

# IMIC'25

# Flexibac problem

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# Theme of IMIC'25: a robot for mail sorting centers

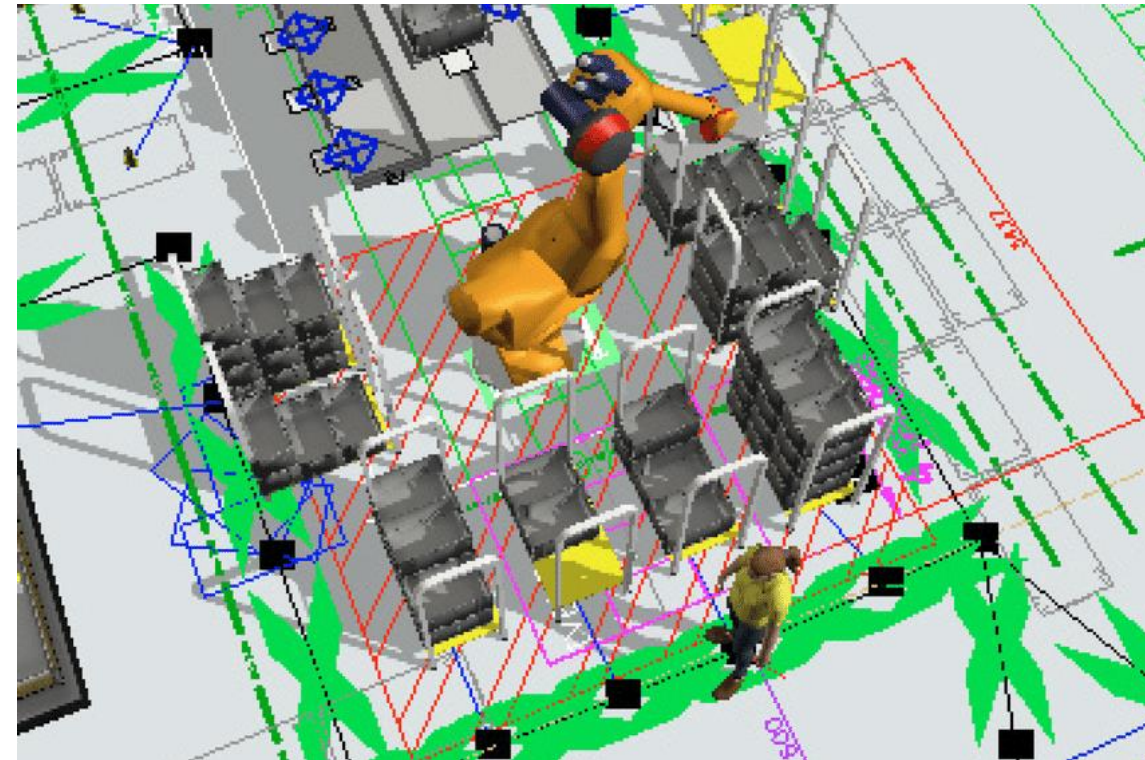
## Industrial context

- *A robot loads carts with mail containers (boxes) having the same destination (homogeneous carts)*
- *250 boxes destinations, only 10 carts around the robot with a fixed capacity*
- *30 to 40 000 boxes to handle each day*
- *Around 5 seconds to handle each box*
- *Around 1 minute to change a cart (full or not)*

## Decisions to be made

- *Which carts around the robot all along the production?*
- *Which boxes are handled by the robot ? Which are handled manually by operators?*

