



# Digital Twin

## Use Case (07/12/2022)

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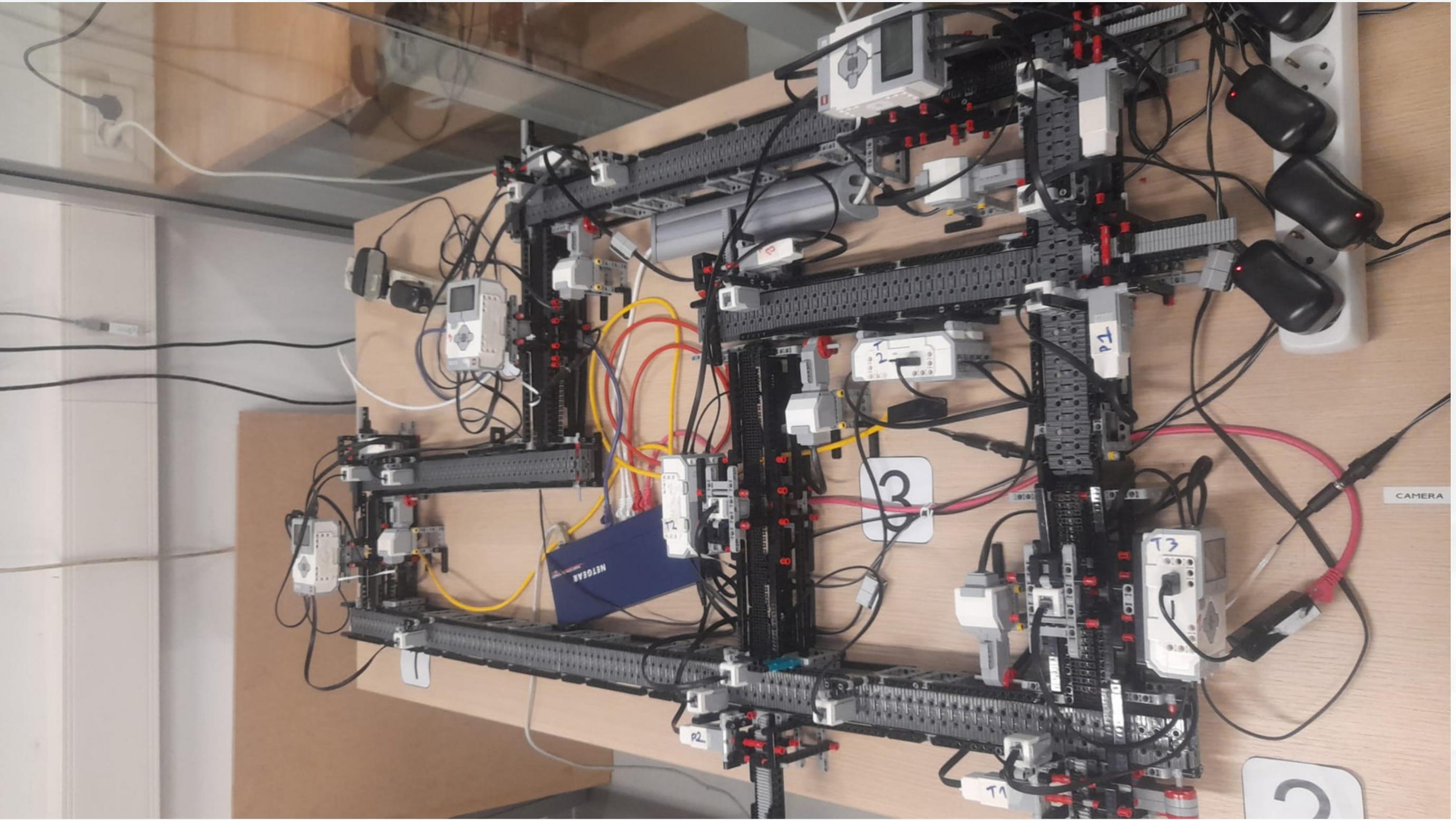
# Proposed Topic

The research goal is to update and test the current Digital Twin Architecture in a more generic scenario. In order to do that and add new developments, considering the GAP in the literature and physical resources available in the lab, it's also proposed a test of a new DT service with feedback. The service proposed is the prediction of the remaining cycle time based on what-if analysis.

