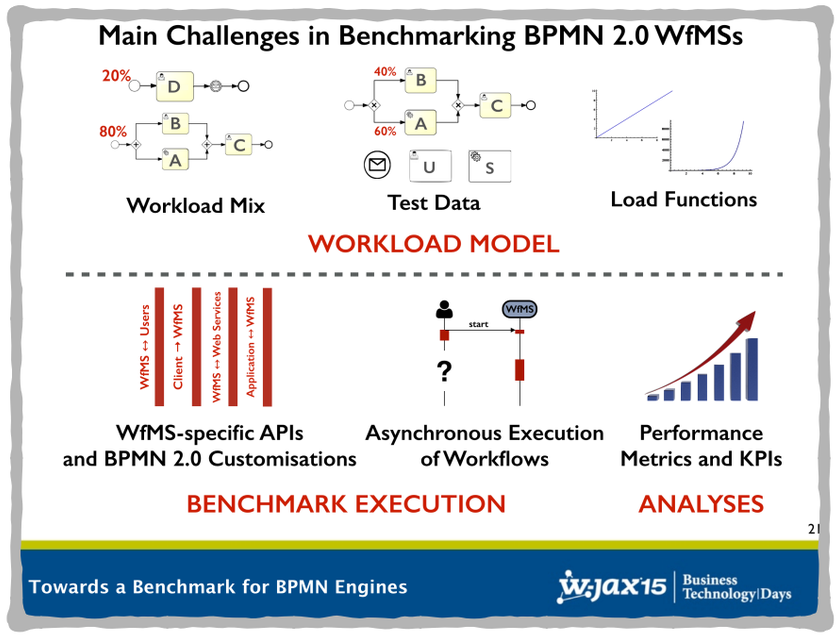

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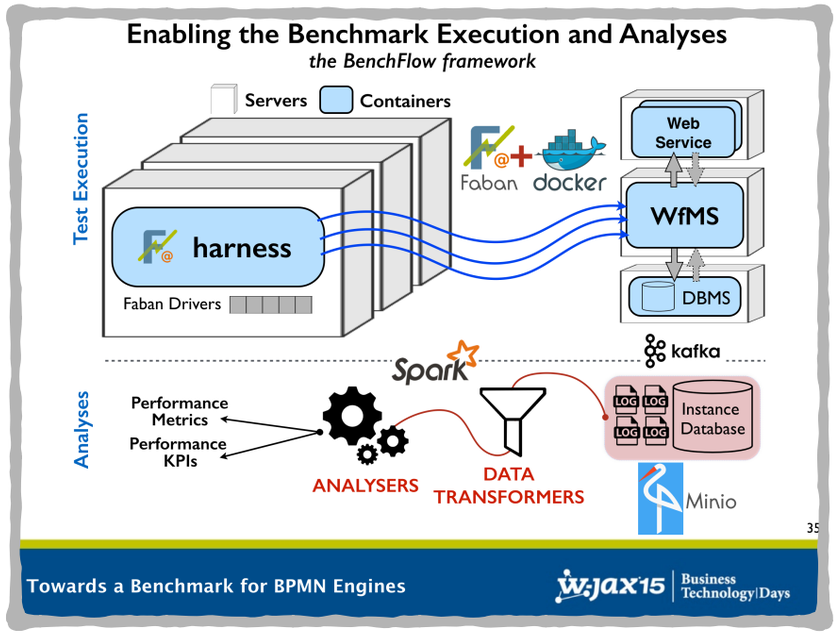

BenchFlow Framework

Future Work

BenchFlow framework

1. Finalise the release of the BenchFlow framework as an open-source project on GitHub and DockerHub;

https://github.com/benchflow **benchflow**

Future Work

BenchFlow framework

1. Finalise the release of the BenchFlow framework as an open-source project on GitHub and DockerHub;

   https://github.com/benchflow **benchflow**

2. Simplify and automate the execution of common performance tests: load test, spike test, scalability test, …

Future Work

experiments

1. Perform the first real-world experiments

Future Work

experiments

1. Perform the first real-world experiments

Execute Different Test Types

- **Stress testing**
- **Spike testing**
- **Scalability testing**
- **Configuration testing**

