horsum
Accelerating technology companies

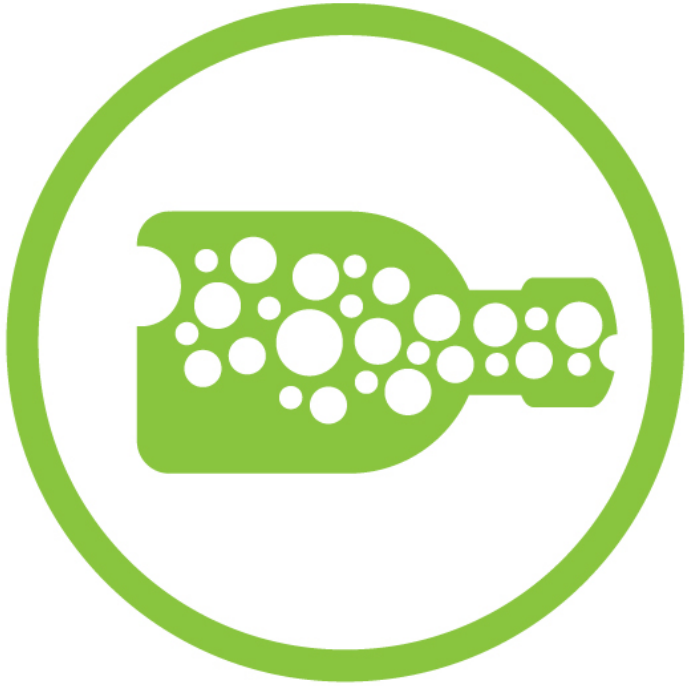
SmartCoat

Process mining explained by an example

The logistics process at SmartCoat Inc.

Episode 5 *(out of 8)*: bottlenecks

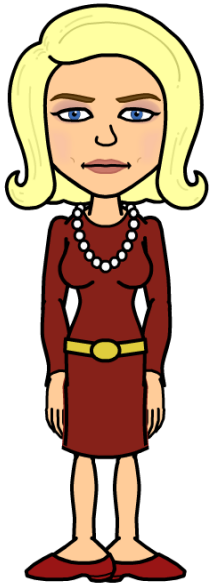
What’s on this week?



Bottlenecks

What preceded …

What preceded…



Marie, CEO of SmartCoat Inc., asked us to analyze and make recommendations for the logistics process via **process mining** and **data analytics** techniques ... Just by looking at the data in SmartCoat's ERP system!

In the fourth episode, Cédric performed some **benchmarking** analysis on the logistics process. He benchmarked brands, retailers and some SmartCoat employees.

Have you **missed** the **fourth episode**? Click on Marie … and you will be redirected to the fourth episode!

Bottlenecks

Cédric, your horsum guide

Cédric
Consultant

Hi, good to see you again!

In this episode, I will focus on the **time aspect** of the logistics process at SmartCoat. First of all, I will identify in the end-to-end process in which process steps important **waiting time** is located. Next, I will search for **process loops**. And finally, I will zoom in on the **coating and testing part** of the logistics process. I will give Marie some feedback based on my analysis.

Great that you come along with me again!

Cédric, your horsum guide

Before I forget it…

In this episode, I'm using most of the time the process mining software Disco for my process mining analyses.

Disco by Fluxicon

But… I will also show you two charts obtained via ProM, an open source process mining software.

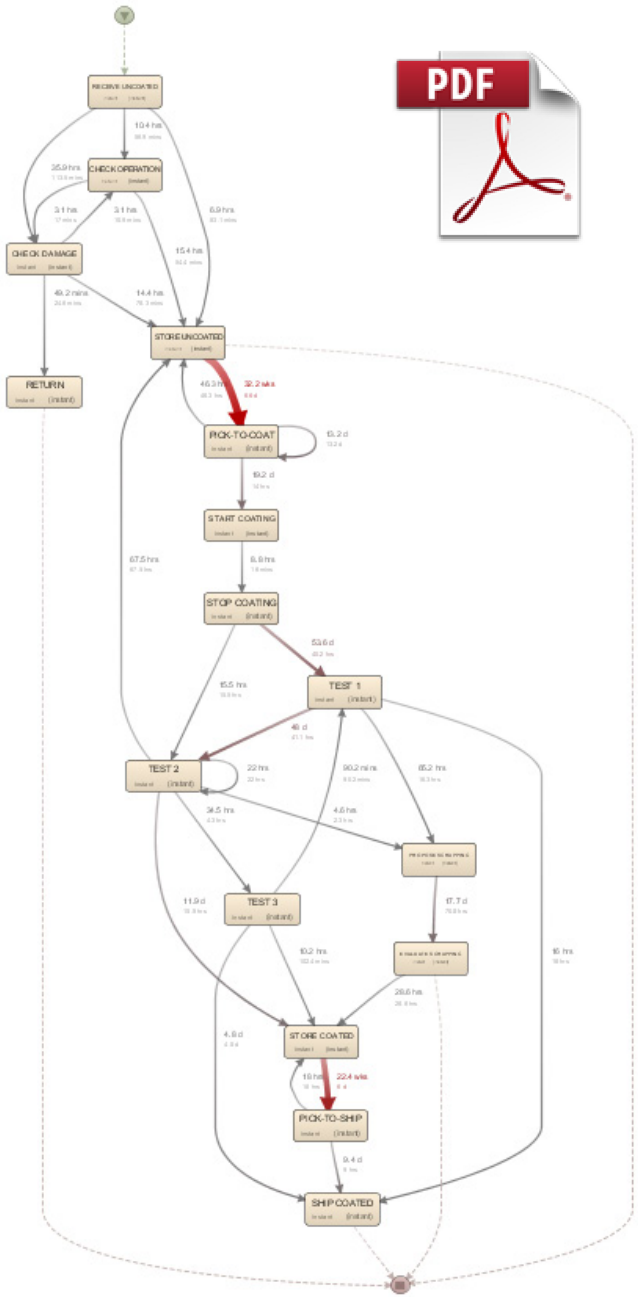
ProM process mining workbench

Analysis

1. Waiting time in entire logistics process

Just as in Episode 2, the process map is shown on the right. But this time, we focus on the **performance** of the logistics process. Next to each arrow, 2 performance indicators are mentioned. The upper one represents the **total duration** between 2 process steps *(activities)* for all smartphones together. It shows the high-impact areas. The lower one represents the **mean duration**.

Is this image too small for you? Then click on the PDF icon to zoom in on the process map.