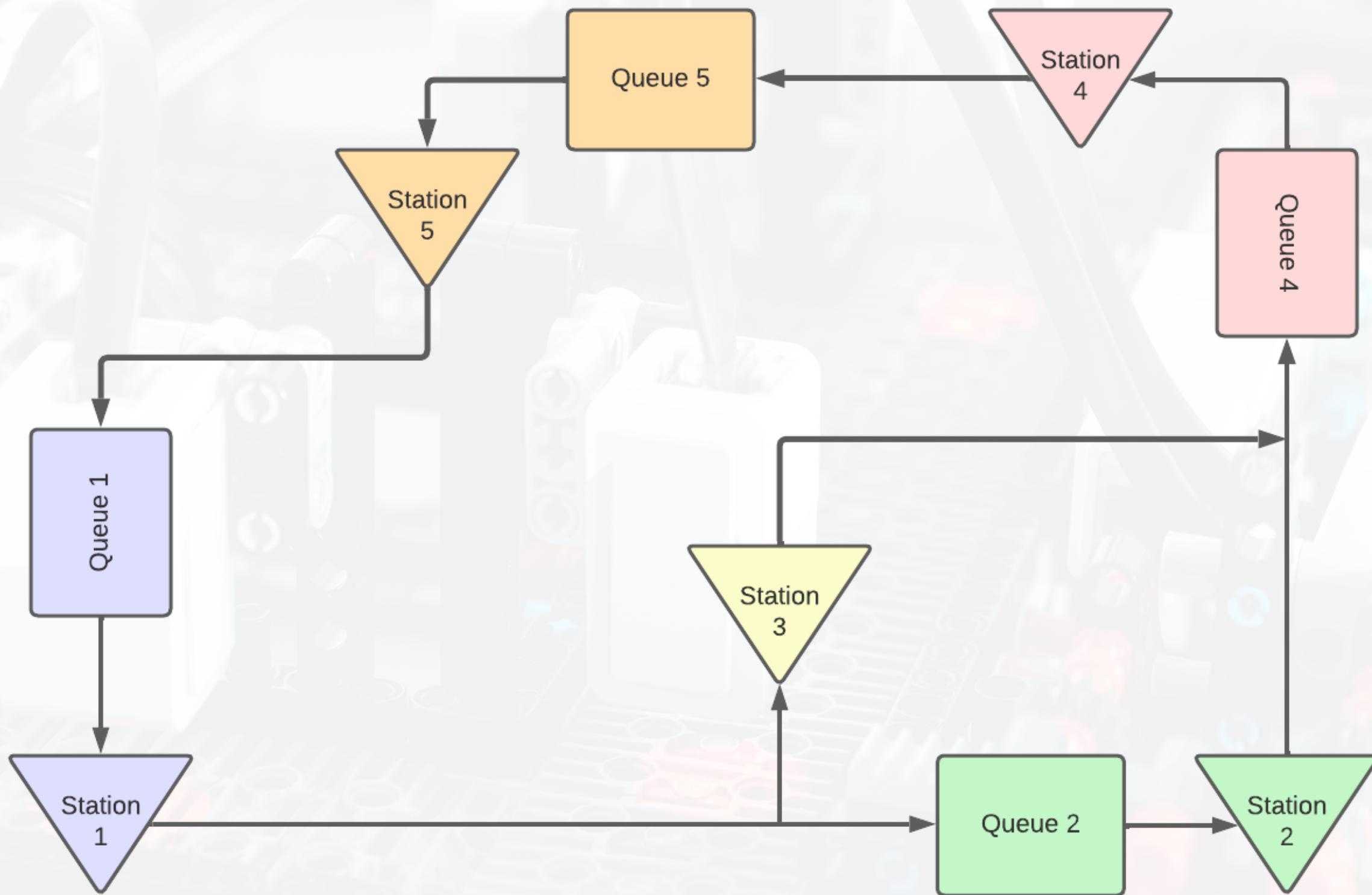
# why do we need a Digital Twin?

