AUTO-ID CENTER

# AUTO-ID DRIVEN CONTROL

Duncan McFarlane, European Research Director

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# OVERVIEW

- What are Control Systems?
- What is Auto-ID based control?
- Control Research
- Demonstration Environment

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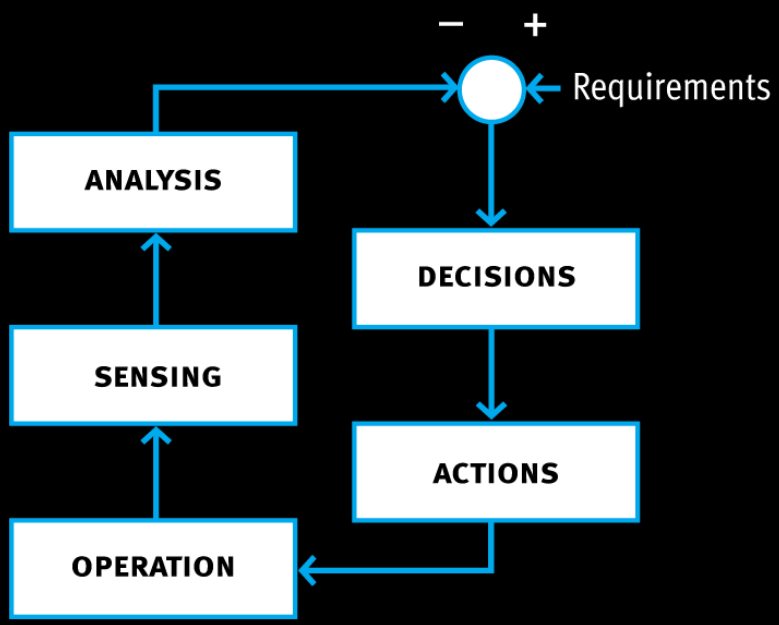
# WHAT ARE CONTROL SYSTEMS?

# CONTROL SYSTEMS




- A control system can be defined as:
  The process of adjusting appropriate variables in order to direct the performance of an operation towards a target level

- A control system for a particular operation comprises the following basic features:
  – Sensing (Analysis)
  – Decision
  – Action

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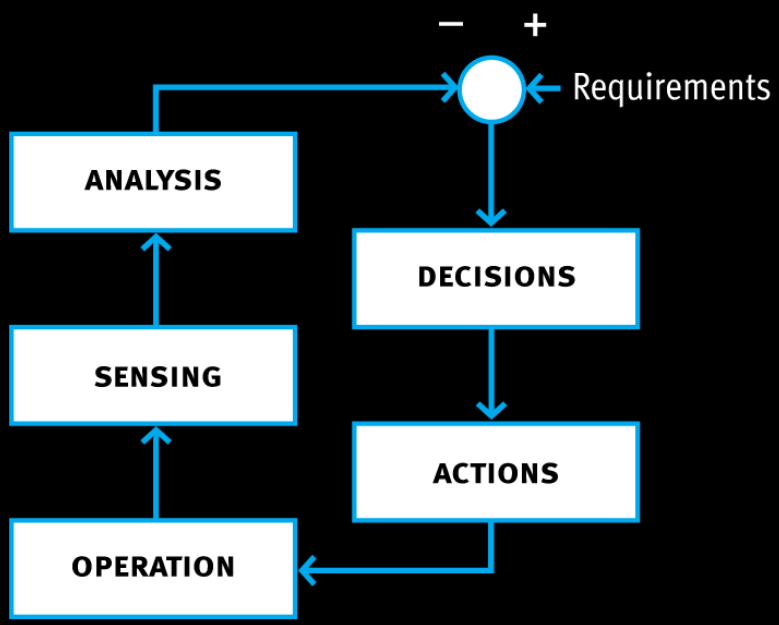
# EXAMPLE: TEMPERATURE CONTROL




- Operation – gas boiler providing heat
- Sensing – room temperature
- Analysis – little or none
- Requirements – 20 degrees C
- Decision – how much to increase / decrease gas flow
- Action – adjust gas valve accordingly

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# WHY DEVELOP AUTO-ID BASED CONTROL?

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# WHY DEVELOP AUTO-ID BASED CONTROL?

- Auto-ID data is
  - Accurate
  - Item Level
  - Timely
- In control terms this means
  - Reliable performance
  - Ability to capture item level "preferences"
  - Supporting "customised" control

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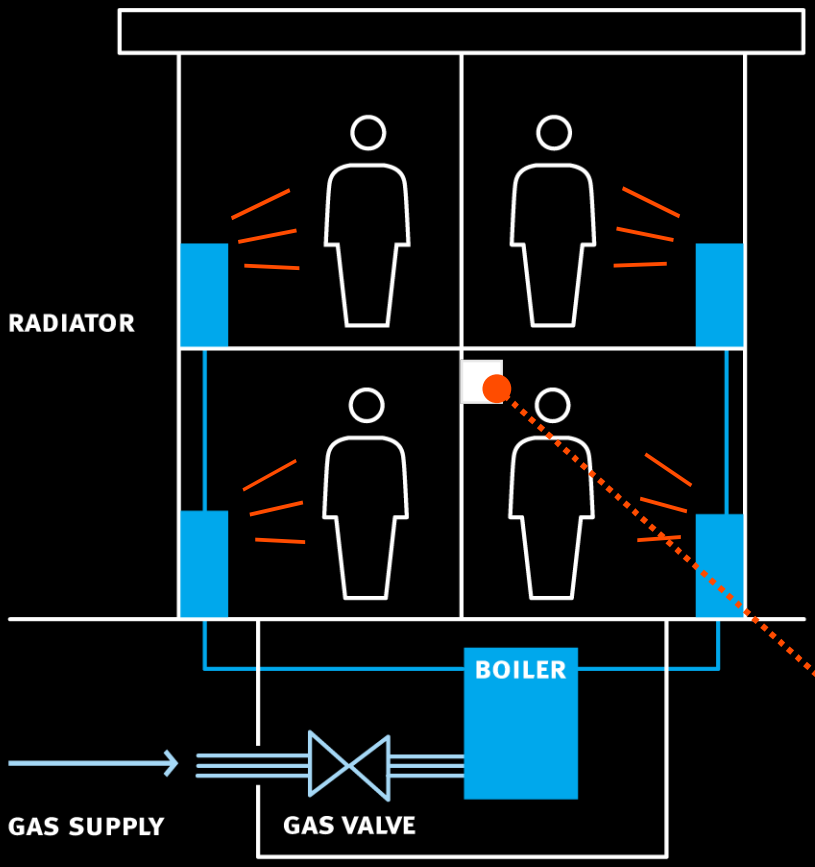
# OPEN LOOP TEMPERATURE CONTROL




- Predetermined gas valve setting
- Same level of heating independent of temperature

Equal heating in each room

We can measure temperature, but would like to regulate it!

