

**Sustainability Circle**

**Ny teknik och digitalisering**

# **Digitala tvillingar**

**Februari 2021**

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# Agenda

- Presentation
- Digital twins
- Industrial automated systems
- Virtual commissioning
- Applications and benefits

# Presentation

- (2000-2005) Studies: **MSc in Electronics and Automation engineering**
- (2003-2017) Work: **Automated logistics, aerospace, automotive industry, Education.**
- (2017-) Entrepreneur: **Simumatik AB**



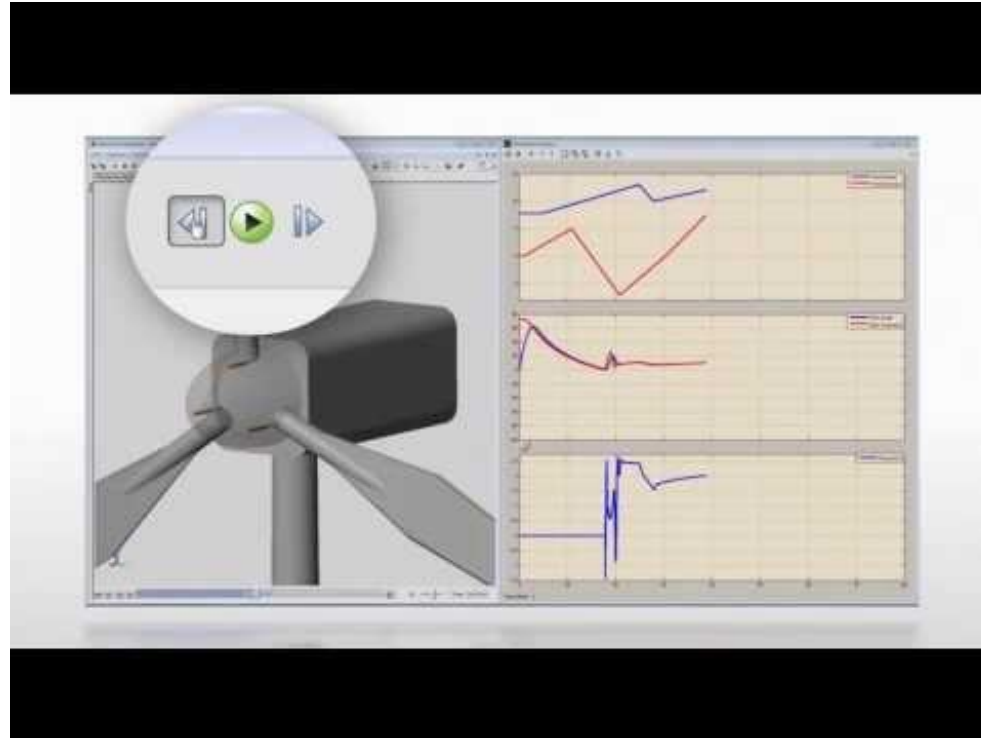
# Digital Twins

# What is a digital twin?





# Computer Aided Simulation



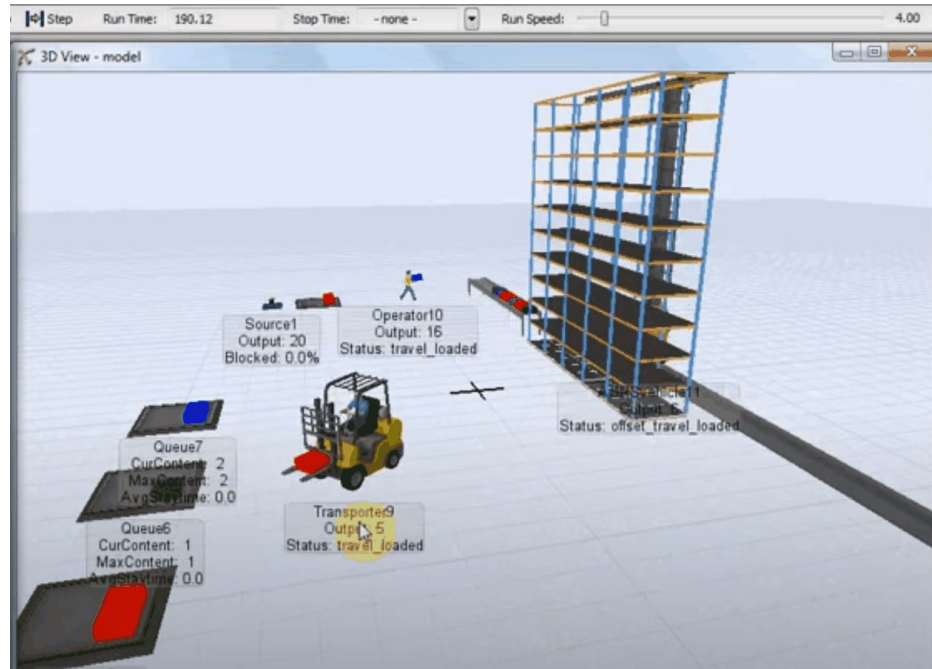
# Simulation vs Emulation

- A simulation is a system that behaves similar to something else, but is implemented in an entirely different way. It provides the basic behavior of a system to give you an idea about how something works.
- An emulation is a system that behaves exactly like something else, and abides by all of the rules of the system being emulated. It is compatible with the emulated system's inputs and outputs, but operating in a different environment to the environment of the original emulated system.