1. Real time data necessary to have accurate predictions
2. The need for a synchronized model capable of receiving a feedback from the automated decision making.

# Proposed Use Case: current layout



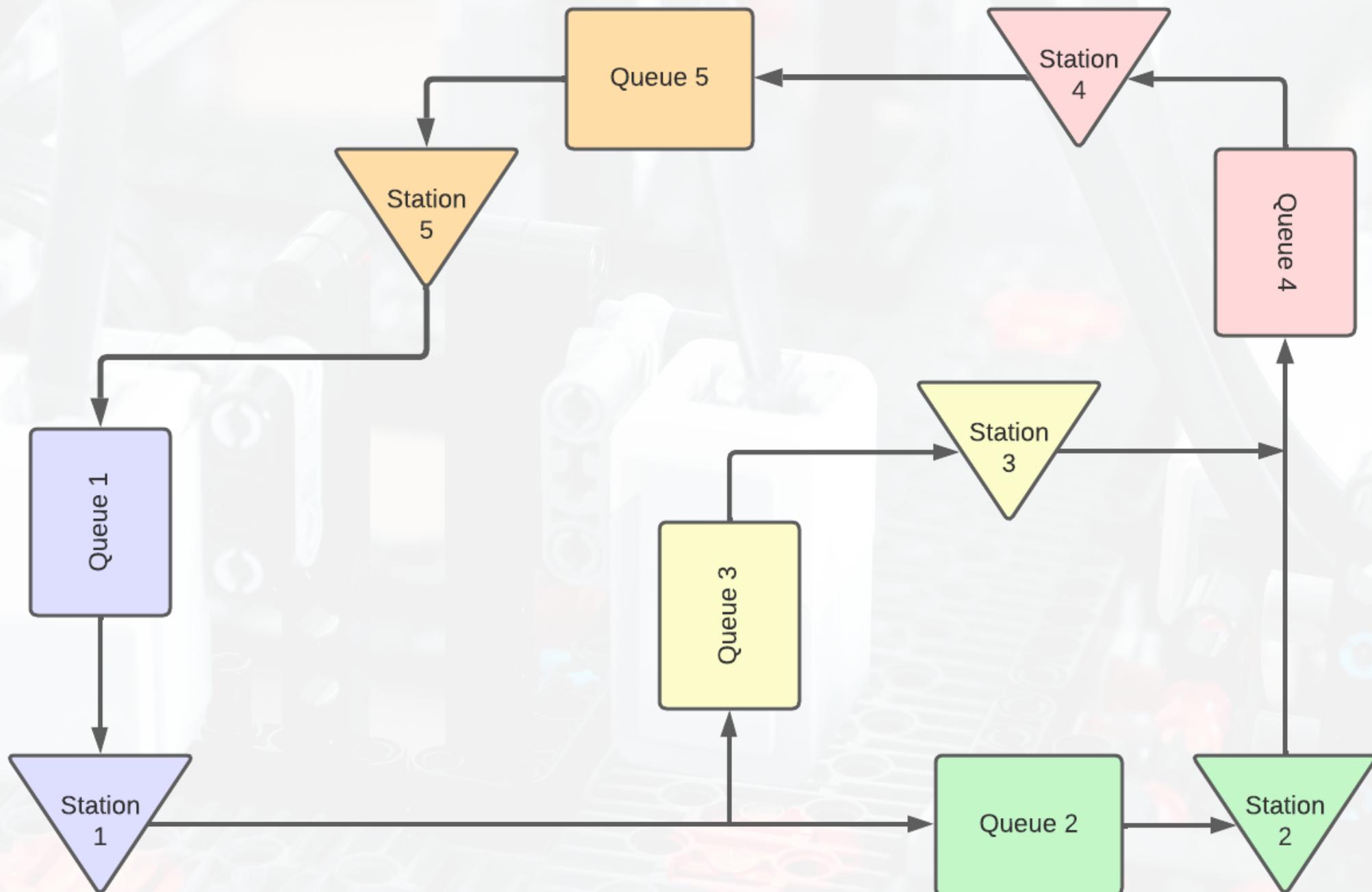
# Proposed Use Case: current layout



Observations:

1. Station 3 without a Queue
2. Considering a production or assemble line, station 2 and 3 are in parallel and executes the same operation
3. Station 4 might not be necessary in that position
4. Even with this layout it's possible to have a decision making between stations 2 and 3.