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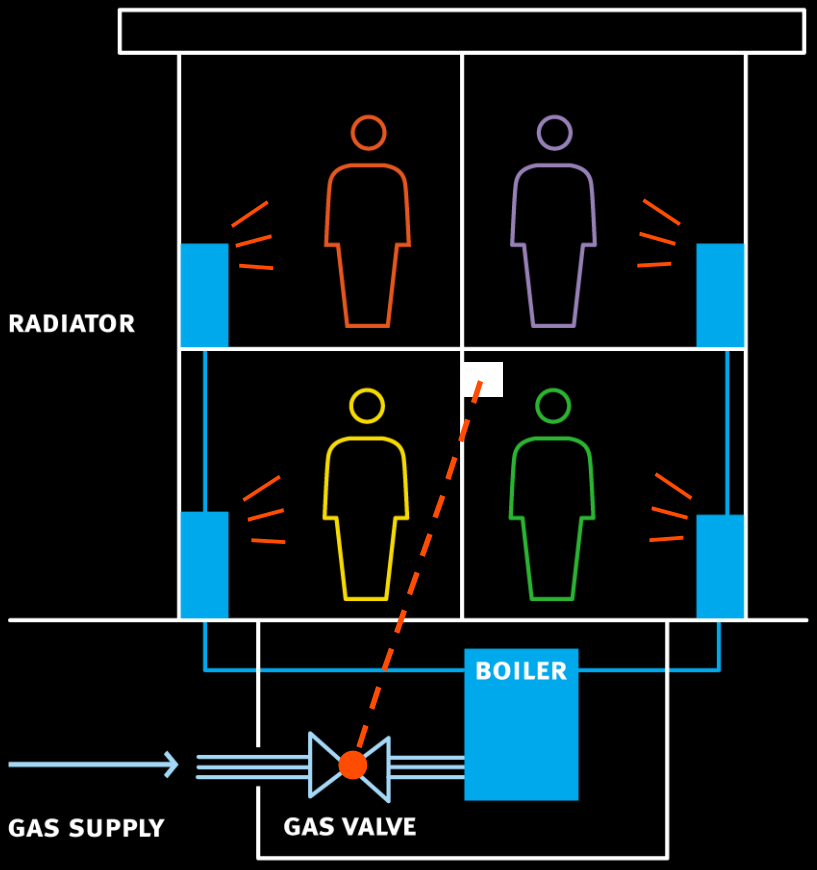
# CLOSED LOOP TEMPERATURE CONTROL




- Thermostat measures room temperature
- Microprocessor adjusts gas flow to boiler
- Temperature in house is regulated

But what if there are personal preferences?

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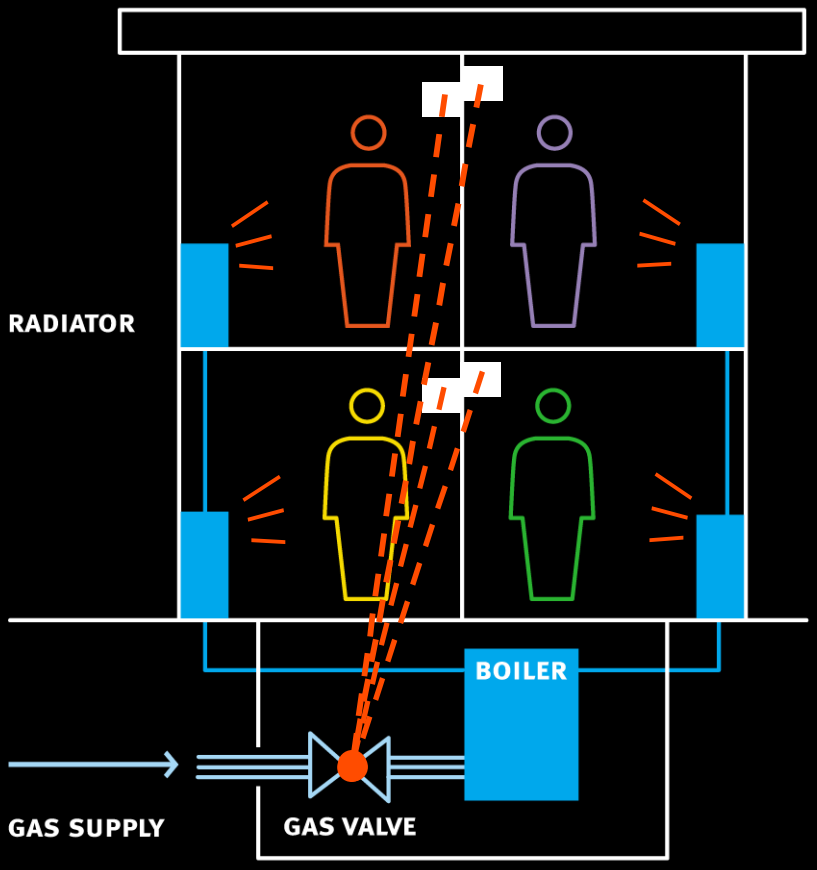
# "PREFERENCE ENHANCED" TEMPERATURE CONTROL




- Adjustable thermostat in each room
- Each thermostat can influence the gas valve adjustment
- "Best" average heat based on personal needs

Would like each person to have their own (customised) heating!

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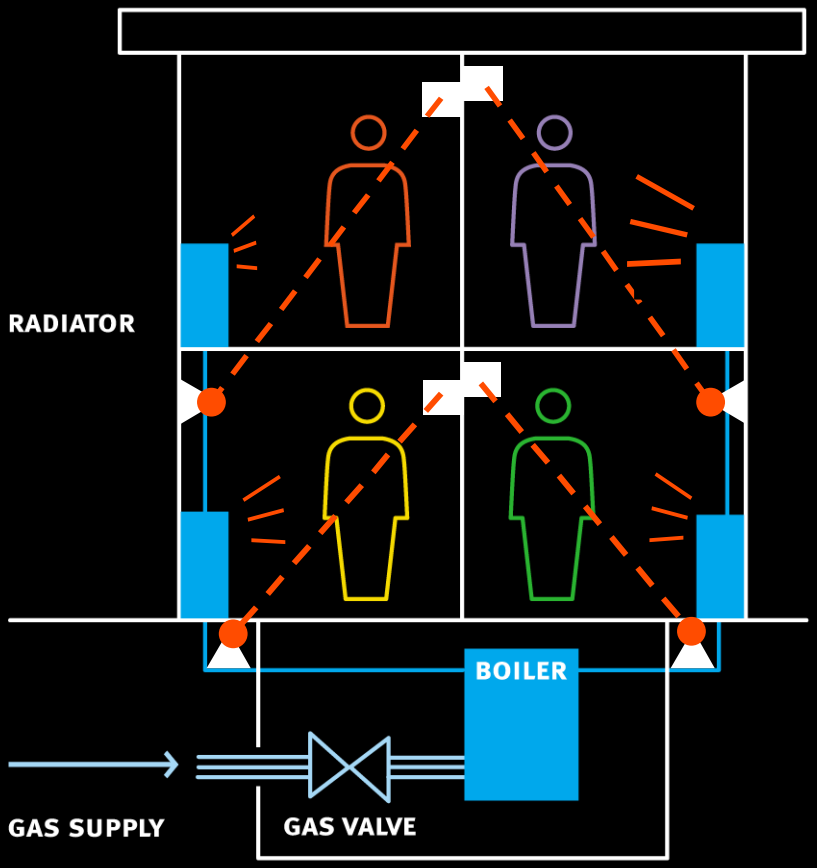
# "CUSTOMISED" TEMPERATURE CONTROL