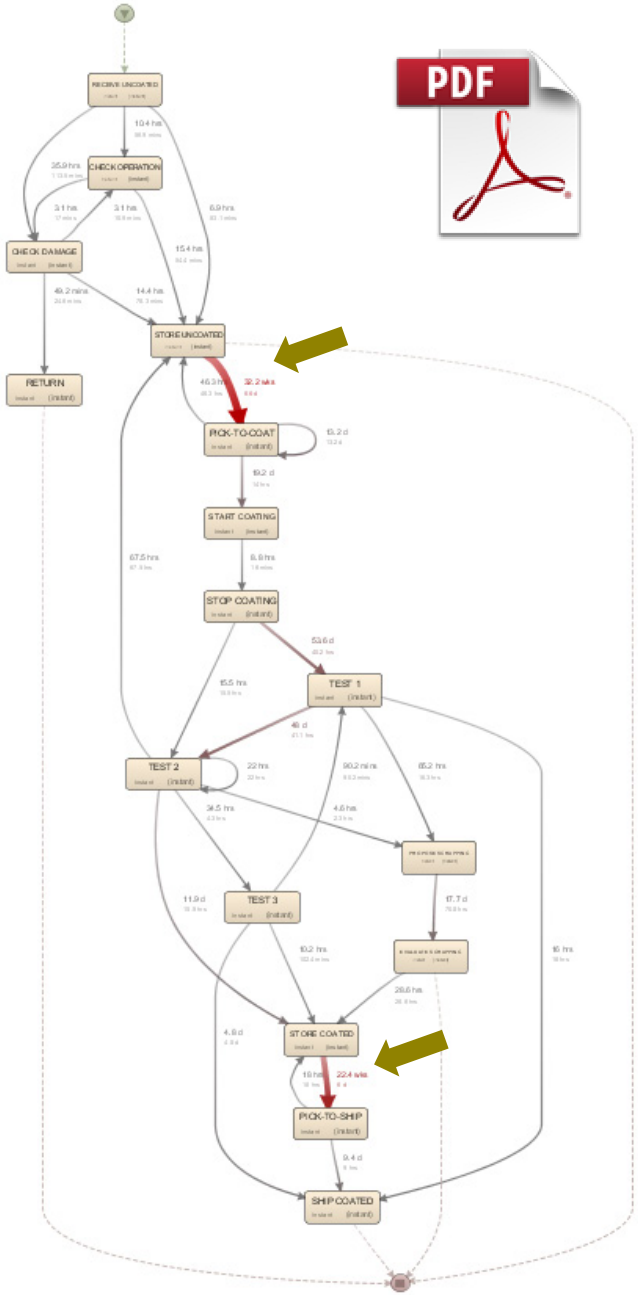
1. Waiting time in entire logistics process

On the right, we immediately note 2 big red arrows:

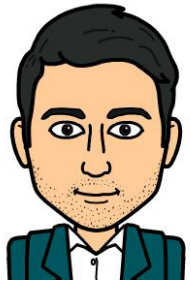
- Arrow between *'Store uncoated'* and *'Pick-to-coat'*
  - Total duration: 32,2 weeks
  - Mean duration: 6,6 days
- Arrow between *'Store coated'* and *'Pick-to-ship'*:
  - Total duration: 22,4 weeks
  - Mean duration: 6 days

This is quite normal because these arrows represent the time that the smartphones are **stored** in the **warehouses** ('warehouse uncoated' and 'warehouse coated'). Nevertheless, storage costs money… Marie told us that the storage cost is about € 0,10 per phone per 24 hours.

I'm wondering whether we can **lower** that **storage time** ... It costs money for SmartCoat without giving any added value. I'm also wondering whether I can see any **differences** amongst the **retailers**? Let's analyze on the next slide.



1. Waiting time in the entire logistics process



In the table below, I see that the mean duration of smartphones from *Wallsmart* (8,6 days in 'warehouse uncoated' and 8,5 days in 'warehouse coated') is longer than those from *Callhouse* and *Phonemarket*.

Let's discuss with Marie what SmartCoat can do to **lower** the **storage time** (waiting time) for ***Wallsmart*** smartphones.

Event log analysis	Entire process map	Wallsmart	Callhouse	Phonemarket
'Store uncoated' > 'Pick-to-coat'				
Total duration	32,2 weeks (225,4 days)	77,7 days	16,1 weeks (112,7 days)	35,1 days
Mean duration	6,6 days	**8,6 days**	6,2 days	5,0 days
'Store coated' > 'Pick-to-ship'				
Total duration	22,4 weeks (156,8 days)	51,3 days	73,7 days	32,1 days
Mean duration	6,0 days	**8,5 days**	5,3 days	5,3 days

2. Process loops

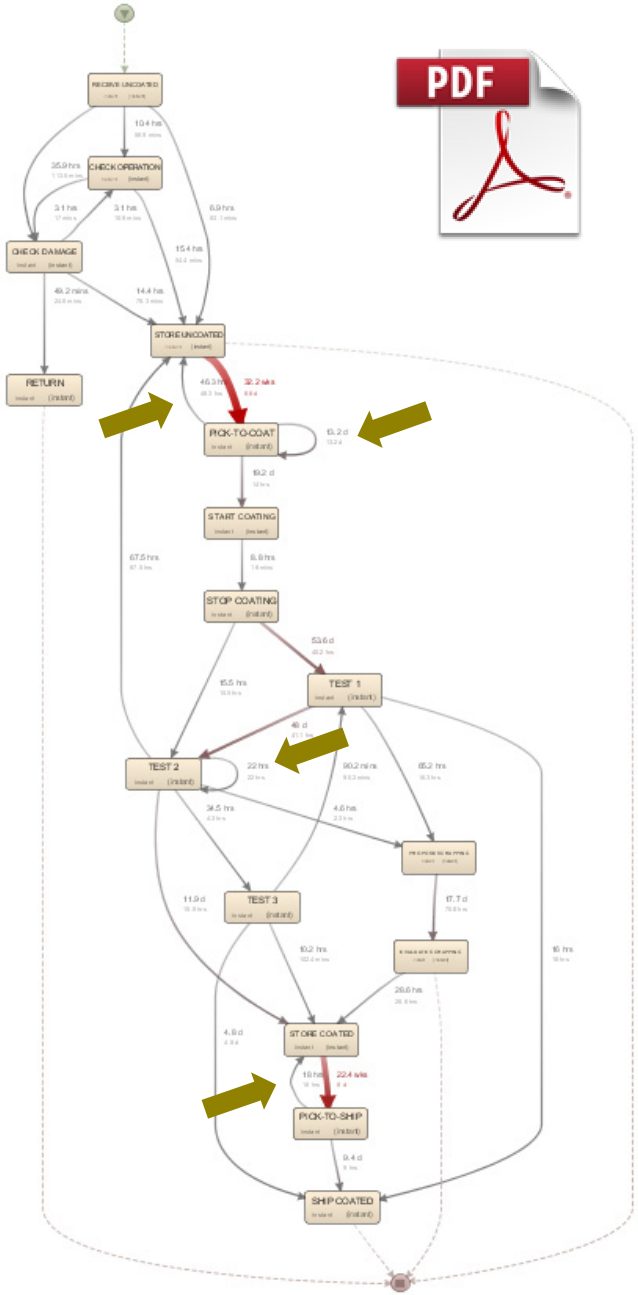
Some bottlenecks can be easily identified when we search for process loops in the process map.

Of course, **process loops** are expected in some process models and may indicate normal functioning of the process. However, in processes that are expected to be linear and branching, such as the logistics process of SmartCoat, a process loop can indicate either an error, or a process issue.

On the right, I can easily identify some **unexpected arrows**:

- Arrow from *'Pick-to-coat'* to *'Store uncoated'*
- Arrow from *'Pick-to-coat'* to *'Pick-to-coat'*
- Arrow from *'Test 2'* to *'Test 2'*
- Arrow from *'Pick-to-ship'* to *'Store coated'*

These process loops should be investigated case by case and it should be checked how these loops can be avoided in the future.



3. Zoom in on ‘coating’ and ‘testing’

In this part of my process mining analysis, I zoom in on the **coating and testing part** of the logistics process.

In the first episode, Marie told us about some rules with regard to the logistics process. Do you remember them? Let me repeat them for you.

