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Camunda BPM and Microservices

A polyglot environment

Version 2021-01

Agenda

Day 1:

1. Process Modeling with BPMN 2.0
2. Camunda BPM Platform
3. Deploying to Camunda Engine
4. Work with External Service Tasks
5. Data Objects, Gateways & Expressions

Day 2:

6. BPMN Event Handling
7. Incident Handling
8. Error Handling and Compensation
9. Human Task Management
10. Process Interaction

Day 3:

11. Architecture
12. Decoupling with Events
13. Testing Processes
14. Business Rules with DMN
15. Camunda BPM Enterprise Edition
16. Wrap up

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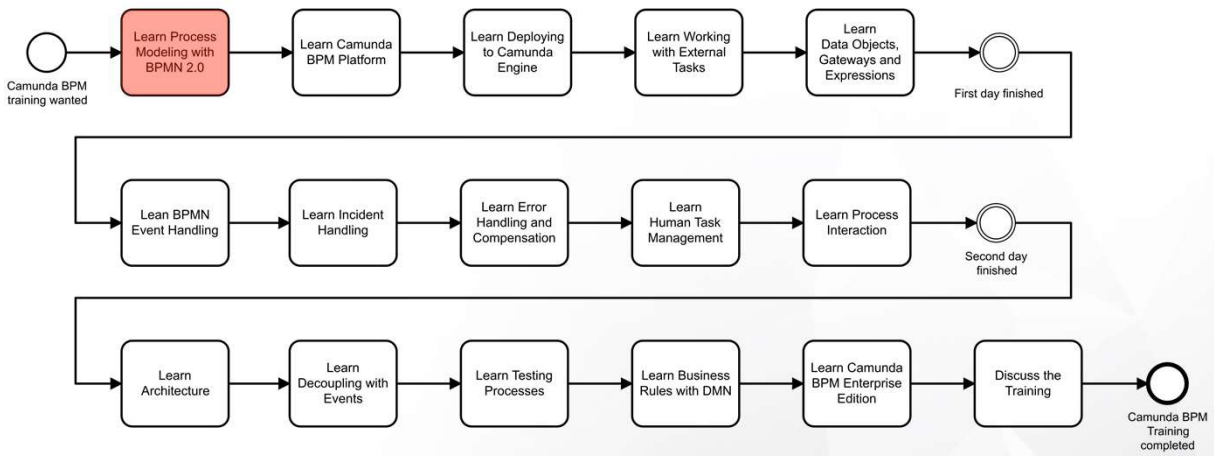

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Business Process Model and Notation (BPMN)

- BPMN is a worldwide OMG standard
- Latest version is BPMN 2.0
- Lots of companies joined the standardization committee
- All major BPMS vendors go for BPMN

OBJECT MANAGEMENT GROUP

NIST ORACLE CAMUNDA SAP IBM

Trisotech Global360 TIBCO FUJITSU INTALIO

4

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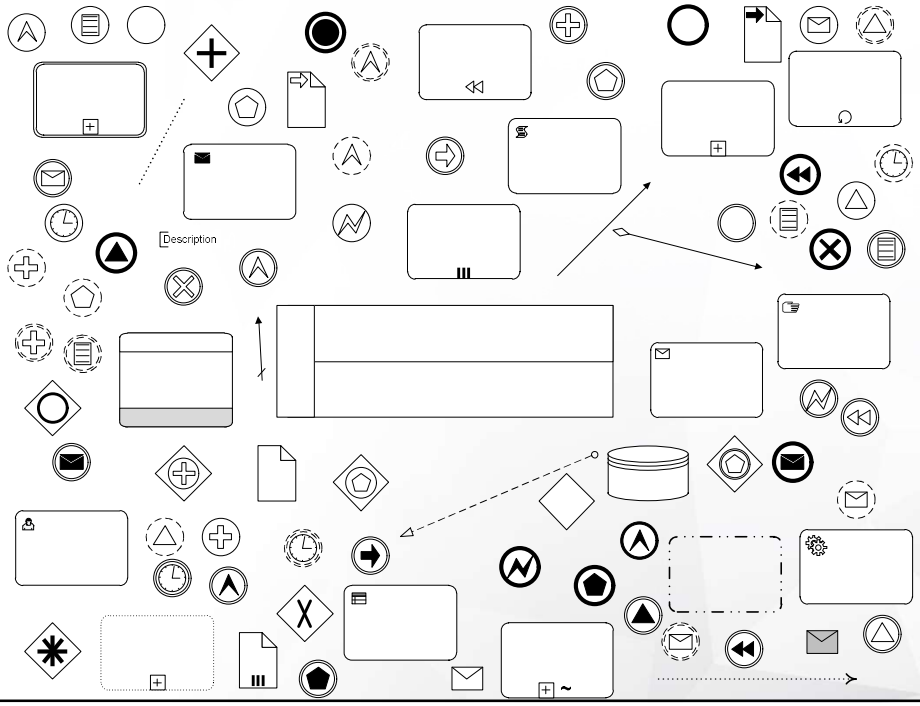

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Our First BPMN Process Model

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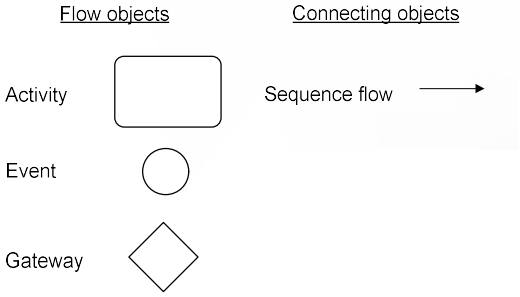
Basic Elements



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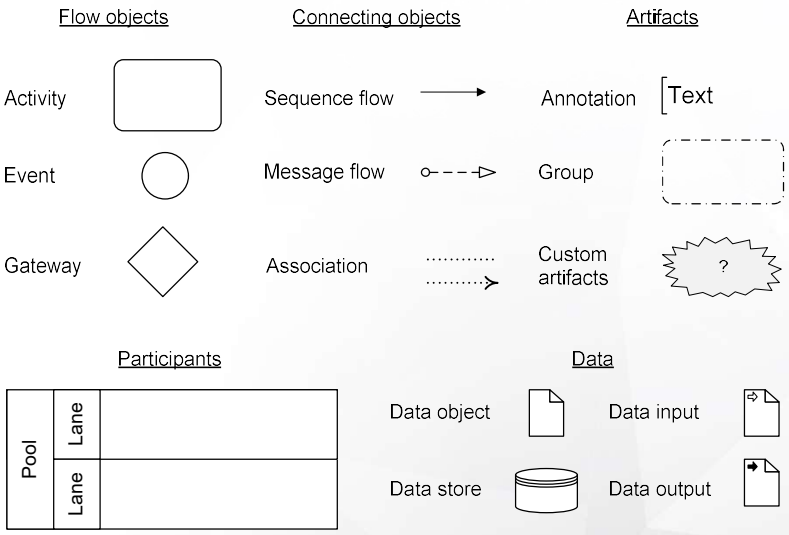
Basic Elements - Documentation



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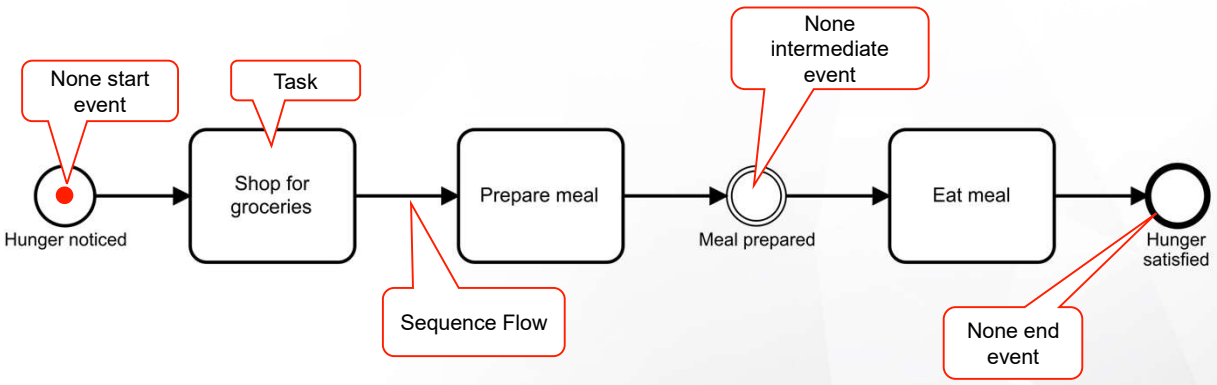
Tasks and events



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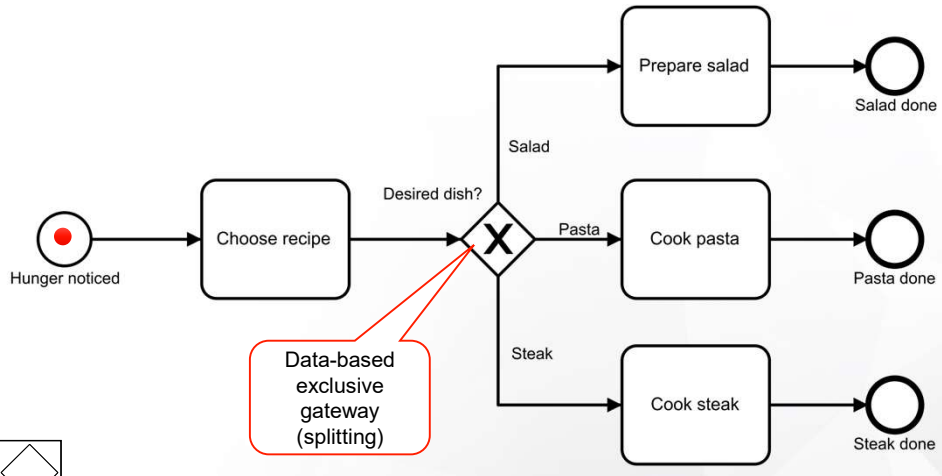
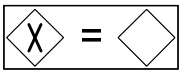
The XOR-Gateway





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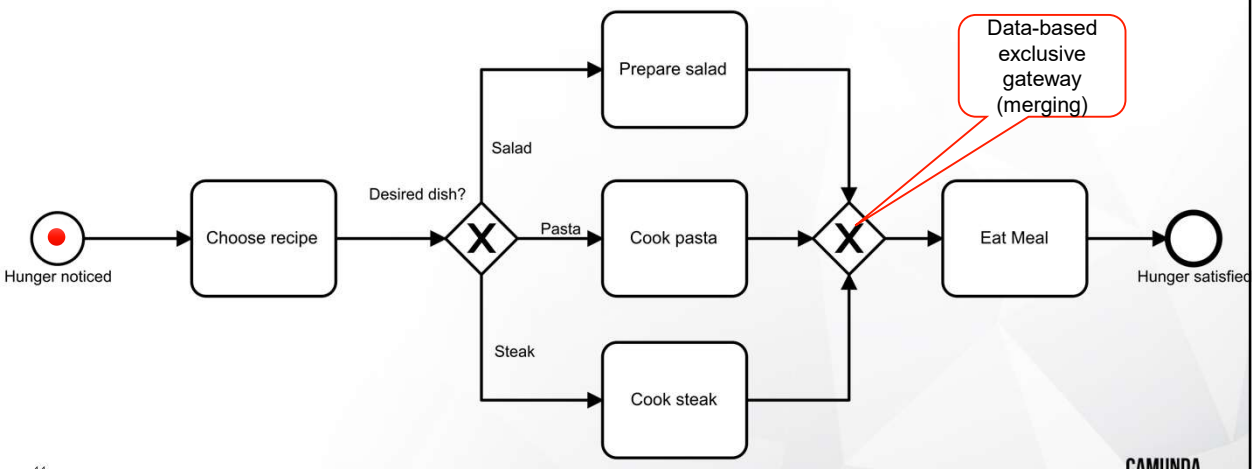
XOR-Gateways Can Also Merge



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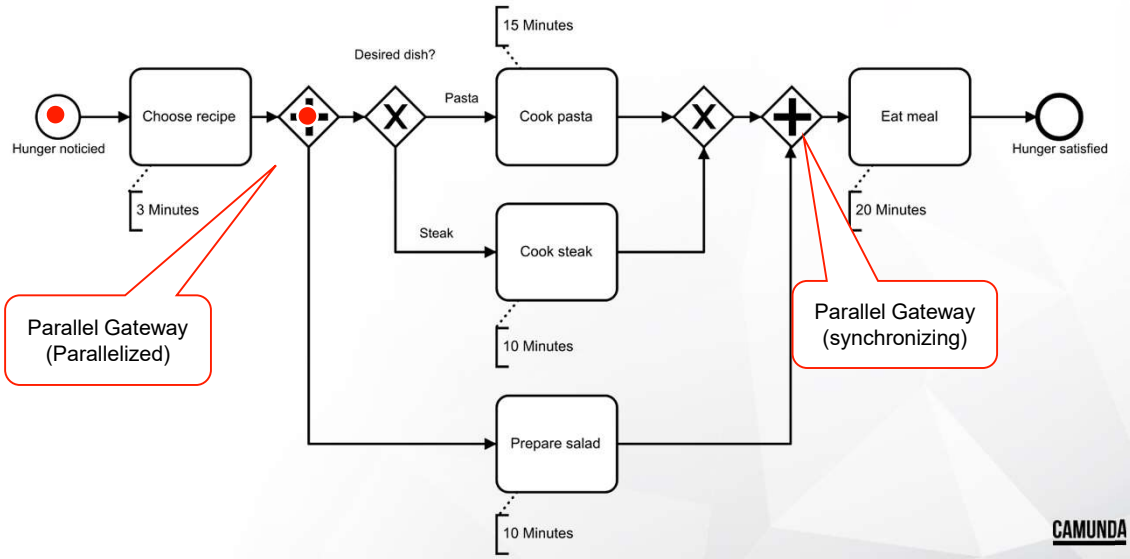
Preparing Salad and Main Course at the Same Time



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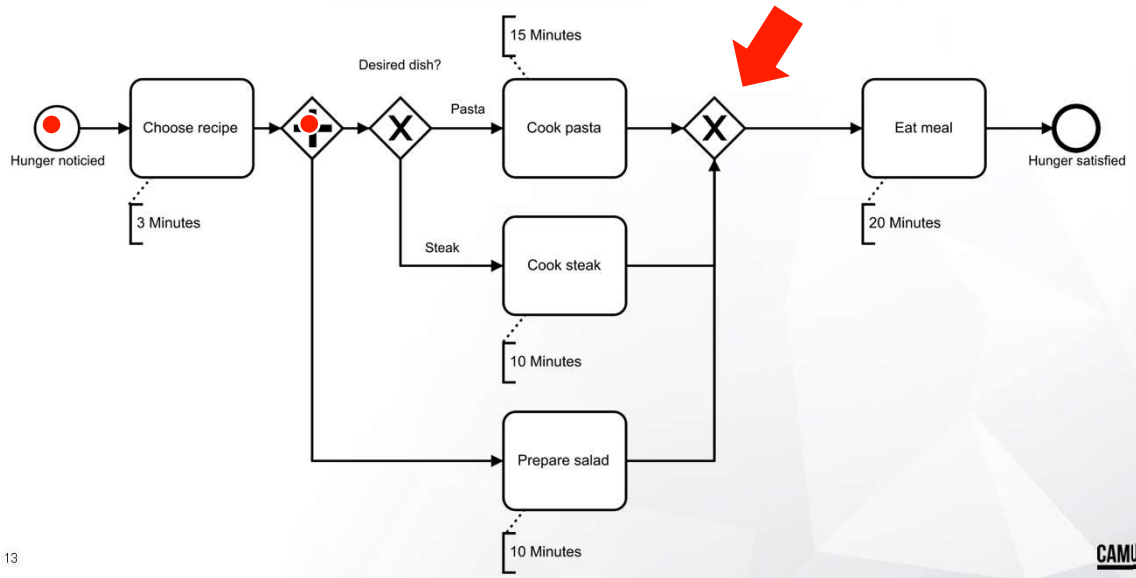
What Happens in This Process?



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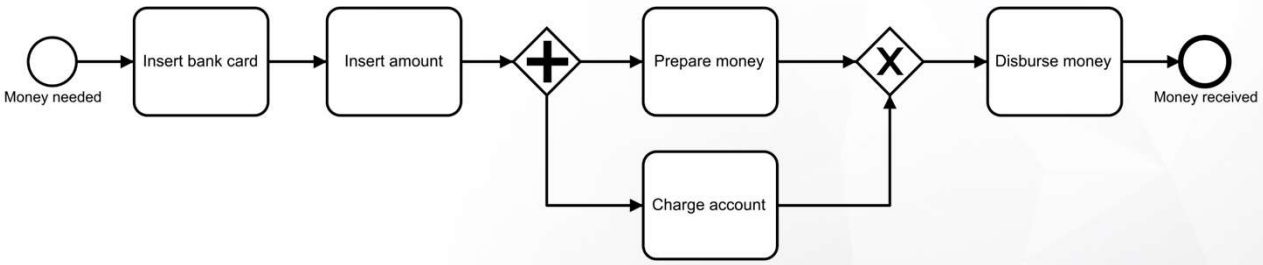
Example: ATM



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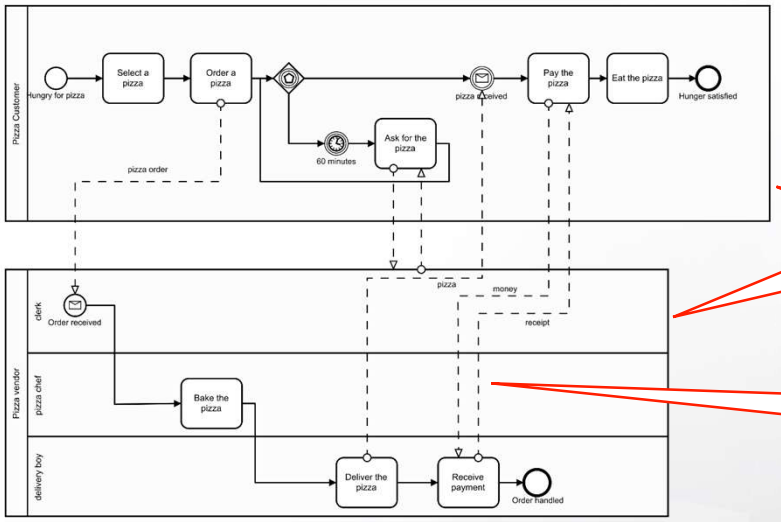
Collaboration Diagram



Two (independent) Participants

Communication by Message Flows

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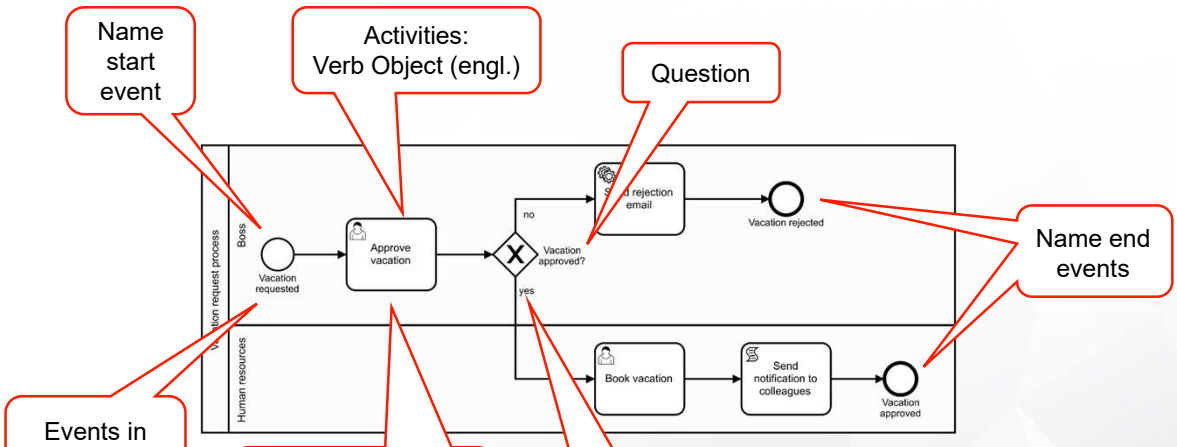
Create Readable Process Models



Name start event

Activities: Verb Object (engl.)

Question

Name end events

Events in past tense

Deutsch: Objekt Verb
Urlaub genehmigen

Answer

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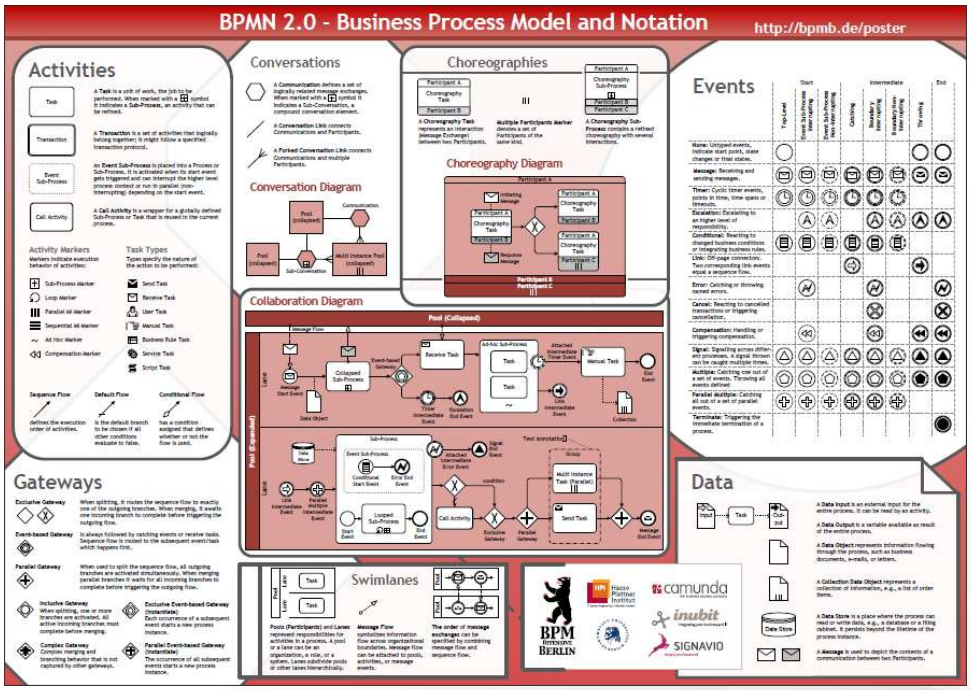
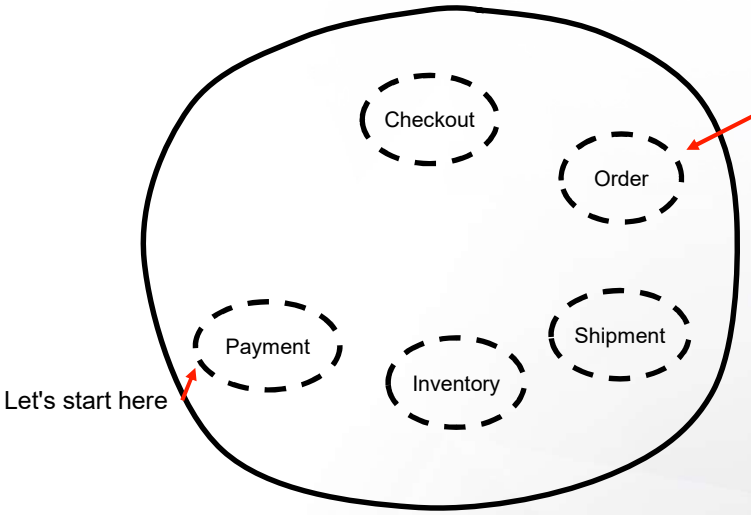


Scenario for Exercises

A Simple Order Process



Domain: a web shop

Bounded Contexts:
- Order
- Shipment
- Payment
- Checkout
- Inventory

A lot of freedom here,
It's just an example

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Let's Do the Payment Process

- The customer can have a credit with us
- We use credit card payment
- If the credit is not sufficient we charge the remaining amount

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Group Exercise 0

Use a whiteboard or flipchart to model a payment process

Payment Process

Can be sketched here

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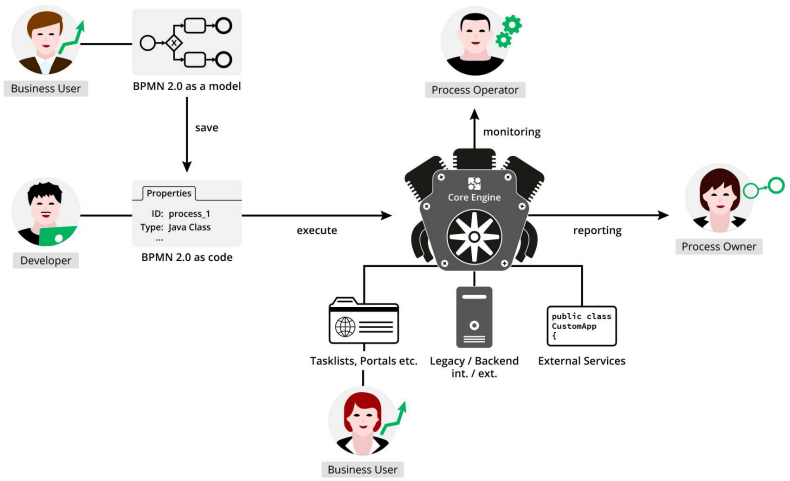
What‘s So Cool About BPMN 2.0



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Why Using a Process Engine?

- Features
  - Timers & escalation
  - Error management and retry mechanisms
  - Versioning
  - The power of BPMN 2.0
  - Tools (modeler, cockpit, …)
  - Task management
  - …
- Transparency and Agility
  - Process is not hidden in the code
  - Process model can be used for monitoring and operations
- Quality

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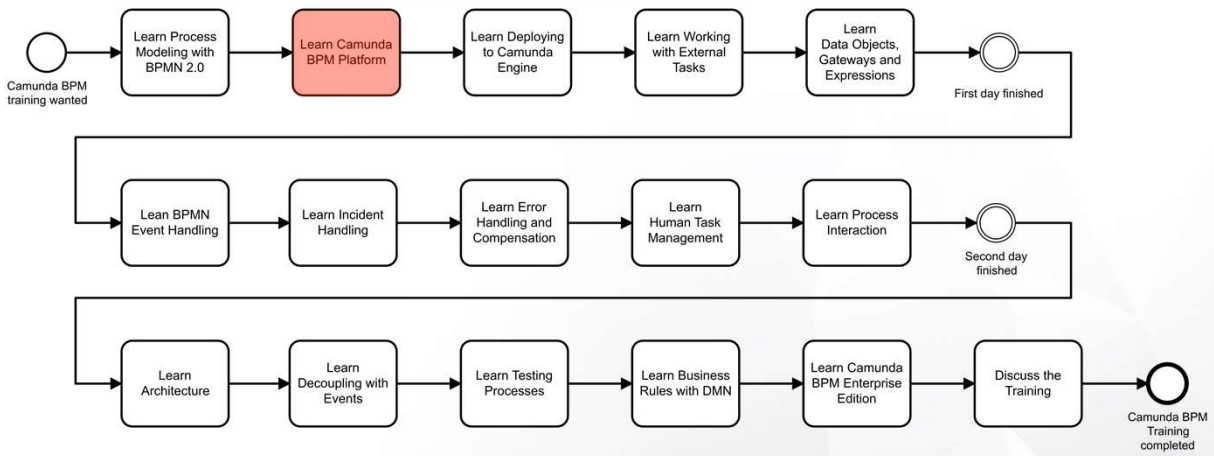

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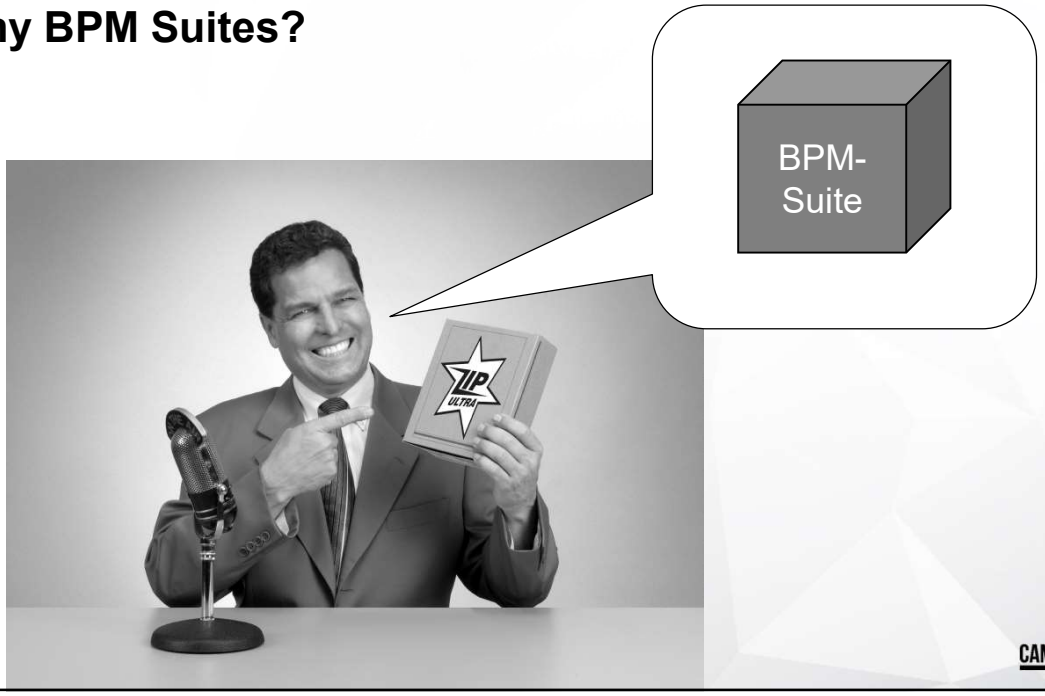
Shiny BPM Suites?



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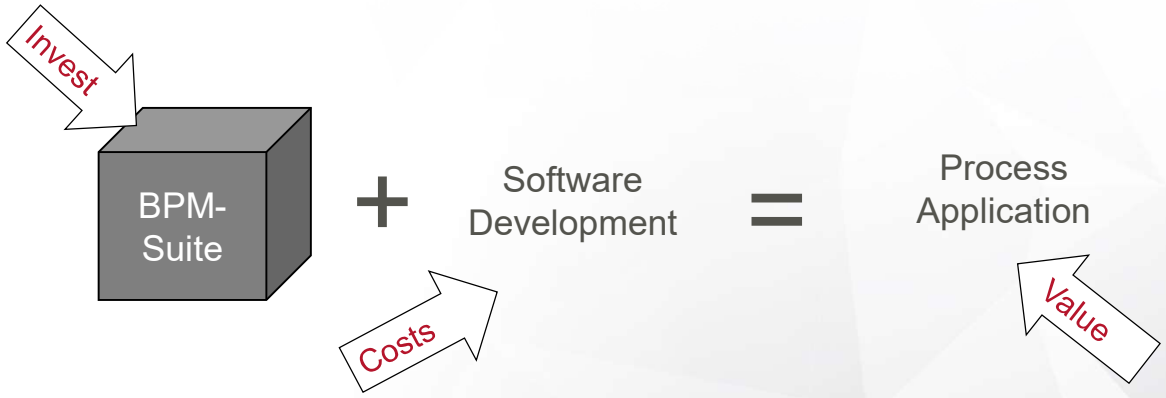
You Always Need Software Development



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Tempting, but Deceptive

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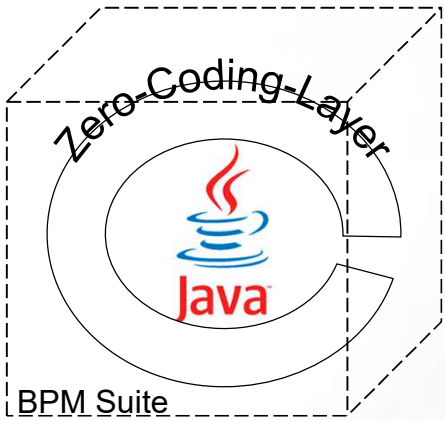
A Fundamentally Wrong Approach*



complicated
restrictive

Business User

restrictive
proprietary

Software
Developer

29 *for automating core business processes

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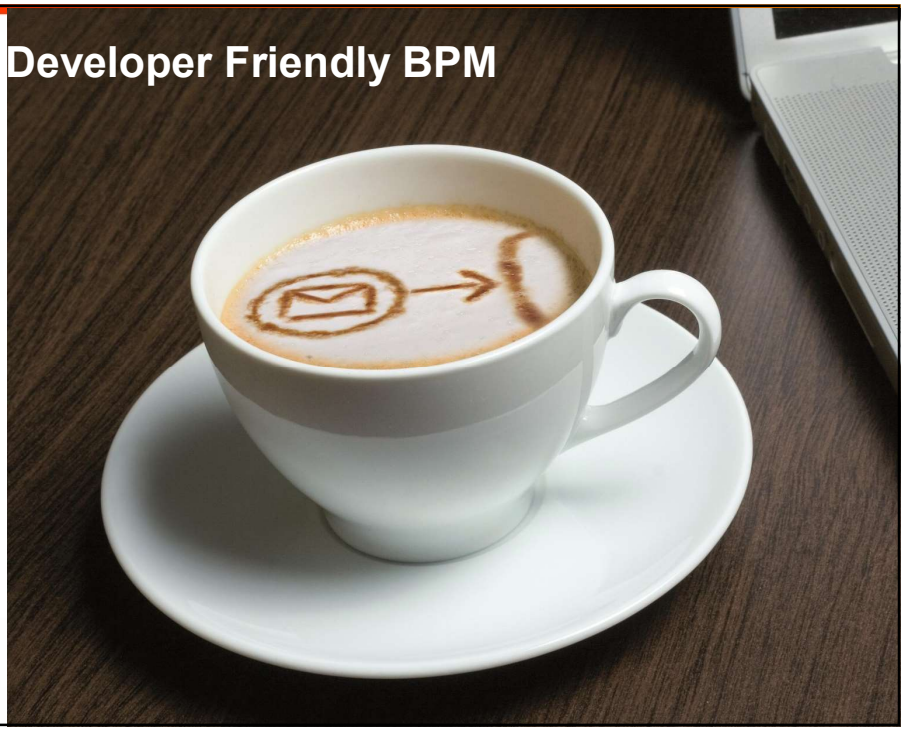
Our Approach: Developer Friendly BPM



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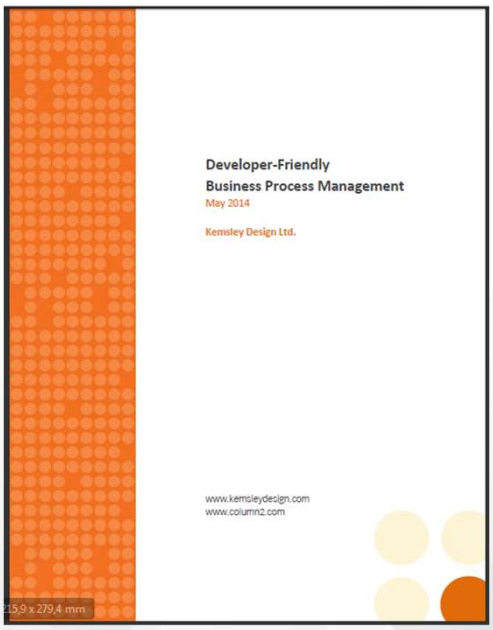
Developer-Friendliness

- A fundamentally different approach compared to Zero-Code Suites!
- It‘s not about „empowering Business Analysts“. Even with low code approaches coding is still required
- Camunda helps developers be more productive („Less code“)
- Camunda is microservice orchestration ready



https://camunda.com/learn/whitepapers/developer-friendly-bpm/

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In short

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Developer-Friendly System Integration

VS.

Zero-Code BPM Suites

Death by Property Panel

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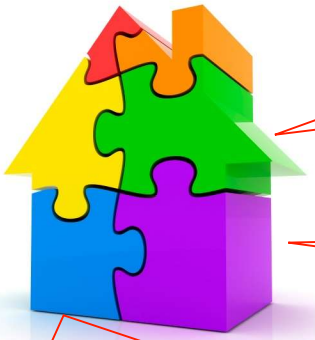
Best of Breed – Based on Standards



You name it!

Any component from the Java cosmos.

Camunda BPM

Process Automation, Monitoring, Operations, …

BPMN 2.0

Process Modeling, Requirements Engineering, Roundtrip, …

Java

Persistence (JPA), Transactions (JTA, EJB3), Clustering, Connectivity (JAX-WS, JAX-RS, JAX-B), UI (JSF), …

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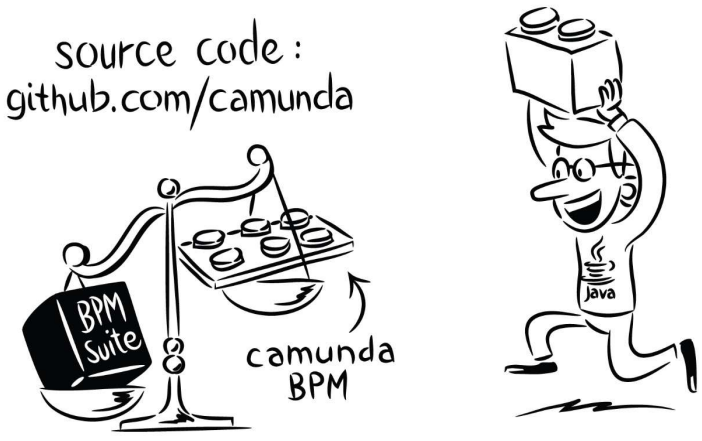
Lightweight and Open Source BPM Framework



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…Plus BPMN Based Business-IT-Alignment

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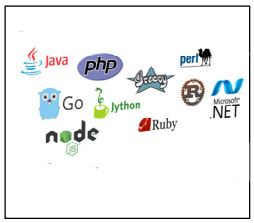
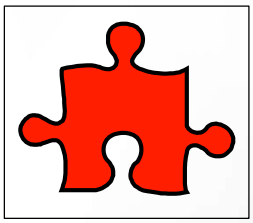
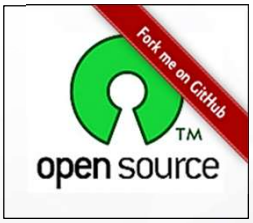
Summary: Core Concepts of Camunda BPM







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Decide Yourself!