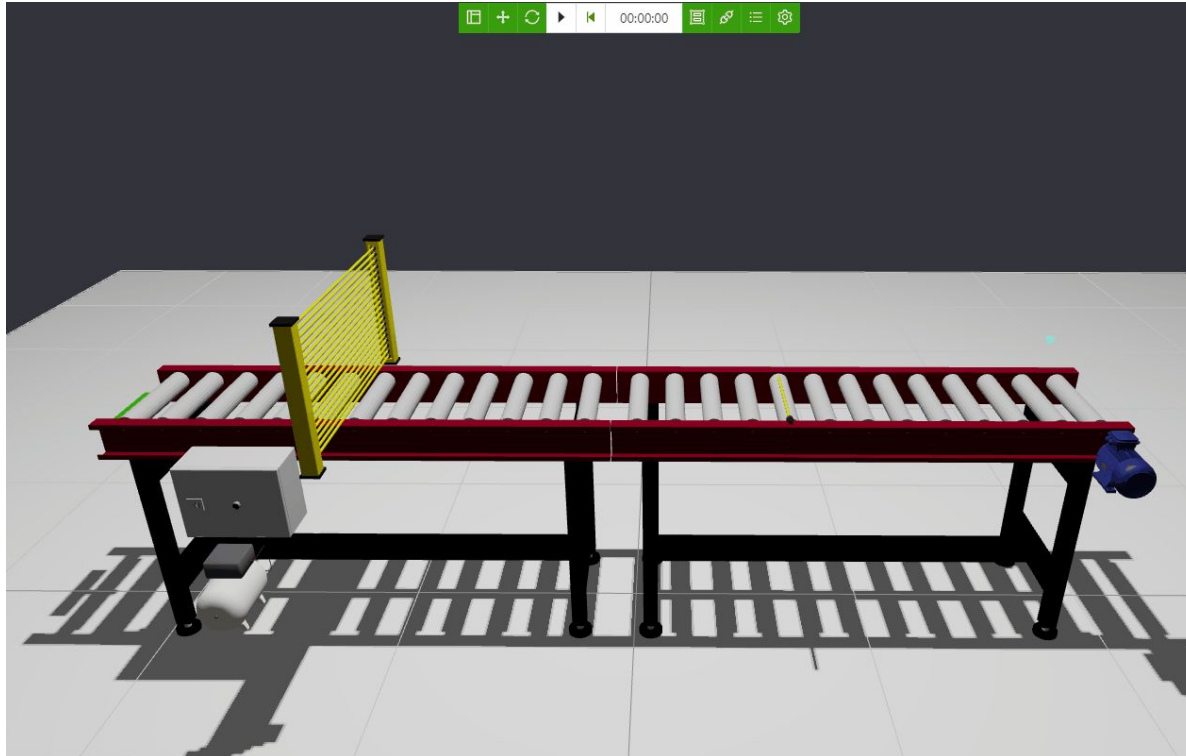
# Simulation vs Emulation

- A **simulation** is a system that **behaves similar** to something else, but is **implemented in an entirely different way**. It provides the basic behavior of a system to **give you an idea** about how something works.
- An **emulation** is a system that **behaves exactly** like something else, and abides by all of the rules of the system being emulated. It is compatible with the emulated system's inputs and outputs, **but operating in a different environment** to the environment of the original emulated system.

# Simulation

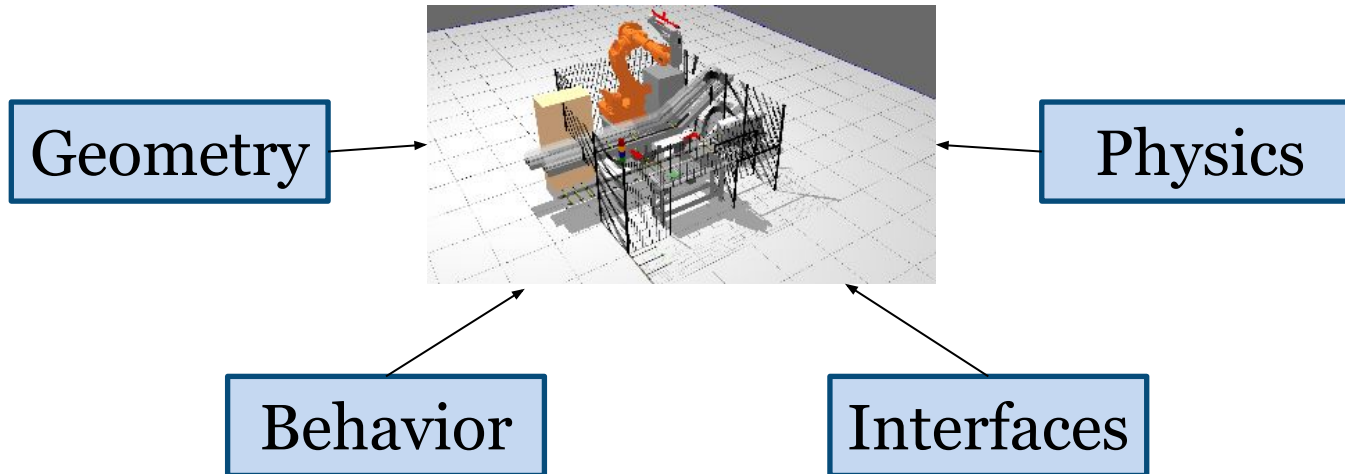


# Emulation



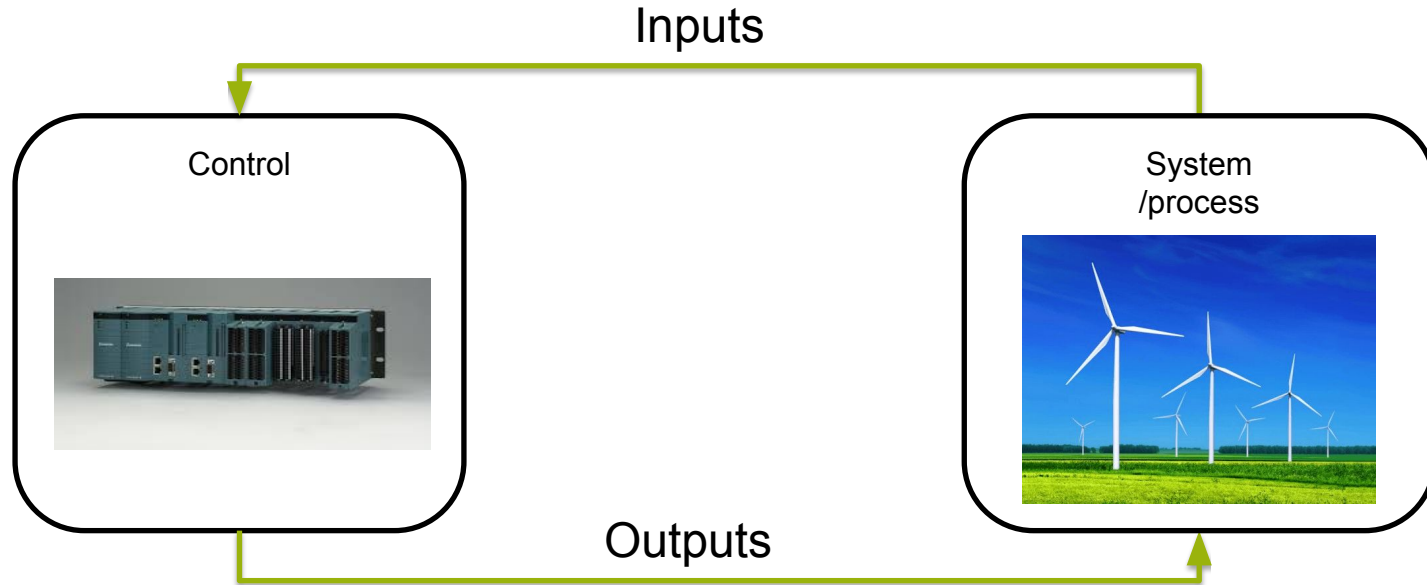
# What is Emulated?