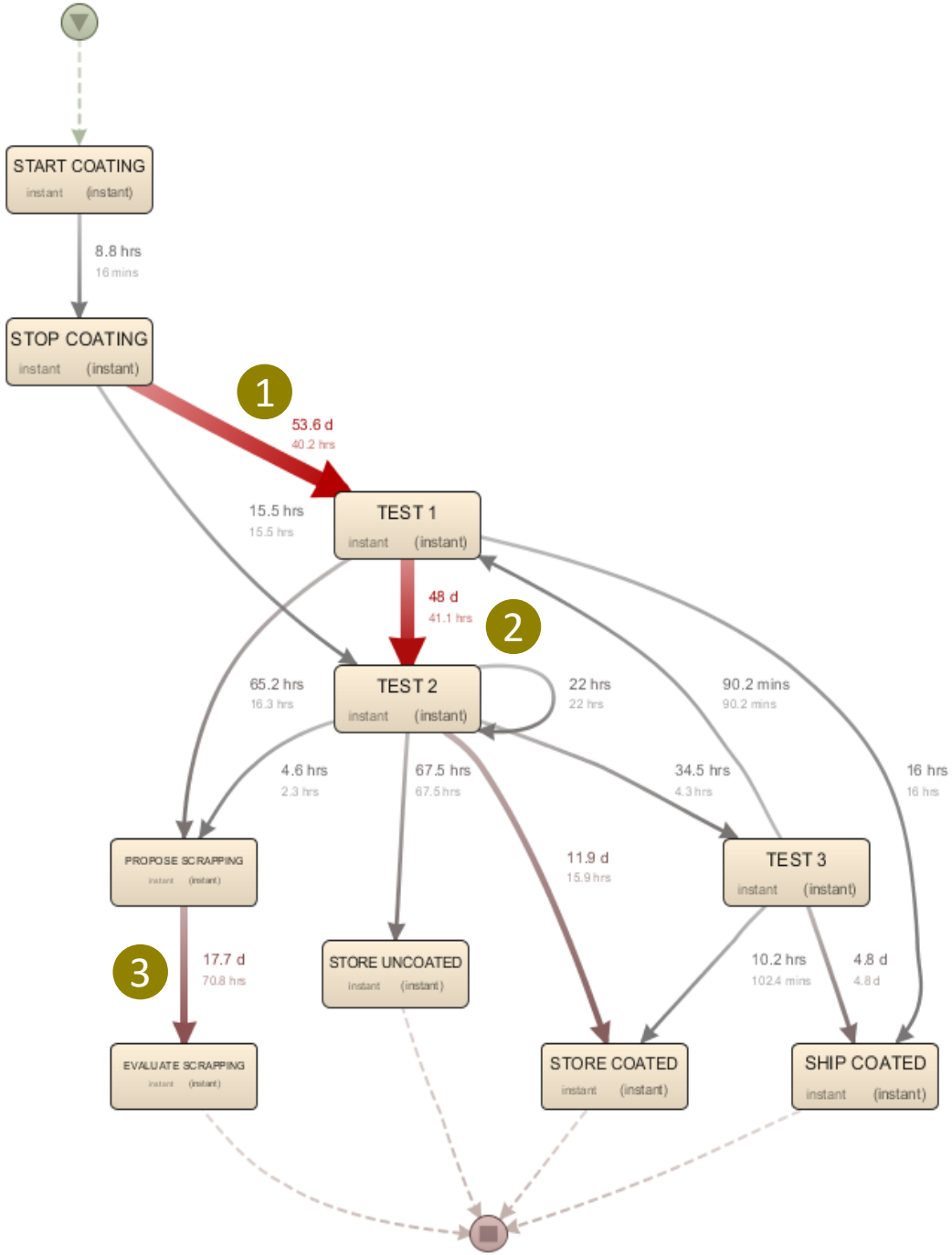
1. Once a smartphone is coated, a cooldown period of 24 hours is required before the tests can start. A period shorter than 24 hours is considered as an exception;
2. It is not allowed to have more than 4 smartphones in the testing room at the same time.

3. Zoom in on ‘coating’ and ‘testing’

On the right, all process steps are shown, starting from ‘coating’ until the next process steps taking place after the ‘testing’. The ‘**total duration**’ and ‘**mean duration**’ are shown again next to each arrow.

Here again, it is easy to identify the high-impact areas (large red arrows):

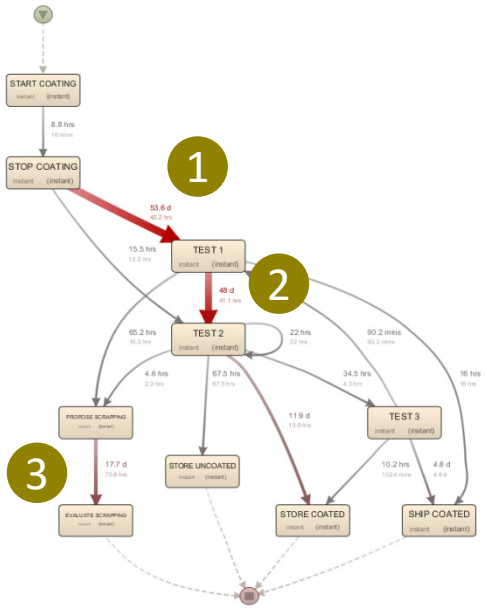
1. Arrow from *‘Stop Coating’* to *‘Test 1’* (mean duration: 40,2 hours)
2. Arrow from *‘Test 1’* to *‘Test 2’* (mean duration: 41,1 hours)
3. Arrow from *‘Propose scrapping’* to *‘Evaluate scrapping’* (mean duration: 70,8 hours)



3. Zoom in on ‘coating’ and ‘testing’

Let’s see …

1. Arrow from *‘Stop Coating’* to *‘Test 1’:* a **cooldown period** of **24 hours** is required before any test can start. So, it is quite normal that the mean duration amounts to 40,2 hours. More interesting to check is … do we have cases for which the cooldown period has not been respected. Let’s investigate on the following pages!
2. Arrow from *‘Test 1’* to *‘Test 2’:* the mean duration here amounts to 41,1 hours. Although I realize that weekends might be included, this is quite long … It is plausible that there are often **too many smartphones** - more than 4 - in the **testing room** at the same time. Let’s investigate this too!
3. Arrow from *‘Propose scrapping’* to *‘Evaluate scrapping’*: it takes on average 70,8 hours for Marie to **evaluate** a **proposed scrapping**. Why does is take that long? Let’s also have a look at this aspect!



3.1 Cooldown period of 24 hours

To identify all smartphones *(cases)* for which the cooldown period of 24 hours has not been respected, I put a filter on the event log of the logistics process in Disco as follows: show me all smartphones for which the time between *'Stop coating'* and the next process step *(activity)* is shorter than 24 hours.