BPM in a can

BPM cook-it-yourself

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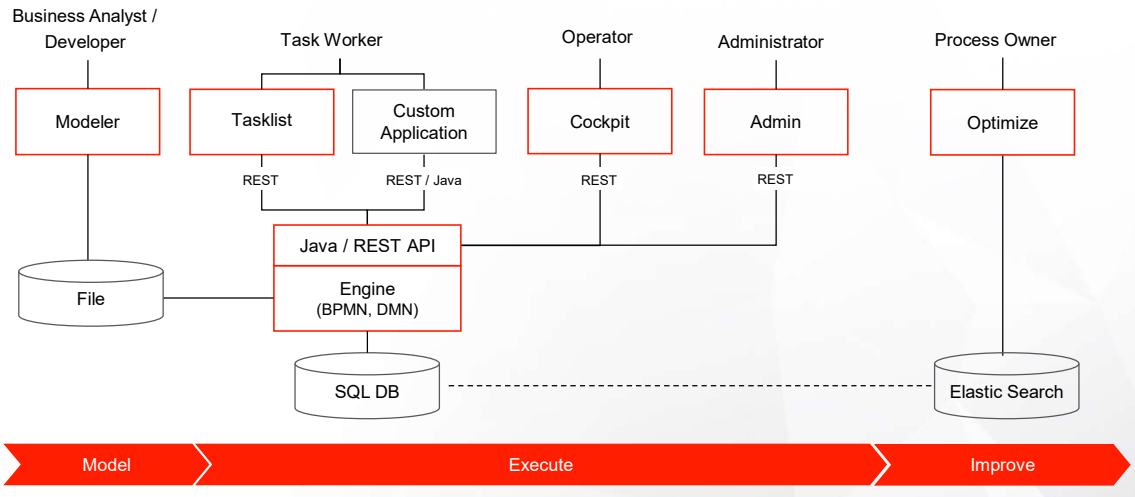
Camunda BPM Components



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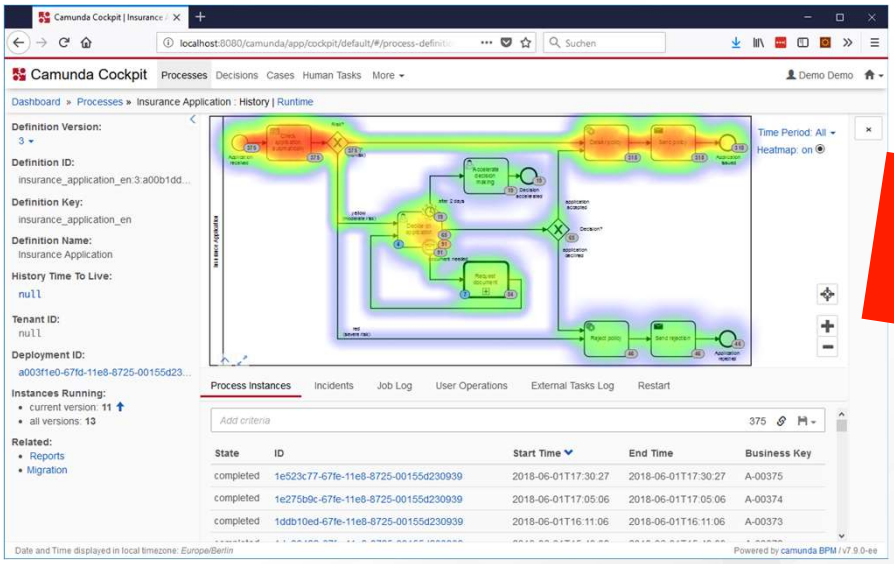
Exercise 1

https://training.camunda.com/microservices
user: microservices
password: camundarocks

Demo

Camunda Cockpit



History view and Heatmap Enterprise Feature

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Cockpit Features

- Dashboard
- Monitor BPMN Processes
- Monitor DMN Decisions
- Browse deployments and resources in the process engine repository
- Graphical Process Instance Modification (EE only)
- Graphical Process Instance Migration (EE only)
- Auditing of Cockpit operations (EE only)
- History Cleanup View (EE only)
- Batch view
- Reports (EE only)

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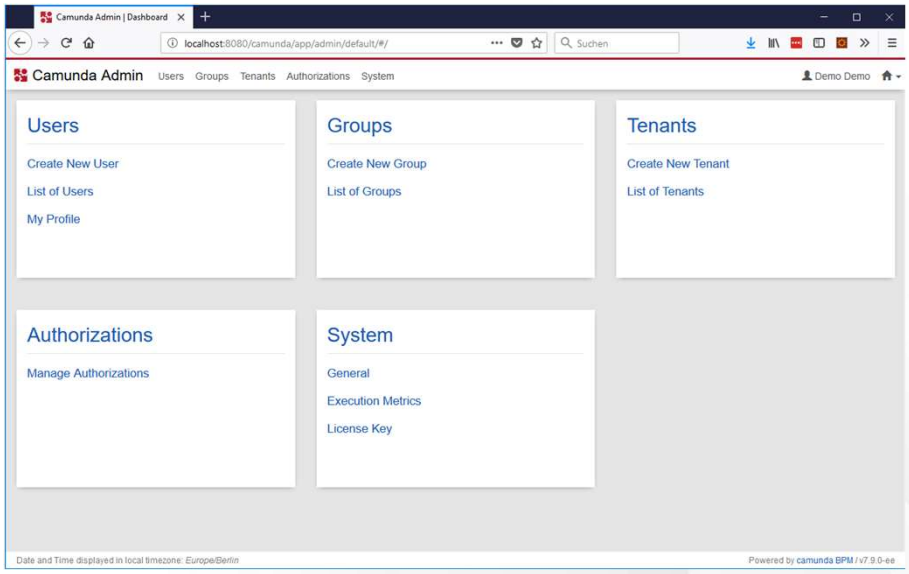
Camunda Admin



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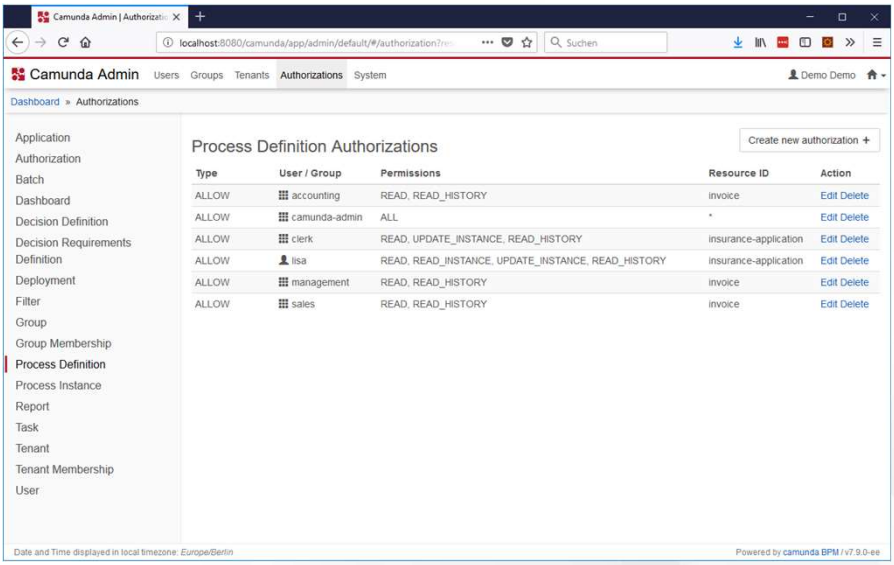
Authorizations



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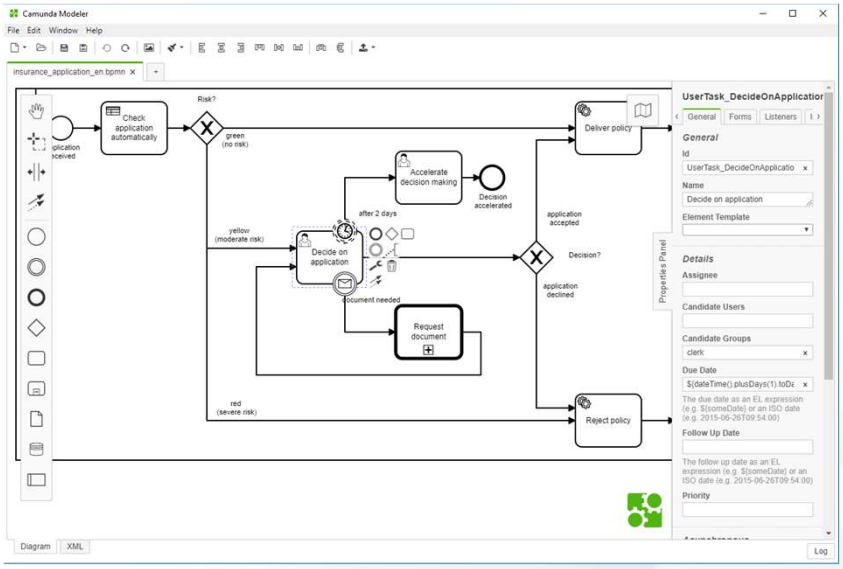
Camunda Modeler



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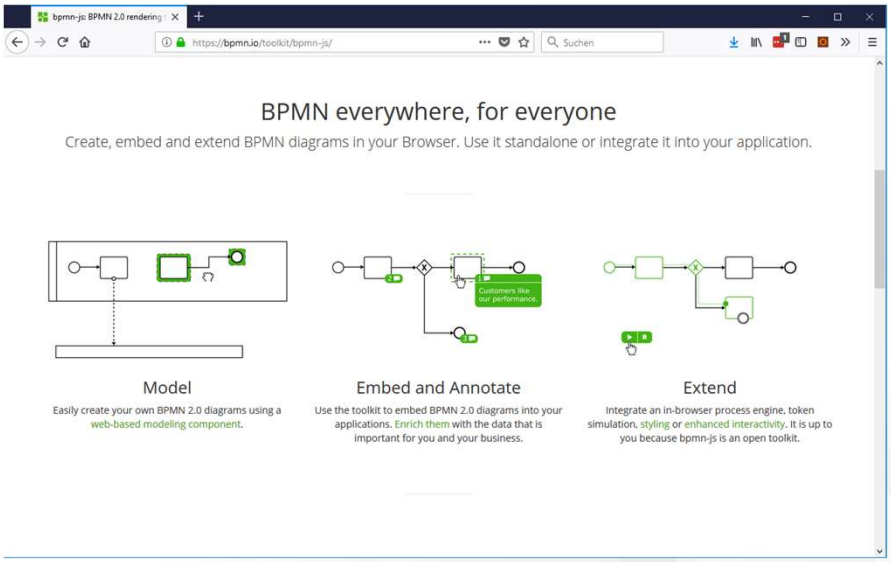
bpmn.io – a Developer Kit and Web Modeler for BPMN 2.0



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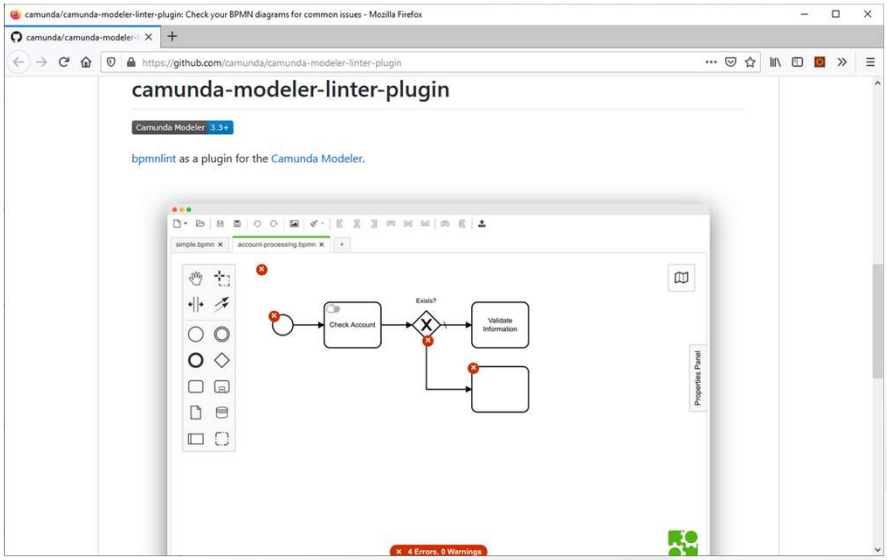
Extend the Camunda Modeler



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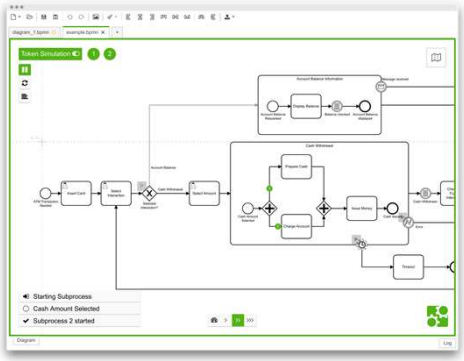
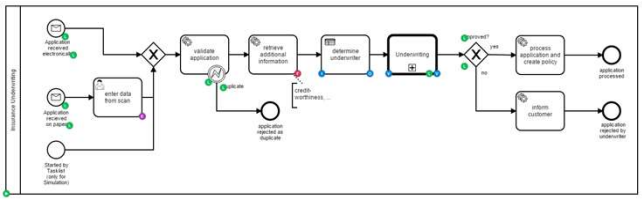
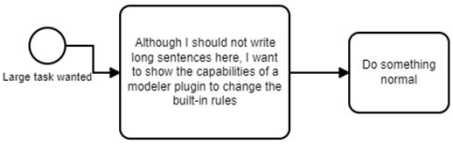
Camunda Modeler Plugin Examples



Token Simulation Plugin



Property Info Plugin



Resize Tasks Plugin

https://github.com/camunda/camunda-modeler-plugins

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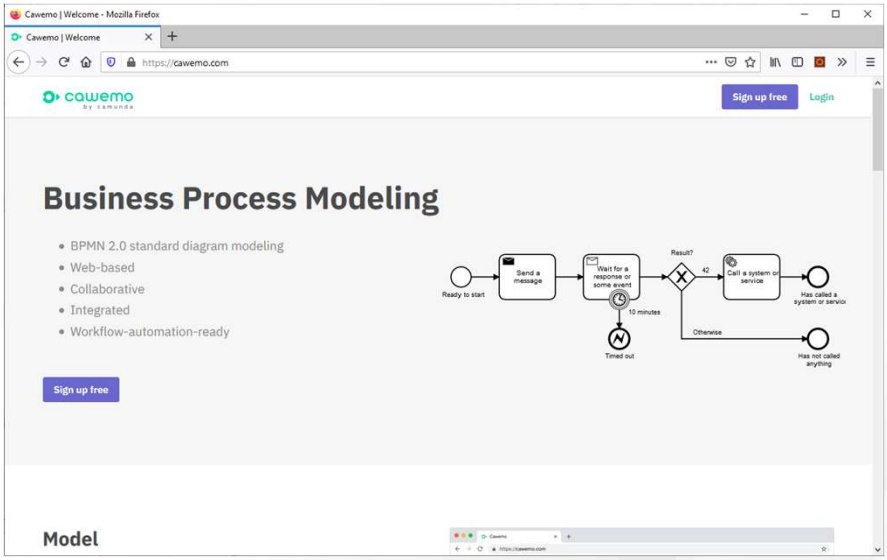
cawemo.com



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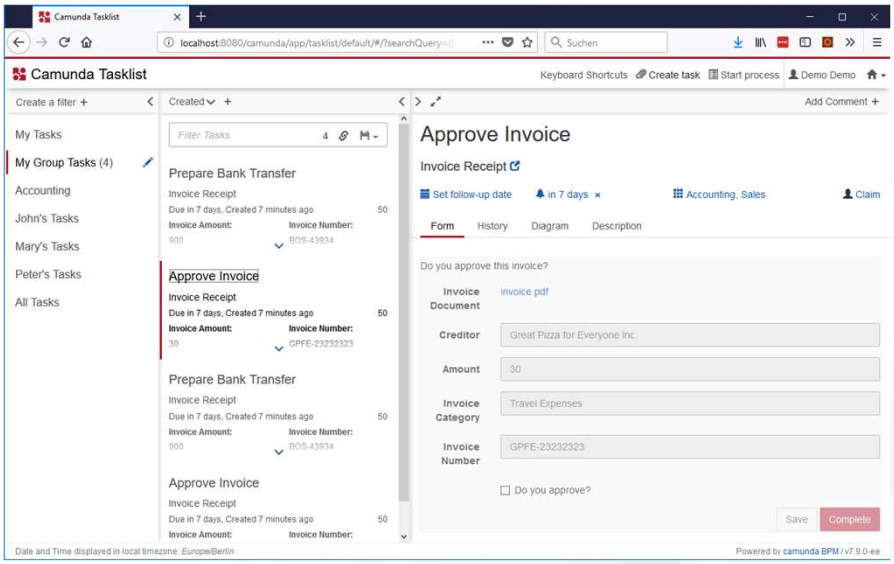
Camunda Tasklist



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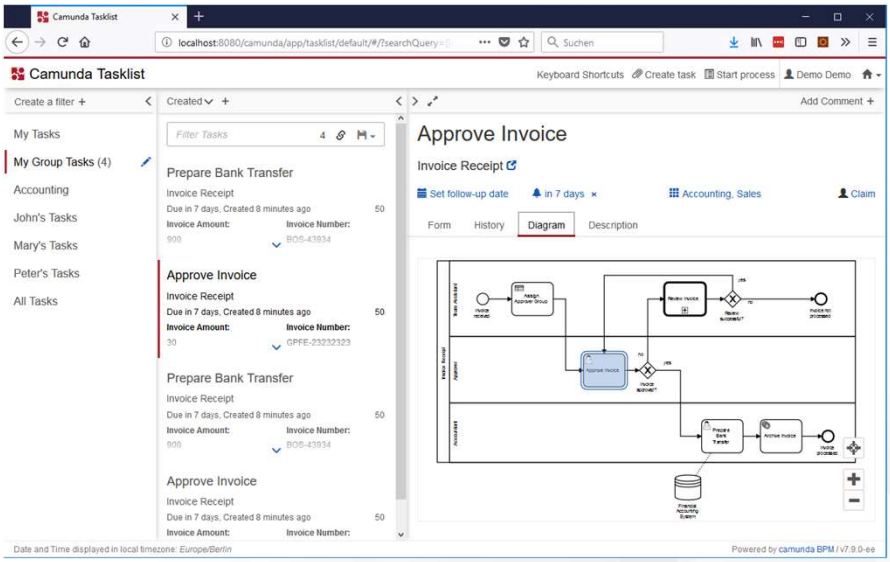
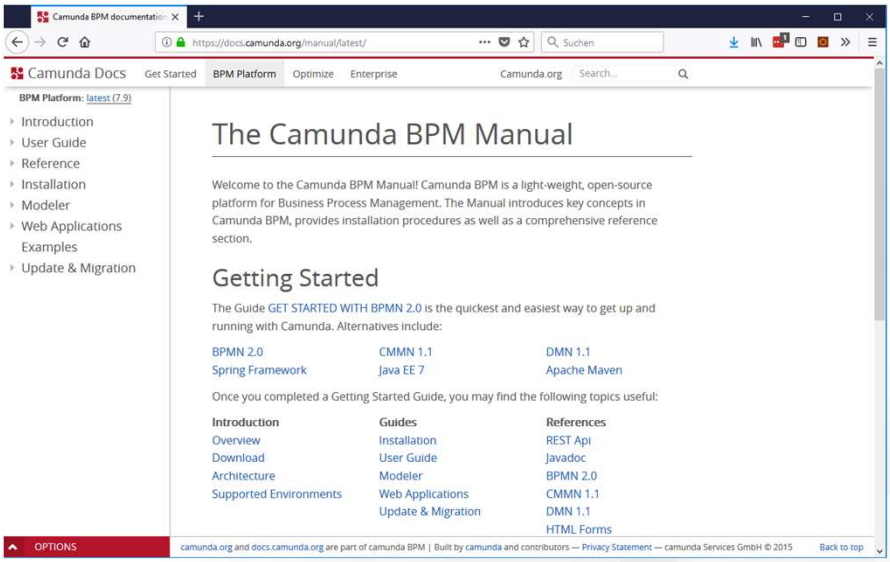
Process Overview



CAMUNDA

https://docs.camunda.org



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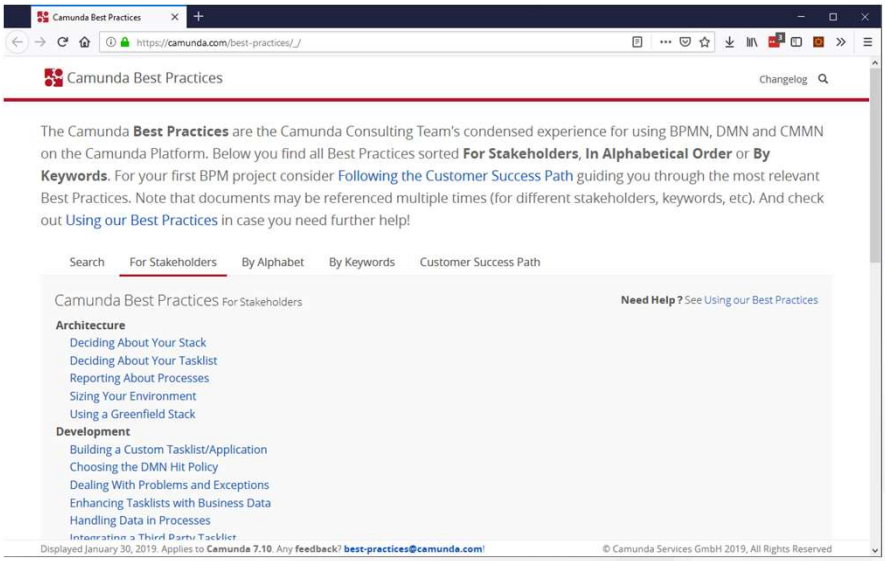
Camunda Best Practices



https://camunda.com/best-practices/

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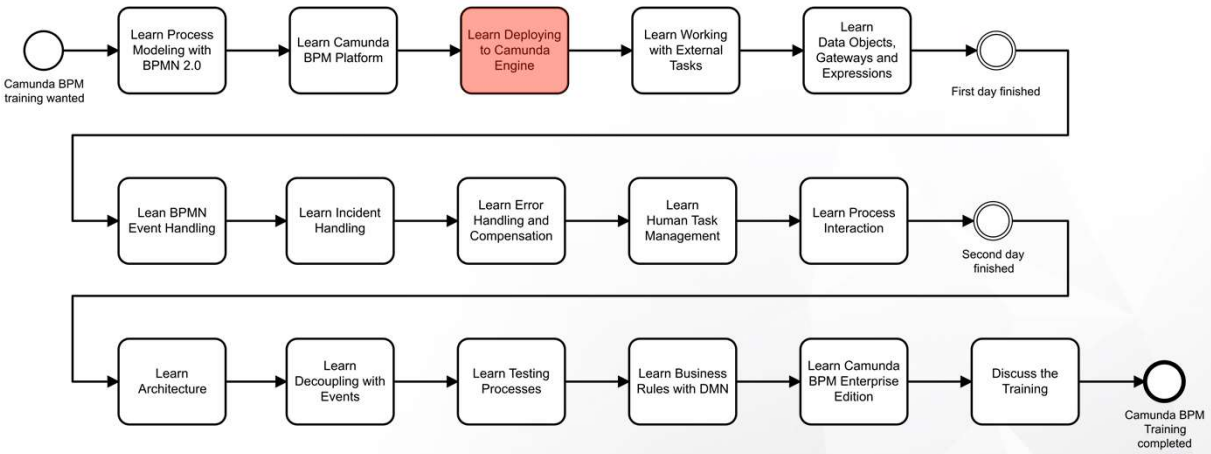

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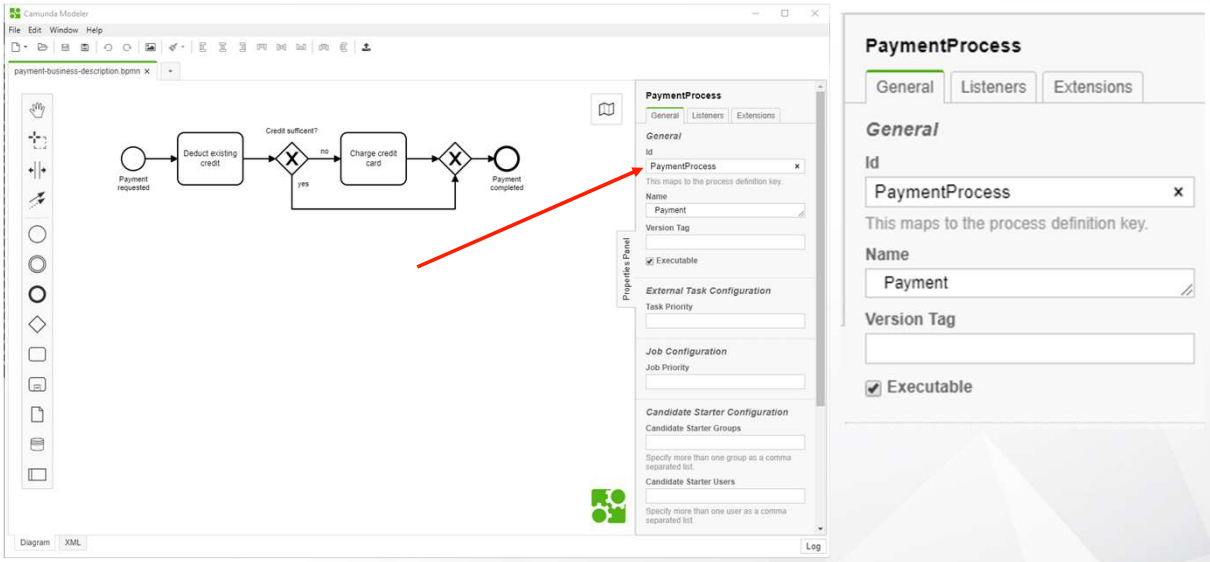
Name the Process



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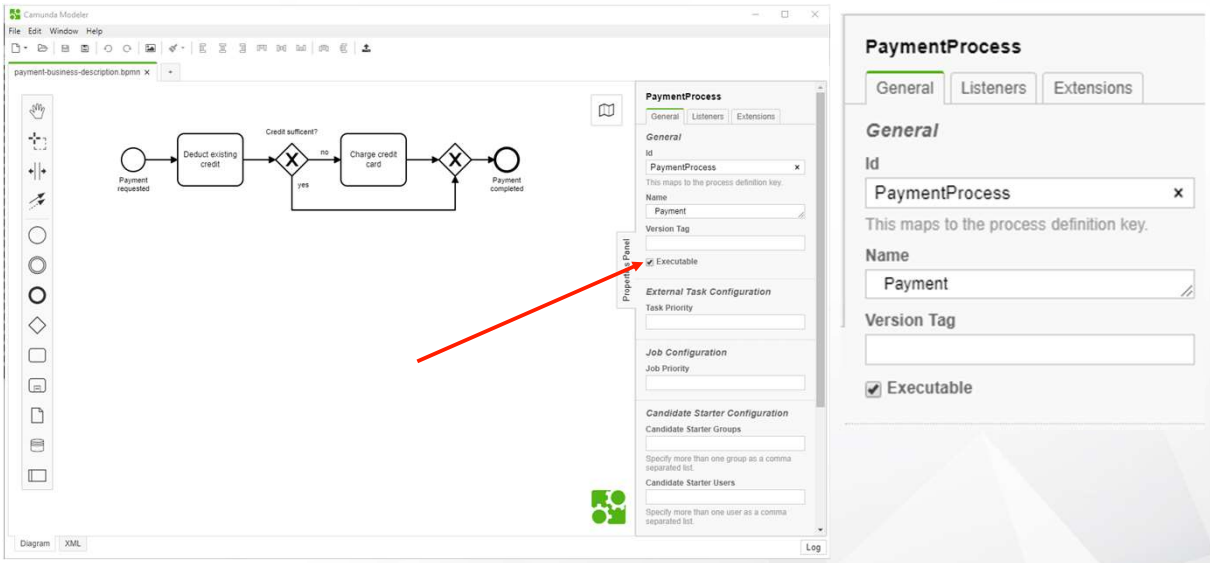
CAMUNDA

Make Process Executable



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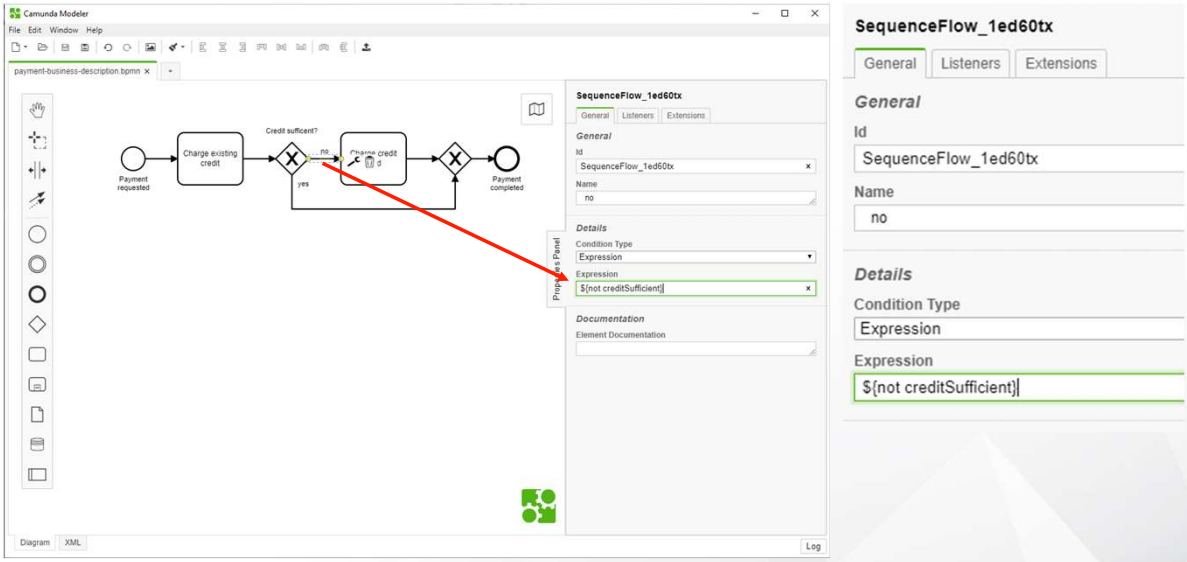
CAMUNDA

Conditions



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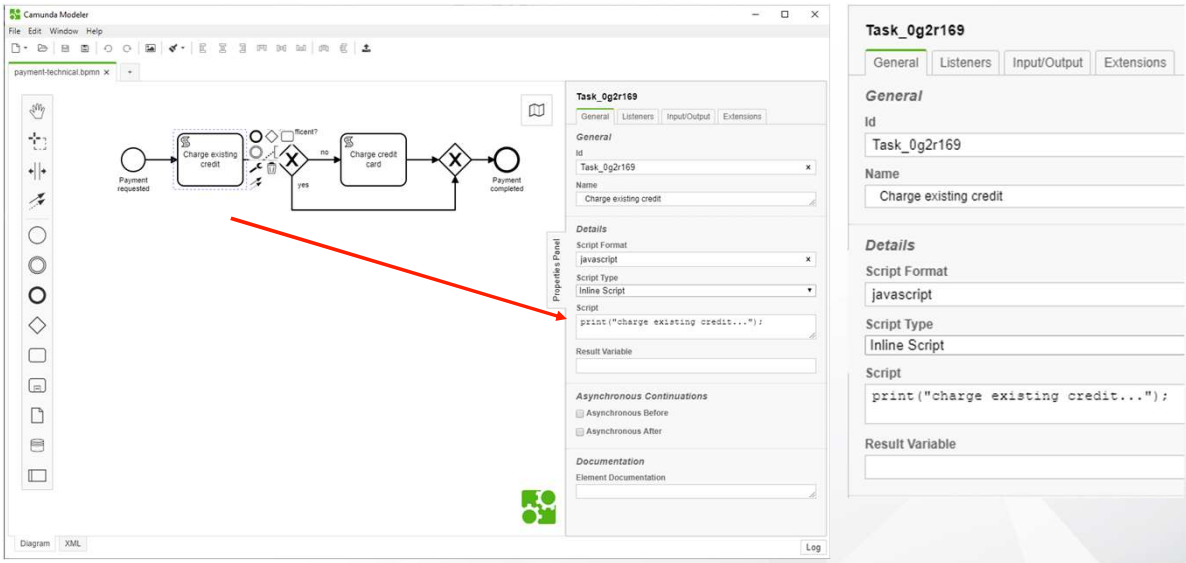
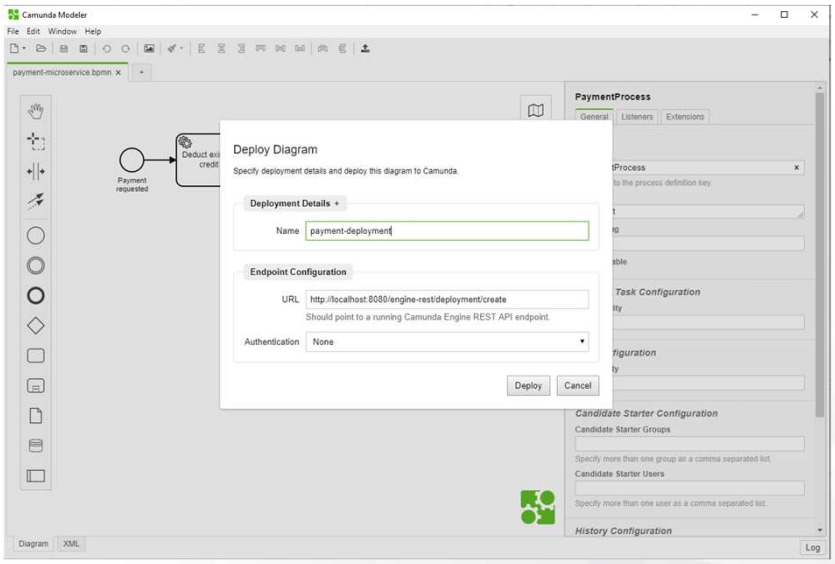
Scripts



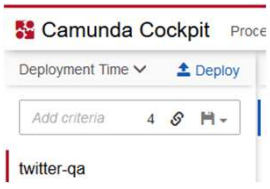
CAMUNDA

Deploy From Modeler

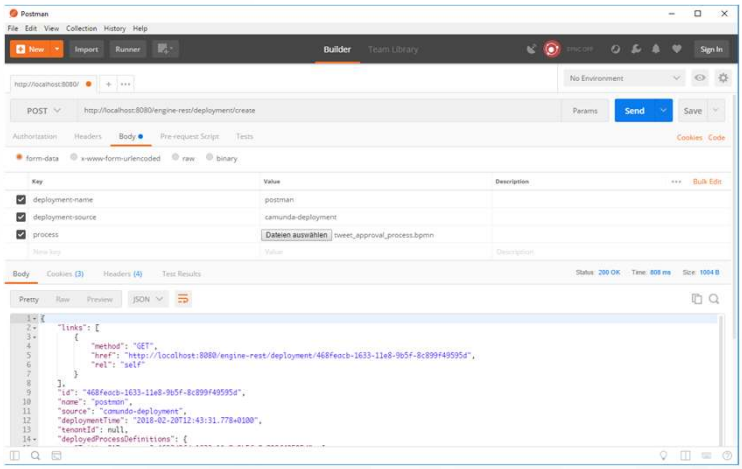


CAMUNDA

Deploy the Process



By enterprise cockpit




```
curl -X POST \
  http://localhost:8080/engine-rest/deployment/create \
  -F deployment-name=camunda-deployment \
  -F deployment-source=curl \
  -F 'process=@C:\Users\Ingo Richtsmeier\Documents\ca054\tweet_approval_process.bpmn'
```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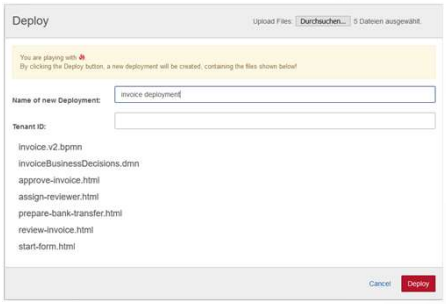
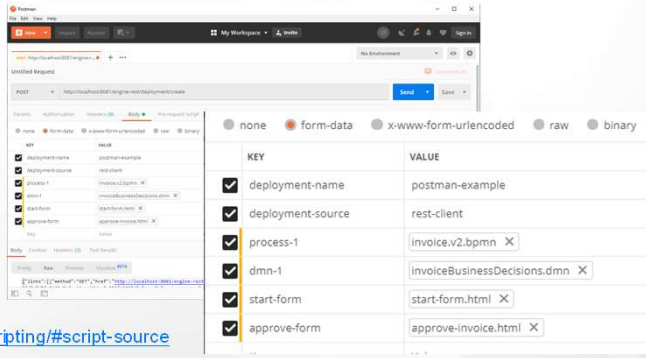
Include Additional Resources

- Include: forms, subprocesses, DMN diagrams, script files
- Reference resources in the BPMN diagram with `deployment://`





https://docs.camunda.org/manual/latest/user-guide/process-engine/scripting/#script-source

https://docs.camunda.org/manual/latest/reference/bpmn20/custom-extensions/extension-attributes/#resource

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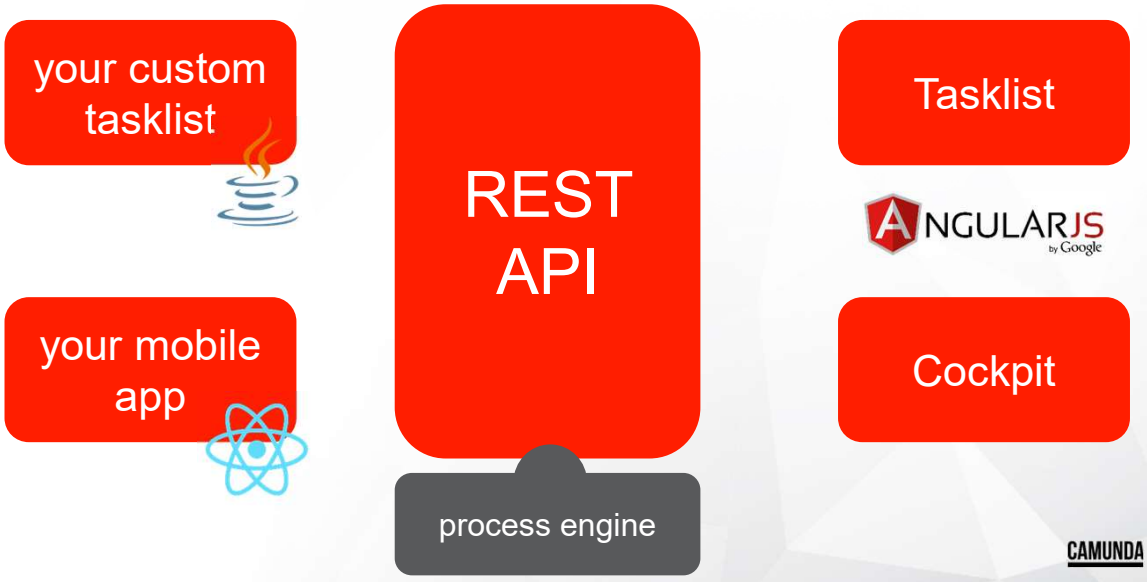
CAMUNDA

Camunda REST API



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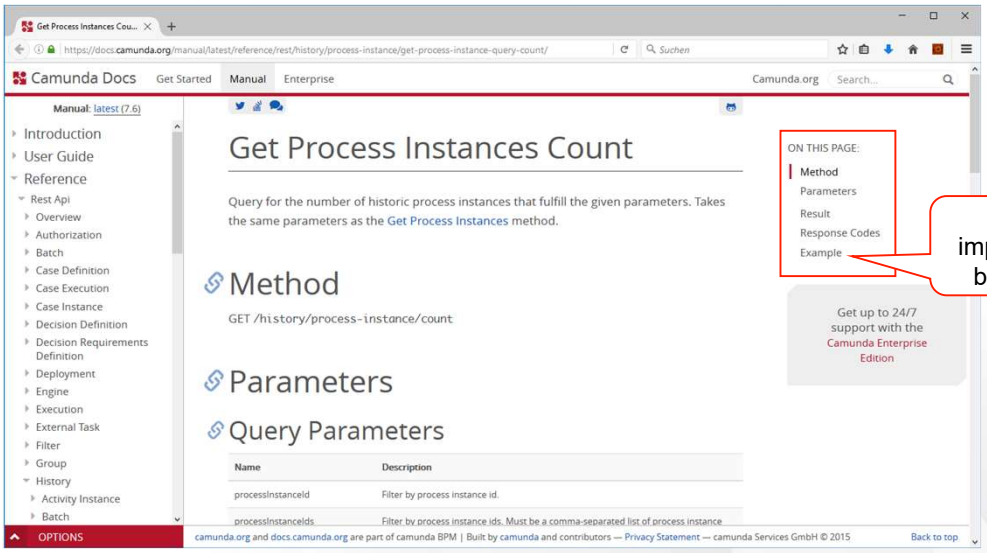
Documentation of REST API



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CAMUNDA

Start Process Instances

Use any REST client

Base URL: `http://localhost:8080/engine-rest`

`POST /process-definition/key/{key}/start`

Payload: `{"variables": {"creditSufficient": {"value":"true"}}}`

https://docs.camunda.org/manual/latest/reference/rest/process-definition/post-start-process-instance/

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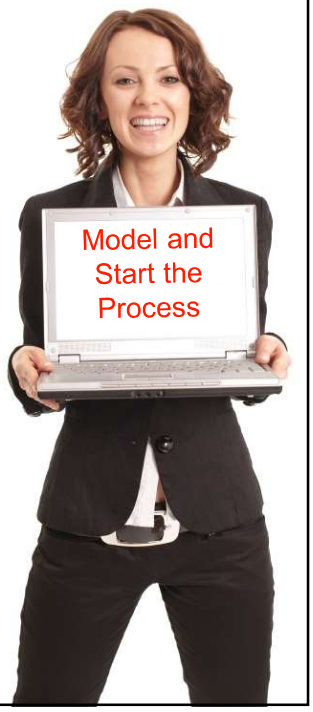
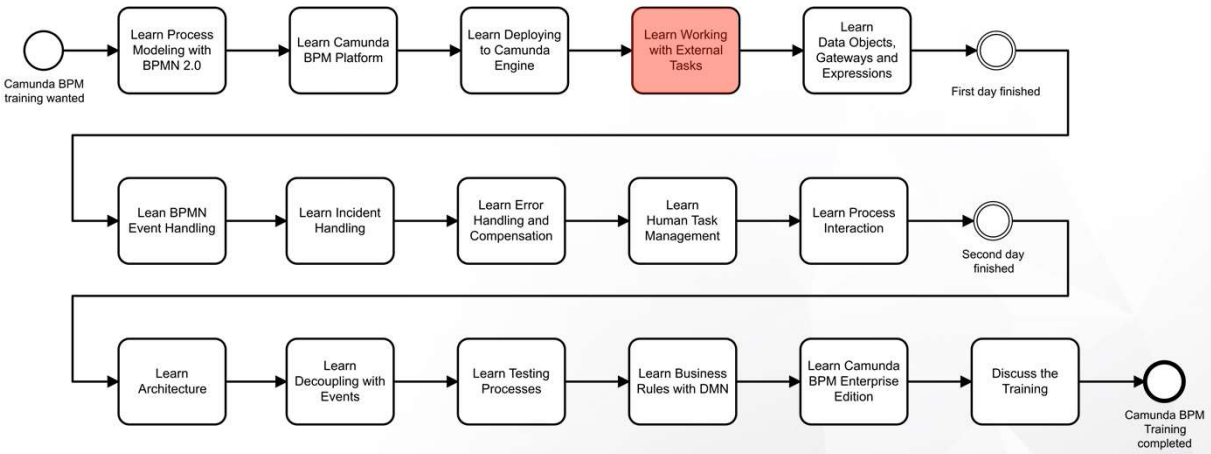
Exercise 2



https://training.camunda.com/microservices
user: microservices
password: camundarocks



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Process Versioning

Process Definitions

ID_	KEY_	VERSION_	...
invoice:1:12ce6c9a-5b09-11e6-bfac-185e0f710ea8	invoice	1	
invoice:2:131a1ba0-5b09-11e6-bfac-185e0f710ea8	invoice	2	

Process Instances

ID_	PROC_DEF_ID_	ACT_ID_	...
1378dcae-5b09-11e6-bfac-185e0f710ea8	invoice:1:12ce6c9a-5b09-11e6-bfac-185e0f710ea8	reviewInvoice	
14b81440-5b09-11e6-bfac-185e0f710ea8	invoice:2:131a1ba0-5b09-11e6-bfac-185e0f710ea8	approveInvoice	

