

# Systems of Systems Case study

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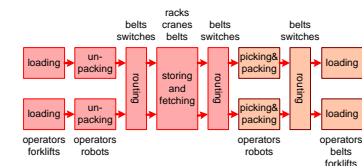
## Abstract

System of Systems case study: a warehouse in a logistics chain.

### Distribution

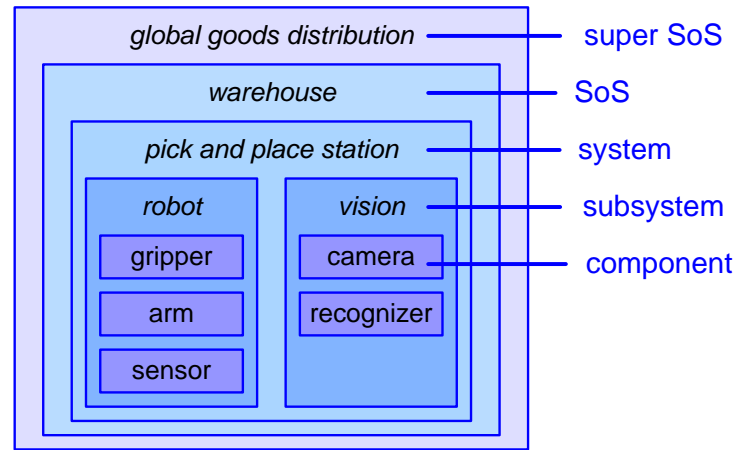
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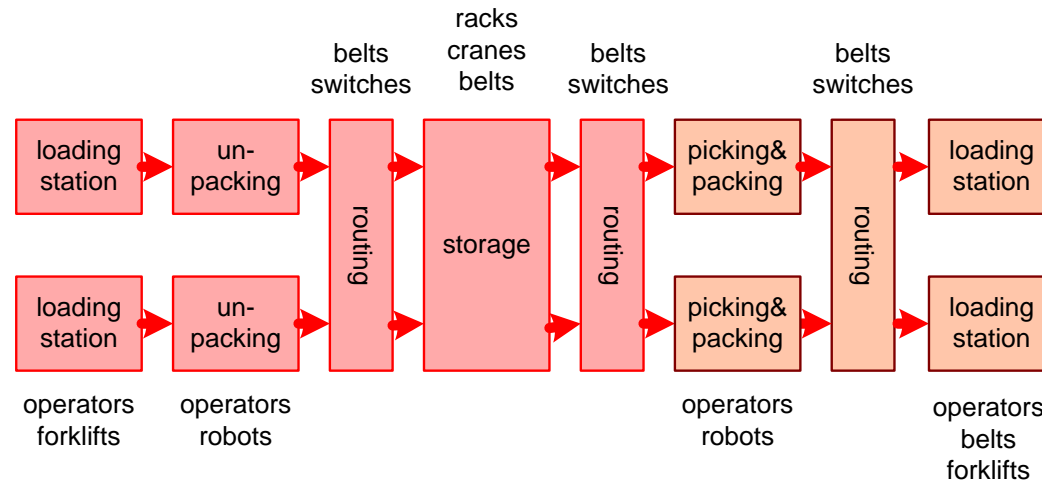