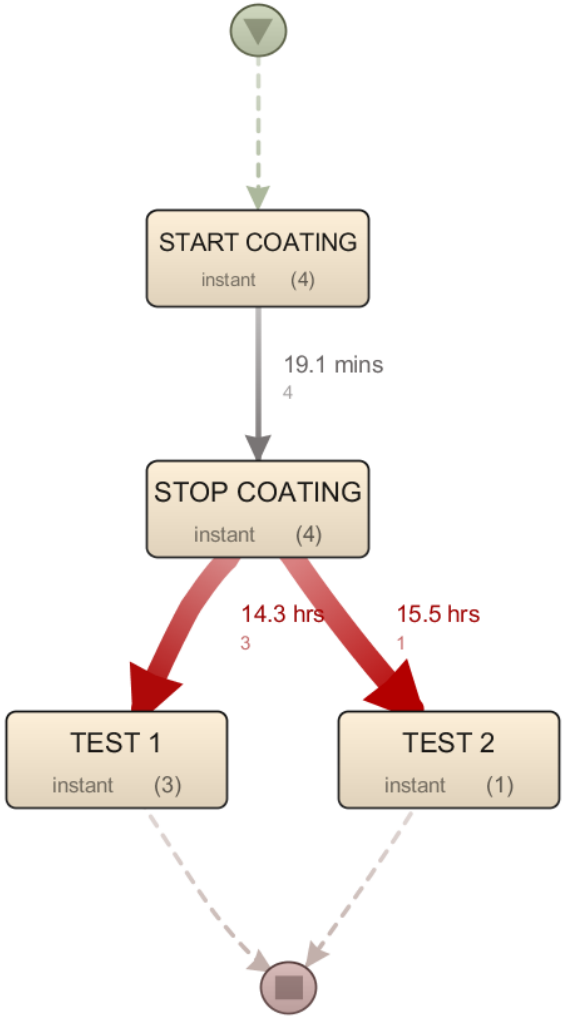
The results are shown on the right. Next to each arrow two indicators are mentioned again:

- The upper part of the graphics represents this time the **mean duration** between 2 process steps *(activities)* for the filtered smartphones (with a cooldown period of less than 24 hours).
- The lower part of the graphics represents the **number of cases**.

We immediately see that the cooldown period of 24 hours has not been respected for 4 cases:

1. Arrow from *'Stop Coating'* to *'Test 1':* 3 cases;
2. Arrow from *'Stop Coating'* to *'Test 2':* 1 cases.

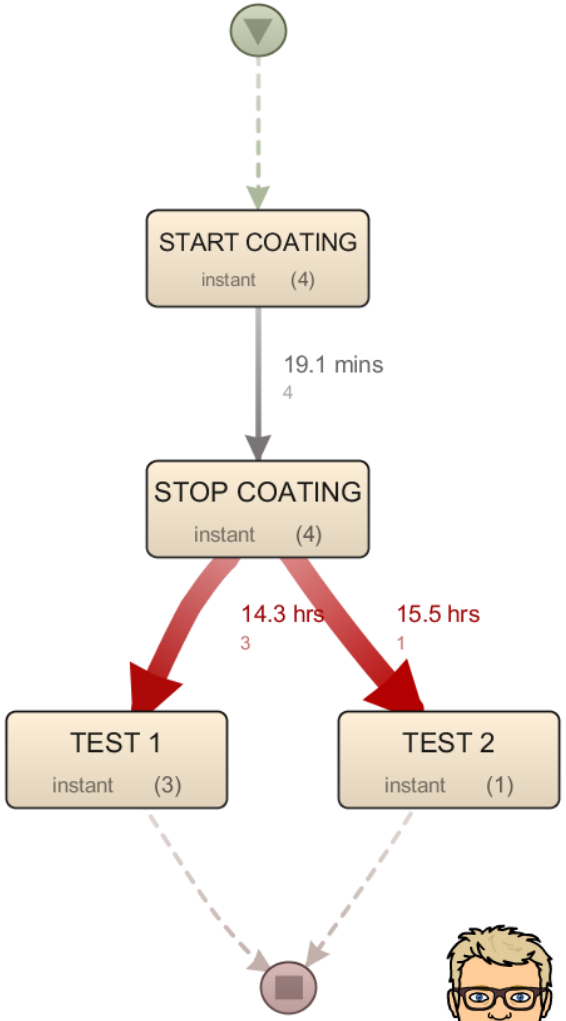
Let's look into the details on the next page!

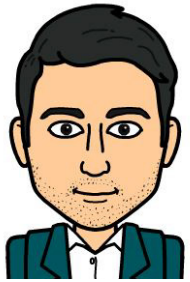


3.1 Cooldown period of 24 hours

In the details shown below we see that **Edward** has not respected the cooldown period for **4 smartphones**. Let's talk to him.

Also, as already discussed in Episode 3, it should be verified whether *'Test 2'* can be done before *'Test 1'.*





Case ID	Stop coating	Start testing	Duration		Resource	Function	Brand	Customer
Phone 3679	10.03.2016 16:44:22	11.03.2016 12:54:07	**20 hours, 9 mins**	'Test **1**'	**Edward**	Test engineer	MePhone	Callhouse
Phone 3678	10.03.2016 17:29:34	11.03.2016 12:10:55	**18 hours, 41 mins**	'Test **1**'	**Edward**	Test engineer	MePhone	Callhouse
Phone 3670	15.03.2016 10:48:36	15.03.2016 15:28:36	**4 hours, 40 mins**	'Test **1**'	**Edward**	Test engineer	MePhone	Callhouse
Phone 3685	23.03.2016 16:49:12	24.03.2016 08:50:57	**16 hours, 1 min**	'Test **2**'	**Edward**	Test engineer	MePhone	Wallsmart