Emulation models need to consider different aspects of the system that represent.



# Industrial automated systems

# What is an automated system?

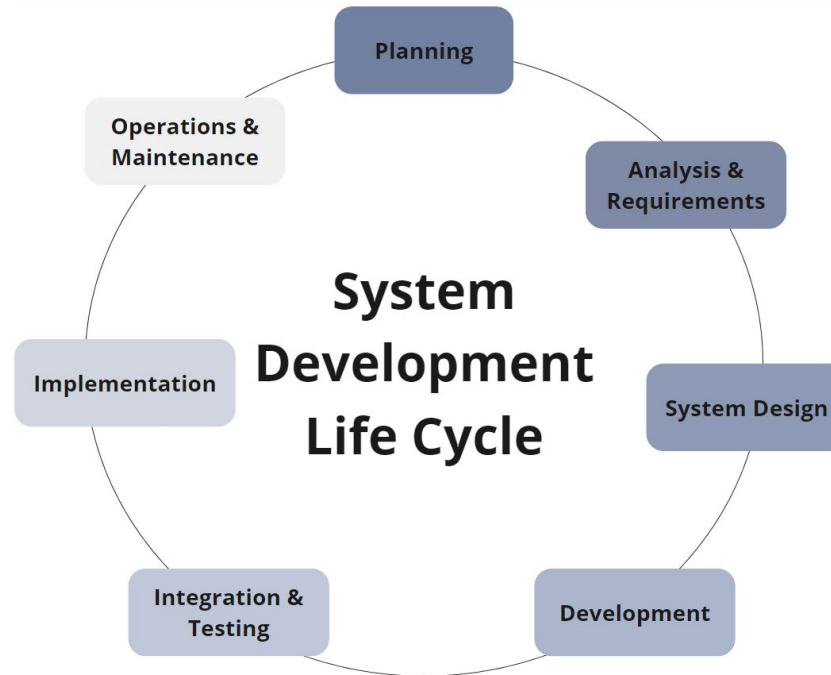




# What is an automated system?

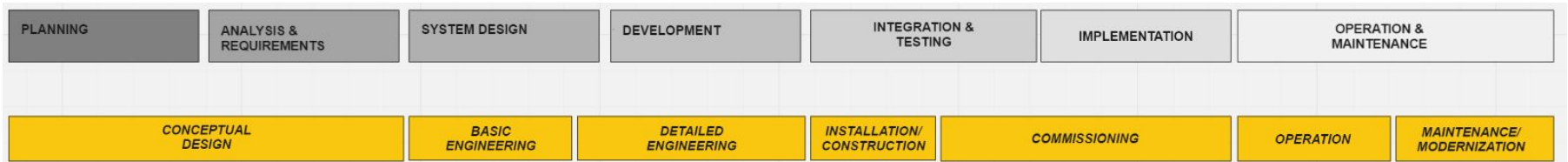


# System Development Life Cycle



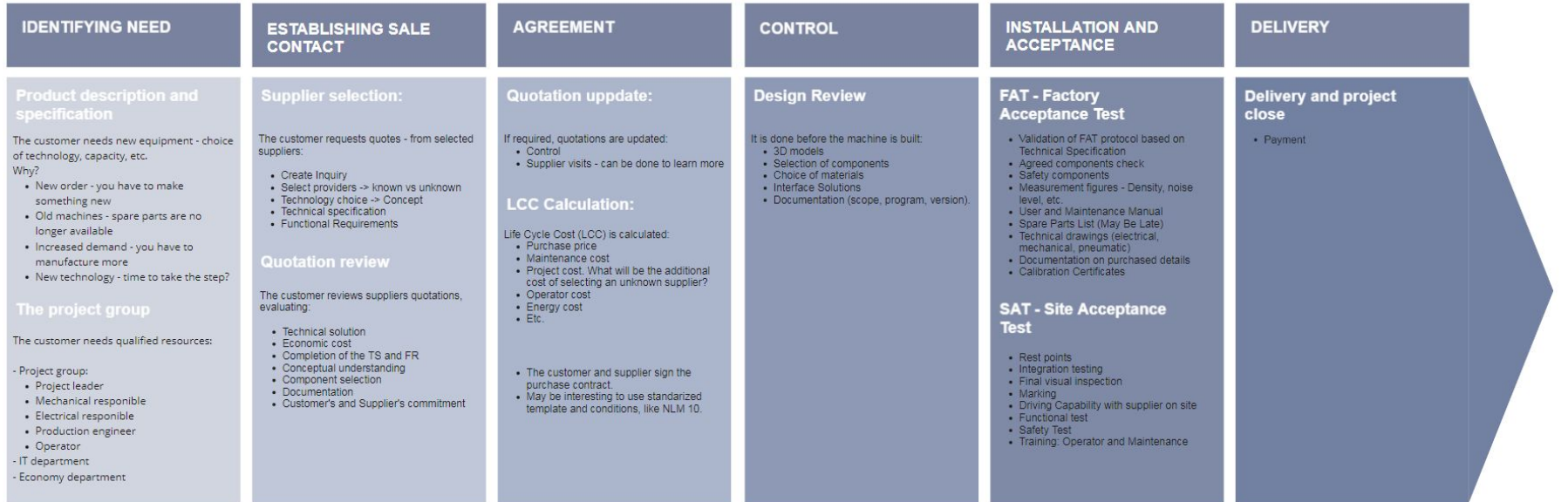
# System Development Life Cycle (Industry)

IT world



Industry

# Purchase process:



# Who is involved?

- OEMs (Original Equipment Manufacturer)
- System integrators
- Manufacturing companies