# Method

physical partitioning



functional model

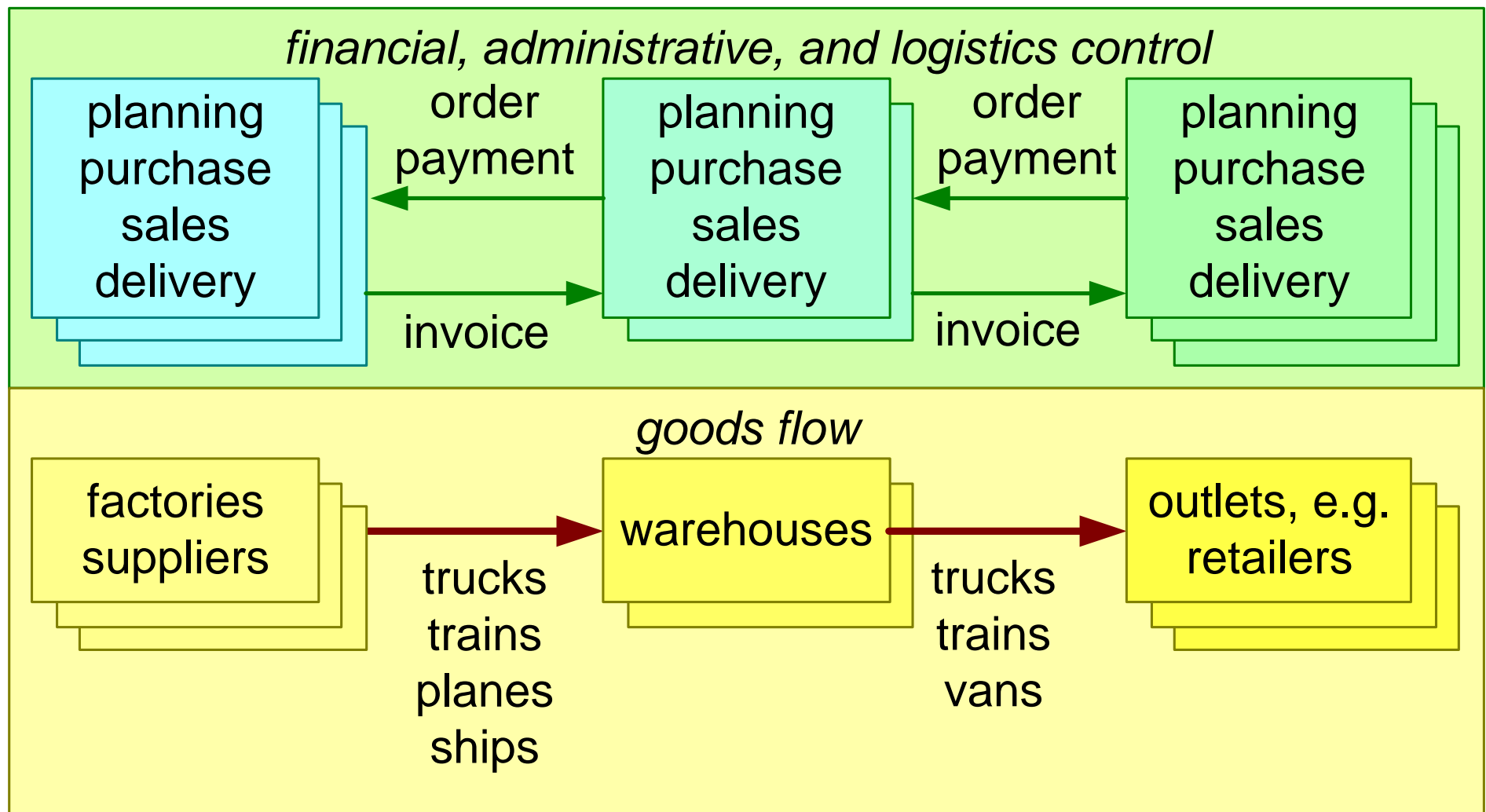


quantification

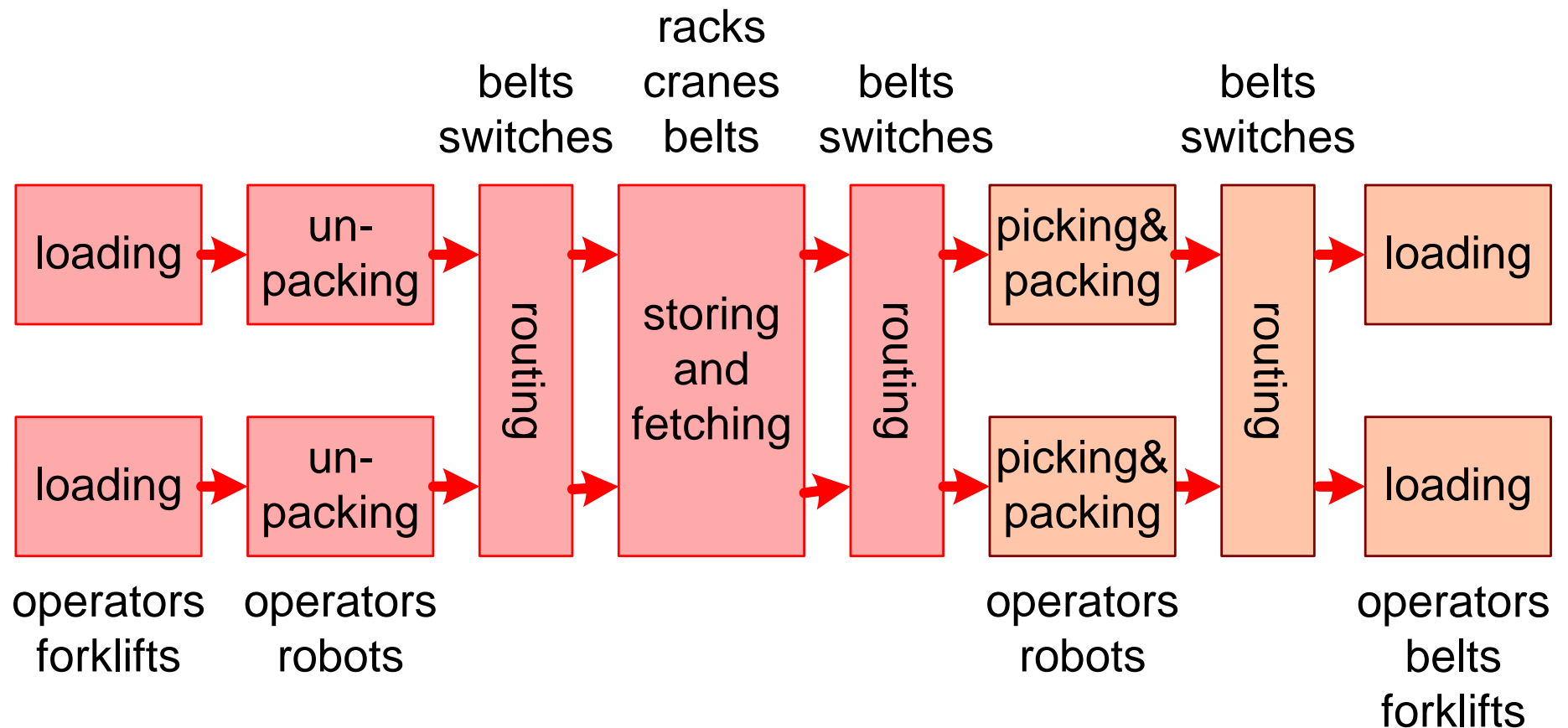
#items/hour, order size, order variation, delivery time, storage capacity, etc.