## Flexibac (La Poste)



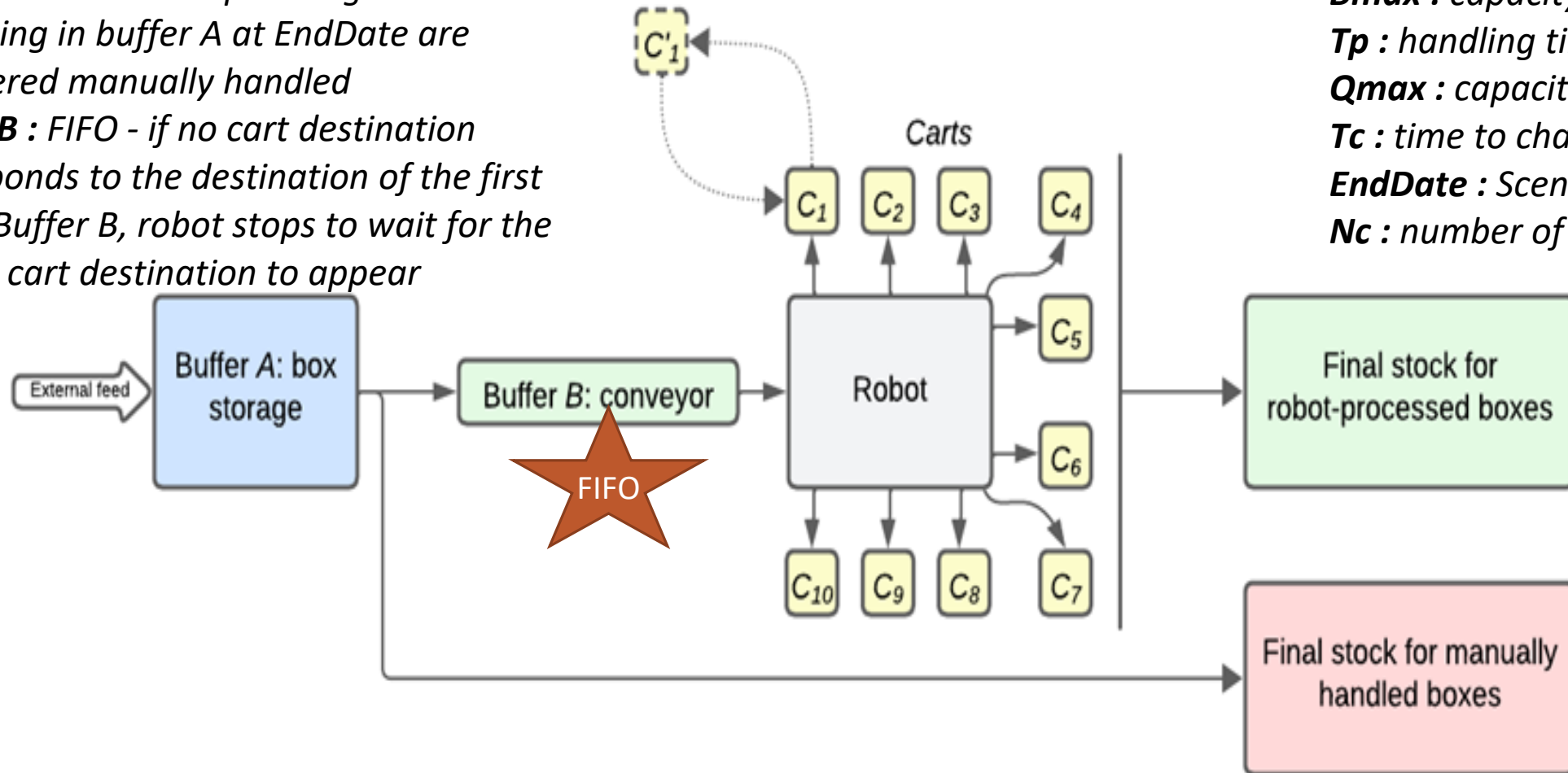
# Considered topology

## Hypotheses:

**Robot down time** : no down time

**Buffer A** : no local dispatching rule – boxes remaining in buffer A at EndDate are considered manually handled

**Buffer B** : FIFO - if no cart destination corresponds to the destination of the first box in Buffer B, robot stops to wait for the correct cart destination to appear