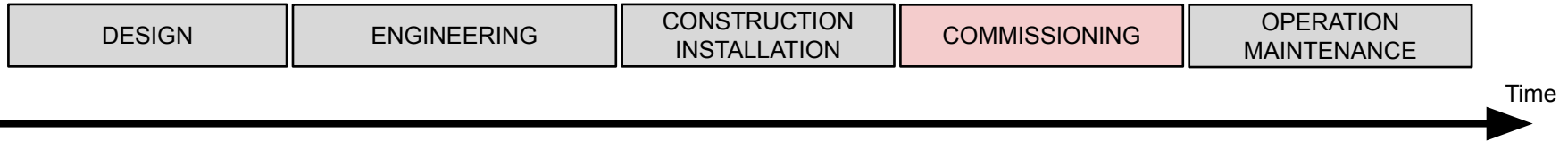


# How can a digital twin help me?



# Virtual commissioning

# What is Commissioning?



## Main issues:

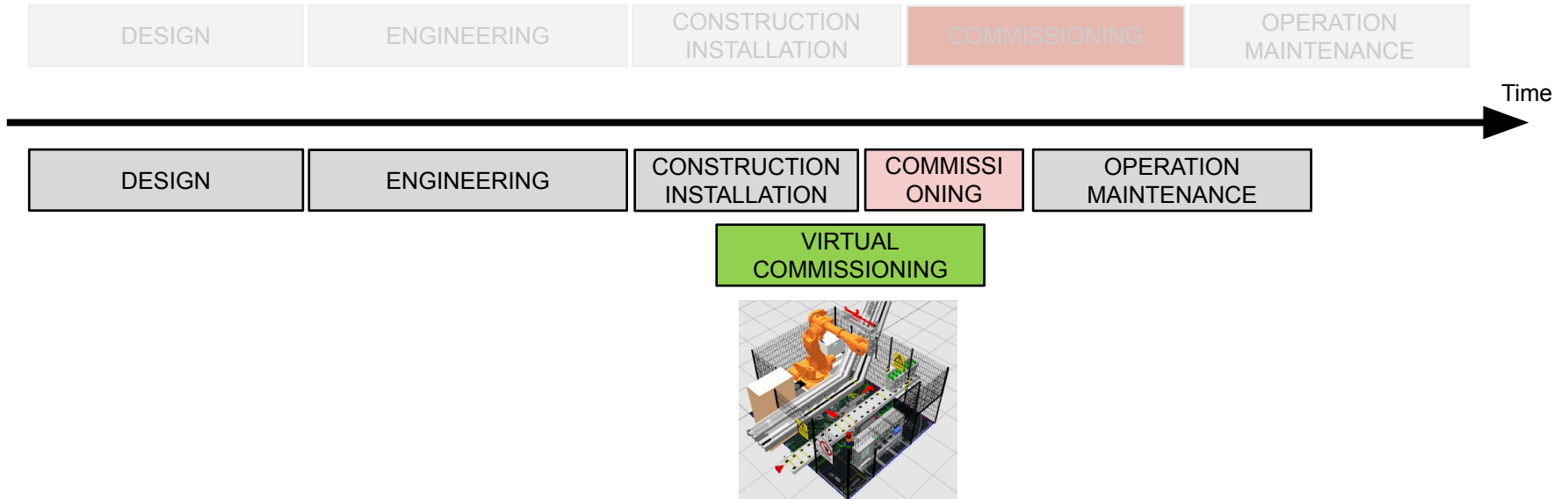
- **Limited time.**
- Requires **different skills** and resources.
- **Last step** before acceptance -> depends on previous engineering activities.
- Needs to **overcome issues** related to previous activities.
- Very **stressful** activity for engineers.



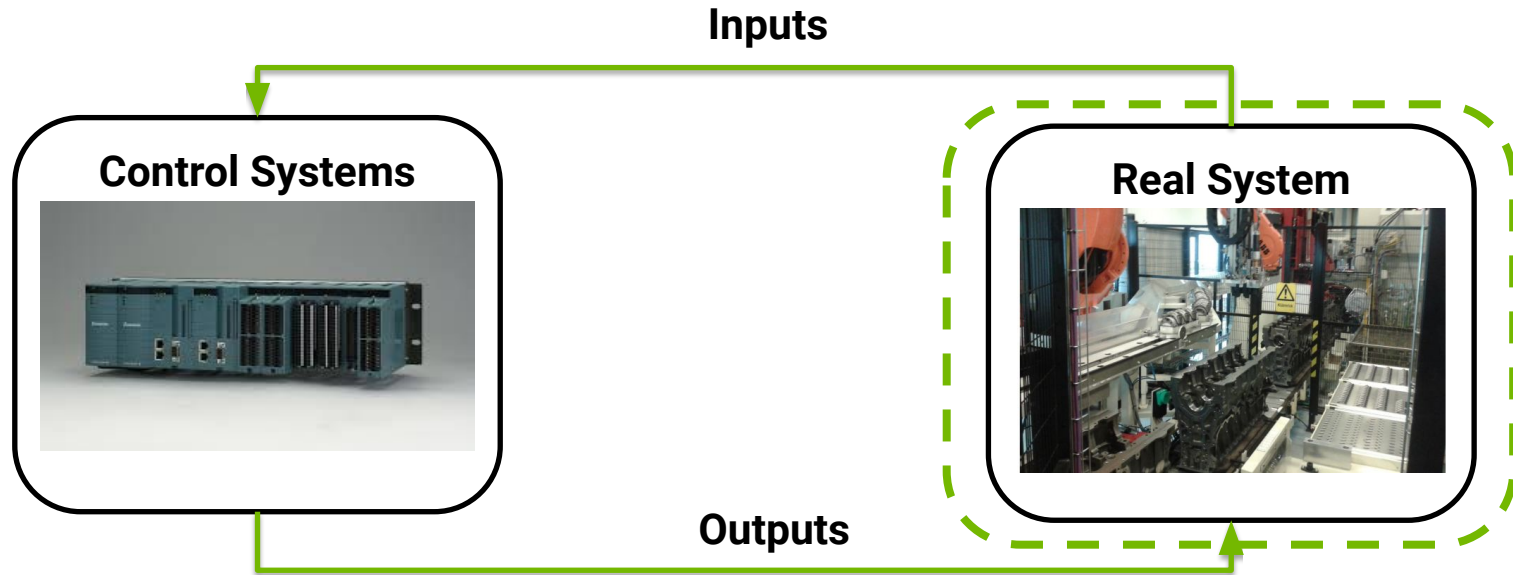
# What is Commissioning?