on many levels

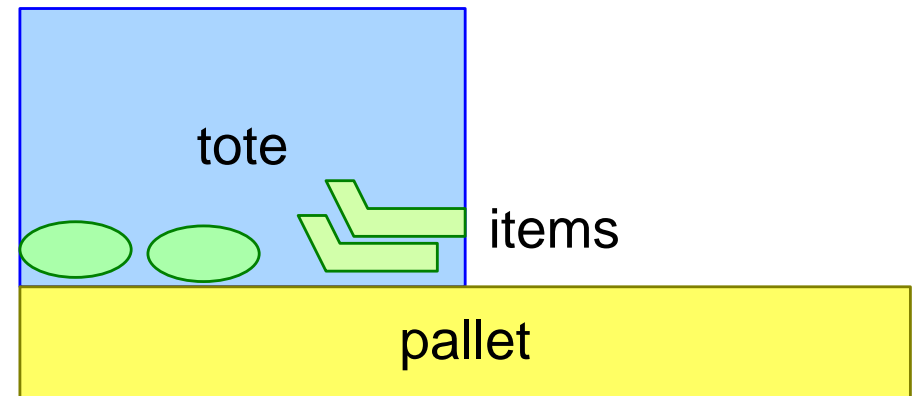
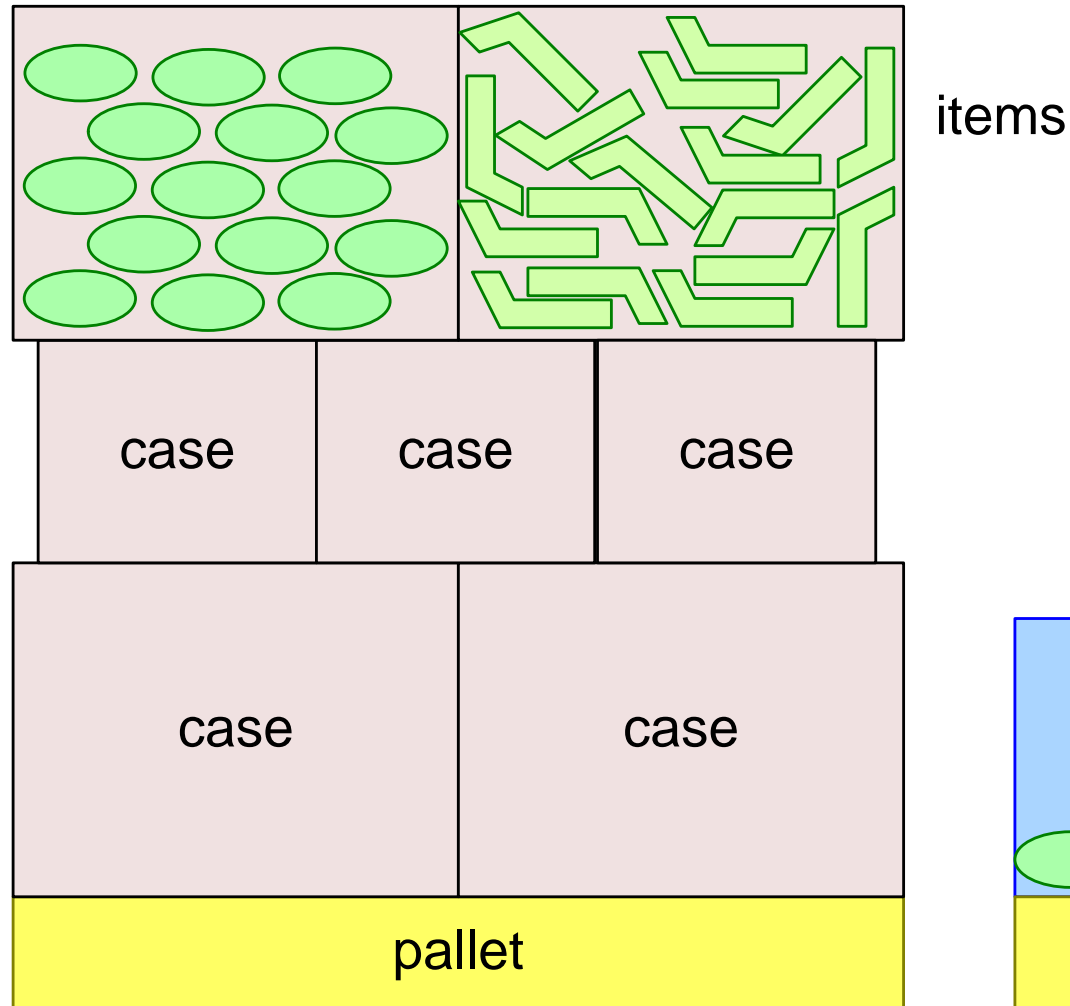
# Goods and Information Flow