## Problem parameters:

**Amax** : capacity max of A

**Bmax** : capacity max of B

**Tp** : handling time for the robot

**Qmax** : capacity max of Carts

**Tc** : time to change 1 cart

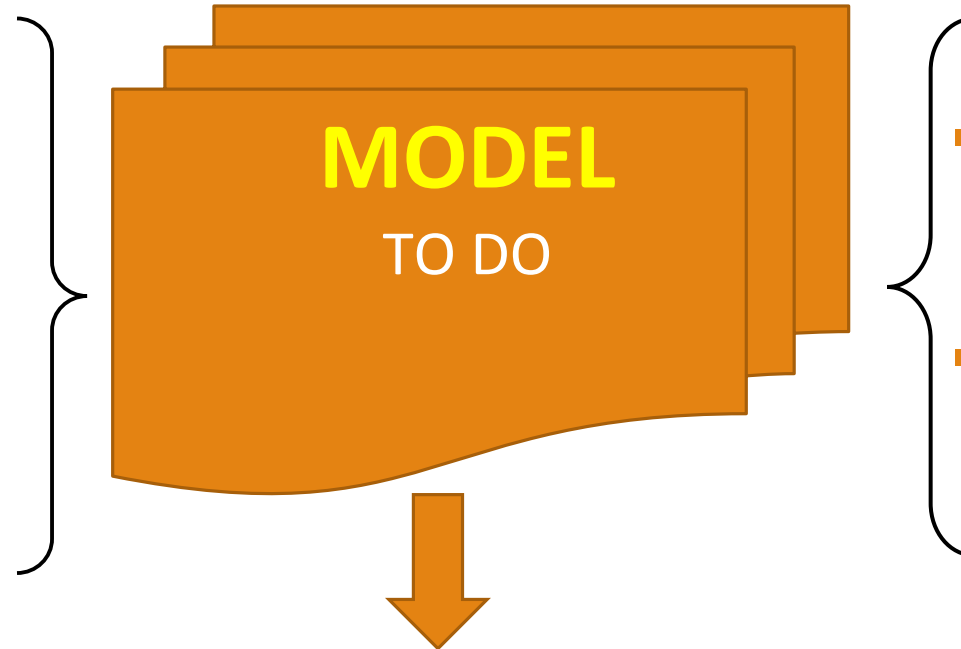
**EndDate** : Scenario horizon

**Nc** : number of carts available

# Work overview

## Inputs

- *Scenario parameters*
- *List of input dates and destinations of the boxes incoming in buffer A*