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Start New Process Instances

Default Behavior:

1. New version upon each changed BPMN XML deployment
2. New process instances start with the latest version
3. Running process instances continue using the version they started with

```
POST /process-definition/key/VacationRequestProcess/start {}
```

If needed, process instance migration is possible

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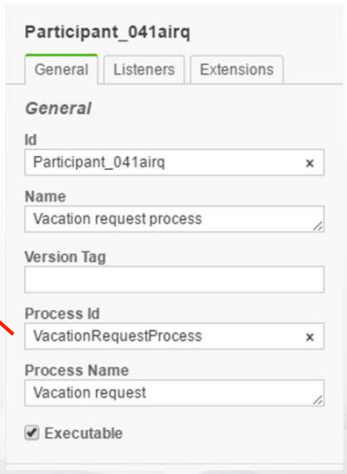
Key vs. ID vs. Name

```
POST /process-definition/key/VacationRequestProcess/start
```

- ProcessDefinitionKey: BPMN Process ID
- ProcessDefinitionName: BPMN Process Name
- ProcessDefinitionId: Generated Unique ID




```
<bpmn2:process id="VacationRequestProcess"
    name="Vacation request"
    isExecutable="true">
```

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Process Variables

Are persisted with the process instance

Client Code:

```
POST /process-definition/key/aProcessDefinitionKey/start

{variables:
          {"aVariableName": {"value": "a variable value", "type": "String"},
           "bVariableName": {"value", true, "type": "Boolean"}
          }
}
```

More details later

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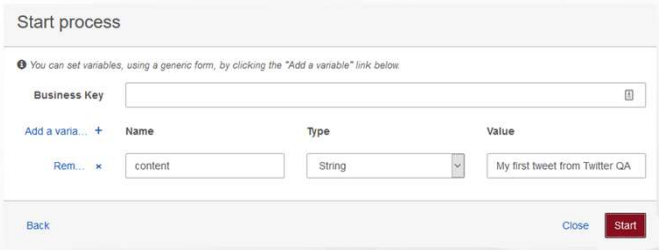
Business Key

- Domain specific identifier of a process instance
- Optional
- Set at the start
- Set or change in an Execution Listener
- Displayed prominently in Cockpit and Tasklist
- Query for process instances

Candidates for the Business Key in the Payment

```
POST /process-definition/key/aProcessDefinitionKey/start

{"businessKey": "my business key"}
```



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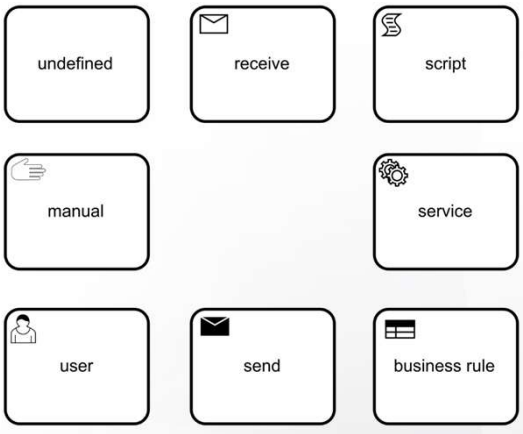
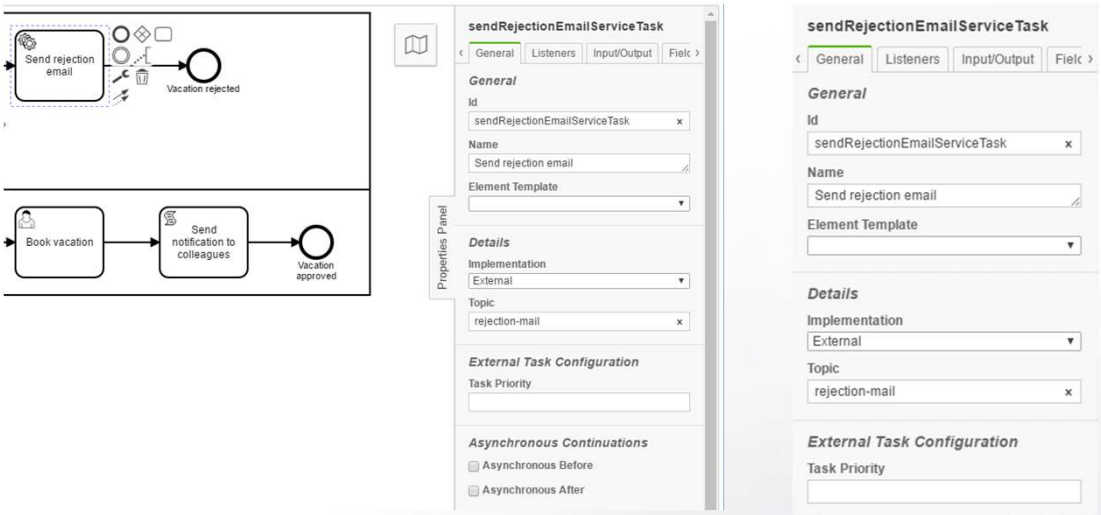
BPMN 2.0 Task Types



CAMUNDA

Service Task With External Worker



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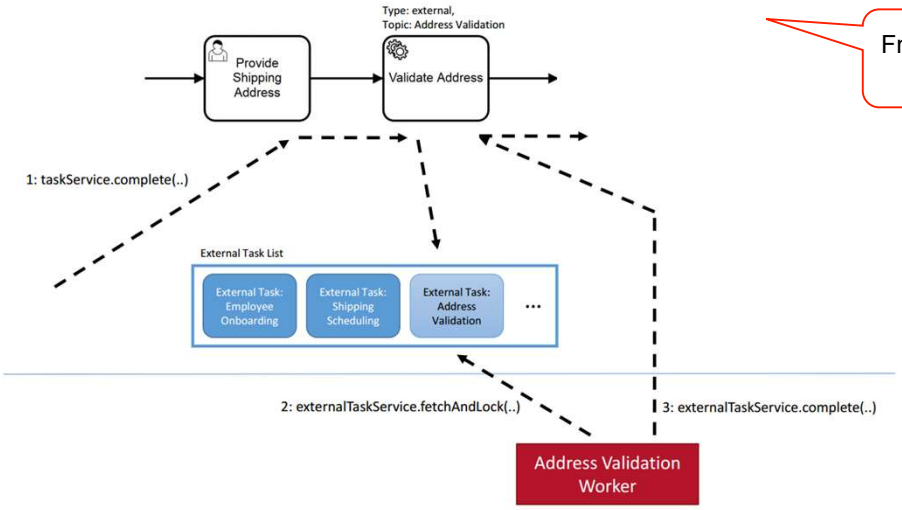
External Service Task: Don't Call Us! We Call You!



From the service point of view

https://docs.camunda.org/manual/latest/user-guide/process-engine/external-tasks/

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Naming Convention for Topics

- Name it from the workers point of view:
  - tweet-rejection
  - tweet publication
  - rejection-publication
  - rejection-mailing
  - ...
- What can I do as a worker?

CAMUNDA

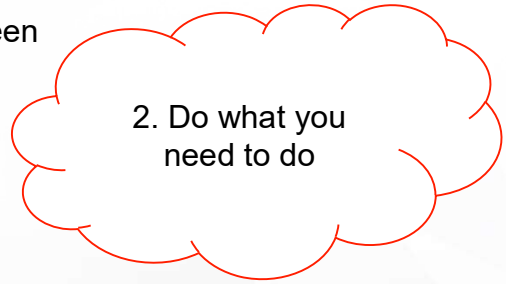
Exercise 3

https://training.camunda.com/microservices
user: microservices
password: camundarocks

Worker

Two rest calls and some code inbetween

```
1. POST /external-task/fetchAndLock
{ "workerId":"mailer",
  "maxTasks":2,
  "topics":
      [{"topicName": "rejection-mail",
      "lockDuration": 60000}]
}
Reponse:
{ …
  "id": "anExternalTaskId",
  … }
```




```
3. POST /external-task/anExternalTaskId/complete
{
  "workerId": "mailer"
}
```

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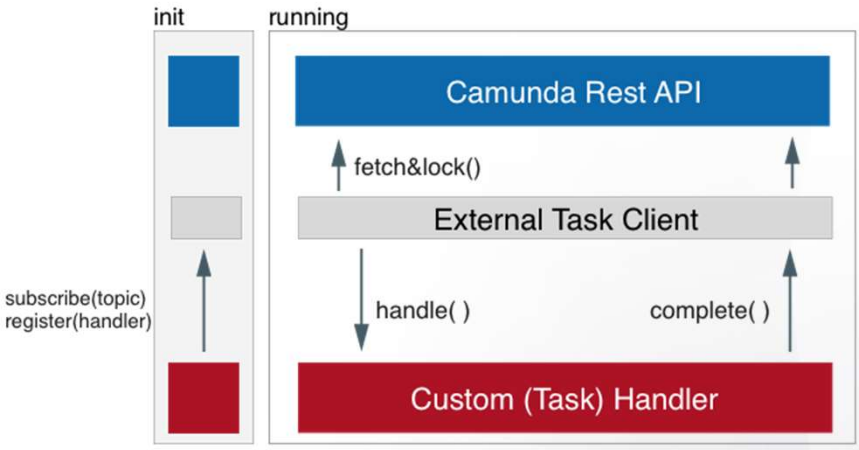
External Task Client



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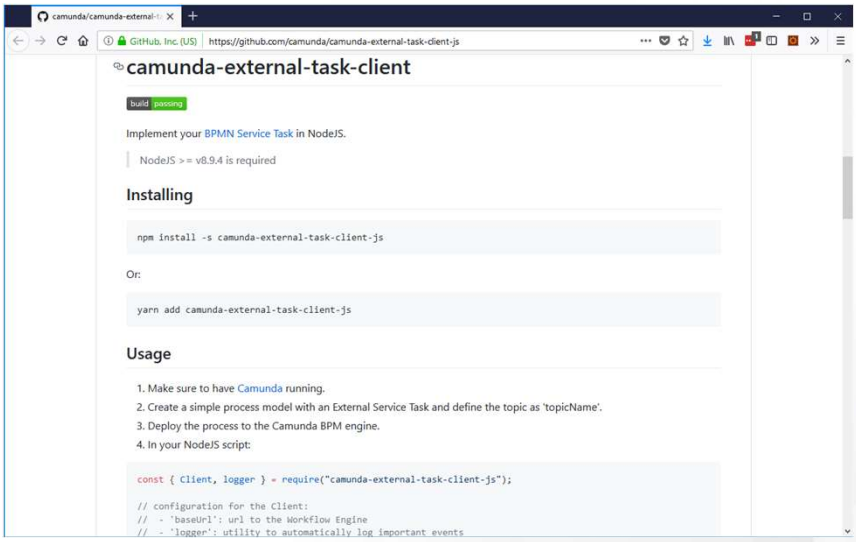
External Task Client in JavaScript



https://github.com/camunda/camunda-external-task-client-js

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Run External Task Client in JavaScript

- Install: `npm install -s camunda-external-task-client-js`
- Code:

```
const { Client, logger } = require("camunda-external-task-client-js");

// configuration for the Client:
//  - 'baseUrl': url to the Workflow Engine
//  - 'logger': utility to automatically log important events
const config = { baseUrl: "http://localhost:8080/engine-rest",
    use: logger,
    maxTasks: 1};

// create a Client instance with custom configuration
const client = new Client(config);

// susbscribe to the topic: 'creditScoreChecker'
client.subscribe("credit-charge", async function({ task, taskService }) {
  console.log("checking credit score");
  // complete the task
  await taskService.complete(task);
});
```

Run: `node my-client.js`

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CAMUNDA

Camunda Client in C#

Install:

```
dotnet new console -o myExternalTaskClient
cd myExternalTaskClient
dotnet add package BerndRuecker.Sample.CamundaClient --version 0.1.1
dotnet add package Newtonsoft.Json --version 12.0.0.0
```

Code Program.cs:

```
using System;
using CamundaClient;

namespace myExternalTaskClient
{
    class Program
    {
        static void Main(string[] args)
        {
            CamundaEngineClient camunda = new CamundaEngineClient();
            camunda.Startup(); // Deploys all models and Start all found ExternalTask-Workers
            Console.ReadLine(); // wait for ANY KEY
            camunda.Shutdown();
        }
    }
}
```


CAMUNDA

External Task Worker in C#

Code Worker.cs:

```
using System;
using System.Collections.Generic;
using CamundaClient.Dto;
using CamundaClient.Worker;

namespace myExternalTaskWorker
{
    [ExternalTaskTopic("credit-charge")]
    class ExampleWorker : IExternalTaskAdapter
    {

        public void Execute(ExternalTask externalTask, ref Dictionary<string, object> resultVariables)
        {
            Console.WriteLine($"checkin credit score");
        }
    }
}
```

Run: `dotnet run`

CAMUNDA

External Task Client in Python

Run: `pip install requests`

PythonWorker.py:

```
import requests
import json
import time

url = 'http://localhost:8080/engine-rest/external-task/fetchAndLock'

fetchAndLockPayload = {"workerId":"myExampleWorker",
  "maxTasks":1,
  "usePriority":"true",
  "topics":
      [{"topicName": "credit-charge",
      "lockDuration": 30000
      }]
}

...
```

https://github.com/camunda-consulting/code/blob/master/snippets/python-external-worker/PythonWorker.py

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External Task Client in Python

```
try:
    while True:

        # Fetch and Lock
        try:
            res = requests.post(url, json=fetchAndLockPayload)
            print('Fetch and lock status code: ', res.status_code)

            body = res.text
            print('Fetch and lock response: ', body)

        except:
            print('Engine is down')

        while body == '[]':
            time.sleep(5)
            res = requests.post(url, json=fetchAndLockPayload)
            body = res.text
            print ('Fetch and lock response: ', body)

            if body !='[]':
                break

        # Put your Business Logic here
        print('Deduct existing credit')

...
```

```
            #Prepare url with task id and the response body
            response = json.loads(body)
            taskId = response[0]['id']
            taskId = str(taskId)

            complete_url = ('http://localhost:8080/'
            'engine-rest/external-task/'
            + taskId + '/complete')

            response = {
              "workerId": "myExampleWorker",
            }

            # API call (Complete)
            try:
                complete = requests.post(complete_url, json=response)
                print('complete status code: ', complete.status_code)

            except:
                print('failed')

    except KeyboardInterrupt:
        pass
```

Run: `python PythonWorker.py`

https://github.com/camunda-consulting/code/blob/master/snippets/python-external-worker/PythonWorker.py

CAMUNDA

Awesome Camunda External Task Clients

Here is a list with all the code Snippetes in different languages that helps you to create an external task client for Camunda.

Supported Code by Camunda

- JavaScript
- Java

Unsupported

- JavaScript
- .Net
- Spring Boot
- Python
- Ruby and a lot of more! amazing

It is just a beginning! If you already have something, create a pull request with a link to your code.

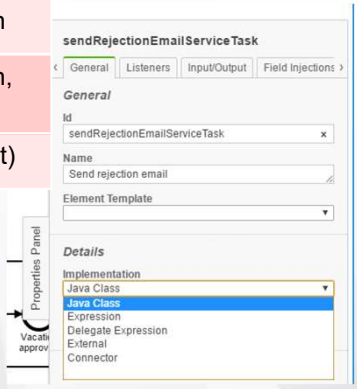
85 https://github.com/camunda/awesome-camunda-external-clients

CAMUNDA

Other Options for Service Tasks

Implementation	Description
Java Class	Implement the service in Java
Expression	Resolve the implementation from an expression
Delegate Expression	Resolve the implementation from an expression, that implements `JavaDelegate`
Connector	Configure the call to a web service (soap or rest)

More details come later



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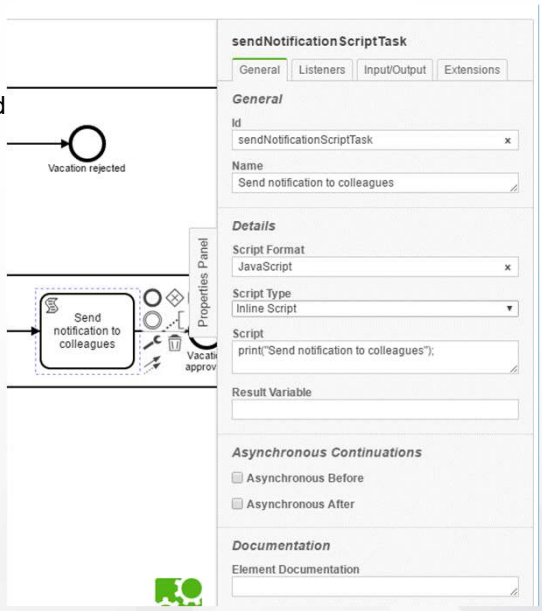
Script Task

- Every JSR-223 compliant scripting engine can be used
- Script sources can be externalized
- Scripts get compiled and cached
- Available variables in all script languages:
  - all process variables
  - `execution`
  - `task`



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Script Task Examples

```
<bpmn:scriptTask id="sendNotificationScriptTask" name="Send notification to colleagues"
scriptFormat="JavaScript">
  <bpmn:script><![CDATA[var message = requester + " will be on holiday from ";
message = message + from + " until " + until;
execution.setVariable("message", message);]]></bpmn:script>
</bpmn:scriptTask>
```

Process variables

Special key word

```
<bpmn:scriptTask id="checkUniqueRSPIDScriptTask" name="Check unique RSP ID"
scriptFormat="JavaScript" camunda:resultVariable="resultCheckUniqueRspID"
camunda:resource="deployment://check_unique_rsp_id.js">
</bpmn:scriptTask>
```

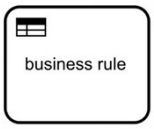
Load script from deployment

Store script result

CAMUNDA

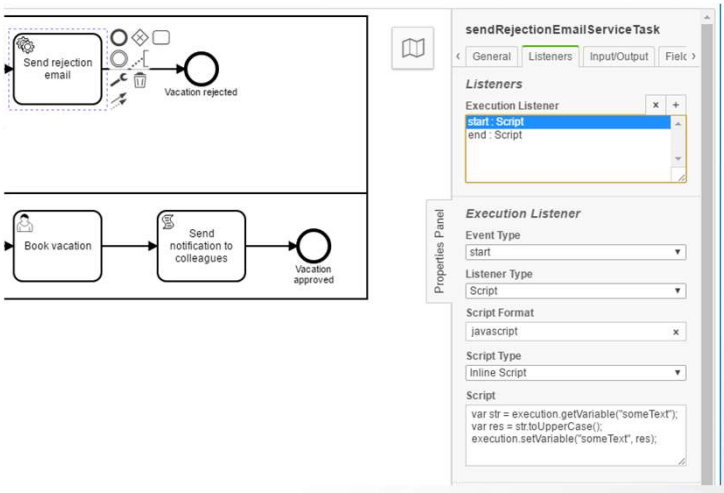
Business Rule Task

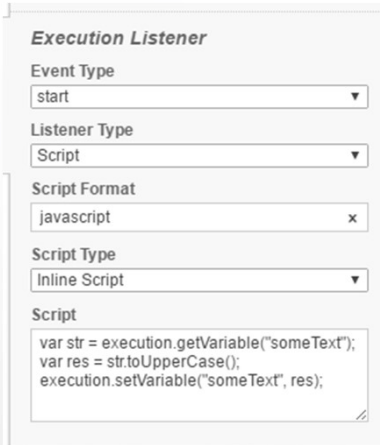
- Behaves like a Service Task
- Link to a DMN Decision Table
- More Details later



CAMUNDA

Execution Listeners





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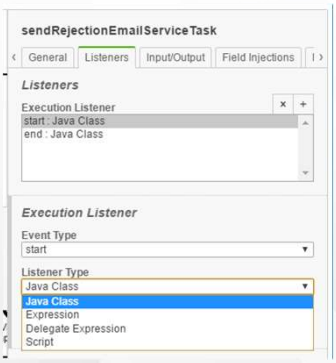
Events for Execution Listeners

Level	Event
On process level	Start, end
On activity level	Start, end
On sequence flow	take

Listener Type
Script
Expression
Delegate Expression
Java Class



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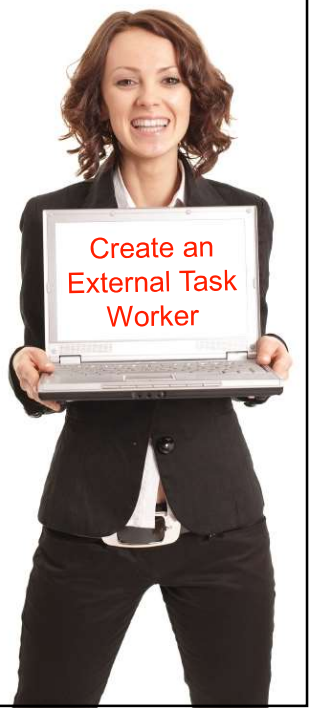
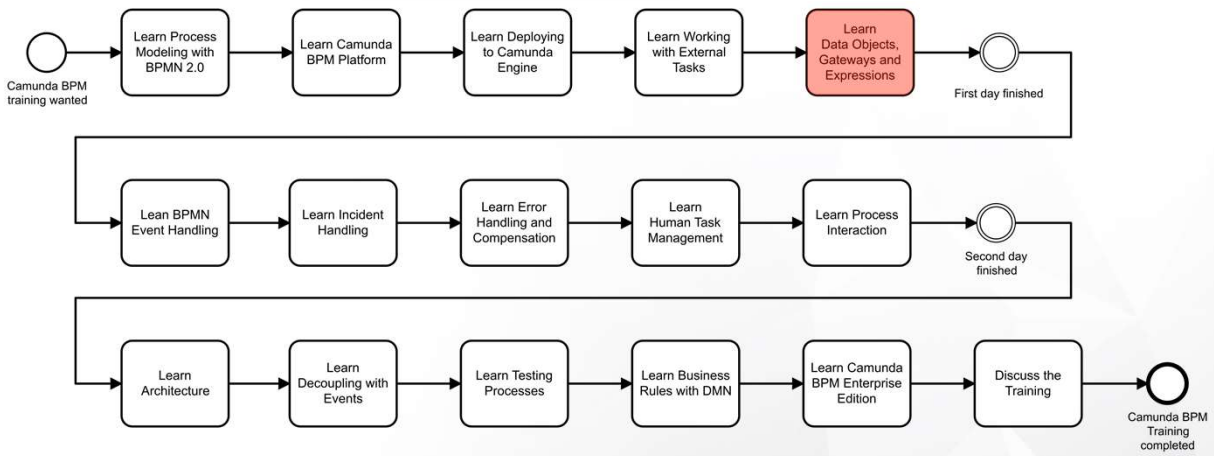
CAMUNDA

Exercise 4



https://training.camunda.com/microservices
user: microservices
password: camundarocks



CAMUNDA

Set Process Variables

- When starting a process instance:

POST `/process-definition/key/aProcessDefinitionKey/start`

```
{
  "variables": {
    "aVariable" : {
        "value" : "aStringValue",
        "type": "String"
    },
    "anotherVariable" : {
      "value" : true,
      "type": "Boolean"
    }
  }
}
```

- On running process instances:

PUT `/process-instance/aProcessInstanceId/variables/aVarName`

```
{"value" : "someValue", "type": "String"}
```


CAMUNDA

Accessing Process Variables

Retrieve variables with `external-task/fetchAndLock`

```
{
  "workerId":"emailer",
  "maxTasks":2,
  "usePriority":true,
  "topics":
      [{"topicName": "rejection-mail",
      "lockDuration": 10000,
      "variables": ["employee"]
      }]
}
```

request

```
[{
  …
  "id": "anExternalTaskId",
  …
  "variables": {
    "employee": {
      "type": "String",
      "value": "Jim",
      "valueInfo": {}
    }
  }
}]
```

response

Set variables with `external-task/anExternalTaskId/complete`

```
{
  "workerId": "emailer",
  "variables":
      {"mailText": {"value": "aStringValue"},
       "sendAt": {"value": 2018-02-20T15:42:36}}
}
```

or at process instance start

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Process Variables

- Are not modeled in BPMN 2.0
- Behave like a Map

vacation request

- Are persisted with the process instance
- Recommended: Primitive types, Date & String
- Objects can be serialized as XML or JSON
- Default fallback: Serializable Java Objects (not recommended!)
- Serialization can be exchanged: https://docs.camunda.org/manual/latest/user-guide/data-formats/data-formats-in-processes/#extending-serialization

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Access Variables in External Task Client

- In the handler (Node.js):

```
client.subscribe("credit-charge", async function({ task, taskService }) {
  const amount = task.variables.get("amount");
  const resultVars = new Variables();

  resultVars.set("creditSufficient", false);
  await taskService.complete(task, resultVars);
}
```


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Object Variables

Examples from the external task client for Java Script

Saving values:

```
variables.set("fullName", { first: "John", last: "Doe" });

variables.setTyped("test", {
  value: "<test id=2 />",
  type: "XML",
  valueInfo: {}
});
```

Serialize explicitly (except JSON)

Reading values:

```
variables.get("fullName");    Output: { first: "John", last: "Doe" }

variables.get("test");        Output: <test id=2 />
```

Deserialize transparently

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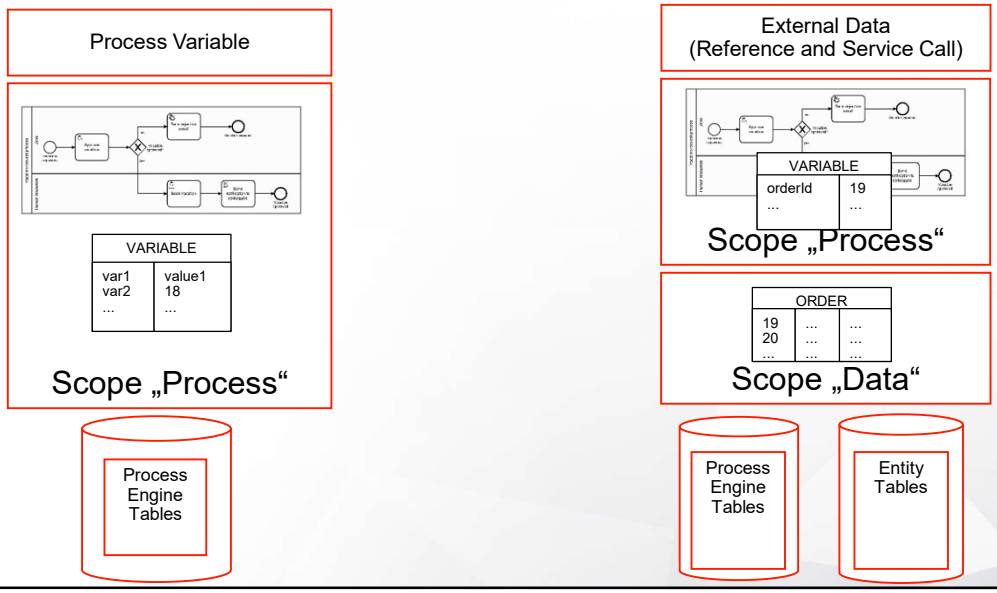
Storage



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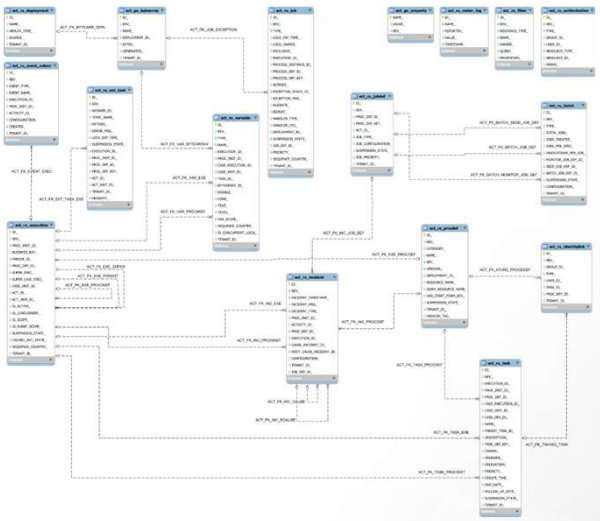
Database Schema



https://docs.camunda.org/manual/latest/user-guide/process-engine/database/#database-schema

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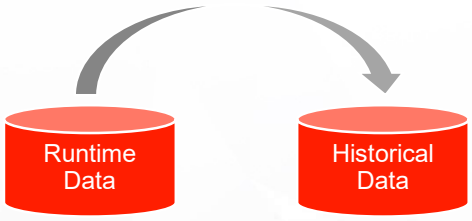
History Configuration

finished process instance are removed from runtime tables



Configuration options:

- None: no history at all
- Activity: process instances and trail of executed BPMN activities
- Audit: + last value of every process variable
  + submitted form properties (works only with forms)
- Full: + variable updates
- Custom: e.g. own filter for events of particular elements or variables

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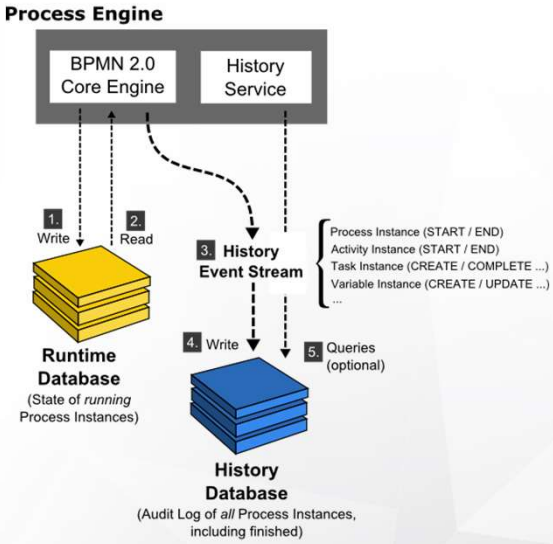
Asynchronous History



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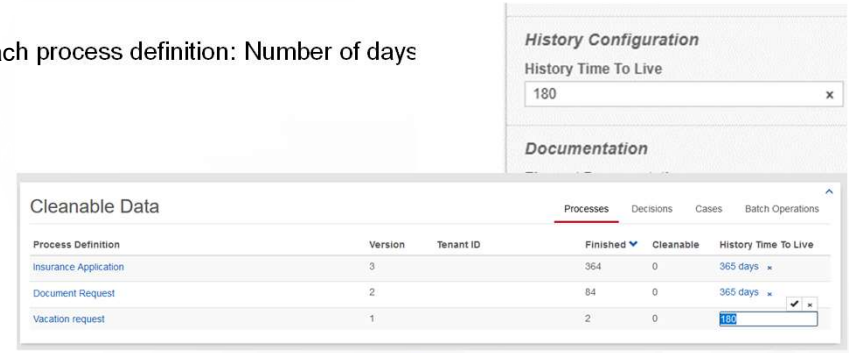
History Cleanup

- `historyTimeToLive` for each process definition: Number of days
- defined by business needs
- either in the process model
- or by API-Call
- or in the Cockpit



- run periodically, configure by weekdays
- run manually

Cleanup View Enterprise Feature

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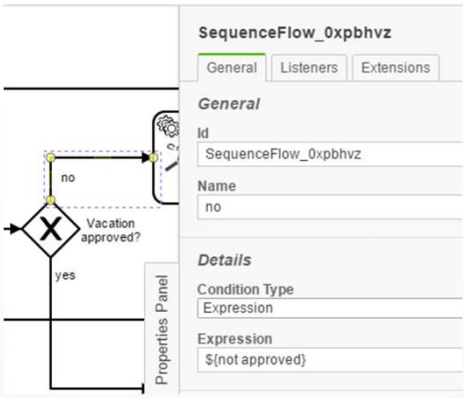
Expressions

- Work on data objects
- May work on Spring/CDI beans
- Used in:
  - Java service tasks
  - Event listeners
  - Conditional sequence flows
- Can use attributes or methods




```
${myVar}
${myBean.myProperty}

${printer.print()}
${myBean.addNewOrder('orderName')}
${myBean.doSomething(myVar, execution)}
```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Unified Expression Language (UEL)

EL Expression	Result
${1 > (4/2)}	false
${4.0 >= 3}	true
${100.0 == 100}	true
${(10*10) ne 100}	false
${'a' < 'b'}	true
${'hip' gt 'hit'}	false
${4 > 3}	true
${1.2E4 + 1.4}	12001.4
${3 div 4}	0.75
${10 mod 4}	2
${!empty param.Add}	False if the request parameter named Add is null or an empty string.
${pageContext.request.contextPath}	The context path.
${sessionScope.cart.numberOfItems}	The value of the numberOfItems property of the session-scoped attribute named cart.

EL Expression	Result
${param['mycom.productId']}	The value of the request parameter named mycom.productId.
${header["host"]}	The host.
${departments[deptName]}	The value of the entry named deptName in the departments map.
${requestScope['javax.servlet.forward.servlet_path']}	The value of the request-scoped attribute named javax.servlet.forward.servlet_path.
#{customer.lName}	Gets the value of the property lName from the customer bean during an initial request. Sets the value of lName during a postback.
#{customer.calcTotal}	The return value of the method calcTotal of the customer bean.

from
http://java.sun.com/javaee/5/docs/tutorial/doc/bnahq.html#bnain

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Predefined Expressions

```
${currentUser()}
${currentUserGroups()}
```

from `org.camunda.bpm.engine.impl.el.CommandContextFunctionMapper`

```
${now()} -> java.util.Date
${dateTime()} -> org.joda.DateTime
```

from `org.camunda.bpm.engine.impl.el.DateTimeFunctionMapper`

https://docs.camunda.org/manual/latest/user-guide/process-engine/expression-language/#internal-context-functions

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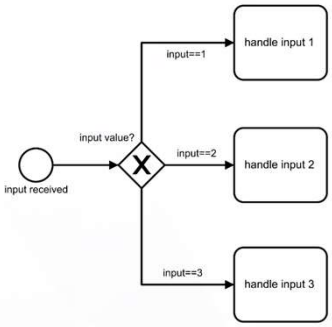
Exclusive Gateway (Decision)




```
<bpmn:exclusiveGateway id="exclusiveGateway" name="input value?">
</bpmn:exclusiveGateway>
<bpmn:sequenceFlow id="flow3" name="input==2" sourceRef="exclusiveGateway" targetRef="handleInput2Task">
  <bpmn:conditionExpression xsi:type="bpmn:tFormalExpression">${input==2}</bpmn:conditionExpression>
</bpmn:sequenceFlow>

<bpmn:sequenceFlow id="flow2" name="input==1" sourceRef="exclusiveGateway" targetRef="handleInput1Task">
  <bpmn:conditionExpression xsi:type="bpmn:tFormalExpression">${input==1}</bpmn:conditionExpression>
</bpmn:sequenceFlow>

<bpmn:sequenceFlow id="flow4" name="input==3" sourceRef="exclusiveGateway" targetRef="handleInput3Task">
  <bpmn:conditionExpression xsi:type="bpmn:tFormalExpression">${input==3}</bpmn:conditionExpression>
</bpmn:sequenceFlow>
```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Camunda Spin Project Example

```
{
  "name" : "jonny",
  "address" : {
    "street" : "12 High Street",
    "post code" : 1234
  }
}
```

Imagine a response from a web service call

Maybe a condition on a sequence flow

Access in an expression:

```
${JSON(customer).prop("address").prop("post code").numberValue() == 1234}
```

Access JSON variable value in an expression:

```
${customer.jsonPath("$.adress.post code").numberValue() == 1234}
```


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Camunda Spin Project

Motivation

- Handle serialized formats such as JSON or XML while interacting with external systems.
- Process such data like parsing, manipulating or mapping from/to Java objects.