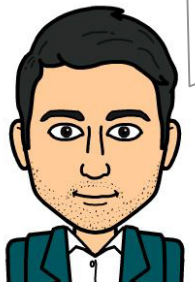
Edward

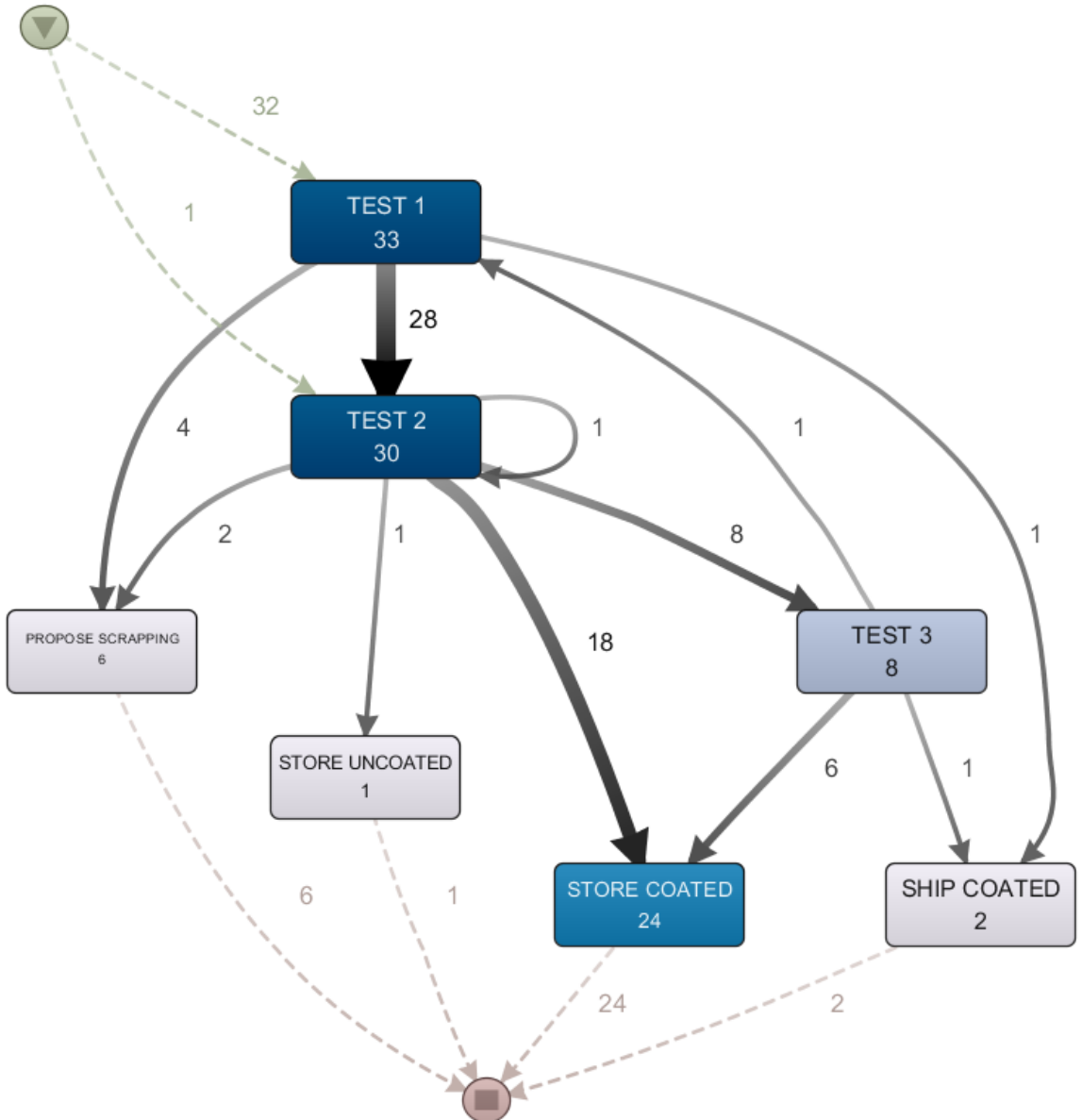
Test engineer

3.2 Maximum of 4 smartphones in testing room

I want to analyze whether there are often more than 4 smartphones in the testing room. Smartphones enter the testing room as from the moment a tests begins until the next process step (non-test) starts.

On the right I can see that 33 smartphones enter the testing room (= 32 + 1) and that 33 smartphones leave the testing room (= 4 + 2 + 1 + 18 + 6 + 1 + 1). I can however not see on the graphics how many smartphones there are in the testing room at the same time. I will show you how to investigate this on the next page!



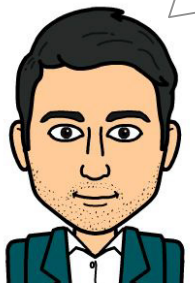


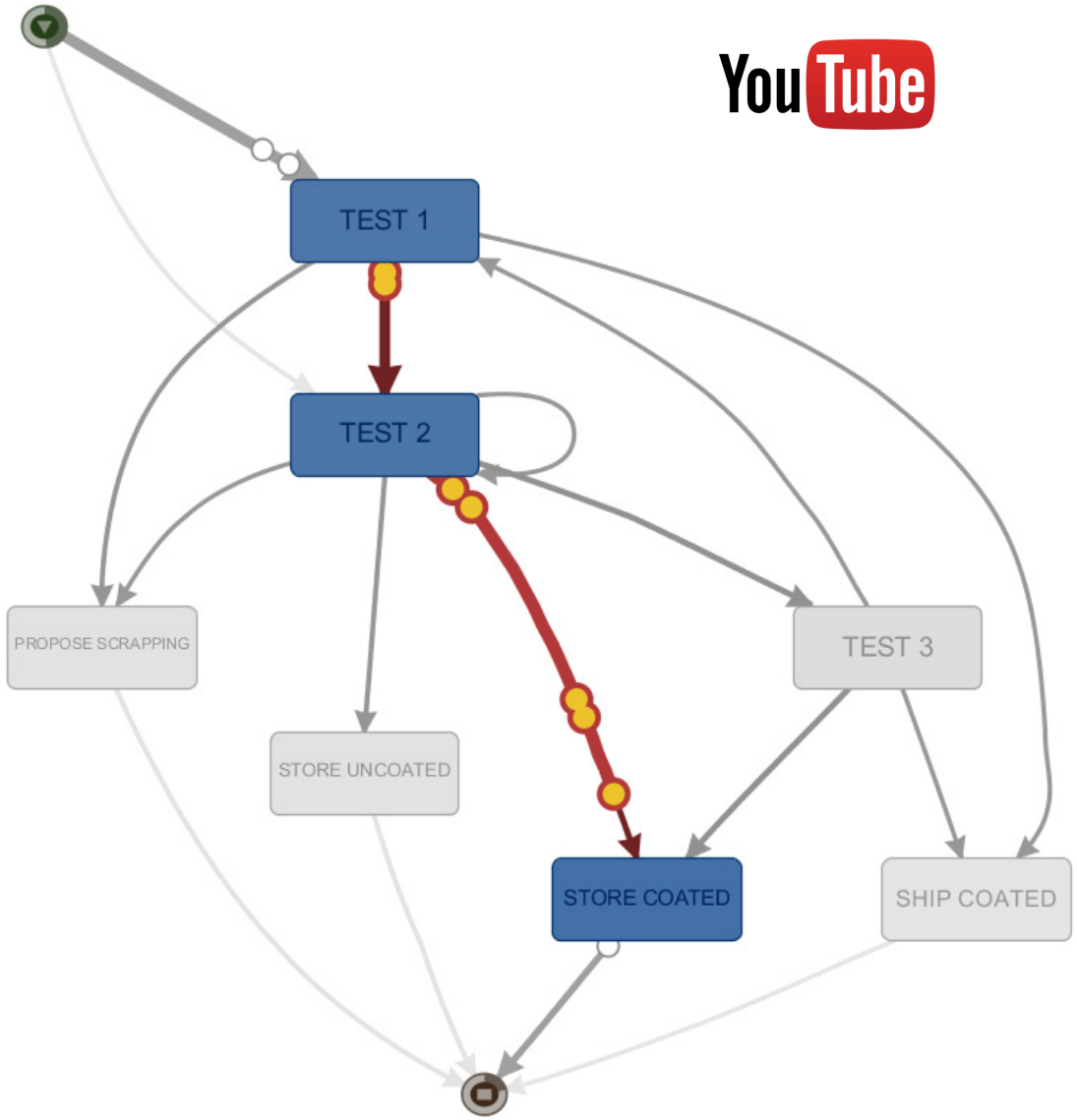
3.2 Maximum of 4 smartphones in testing room

With the process software Disco, the logistics process can be visualized as it happened over time. A screenshot of that animation is shown on the right.

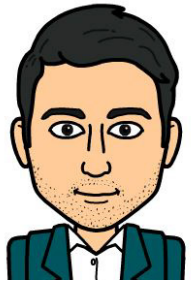
The screenshot shows the smartphones in the testing room on *Tuesday March 15, 2016* at *14:17:52*. Each yellow dot on the arrows between *'Test 1'*, *'Test 2'* and *'Store coated'* represent a smartphone. I clearly see that there are **7 smartphones** in the testing room on the moment … That's much more than 4!

Do you want to see the full animation? Click then on the screenshot and you will see it in YouTube!



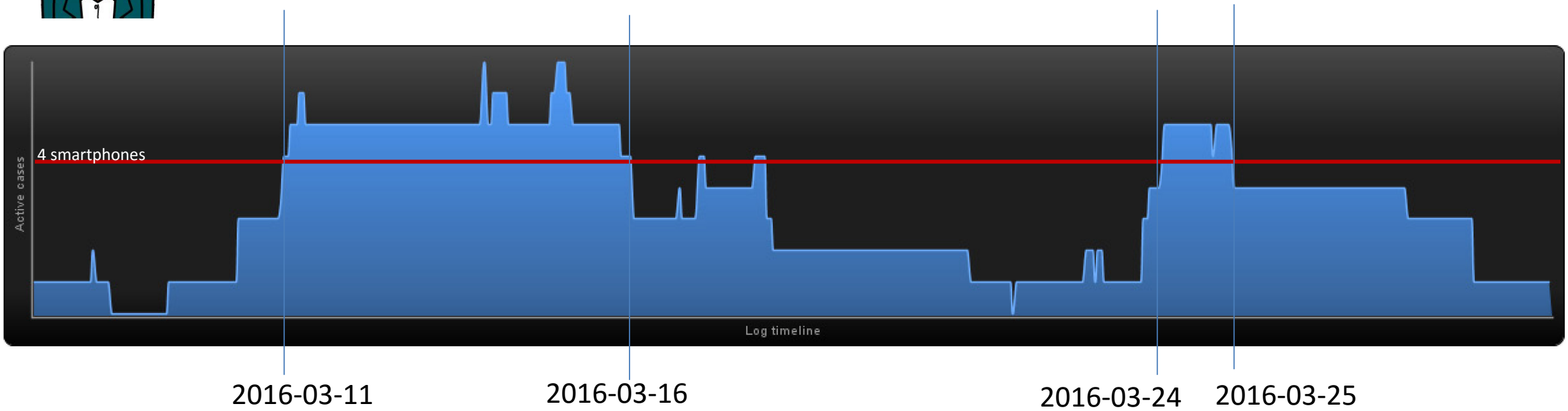


3.2 Maximum of 4 smartphones in testing room



In the chart below, I also see that there are often more than 4 smartphones in the testing room at the same time. On the horizontal axis, the time line is represented. The number of active cases (smartphones) at a certain moment is shown on the vertical axis.

The blues zone above the red line (number of smartphones = 4) shows that there are more than 4 smartphones in the testing room: we can see that there are **more than 4 smartphones** in the period March 11 until March 16 and the period March 24 until March 25.



3.3 Time to evaluate proposed scrappings

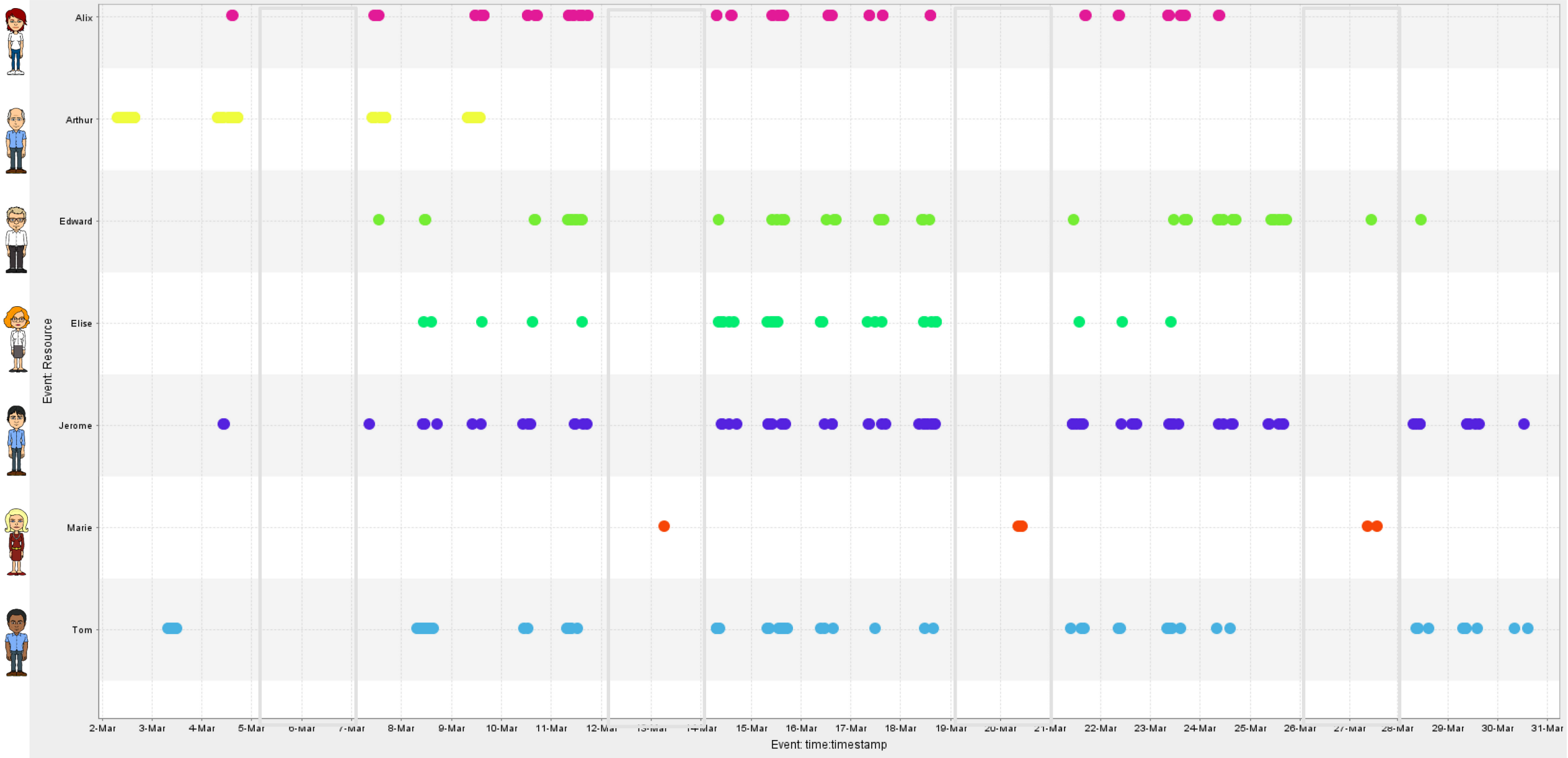
I noted that it takes for Marie on average 70,8 hours to **evaluate** a "**proposed scrapping**". I wonder why it takes that long?

I will analyze this by means of the **dotted chart** in the open-source software ProM. The dotted chart (ref. next slide) is a chart similar to a Gant chart. It shows a spread of process activities of an event log over time:

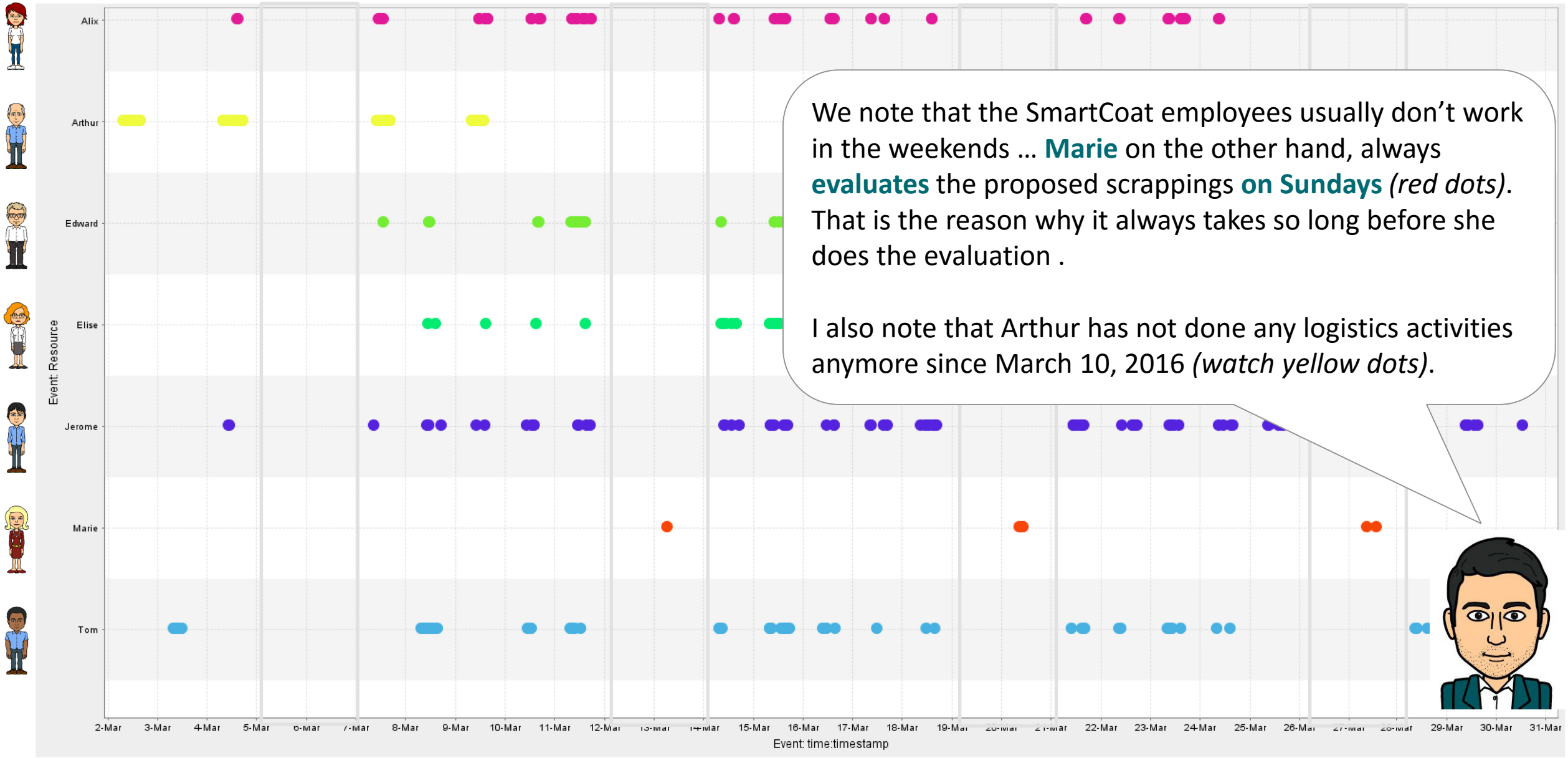
- The horizontal axis represents the time line;
- The dots represent the process activities. Each time a process activity has been executed a dot is showed.

On the next pages, I will display two dotted charts: One for which the vertical axis shows the SmartCoat team *(resources)* and one for which the vertical axis displays the smartphones *(cases)*. Let's discuss.

3.3 Time to evaluate proposed scrappings



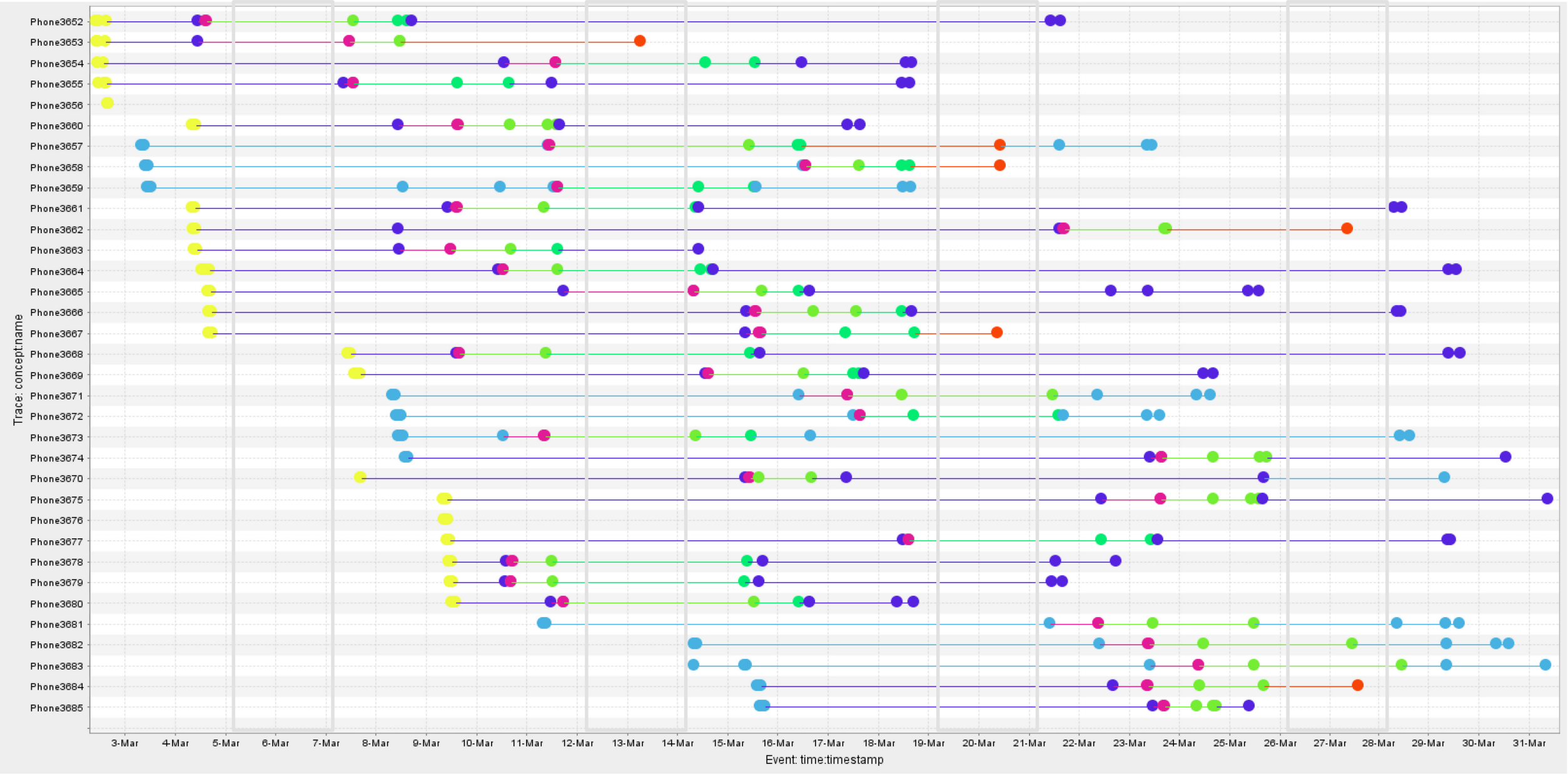
3.3 Time to evaluate proposed scrappings