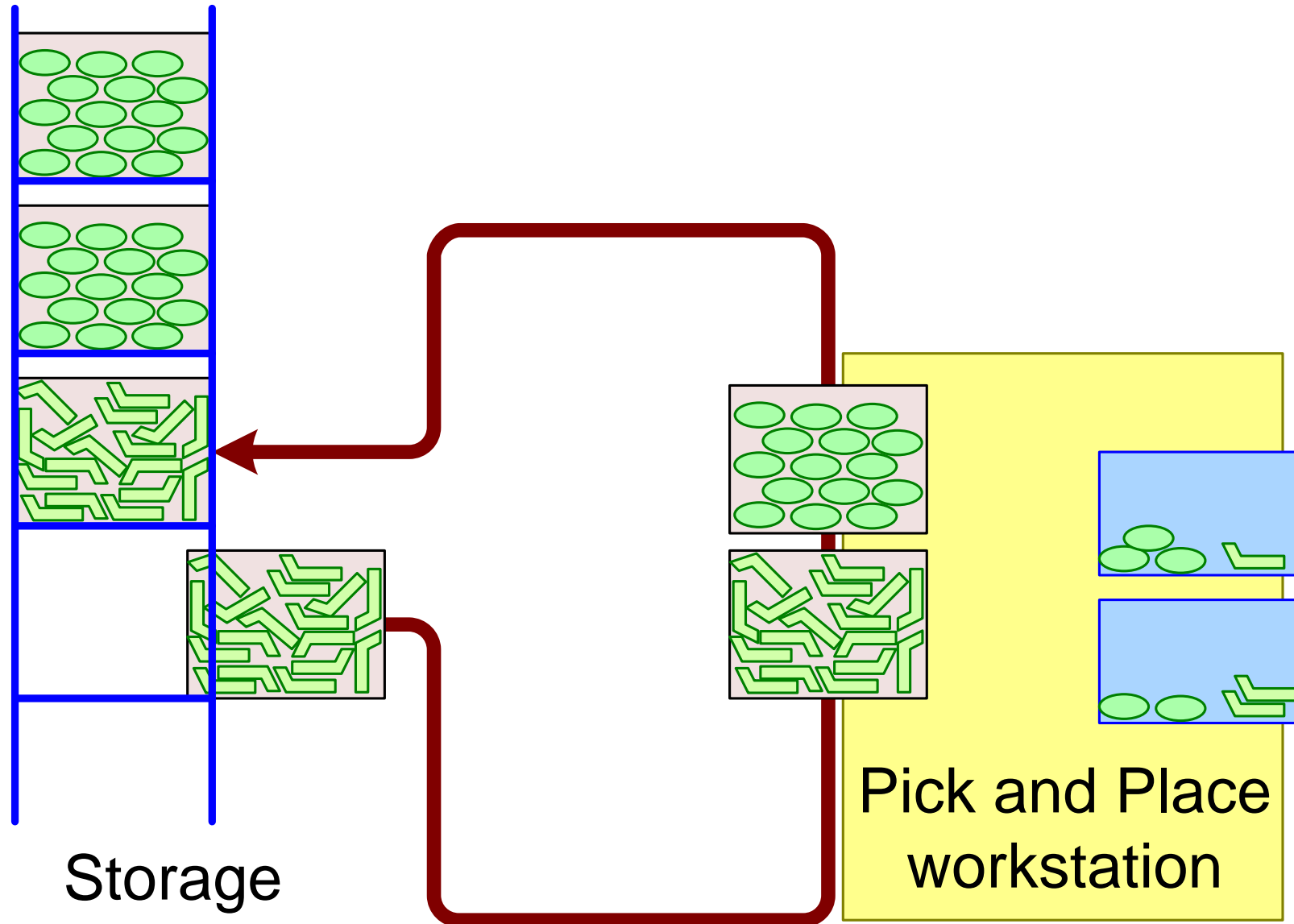
# Functional Model Warehouse



# Some Warehouse Jargon



# Pick and Place



# Pick and Place Design Questions

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One order at a time?