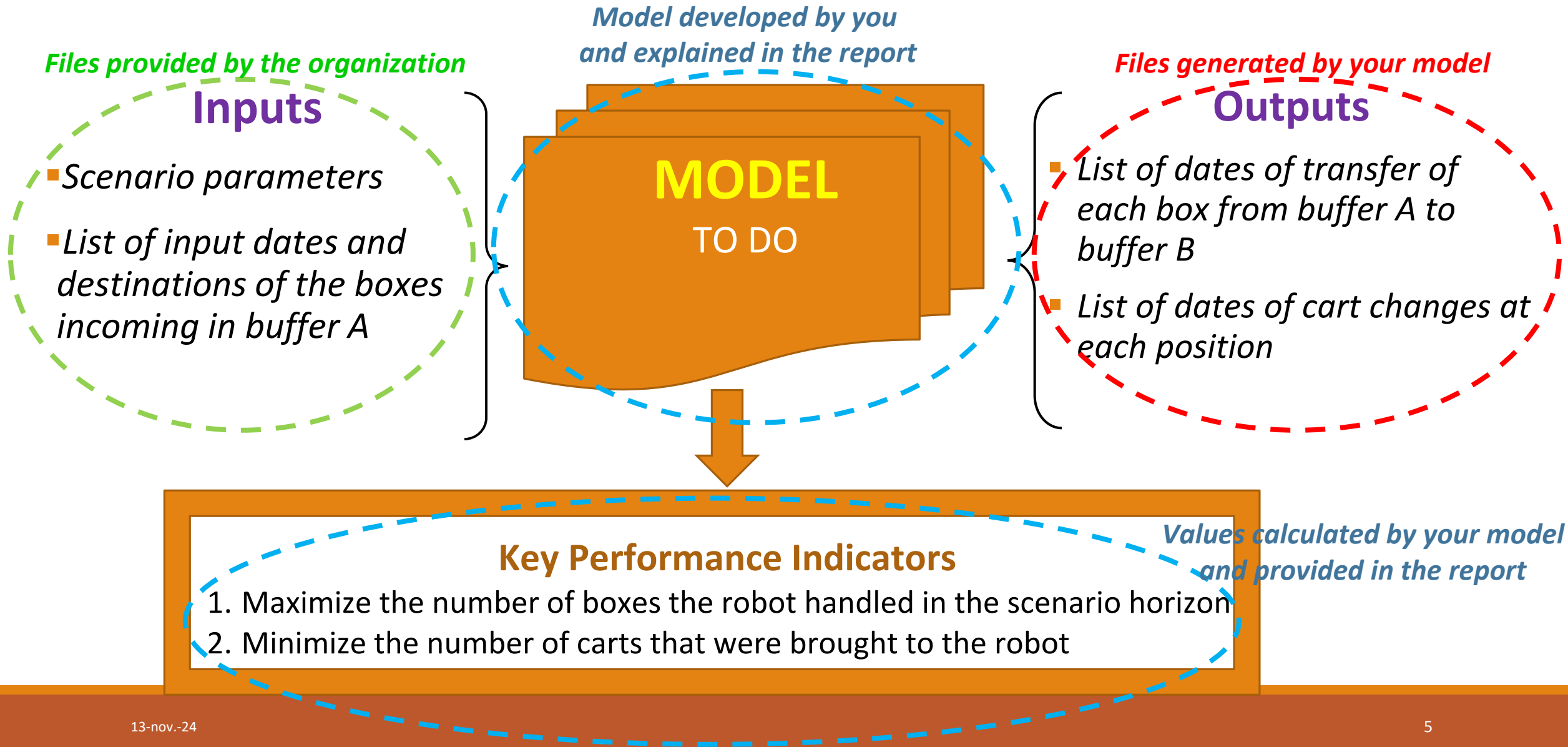
## Outputs

- *List of dates of transfer of each box from buffer A to buffer B*
- *List of dates of cart changes at each position*

## Key Performance Indicators

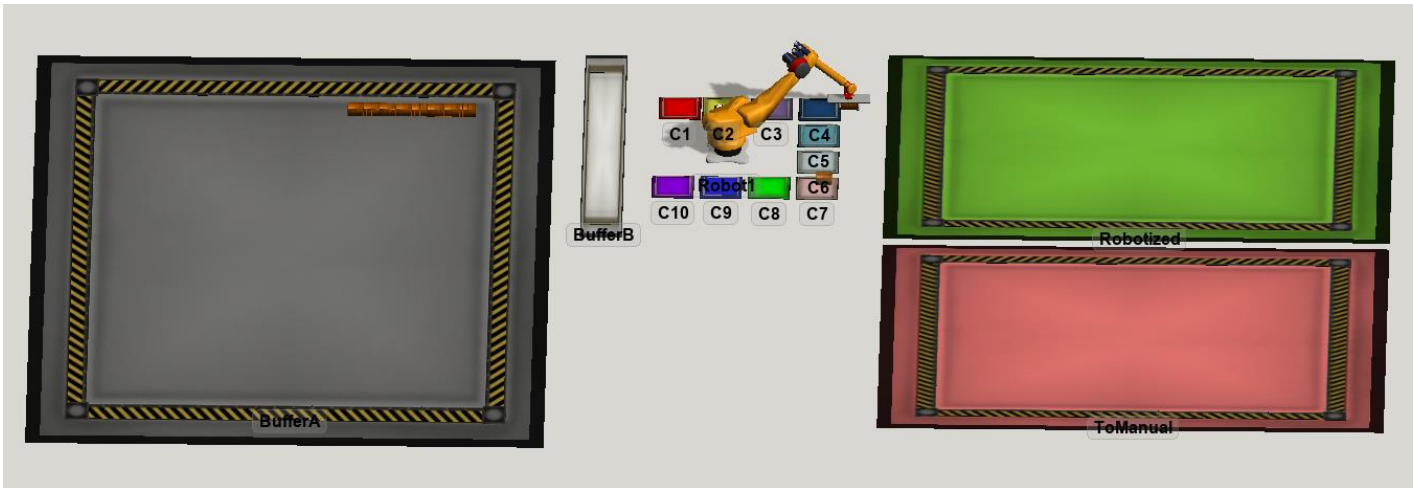
1. Maximize the number of boxes the robot handled in the scenario horizon
2. Minimize the number of carts that were brought to the robot