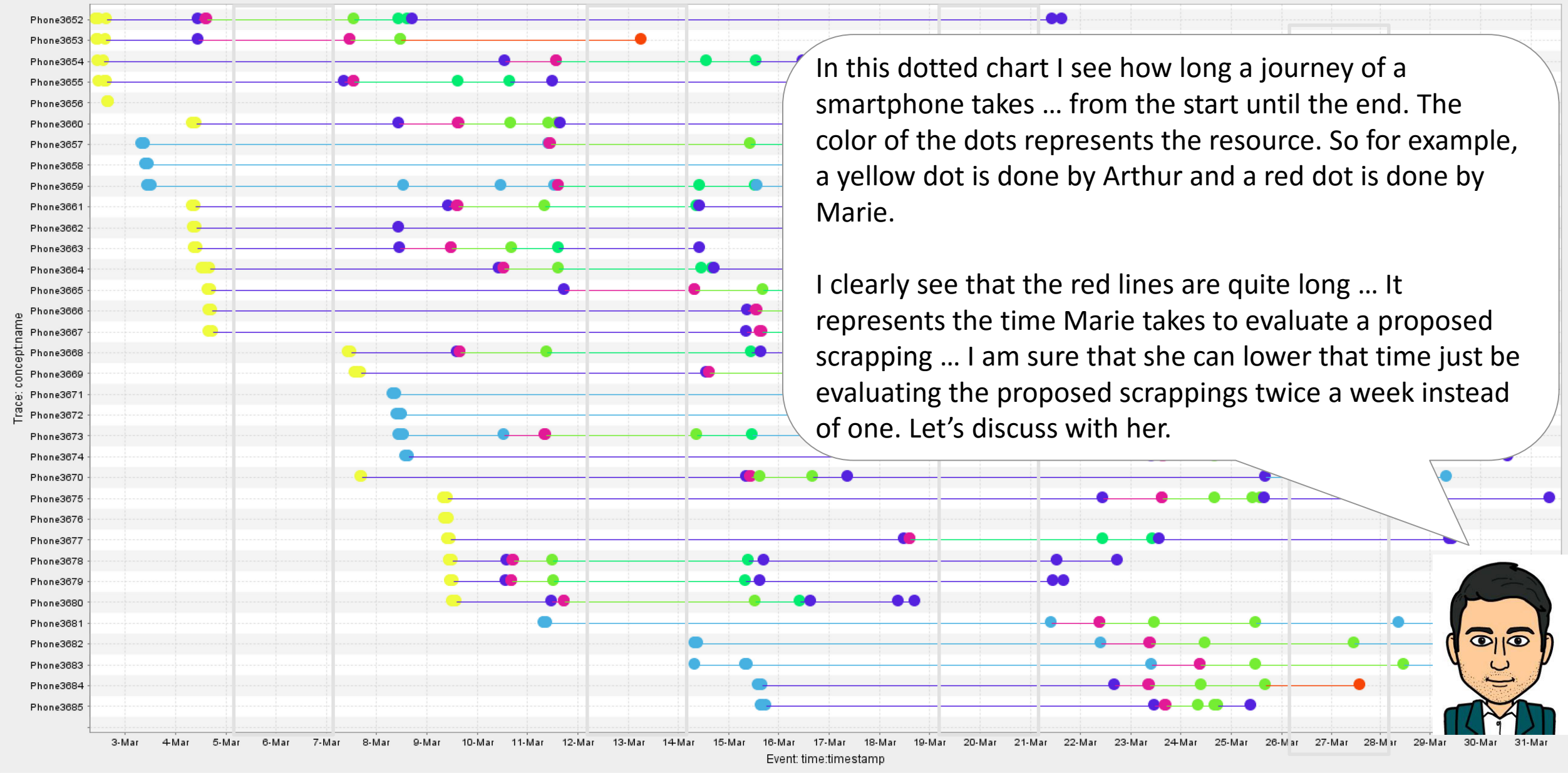
We note that the SmartCoat employees usually don't work in the weekends … **Marie** on the other hand, always **evaluates** the proposed scrappings **on Sundays** *(red dots)*. That is the reason why it always takes so long before she does the evaluation .

I also note that Arthur has not done any logistics activities anymore since March 10, 2016 *(watch yellow dots)*.

3.3 Time to evaluate proposed scrappings



3.3 Time to evaluate proposed scrappings



In this dotted chart I see how long a journey of a smartphone takes … from the start until the end. The color of the dots represents the resource. So for example, a yellow dot is done by Arthur and a red dot is done by Marie.

I clearly see that the red lines are quite long … It represents the time Marie takes to evaluate a proposed scrapping … I am sure that she can lower that time just be evaluating the proposed scrappings twice a week instead of one. Let’s discuss with her.

Feedback to Marie

Feedback

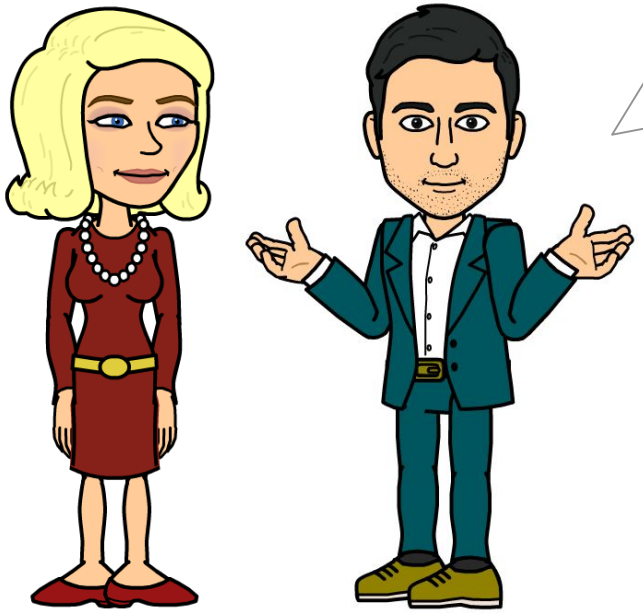
Hi Marie, I have performed some bottleneck analysis this time. In the first Episode, you told me that SmartCoat performs better than the competitors because of the **high quality** and **on-time delivery**. Well, I have kept that in mind for my bottleneck analysis.

I noted that the **smartphones** – both uncoated and coated – remain **quite long** in the **warehouses** … especially those from retailer *Wallsmart*. You told me that storage costs money. I advice that we verify – maybe together with the retailers – how we can lower the waiting time and as a result, the storage costs.

I also discovered some **process loops**. I suggest to talk with the concerned people and to see how we can avoid such loops in the future.

Finally, I noticed that you always evaluate scrappings on Sundays. This might slow down the logistics process … especially in the cases you reject the proposal. Is it possible for you to do the **evaluation twice a week**?

Feedback



Next, I checked whether the **cooldown period** of 24 hours is respected. I found **4 examples** for which it was not the case. I discovered that it was 4 times Edward who did not respect the cooldown period. Let's talk to him and stress the importance of the cooldown period.

I also discovered that there are **often more than 4 smartphones** in the testing room at the same time. This might have an impact on the quality.

I suggest organizing a short meeting with Alix, Elise and Edward and to check how we can avoid these situations.

Do you want to know **which interactions** between employees Cédric will identify through **process mining ?**

Watch the episode next week!

Planning

April 7th, 2016	Episode 1: **introduction**
April 14th, 2016	Episode 2: **process discovery**
April 21st, 2016	Episode 3: **process deviations**
April 28th, 2016	Episode 4: **benchmarking**
May 5th, 2016	Episode 5: **bottlenecks**
May 12th, 2016	Episode 6: **interactions**
May 19th, 2016	Episode 7: **process costs**
May 26th, 2016	Episode 8: **prediction** and **real-time**

Or check our website! www.horsum.be

Questions? Contact us!

Contact us!

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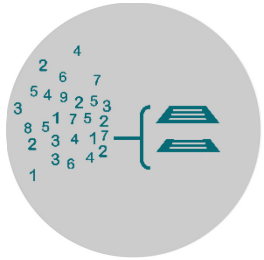

Data analytics

Process mining

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