Business Process Intelligence (BPI) course

Organizational Mining

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BPI-I12

Chair of Process and Data Science

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Exercise 1

Create the resource-activity matrix for the following event log.

$$
\begin{aligned}
L = [&\langle a^{John}, b^{Mike}, c^{John}, d^{Pete}\rangle,\\
&\langle a^{John}, c^{Mike}, b^{John}, d^{Pete}\rangle,\\
&\langle a^{Sue}, b^{Carol}, c^{Sue}, d^{Pete}\rangle,\\
&\langle a^{Sue}, c^{Carol}, b^{Sue}, d^{Pete}\rangle,\\
&\langle a^{Sue}, e^{Clare}, d^{Clare}\rangle]
\end{aligned}
$$

Exercise 1 - Solution

Create the resource-activity matrix for the following event log.

$$
\begin{aligned}
L = [&\langle a^{John}, b^{Mike}, c^{John}, d^{Pete}\rangle, \\
&\langle a^{John}, c^{Mike}, b^{John}, d^{Pete}\rangle, \\
&\langle a^{Sue}, b^{Carol}, c^{Sue}, d^{Pete}\rangle, \\
&\langle a^{Sue}, c^{Carol}, b^{Sue}, d^{Pete}\rangle, \\
&\langle a^{Sue}, e^{Clare}, d^{Clare}\rangle]
\end{aligned}
$$

Resource-activity matrix:

	a	b	c	d	e
Mike	0	0.2	0.2	0	0
John	0.4	0.2	0.2	0	0
Carol	0	0.2	0.2	0	0
Sue	0.6	0.2	0.2	0	0
Pete	0	0	0	0.8	0
Clare	0	0	0	0.2	0.2

Exercise 2

Based on the following event log, create the handover of work matrix where you consider multiple transfers within the same case. Create the corresponding social network and annotate each arc with its corresponding weight*.

$$
\begin{aligned}
L = [&\langle a^{Sara}, b^{John}, e^{Felix}, d^{Alex}, a^{John}, b^{Felix}\rangle,\\
&\langle a^{Sara}, c^{Rene}, d^{Felix}, b^{Alex}, d^{Felix}, c^{John}\rangle,\\
&\langle a^{Sara}, b^{Rene}, e^{John}, d^{Alex}, a^{John}, b^{Felix}\rangle,\\
&\langle a^{Sara}, b^{Rene}, c^{Sara}, d^{Rene}, a^{John}, b^{Felix}, d^{John}\rangle,\\
&\langle a^{Sara}, b^{Rene}, d^{John}, b^{Alex}, c^{John}, c^{John}\rangle]
\end{aligned}
$$

*: Mean number of times a resource passes over work to another resource per case.

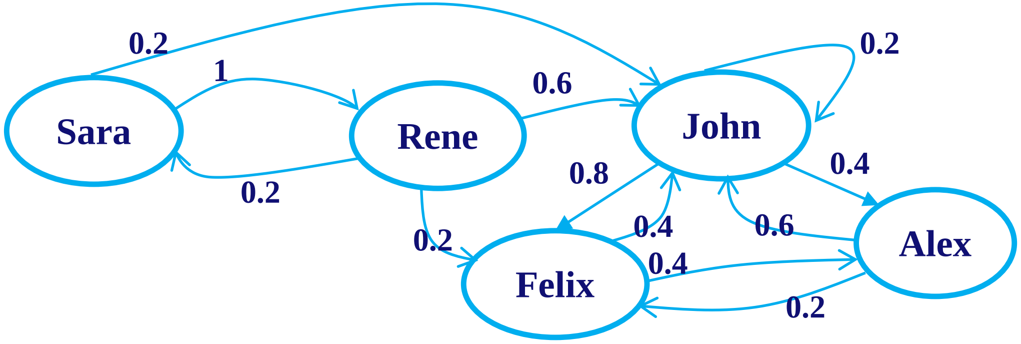
Exercise 2: Solution

$$L = [\langle a^{Sara}, b^{John}, e^{Felix}, d^{Alex}, a^{John}, b^{Felix}\rangle, \\ \langle a^{Sara}, c^{Rene}, d^{Felix}, b^{Alex}, d^{Felix}, c^{John}\rangle, \\ \langle a^{Sara}, b^{Rene}, e^{John}, d^{Alex}, a^{John}, b^{Felix}\rangle, \\ \langle a^{Sara}, b^{Rene}, c^{Sara}, d^{Rene}, a^{John}, b^{Felix}, d^{John}\rangle, \\ \langle a^{Sara}, b^{Rene}, d^{John}, b^{Alex}, c^{John}, c^{John}\rangle]$$

Handover of work matrix:

	Alex	John	Felix	Rene	Sara
Alex	0	0.6	0.2	0	0
John	0.4	0.2	0.8	0	0
Felix	0.4	0.4	0	0	0
Rene	0	0.6	0.2	0	0.2
Sara	0	0.2	0	1	0

Social network:



Exercise 3

Based on the following event log, create the handover of work matrix where you ignore multiple transfers within the same case. Create the corresponding social network by drawing only the arcs whose corresponding weight is ≥ 0.4.

$$
\begin{aligned}
L = [&\langle \boldsymbol{a^{R1}}, \boldsymbol{b^{R2}}, \boldsymbol{a^{R2}}, \boldsymbol{c^{R3}}, \boldsymbol{e^{R4}} \rangle, \\
&\langle \boldsymbol{a^{R2}}, \boldsymbol{c^{R2}}, \boldsymbol{c^{R3}}, \boldsymbol{c^{R4}}, \boldsymbol{d^{R1}} \rangle, \\
&\langle \boldsymbol{a^{R4}}, \boldsymbol{b^{R4}}, \boldsymbol{c^{R2}}, \boldsymbol{b^{R2}}, \boldsymbol{d^{R4}}, \boldsymbol{e^{R4}} \rangle, \\
&\langle \boldsymbol{a^{R1}}, \boldsymbol{b^{R2}}, \boldsymbol{b^{R4}}, \boldsymbol{d^{R2}}, \boldsymbol{e^{R3}} \rangle, \\
&\langle \boldsymbol{b^{R2}}, \boldsymbol{b^{R2}}, \boldsymbol{b^{R3}}, \boldsymbol{c^{R4}}, \boldsymbol{d^{R4}} \rangle]
\end{aligned}
$$

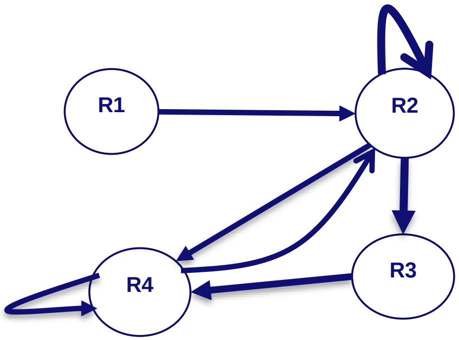
Exercise 3: Solution

$$
\begin{aligned}
L = [&\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4}\rangle ,\\
&\langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1}\rangle,\\
&\langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4}\rangle,\\
&\langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3}\rangle,\\
&\langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4}\rangle]
\end{aligned}
$$

Handover of work matrix:

	R1	R2	R3	R4
R1	0	0.4	0	0
R2	0	0.8	0.8	0.4
R3	0	0	0	0.6
R4	0.2	0.4	0	0.4

Social network:



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Exercise 3: Solution

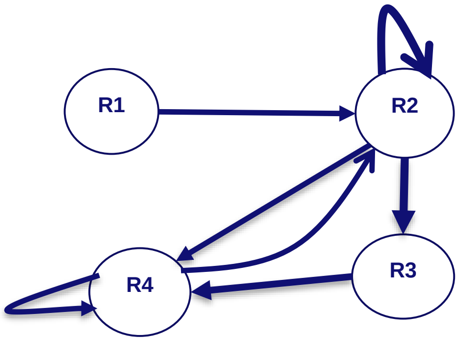
$$L = [\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4} \rangle,$$
$$\langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1} \rangle,$$
$$\langle \boxed{a^{R4}, b^{R4}}, c^{R2}, b^{R2}, \boxed{d^{R4}, e^{R4}} \rangle,$$
$$\langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3} \rangle,$$
$$\langle b^{R2}, b^{R2}, b^{R3}, \boxed{c^{R4}, d^{R4}} \rangle]$$

Handover of work matrix:

	R1	R2	R3	R4
R1	0	0.4	0	0
R2	0	0.8	0.8	0.4
R3	0	0	0	0.6
R4	0.2	0.4	0	$\boxed{0.4}$

Multiple handovers per case are ignored.