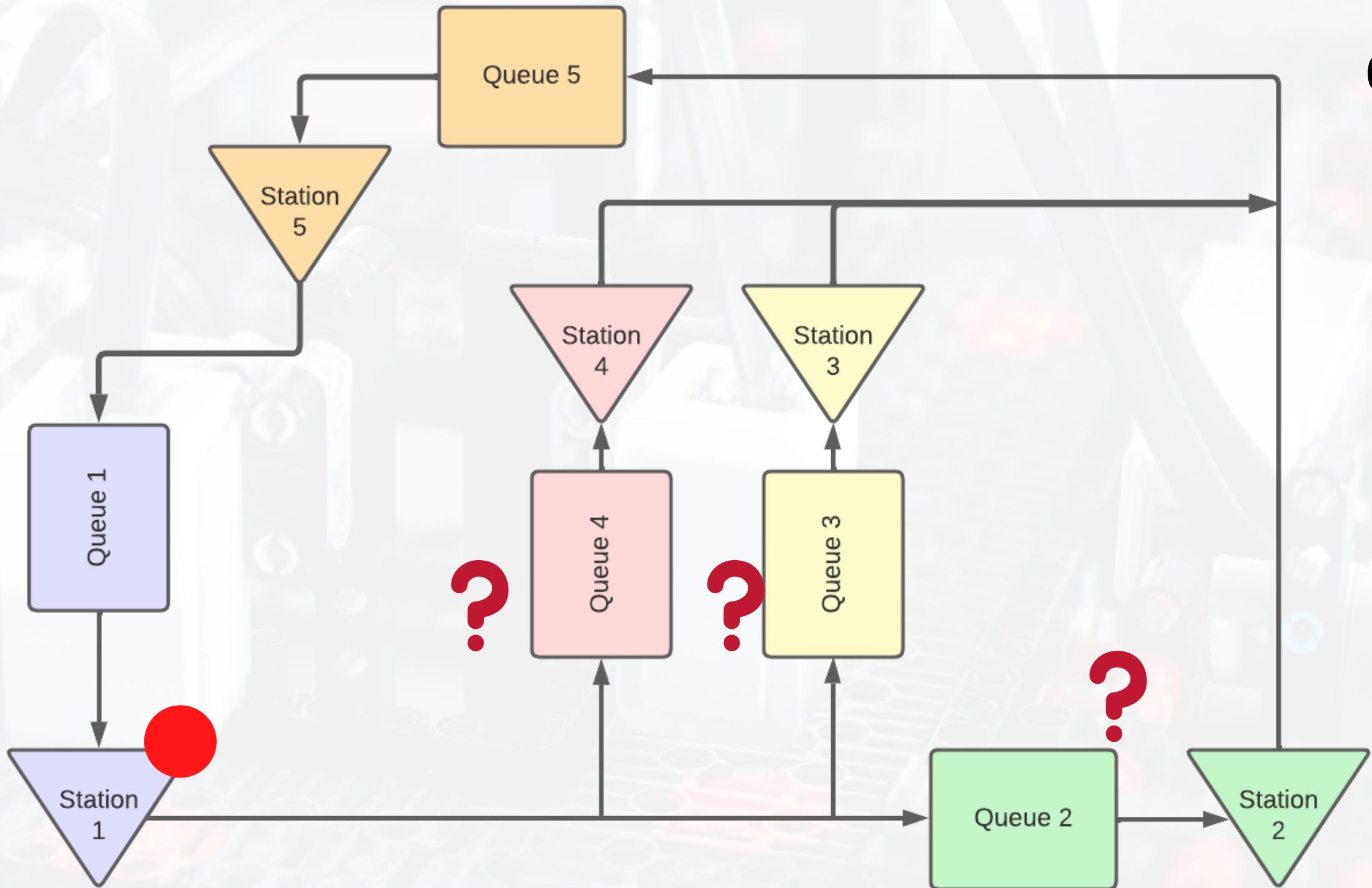
# Proposed Use Case: new layout



Observations:

1. Add missing queue for station 3
2. Use the decision making between station 3 and 2.
3. Keep station 4

# Proposed Use Case: new layout



Observations:

1. Add missing queue for station 3
2. Move station 4 to the parallel system
3. Use the decision making between station 2,3 and 4.

# Application: Remaining Cycle Time

Goal:

- Predict the remaining cycle time for each parallel station based on the current scenario.
- Choose the best route for the workpiece

Given conditions:

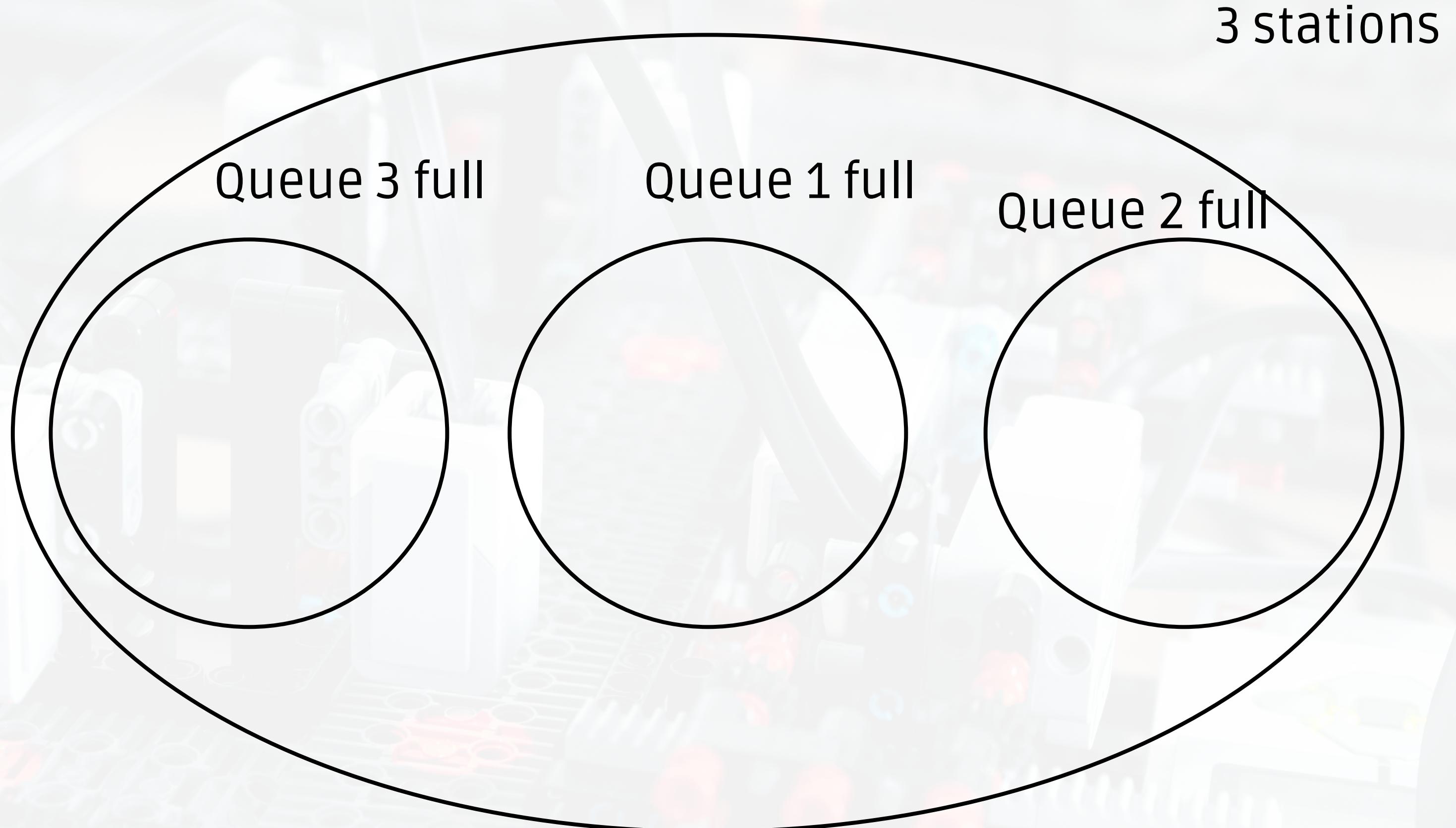
- Queue status of the parallel stations
  - If queues are full or not
- Availability of parallel stations
  - Stations in maintenance
- Current measured time of station S1 and S5
  - Cluster of productive
  - Machine power, employees engagement

# Application: Remaining Cycle Time

3 stations

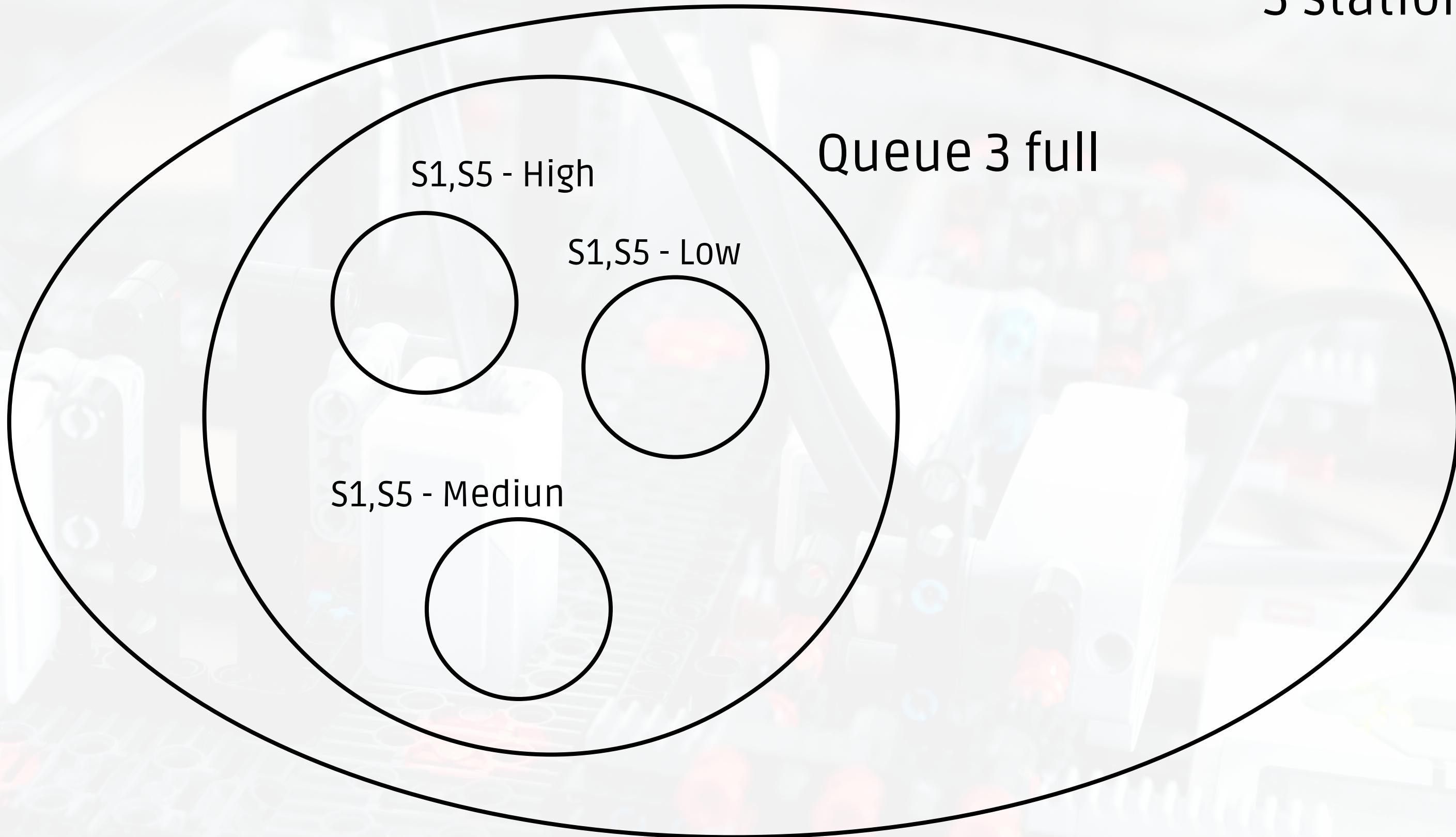
2 stations

# Application: Remaining Cycle Time



# Application: Remaining Cycle Time

3 stations



# Application: Remaining Cycle Time

3 stations

S1,S5 - High

**S2 - 15 seconds**

S3 - 25 seconds

S4 - 17 seconds

Queue 3 full

# Application: Remaining Cycle Time

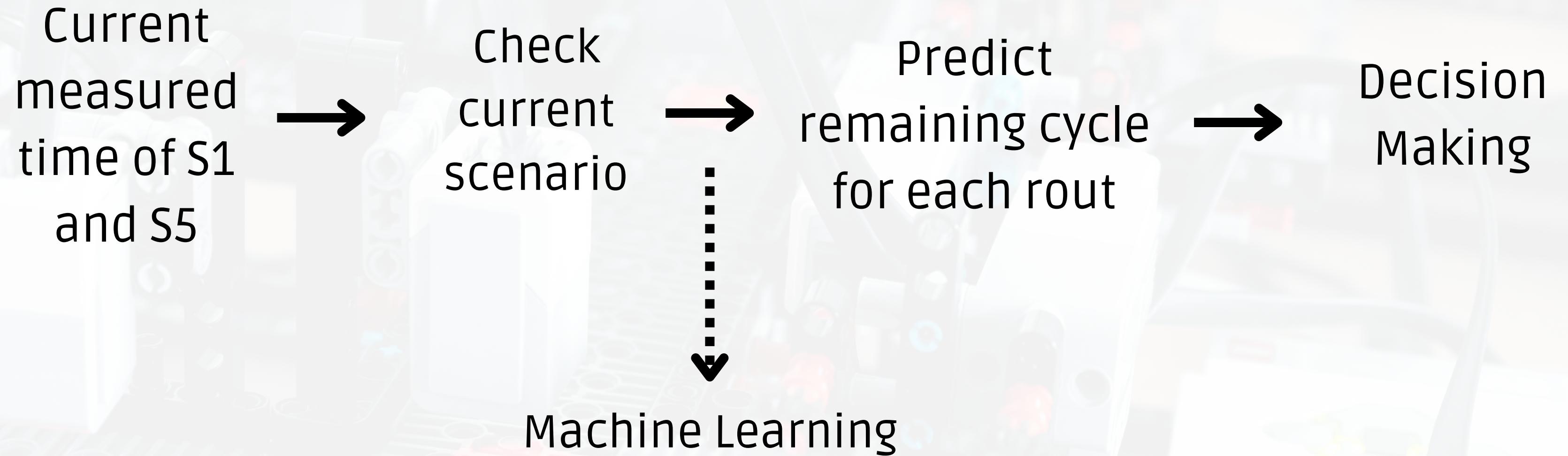
Historical data to create clusters for each scenario

Scenarios	Product Type	Queue occupation	Available stations	Measured Time S5 & S6
Sc1.1	A	[not full, not full, full]	3	[15,17]
Sc1.2	A	[full, full, full]	3	[35,30]
Sc2.1	A	[full, not full, not full]	2	[10,8]

↓  
↓  
Deterministic scenarios

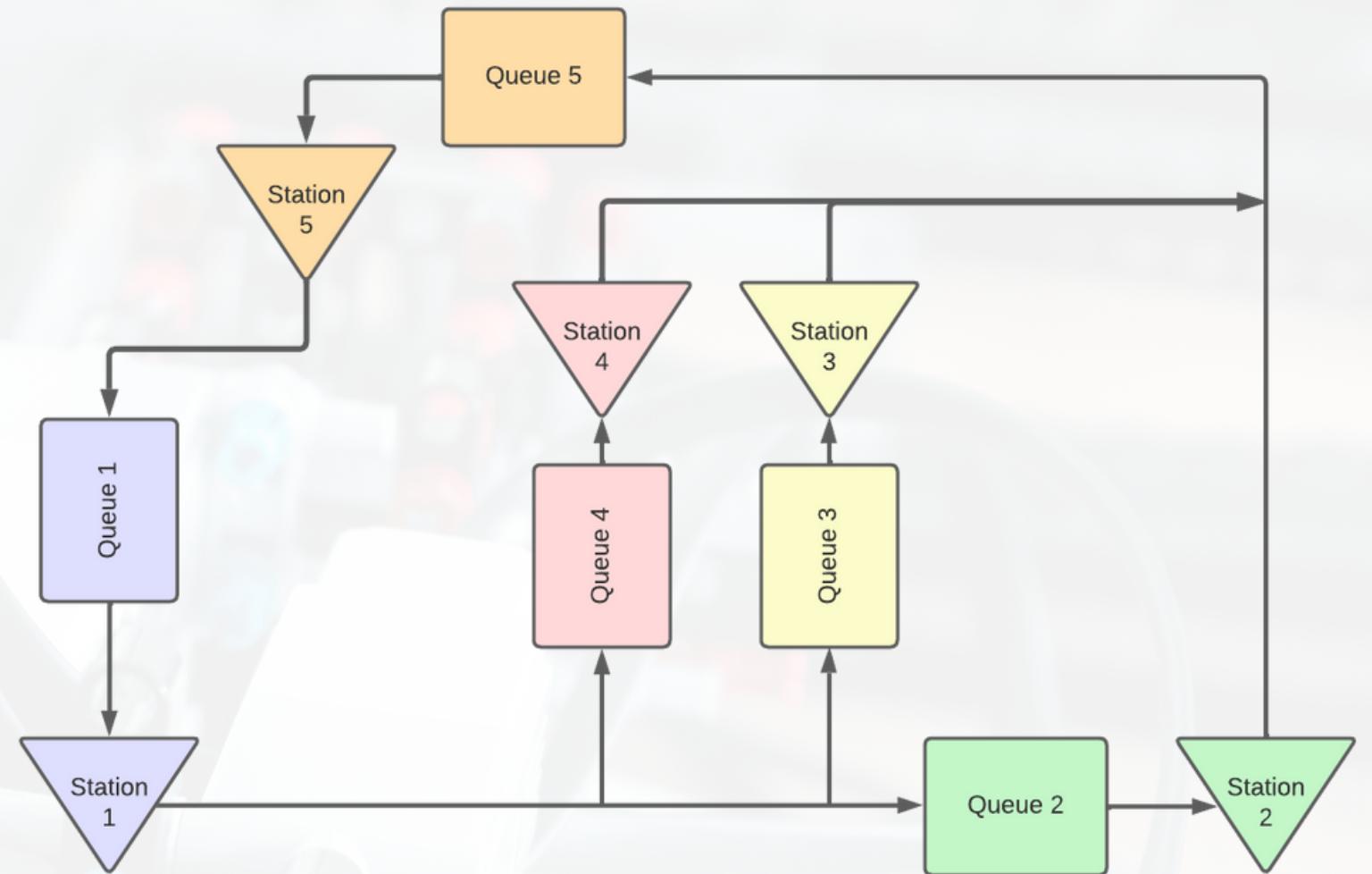
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Generated  
Scenarios

# Application: Remaining Cycle Time



# Application: What-if analysis

- Application that allows the user to play with the existing scenarios, for example
  - Based on the real data, see what would happen if the productivity higher
  - Increase the occupation of the buffer
  - Simulate a failure in one machine by decreasing the number of available machines





Thank You