Features

- Provide data format functionality
- Plugged into the engine
- Wrapper for processing data formats like XML and JSON
- Integrated with the engine's data handling functionality
- Designed to be extensible

https://docs.camunda.org/manual/latest/user-guide/data-formats/

https://docs.camunda.org/manual/latest/reference/spin/

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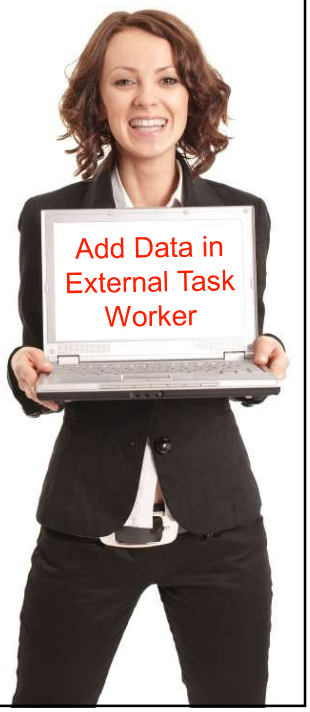
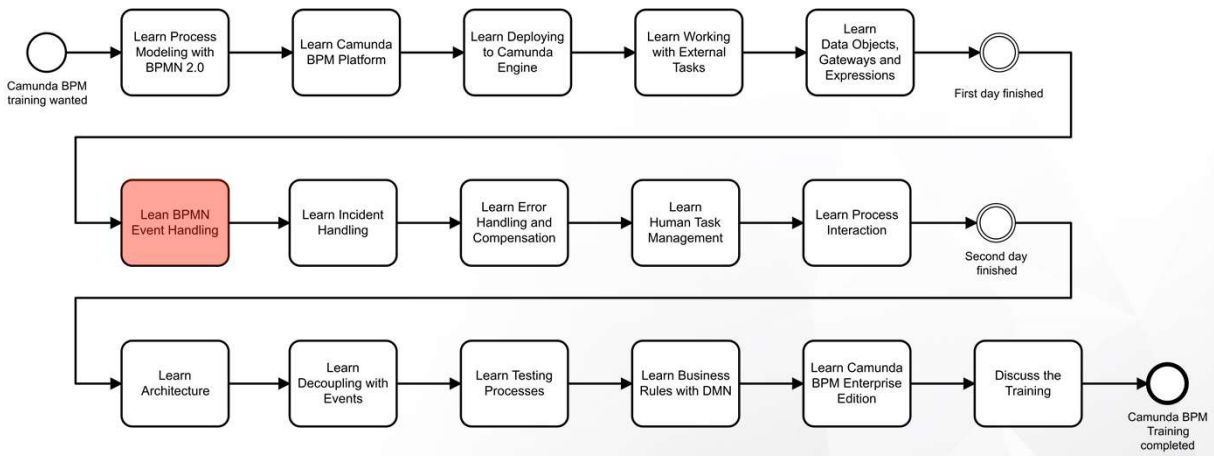
Exercise 5



https://training.camunda.com/microservices
user: microservices
password: camundarocks



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Event Coverage

Type	Start			Intermediate				End
	Normal	Event Subprocess	Event Subprocess non-interrupt	catch	boundary	boundary non-interrupt	throw	
None	○						◎	○
Message	✉	✉	✉	✉	✉	✉	✉	✉
Timer	◷	◷	◷	◷	◷	◷		
Conditional	▤	▤	▤	▤	▤	▤		
Link				⇨			⇨	
Signal	△	△	△	△	△	△	▲	▲
Error		↯			↯			↯
Escalation		⋀	⋀		⋀	⋀	⋀	⋀
Termination								●
Compensation		◀◀			◀◀		◀◀	◀◀
Cancel					⊗			⊗
Multiple	⬠	⬠	⬠	⬠	⬠	⬠	⬟	⬟
Multiple Parallel	✚	✚	✚	✚	✚	✚		

See: docs.camunda.org/manual/latest/reference/bpmn20/#events

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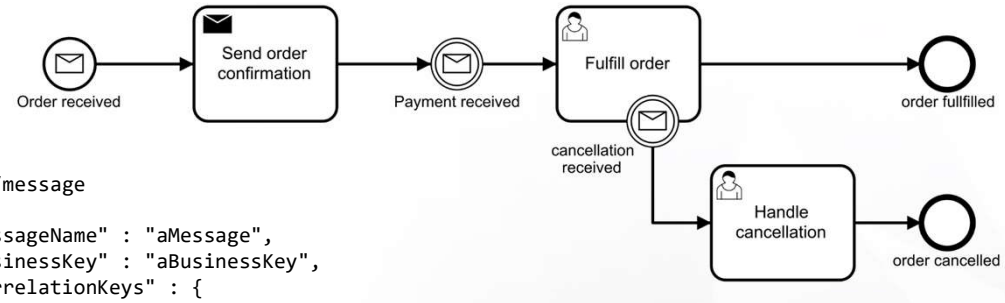
Message Events




```
POST /message
{
  "messageName" : "aMessage",
  "businessKey" : "aBusinessKey",
  "correlationKeys" : {
    "aVariable" : {"value" : "aValue", "type": "String"}
  },
  "processVariables" : {
    "aVariable" : {"value" : "aNewValue", "type": "String",
                   "valueInfo" : { "transient" : true } },
    "anotherVariable" : {"value" : true, "type": "Boolean"}
  }
}
```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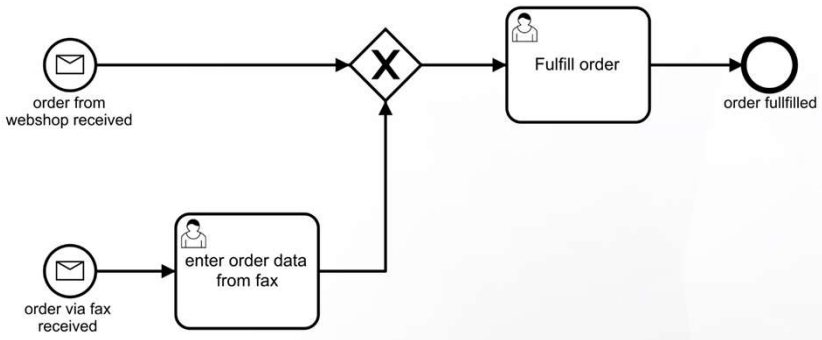
Demo

Multiple Message Start Events Possible



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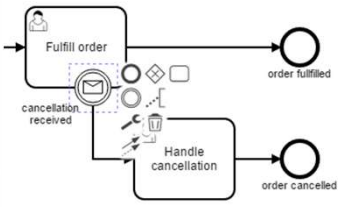
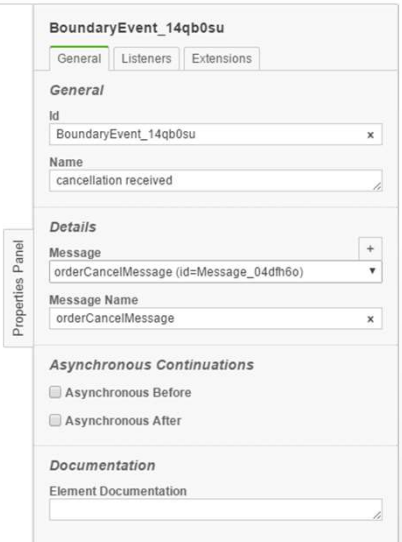
Configuring Message Names






```
<bpmn:process id="OrderHandlingProcess" isExecutable="true">
    ...
    <bpmn:boundaryEvent id="BoundaryEvent_14qb0su"
name="cancellation received" attachedToRef="fulFillOrderUserTask">
      <bpmn:messageEventDefinition messageRef="Message_04dfh6o" />
    </bpmn:boundaryEvent>
    <bpmn:userTask id="fulFillOrderUserTask" name="Fulfill order">
    </bpmn:userTask>
    ...
</bpmn:process>
<bpmn:message id="Message_04dfh6o" name="orderCancelMessage" />
```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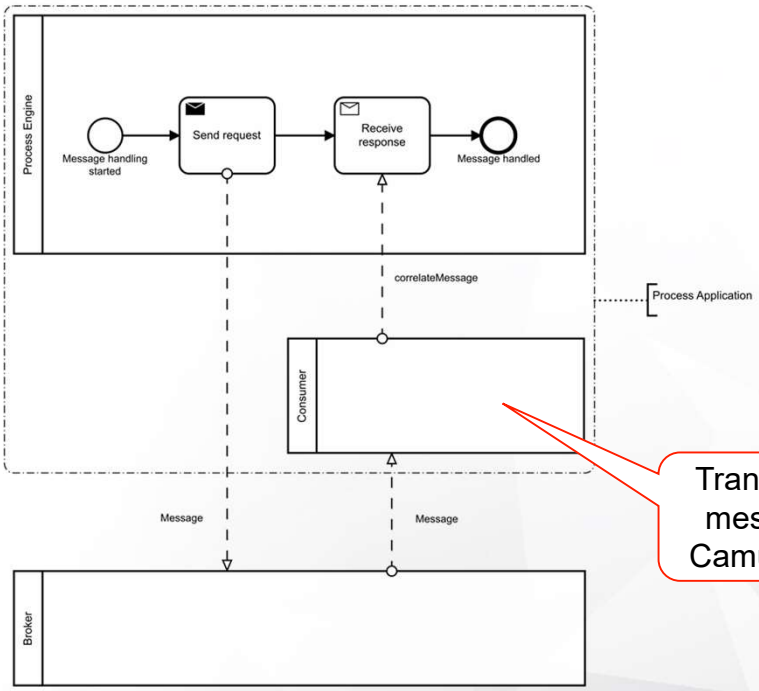
Messaging



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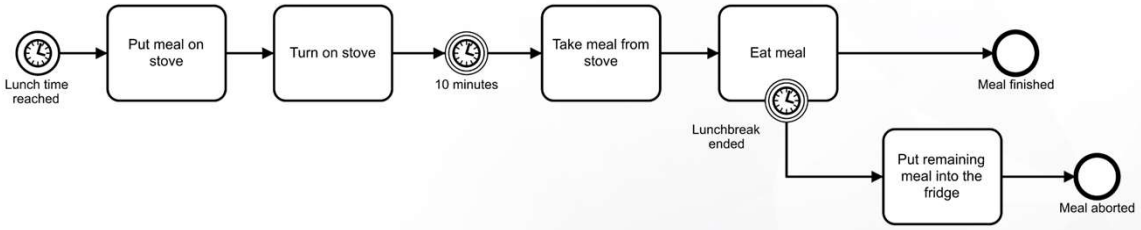
Exercise 6

https://training.camunda.com/microservices
user: microservices
password: camundarocks

Timer Events



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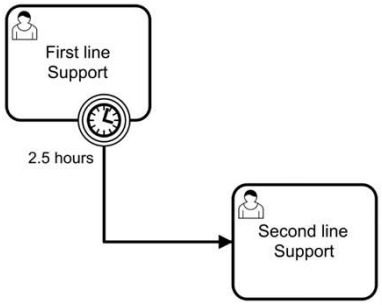
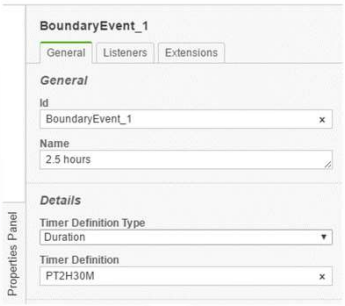
Timer Event Configuration






```
<bpmn:process id="Process_1" name="Timer Event Configuration Example" isExecutable="true">
  <bpmn:userTask id="firstLineSupportUserTask" name="First line Support" />
  <bpmn:boundaryEvent id="BoundaryEvent_1" name="2.5 hours" attachedToRef="firstLineSupportUserTask">
    <bpmn:timerEventDefinition>
      <bpmn:timeDuration xsi:type="bpmn:tFormalExpression">PT2H30M</bpmn:timeDuration>
    </bpmn:timerEventDefinition>
  </bpmn:boundaryEvent>
  <!--  -->
</bpmn:process>
```

ISO8601: https://en.wikipedia.org/wiki/ISO_8601

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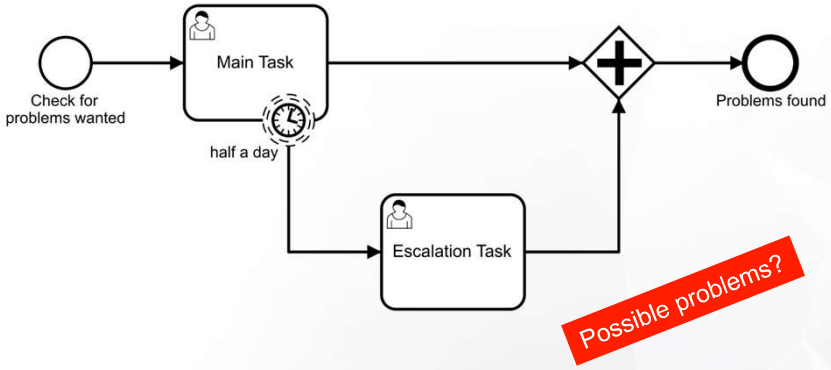
Non Interrupting Timer Event



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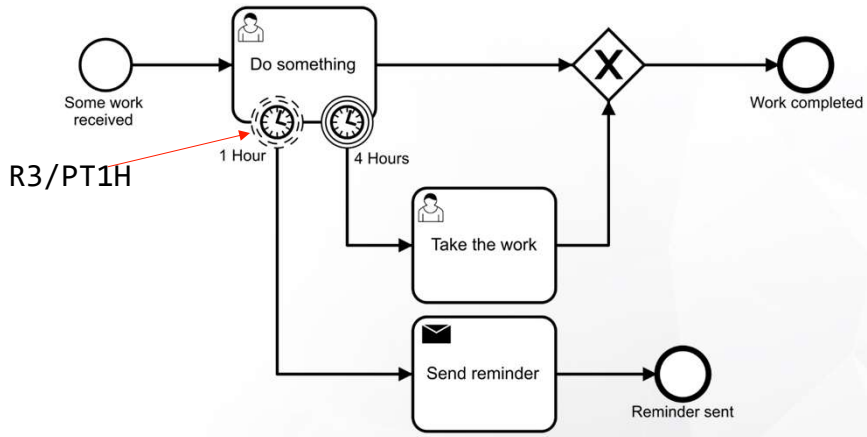
Pattern for Two Stage Escalation



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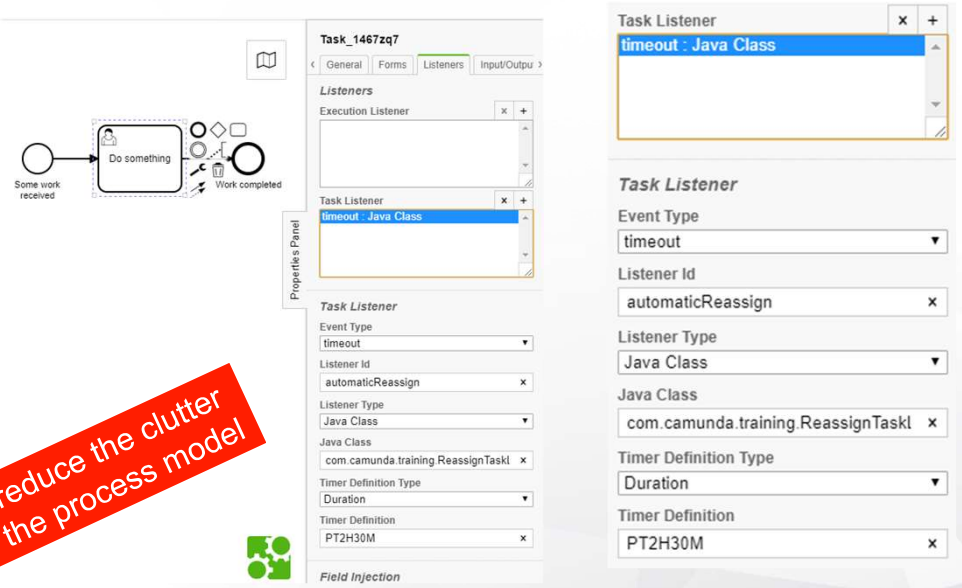
Time-triggered Events



To reduce the clutter in the process model

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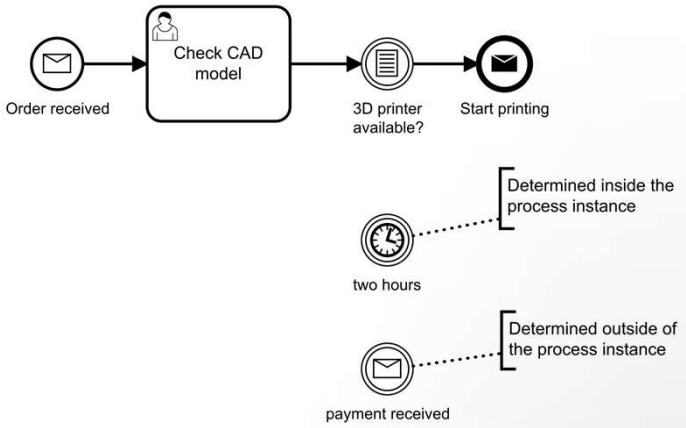
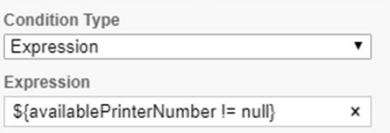
Conditional Events





Trigger evaluation:

- via API
- in a Java Delegate

  (e.g. on a parallel branch)

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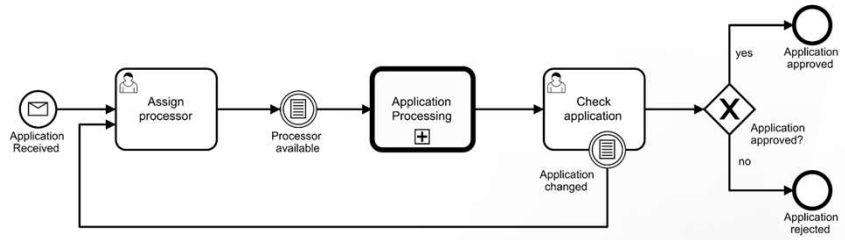
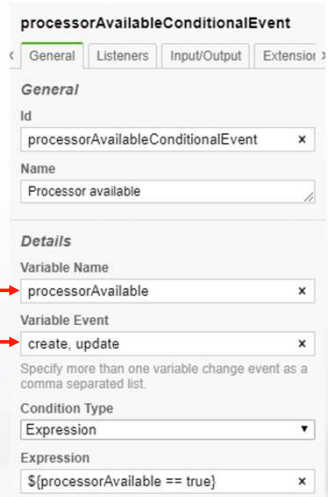
Conditional Events



Limit evaluation to process variable

Limit evaluation to events



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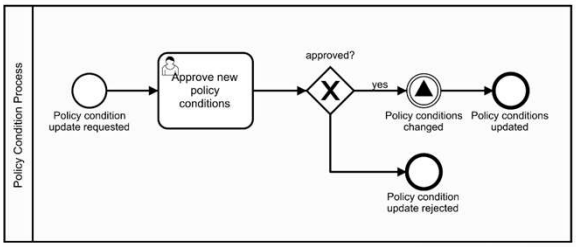
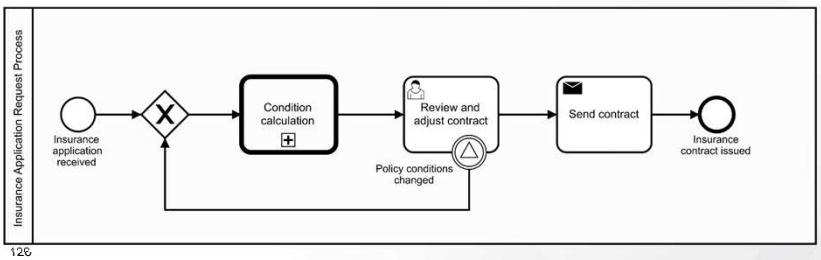
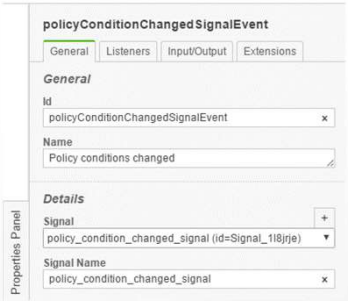
Signal Events – Broadcast to All Process Instances







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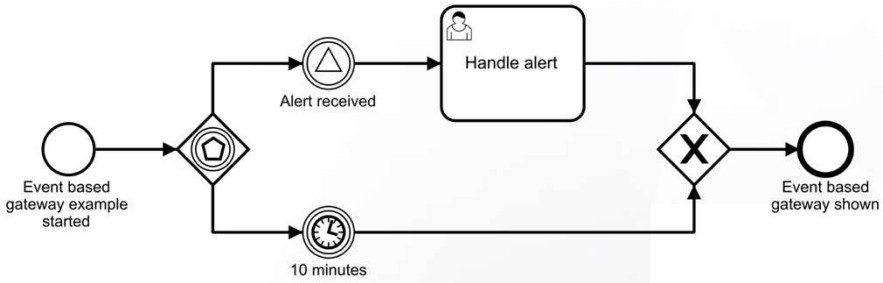
Event-Based Gateway – Simple Example



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Event-Based Gateway – Real World Example

Please model the following process:

If an insurant could be possibly subrogated against, I get information about that. I check that case and if the possibility is really there, I send a request for payment to the insurant and make me a reminder. If recourse is not possible, I close the case.

When we receive the money, I make a booking and close the case. If the insurant disagrees with the recourse, I'll have to check the reasoning of that. If he is right, I simply close the case. If he is wrong, I forward the case to a collection agency.

If the deadline for disagreement is reached and we haven't received any money, I forward the case to the collection agency as well.

Background information:

Insurants can be forced to pay back money they received from the insurance company for different reasons. This is called recourse. Here the clerk describes how this process works.

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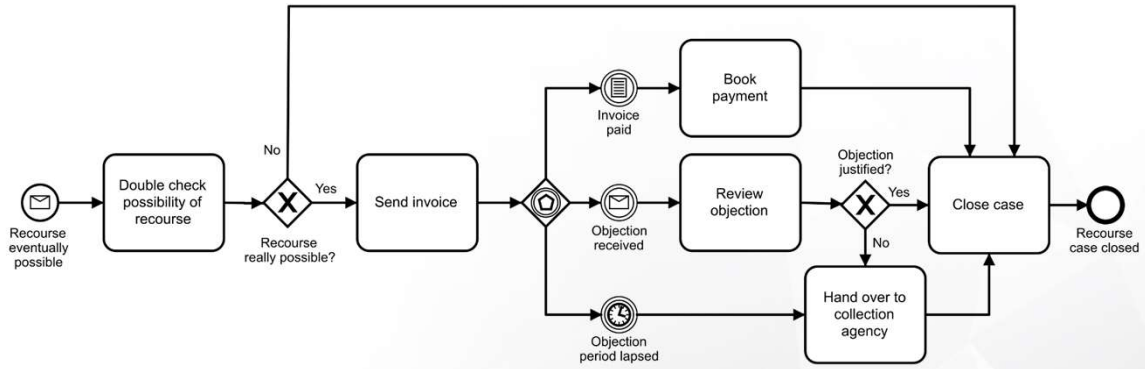
Event-Based Gateway – Real World Example



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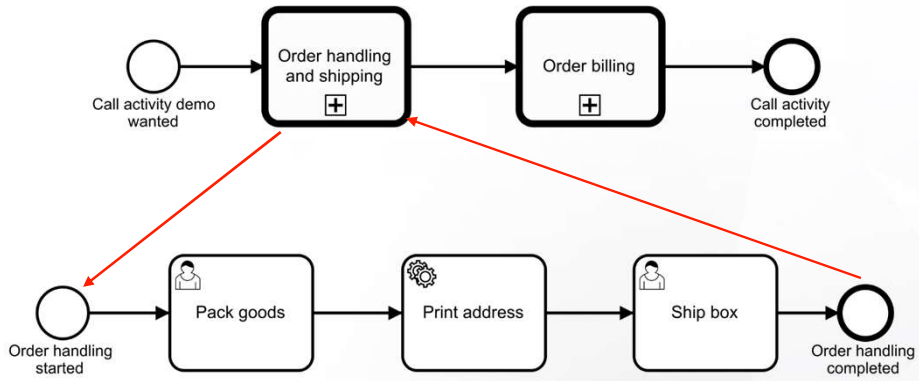
Reusable Sub-Processes: Call Activities



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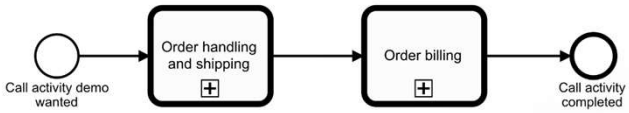
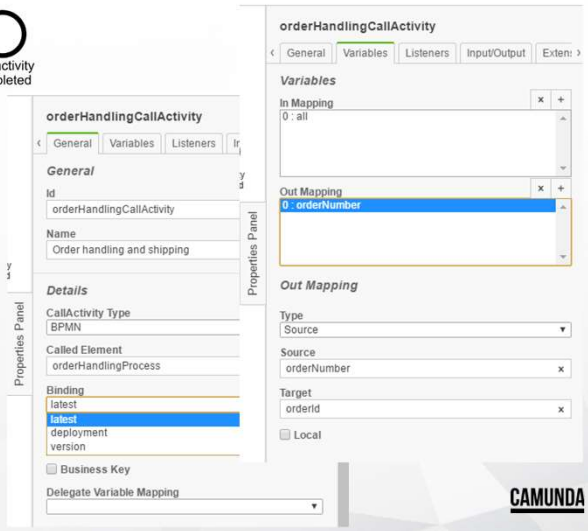
Reusable Sub-Processes: Call Activities



- Key is used to identify called process
- Process is resolved at runtime
- Variables can be mapped



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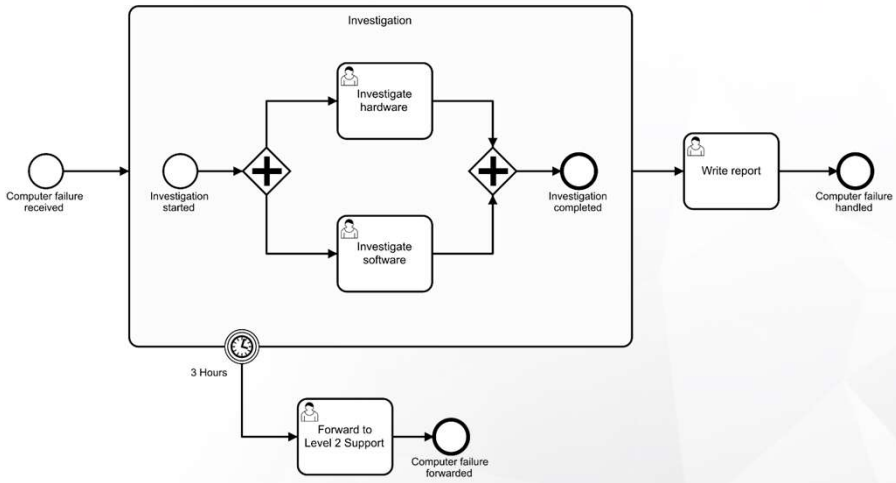
Embedded Sub-Processes



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The Sub-Process Is Part of the Main Process

```
<bpmn:process id="Process_1" isExecutable="false">
  <bpmn:startEvent id="StartEvent_1" name="Computer failure received"></bpmn:startEvent>
  <bpmn:sequenceFlow id="SequenceFlow_1ilu0mr" sourceRef="StartEvent_1"
targetRef="investigationSubprocess" />
  <bpmn:subProcess id="investigationSubprocess" name="Investigation">
    <bpmn:startEvent id="investigationStartedStartEvent" name="Investigation
started"></bpmn:startEvent>
    <bpmn:parallelGateway id="ParallelGateway_1"></bpmn:parallelGateway>
    <bpmn:userTask id="investigateHardwareUserTask" name="Investigate hardware"></bpmn:userTask>
    <bpmn:userTask id="investigateSoftwareUserTask" name="Investigate software"></bpmn:userTask>
    <bpmn:parallelGateway id="ParallelGateway_2"></bpmn:parallelGateway>
    <bpmn:endEvent id="investigationCompletedEndEvent" name="Investigation
completed"></bpmn:endEvent>
    <bpmn:sequenceFlow id="SequenceFlow_01s0ans" sourceRef="investigationStartedStartEvent"
targetRef="ParallelGateway_1" />
      ...
  </bpmn:subProcess>
  ...
```


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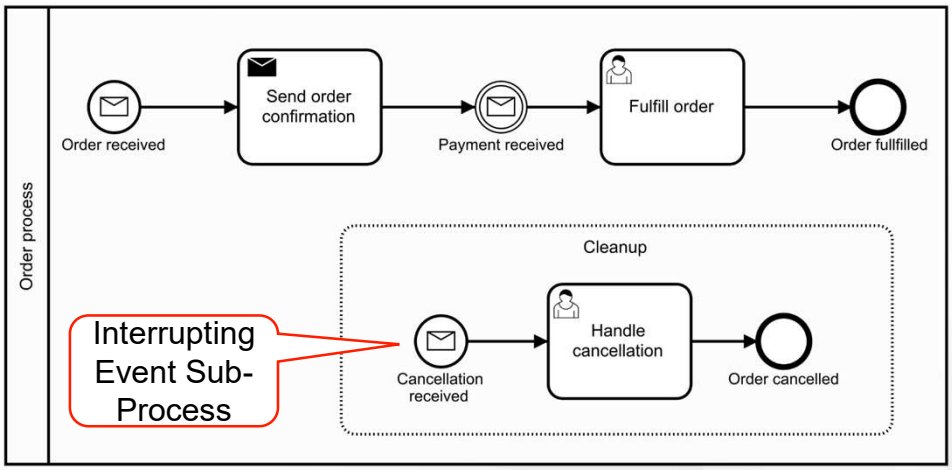
Event Sub-Process



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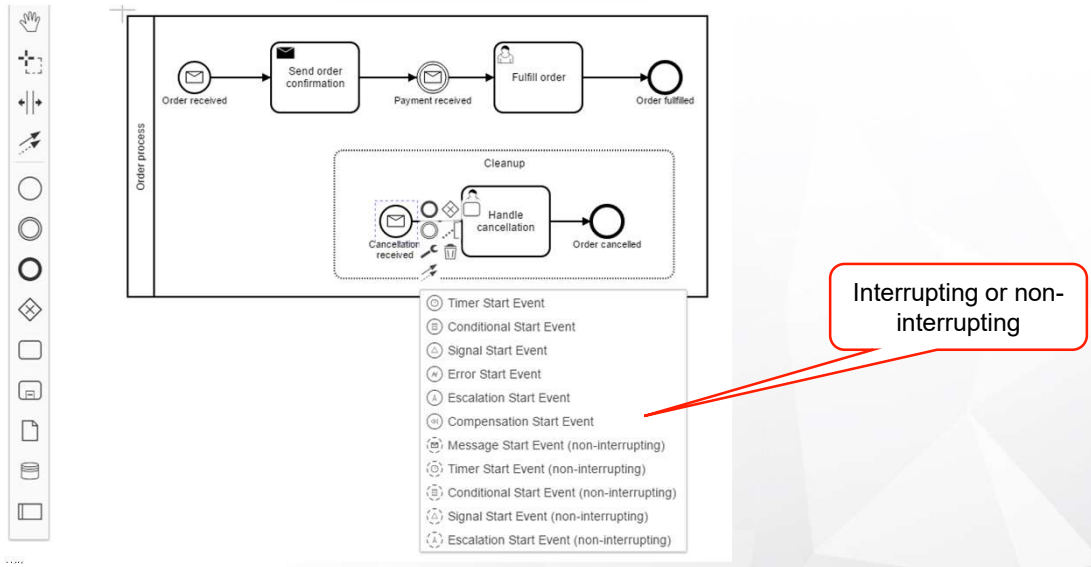
Possible Events to Start an Event Sub-Process



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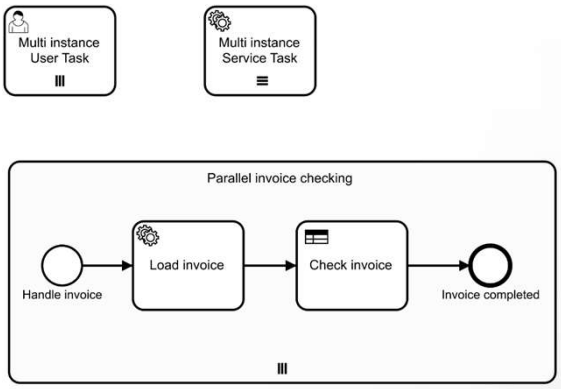
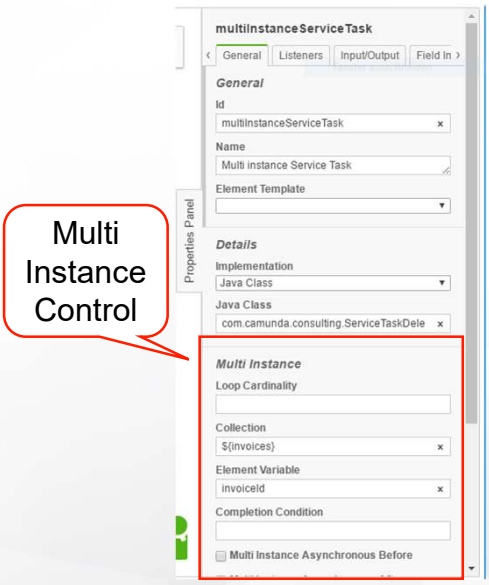
Multiple Instance Marker





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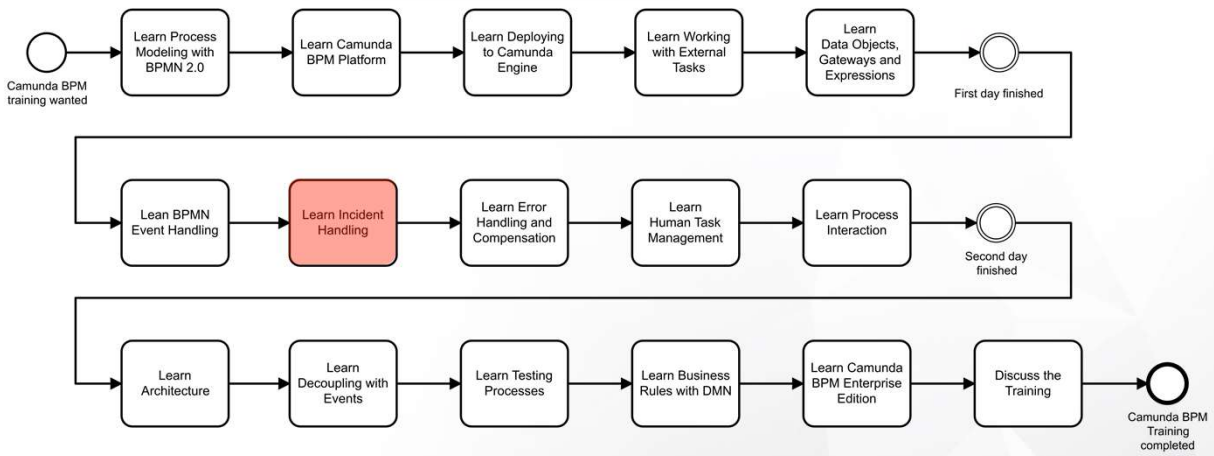

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Something Wrong in the Worker

- Reply with
- POST `/external-task/{id}/failure`

```
{
  "workerId": "aWorker",
  "errorMessage": "Does not compute",
  "retries": 3,
  "retryTimeout": 60000
}
```

- Handle retries in the client
- Return the open retries in response

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Demo

Archive Invoice failed

Retry Strategy

- Manage retries in the worker

```
POST /external-task/{id}/failure
```

```
{
  "workerId": "aWorker",
  "errorMessage": "Does not compute",
  "retries": retryVariable - 1,
  "retryTimeout": 60000
}
```

retries A number of how often the task should be retried. Must be >= 0. If this is 0, an incident is created and the task cannot be fetched anymore unless the retries are increased again. The incident's message is set to the `errorMessage` parameter.

retryTimeout A timeout in milliseconds before the external task becomes available again for fetching. Must be >= 0.

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Implement Retries

```
client.subscribe("credit-charge", async function({ task, taskService }) {
  var remainingRetries = task.retries;                        // Get the retries
  if (remainingRetries == null) remainingRetries = 3;         // initialize if empty
  remainingRetries = remainingRetries - 1;                    // decrement
  const possibleFailure = task.variables.get("possibleFailure");
  if (!!possibleFailure && possibleFailure) {
    await taskService.handleFailure(task, {
        errorMessage: "sorry this failed",
        errorDetails: "because of my implementation",
        retries: remainingRetries,                            // include in response
        retryTimeout: 10000 });
  } else {
      const resultVars = new Variables();
      resultVars.set("remaining", amount - 50.00);
      await taskService.complete(task, resultVars);
  }
});
```

Javascript example

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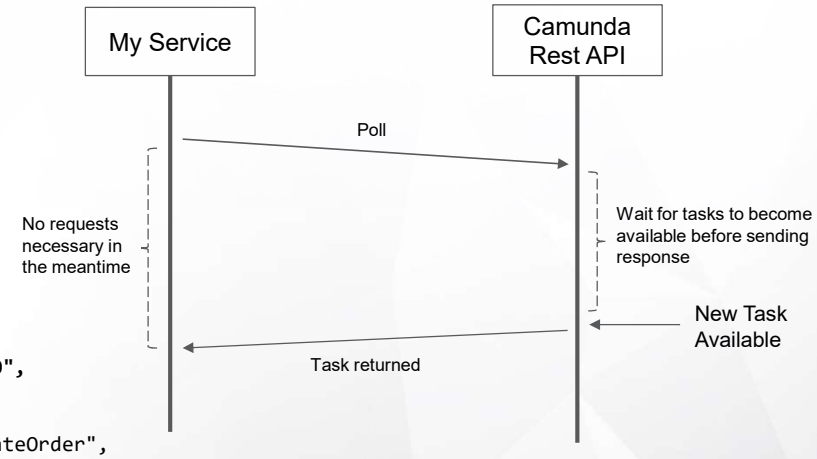
Long Polling

Reduce latency between create and work




```
POST /external-task/fetchAndLock

Request Body:

{
   "workerId": "myService",
   "asyncResponseTimeout": "60000",
   "maxTasks": 1,
   "usePriority": true,
   "topics": [{"topicName": "createOrder",
   "lockDuration": 10000, "variables": ["orderId"]}]

}
```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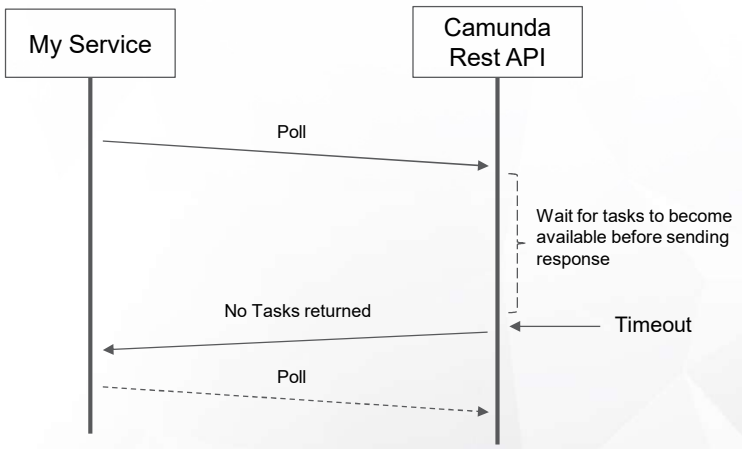
What if no task is created?



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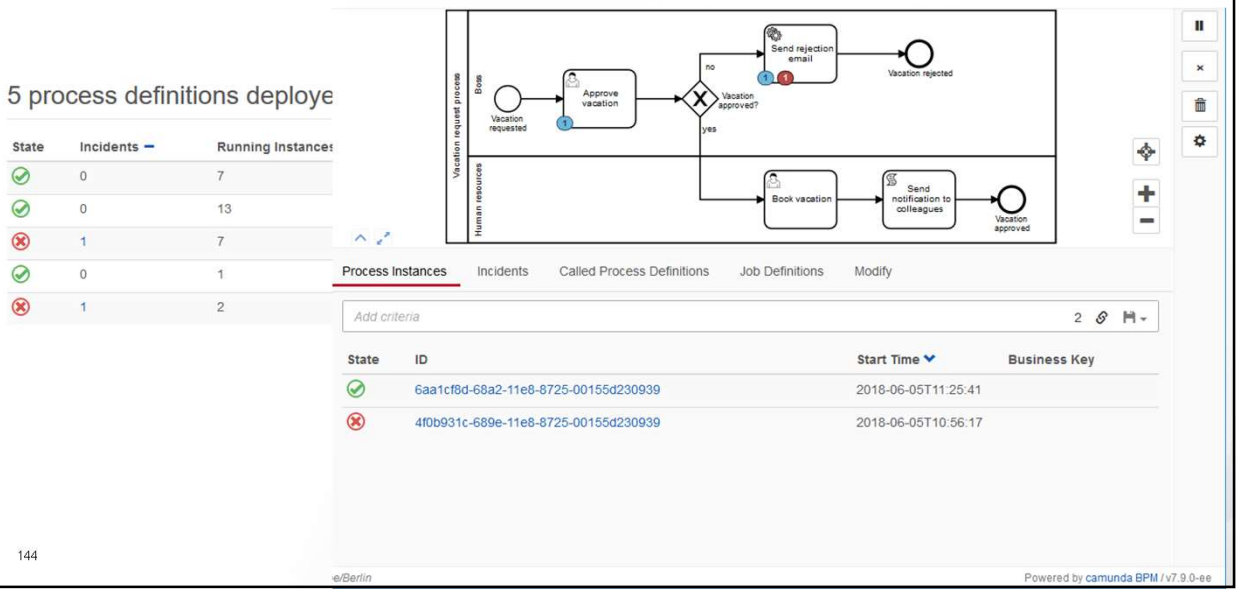
Incidents Overview



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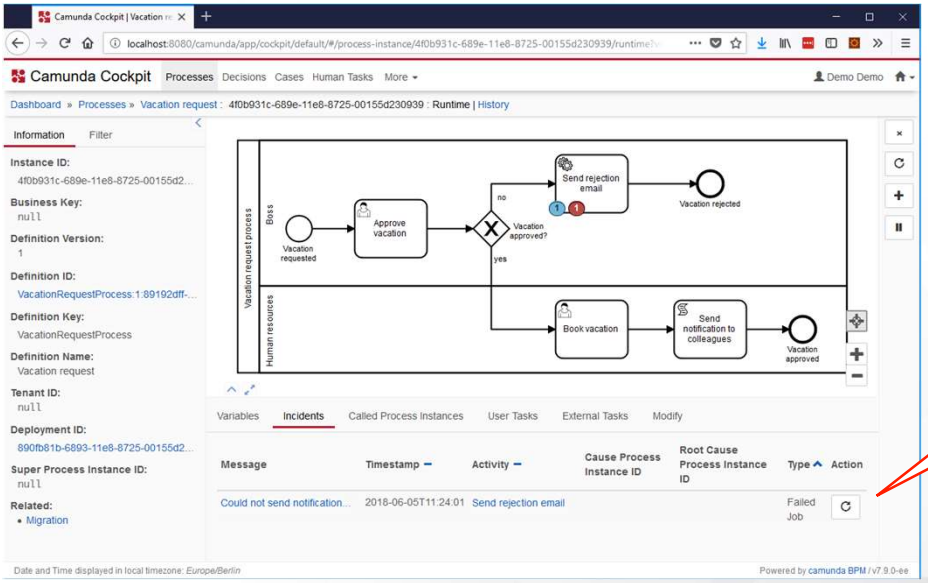
Incidents Details



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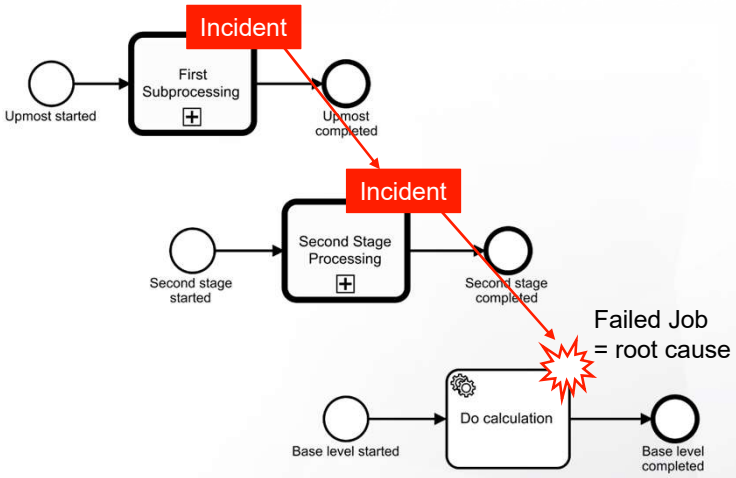
Drill Down



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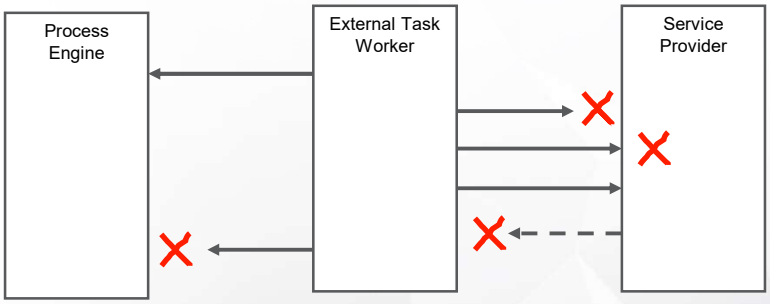
Exercise 7

https://training.camunda.com/microservices
user: microservices
password: camundarocks

Automatic Retry of External Service Tasks

- The worker dies
  - When? Maybe between work and complete
- Lock is timed out
- Next worker picks up again
  - Work is done again



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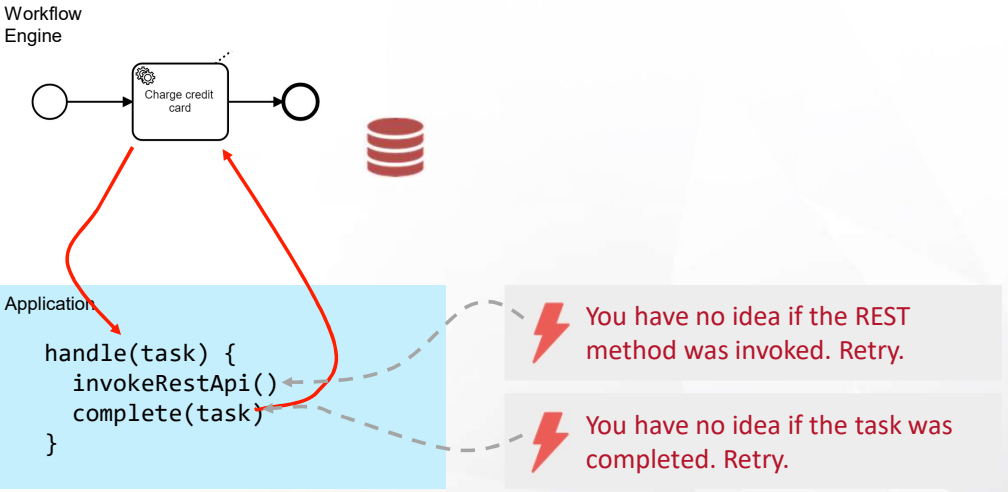
„At Least Once“



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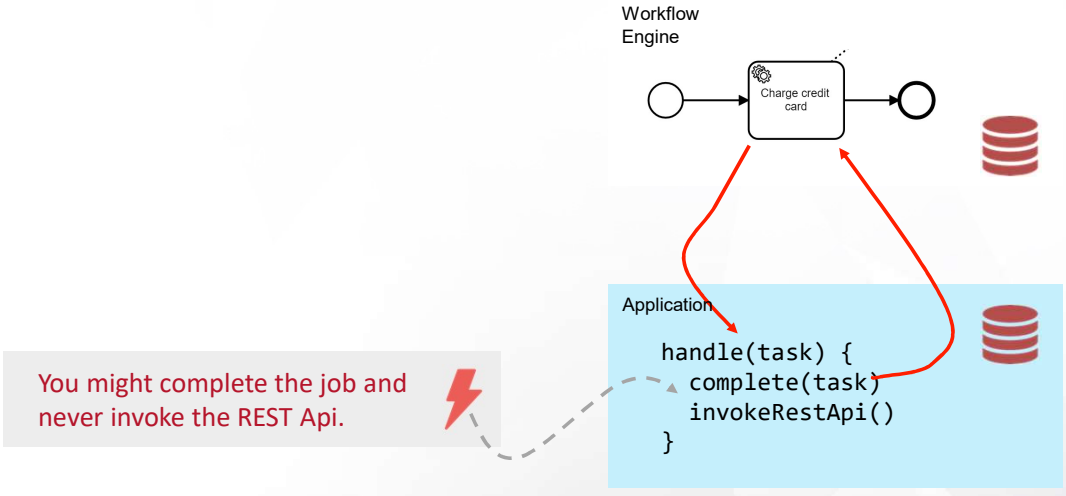
„At Most Once“



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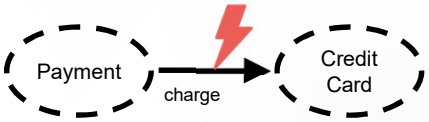
Network Problems



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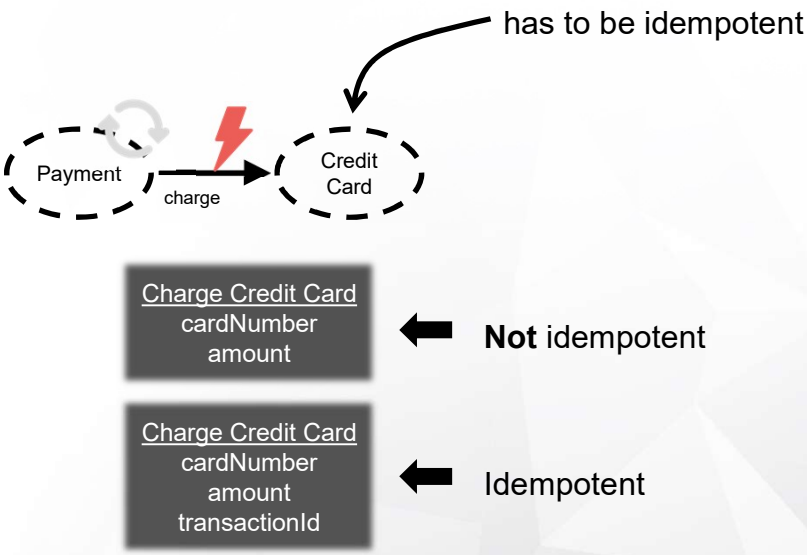
Strategy: Retry



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Support for Idempotency

- State of process instance: Process variables
- Unique Key
  - Business Key
  - Transaction ID
  - …
- Create early
- Retry is possible

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Remember the Retry Strategy

- Manage retries in the worker

```
POST /external-task/{id}/failure
```

```
{
  "workerId": "aWorker",
  "errorMessage": "Does not compute",
  "retries": retryVariable - 1,
  "retryTimeout": 60000
}
```

retries A number of how often the task should be retried. Must be >= 0. If this is 0, an incident is created and the task cannot be fetched anymore unless the retries are increased again. The incident's message is set to the `errorMessage` parameter.
retryTimeout A timeout in milliseconds before the external task becomes available again for fetching. Must be >= 0.