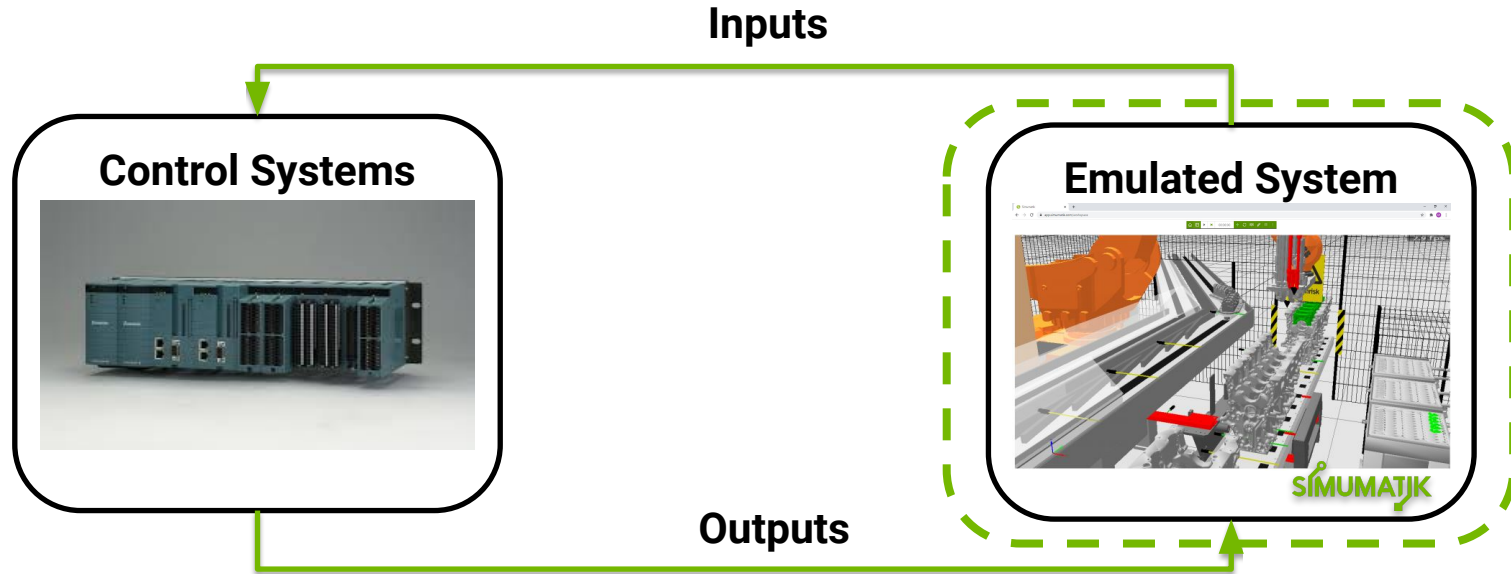
# What is Virtual Commissioning?