# Work overview



# A simulator to check your results

- Model developed in Flexsim
- Made available to the community, freely usable without license
- Used to check the solutions proposed by the contestants
  - KPI values
  - Constraint violation



KPI 1

Containers successfully treated		
Buffer		Final content
Robotized		7
ToManual		13

Containers unsuccessfully treated

Buffer	Final content	Maximum content
BufferA	5	11
BufferB	6	7
C1	0	3
C2	5	5
C3	4	4
C4	2	2
C5	6	6
C6	6	6
C7	5	5
C8	0	0
C9	0	2
C10	1	2

Amax measured  
Bmax measured

Qmax measured

Constraints

Maximum capacity of BufferA:	Value: 101Type: Integer
Maximum capacity of BufferB:	Value: 11Type: Integer
Maximum capacity of carts C:	Value: 16Type: Integer
Number of carts:	Value: 10Type: Discrete

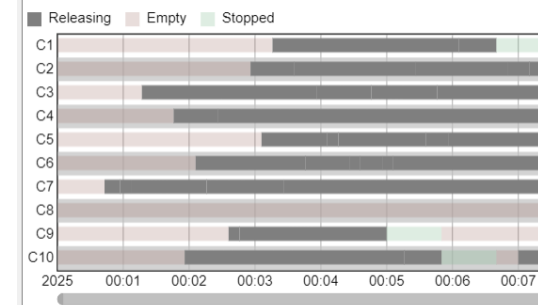
Amax target  
Bmax target  
Qmax target  
Nc