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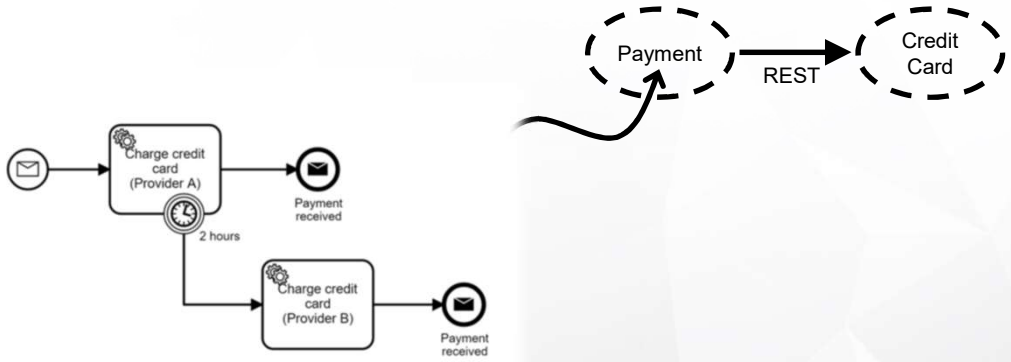
Fallbacks Increase Resilience



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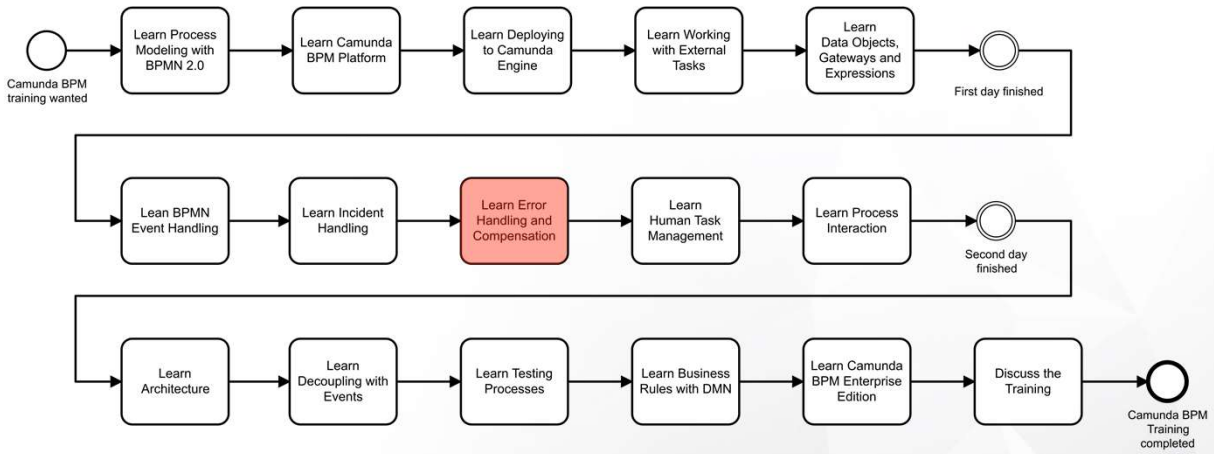

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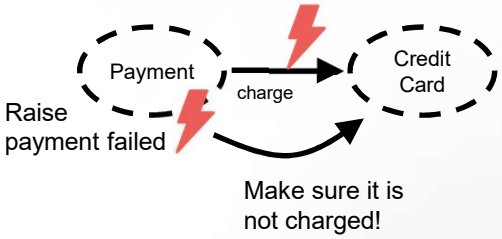
Strategy: Cleanup



Cancel charge
cardNumber
amount
transactionId

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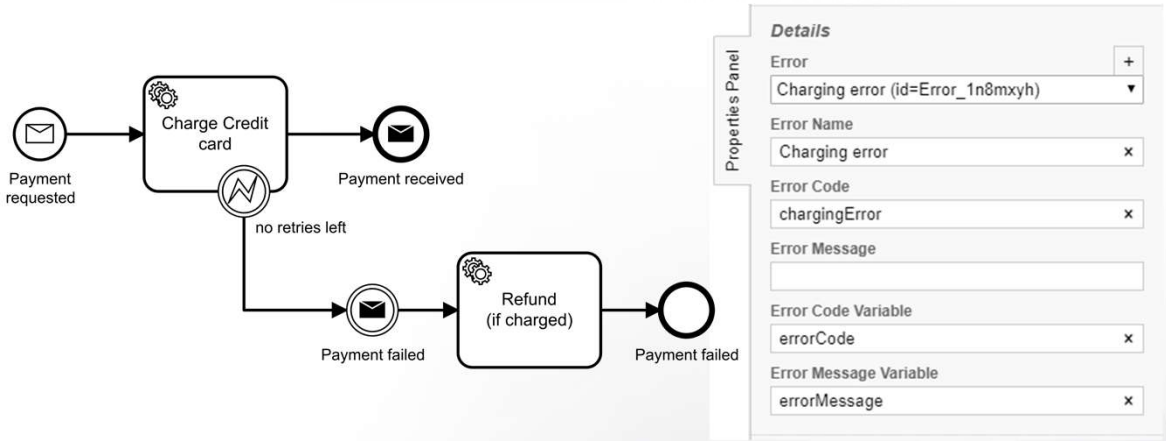
Error Handling



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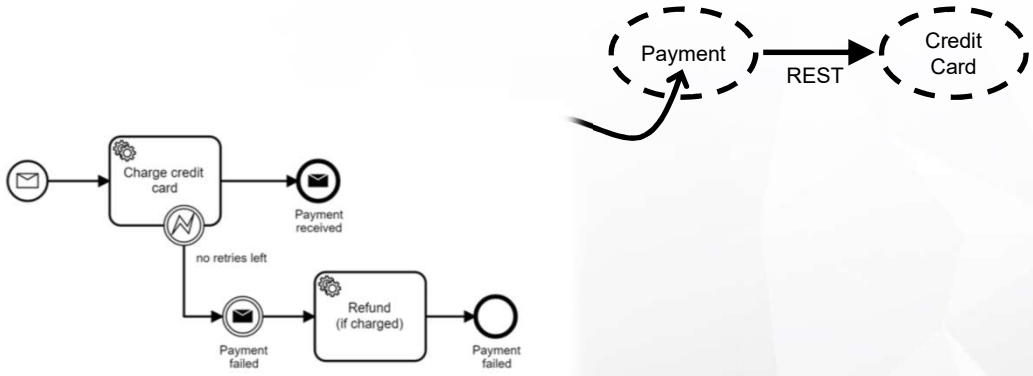
Example



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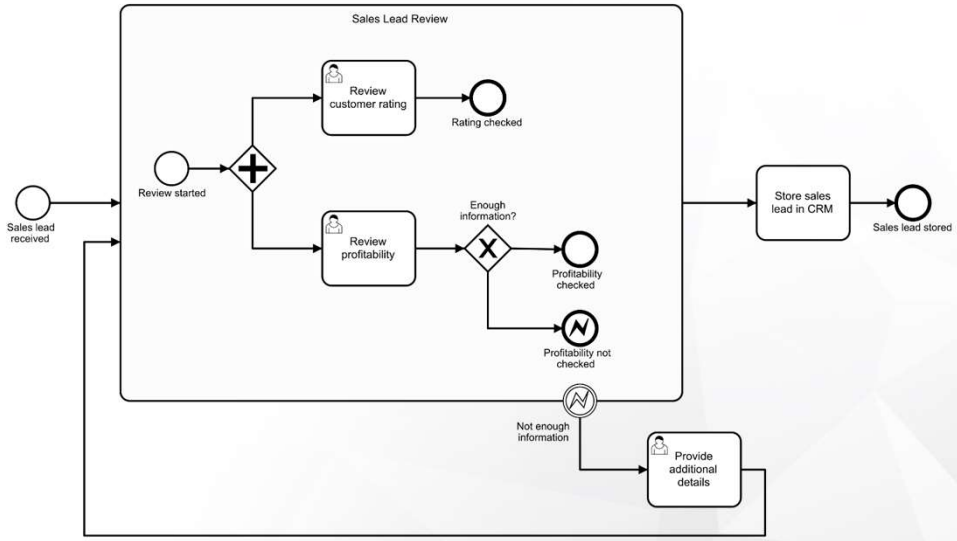
Error Event



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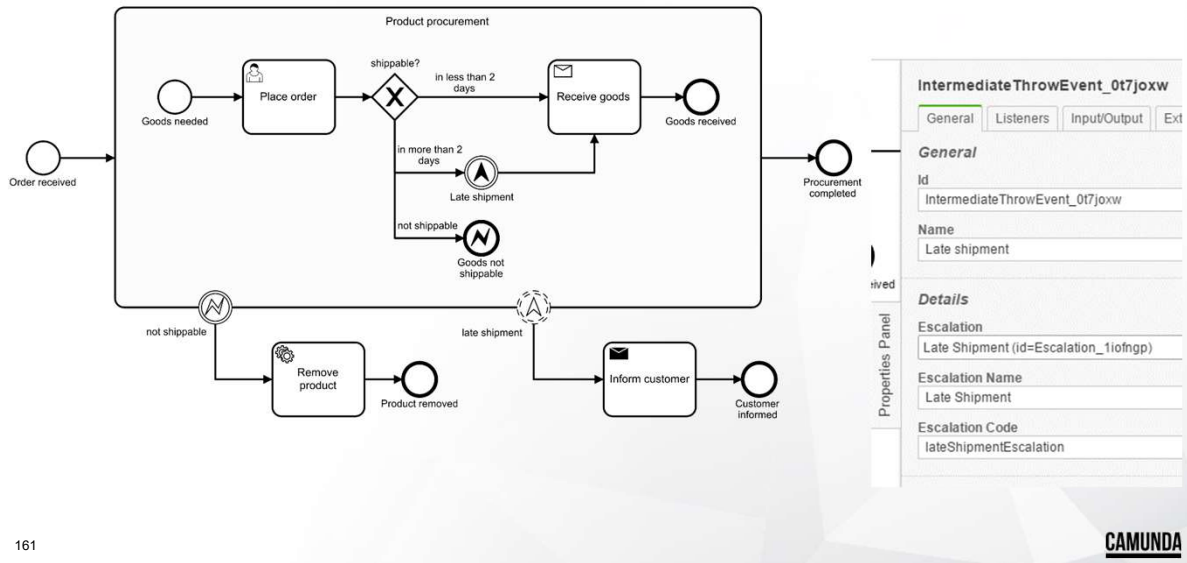
Escalation and Error Events



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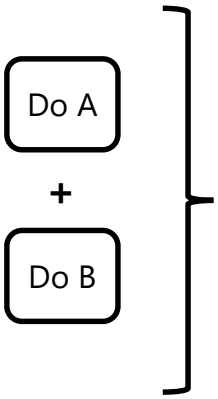
Transactions on Central Servers



All or nothing

Once upon a time:

```
try {
 tx.begin();
 doA();
 doB();
 tx.commit();
} catch (Exception e) {
 tx.rollback();
}
```

Or simply:

```
@Transactional
public void createCustomer(Customer cust)
{
  // ...
}
```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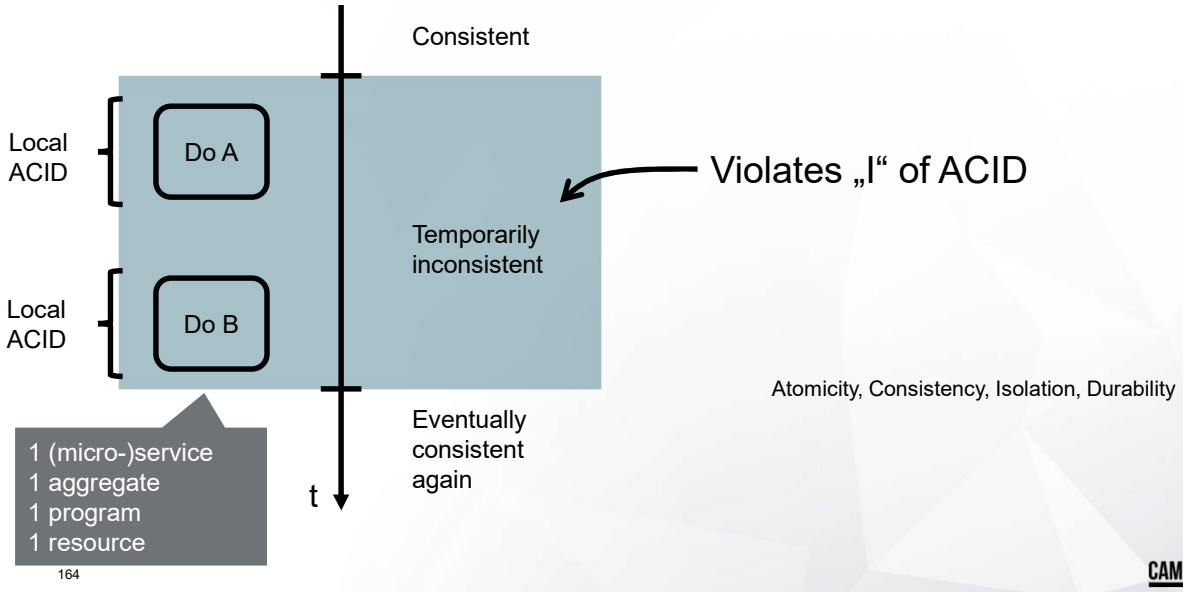
That Means



Atomicity, Consistency, Isolation, Durability

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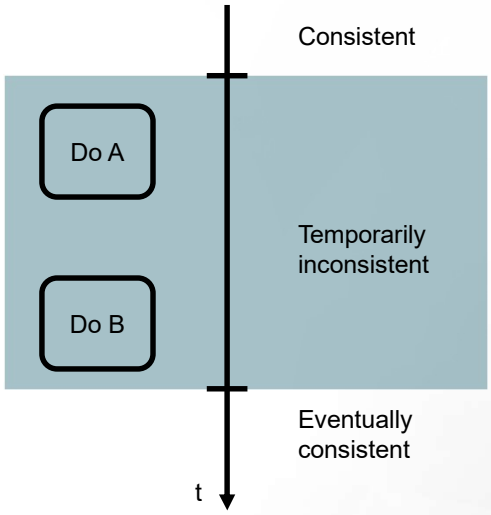
That Means



In case of failure:
Compensate or apologise

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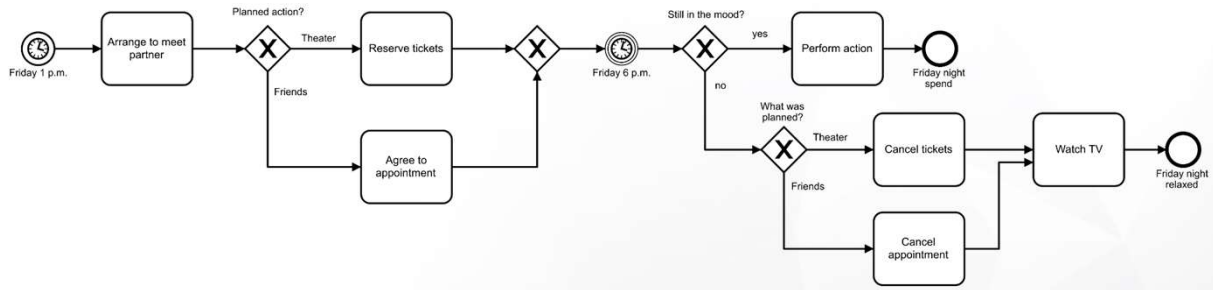
Compensation



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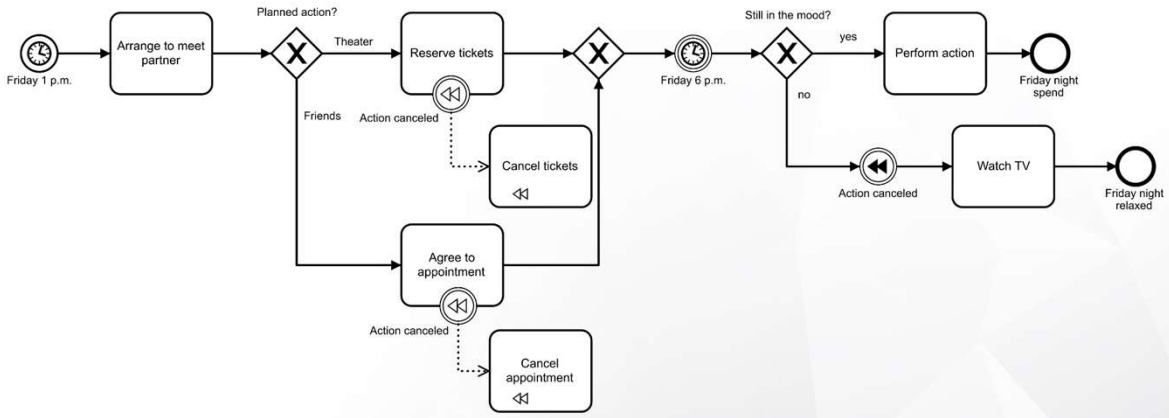
Compensation Events



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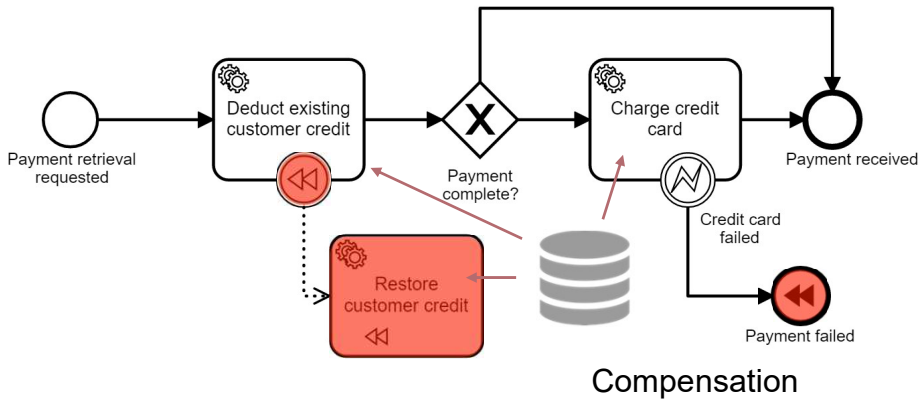
Distributed Transactions Using Compensation *

*aka Saga pattern



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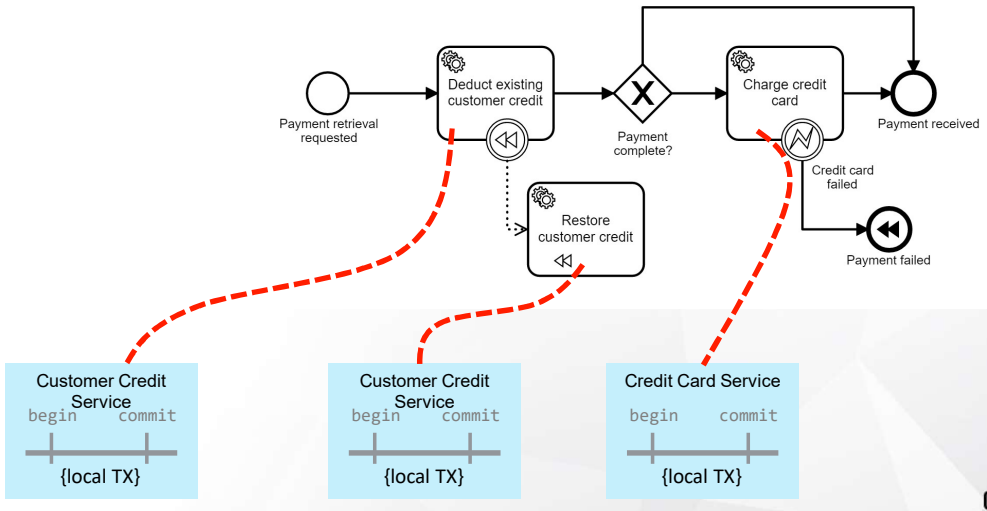
A Saga Coordinator



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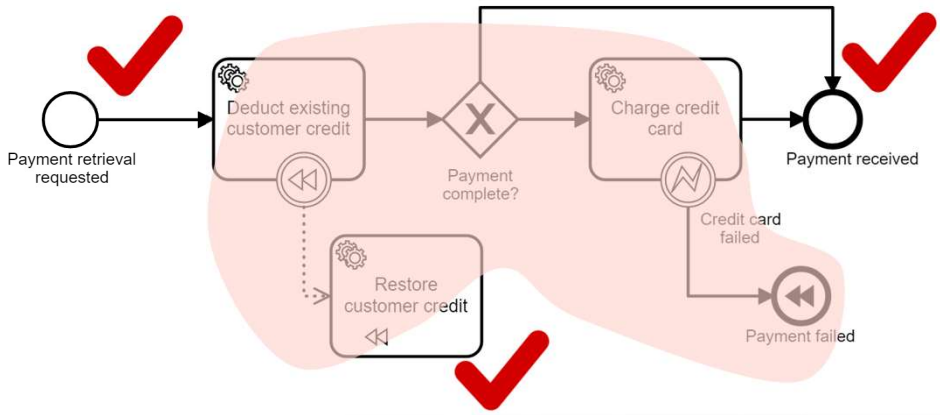
Relaxed Consistency



Temporarily inconsistent state

But eventually consistent

No Isolation (as in ACID)

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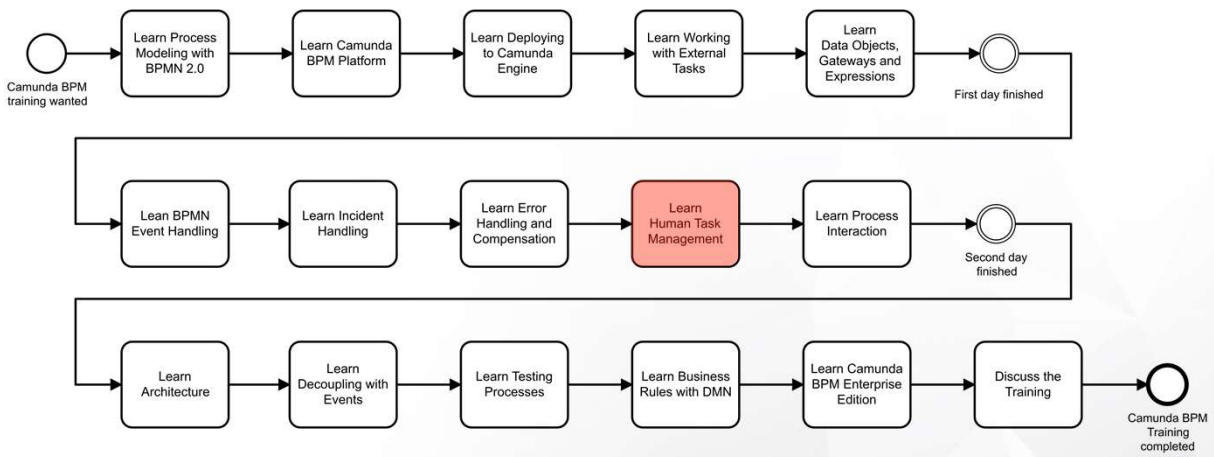
Exercise 8

https://training.camunda.com/microservices
user: microservices
password: camundarocks



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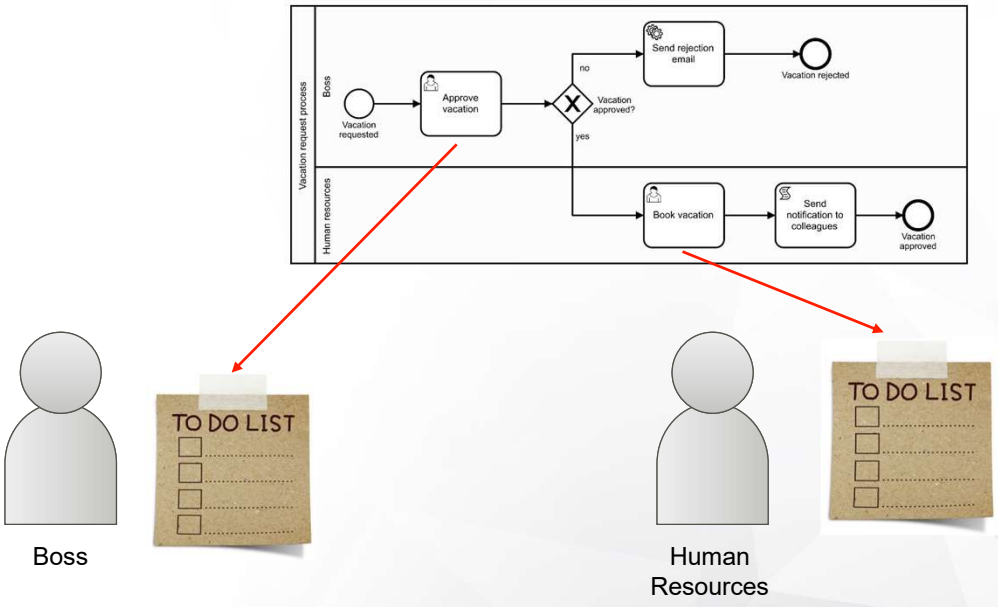
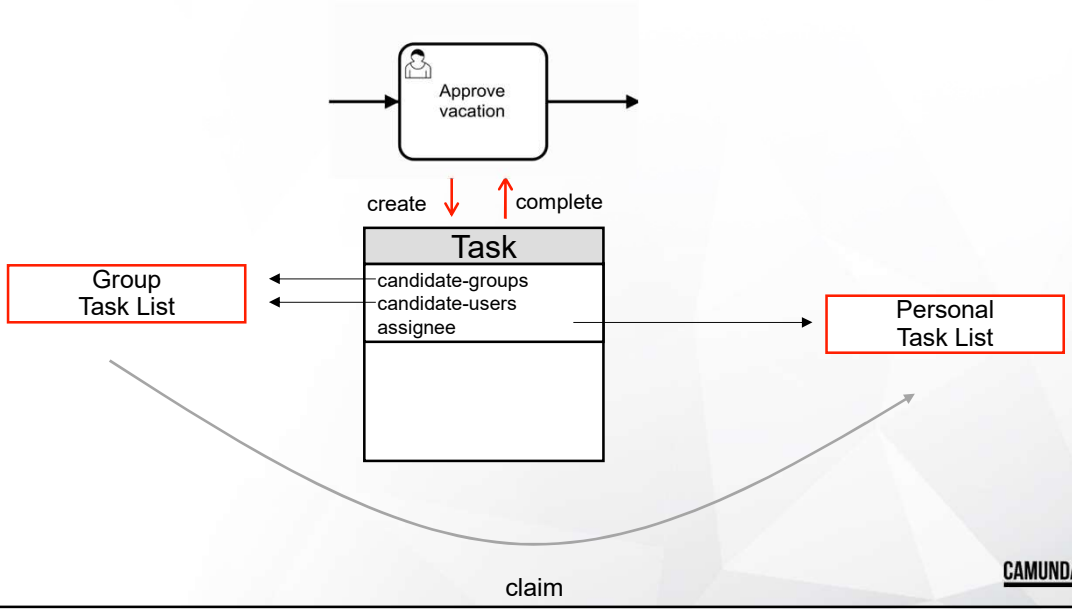
Task Management



CAMUNDA

Task Management



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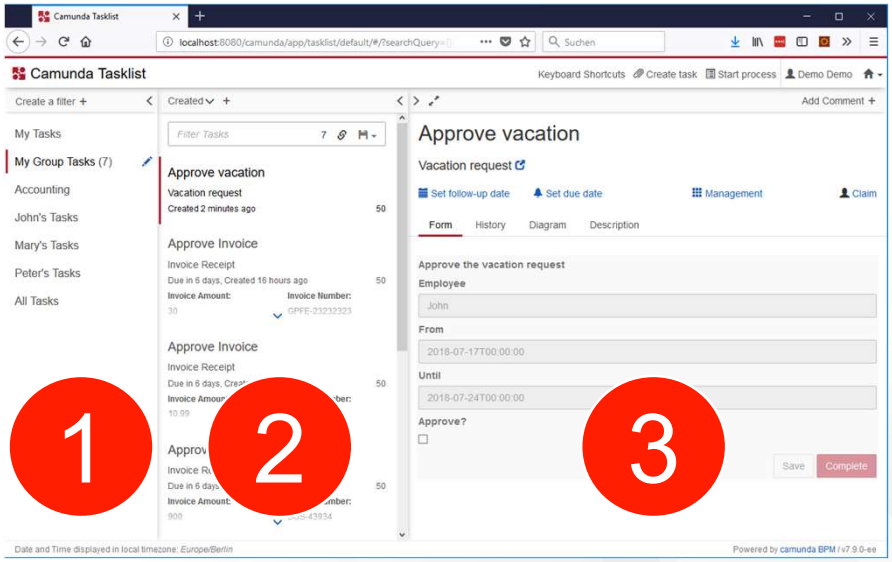
Tasklist in Camunda BPM



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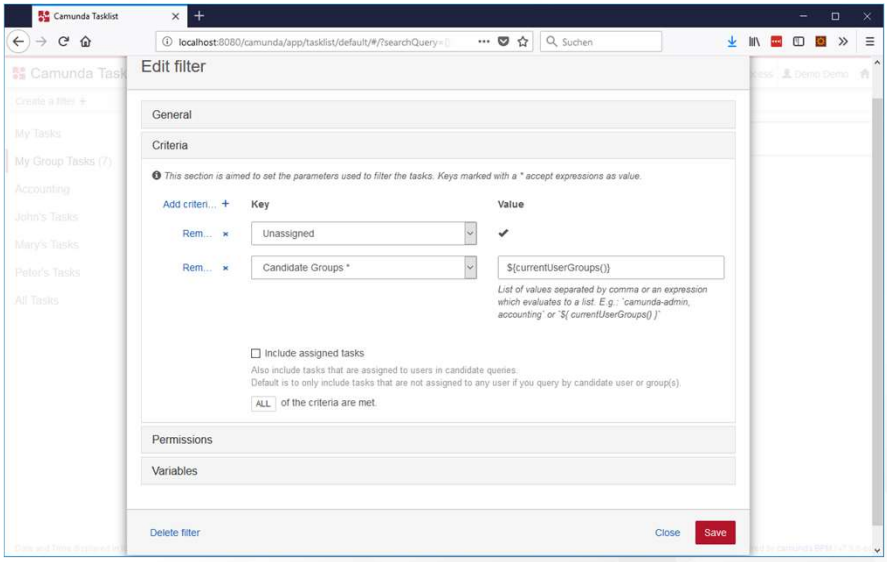
Groups & Personal Task List (Via Filters)



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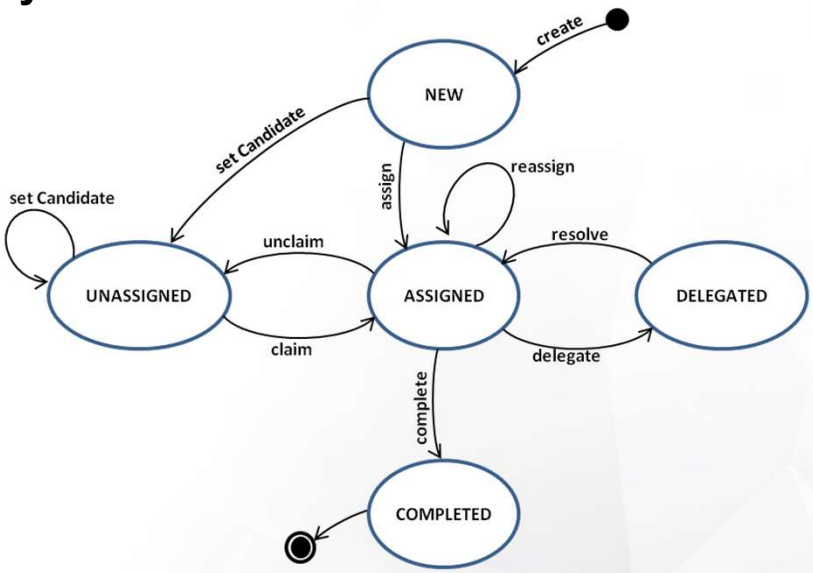
Task Lifecycle



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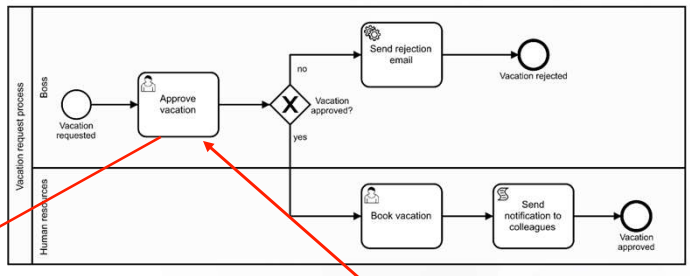
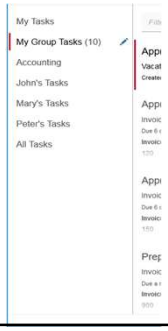
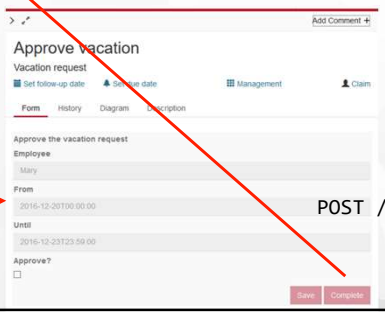
Task Management API



GET /task



GET /task/{id}/form



POST /task/{id}/complete

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Personal and Group Task Lists

```
TaskService taskService = processEngine.getTaskService();

List<Task> personalTaskList = taskService.createTaskQuery()
          .taskAssignee("demo").list();


List<Task> groupTaskList = taskService.createTaskQuery()
          .taskCandidateUser("demo").list();

groupTaskList.addAll(taskService.createTaskQuery()
          .taskCandidateGroup("marketing").list());
```


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Task Query & Completion

```
TaskService taskService = processEngine.getTaskService();

List<Task> personalTaskList = taskService.createTaskQuery()
          .taskAssignee("demo").list();

Task task = personalTaskList.get(0);

Map<String,Object> variables = new HashMap<String, Object>();
variables.put("approved", false);

taskService.complete(task.getId(), variables);
```


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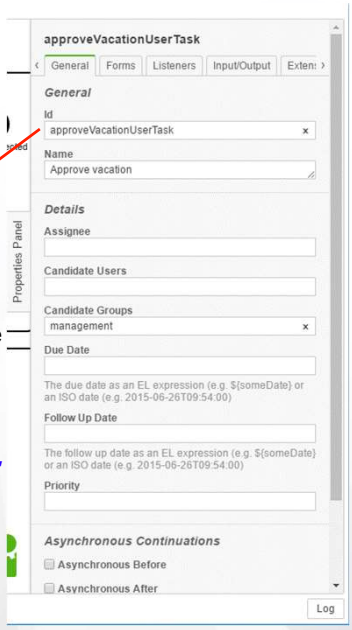
Key vs. ID vs. Name

```
GET /task
```

- `task.id:` Task Instance ID
- `task.taskDefinitionKey:` BPMN User Task ID
- `task.name:` BPMN User Task Name




```
<bpmn:userTask id="approveVacationUserTask" name="Approve vacation"
camunda:candidateGroups="management">
</bpmn:userTask>
```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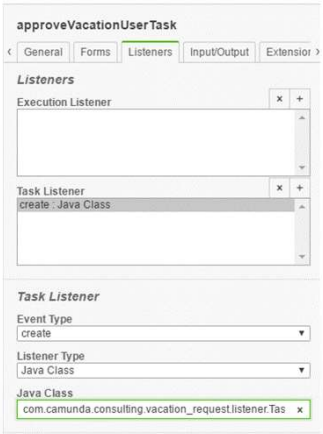
Task Listener

Typical Use Cases:

- Send notification e-mail
- Task modifications, e.g. priority, due date, display name
- Vacation substitute
- Create task in third-party application



Available events:

```
create
update
assignment
complete
delete
```

Listener Type
Script
Expression
Java Class
Delegate Expression

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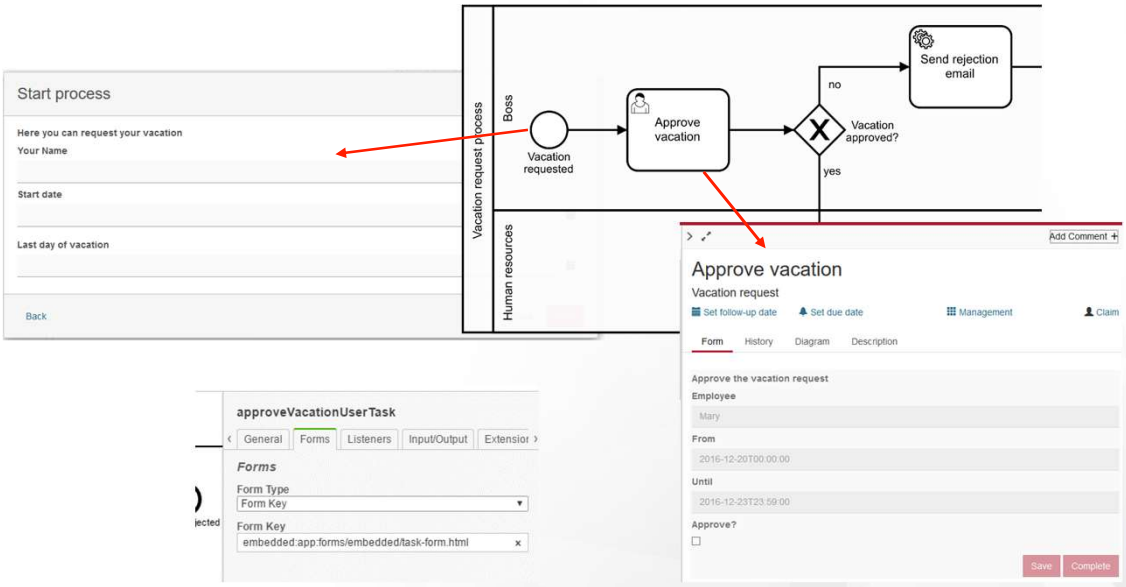
Task Forms