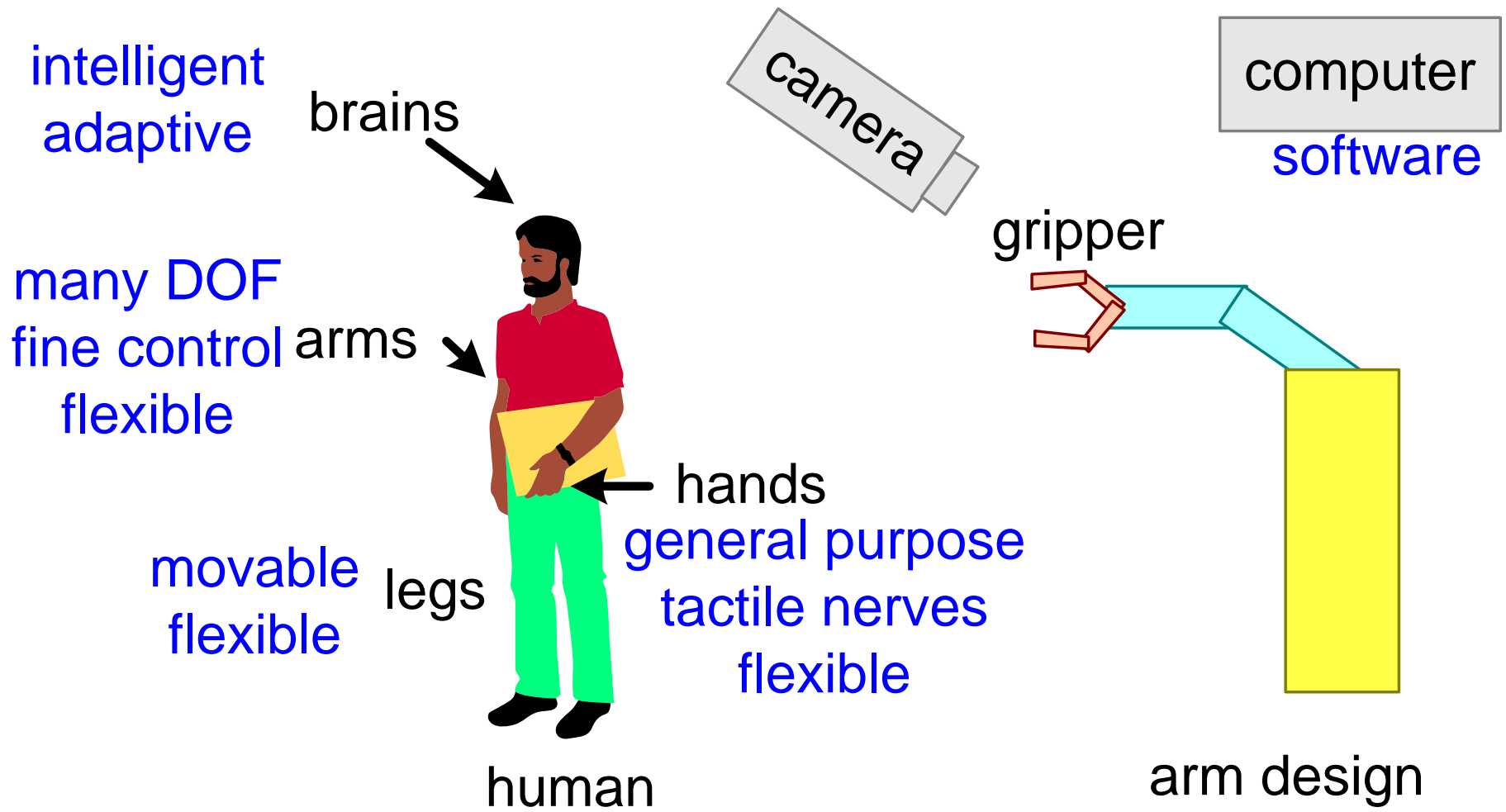
One item at a time?

Stock travels along many workstations?

What are the critical design choices?

What concepts are available?

# From Human to Robot





# Robot Design Questions

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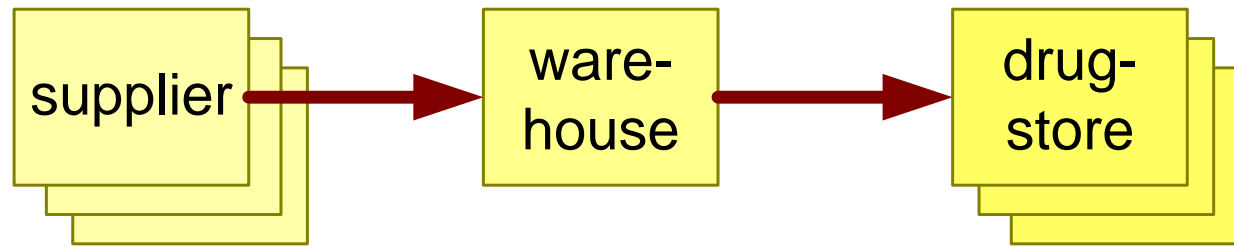
What Gripper and Robot Concepts are appropriate?