Social network:



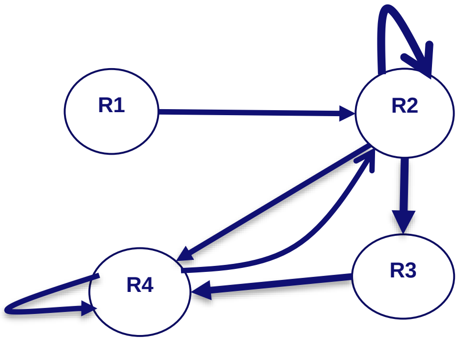
Exercise 3: Solution

$$
\begin{aligned}
L = [&\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4} \rangle,\\
&\langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1} \rangle,\\
&\langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4} \rangle,\\
&\langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3} \rangle,\\
&\langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4} \rangle]
\end{aligned}
$$

Handover of work matrix:

	R1	R2	R3	R4
R1	0	0.4	0	0
R2	0	0.8	0.8	0.4
R3	0	0	0	0.6
R4	0.2	0.4	0	0.4

Social network:



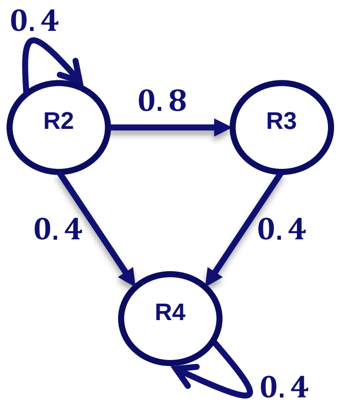
Only the arcs whose weights ≥ 0.4 are shown.

Exercise 4

Given the following event log, create the real handover of work matrix by considering multiple transfers within the same case. Use dependency measure threshold ≥ 0.5 to derive causal relations between activity pairs. Create the corresponding social network and display only the arcs and their weights where the weight ≥ 0.4.

$$
\begin{aligned}
L = [&\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4} \rangle,\\
&\langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1} \rangle,\\
&\langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4} \rangle,\\
&\langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3} \rangle,\\
&\langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4} \rangle]
\end{aligned}
$$

Exercise 4: Solution



Exercise 4 – Solution steps

Given the following event log, create the handover of work matrix by considering multiple transfers within the same case. Use dependency measure threshold ≥ 0.5 to derive causal relations between activity pairs. Create the corresponding social network for the real handover of work and display only those arcs and their weights where the weight ≥ 0.4.

Step 1: Create directly-follows matrix of activities.
Step 2: Compute dependency values for each activity pair.
Step 3: Apply thresholds to the dependency values and obtain pairs of activities that have a causal relationship.
Step 4: Create the real handover of work matrix where you only consider handover of work between activity pairs with a causal relationship.
Step 5: Draw the social network. Only arcs correponding to real handovers (above the threshold) remain.

$$|a \Rightarrow_L b| = \begin{cases} \dfrac{|a >_L b| - |b >_L a|}{|a >_L b| + |b >_L a| + 1} & if\, a \neq b \\ \dfrac{|a >_L a|}{|a >_L a| + 1} & if\, a = b \end{cases}$$

Exercise 4: Solution

Step 1: Create directly-follows matrix of activities.

$$L = [\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4}\rangle, \langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1}\rangle, \langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4}\rangle, \langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3}\rangle, \langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4}\rangle]$$

1

	a	b	c	d	e
a	0	3	2	0	0
b	1	3	2	2	0
c	0	1	2	2	1
d	0	0	0	0	2
e	0	0	0	0	0

Step 2: Compute dependency values for each activity pair.

$$|a \Rightarrow_L b| = \begin{cases} \dfrac{|a >_L b| - |b >_L a|}{|a >_L b| + |b >_L a| + 1} & if\ a \neq b \\ \dfrac{|a >_L a|}{|a >_L a| + 1} & if\ a = b \end{cases}$$

2

	a	b	c	d	e
a	0	0.4	0.67	0	0
b	-0.4	0.75	0.25	0.67	0
c	-0.67	-0.25	0.67	0.67	0.5
d	0	-0.67	-0.67	0	0.67
e	0	0	-0.5	-0.67	0

Exercise 4: Solution

Step 3: Apply thresholds to the dependency values and obtain pairs of activities that have a causal relationship.

$threshold \geq 0.5$

3

	a	b	c	d	e
a	0	0.4	0.67	0	0
b	-0.4	0.75	0.25	0.67	0
c	-0.67	-0.25	0.67	0.67	0.5
d	0	-0.67	-0.67	0	0.67
e	0	0	-0.5	-0.67	0

<a,c>
<b,b>
<b,d>
<c,c>
<c,d>
<c,e>
<d,e>

Exercise 4: Solution

Step 4: Create the real handover of work matrix where you only consider handover of work between activity pairs with a causal relationship.

4

	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0.4	0.8	0.4
R3	0	0	0	0.4
R4	0.2	0.2	0	0.4

<a,c>
<b,b>
<b,d>
<c,c>
<c,d>
<c,e>
<d,e>

$$L = [\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4}\rangle, \langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1}\rangle, \langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4}\rangle, \langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3}\rangle, \langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4}\rangle]$$

Exercise 4: Solution

Step 4: Create the real handover of work matrix where you only consider handover of work between activity pairs with a causal relationship.

	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0.4	0.8	0.4
R3	0	0	0	0.4
R4	0.2	0.2	0	0.4

(a→b)
(a→b)

<a,c>
<b,b>
<b,d>
<c,c>
<c,d>
<c,e>
<d,e>

$$\begin{aligned} L = [& \langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4} \rangle, \\ & \langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1} \rangle, \\ & \langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4} \rangle, \\ & \langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3} \rangle, \\ & \langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4} \rangle] \end{aligned}$$

Exercise 4: Solution

Step 4: Create the real handover of work matrix where you only consider handover of work between activity pairs with a causal relationship.

	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0.4	0.8	0.4
R3	0	0	0	0.4
R4	0.2	0.2	0	0.4

(b→a)
(a→c)
(c→b)
(b→b)

<a,c>
<b,b>
<b,d>
<c,c>
<c,d>
<c,e>
<d,e>

$$L = [\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4} \rangle, \langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1} \rangle, \langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4} \rangle, \langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3} \rangle, \langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4} \rangle]$$

Exercise 4: Solution

Step 4: Create the real handover of work matrix where you only consider handover of work between activity pairs with a causal relationship.

	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0.4	0.8	0.4
R3	0	0	0	0.4
R4	0.2	0.2	0	0.4

(a→c)
(c→c)
(d→e)
(b→b)

<a,c>
<b,b>
<b,d>
<c,c>
<c,d>
<c,e>
<d,e>

$$L = [\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4}\rangle, \langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1}\rangle, \langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4}\rangle, \langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3}\rangle, \langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4}\rangle]$$

Exercise 4: Solution

Step 4: Create the real handover of work matrix where you only consider handover of work between activity pairs with a causal relationship.

	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0.4	0.8	0.4
R3	0	0	0	0.4
R4	0.2	0.2	0	0.4

<a,c>
<b,b>
<b,d>
<c,c>
<c,d>
<c,e>
<d,e>

(b→d)
(b→b)

$$L = [\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4}\rangle, \langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1}\rangle, \langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4}\rangle, \langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3}\rangle, \langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4}\rangle]$$

Exercise 4: Solution

Step 4: Create the real handover of work matrix where you only consider handover of work between activity pairs with a causal relationship.

	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0.4	0.8	0.4
R3	0	0	0	0.4
R4	0.2	0.2	0	0.4

(c→e)
(c→c)
(b→c)

<a,c>
<b,b>
<b,d>
<c,c>
<c,d>
<c,e>
<d,e>

$$L = [\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4}\rangle, \langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1}\rangle, \langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4}\rangle, \langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3}\rangle, \langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4}\rangle]$$

Exercise 4: Solution

Step 4: Create the real handover of work matrix where you only consider handover of work between activity pairs with a causal relationship.