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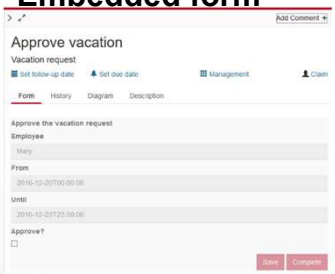
Task Forms in Camunda Tasklist

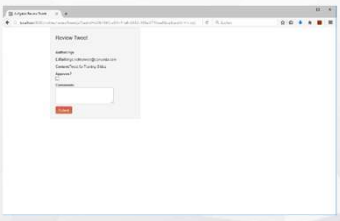
Generic form

Embedded form



Generated form

External form



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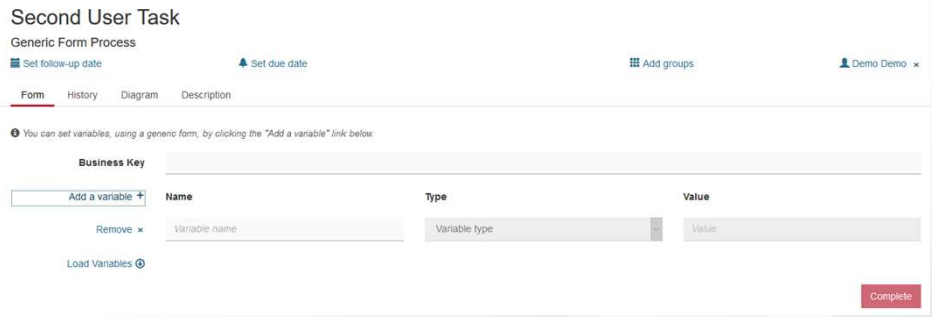
Generic Task Forms

- `formKey=""`
- Completely generic, shows all process variables after load
- Add variables manually on demand
- Edit existing variables



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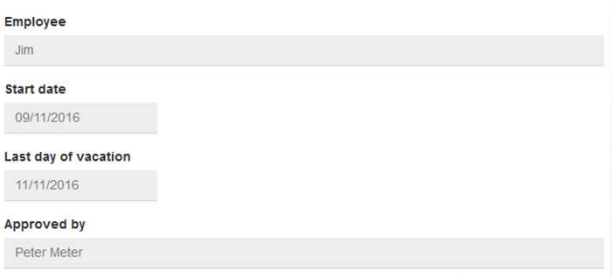
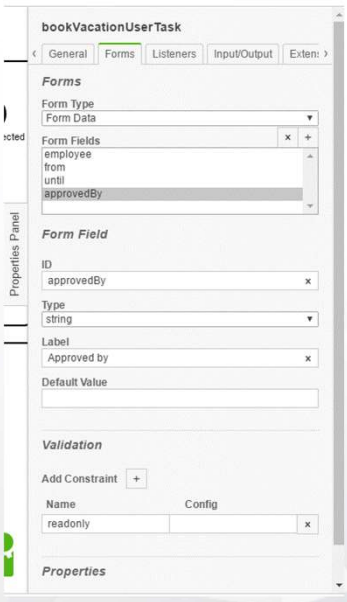
Generated Task Forms (From Form Fields)

- Form Data Metadata provided by BPMN 2.0 XML
- Rendered in task list





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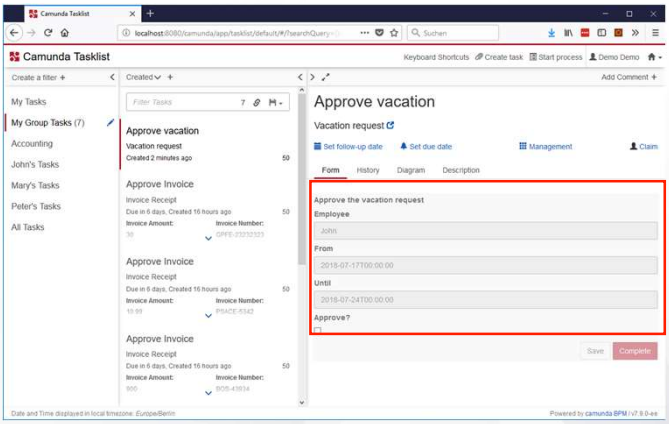
Embedded Task Forms

- `formKey="embedded:deployment:approve-vacation.html"`
- HTML-Form provided by Process Application (HTML-File)
- Mix HTML and Angular-JS JavaScript
- Rendered in task list



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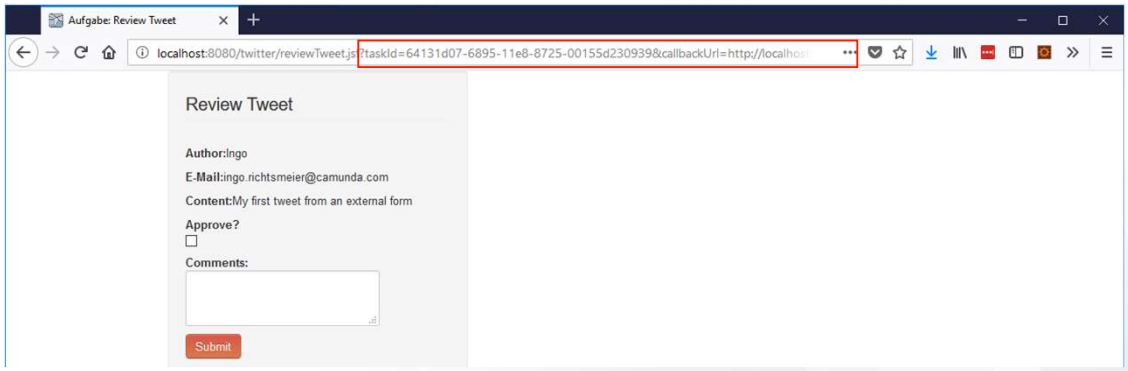
External Task Form

- `formKey="app:reviewTweet.jsf“`
- Params `taskId` and `callbackURL` needed



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Embedded Task Forms Form SDK

- *Form handling*: Attach to a form existing in the DOM or load a form from a URL.
- *Variable handling*: Load and submit variables used in the form.
- *Script handling*: Execute custom JavaScript in Forms
- *Angular JS Integration*: The Forms SDK optionally integrates with AngularJS to take advantage of AngularJS form validation and other AngularJS goodies.

  `cam-variable-name`: Bind input to the model
  `cam-variable-type`: Type of process variable

Form templates are generated from the archetypes

https://docs.camunda.org/manual/latest/reference/embedded-forms/

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Simple Form Example

```
<strong>Here you can request your vacation</strong>

<form class="form-horizontal">
  <div class="control-group">
    <label class="control-label">Your Name</label>
    <div class="controls">
      <input type="text"
             cam-variable-name="employee"
             cam-variable-type="String"
             required
             class="form-control" />
    </div>
  </div>
  <div class="control-group">
    <label class="control-label">Start date</label>
    <div class="controls">
      <input type="text"
             cam-variable-name="from"
             cam-variable-type="Date"
             required
             class="form-control" />
    </div>
  </div>
  <div class="control-group">
    <label class="control-label">Last day of vacation</label>
    <div class="controls">
      <input type="text"
             cam-variable-name="until"
             cam-variable-type="Date"
             required
             class="form-control" />
    </div>
  </div>

  <script cam-script type="text/form-script">
    // custom JavaScript goes here
  </script>
</form>
```


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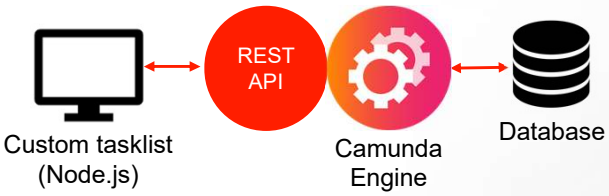
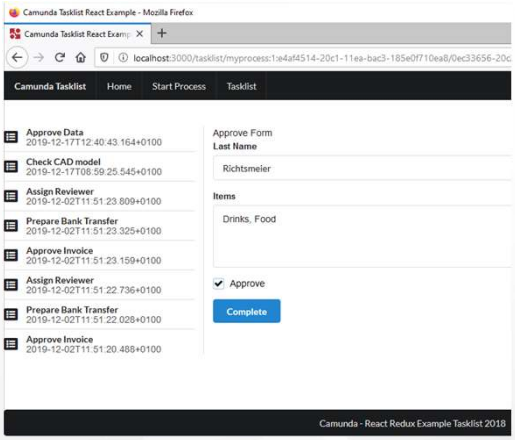
Custom Tasklists

- Leverage the REST API
- Can use any technology (Vue.js, React, Angular, …)
- Be creative with the Form Key





https://blog.camunda.com/post/2018/02/custom-tasklist-examples/
https://github.com/camunda-consulting/code/tree/master/snippets/camunda-tasklist-examples/

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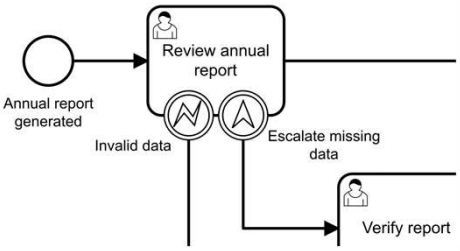
Error and Escalation Event on User Tasks




```
<button cam-error-code="bpmn-error-543"
    cam-error-message="anErrorMessage"
    class="form-control">Abort</button>

<button cam-escalation-code="escalation-123"
    class="form-control">Escalate</button>
```

```
POST /task/aTaskId/bpmnError
{ "errorCode": "bpmn-error-543",
  "errorMessage": "an error message",
  "variables": ... }

POST /task/aTaskId/bpmnEscalation
{ "escalationCode": "bpmn-escalation-432",
  "variables": ... }
```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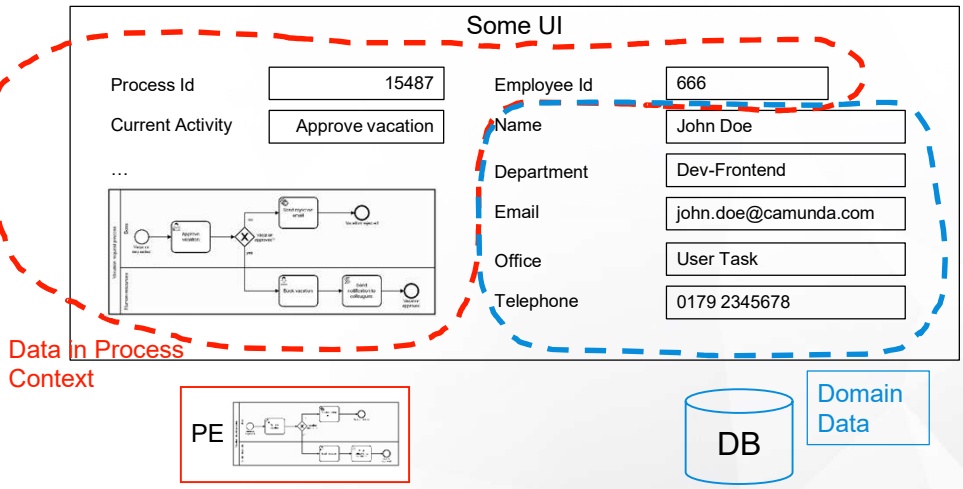
Typical: Process Data and External Data Are Mixed



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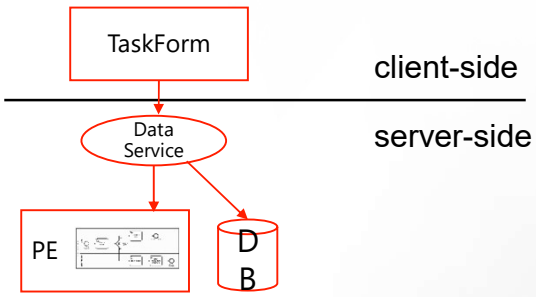
How to Call Data Service



Composed Service

- The UI calls a combined service
- This service calls the Data Service and the Process Service
- TX possible

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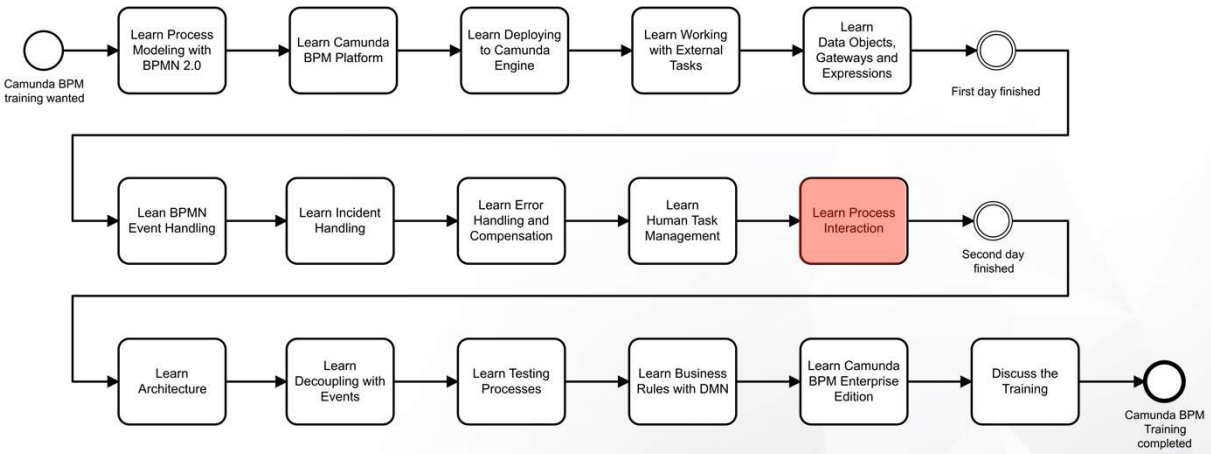
Exercise 9

https://training.camunda.com/microservices
user: microservices
password: camundarocks



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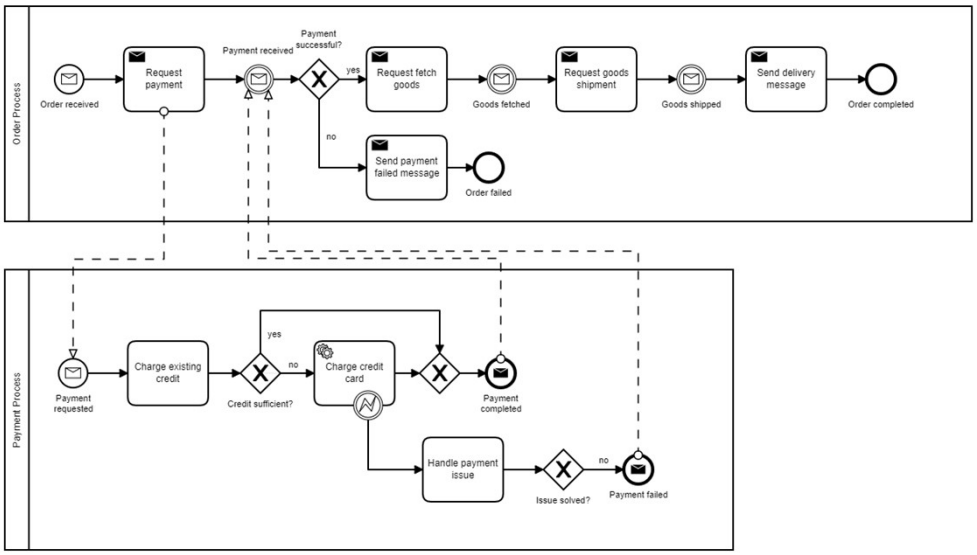
Collaboration Diagram



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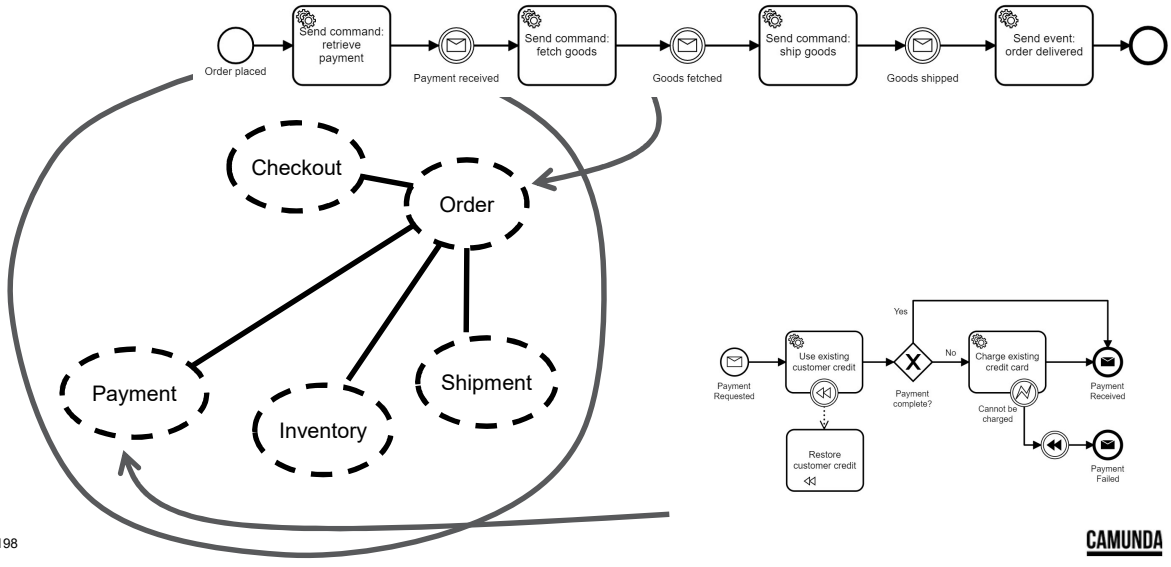
Every Service Owns Its Workflow (Engine)



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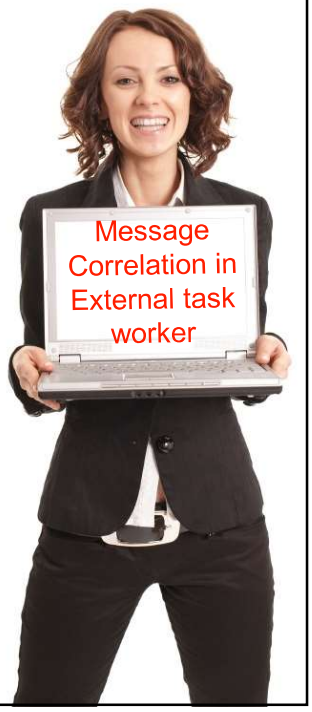
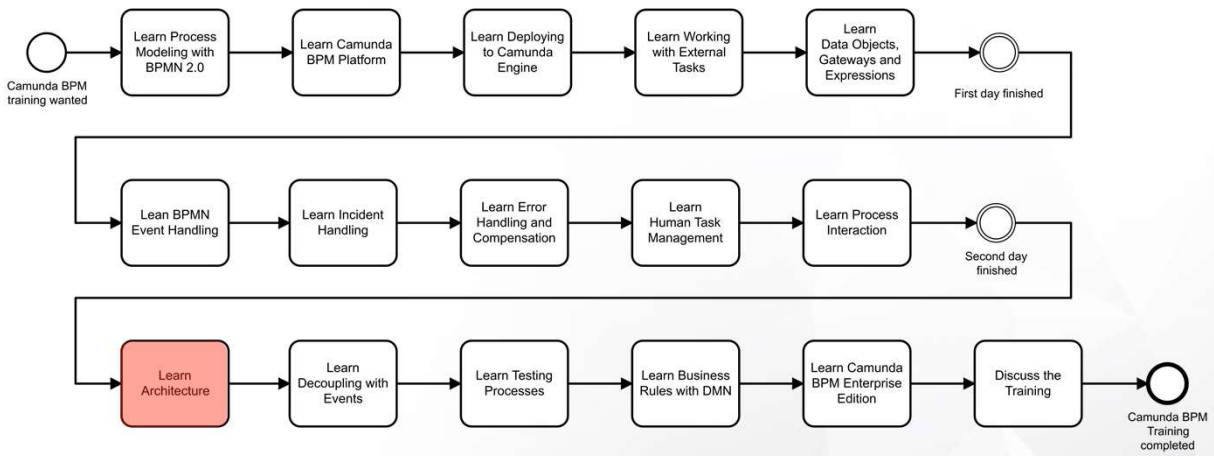
Demo



Exercise 10

https://training.camunda.com/microservices
user: microservices
password: camundarocks



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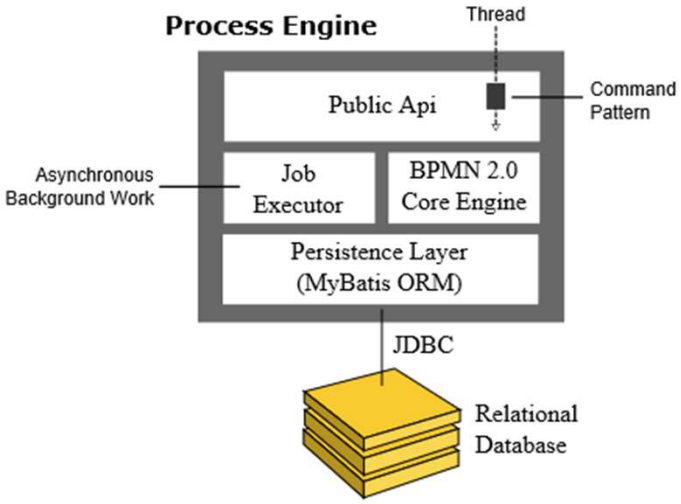
Process Engine Architecture



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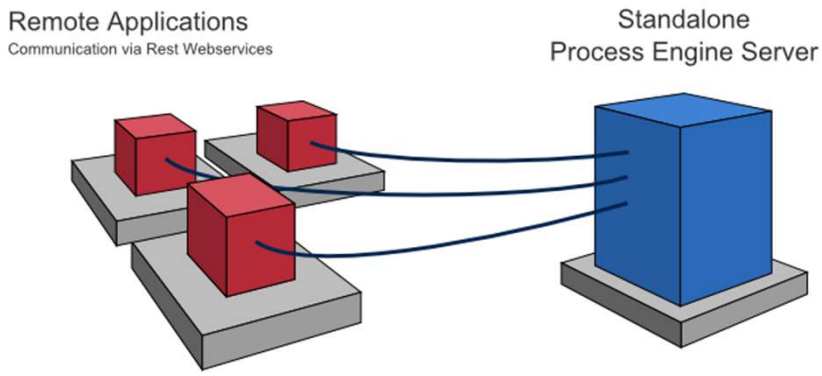
Standalone / Remote Process Engine Server



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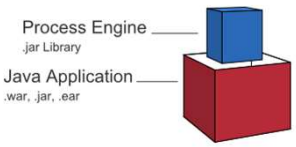
Other Options for Java Programmers



Various environments possible:

most popular

Pure Java | Spring | CDI | Blueprint

Basic question: Who controls the lifecycle of the engine (startup / shutdown)?

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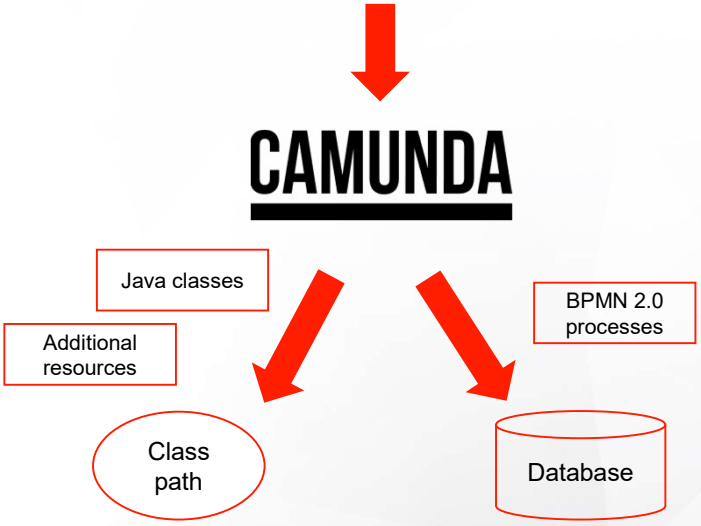
Process Deployment



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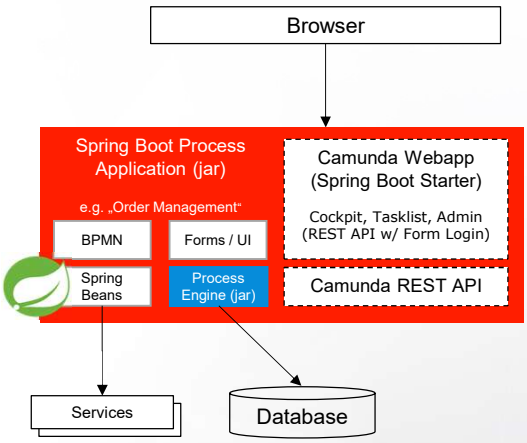
Spring Boot:
Embedded Process Engine, Webapp & REST API



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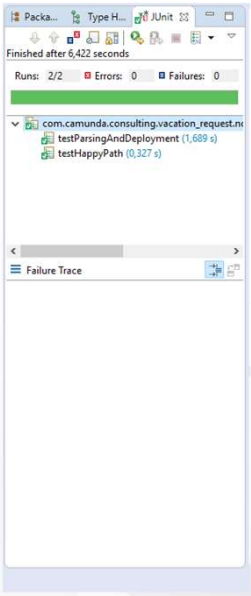
Example: Unit Test

```
import static org.camunda.bpm.engine.test.assertions.ProcessEngineTests.*;

public class VacationRequestProcessTest {

  @Rule
  public ProcessEngineRule rule = new ProcessEngineRule();

  @Test
  @Deployment(resources = "vacation-request.bpmn")
  public void testHappyPath() {
    ProcessInstance processInstance = runtimeService()
        .startProcessInstanceByKey(PROCESS_DEFINITION_KEY);
    assertThat(processInstance).isWaitingAt("approveVacationUserTask");
    complete(task(), withVariables("approved", true));
    assertThat(processInstance).isWaitingAt("bookVacationUserTask");
    complete(task());
    assertThat(processInstance).isEnded();
  }
}
```



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Example: Spring

```
ClassPathXmlApplicationContext applicationContext =
    new ClassPathXmlApplicationContext("/spring-context.xml");
ProcessEngine processEngine = (ProcessEngine) applicationContext.getBean("processEngine");

processEngine.getRepositoryService().createDeployment()
    .addClasspathResource("vacation-request.bpmn").deploy();

processEngine.getRuntimeService().startProcessInstanceByKey("vacation-request-process");

Task task = processEngine.getTaskService().createTaskQuery().taskAssignee("john").singleResult();

//Simulate task completion
processEngine.getTaskService().complete(task.getId());
```

Sample Spring Configuration:
https://docs.camunda.org/get-started/spring/embedded-process-engine/

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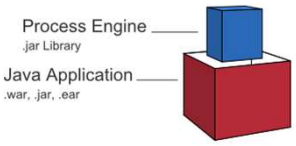
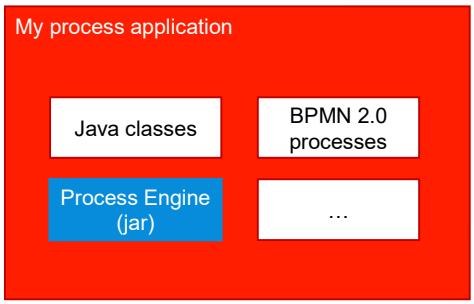
One Process Application





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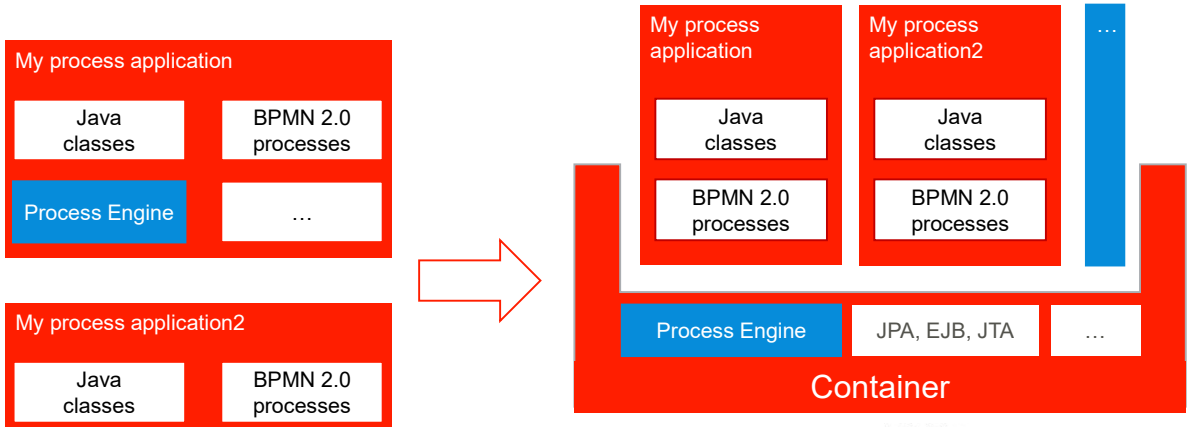
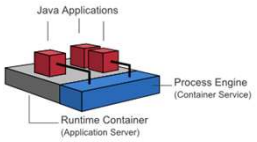
Multiple Process Applications



Supported on:
Tomcat, JBoss AS/EAP, Wildfly AS, WebSphere AS and WebLogic



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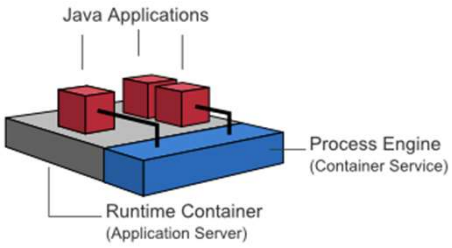
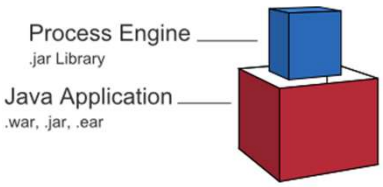
Process Engine Modes

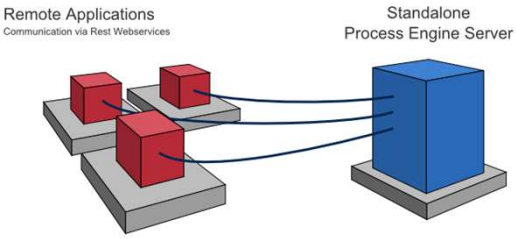
Shared, Container Managed Process Engine



Embedded Process Engine



Remote Process Engine



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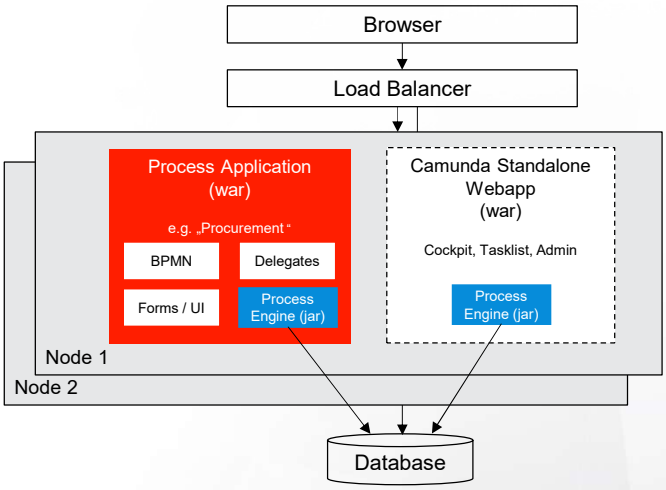
Example Architecture With Embedded Process Engines



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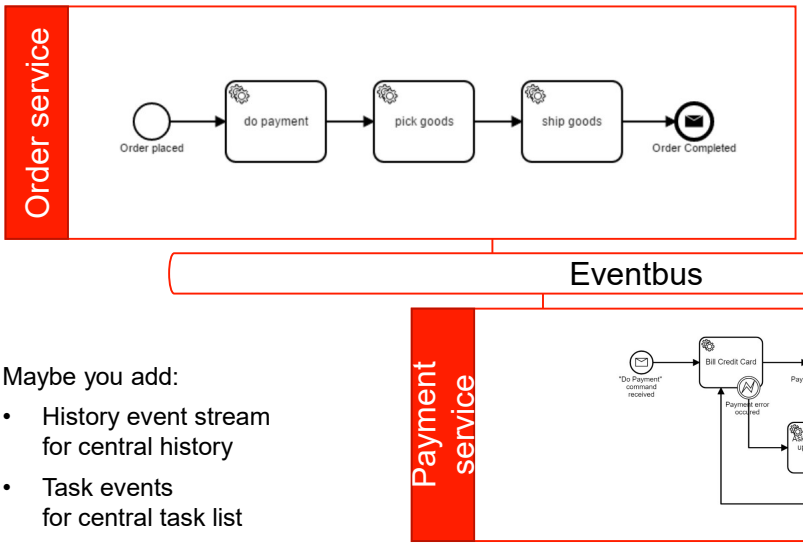
Orchestration With Microservices



Possible Environments:

- Embedded engines
- Container managed engines with single process application

Maybe you add:

- History event stream for central history
- Task events for central task list

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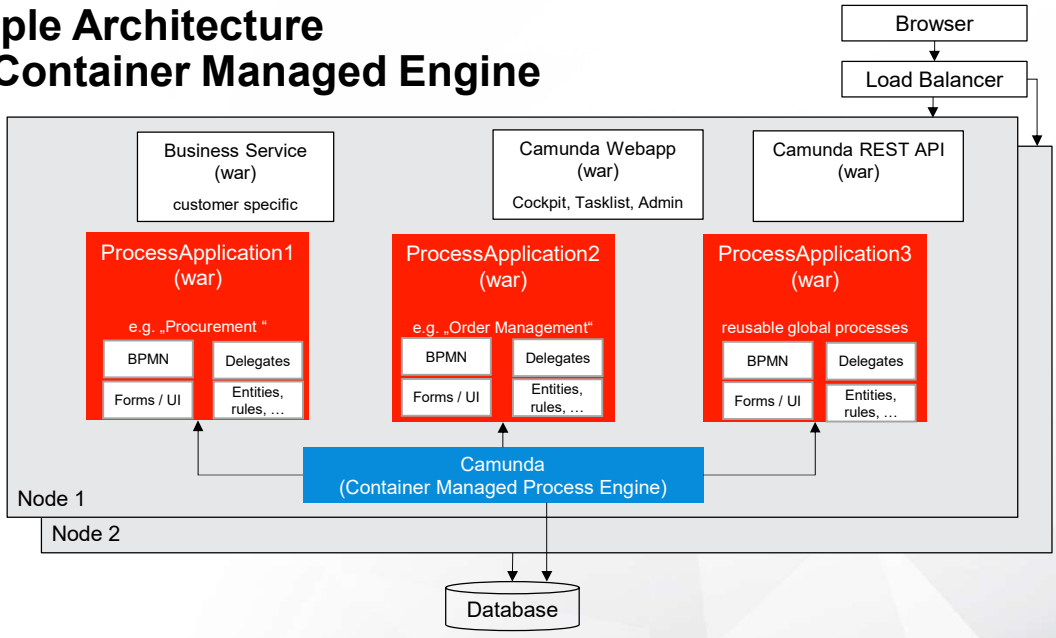
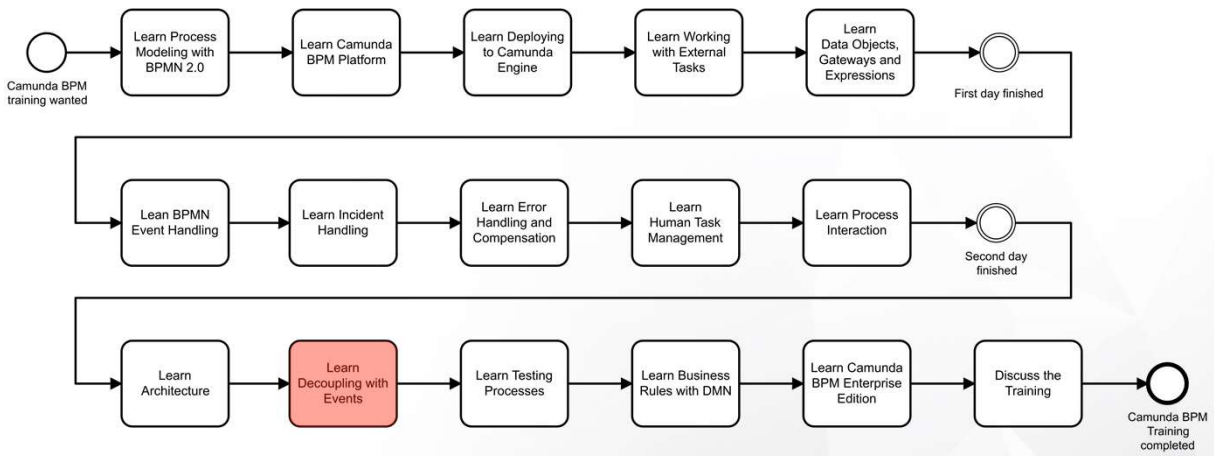
Example Architecture With Container Managed Engine



CAMUNDA



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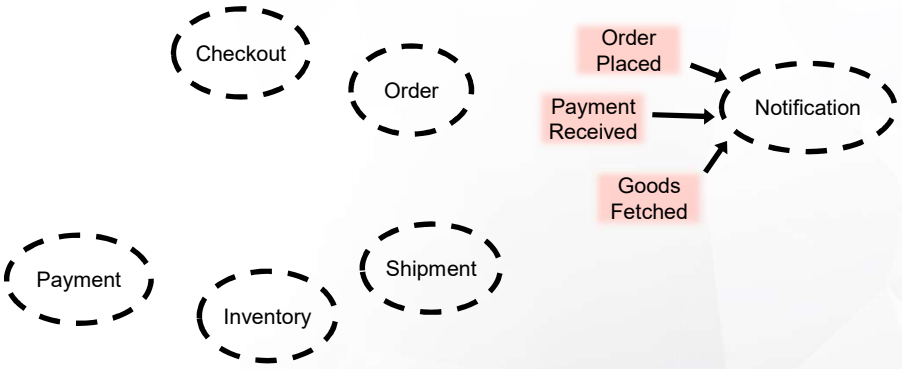
Event-Driven Architecture



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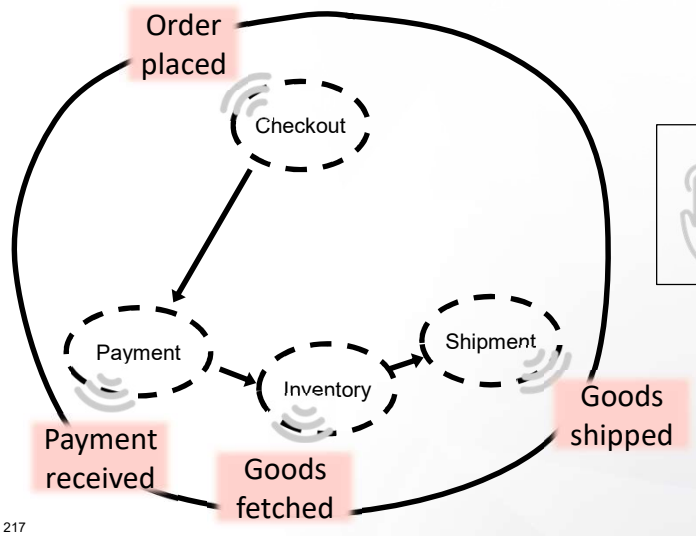
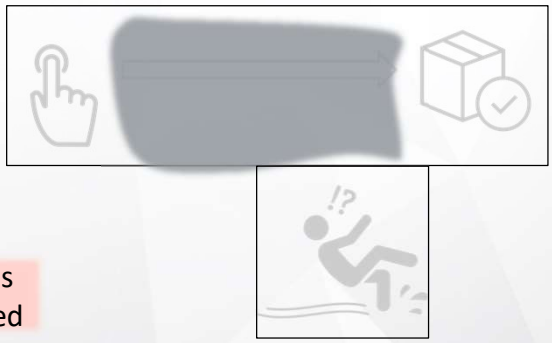
Peer-to-Peer Event Chains





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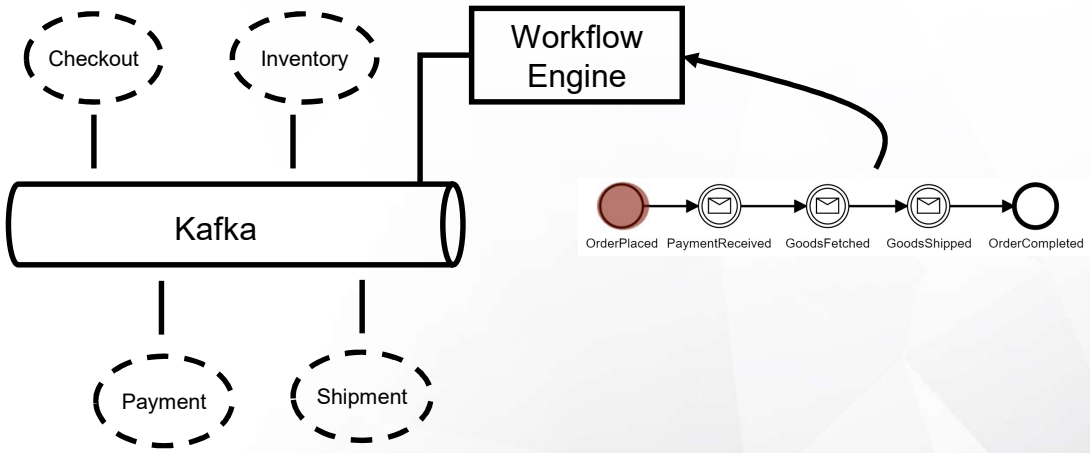
Tracking