- Individual (distributed) control strategy for each room (person)
- Optimal use of resources
- Adaptable to changing circumstances

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# AUTO-ID CONTROL RESEARCH

# AUTO-ID CONTROL RESEARCH

- Aim

  a) To develop control systems which extract maximum benefit from the availability of auto id data and

  b) To demonstrate their application

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# PRODUCT AND RESOURCE SENSORS

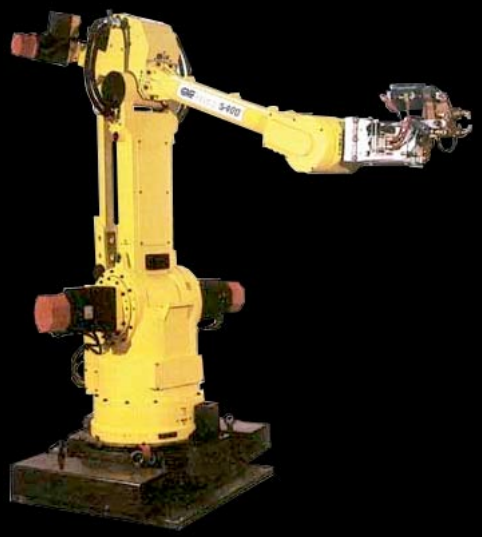
- 2 classes of sensed data

  Operational Data:

  Status, Load, Position, Temp

  Product data:

  ID, Location



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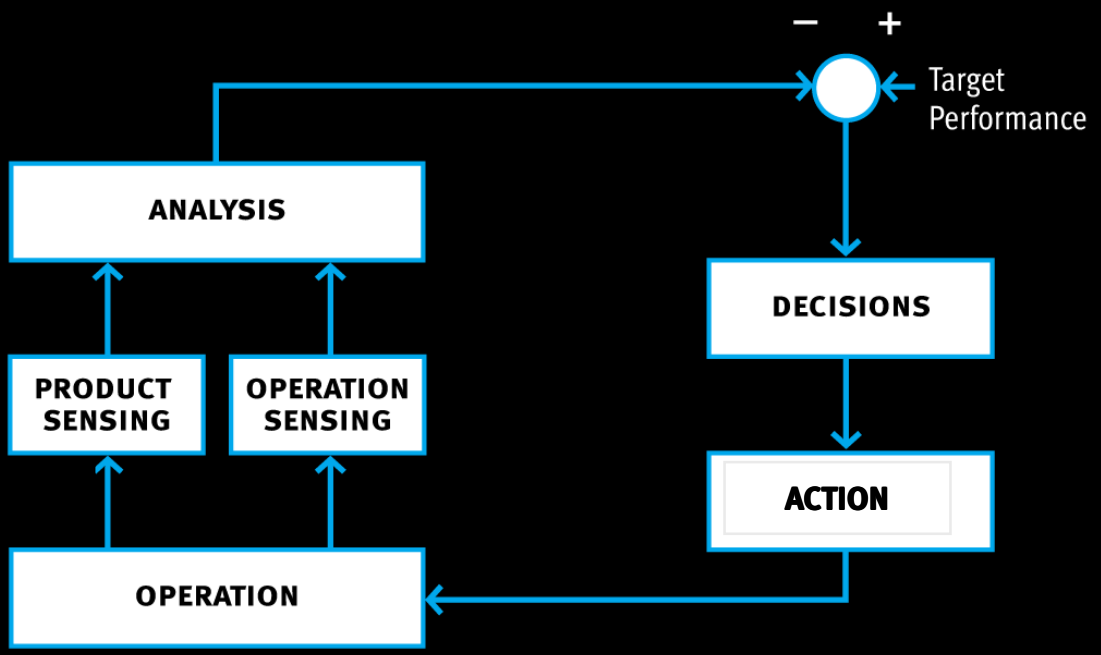
# AUTO-ID ENHANCED CONTROL SYSTEM

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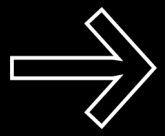
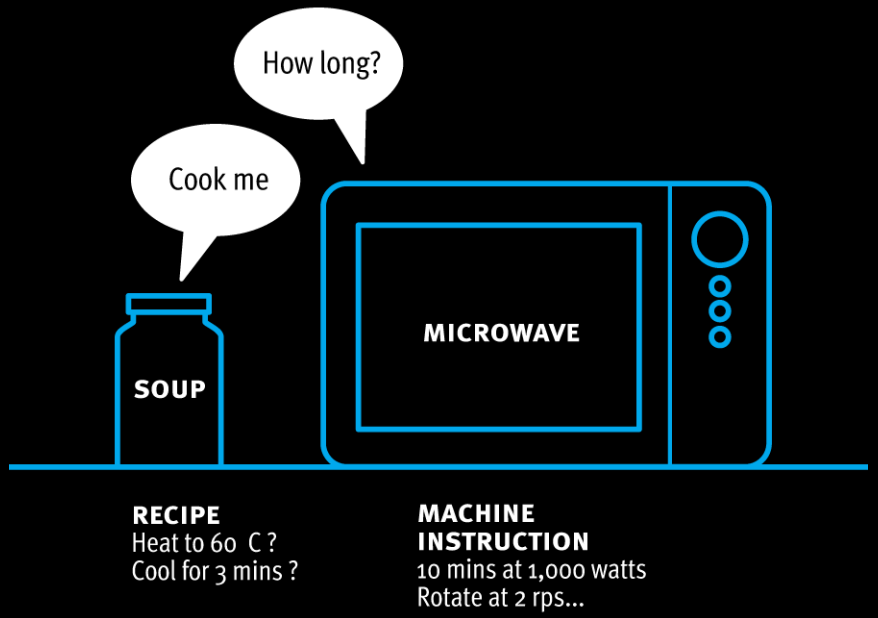
# AUTO-ID CONTROL RESEARCH

Individual preferences using conventional control



Auto-ID Enhanced Control

- Combination of Auto-ID and other sensed data
- Accessing PML files for
  - product data
  - product history
  - product requirements (recipes)

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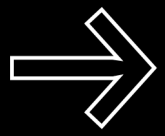
# AUTO-ID CONTROL RESEARCH

Individual preferences
using conventional control



Auto-ID-Enhanced Control

- Combination of Auto-ID and other sensed data
- Accessing PML files for
  - product data
  - product history
  - product requirements (recipes)
- Information into aggregated form for control system