	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0.4	0.8	0.4
R3	0	0	0	0.4
R4	0.2	0.2	0	0.4

(c→d)

<a,c>
<b,b>
<b,d>
<c,c>
<c,d>
<c,e>
<d,e>

$$L = [\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4}\rangle, \langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1}\rangle, \langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4}\rangle, \langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3}\rangle, \langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4}\rangle]$$

Exercise 4: Solution

Step 4: Create the real handover of work matrix where you only consider handover of work between activity pairs with a causal relationship.

	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0.4	0.8	0.4
R3	0	0	0	0.4
R4	0.2	0.2	0	0.4

(b→c)
(b→d)

<a,c>
<b,b>
<b,d>
<c,c>
<c,d>
<c,e>
<d,e>

$$
\begin{aligned}
L = [&\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4}\rangle,\\
&\langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1}\rangle,\\
&\langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4}\rangle,\\
&\langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3}\rangle,\\
&\langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4}\rangle]
\end{aligned}
$$

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Exercise 4: Solution

Step 4: Create the real handover of work matrix where you only consider handover of work between activity pairs with a causal relationship.

	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0.4	0.8	0.4
R3	0	0	0	0.4
R4	0.2	0.2	0	0.4

<a,c>
<b,b>
<b,d>
<c,c>
<c,d>
<c,e>
<d,e>

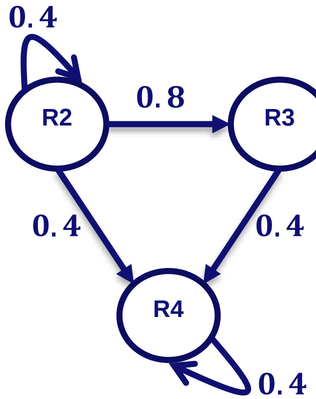
$$L = [\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4}\rangle, \langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1}\rangle, \langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4}\rangle, \langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3}\rangle, \langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4}\rangle]$$

(a→b)
(d→e)
(c→d)

Exercise 4: Solution

Step 5: Draw the social network. Only arcs correponding to real handovers (above the threshold) remain.

5



	R1	R2	R3	R4
R1	0	0	0	0
R2	0	0.4	0.8	0.4
R3	0	0	0	0.4
R4	0.2	0.2	0	0.4

$$
\begin{aligned}
L = [&\langle a^{R1}, b^{R2}, a^{R2}, c^{R3}, e^{R4} \rangle\,,\\
&\langle a^{R2}, c^{R2}, c^{R3}, c^{R4}, d^{R1} \rangle,\\
&\langle a^{R4}, b^{R4}, c^{R2}, b^{R2}, d^{R4}, e^{R4} \rangle,\\
&\langle a^{R1}, b^{R2}, b^{R4}, d^{R2}, e^{R3} \rangle,\\
&\langle b^{R2}, b^{R2}, b^{R3}, c^{R4}, d^{R4} \rangle]
\end{aligned}
$$

Performance analysis with Celonis

Data Integration (same as always)

- Upload the files “activity_table.csv” and “case_table.csv” into Celonis. Create a corresponding data model using the CASE ID to connect the activity table (“activity_table.csv”) and the case table (“case_table.csv”).
- Make sure you assign the case table as the “Case Table” of your “Activity Table”.
- Optional: Set aliases (e.g. “cases” for the case table and “events” for the activity table).
- Don’t forget to load the data model before you start your Analysis.
- Create a new analysis using the newly created data model.

PQL documentation: https://docs.celonis.com/en/pql-function-library.html

Task 1: Exploration

a) Using a Pie Chart, show which activities are executed how often.
b) Using a Column Chart component, show for each resource (x-axis), the total number of activities handled by that resource in the process (y-axis).
c) Using a Pie Chart component, visualize how often one specific resource (of your choice) executes different activities.
d) Using a Pie Chart component, visualize how the executions of one specific activity (of your choice) are split among the corresponding resources.

Task 1: Exploration

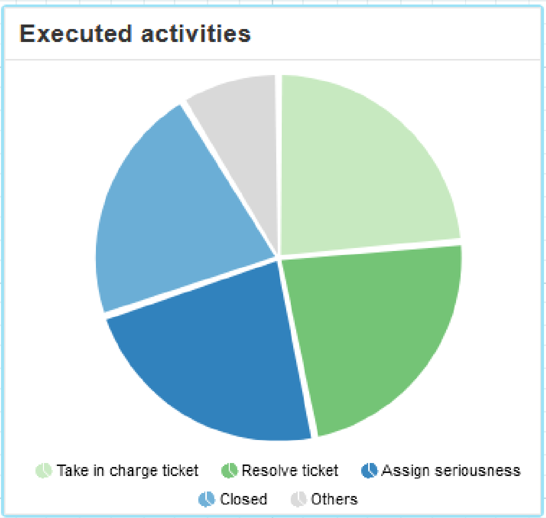
a) Using a Pie Chart, show which activities are executed how often.

Dimension

```
"events"."ACTIVITY"
```

KPI

```
COUNT("events"."ACTIVITY")
```



Task 1: Exploration

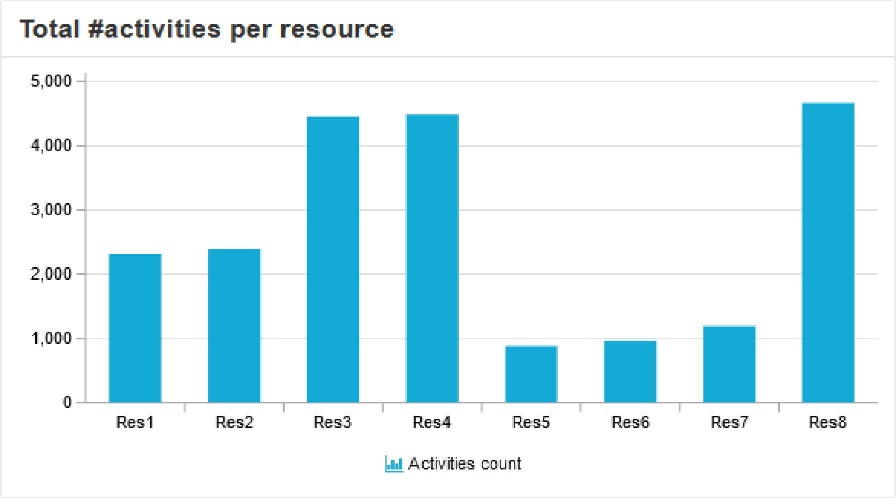
b) Using a Column Chart component, show for each resource (x-axis), the total number of activities handled by that resource in the process (y-axis).

Dimension

```
"events"."RESOURCE"
```

KPI

```
COUNT("events"."ACTIVITY")
```



Task 1: Exploration

c) Using a Pie Chart component, visualize how often one specific resource (of your choice) executes different activities.

Dimension

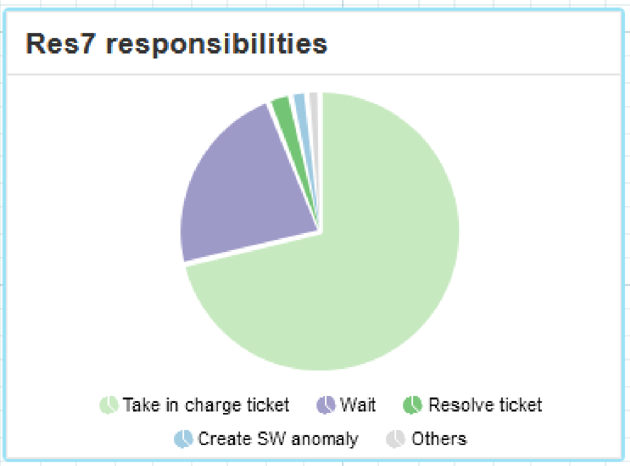
```
"events"."ACTIVITY"
```

KPI

```
COUNT("events"."ACTIVITY")
```

Filter

```
FILTER "events"."RESOURCE" = 'Res7'
```



Task 1: Exploration

c) Using a Pie Chart component, visualize how often one specific resource (of your choice) executes different activities.