What are the desired properties?

What kind of items must be handled, and how?

→ Use examples to explore

# Example 1: Large Volume Drugstore



Large quantities  
box-like packages

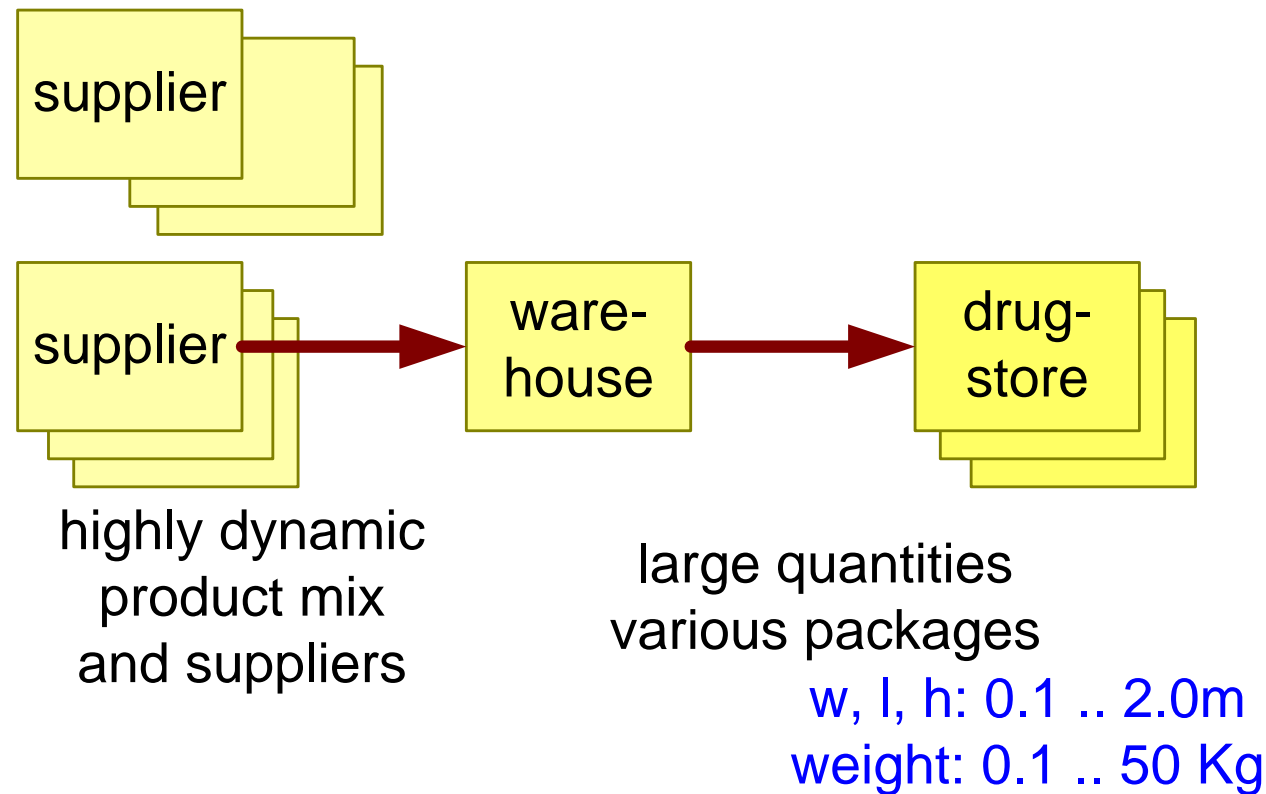
w, l, h: 0.1..0.5m  
weight: 1..40 Kg



simple gripper  
1 DOF

simple robot  
"H" for X, Y, and Z  
movements

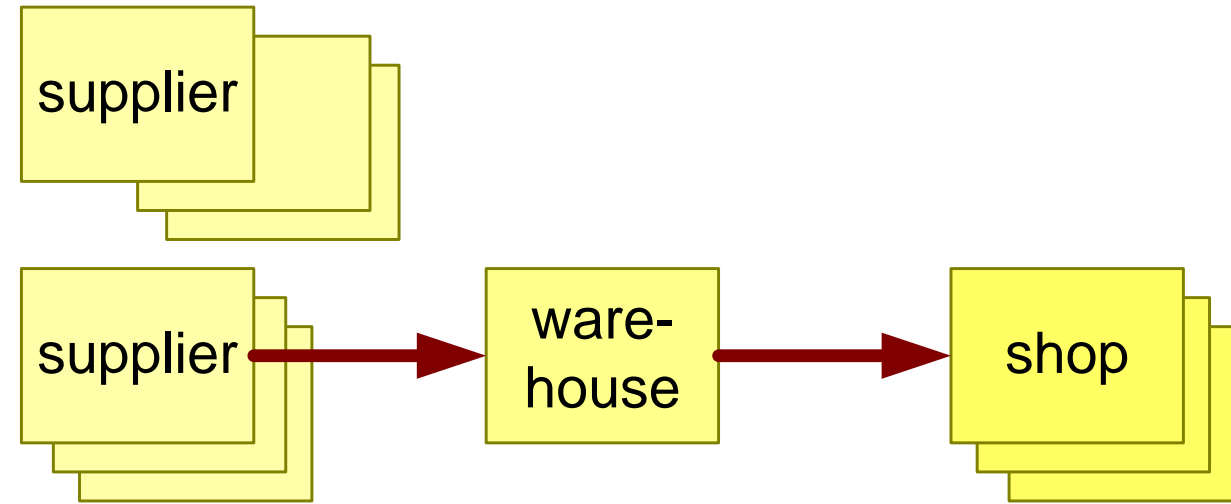
# Example 2: High Dynamics



multiple grippers needed?

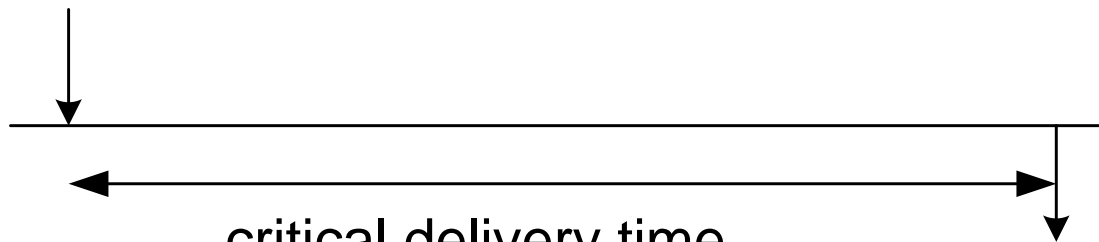
there is no time to teach (program)  
the robots how to handle package variety