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# AUTO-ID CONTROL RESEARCH

Customised control driven by individual preferences ⇒ Auto-ID-Driven Control

- Introducing product specific control
  – intelligent products

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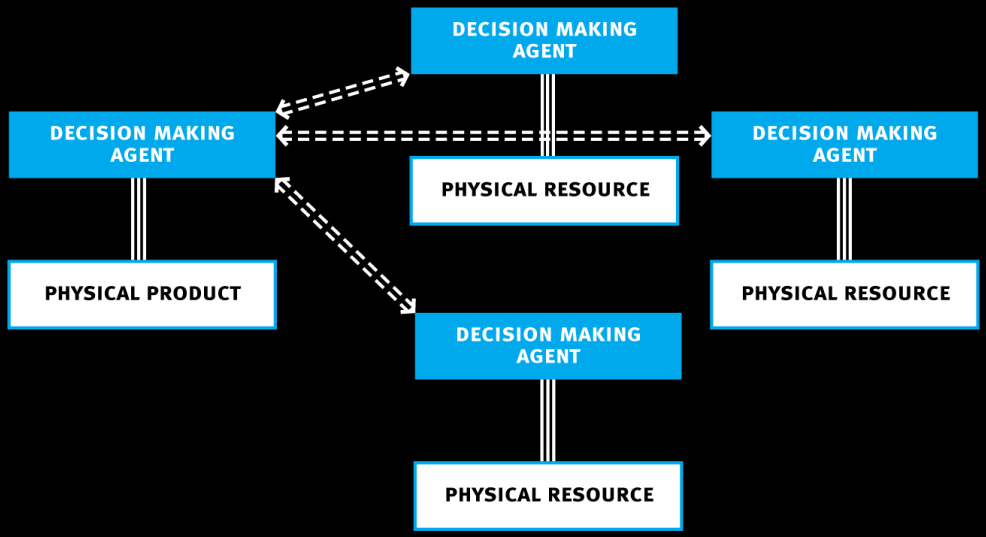
# AUTO-ID CONTROL RESEARCH

Customised control driven by individual preferences ⇒ Auto-ID-Driven Control

- Introducing product specific control – intelligent products
- Ability to customise control via product / resource negotiations

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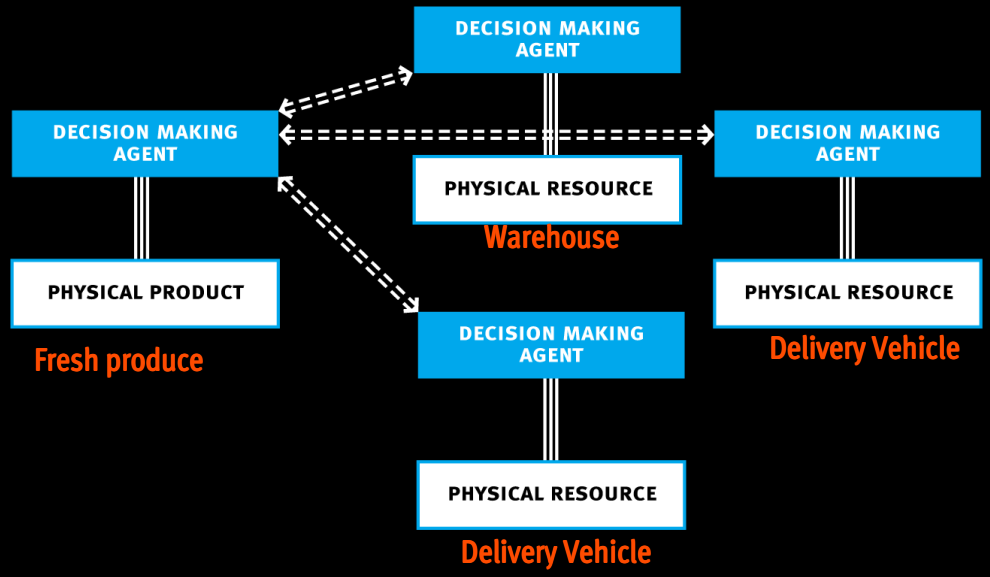
# AUTO-ID CONTROL RESEARCH

Customised control driven by individual preferences ⇒ Auto-ID-Driven Control

- Introducing product specific control – intelligent products
- Ability to customise control via product / resource negotiations
- Distributed solutions for manufacturing control, fleet optimisation, shelf management, domestic control

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# HOW WILL WE DEVELOP AUTO-ID BASED CONTROL?

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# RESEARCH APPROACH

- New Methods
  - Specification and interpretation of recipes
  - Control system rules and protocols
- Compatibility with existing Systems
- Demonstrations
  - Illustrative applications
  - Guidelines

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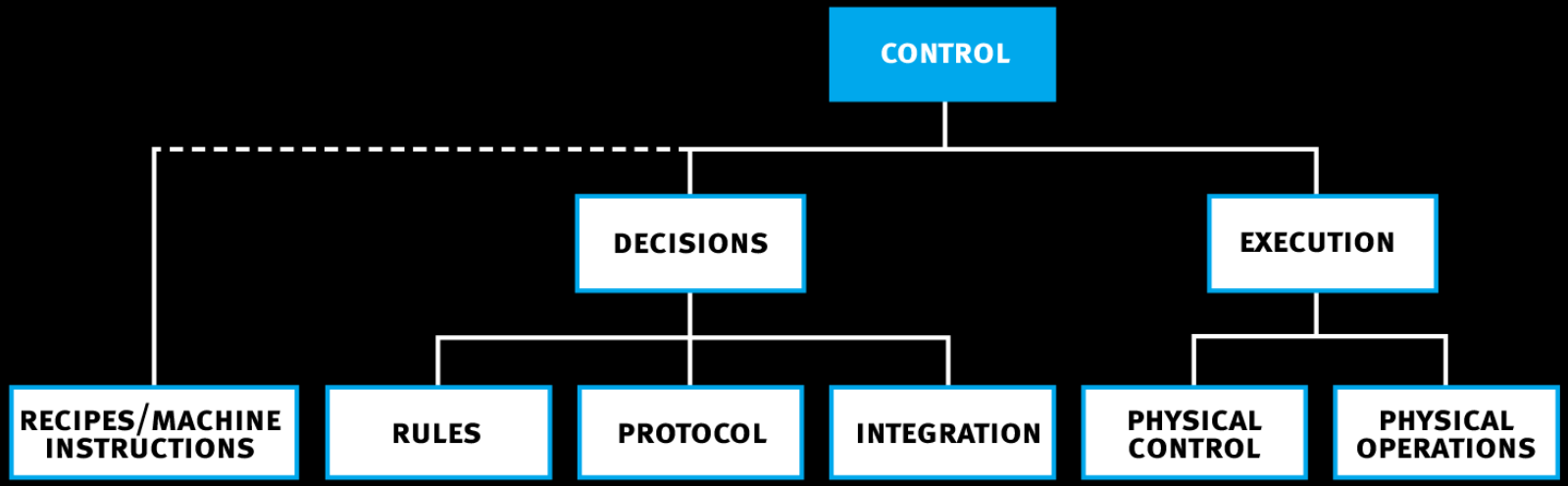
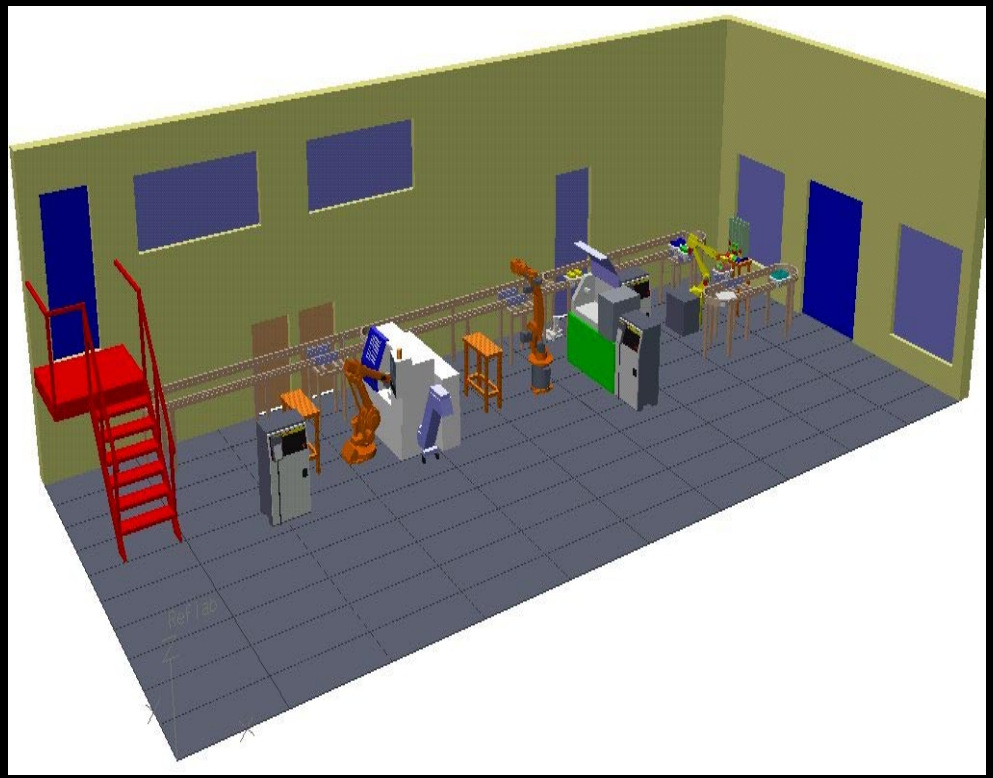
# RESEARCH STRUCTURE



# DEMONSTRATOR - OVERVIEW



- Phase 1

  Auto-ID enhanced packing and storage (conventional control)

- Phase 2

  Auto-ID Driven packing and storage (distributed, intelligent control)

- Phase 3

  Auto-ID Driven mini supply chain (distributed, intelligent control)

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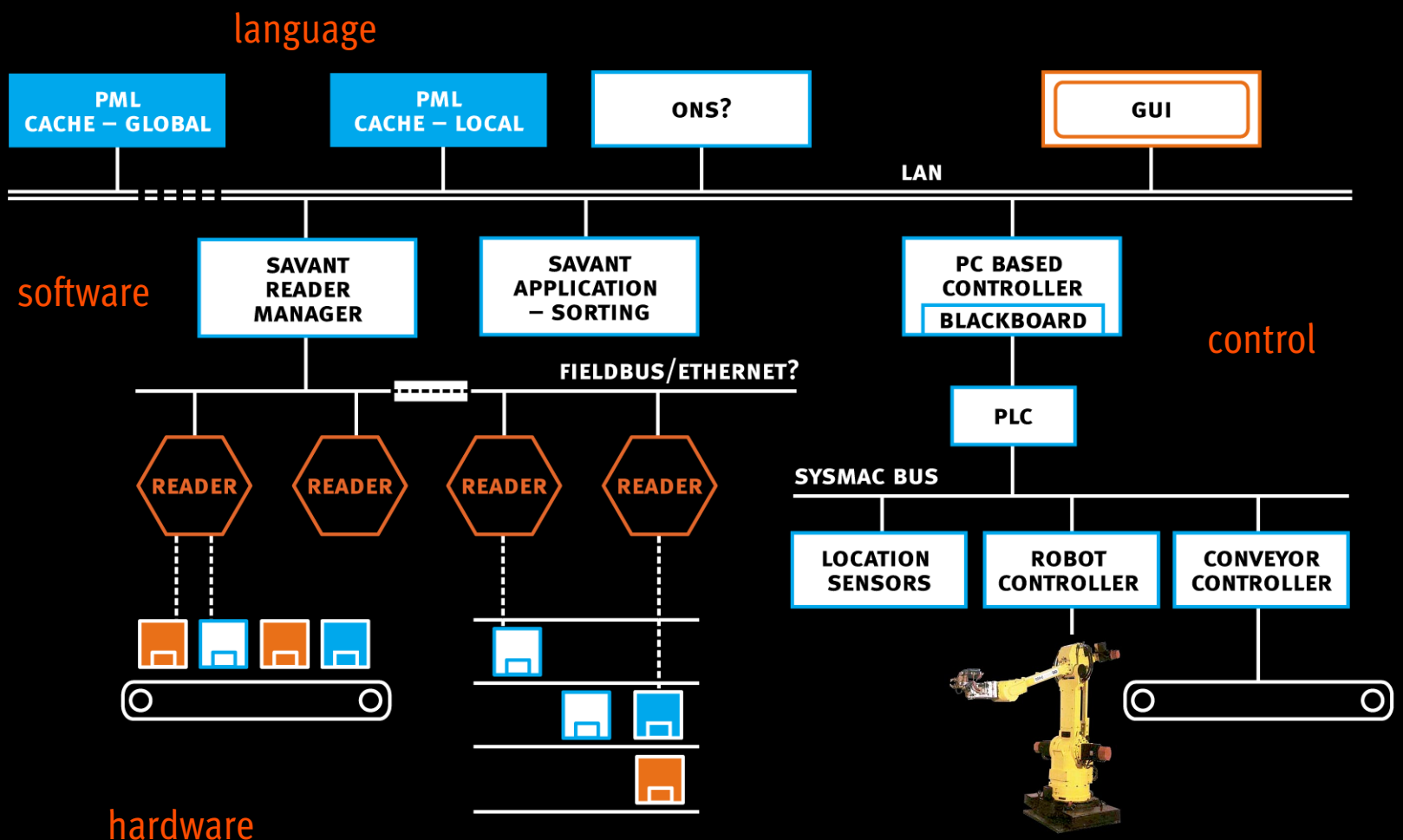
# DEMONSTRATOR - SYSTEMS ARCHITECTURE

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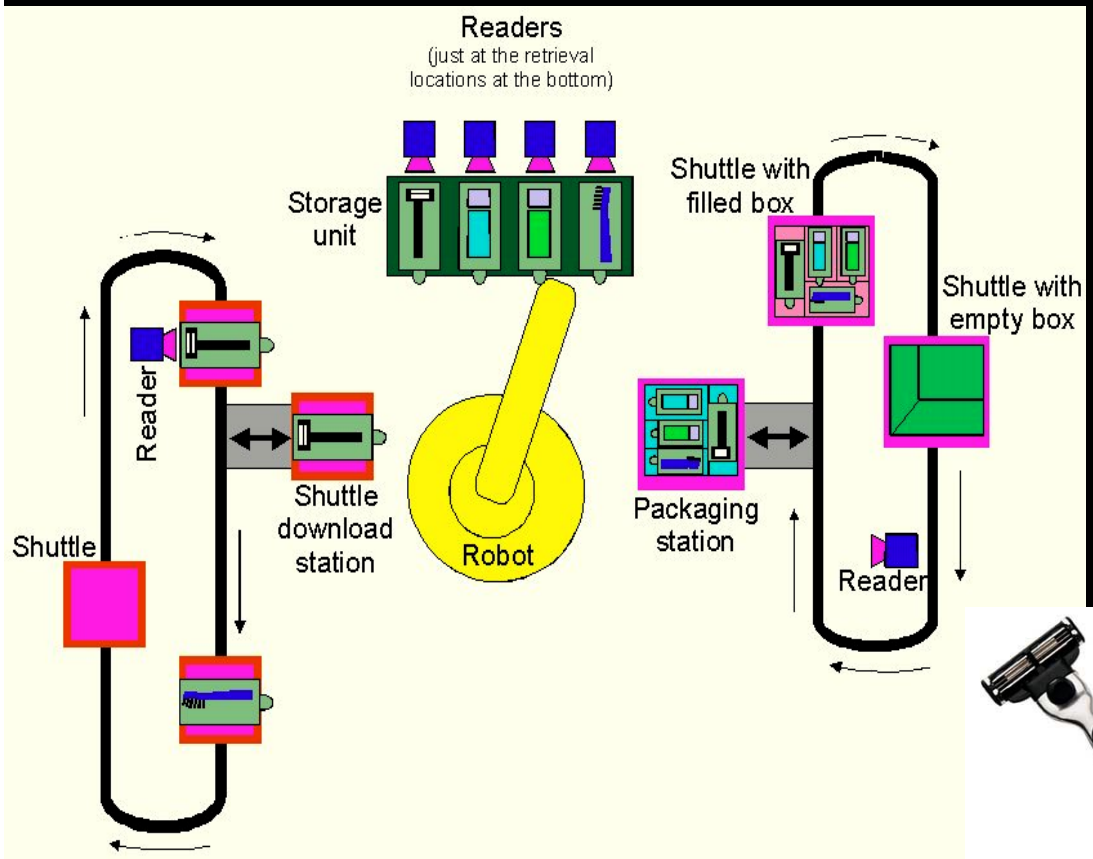
# DEMONSTRATOR - PHASE 1

- Phase 1

  Auto-ID enhanced packing and storage (conventional control)



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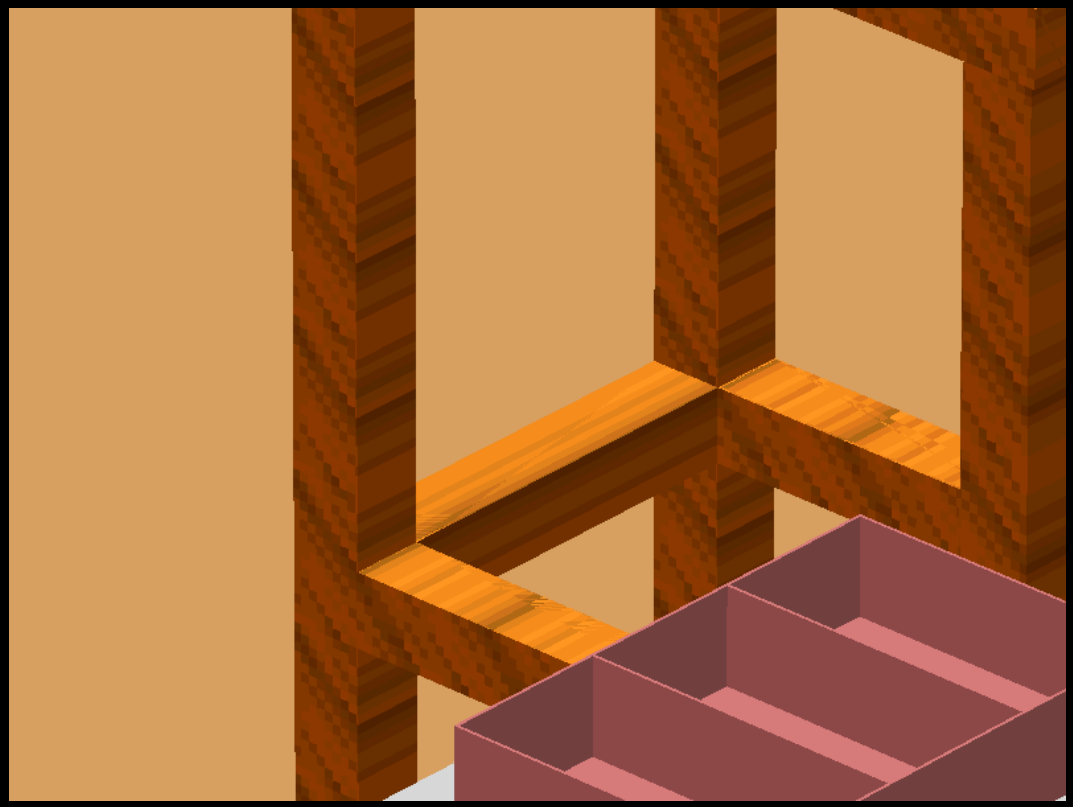
# DEMONSTRATOR - PHASE 1



- Phase 1

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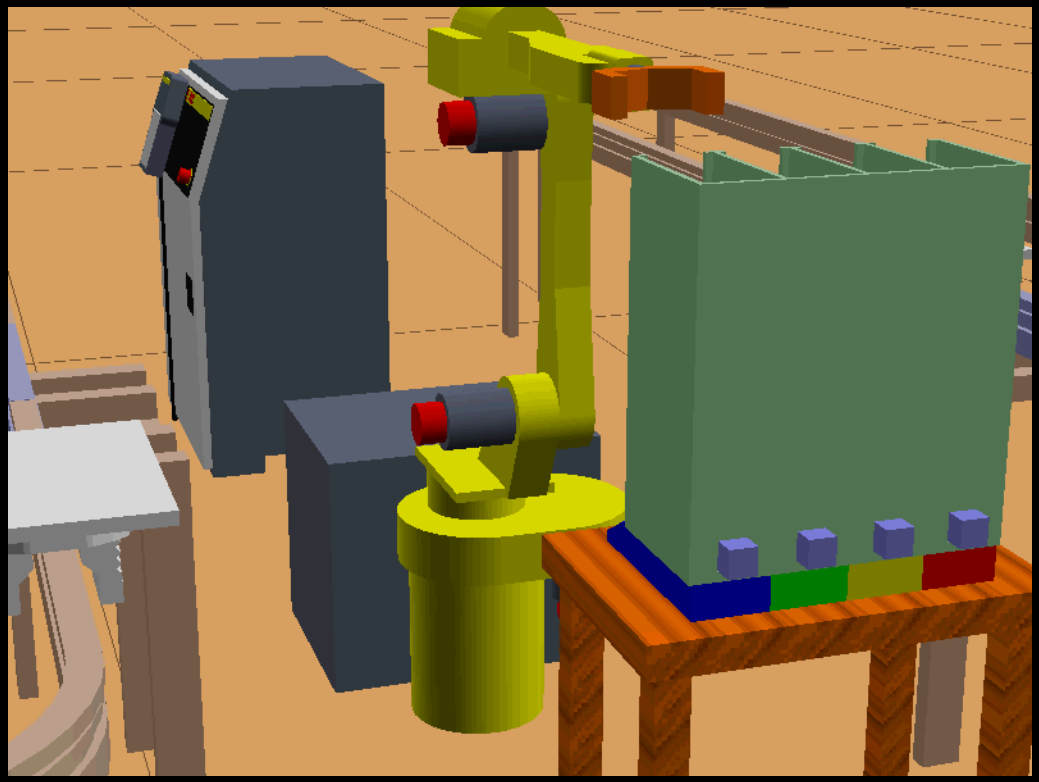

- Phase 1

  Auto-ID enhanced packing and storage (conventional control)

- Aims

  To demonstrate that Auto ID infrastructure can be integrated into closed loop control

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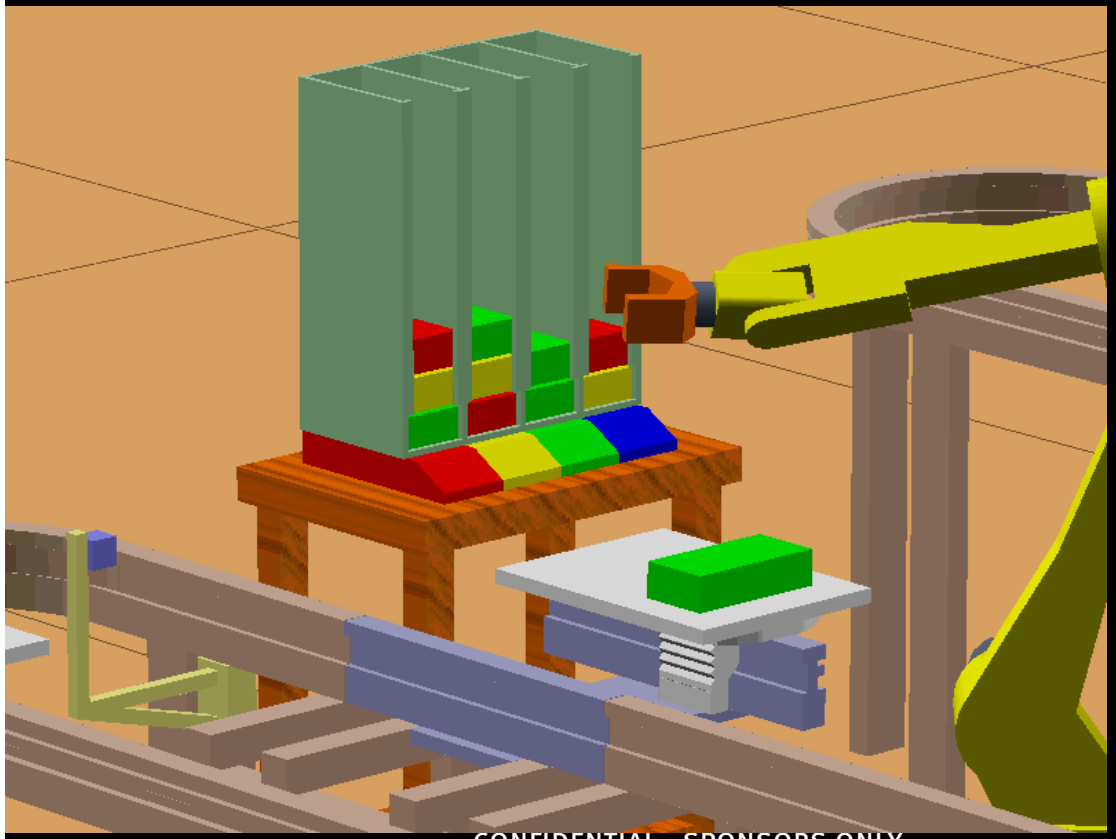
# DEMONSTRATOR - PHASE 1



- Phase 1

  Auto-ID enhanced packing and storage (conventional control)

Aims

To demonstrate that Auto ID infrastructure can be integrated into closed loop control

To demonstrate that effective packing can achieved when raw materials supply is random and varying

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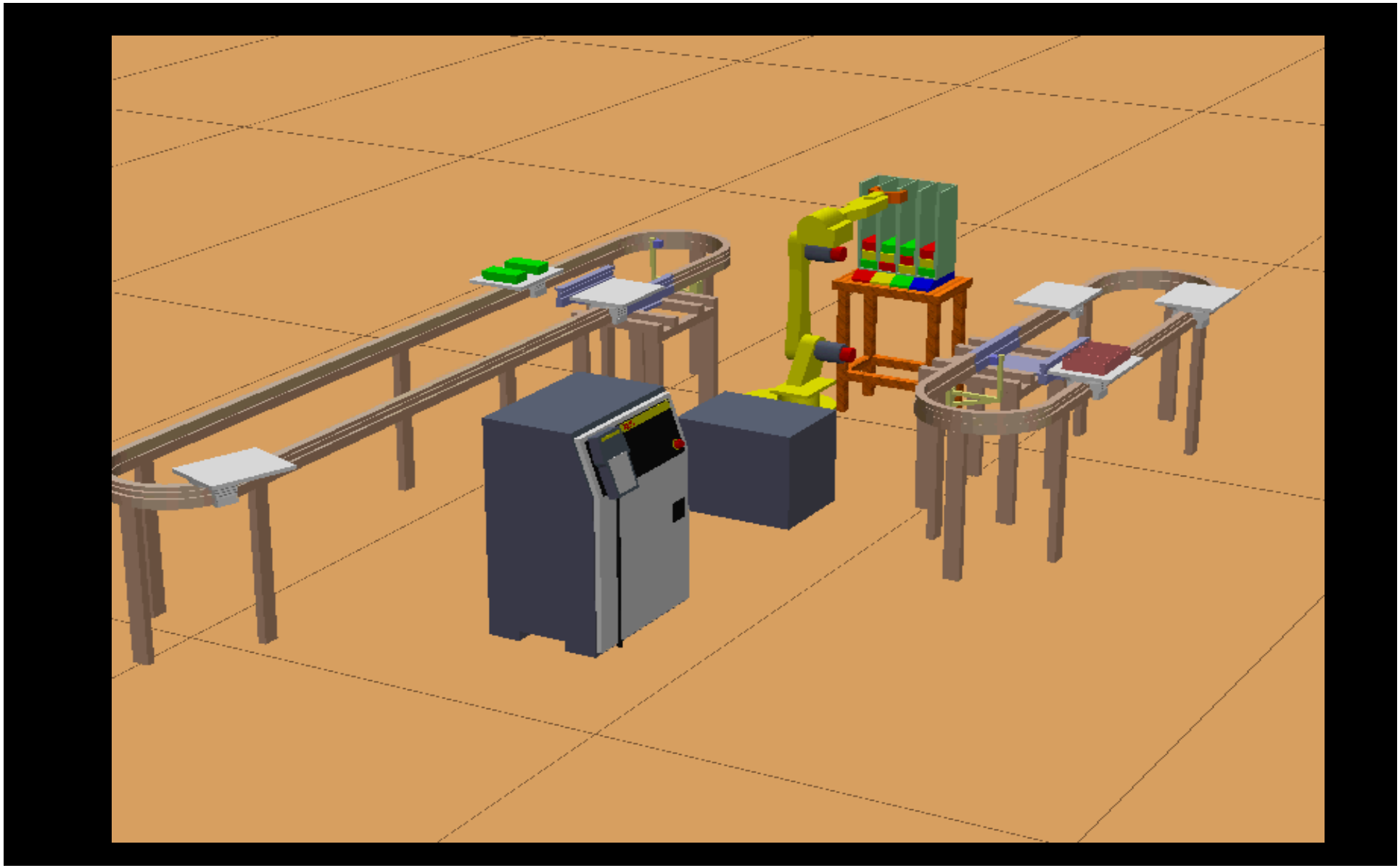
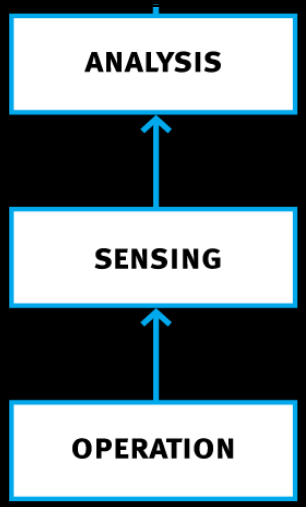
# DEMONSTRATOR - PHASE 1



# EXAMPLE: RETAIL SHELF MANAGEMENT



- Operation – products available on shelves
- Sensing – stock levels, removal rates, POS data
- Analysis – estimated stock out times, removal patterns

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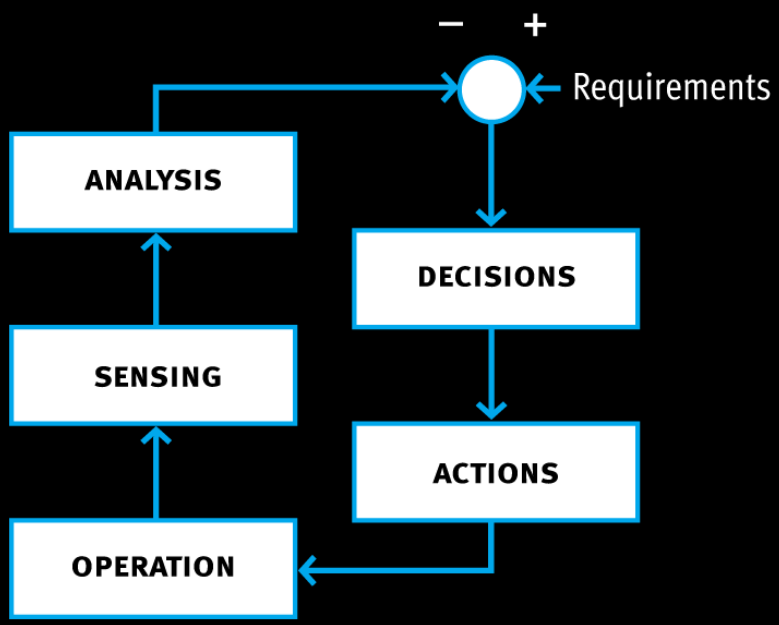
# EXAMPLE: RETAIL SHELF MANAGEMENT



- Operation – products available on shelves
- Sensing – stock levels, removal rates, POS data
- Analysis – estimated stock out times, removal patterns
- Requirements – zero stock outs, no abnormal removals
- Decision – replenishment & reordering planning, theft detection
- Action – replenishment, security alert

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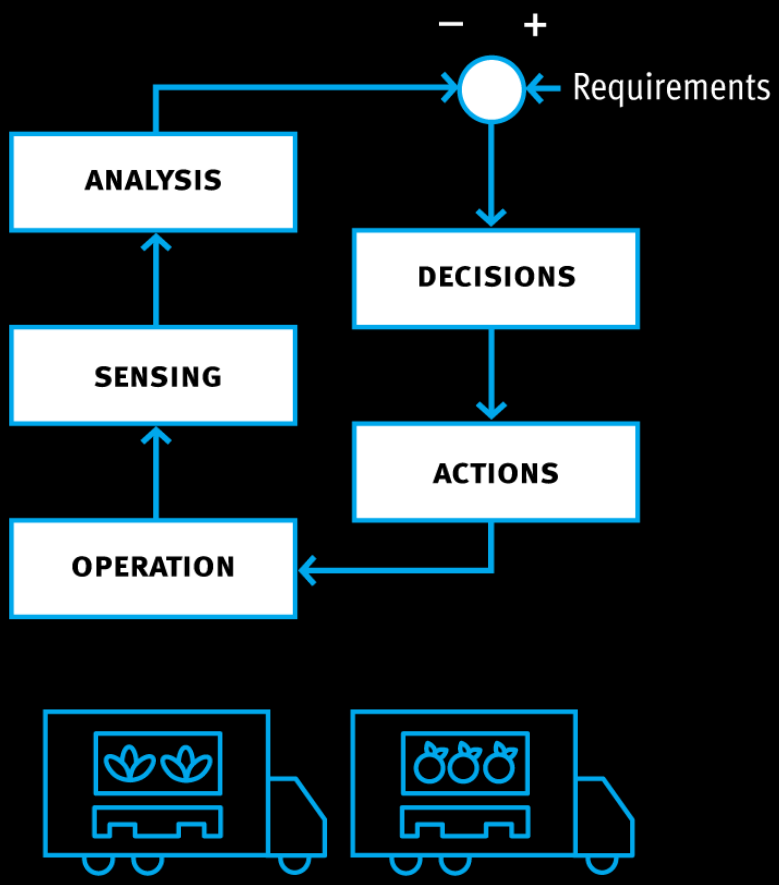
# EXAMPLE: CONTROL OF A DISTRIBUTION FLEET




- Operation – delivering food products to retailer outlets
- Sensing – truck location, load mix & condition
- Analysis – overall fleet status
- Requirements – (changing) retailer needs
- Decision – (re)scheduling, rerouting planning
- Action – directions to individual vehicles with new targets

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# Questions?