Dimension

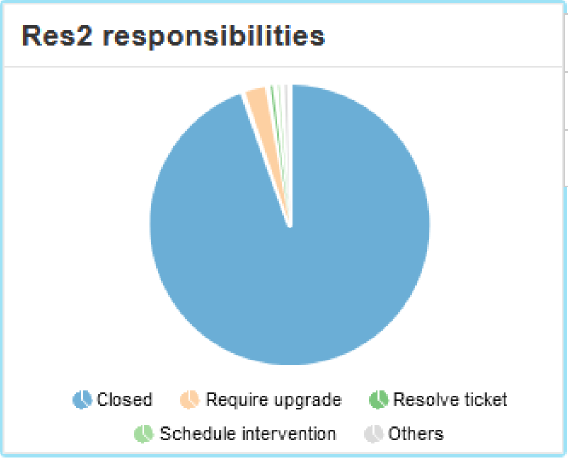
```
"events"."ACTIVITY"
```

KPI

```
COUNT("events"."ACTIVITY")
```

Filter

```
FILTER "events"."RESOURCE" = 'Res2'
```



Task 1: Exploration

d) Using a Pie Chart component, visualize how the executions of one specific activity (of your choice) are split among the corresponding resources.

Dimension

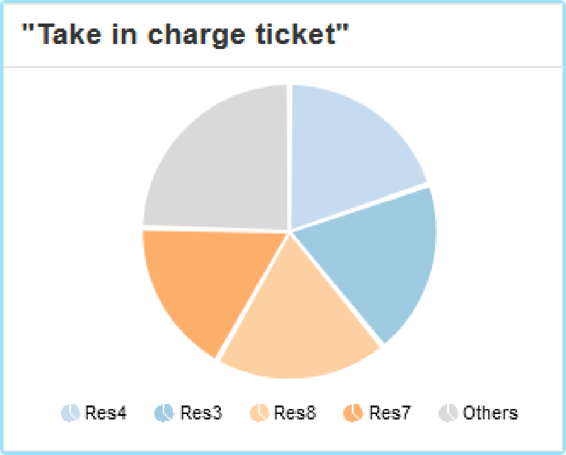
```
"events"."RESOURCE"
```

KPI

```
COUNT("events"."ACTIVITY")
```

Filter

```
FILTER "events"."ACTIVITY" = 'Take in charge ticket'
```



Task 1: Exploration

d) Using a Pie Chart component, visualize how the executions of one specific activity (of your choice) are split among the corresponding resources.

Dimension

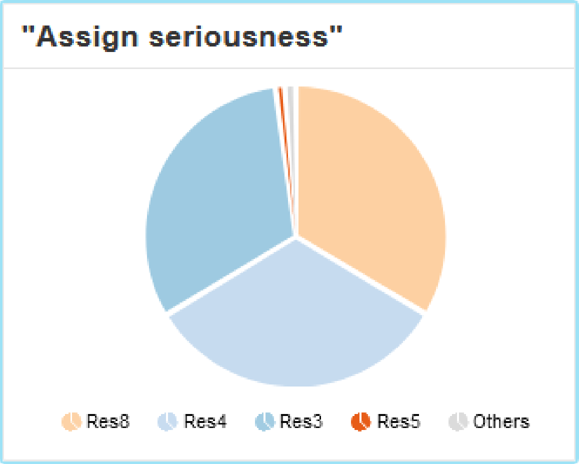
```
"events"."RESOURCE"
```

KPI

```
COUNT("events"."ACTIVITY")
```

Filter

```
FILTER "events"."ACTIVITY" = 'Assign seriousness'
```



Task 2: Resource-activity matrix

We want to compute the resource-activity matrix. For this we want to create a resource-based situation table, where each row corresponds to a resource and each column corresponds to an activity. The value of each entry must reflect the average number of times per case that the resource executes the corresponding activity.

a) Add a Pivot component to your analysis. The table must have two dimensions: one for resources, and one for activities. The KPI must reflect the average number of times per case that each resource executes the corresponding activity.
b) Export the table and import it to RapidMiner. Use the k-means Algorithm with k=3 to split the resources into 3 clusters. What are the clusters?

Task 2: Resource-activity matrix

a)

Dimension 1

```
"events"."RESOURCE"
```

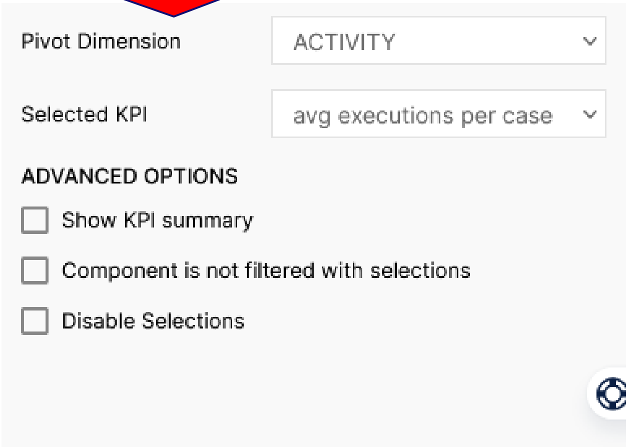
Dimension 2

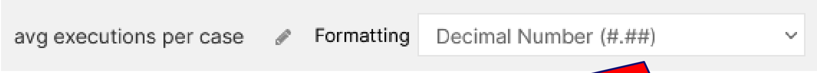
```
"events"."ACTIVITY"
```

avg executions / case

```
COUNT("events"."ACTIVITY") /
COUNT_TABLE ("cases")
```

Set Activity as Pivot Dimension





Important to obtain decimal numbers.

Task 2: Resource-activity matrix

a) Result:

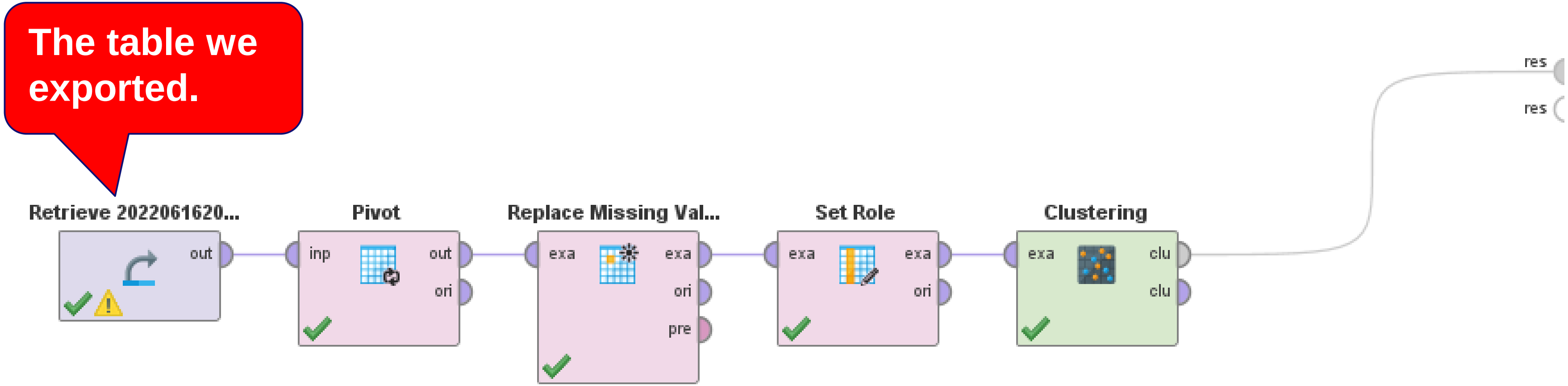
Pivot: ACTIVITY KPI: avg executions per case
Rows: RESOURCE

Configure

	Assign serious...	Closed	Create SW ano...	DUPLICATE	INVALID	Insert ticket	RESOLVED	Require upgrade	Resolve SW an...	Resolve ticket	Schedule int
Res1		1.00			1.00		1.00	1.17		1.00	
Res2		1.00		1.00	1.00		1.00	1.08		1.00	
Res3	1.03		1.00			1.00			1.25	1.03	
Res4	1.04		1.00			1.00			1.00	1.03	
Res5	1.00		1.10							1.00	
Res6	1.00		1.00							1.00	
Res7	1.00		1.00							1.00	
Res8	1.04		1.00			1.00			1.20	1.02	

Task 2: Resource-activity matrix

b) Export the table and import it to RapidMiner. Use the k-means Algorithm with k=3 to split the resources into 3 clusters. What are the clusters?