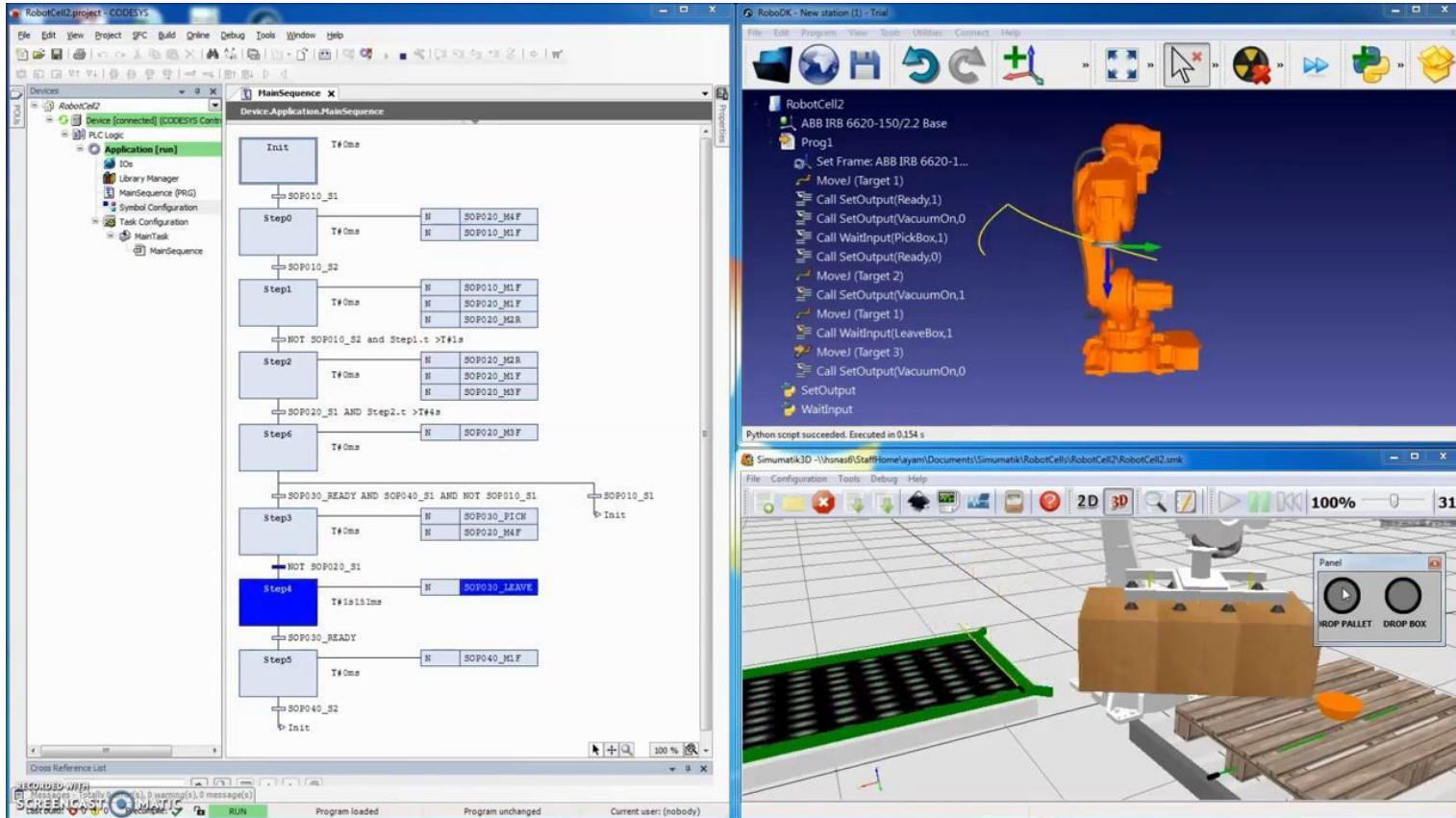


# What is Emulation?



# What is Emulation?





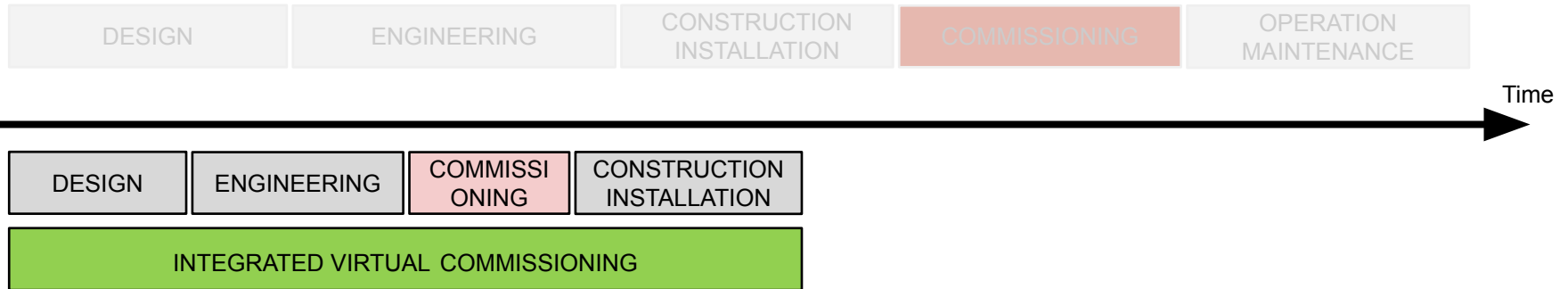
The image displays two windows from a virtual commissioning environment. The left window, titled "RobotCell2project - CODESYS", shows the PLC logic editor. The "MainSequence" ladder logic is visible, featuring steps from Init to Step5. Step4 is currently active, with a timer T#19.15s. The right window, titled "RoboDK - New station (1) - Trial", shows a 3D simulation of an orange ABB IRB 6620-150/2.2 Base robot arm. A Python script is displayed in the background, listing actions such as "MoveJ (Target 1)", "Call SetOutput(Ready,1)", and "Call WaitInput(PickBox,1)". Below the script, a status message reads "Python script succeeded. Executed in 0.154 s". The bottom window, titled "Simumata3D", shows a 3D perspective view of the robot cell, including a pallet with a box and a control panel with buttons for "DROP PALLET" and "DROP BOX".

An the future is...



Effective  
Sustainable

# An the future is...



# Applications and benefits



# Implicit impact

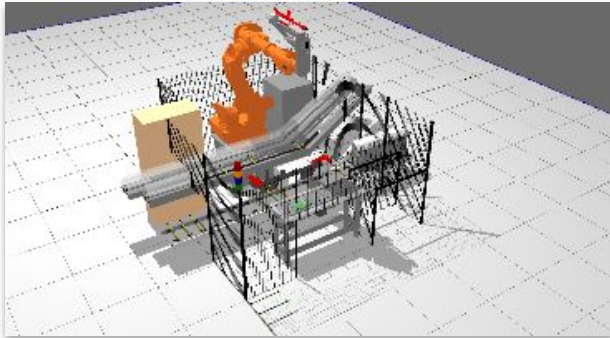
The use of emulation models for different activities, instead of using the real system, has a direct impact different aspects:

- Reduction of energy consumption.
- Reduction of waste.
- Reduction of required time.