KPI 2

Number of cart changes

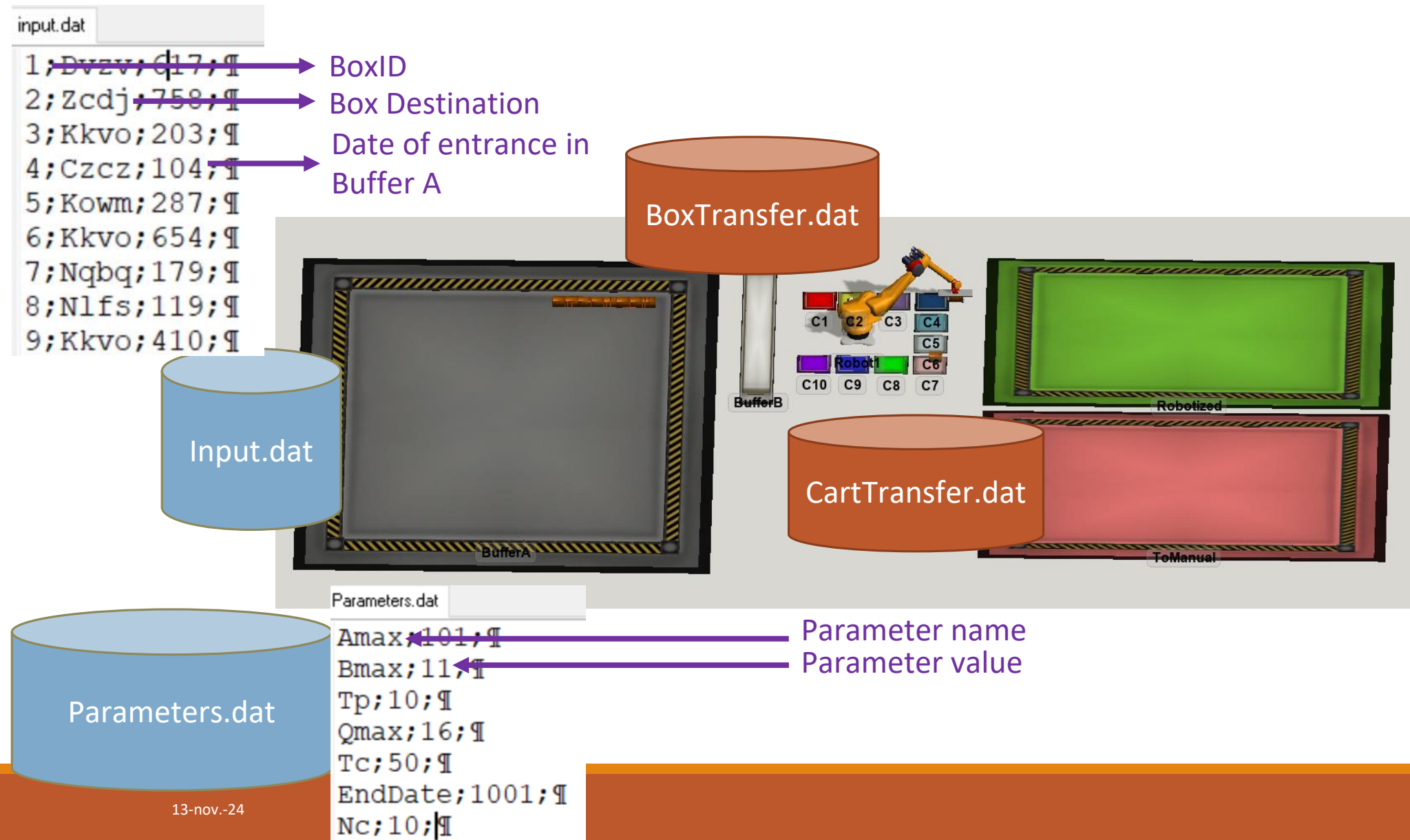
Name	Current
NumerofChanges	3

State Gantt





# The input files



# The output files

BoxID (see input file)

Date of movement  
from A to B

Box Destination

BoxTransfer.dat \*

```
1;648;Robot;¶  
2;759;Robot;¶  
3;218;Robot;¶  
4;132;Manual;¶  
5;332;Manual;¶  
6;680;Robot;¶
```

BoxTransfer.dat

Input.dat

Parameters.dat



A semicolon (;) at the  
end of each line!

CartTransfer.dat

CartTransfer.dat

```
C1;0;Dvzv;¶  
C2;0;Zcdj;¶  
C3;0;Kkvo;¶  
C4;0;Czcz;¶  
C5;0;Kowm;¶  
C6;0;Nqbc;¶
```

Cart name (C1 to C10)

Date of beginning of cart change; new cart will  
be available immediately if first change,  
otherwise Tc seconds later

New destination after the change



# Categories and problems

- Two categories:
  - Online category
    - No prior knowledge of the input list of boxes
    - Searching for the robustness of the solution
  - Offline category
    - Knowledge of the full list of inputs before the execution
    - Searching for optimal solutions
- Several problem sizes and complexities, depending on:
  - *Variability* - Number of different destinations: up to 300
  - *Volume* - Number of boxes to handle: up to 40 000
  - *Size of the solution space* - Number of carts: up to 10
- Several data instances for each problem to test the robustness of the solutions proposed

# Why wouldn't you participate?

- Everything freely available on IMIC website: <https://bit.ly/IMIC25>
  - Regular updates and more problems to come!
  - Frequently asked questions made available for everyone
- The only way to register: <https://bit.ly/IMIC25registration>
- Results announcement in SOHOMA'25 in Aix-en-Provence



*Scan me*



*Register here*

*See you soon!*