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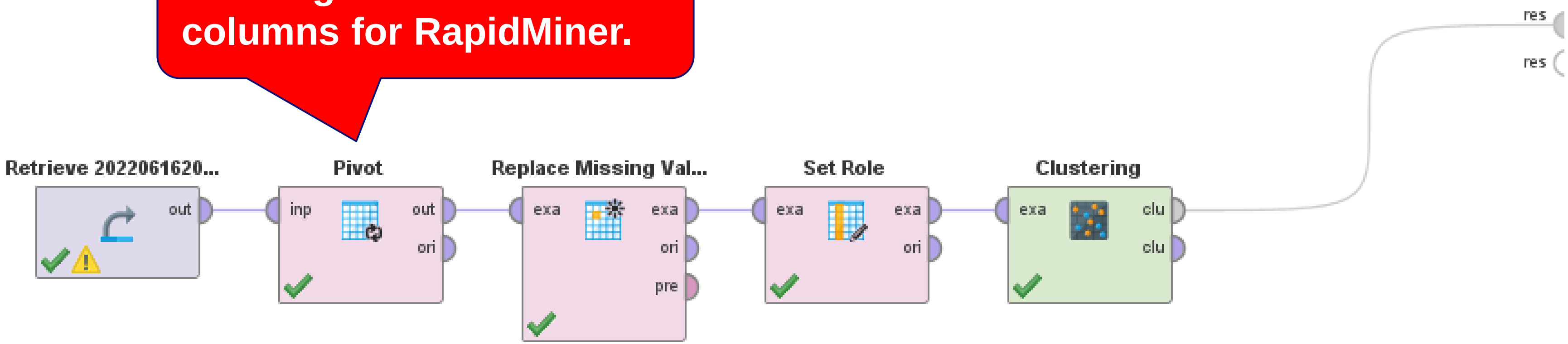
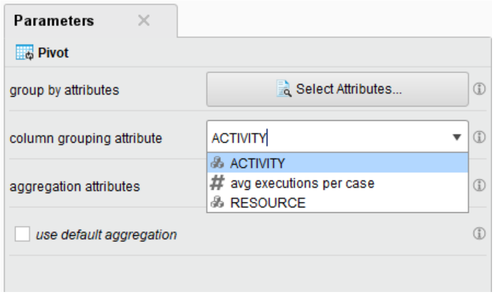
Task 2: Resource-activity matrix

Defining rows and columns for RapidMiner.

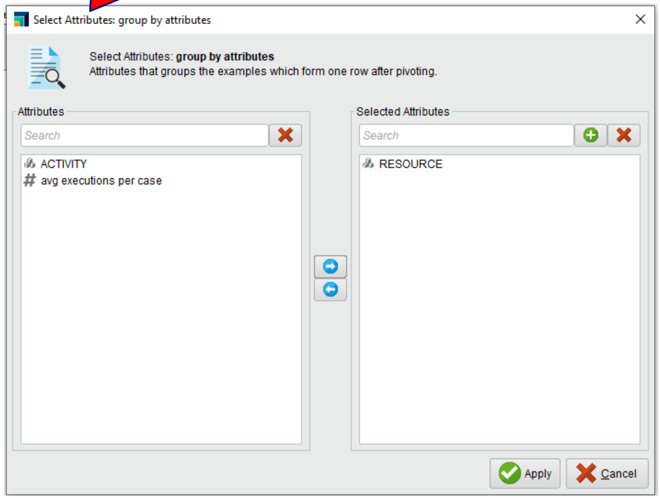


Task 2: Resource-activity matrix

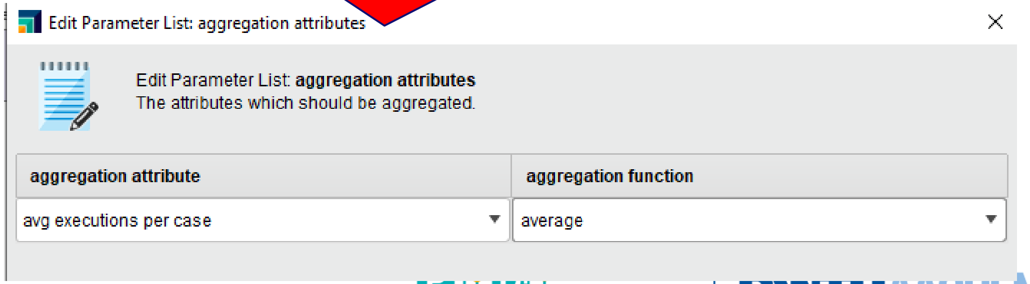
1) Select the column attribute.



2) Select the rows attribute.

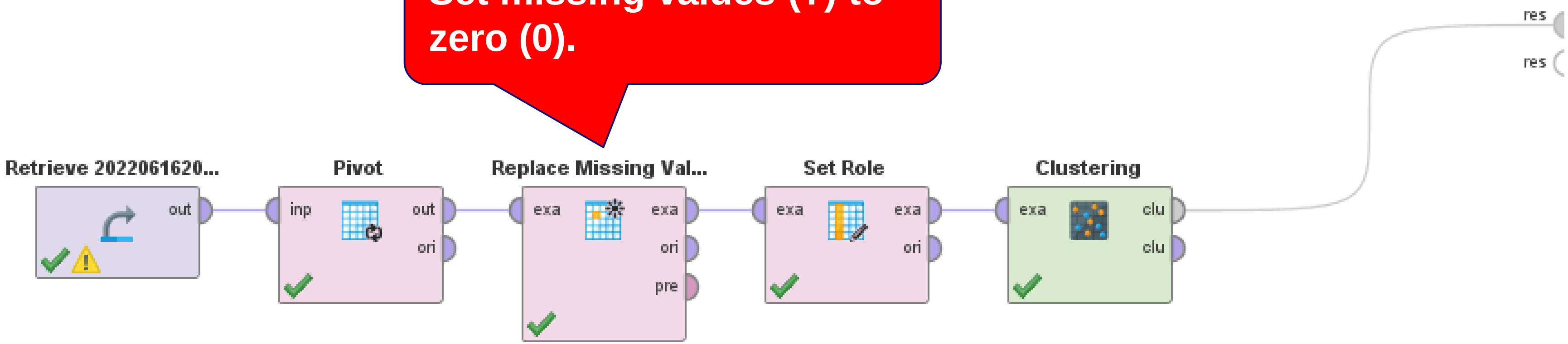


3) Select the aggregation attribute.



Task 2: Resource-activity matrix

Set missing values (?) to zero (0).