Future Work

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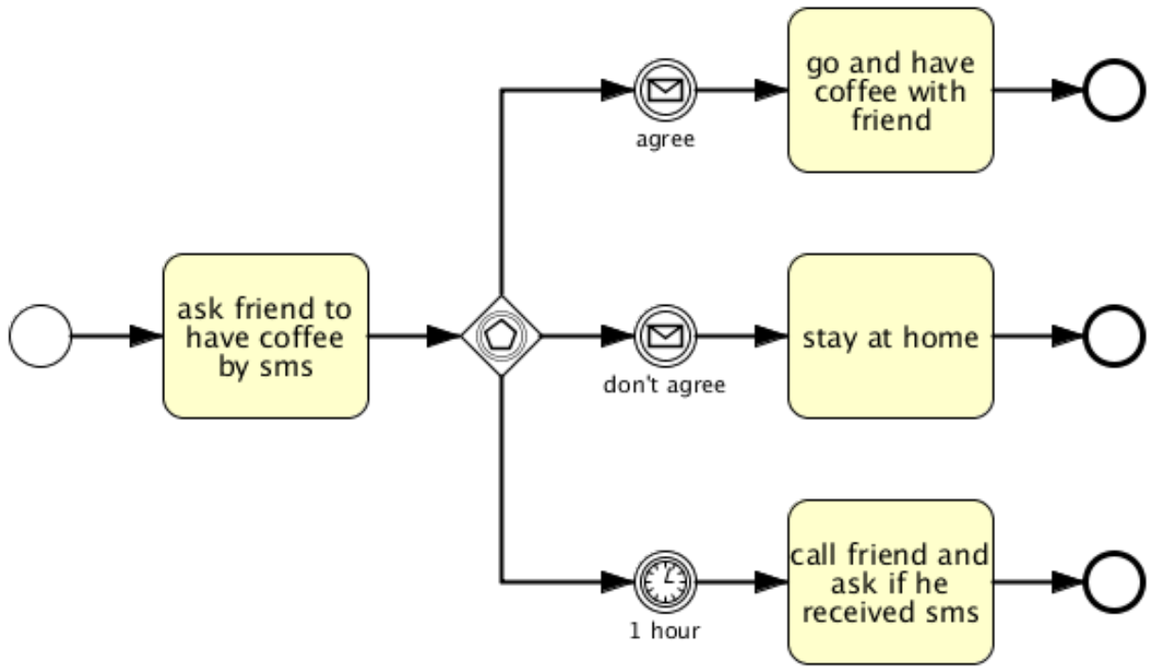
Use Real-World Workflows



Future Work

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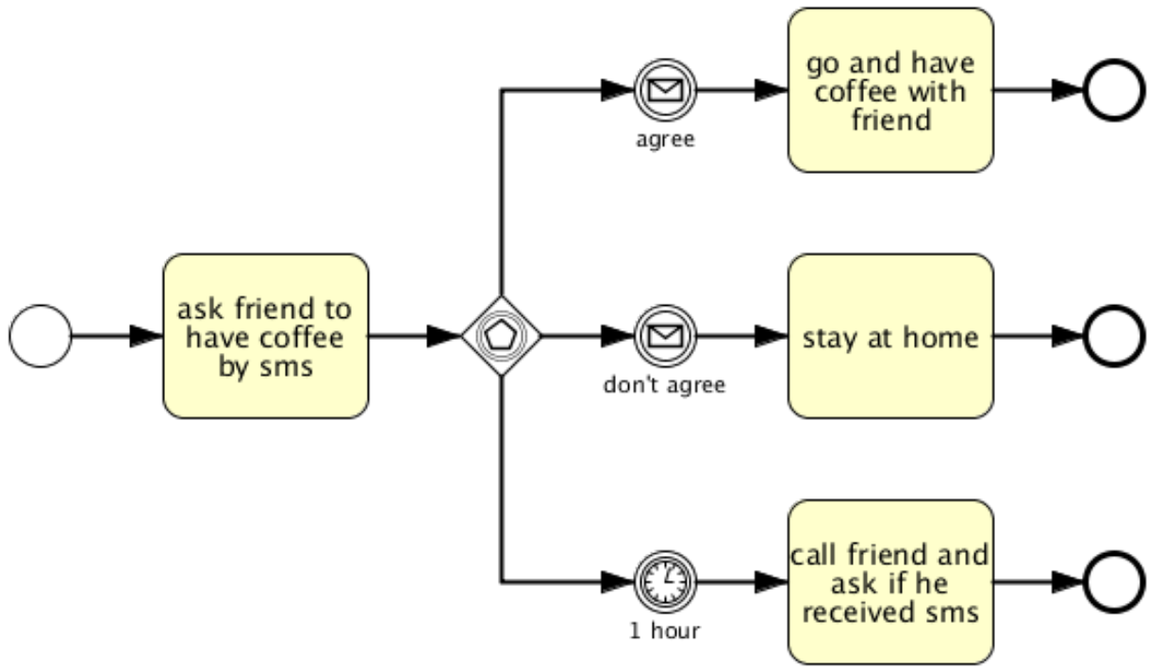

Production-like Configurations

Future Work

experiments

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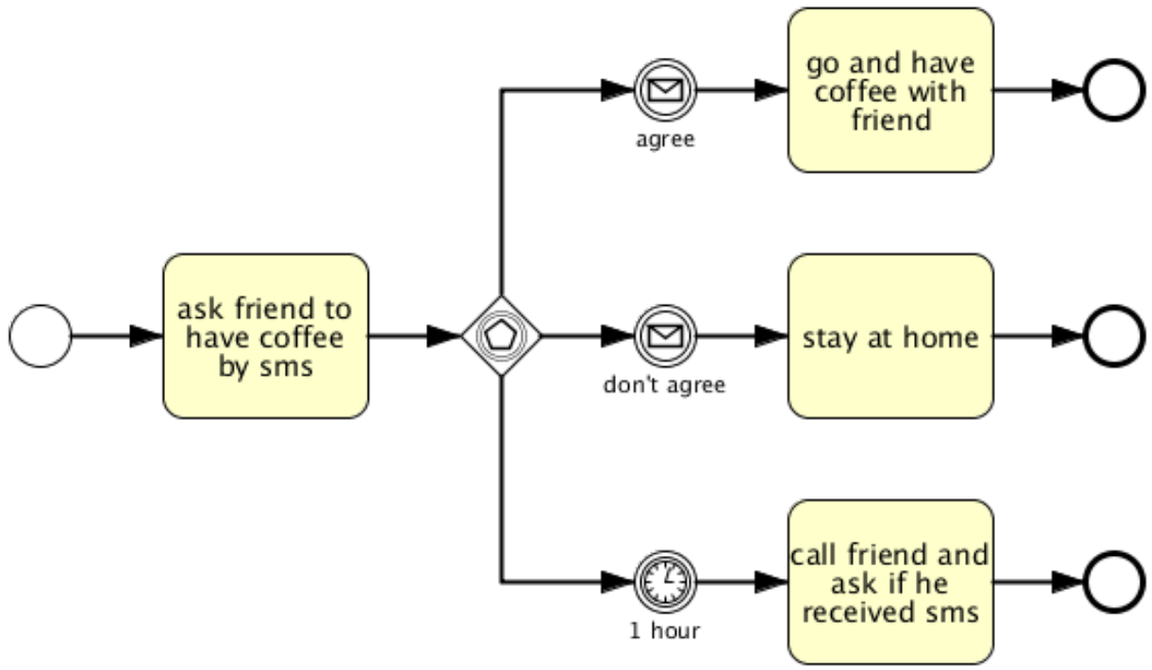

Production-like Configurations

Realistic:

- Load Functions
- Test Data

2. Increase the number of supported WfMSs

APIs:

CORE: Load Driver APIs

\+ **ADVANCED: User and Web Service APIs**

\+ **FULL: Event APIs**

2. Increase the number of supported WfMSs

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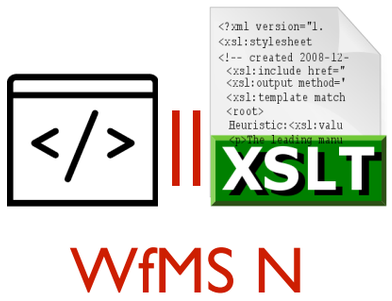
Deployable BPMN 2.0 Models:



WfMS N

WfMS N
BPMN 2.0
Serialisation

\+

customised test data formatting

Future Work

experiments

2. Increase the number of supported WfMSs

APIs:

CORE: Load Driver APIs

\+ ADVANCED: User and Web Service APIs

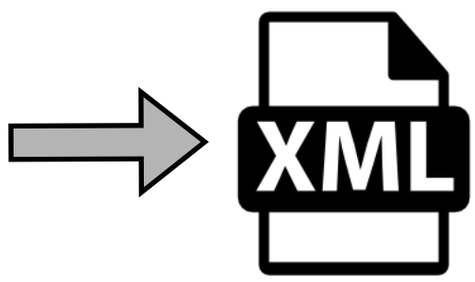
\+ FULL: Event APIs

Data:

- Accessibility of the data
- Availability of timing data
- Availability of execution state

Deployable BPMN 2.0 Models:

WfMS N



WfMS N
BPMN 2.0
Serialisation

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Call for Collaboration

WfMSs, process models, process logs

WfMSs

- We want to add more and more WfMSs to the benchmark
- **Contact us for collaboration, and BenchFlow framework support**

Process Models

- We want to characterise the Workload Mix using Real-World process models
- **Share your executable BPMN 2.0 process models, even anonymised**

Execution Logs

- We want to characterise the Load Functions using Real-World behaviours
- **Share your execution logs, even anonymised**

Join Us @ ICWE 2016 in Lugano!

Lugano

ICWE2016

6-9 June 2016, USI Lugano, Switzerland

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Towards a Benchmark for BPMN Engines

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Towards a Benchmark for BPMN Engines

Vincenzo Ferme, Cesare Pautasso | University of Lugano (USI)

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