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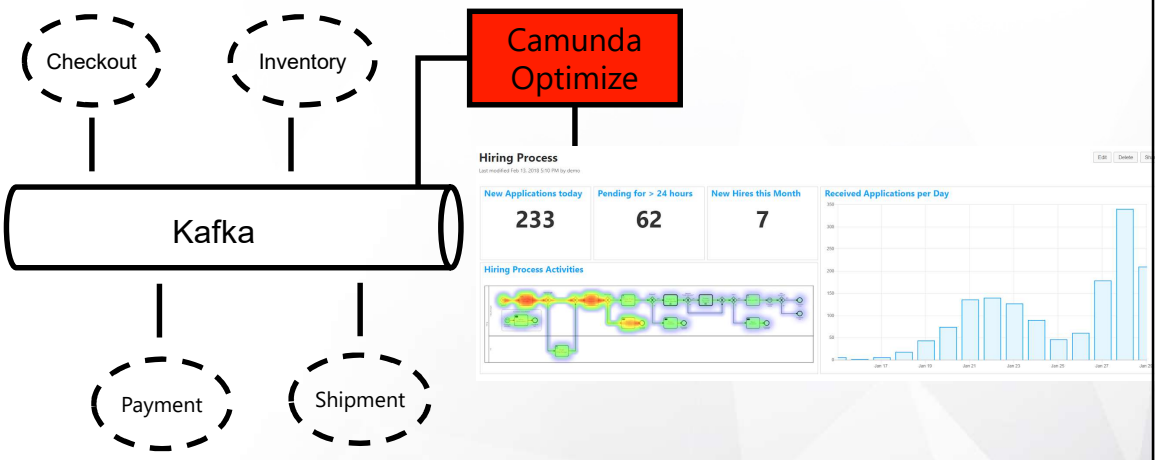
Event Based Processes



https://docs.camunda.org/optimize/latest/user-guide/event-based-processes/

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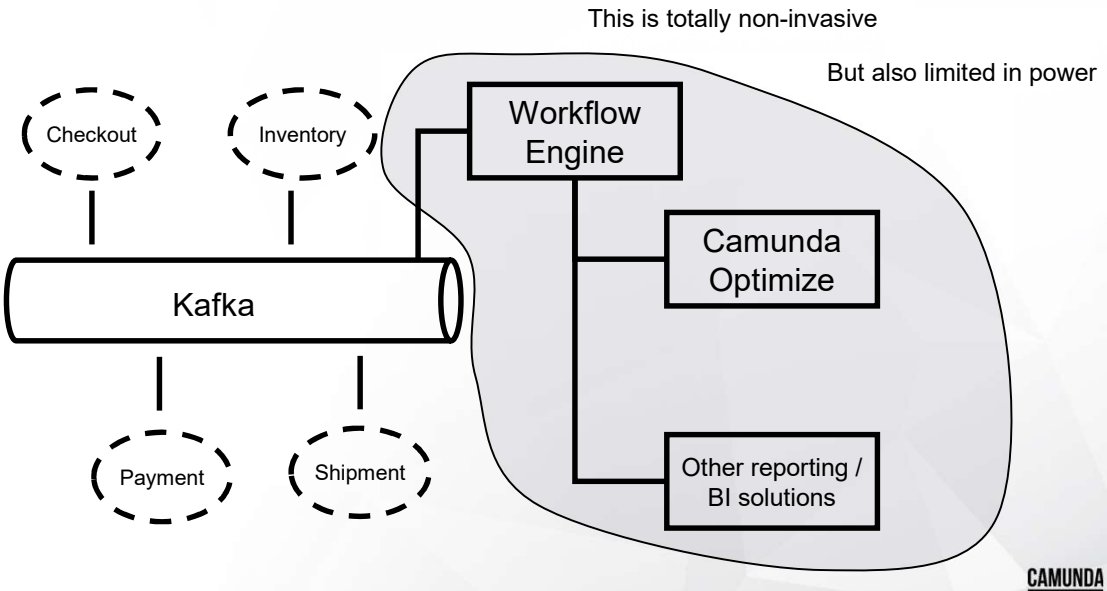
Tracking + BI



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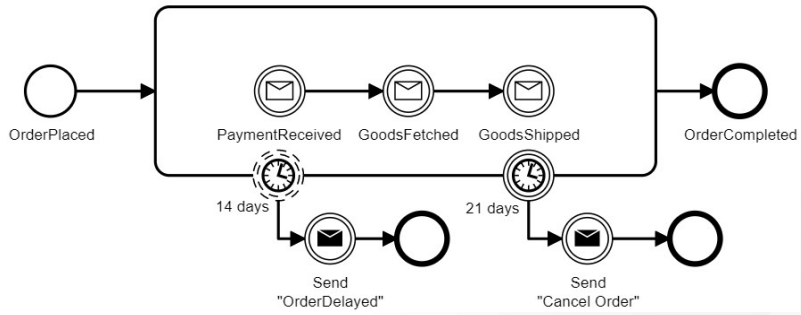
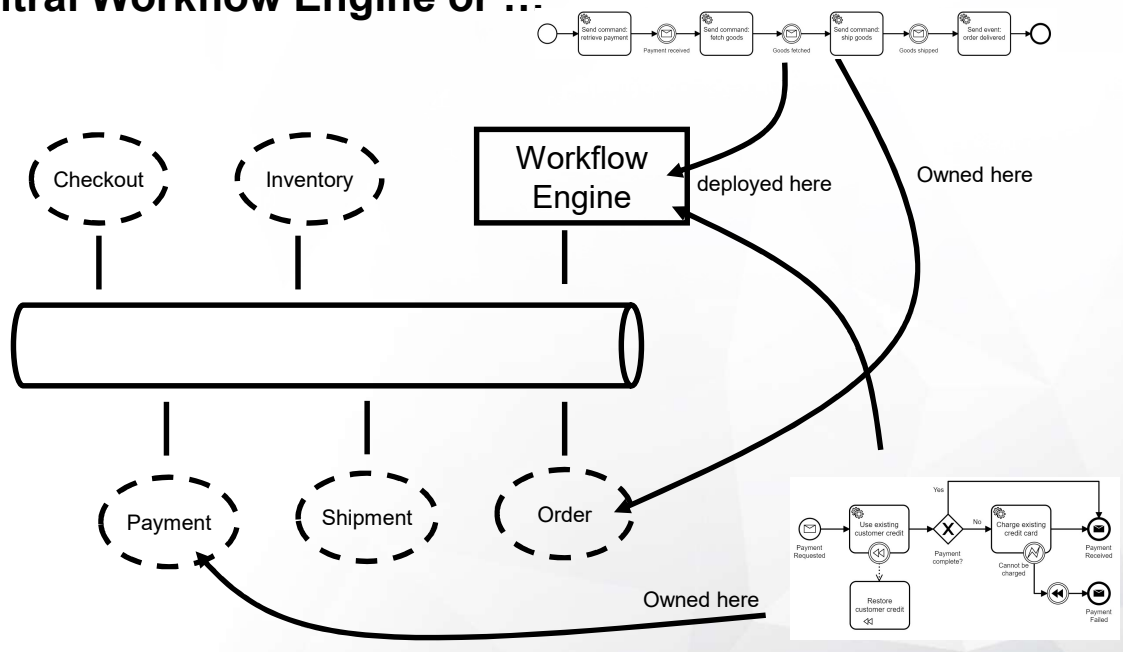
Start Acting Upon Certain Events

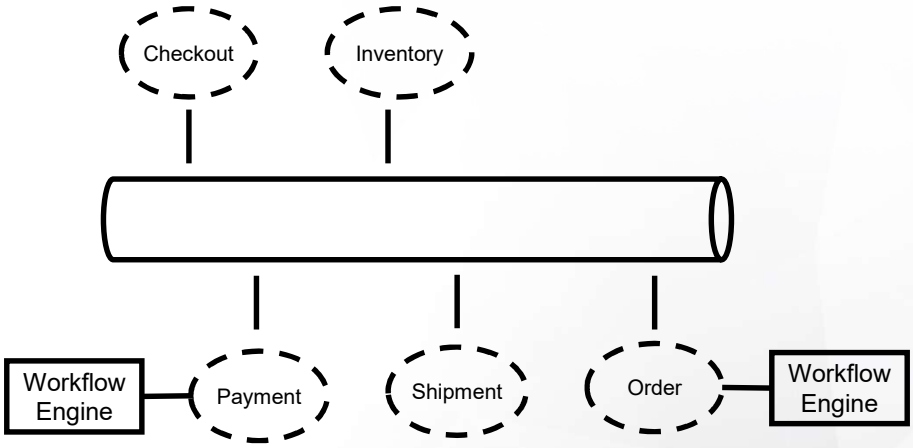


CAMUNDA

Central Workflow Engine or …



…Decentral Workflow Engines



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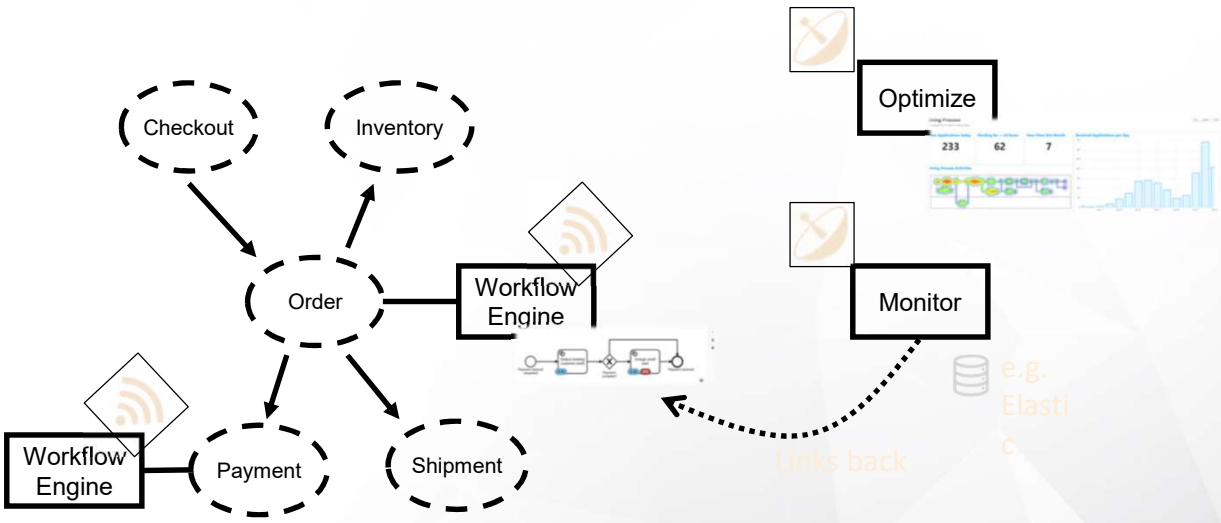
Challenge Monitoring



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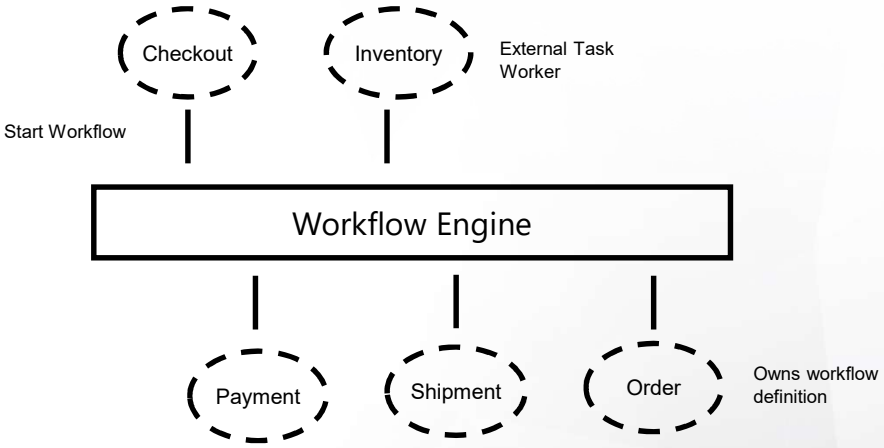
Work Distribution via Workflow Engine



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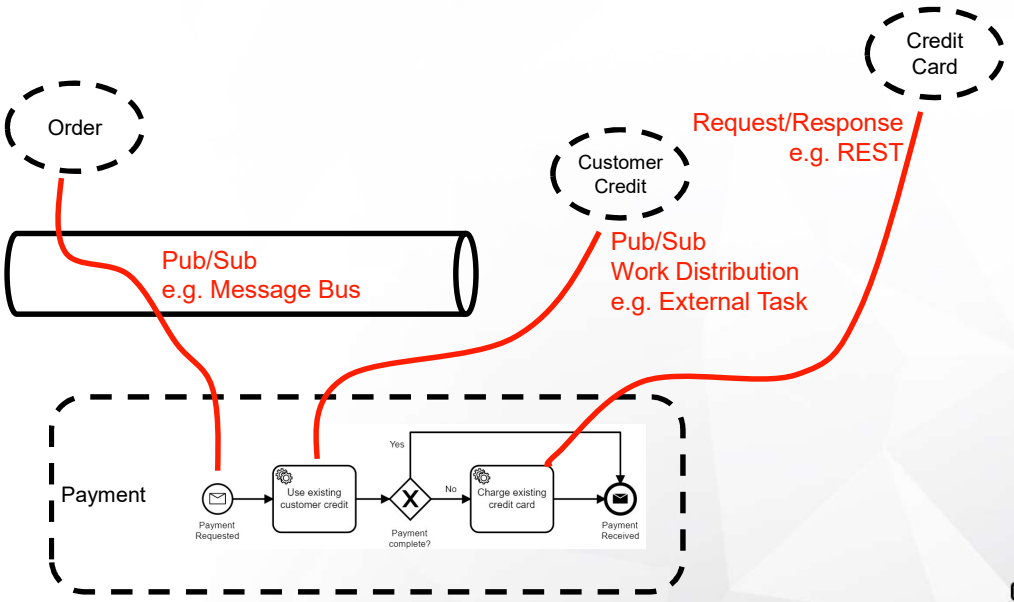
Hybrid Architectures



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Recap

- Microservices have its merits
- You need to balance orchestration and chorography
- Distributed systems need stateful orchestration
- Visibility is essential to survive
- Track, monitor or manage the flow – depending on your scenario
- Workflow automation is an essential building block,
- make sure to use BPMN

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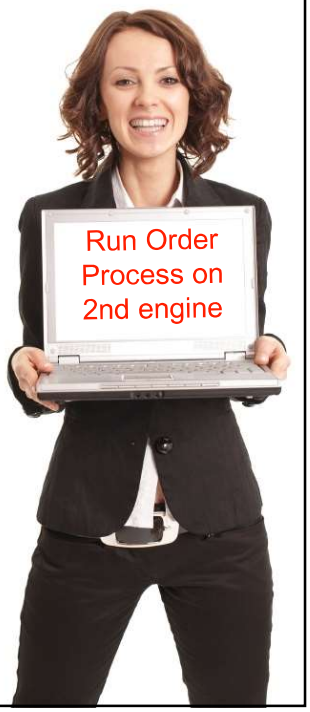
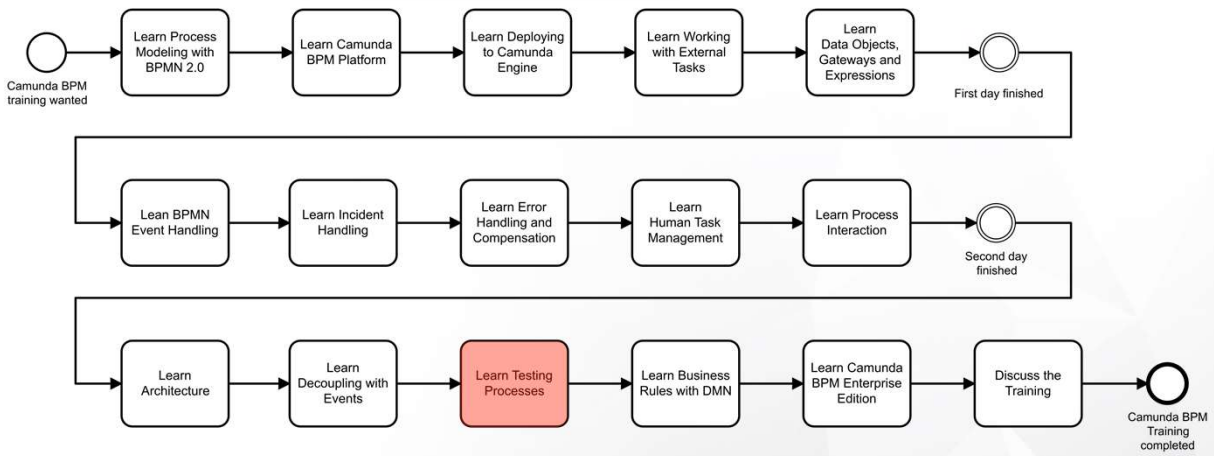
Demo





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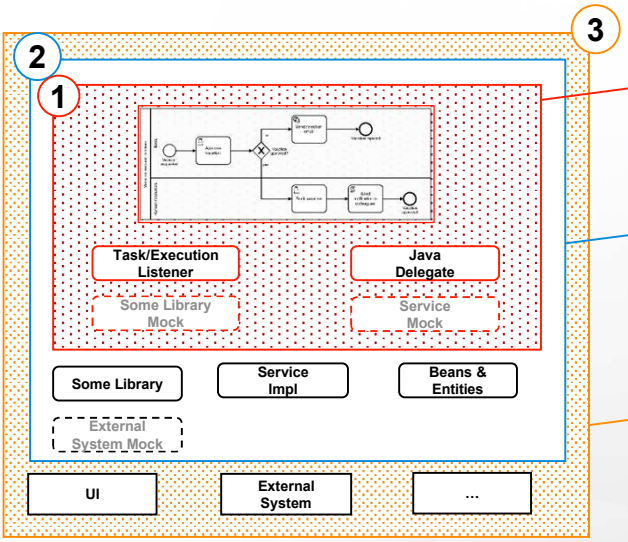
Testing Scopes



Goal: Process Model with Data, EL & Adapter Logic
- In Memory
- Single Thread
- No JobExecutor

Goal: Close to Real-Life environment
- Container
- Arquillian & co

Goal: It REALLY works
- Integration Tests
- Human Driven

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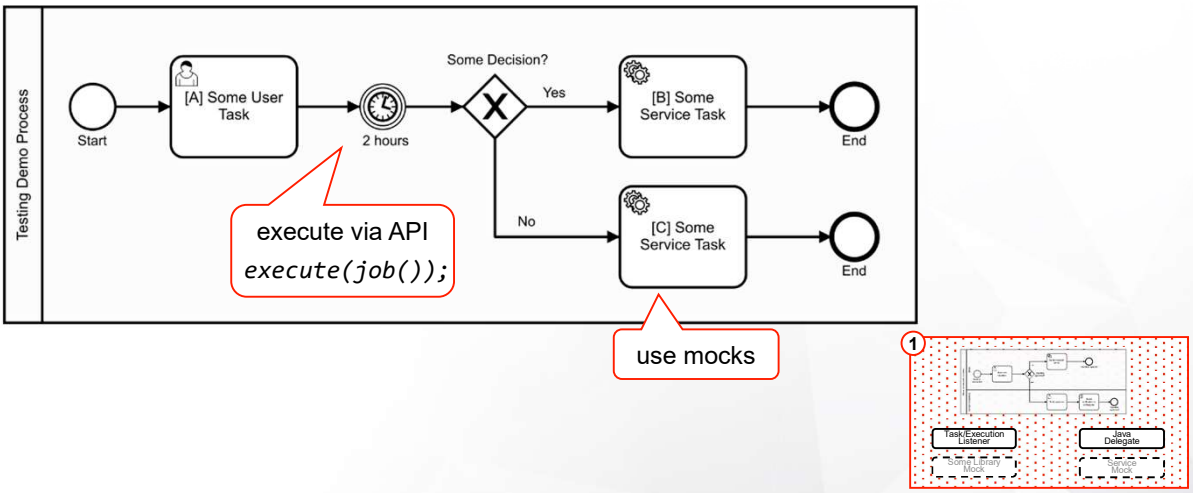
Example



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Unit Test Support

- In memory database: `url: jdbc:h2:mem:process-engine`
- Use the REST API or Java API
- Reproduceable scripted tests
  - Postman collections (REST API)
  - Jest (Javascript, Node.js)
  - … (your programming language)
  - JUnit + camunda-bpm-assert (Java)

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Postman Collection

- Set up an engine with
  - in-memory-database
  - Disable jobExecutor
- Run API calls
- Assert the results
- Transfer variables from response to further requests
- Wrap them in a deployment
- Use collection runner

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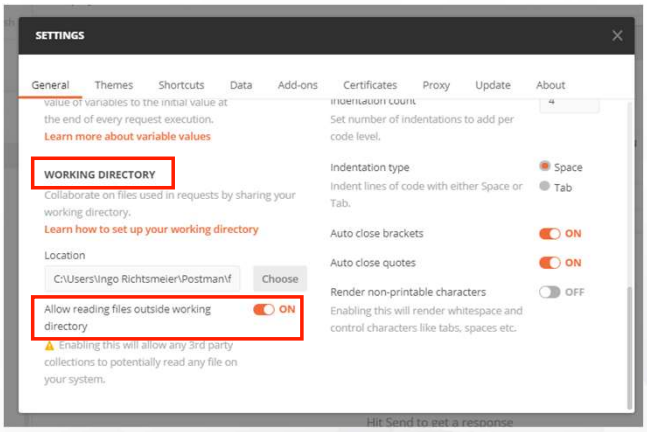
Demo

Settings for process deployment call

To avoid:

```
Form param `process-model`, file load error: PPERM:
insecure file access outside working directory
```

Check the settings:



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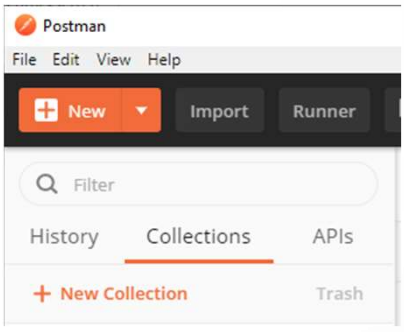
Import Collection



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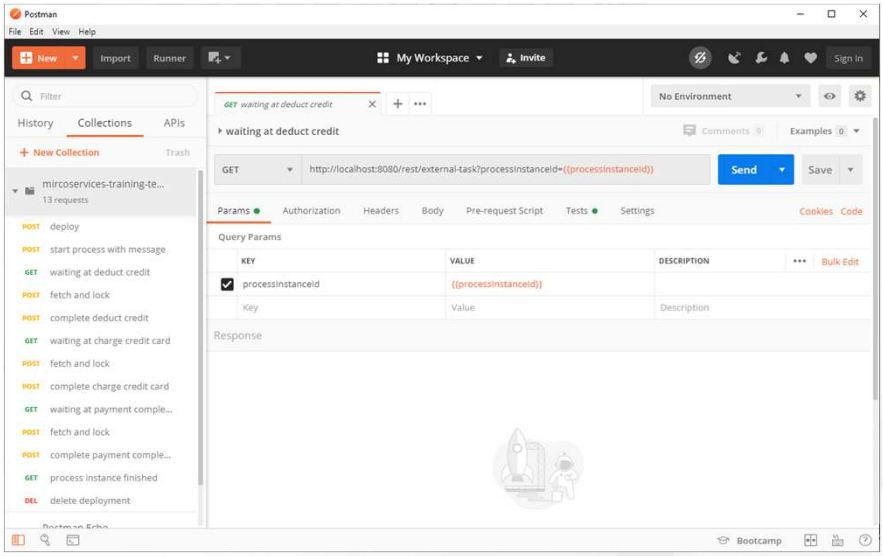
Edit Requests



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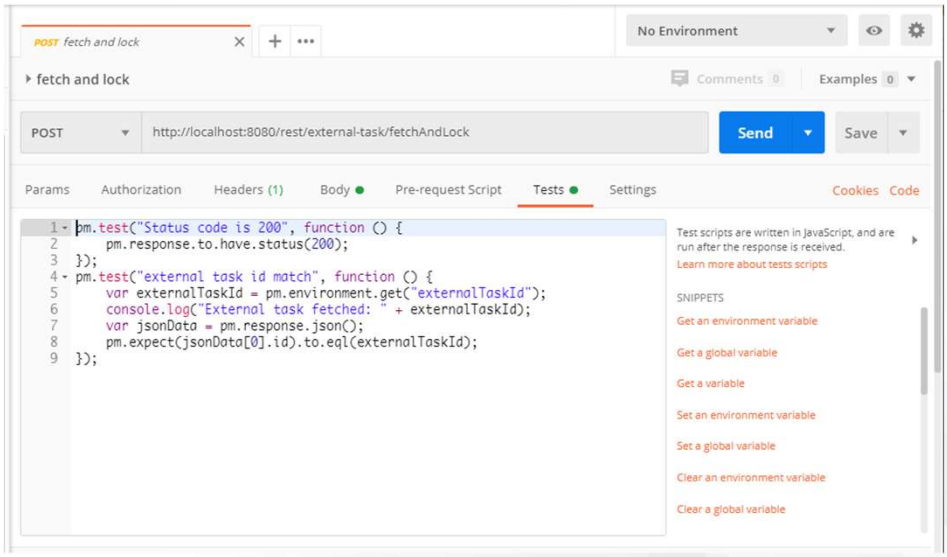
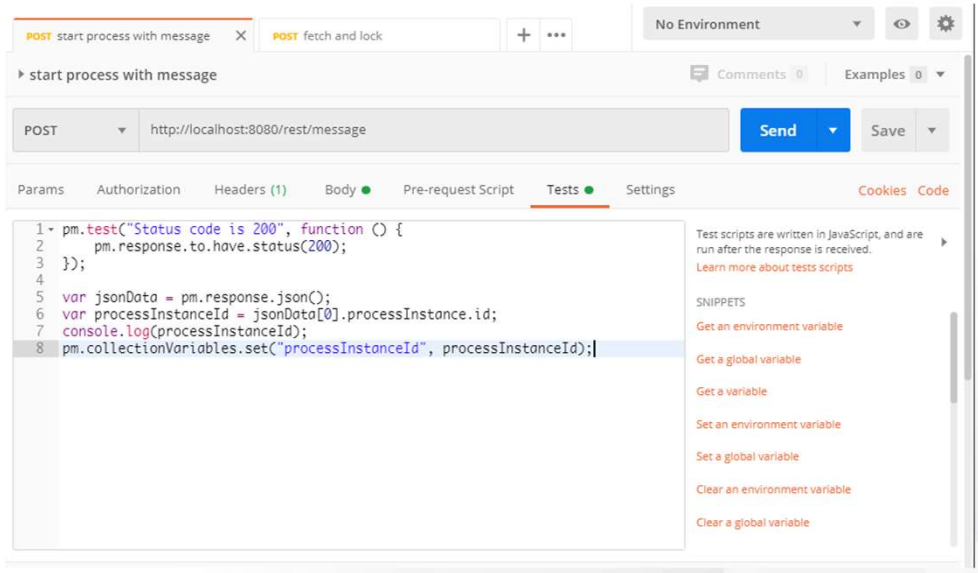
Edit Assertions



CAMUNDA

Transfer Results



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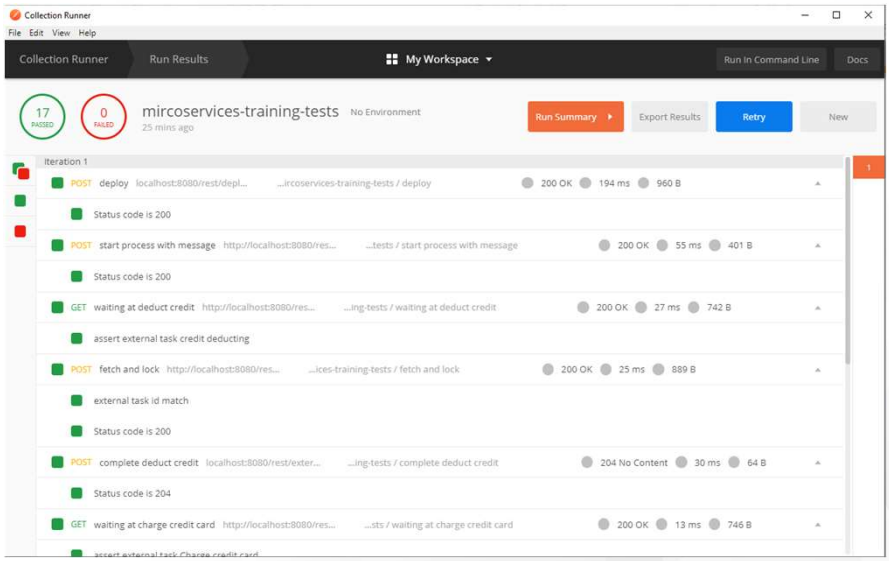
Run Collection



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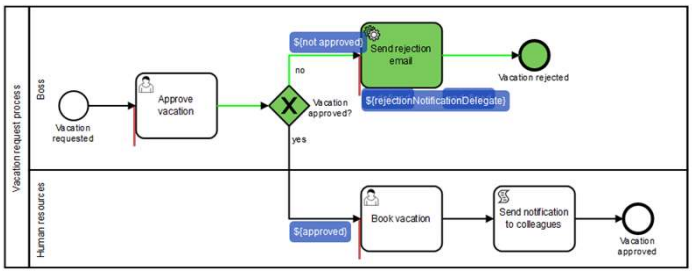
Real Unit Test




```
POST /process-definition/key/VacationRequestProcess/start

{"variables": {"from" : {"value" : "2019-12-20T00:00:00.000+0100", "type": "Date"},
               "until" : {"value" : "2019-12-23T23:59:59.000+0100", "type": "Date"}},
 "startInstructions" :
    [{
        "type": "startAfterActivity",
        "activityId": "approveVacationUserTask",
        "variables": {
          "approved": {"value": false, "local": false, "type": "Boolean"}
        }
    }]
}
```

Process Instance Modification

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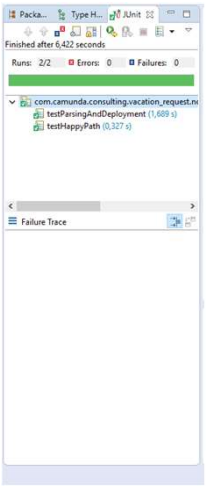
Unit Testing in Java



```
import static org.camunda.bpm.engine.test.assertions.ProcessEngineTests.*;

public class VacationRequestProcessTest {

  @Rule
  public ProcessEngineRule rule = new ProcessEngineRule();

  @Test
  @Deployment(resources = "vacation-request.bpmn")
  public void testHappyPath() {
    ProcessInstance processInstance = runtimeService()
        .startProcessInstanceByKey(PROCESS_DEFINITION_KEY);
    assertThat(processInstance).isWaitingAt("approveVacationUserTask");
    complete(task(), withVariables("approved", true));
    assertThat(processInstance).isWaitingAt("bookVacationUserTask");
    complete(task());
    assertThat(processInstance).isEnded();
  }
}
```

Shortcuts from camunda-bpm-assert

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Mock the Worker

- *assertThat*(processInstance).externalTask("myServiceTask").hasTopic("expectedTopic");
- *complete*(externalTask(), withVariables("name1", "value1", "name2", 123));

https://docs.camunda.org/manual/latest/user-guide/testing/#camunda-assertions

https://github.com/camunda/camunda-bpm-assert/blob/master/docs/User_Guide_BPMN.md

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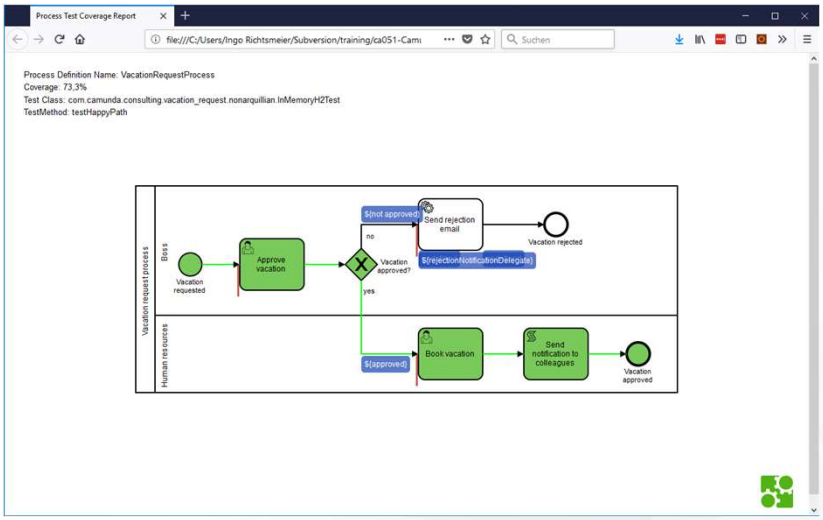
Benefit: Process Test Coverage



https://github.com/camunda/camunda-bpm-process-test-coverage

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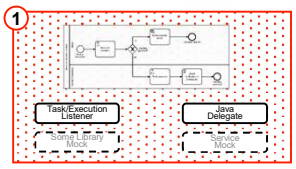
Testing on Scope 1 for Java Developers



We recommend

- JUnit
- Camunda Rule (included in camunda-engine)
- Camunda-bpm-assert (https://github.com/camunda/camunda-bpm-assert)
- Mock-Provider of your choice, e.g. Mockito or EasyMock or Jmockit (maybe + PowerMock)
- Process Instance Modification to start before the unit to test

Benefits

- In Memory Process Engine: Fast & always clean
- Single Thread / No Job Executor: Much easier to understand, no timing issues
- No Container: Less environment, faster turnaround times
- Runs quickly on every developer machine! By “right-click -> Run as Junit”!

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Testing on Scope 2: Integration Tests

Five microservice testing strategies for startups

1. The documentation-first strategy
2. The full stack in-a-box strategy
3. The AWS testing strategy
4. The shared testing instances strategy
5. The stubbed services strategy

https://medium.freecodecamp.org/these-are-the-most-effective-microservice-testing-strategies-according-to-the-experts-6fb584f2edde

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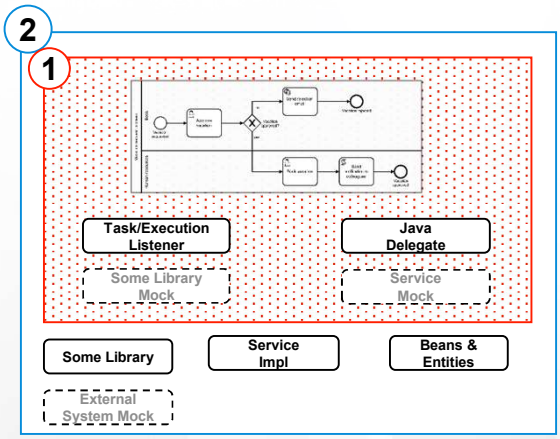
Testing on Scope 2 with Java

- Infrastructure needed (e.g. CDI, Transactions, JPA, …)
- Possible Alternatives
  - Start own test environment
    - Minimalistic (Needle, …)
    - Real (Weld, Hibernate, OpenEJB, …)
    - Often Spring-Driven
  - Run tests as integration tests
  - Arquillian
- Forces:
  Effort for setup & maintenance, effort to run, possibility to run on developer machine



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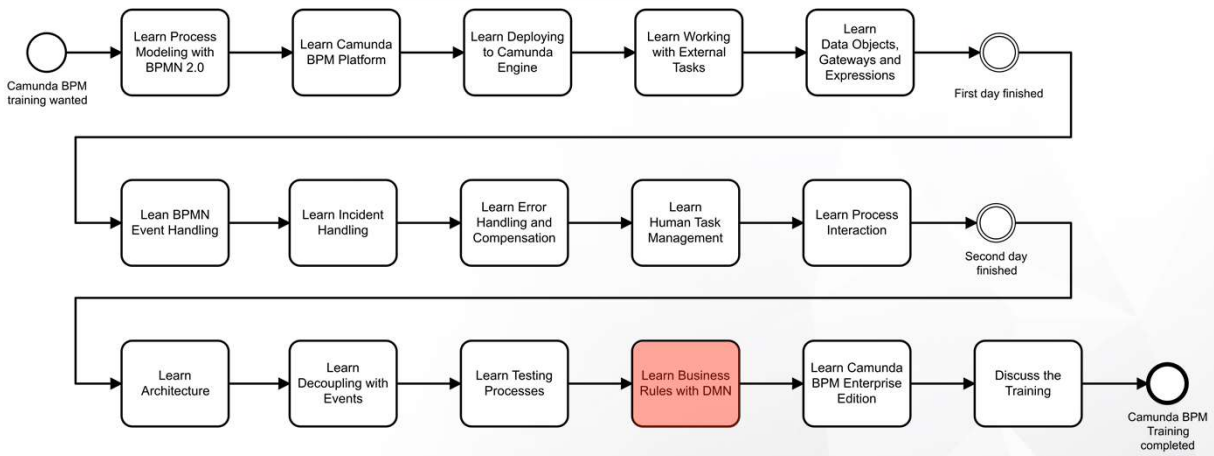
Exercise 11

https://training.camunda.com/microservices
user: microservices
password: camundarocks



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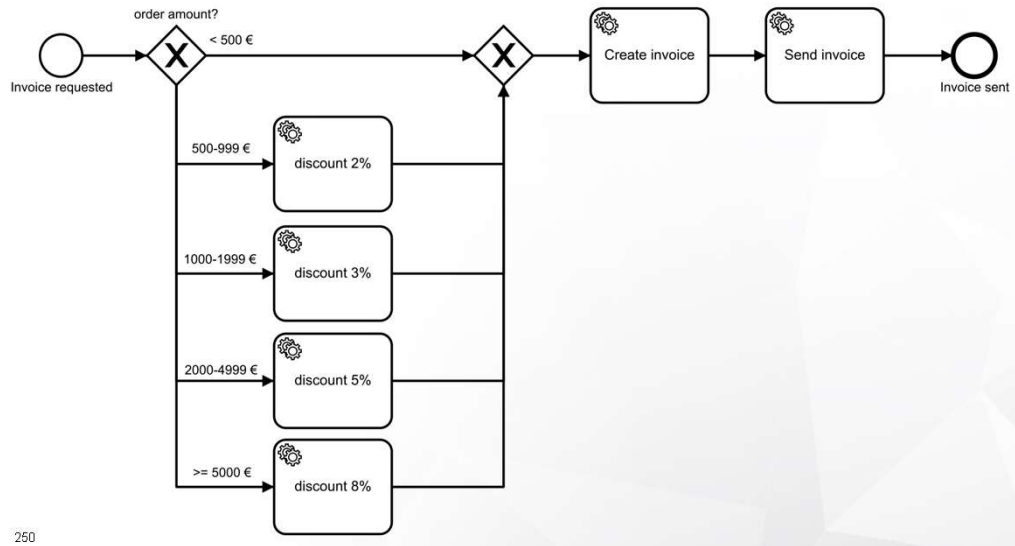
Is This a Good Process Model?



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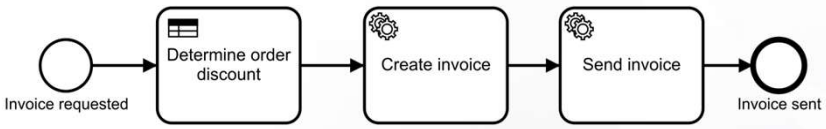
An Improved Version



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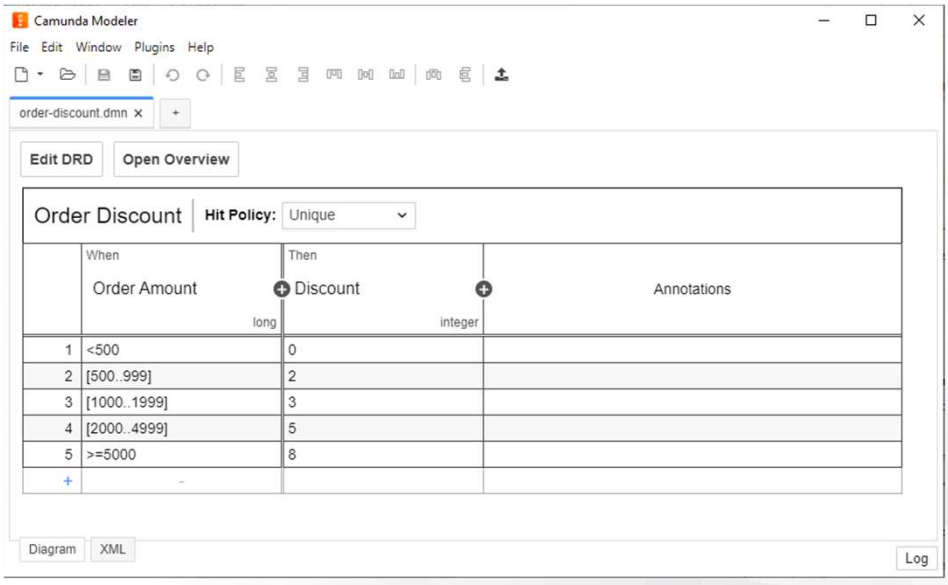
Discount Rules as DMN Decision Table



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The Standard DMN

- Decision Model and Notation
- Is currently in publications by OMG for Decisions/Business Rules

- Specification: „The primary goal of DMN is to provide a **common notation** that is readily understandable by all **business users**, from the business analysts needing to create initial decision requirements and then more detailed decision models, to the **technical developers** responsible for automating the decisions in processes, and finally, to the business people who will manage and monitor those decisions. DMN creates a standardized **bridge for the gap between the business decision design and decision implementation**. DMN notation is designed to be **useable alongside the standard BPMN** business process notation."

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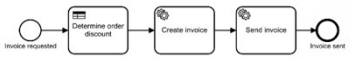
Typical Frequency of Changes

Business Processes	Rule Structure (Columns)	Rules (Rows)
		
Changes of Process Model causes effort for system integration or even organizational change	Change of the structure causes effort, as you may need additional input parameters	Changes of rules (rows in table) are very easy to do, but think about validation & testing
Less frequent (months or years)	Less frequent (months)	Very frequent (weeks)

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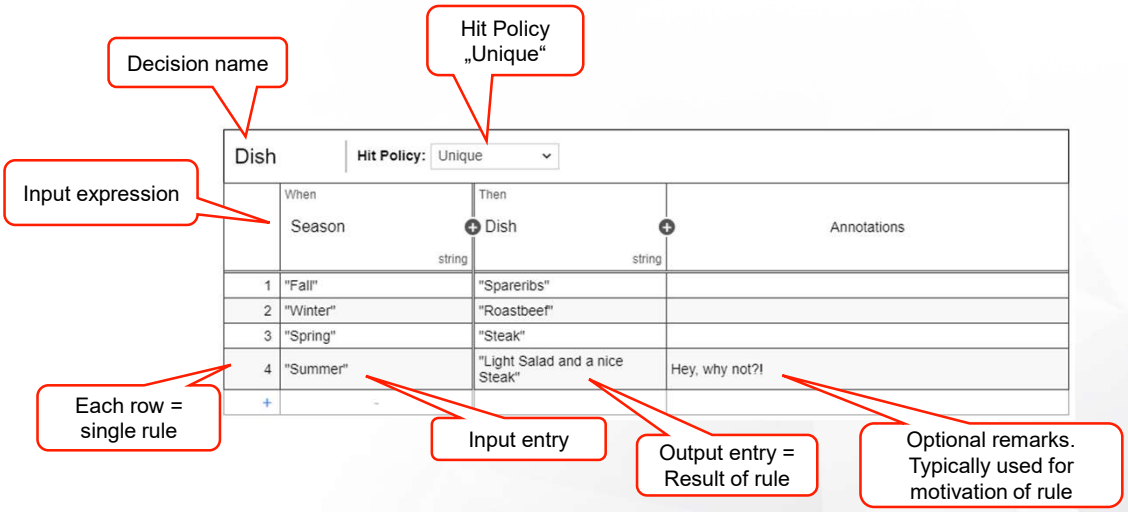
Rules Expressed as Decision Table



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Multiple Inputs

Input entries can have various data formats

Dish | Hit Policy: Unique

	When Season (string)	And Vegetarian Guests (boolean)	Then Dish (string)	Annotations
1	"Fall"	false	"Spareribs"	
2	"Winter"	false	"Roastbeef"	
3	"Spring"	false	"Steak"	
4	"Summer"	false	"Light Salad and a nice Steak"	Hey, why not?!
5	-	true	"Pasta"	

Multiple inputs always follow „AND“ logic

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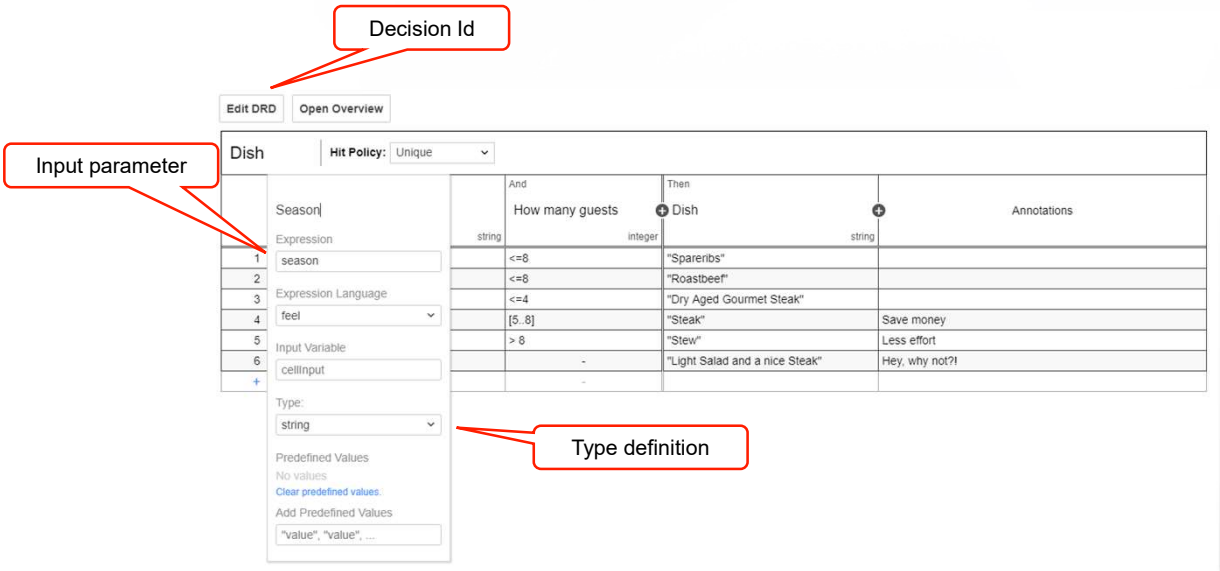
Technical Details (1)



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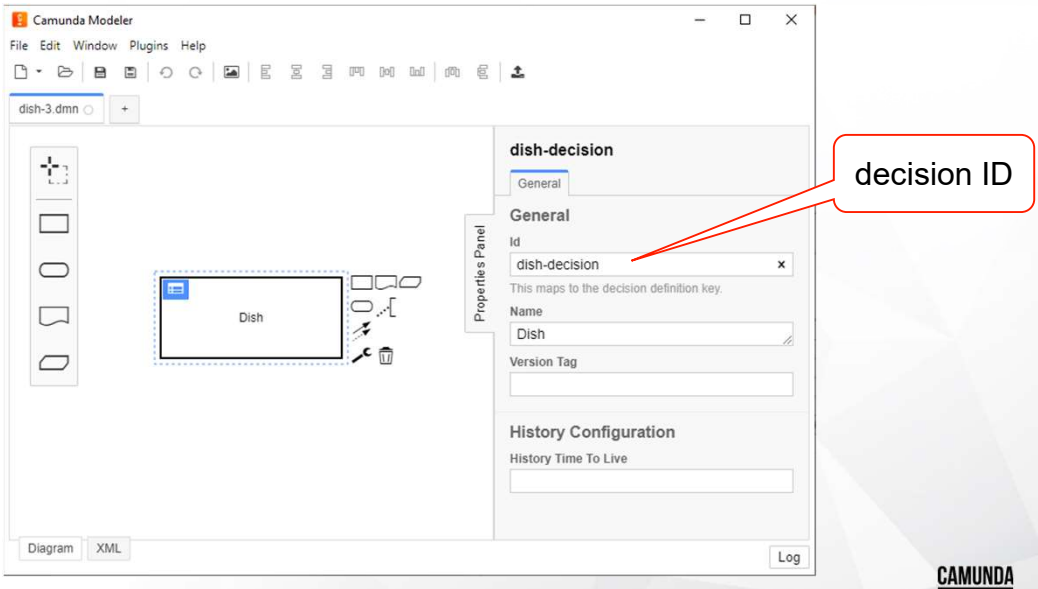
Technical Details (2)



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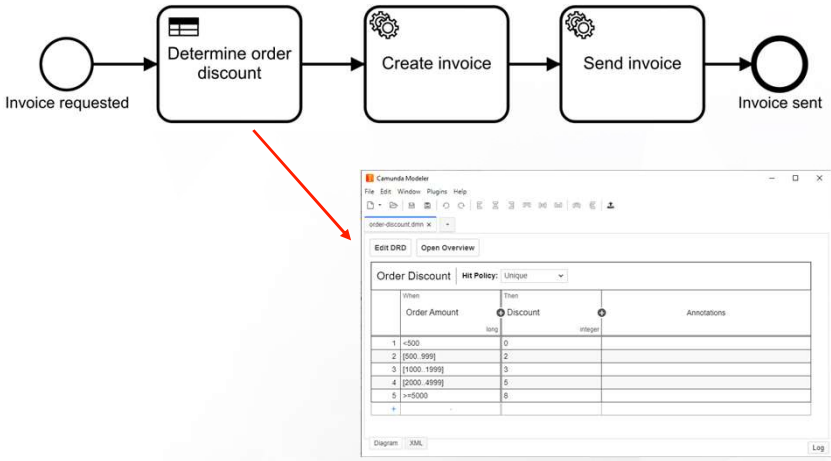
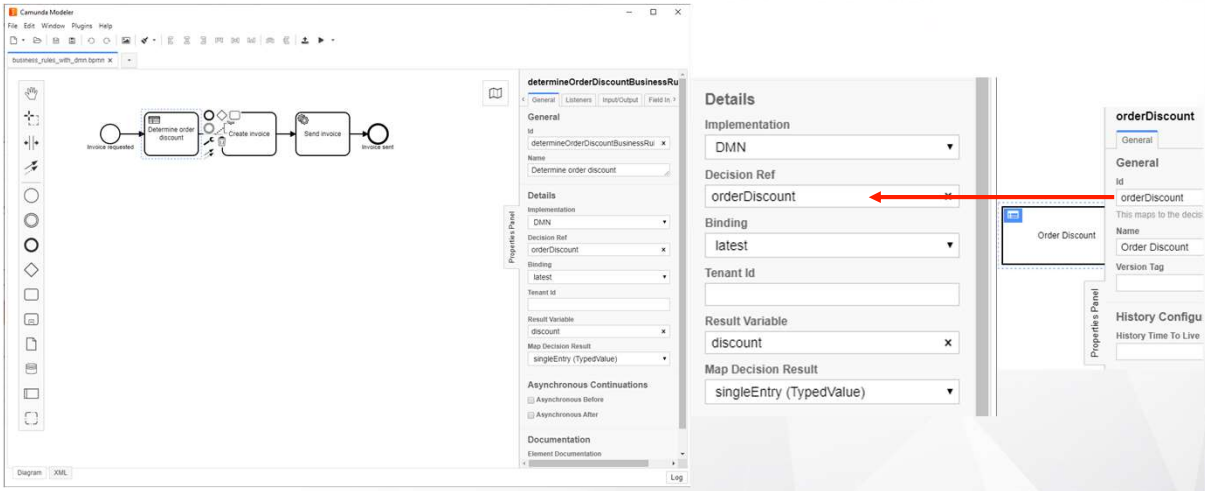
Business Rule Task Reference a DMN Decision Table



CAMUNDA

Reference in Camunda Modeler



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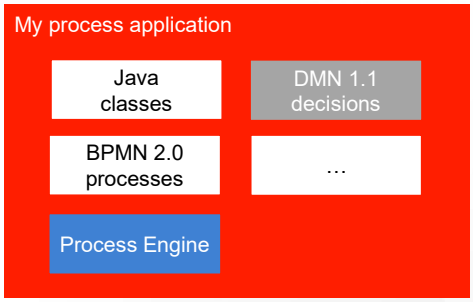
DMN Is Part of the BPM Platform



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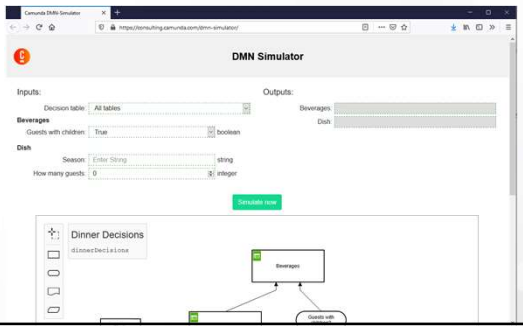
Standalone Stateless Decision Engine

- You can use the core DMN engine as stateless Rule Engine separately from the BPM Platform if you like
- Available as library
- Example:
  DMN Simulator: https://consulting.camunda.com/dmn-simulator/



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Decision Service in the Platform

```
DmnDecisionTableResult result  = processEngine
    .getDecisionService()
    .evaluateDecisionTableByKey(decisionDefinitionKey, variables);
```

Also available as REST-Service

```
POST /decision-definition/key/aDecisionDefinitionKey/evaluate

Request body:
{
  "variables" : {
    "amount" : { "value" : 600, "type" : "Double" },
    "invoiceCategory" : { "value" : "Misc", "type" : "String" }
  }
}

Response:
[
  {
    "result": { "value" : "management", "type" : "String", "valueInfo" : null }
  }
]
```


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Hit Policies

- Single
  - **U**(nique): Only one rule can match
  - **A**(ny): Multiple rules may match – must have same output
  - ***P***(riority): Rule with highest priority (output field) is selected
  - **F**(irst): First matching rule (order in table!) is selected
- Multiple
  - ***O***(utput Order): List of rules in order of priority (output field)
  - **R**(ule Order): List of rules in order of table
  - **C**(ollect): List of all hits without order, might be combined with operator **+** (sum), **<** (min), **>** (max), **#** (count)

Italic hit policies are not yet supported by the Camunda DMN engine

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Examples From the Spec

Applicant Risk Rating

U	Applicant Age	Medical History	Applicant Risk Rating
1	> 60	*good*	*Medium*
2		*bad*	*High*
3	[25..60]	-	*Medium*
4	< 25	*good*	*Low*
5		*bad*	*Medium*

Student Financial Package Eligibility

R	Student GPA	Student Extra-Curricular Activities Count	Student National Honor Society Membership	Student Financial Package Eligibility List
1	> 3.5	>= 4	*Yes*	20% Scholarship
2	> 3.0	-	*Yes*	30% Loan
3	> 3.0	>= 2	*No*	20% Work-On-Campus
4	<= 3.0	-	-	5% Work-On-Campus

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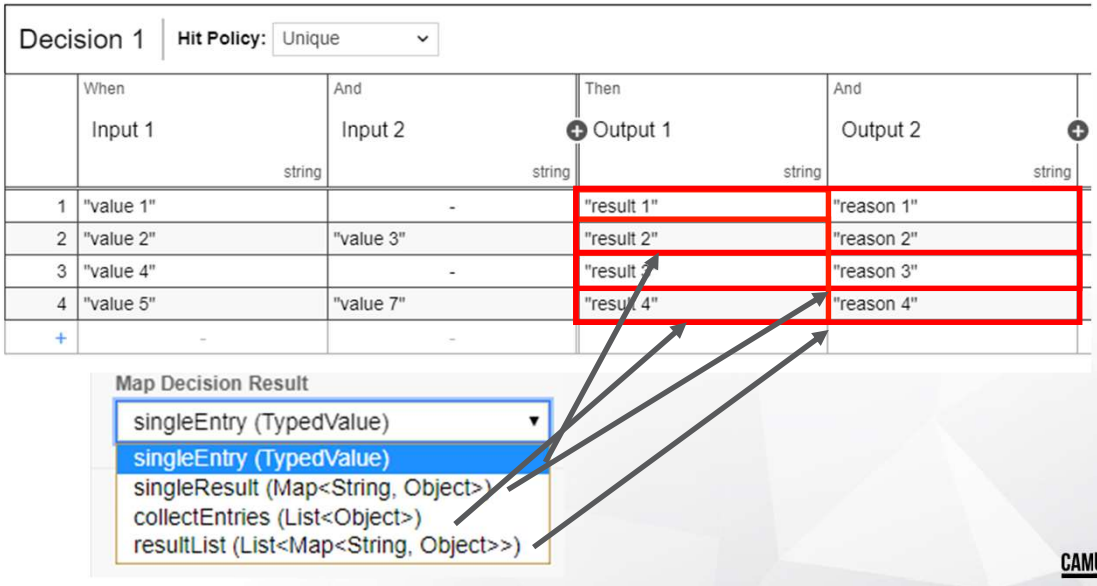
Map the Result to the Process



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Map the Result to the Process

Mapper	Result	Is suitable for decision tables with
singleEntry	`TypedValue`	No more than one matching rule and only one output
singleResult	`Map<String, Object>`	No more than one matching rule and multiple outputs
collectEntries	`List<Object>`	Multiple matching rules and only one output
resultList	`List<Map<String, Object>>`	Multiple matching rules and multiple outputs

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Friendly Enough Expression Language (FEEL)

[date and time(„2016-12-24T00:00:00“)
..
date and time(„2016-12-26T23:59:99“)]

Support for different „endpoint“ data types: number, string, boolean, time, date, date-time, time-duration.

Simple Expressions | Hit Policy

	When Season string	And Date date	And Number of guests integer	And Children boolean	Dish string	Annotations
1	-	[date and time("2016-12-24T00:00:00")..date and time("2016-12-26T23:59:99")]	-	-	"Christmas Dinner"	
2	"Winter"	-	-	true	"Vegetables"	
3	"Winter"	-	<=6	-	"Steak"	
4	"Winter"	-	]6..10[	-	"Pizza"	Same as (6..10)
5	"Winter"	-	[10..12]	-	"Huge Pizza"	
6	"Winter"	-	12,[13..14],>14	-	"Family Deluxe Pizza"	
7	"Spring", "Summer", "Fall"	-	-	true	"Salad"	
8	not("Winter")	-		false	"Salad with Goat Cheese"	
9	not("Spring","Summer","Fall")	-		-	"Vegetables"	It is Winter again :-)
+	-	-	-	-		

Negation

Support for Comparison (<, <=, >, >=) and Ranges ([x..y]):
- Start included: [
- Start excluded:] or (
- End included:]
- End excluded: [or)

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FEEL Functions

- Full support for FEEL (since 7.13)
- Built-in functions (see https://camunda.github.io/feel-scala/):
- Example expressions and functions:

```
contains("foobar", "of")

applicant.monthly.income * 12

if applicant.maritalStatus in ("M","S") then "valid" else "not valid"

sum( [applicant.monthly.repayments, applicant.monthly.expenses] )

sum( credit_history[record_date > date("2011-01-01")].weight )

some ch in credit_history satisfies ch.event = "bankruptcy"
```

https://github.com/camunda/feel-scala

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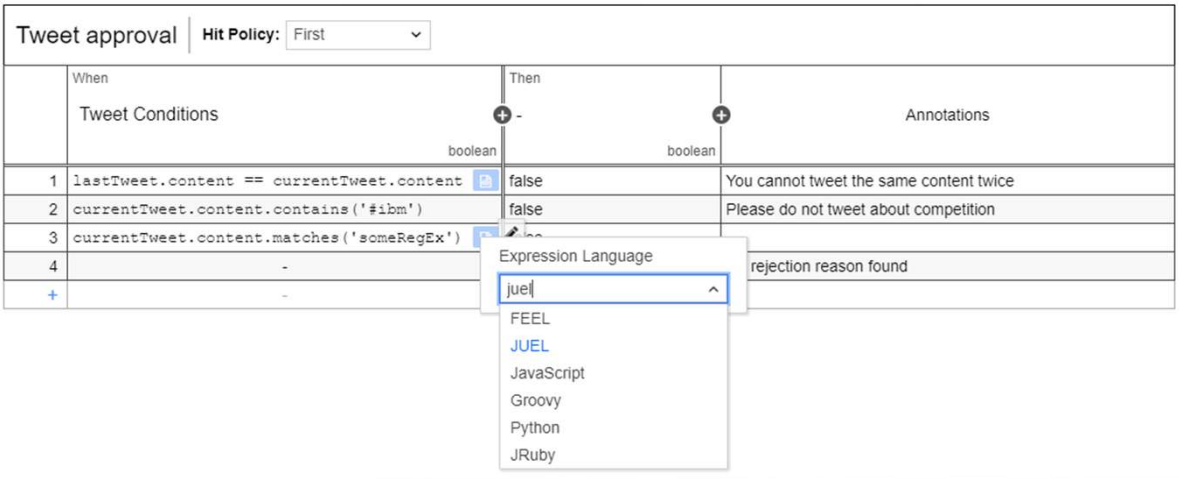
Scripting as Expression Language



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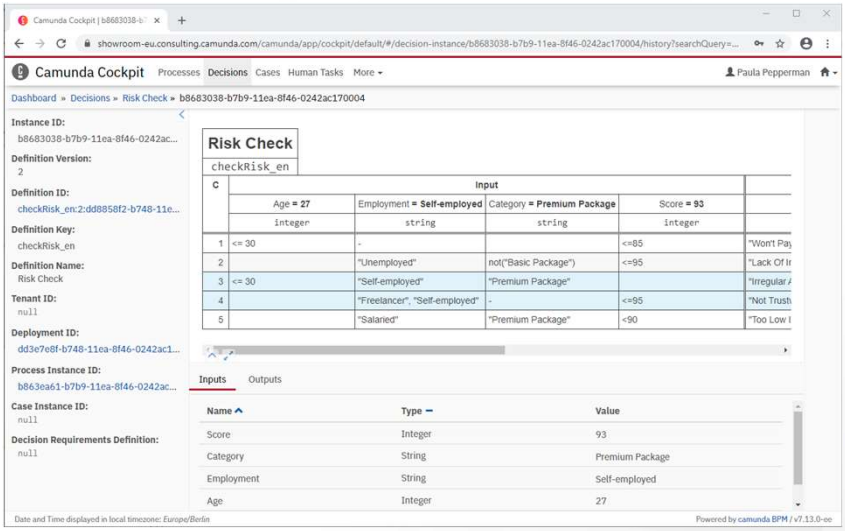
Cockpit for Decisions



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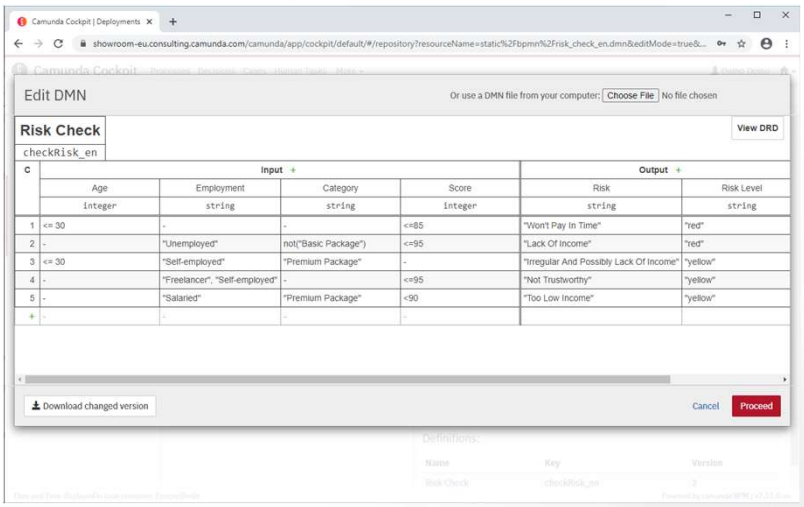
Live Editing of Decision Tables

Enterprise Feature



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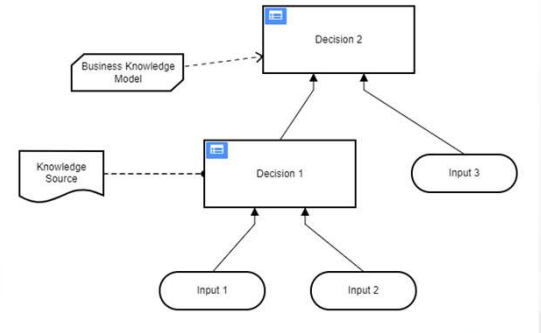
Beyond (Or Before) Decision Tables

- DMN defines „Decision Requirements Diagram“
- Decision Requirements Diagrams will define the decisions […], their interrelationships, and their requirements for decision logic
- Starting point for modeling complex decisions
- Elements of Decision Requirements Diagram



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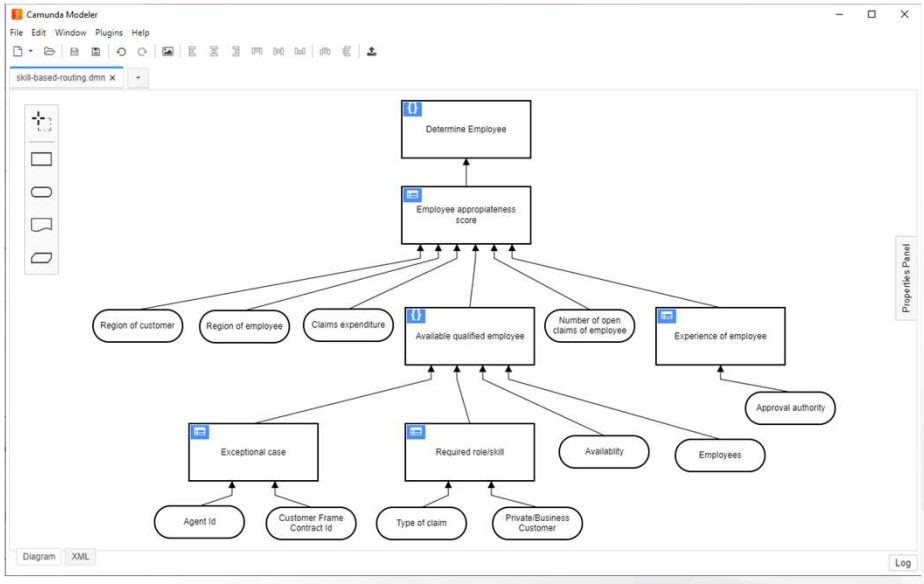
DRD Example: Skill Based Routing



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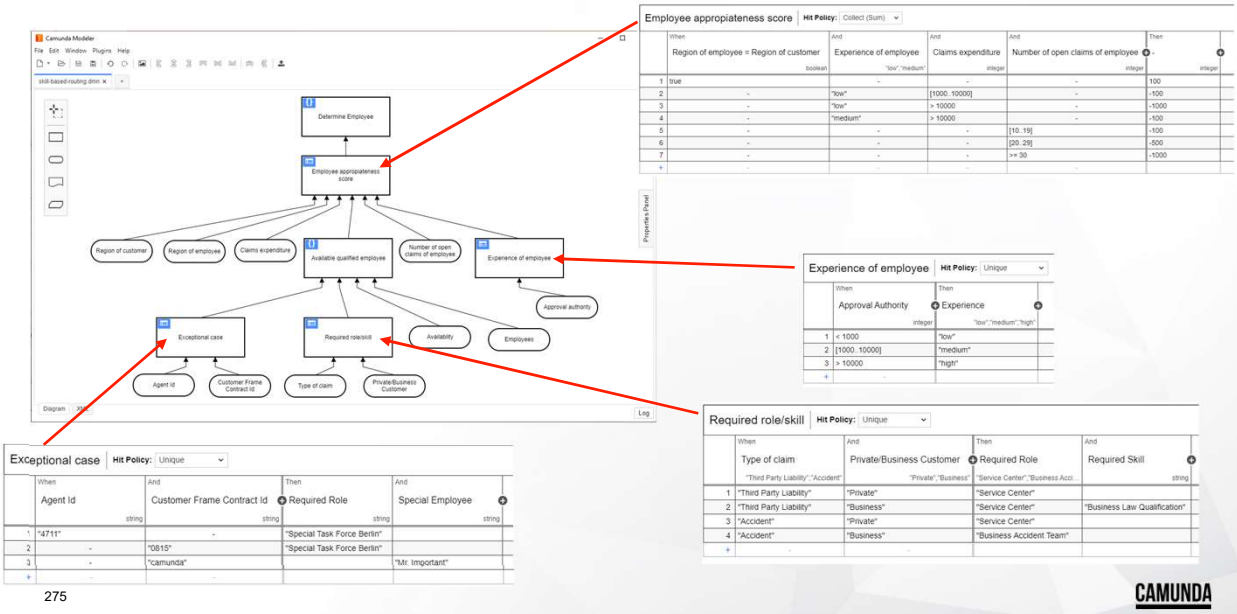
Decisions Reference Decision Tables



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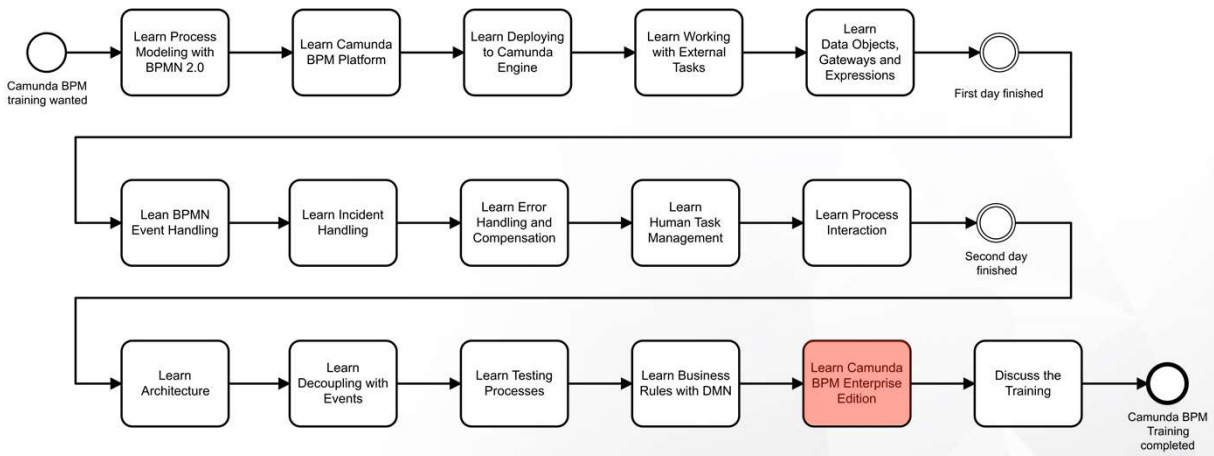
Exercise 12

https://training.camunda.com/microservices
user: microservices
password: camundarocks



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Enterprise Exclusive Cockpit Features

- Process Definition History
- Process Definition Heatmap
- Process Instance History
- Process Instance Migration
- Process Instance Modification
- Bulk Retry and Bulk Cancel
- Decision Table Live Editing
- Process Duration Report
- Redeploy Definitions

https://camunda.com/bpm/enterprise/#cockpit

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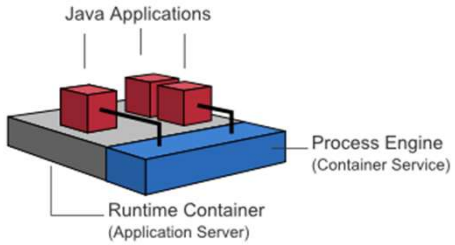
Runtime Support

- Integration with IBM WAS
- Integration with Oracle WLS



https://camunda.com/bpm/enterprise/#as

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SLA Based Support

- Reliable support infrastructure with direct contact to core developers
- Service Level Agreements (SLA)

Level	Name	Description	Availability		Max. response time	
			Standard SLA	Advanced SLA	Standard SLA	Advanced SLA
L1	Blocker	Core components (i.e., process engine) of Camunda BPM do not work at all/produce critical errors that prevent usage in production mode.	8x5	24x7	8 business hours	2 hours
L2	Critical	Usage of Camunda BPM seriously affected, a workaround is urgently needed.	8x5		8 business hours	
L3	Help Request	Non-critical errors, Help Requests, Feature Requests.	8x5		16 business hours	

https://camunda.com/bpm/enterprise/#support

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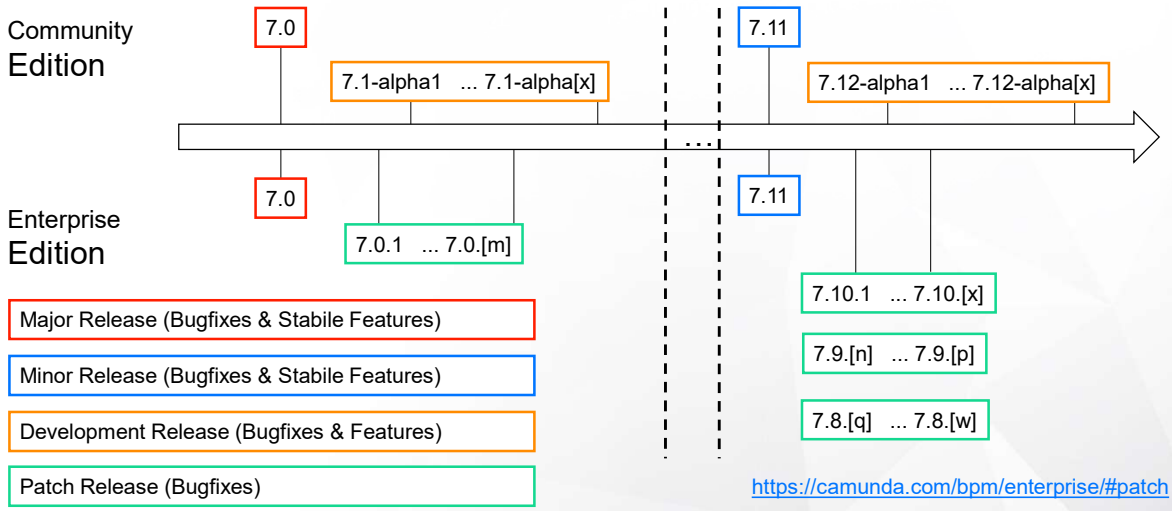
Patch Releases



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Please Plan your Updates

- Check patch releases: Bugs that bother you?
- Minor release:
  - 6 Months before End of Support you will receive a mail
  - Check if you run the version mentioned here
  - If yes, start planning your update

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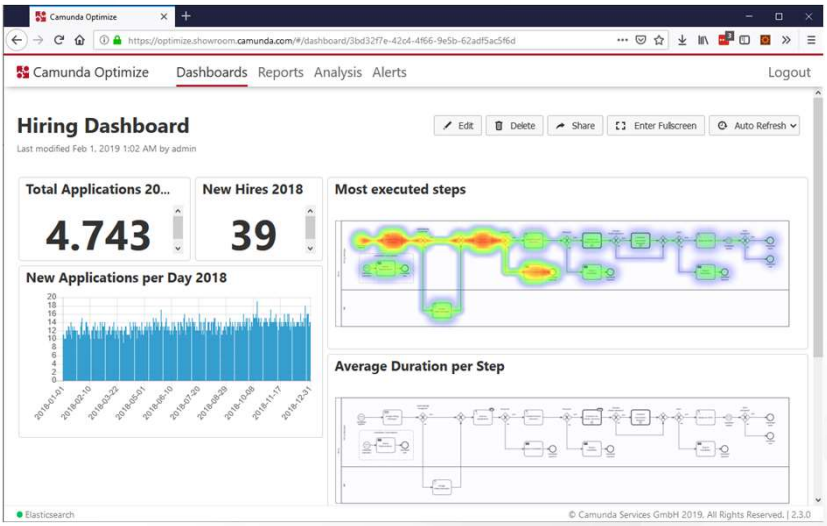
Optimize



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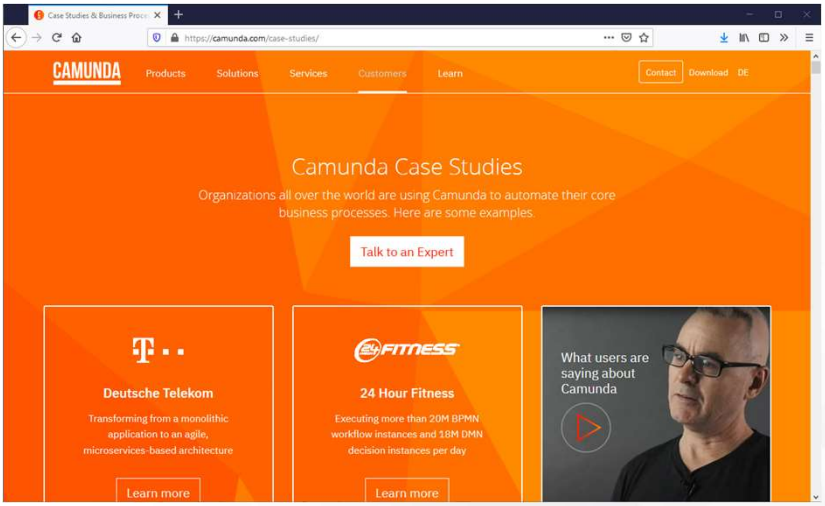
References



https://camunda.com/case-studies/

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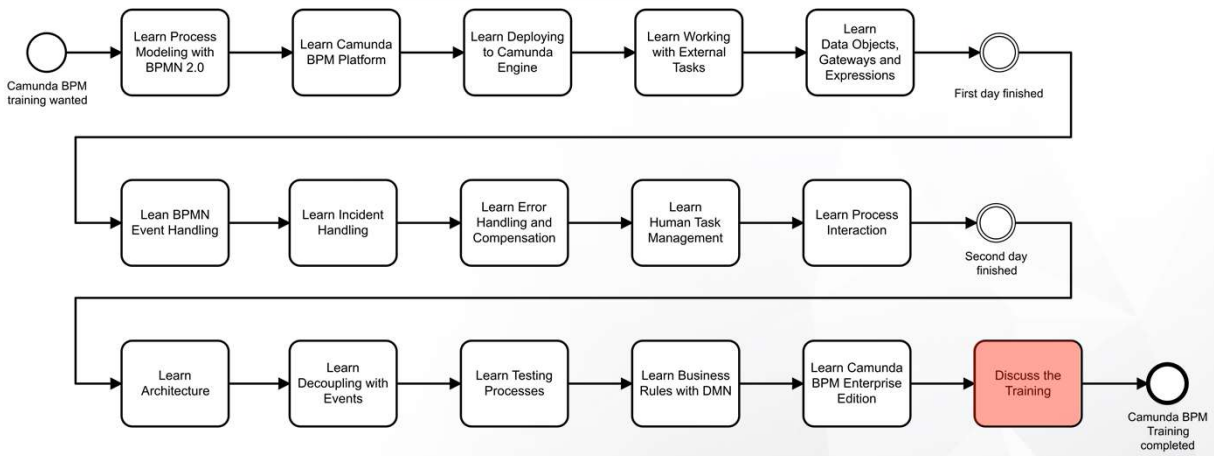

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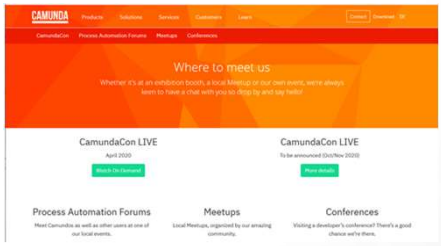
How to Get Updates From the Team?

Blog: https://blog.camunda.org/

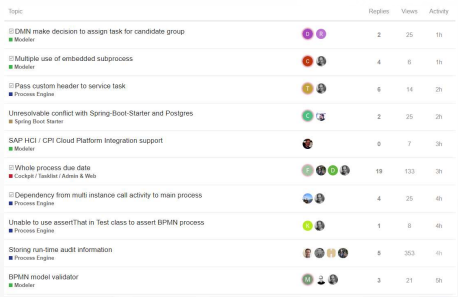
Camunda Team Blog

Whitepapers:
https://camunda.com/learn/whitepapers/

Events: https://camunda.com/events/



Forum: https://forum.camunda.org/



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Camunda Training Offering

Overview trainings	Modeling trainings	Development trainings
Camunda BPM Overview (1 day) → Introduction into BPMN → Hands on Camunda BPM → Monitoring & Reporting → How to start with Camunda	**BPMN (3 days)** → BPMN in detail → Implementing BPM-projects with BPMN → BPMN real world examples → BPMN in context of DMN	**Camunda BPM for developers (3 days)** → Introduction BPMN → Camunda BPM Architecture → Automating processes with Camunda → Testing, deployment, versioning
OCEB training (2 days) → Prepare for the OCEB BPM certification	**DMN (1 day)** → DMN in detail → Decision design → Complex decisions with DRDs → DMN in context of BPMN	**Camunda BPM DevOps (2 days)** → Camunda BPM installation → Monitoring & alarming → Process version migration → Advanced DevOps topics

You'll find further information under
camunda.com/de/services/training

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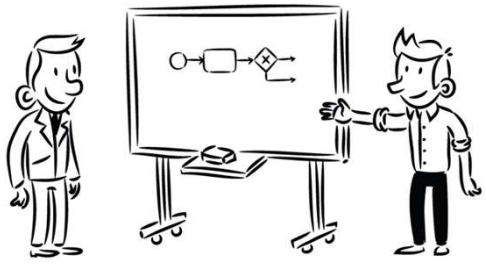
Want to Learn More BPMN?

- 3-day training
- Learn in-depth BPMN 2.0
  - Understand BPMN
  - Apply BPMN
  - Introduce BPMN



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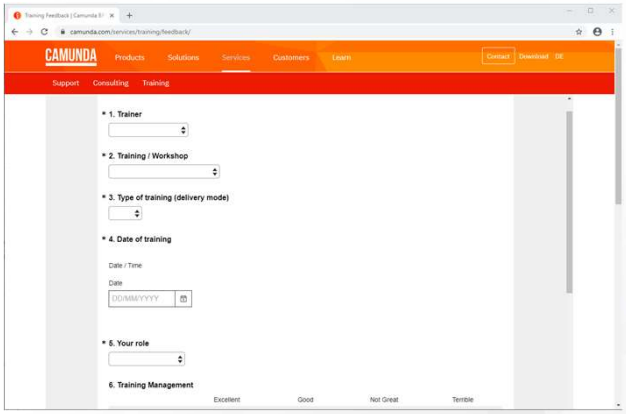
Feedback

Please fill out this form:

https://camunda.com/services/training/feedback/



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