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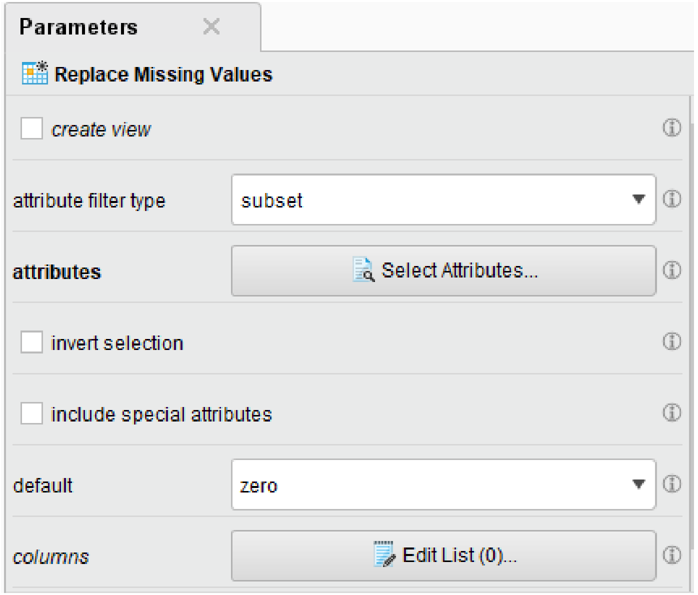
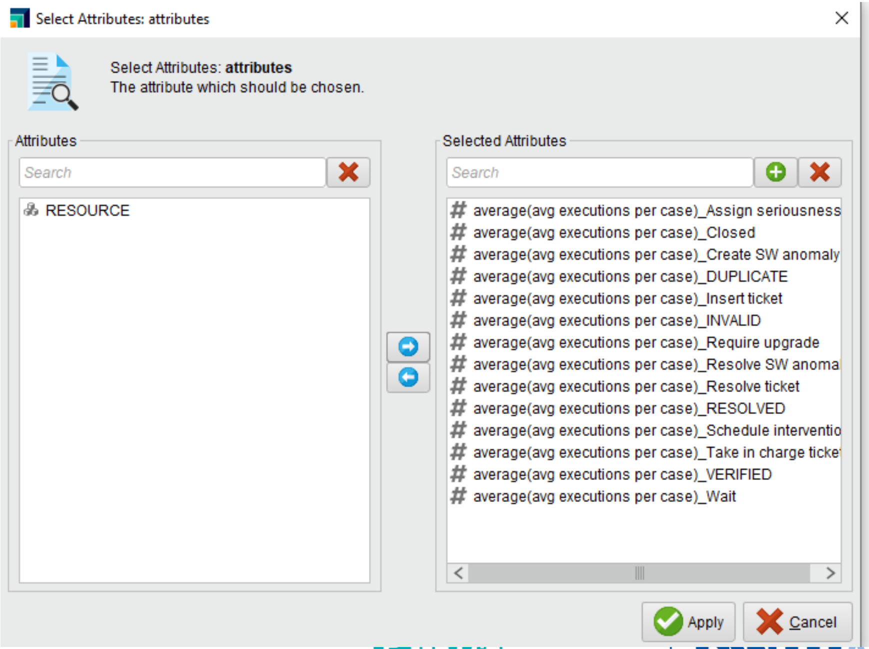
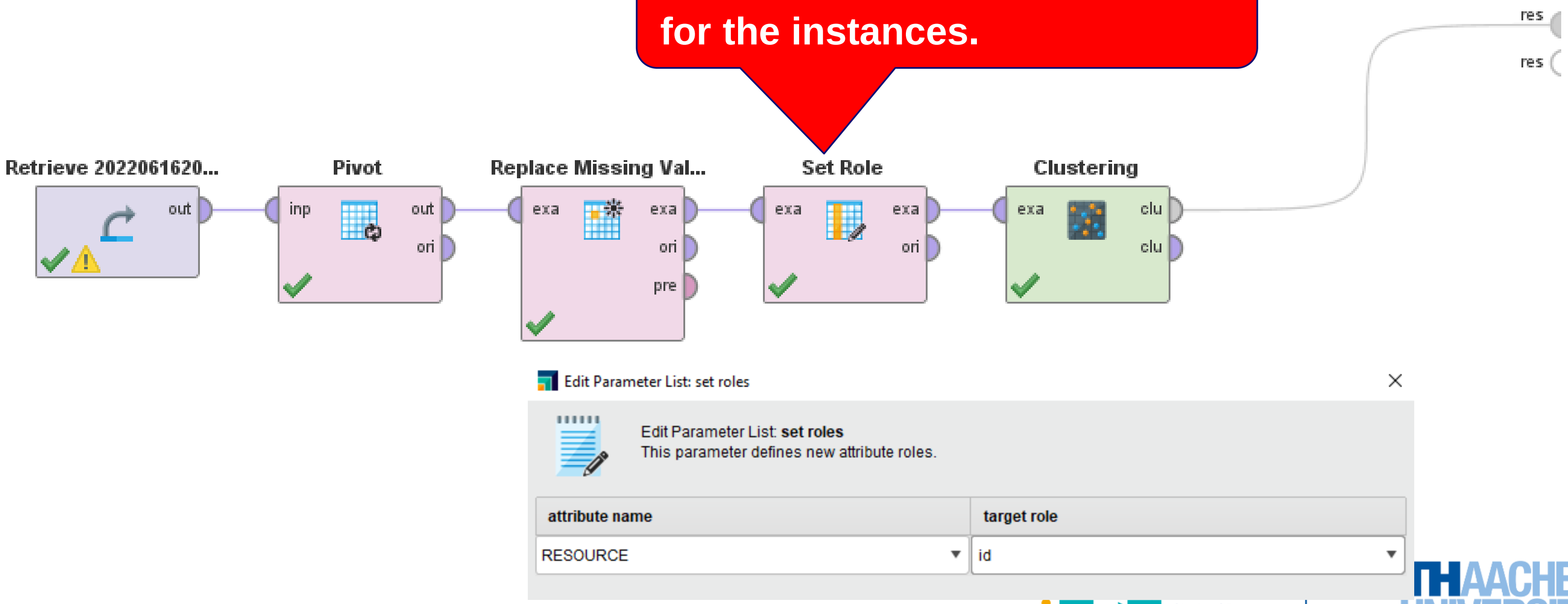
Task 2: Resource-activity matrix



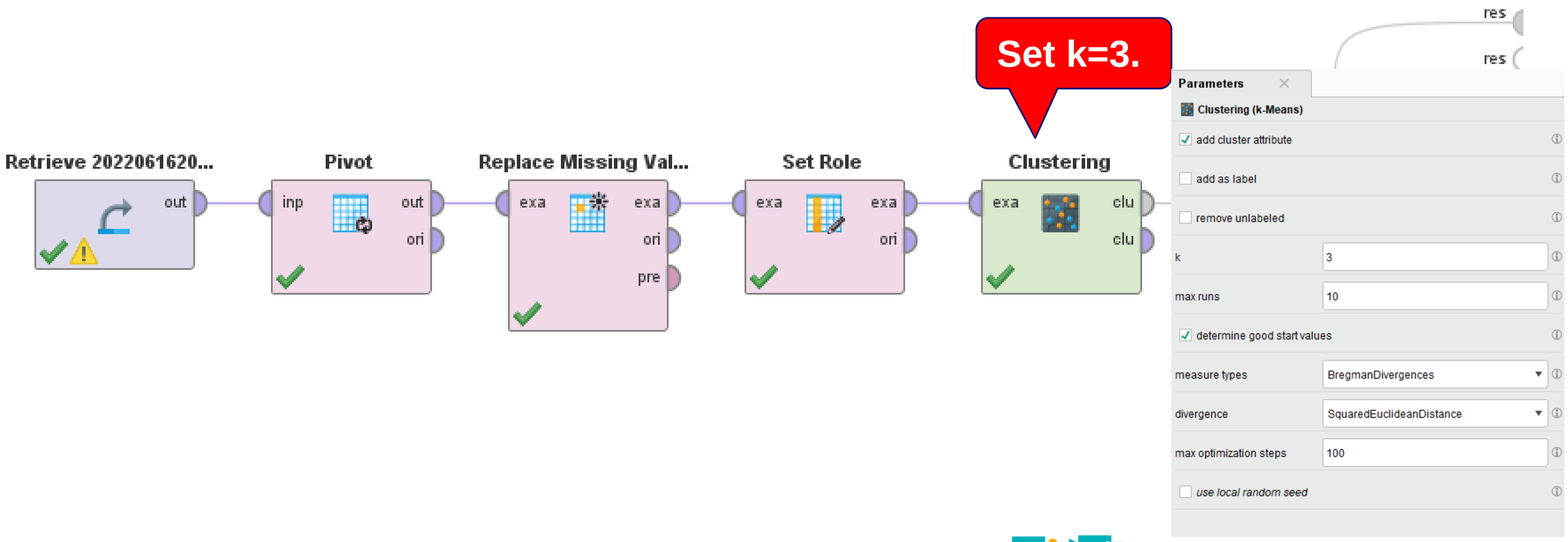


Task 2: Resource-activity matrix

Set the resources as identifiers for the instances.



Task 2: Resource-activity matrix



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Task 2: Resource-activity matrix

b) Result:

- root
  - cluster_0
    - Res5
    - Res6
    - Res7
  - cluster_1
    - Res3
    - Res4
    - Res8
  - cluster_2
    - Res1
    - Res2

Attribute	cluster_0	cluster_1	cluster_2
average(avg executions per case)_Assign seriousness	1	1.034	0
average(avg executions per case)_Closed	0	0	1.003
average(avg executions per case)_Create SW anomaly	1.033	1	0
average(avg executions per case)_DUPLICATE	0	0	0.500
average(avg executions per case)_INVALID	0	0	1
average(avg executions per case)_Insert ticket	0	1	0
average(avg executions per case)_RESOLVED	0	0	1
average(avg executions per case)_Require upgrade	0	0	1.123
average(avg executions per case)_Resolve SW anomaly	0	1.150	0
average(avg executions per case)_Resolve ticket	1	1.029	1
average(avg executions per case)_Schedule intervention	0	0	1
average(avg executions per case)_Take in charge ticket	1	1.105	0
average(avg executions per case)_VERIFIED	0	0	0.500
average(avg executions per case)_Wait	1.035	1.087	0

Task 3: Simple work handover

We want to compute the simple handover of work matrix. For this we want to create a resource-based situation table, where each row corresponds to a resource and each column also corresponds to a resource. The value of each entry must reflect the average number of times per case that the (row) resource hands over work to the (column) resource.

a) Add a Pivot component to your analysis. The table must have two dimensions: one for the (source) resource, and one for the (target) resource. The KPI must reflect the handover of work value.
b) Export the table and import it to RapidMiner. Use the Transition Graph to discover a Social Network. Show only the arcs whose weight is at least 1.05.