# And more variants...

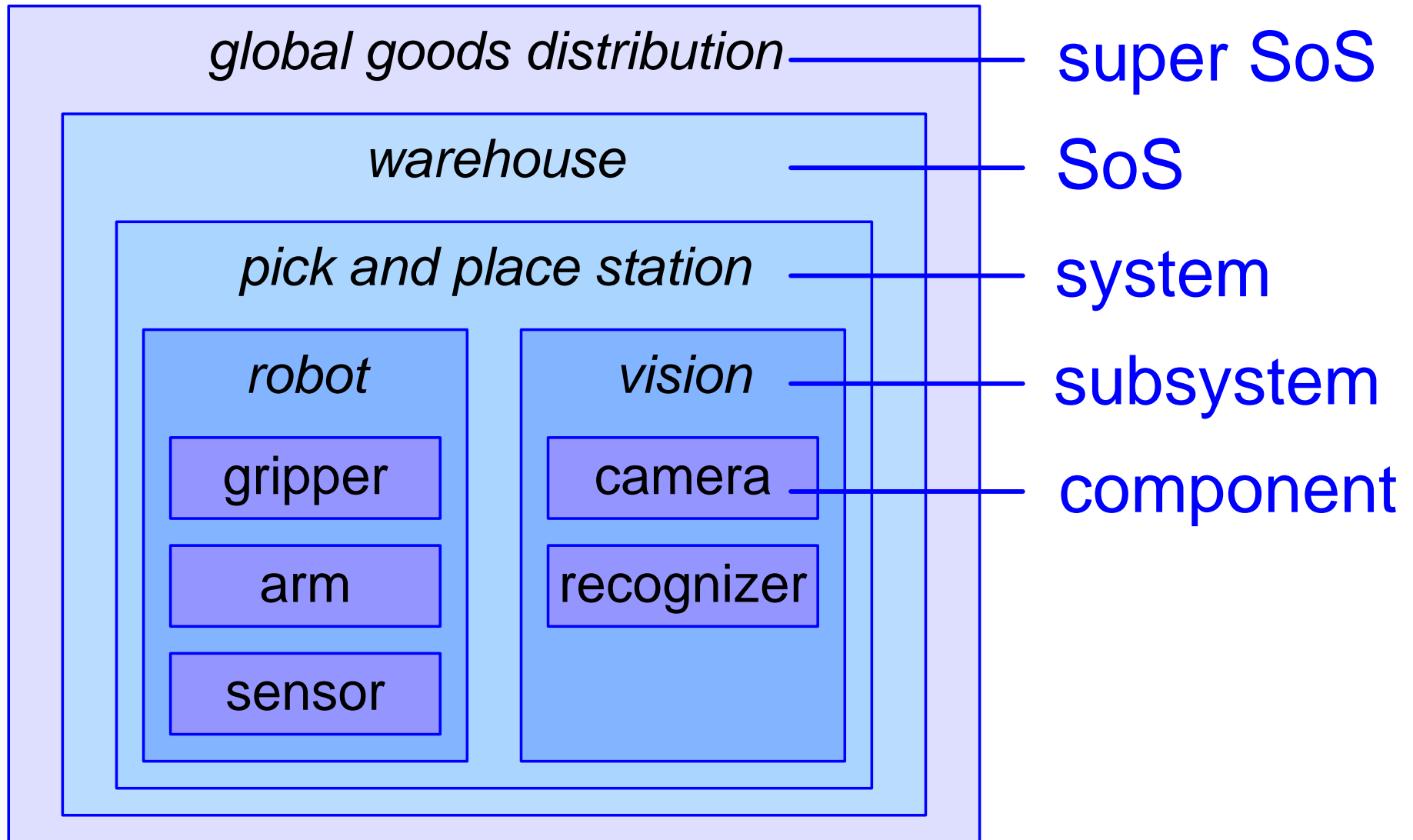


small quantities  
fragile packages  
packaging constraints