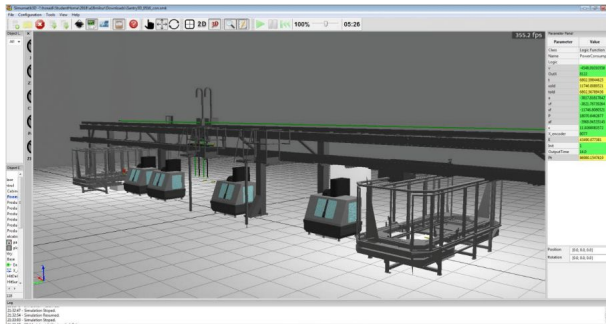


# Industrial Applications using Emulation

## Virtual commissioning



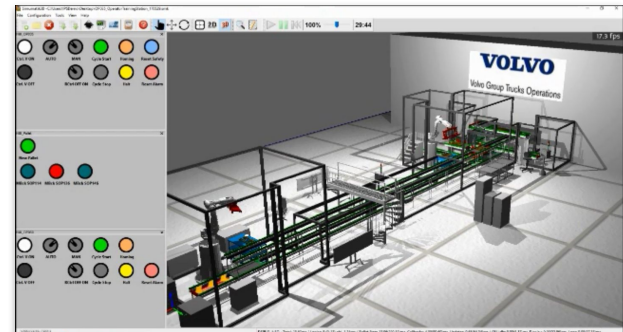
## Energy optimization



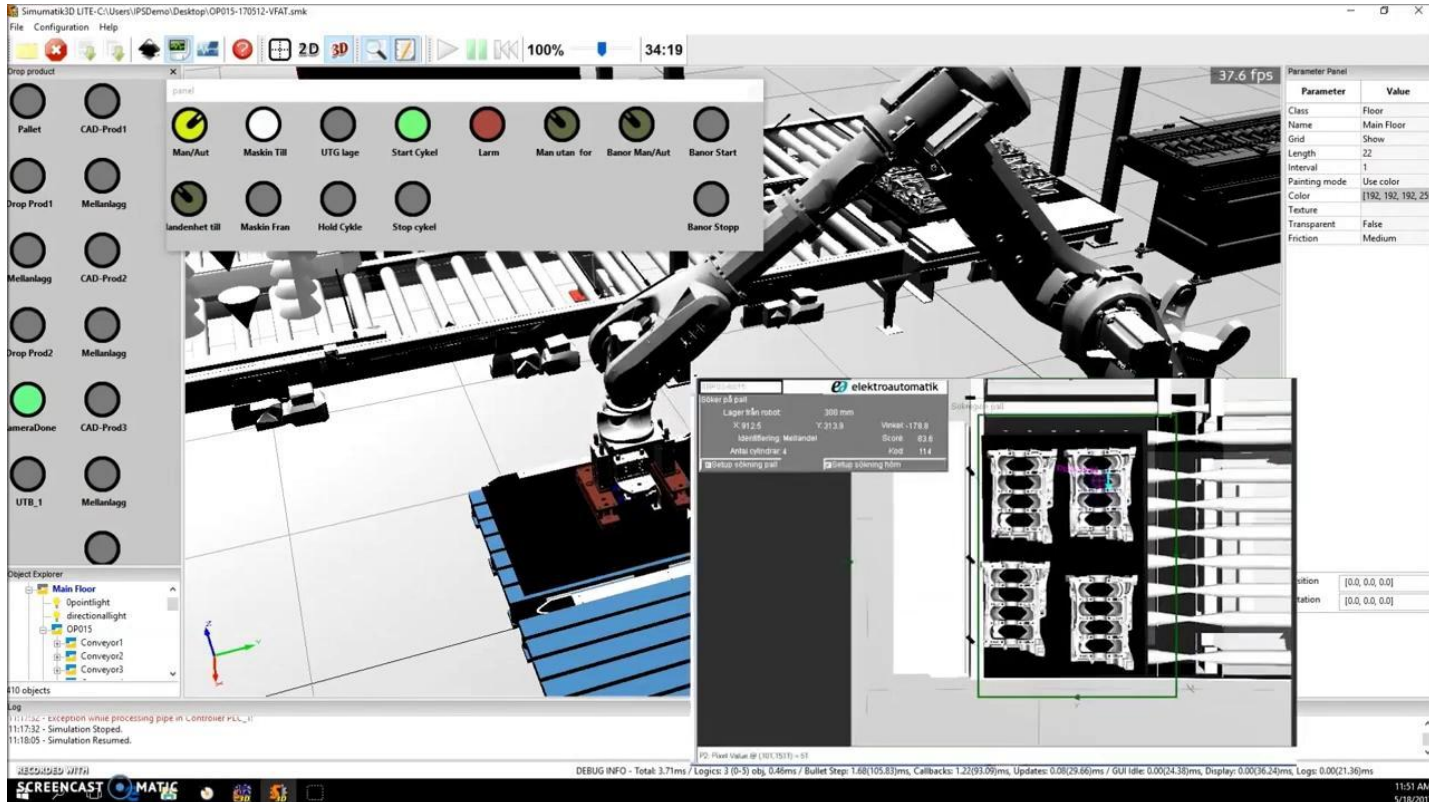
## Retrofitting



## Operator training



# Industrial Applications using Emulation



The screenshot displays the Simumat3D software interface. The main window shows a 3D simulation of an industrial robotic cell with a robotic arm and conveyor system. The interface includes several panels:

- Control Panel:** A central panel with various colored buttons for manual and automatic control, including 'Man/Aut', 'Maskin Till', 'UTG lagg', 'Start Cykel', 'Larm', 'Man utan for', 'Banor Man/Aut', 'Banor Start', 'landeshet till', 'Maskin Fran', 'Hold Cykle', 'Stop cykel', and 'Banor Stopp'.
- Parameter Panel:** A table on the right side of the interface showing parameters and their values.
 

Parameter	Value
Class	Floor
Name	Main Floor
Grid	Show
Length	22
Interval	1
Painting mode	Use color
Color	192, 192, 192, 255
Texture	
Transparent	False
Friction	Medium
- Object Explorer:** A tree view on the bottom left showing the hierarchy of objects in the simulation, including 'Main Floor', 'Spotlight', 'directionalLight', 'OP015', 'Conveyor1', 'Conveyor2', and 'Conveyor3'.
- Info Panel:** A window titled 'elektroautomatik' showing technical data for a component, such as 'Borer på gall', 'Lage till robot', 'Vinkel -170.8', 'X: 912.5', 'Y: 213.9', 'Z: 63.8', 'ID: 114', and 'Atlas cylinder: 4'.
- Status Bar:** At the bottom, it shows simulation status: '11:17:32 - Simulation Stopped', '11:18:05 - Simulation Resumed', and 'DEBUG INFO - Total 3.71ms / Logics 3 (0-5) obj. 0.46ms / Bullet Step: 1.68(105.8)ms, Callbacks: 1.22(93.0)ms, Updates: 0.08(29.6)ms / GUI Idle: 0.00(24.3)ms, Display: 0.00(16.24)ms, Logs: 0.00(21.36)ms'.

# Specific impact

Virtual Commissioning:

- Reduction of travel cost and time.
- Improvement of working conditions.
- Increase quality and robustness.



# Specific impact

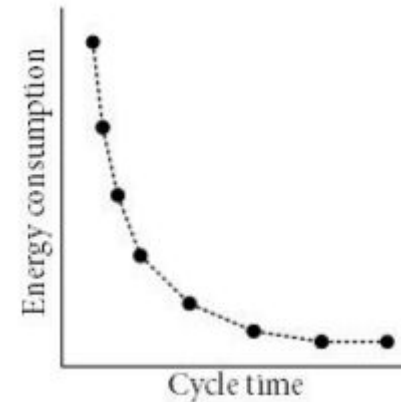
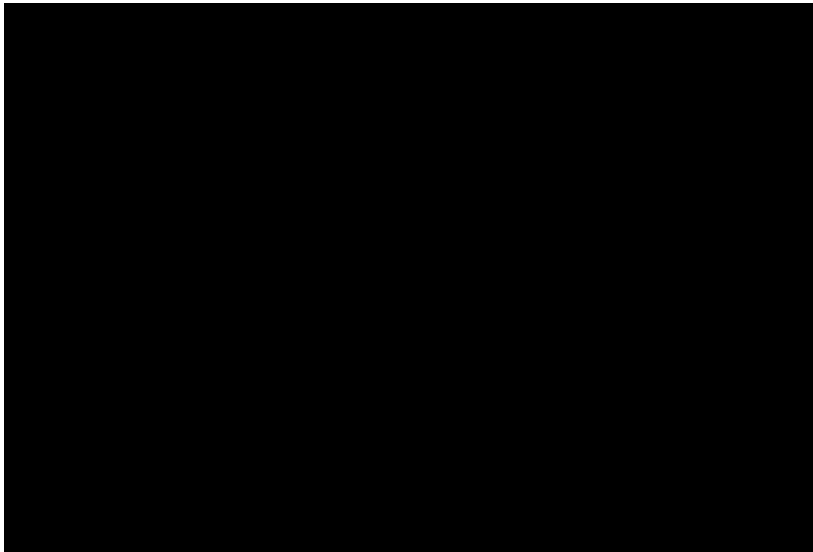
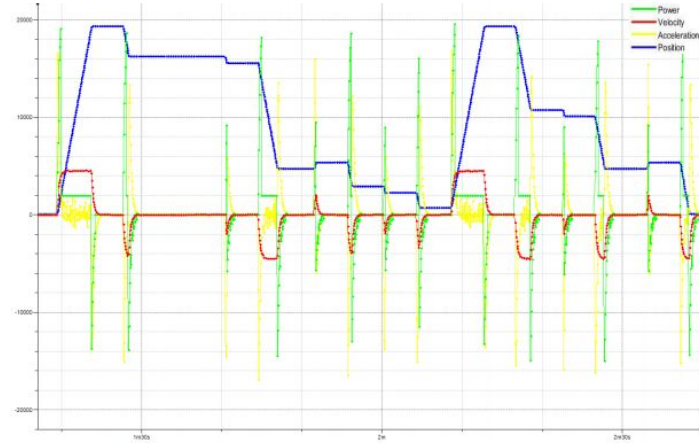
Effective design and energy optimization:

- Optimal dimensioning of components.
- Optimized layout for increased efficiency.
- Early detection of problems.



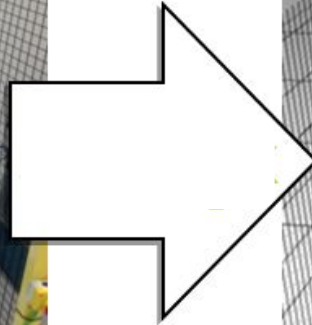
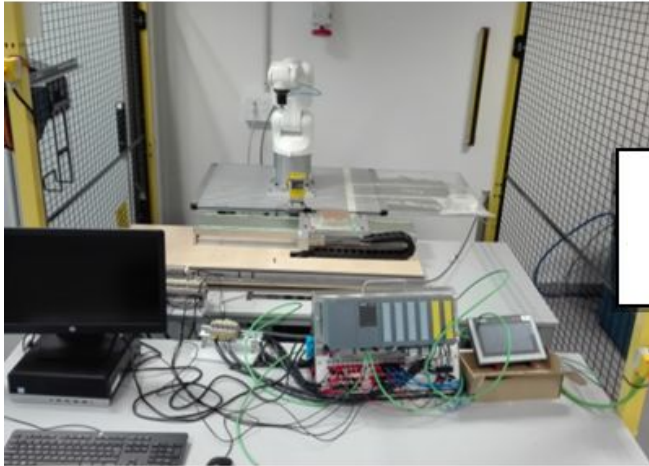
# Specific impact

Example: Energy optimization

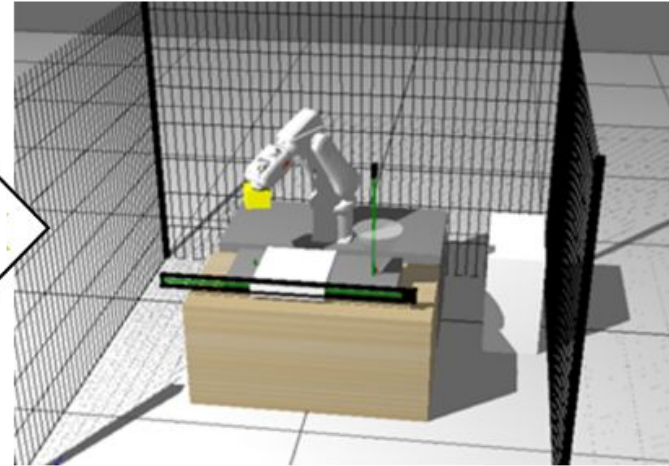


# Educational Applications using Emulation

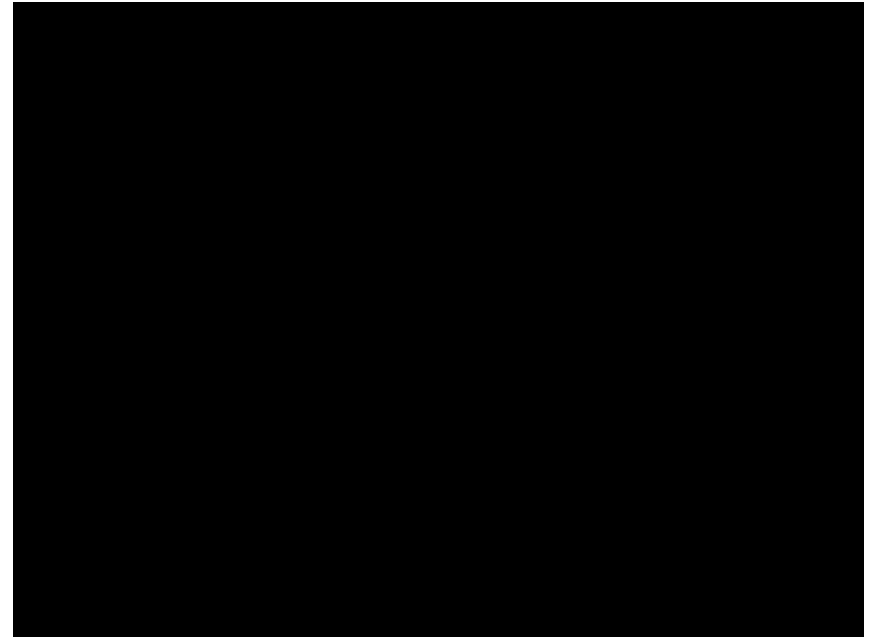
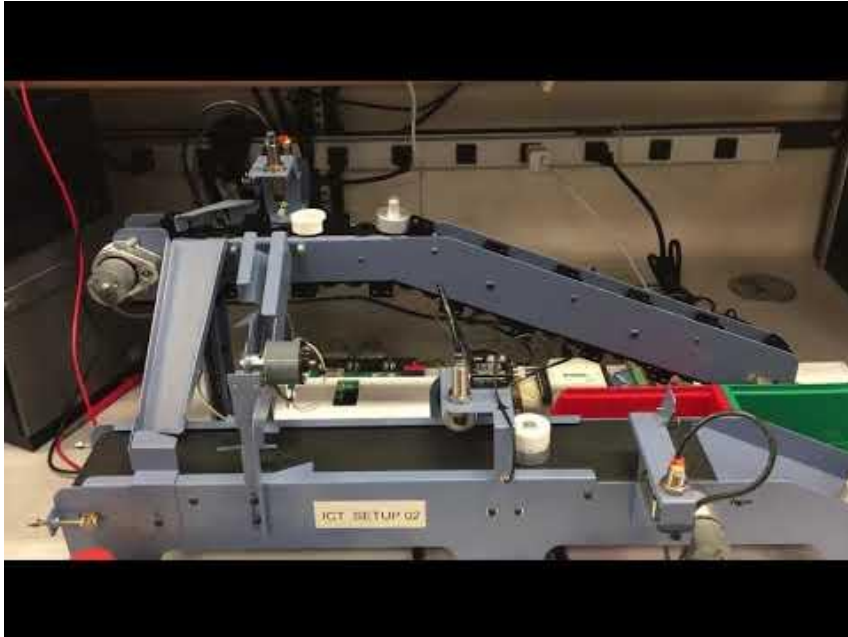
**Physical lab**



**Virtual lab**



# Educational Applications using Emulation





# Specific impact

## Education:

- Enables direct access to technology.
- Distance learning.
- Reduces requirement of physical resources.



# Q&A

# THANK YOU FOR LISTENING!

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