Task 3: Simple work handover

a)

Dimension 1

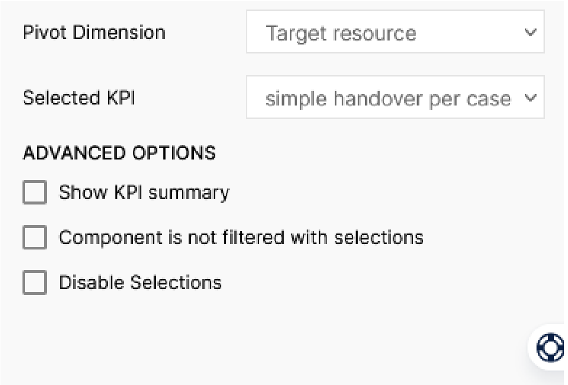
```
SOURCE("events"."RESOURCE")
```

Dimension 2

```
TARGET("events"."RESOURCE")
```

Simple handover per case

```
COUNT(SOURCE("events"."RESOURCE")) /
COUNT_TABLE("cases")
```



Important to obtain decimal numbers.

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Task 3: Simple work handover

a) Result:

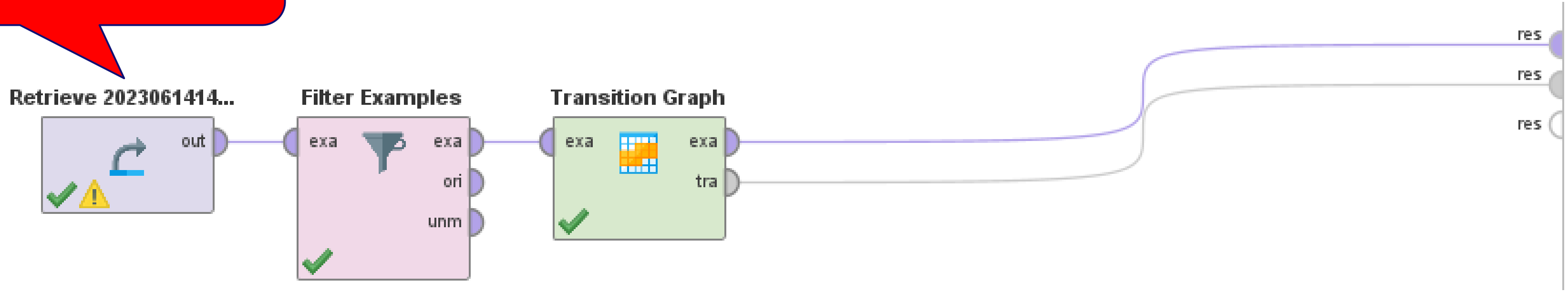
Pivot: Target resource KPI: simple handover per case
Rows: Source resource

	Res1	Res2	Res3	Res4	Res5	Res6	Res7	Res8
Res1	1.07	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Res2	1.00	1.43	1.00	1.00	1.00		1.00	1.00
Res3	1.00	1.00	1.31	1.07	1.00	1.00	1.00	1.06
Res4	1.00	1.00	1.07	1.30	1.00	1.00	1.00	1.06
Res5	1.00	1.00	1.00	1.00	1.01	1.00	1.00	1.00
Res6	1.08	1.00	1.00	1.00	1.00	1.03	1.00	1.00
Res7	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.00
Res8	1.00	1.00	1.08	1.05	1.00	1.00	1.00	1.30

Task 3: Simple work handover

b)

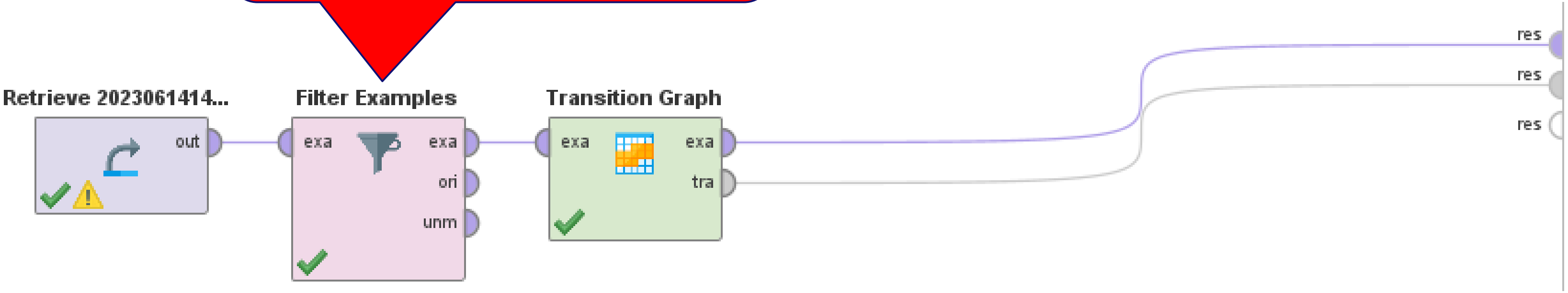
The table we exported.

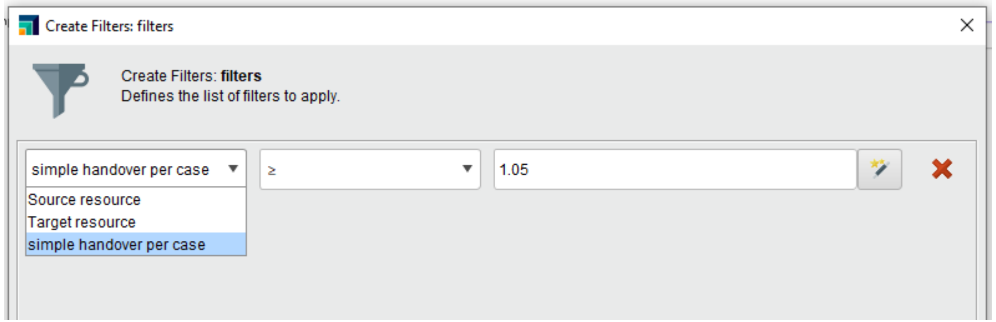


Task 3: Simple work handover

b)

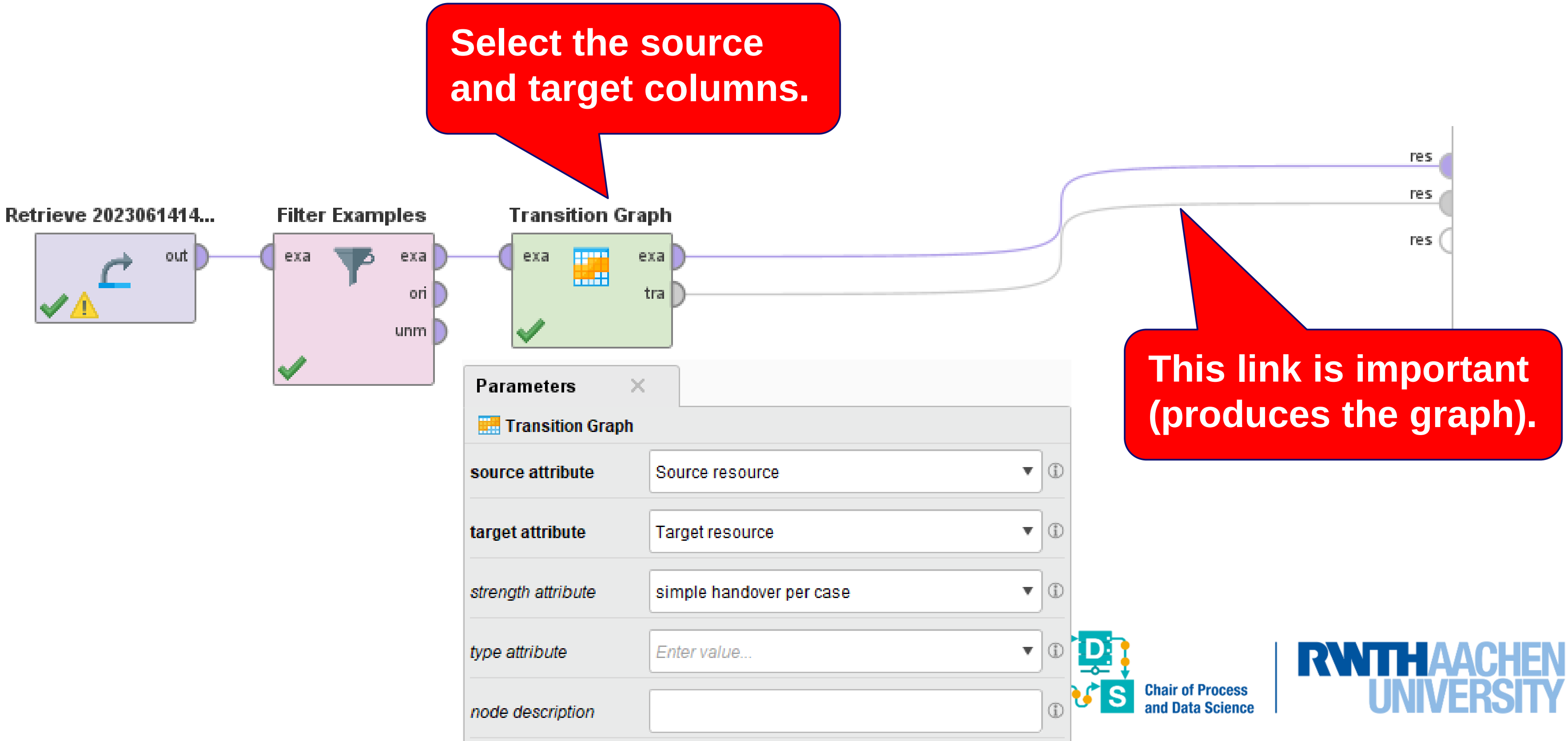
Keep only resource pairs where handover is at least 1.05.