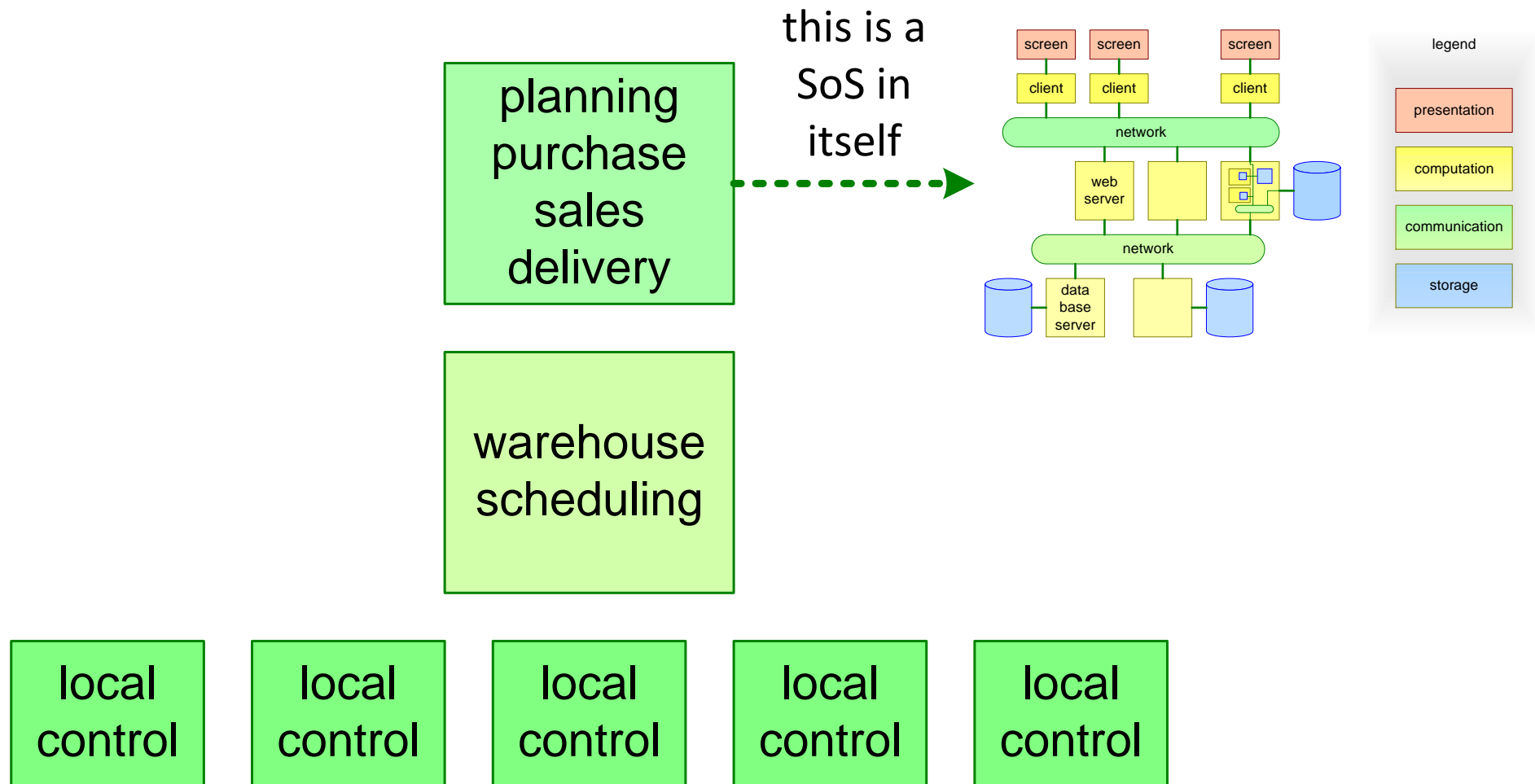
production



# Recap: Levels and Partitioning



# Warehouse Control



# Typical Project Life Cycle