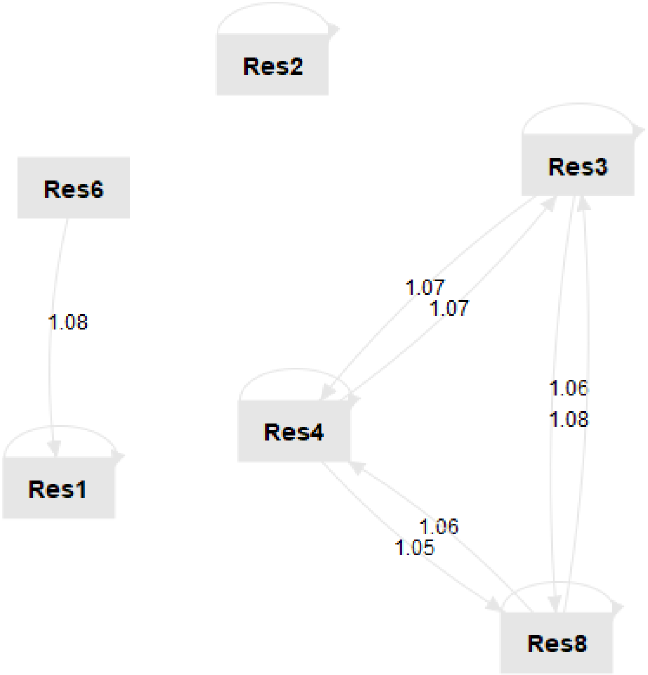
Task 3: Simple work handover

b)



Task 3: Simple work handover

b) Result:

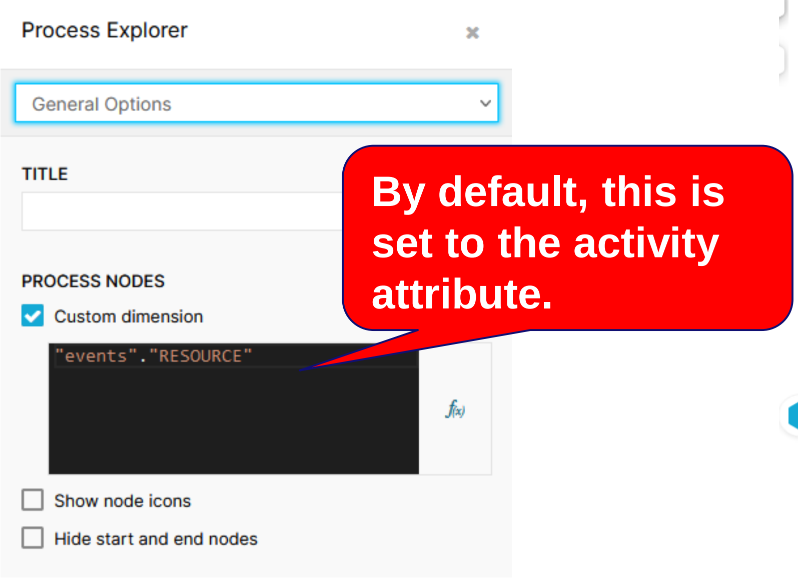


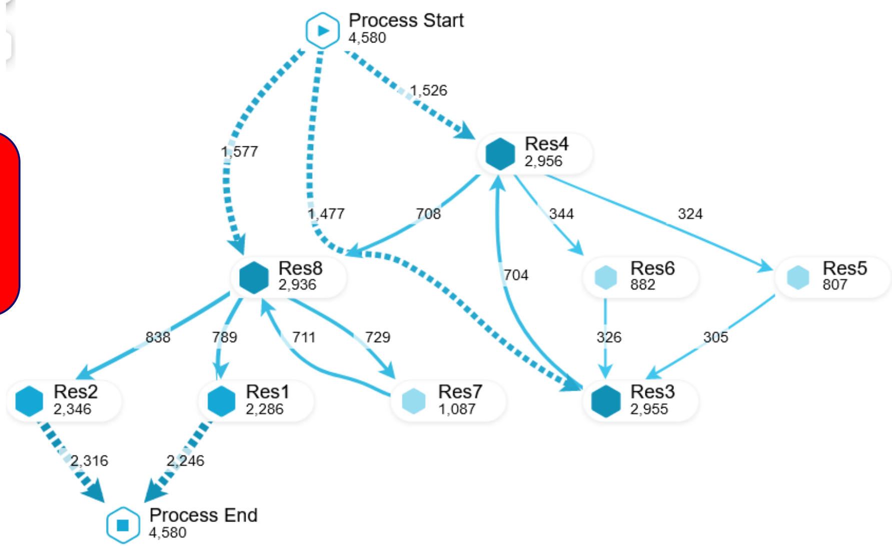
Task 4: Resource DFG

Using the Process Explorer component, create a DFG where the nodes correspond to resources (instead of activities).

Task 4: Resource DFG

Using the Process Explorer component, create a DFG where the nodes correspond to resources (instead of activities).

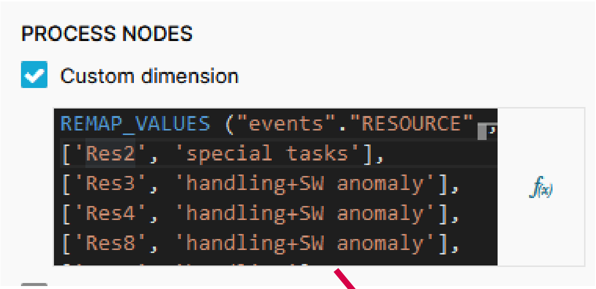




Task 5: Cluster DFG

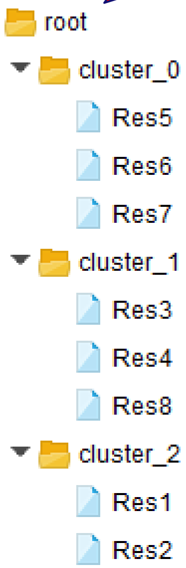
Using the Process Explorer component, create a DFG where the nodes correspond to the resource clusters you discovered in Task 2 b). Adjust the Custom dimension accordingly.

Task 5: Cluster DFG




```
REMAP_VALUES ("events"."RESOURCE" ,
['Res1', 'special tasks'],
['Res2', 'special tasks'],
['Res3', 'handling+SW anomaly'],
['Res4', 'handling+SW anomaly'],
['Res8', 'handling+SW anomaly'],
['Res5', 'handling'],
['Res6', 'handling'],
['Res7', 'handling'])
```

Result from Task 2b)



Here,
cluster 0: “handling”.
cluster 1: “handling+SW anomaly”
cluster 2: “special tasks”

Task 5: Cluster DFG

Result: