What devilish detail might kill your grand design? An example of connecting breadth and depth

by *Gerrit Muller* University of South-Eastern Norway-NISE
e-mail: gaudisite@gmail.com
www.gaudisite.nl

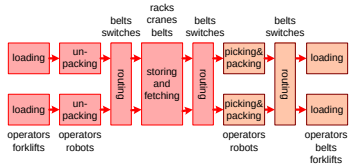
Abstract

We briefly look at some devilish details and their consequences. We observe that there is a natural tendency to either zoom in on details, or to zoom out for a helicopter view. We pose that it is the systems engineer's contribution to connect depth and breadth:

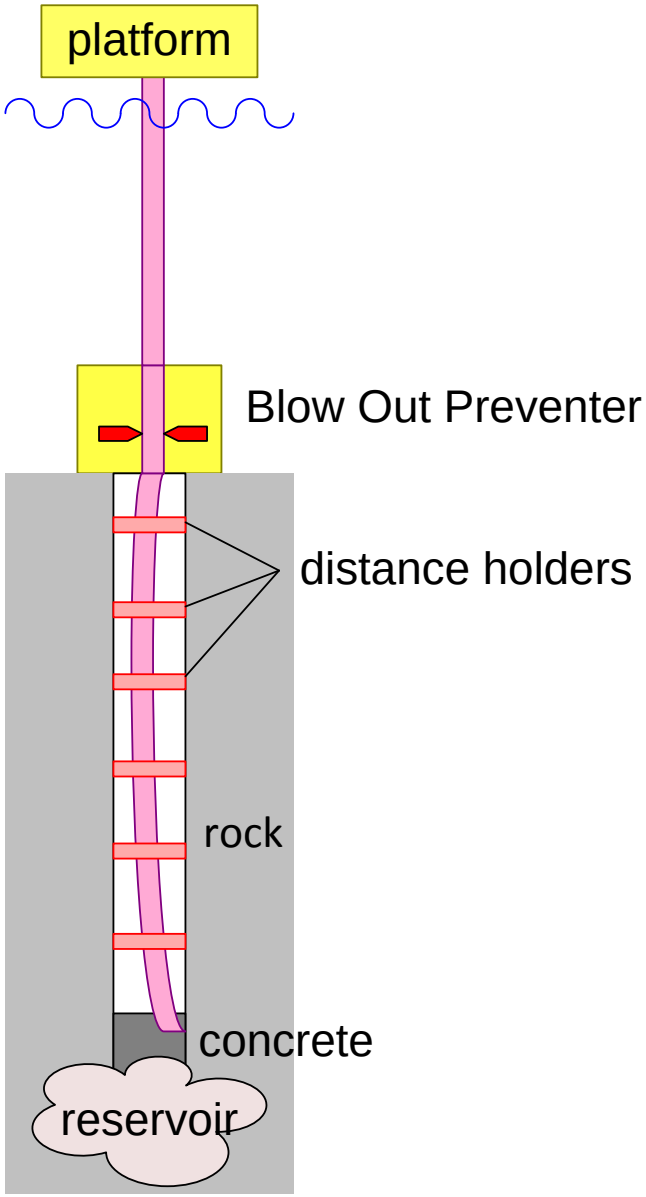
- to help experts to understand the broader context
- to help"helicopter pilots" to see details that must be taken into account

Later we discuss an example from the logistics world, a warehouse, to see how a systems engineer can make such connection.

September 6, 2020
status: draft
version: 0



Deepwater Horizon: What Went Wrong?



original problems

instable concrete

too few distance holders

pressure test wrongly explained

pressure verification inconsistency ignored

Blow Out Preventer did not work:

- connections were severed
- backup battery was empty
- BOP type fails in 50%

Alarm in crew cabins was switched-off

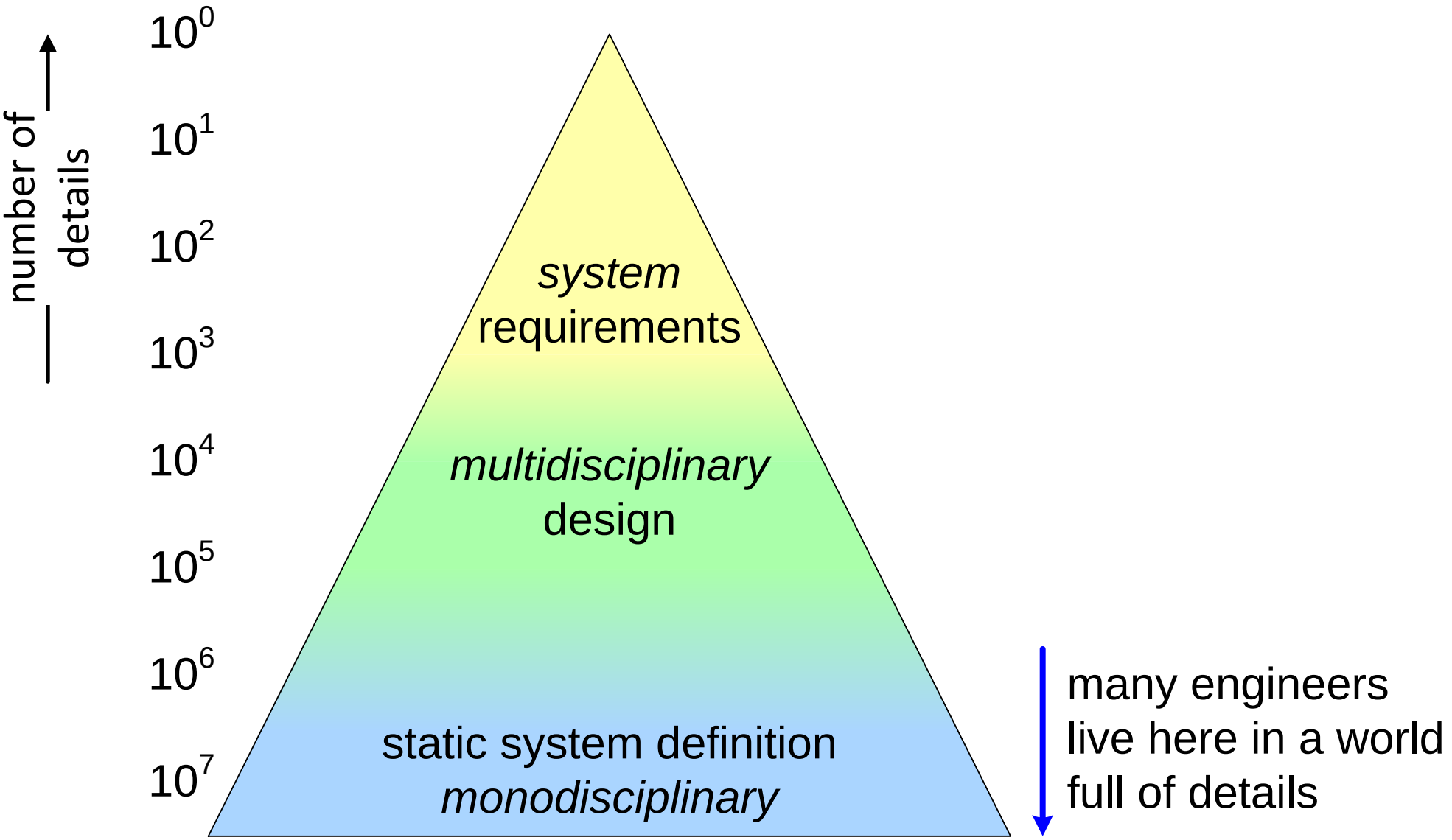
conclusions in retrospect

missing communication

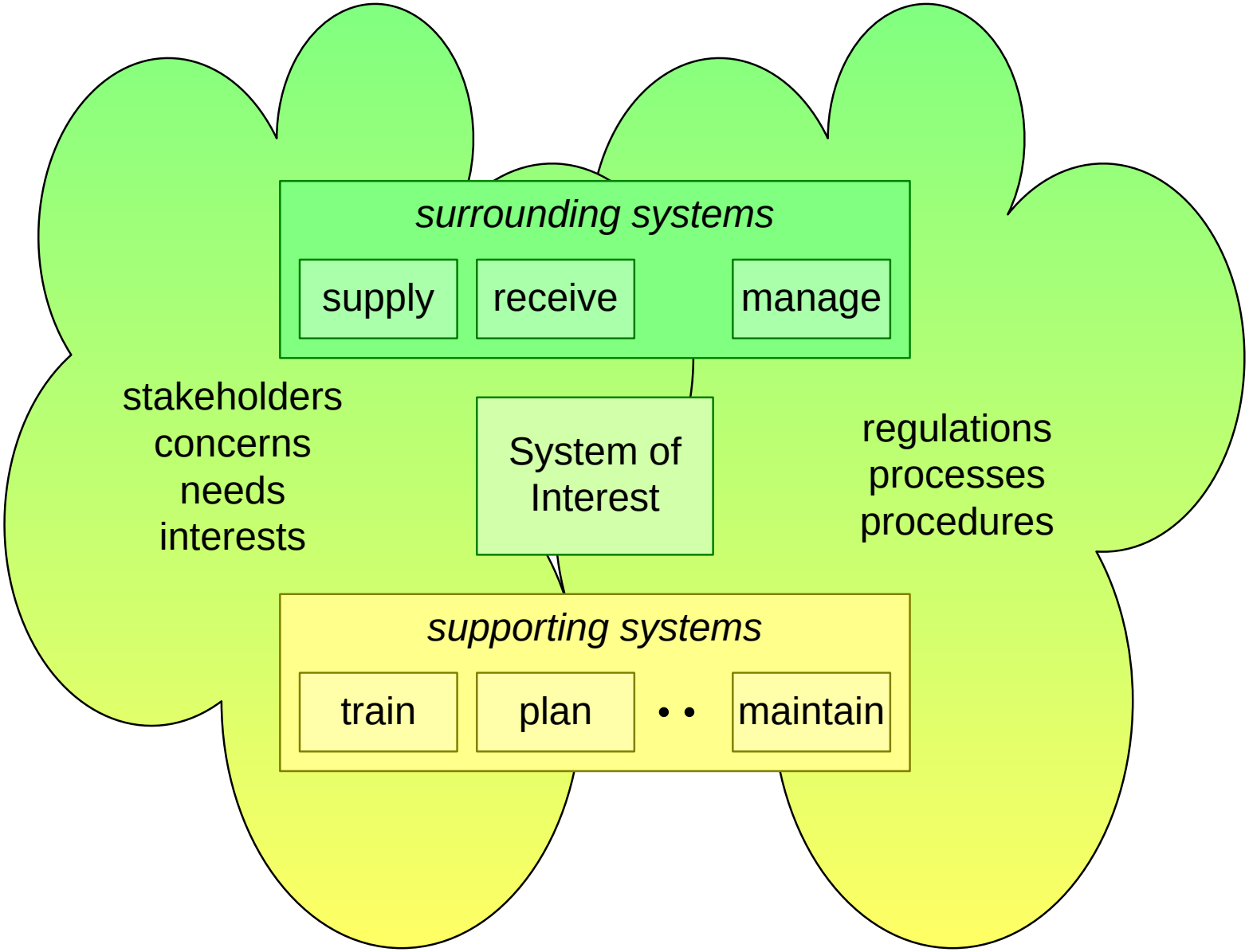
missing overview

local crew did not understand system

Depth


number of details
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
system requirements
multidisciplinary design
static system definition
monodisciplinary
many engineers live here in a world full of details

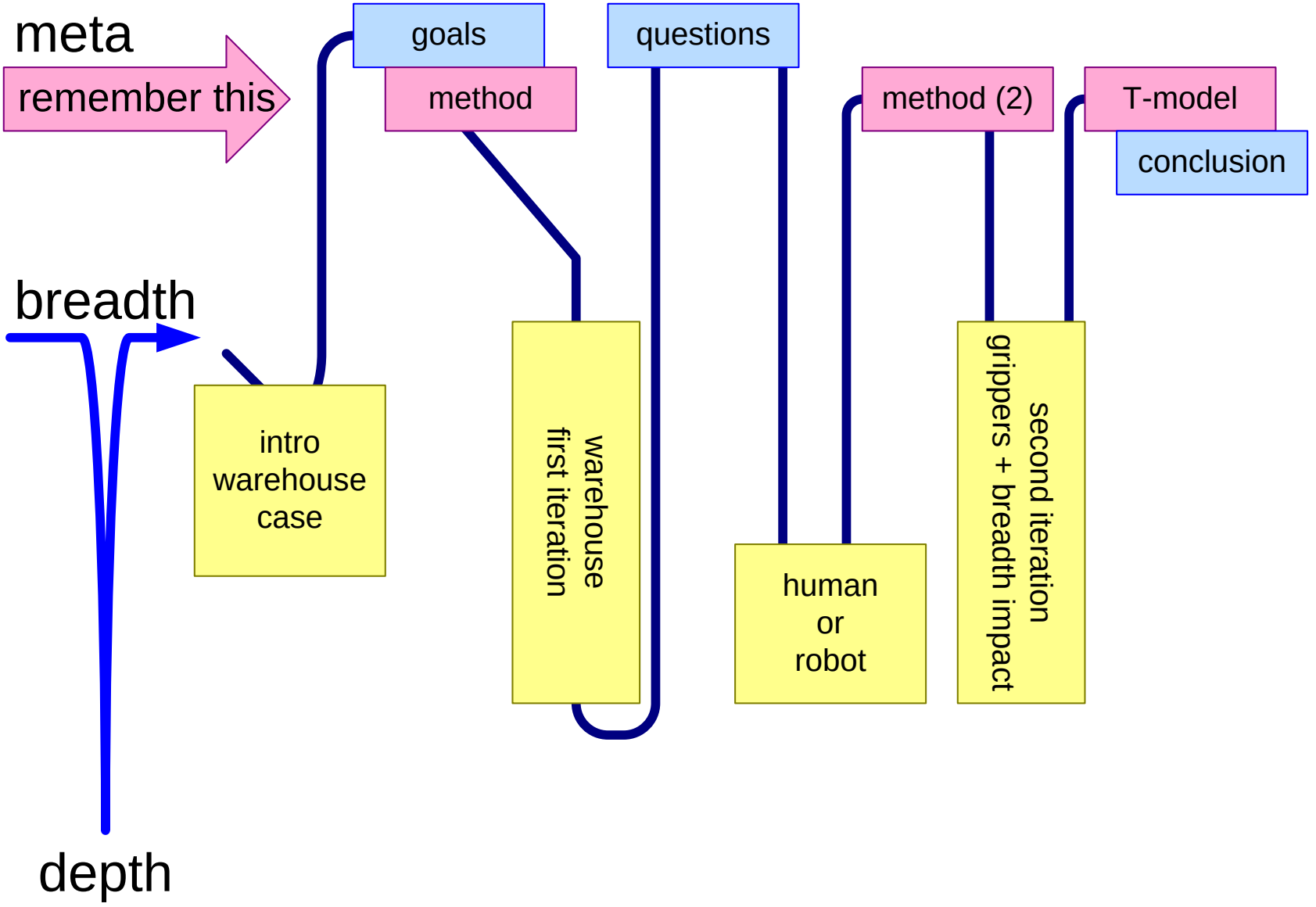
Breadth


surrounding systems
supply
receive
manage
stakeholders
concerns
needs
interests
System of Interest
regulations
processes
procedures
supporting systems
train
plan
maintain

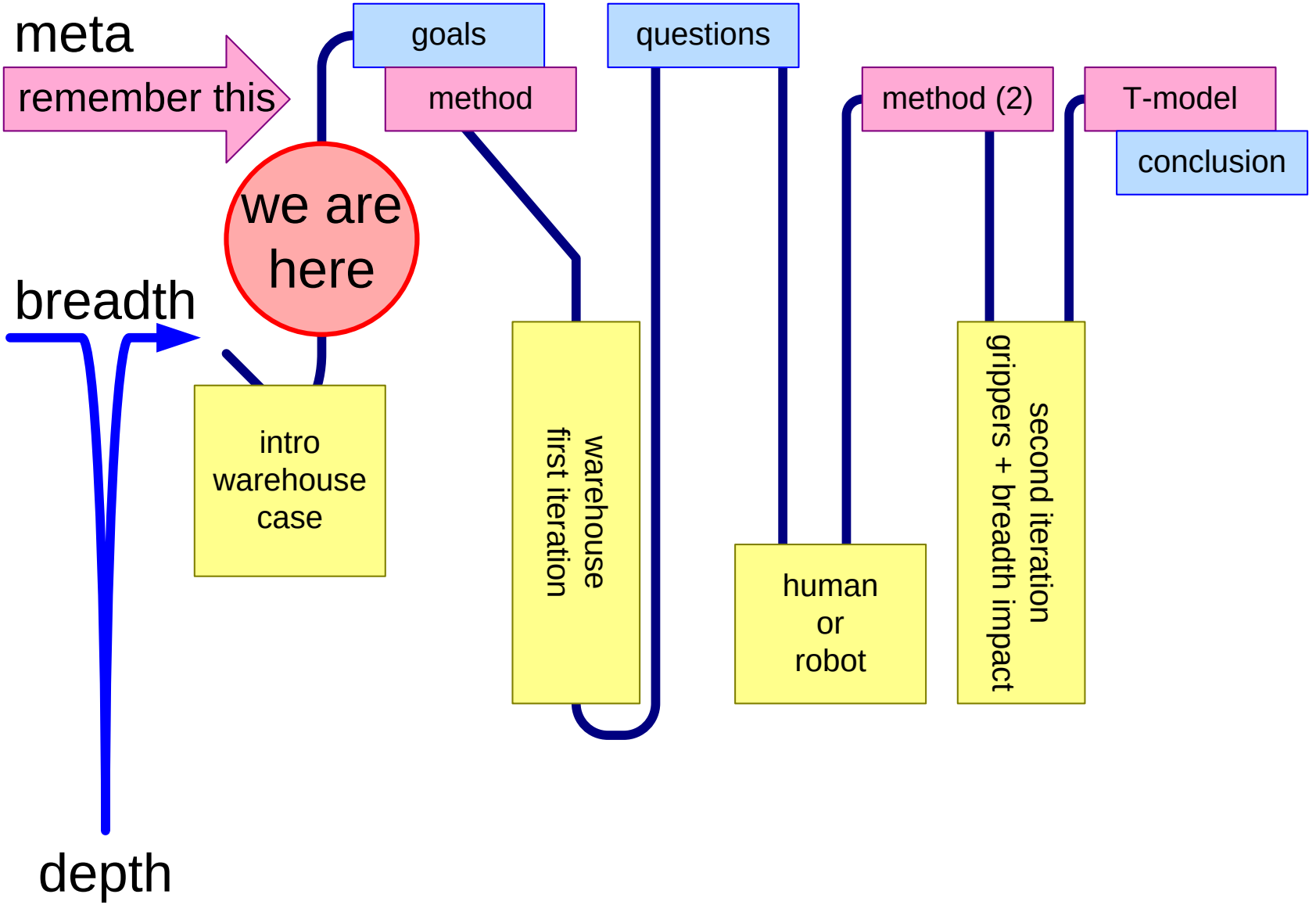
Work Form KSEE 2012

	Depth What "detail" might kill your business?	*Breadth* What contextual information is missing or unknown to your engineers?
Maarten Bonnema System Design's Three Pillars: Process, Tools and Thinking Tracks		
Haldor Husby Narrow but shallow, an unfortunate combination		
Patrik Möller Wave Energy Converters and system engineering in startup environments		
Alf Dale Systems engineering in advanced missiles design		
Rob Cloutier Graphical CONOPS – A Strategy to Improve Stakeholder/Designer Shared Understanding		
Tom Eddy Johansen Toolbox to ensure control of the details to fulfill system requirements		
Vickram Singh, Knowledge Capture, Cross Boundary Communication and Early Validation with Dynamic A3 Architectures		
Gerrit Muller What devilish detail might kill your grand design? An example of connecting breadth and depth		

Figure Of Contents™



Time To Reflect



Needs, Project Goals

Human labor, a.o. for pick and place is major part of cost

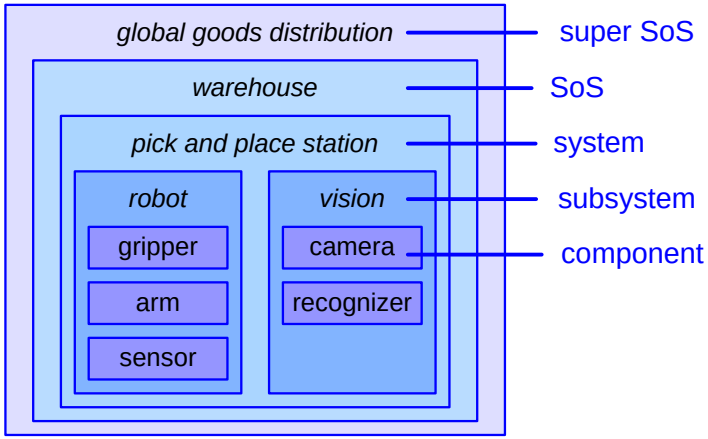
In Western world lack of staff

Can pick and place be automated?

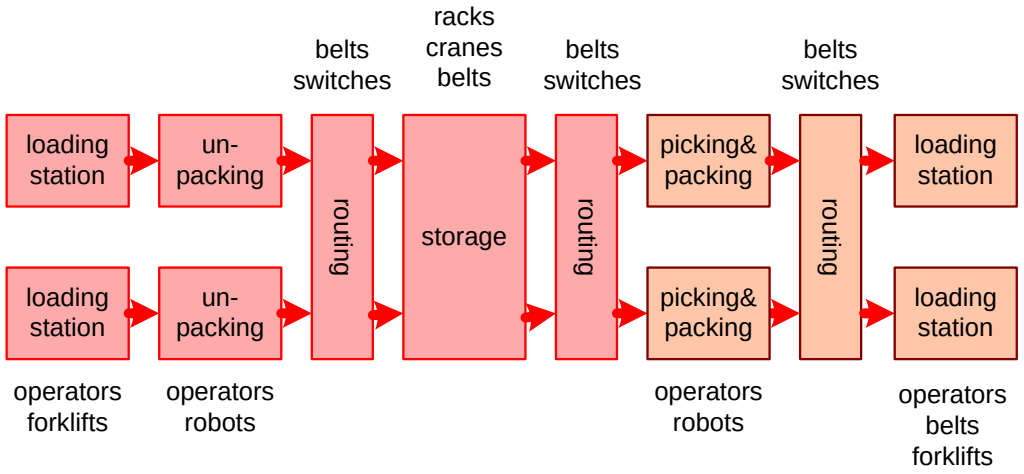
Understand design choices and impact of pick and place automation

Method to Connect Depth and Breadth

physical partitioning



functional model

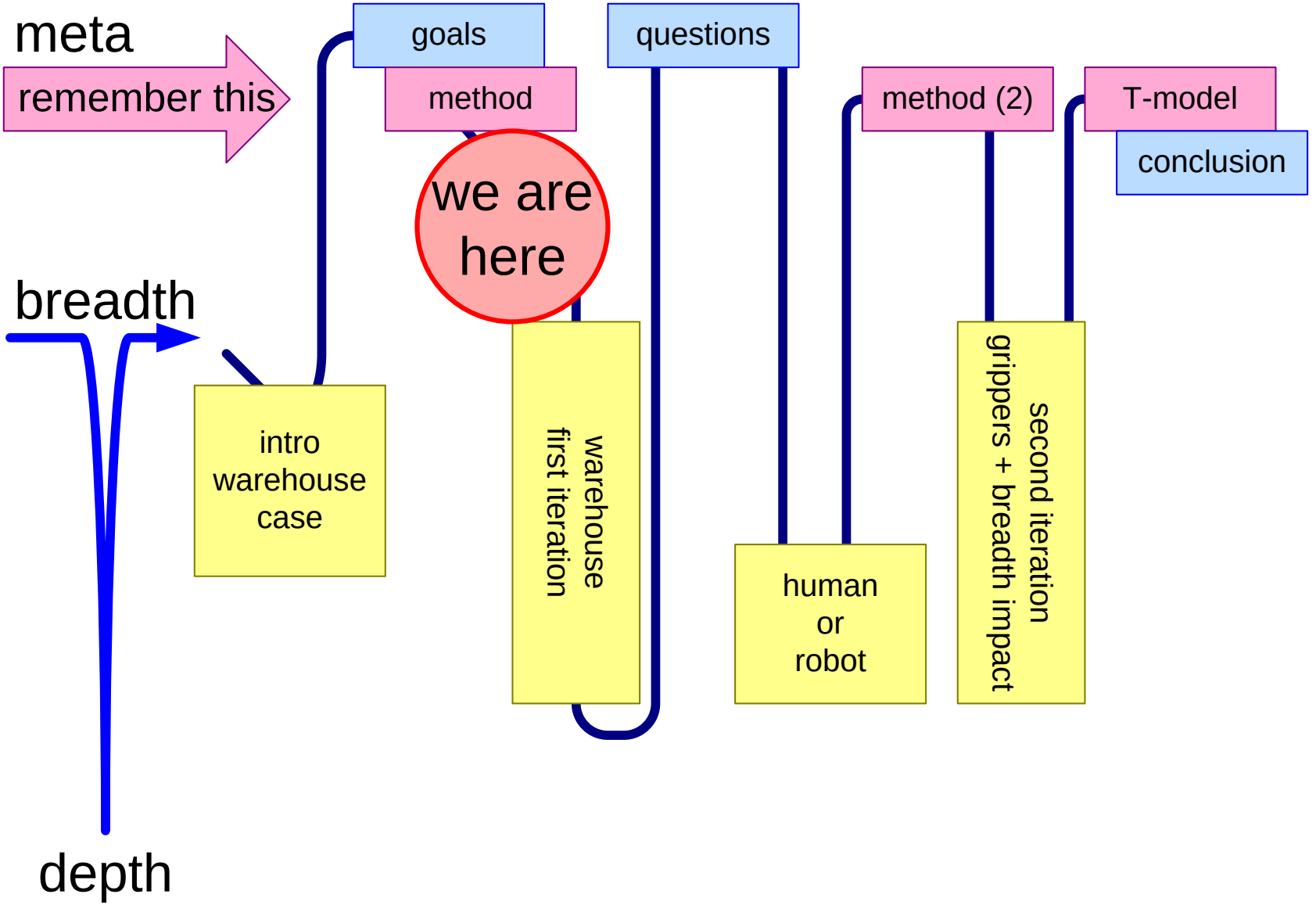


quantification

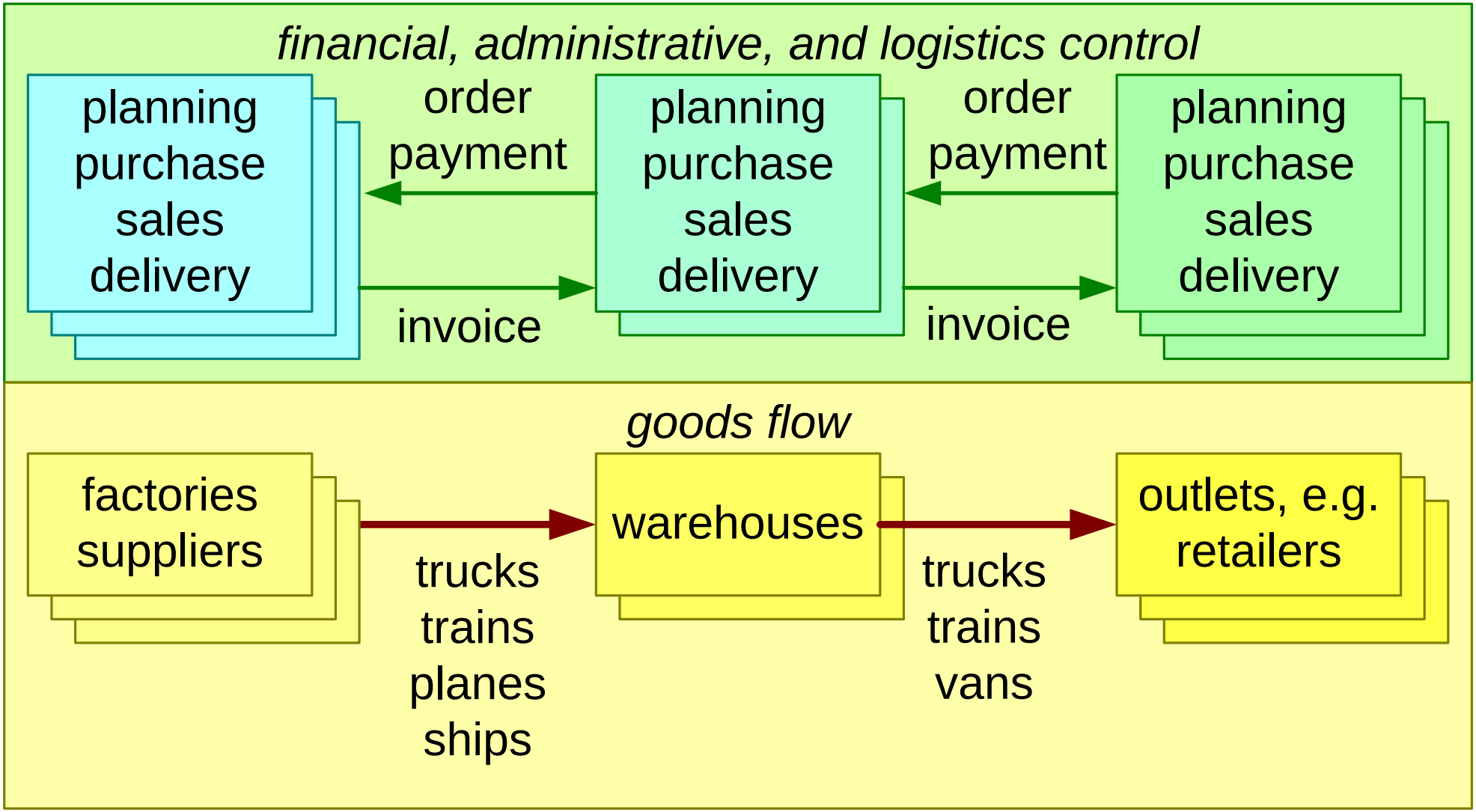
#items/hour, order size, order variation, delivery time, storage capacity, etc.

on many levels

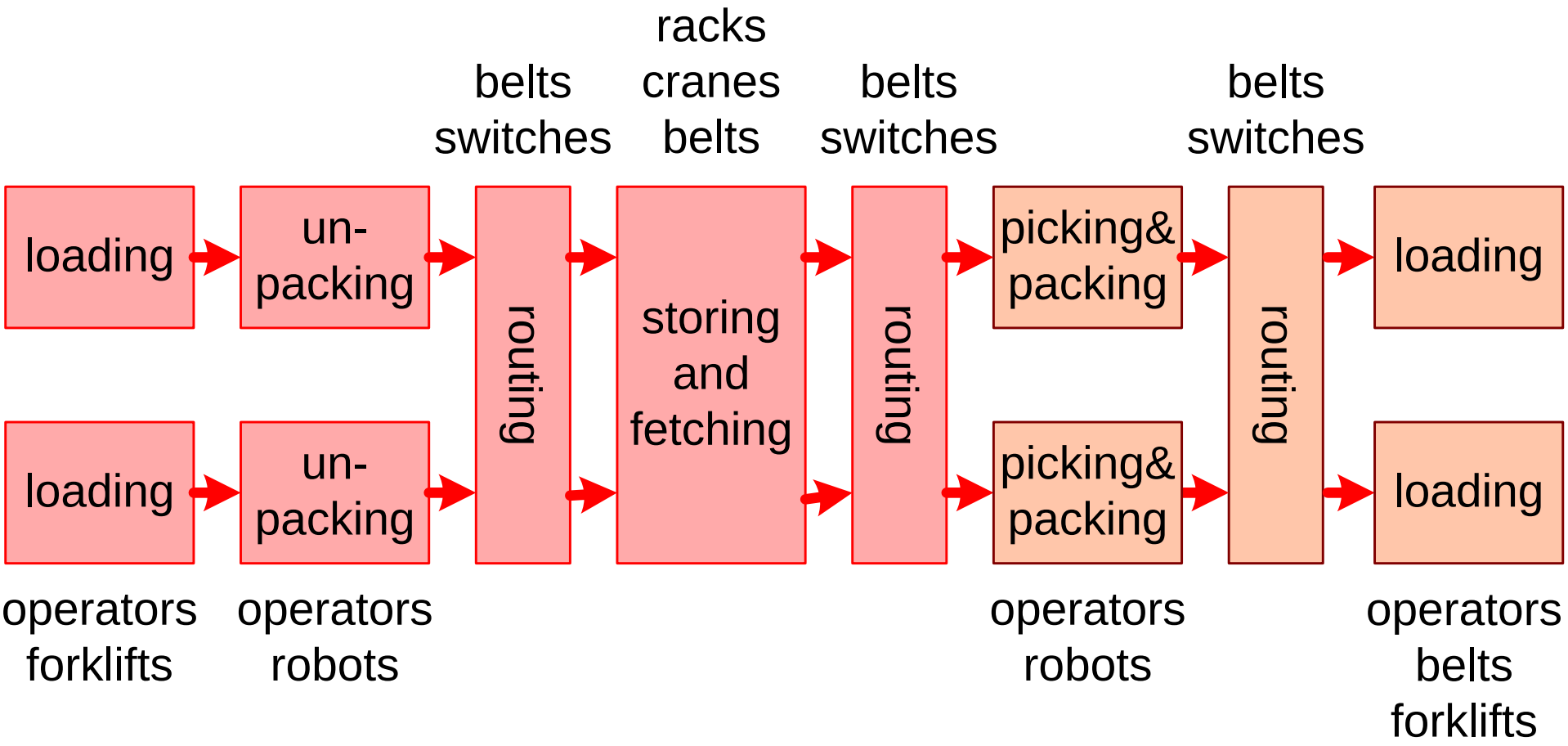
First Iteration



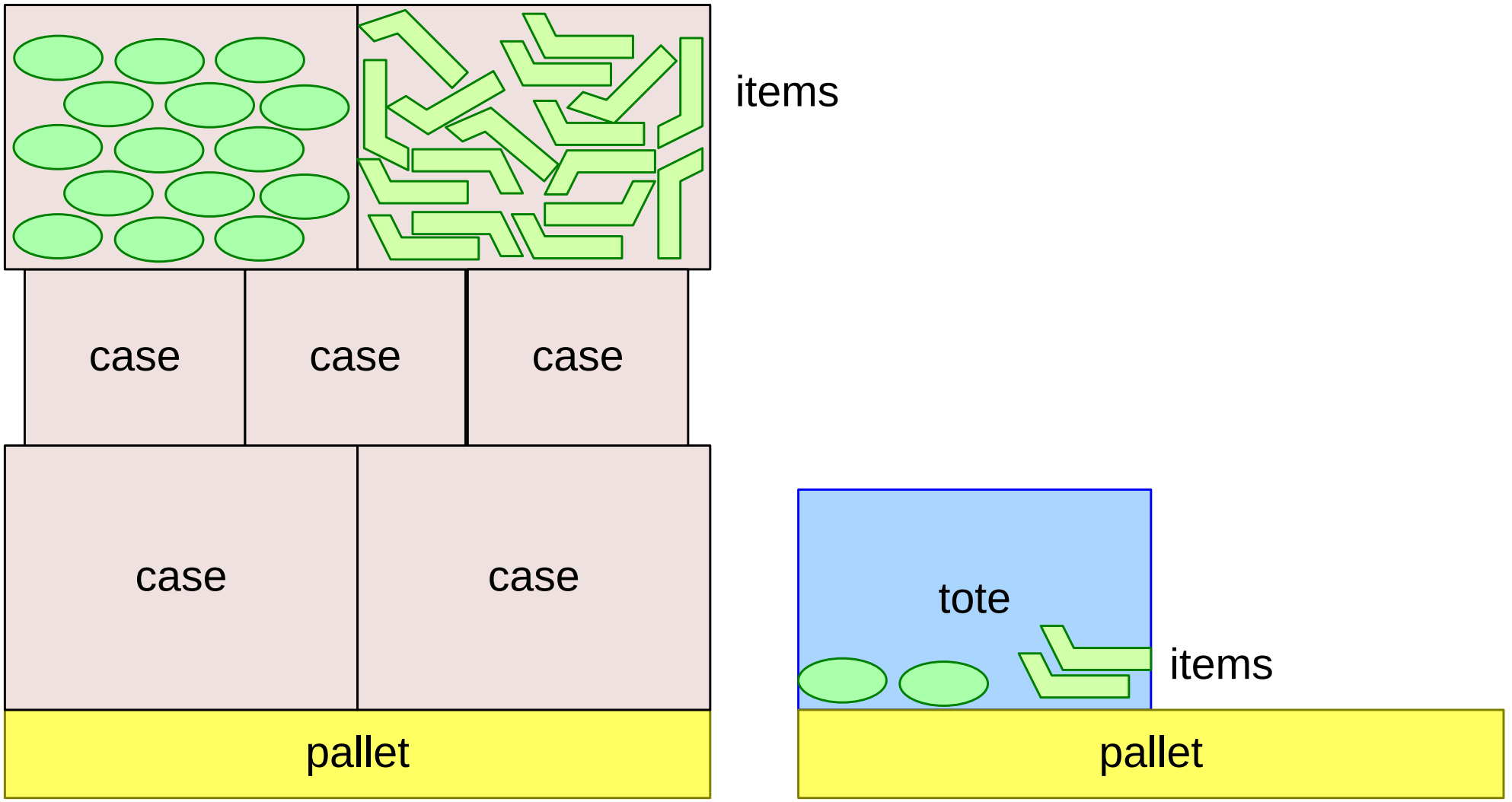
Goods and Information Flow



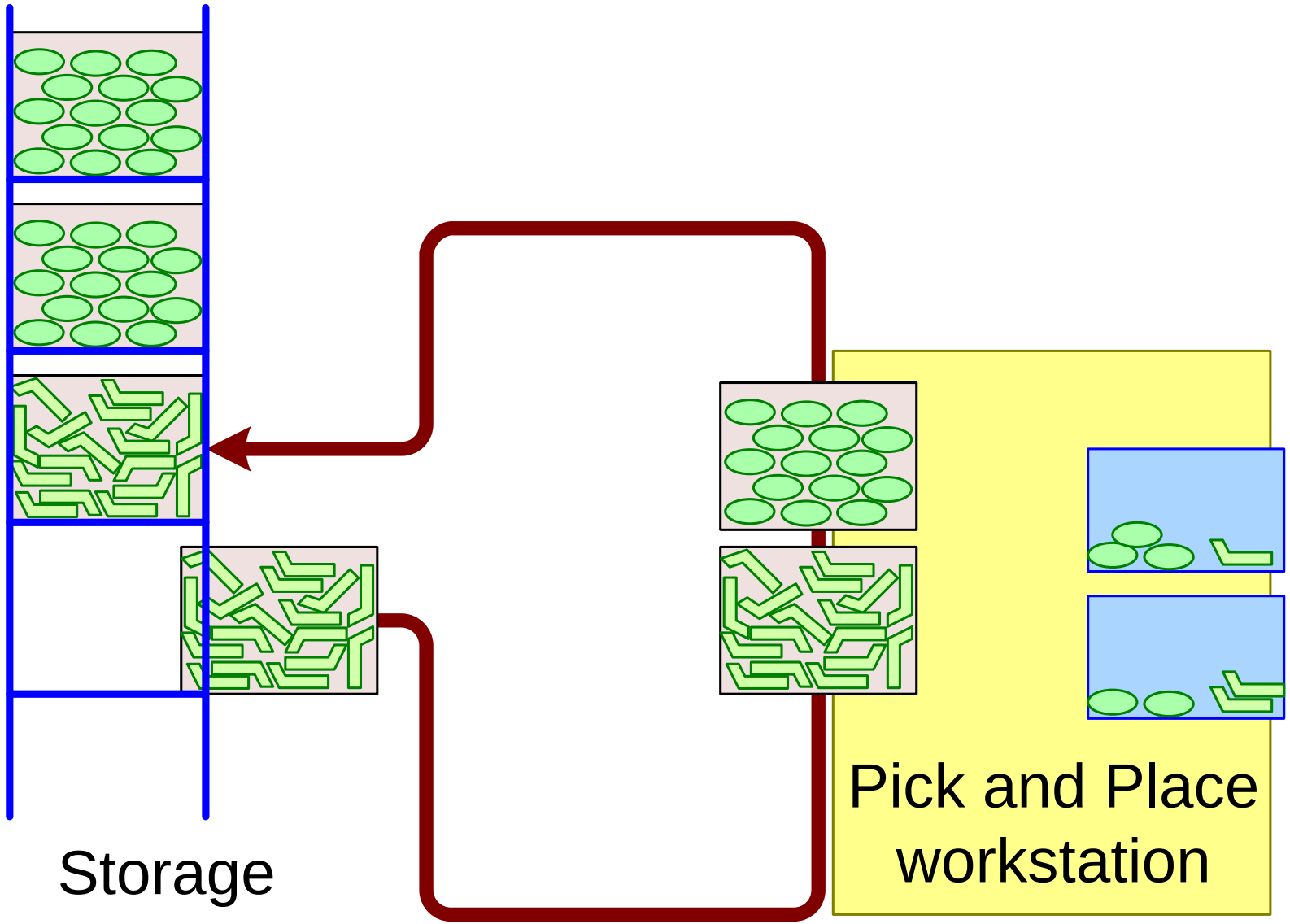
Functional Model Warehouse



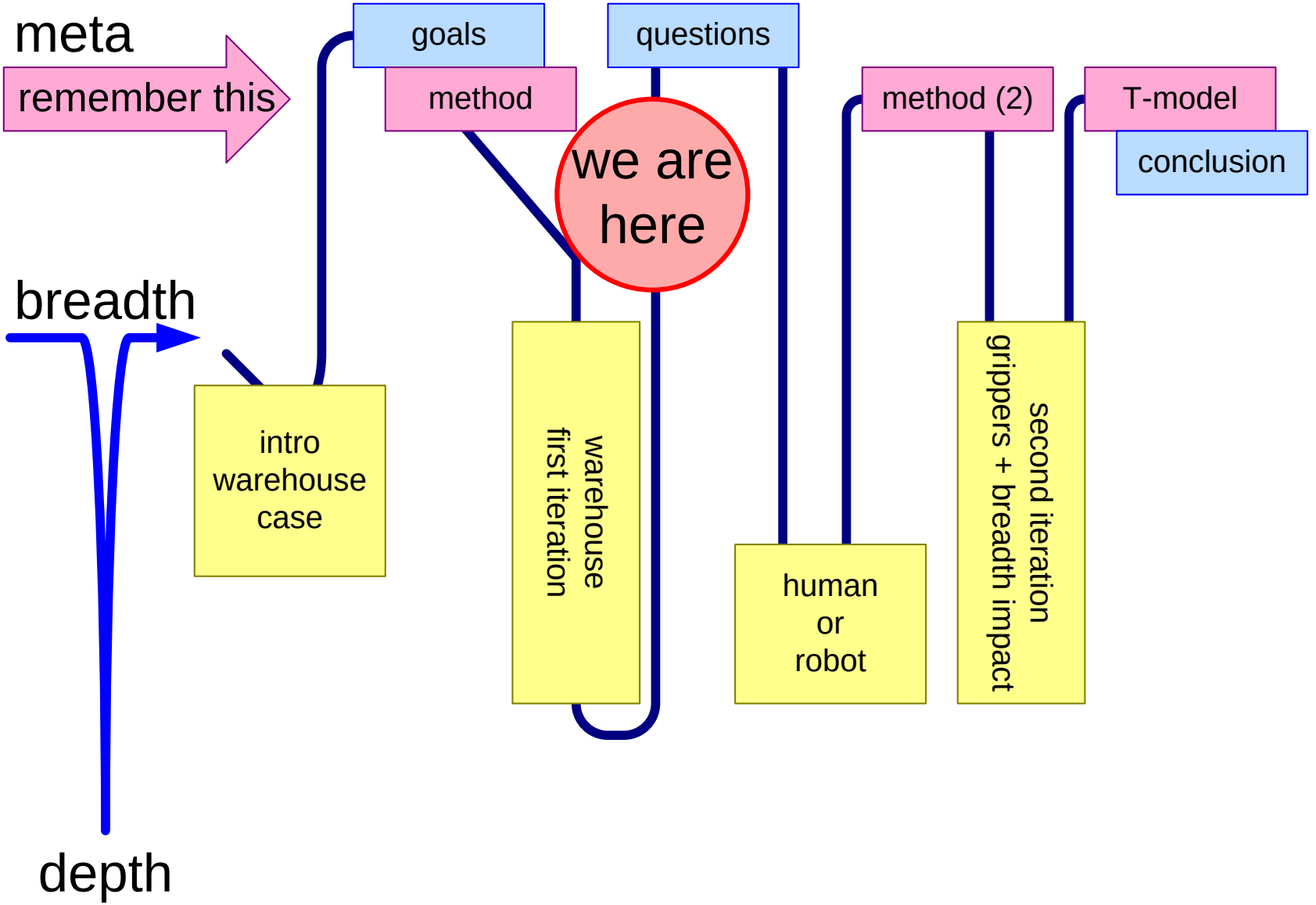
Some Warehouse Jargon



Pick and Place



What do We Want to Know?



Pick and Place Design

One order at a time?

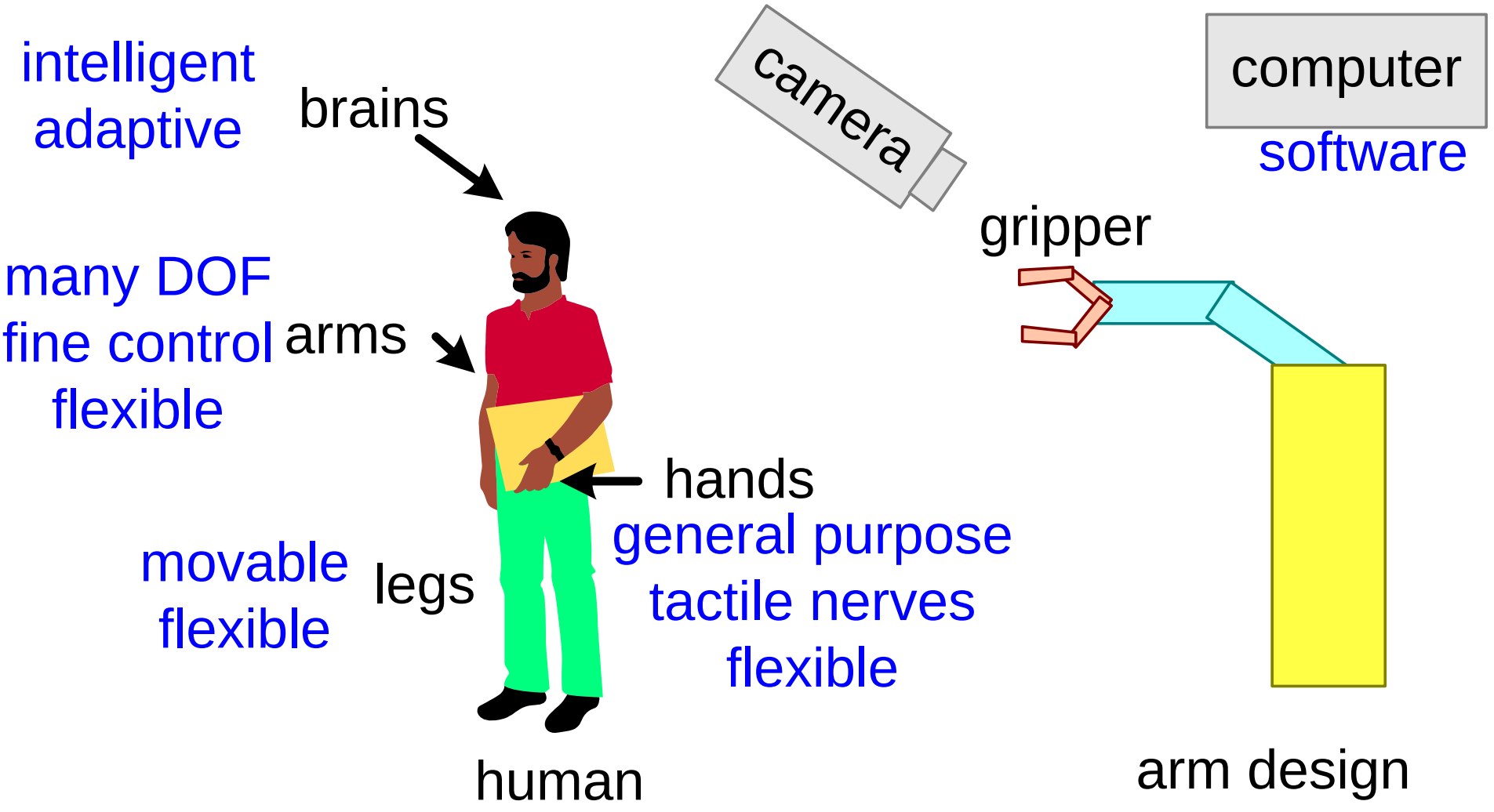
One item at a time?

Stock travels along many workstations?

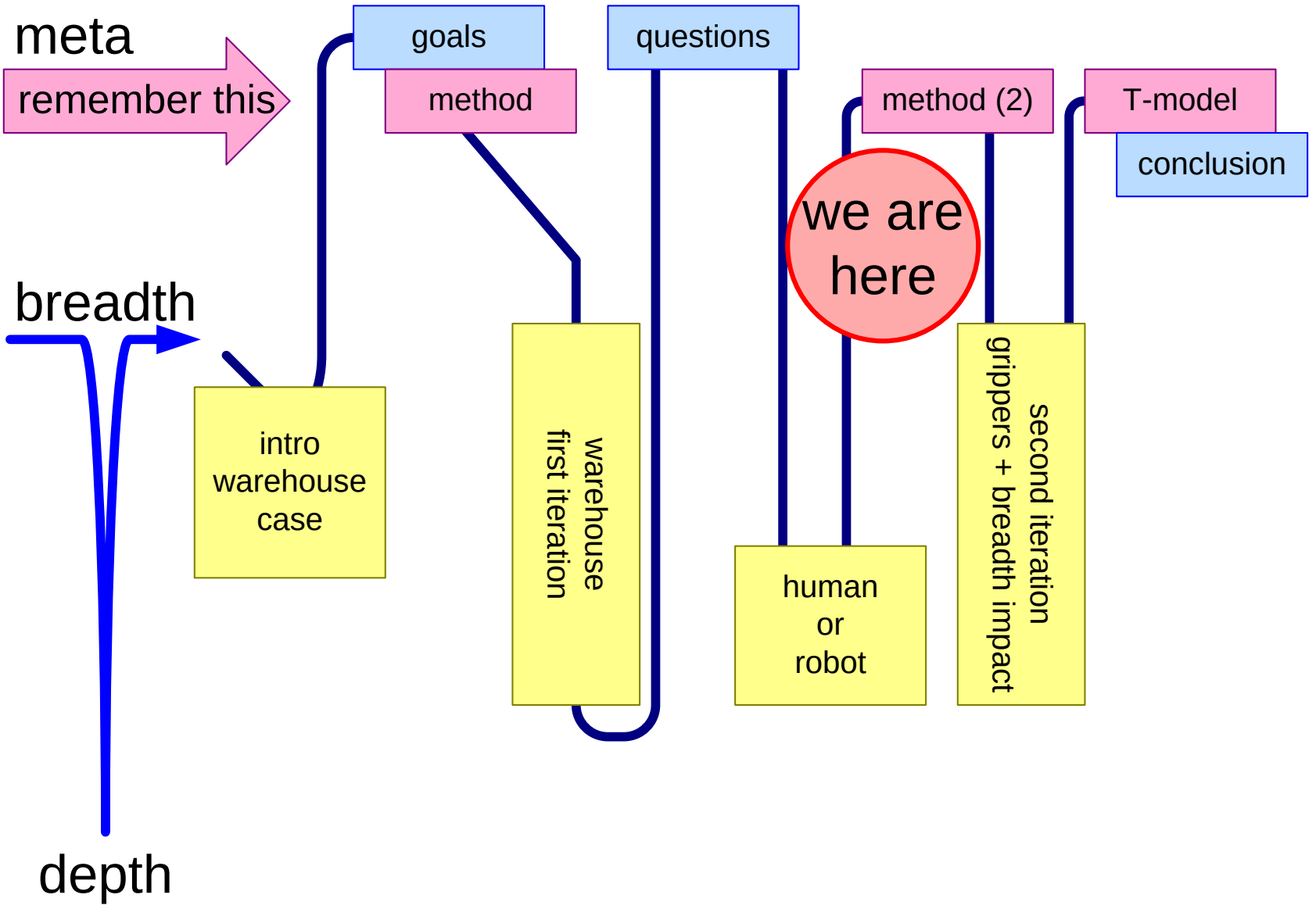
What are the critical design choices?

What concepts are available?

From Human to Robot



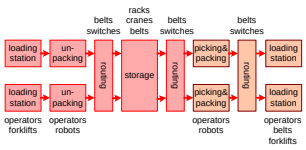
What Method can We Apply?

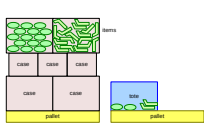


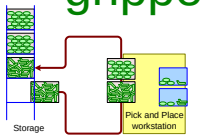
Method Recommendations

recommendations

- Time-box — 6 slides
- Iterate — first explanation of warehouse
- Multi-view — physical, functional; space 2D, 3D; time; qualities
- Multiple levels — logistics chain; warehouse, workstation, robot; gripper
- Visualize
- Quantify early
- Use examples







Next Time-box

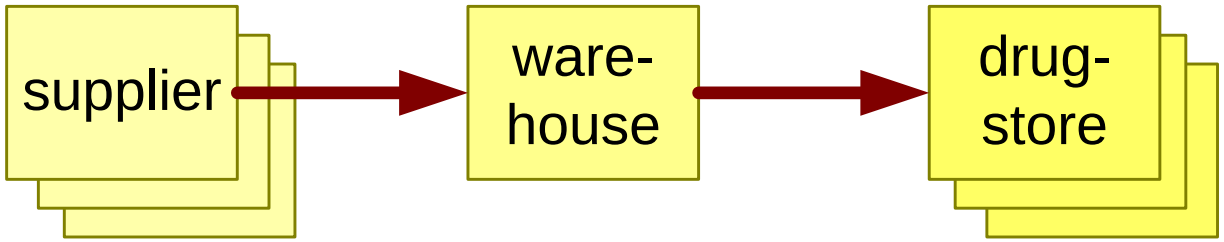
What Gripper and Robot Concepts are appropriate?

What are the desired properties?

What kind of items must be handled, and how?

→ Use examples to explore

Example 1: Large Volume Drugstore

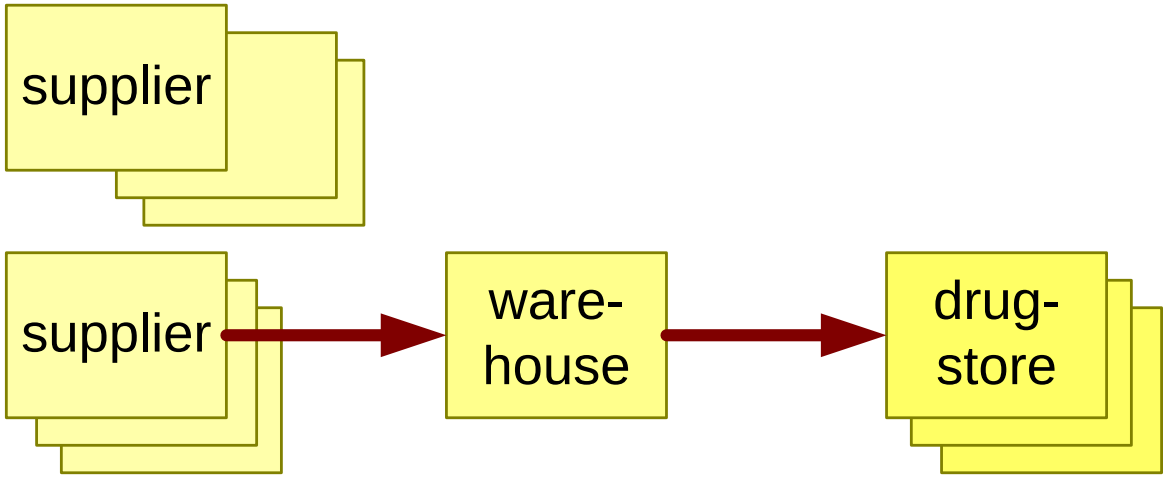


Large quantities
box-like packages
w, l, h: 0.1..0.5m
weight: 1..40 Kg

simple gripper
1 DOF

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

Example 2: High Dynamics



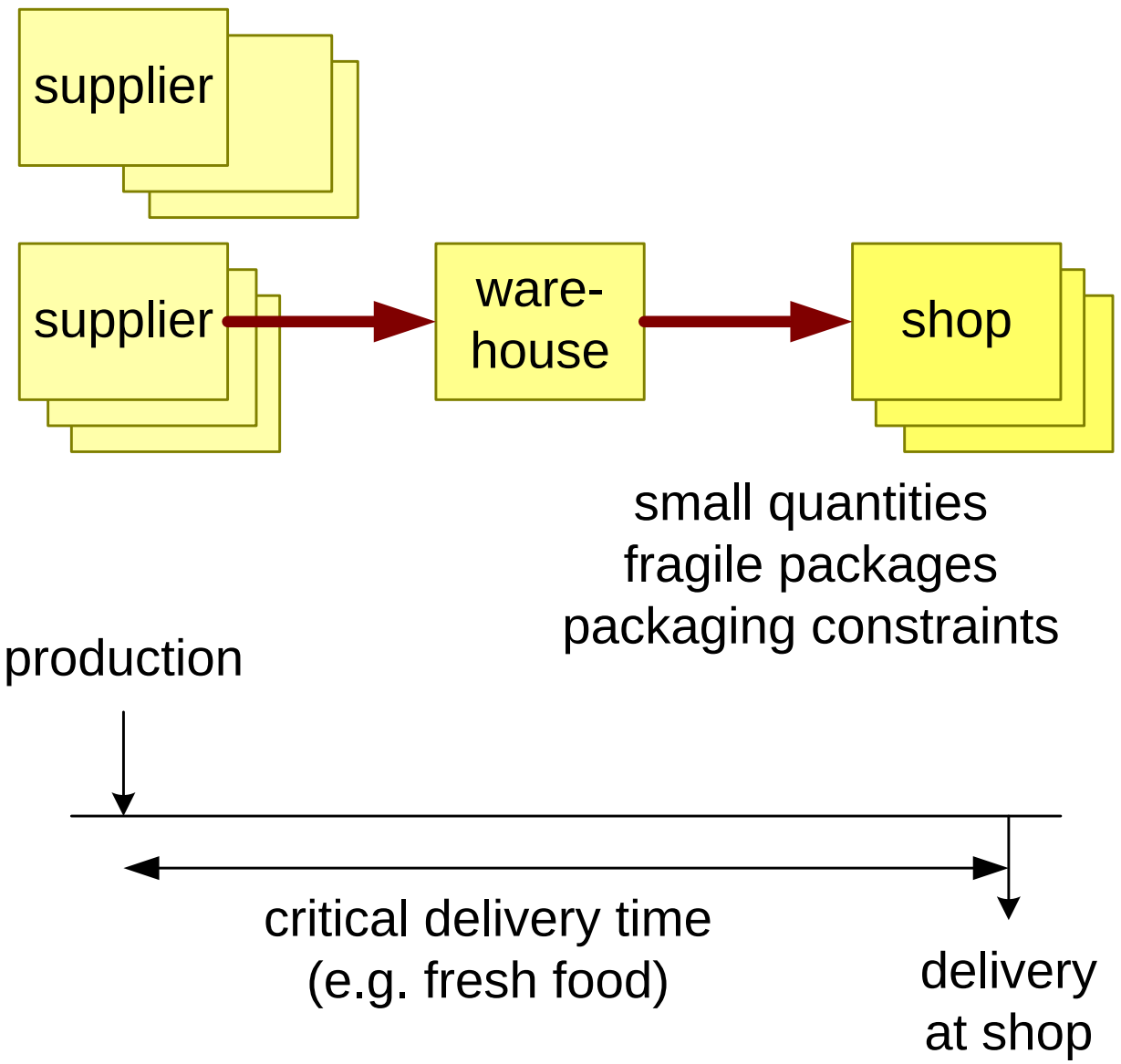
highly dynamic
product mix
and suppliers

large quantities
various packages
w, l, h: 0.1 .. 2.0m
weight: 0.1 .. 50 Kg

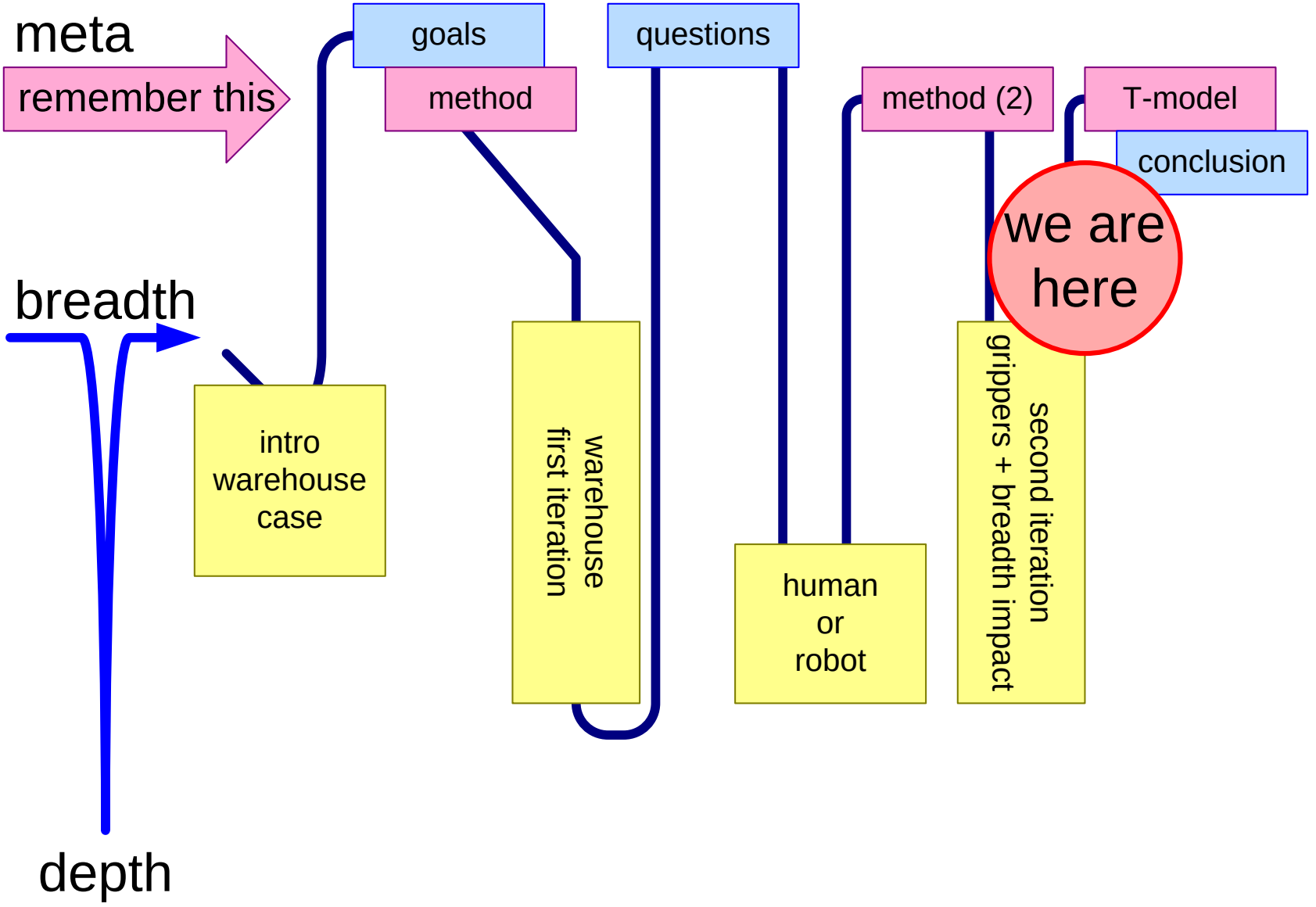
multiple grippers needed?

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

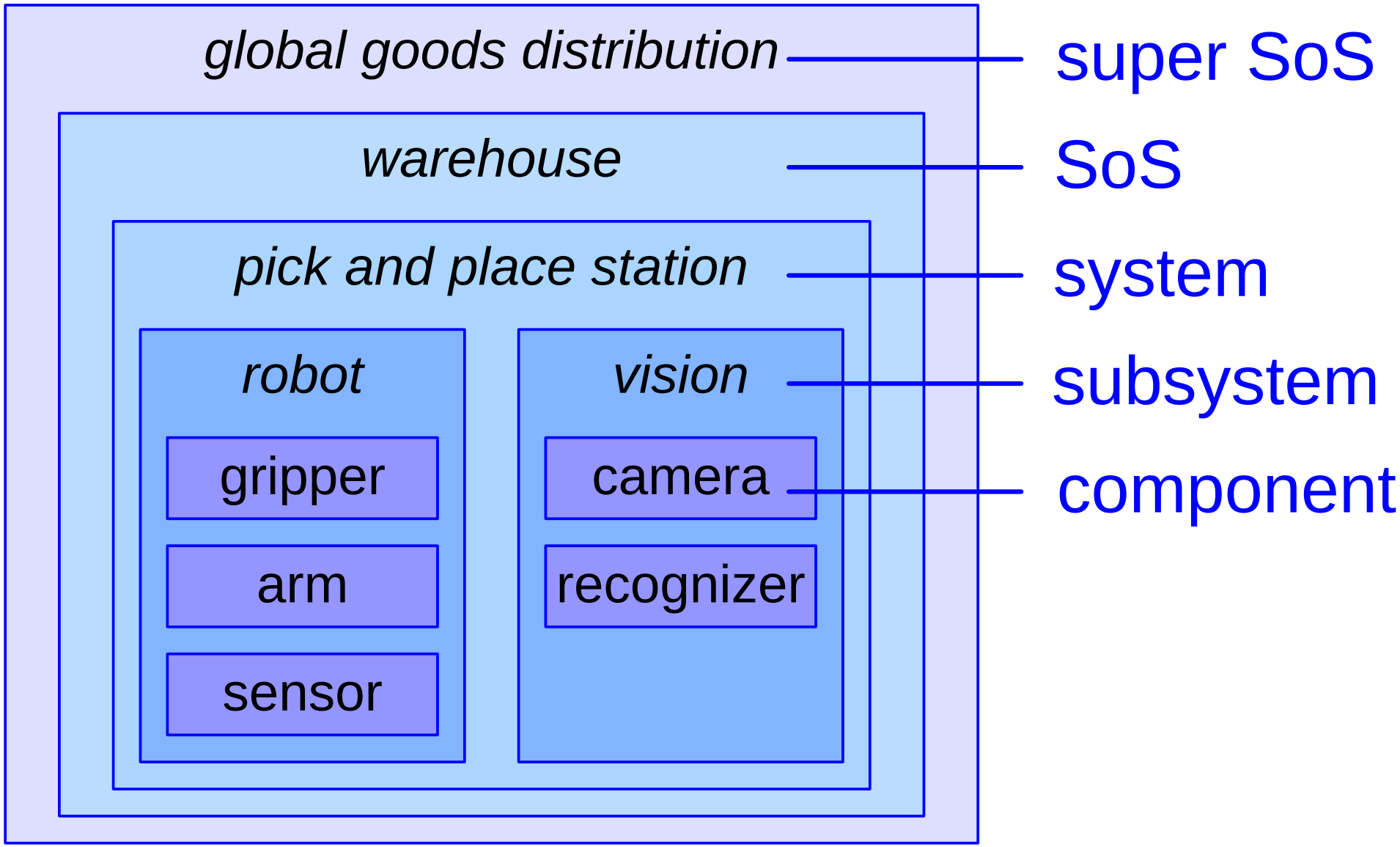
And more variants...



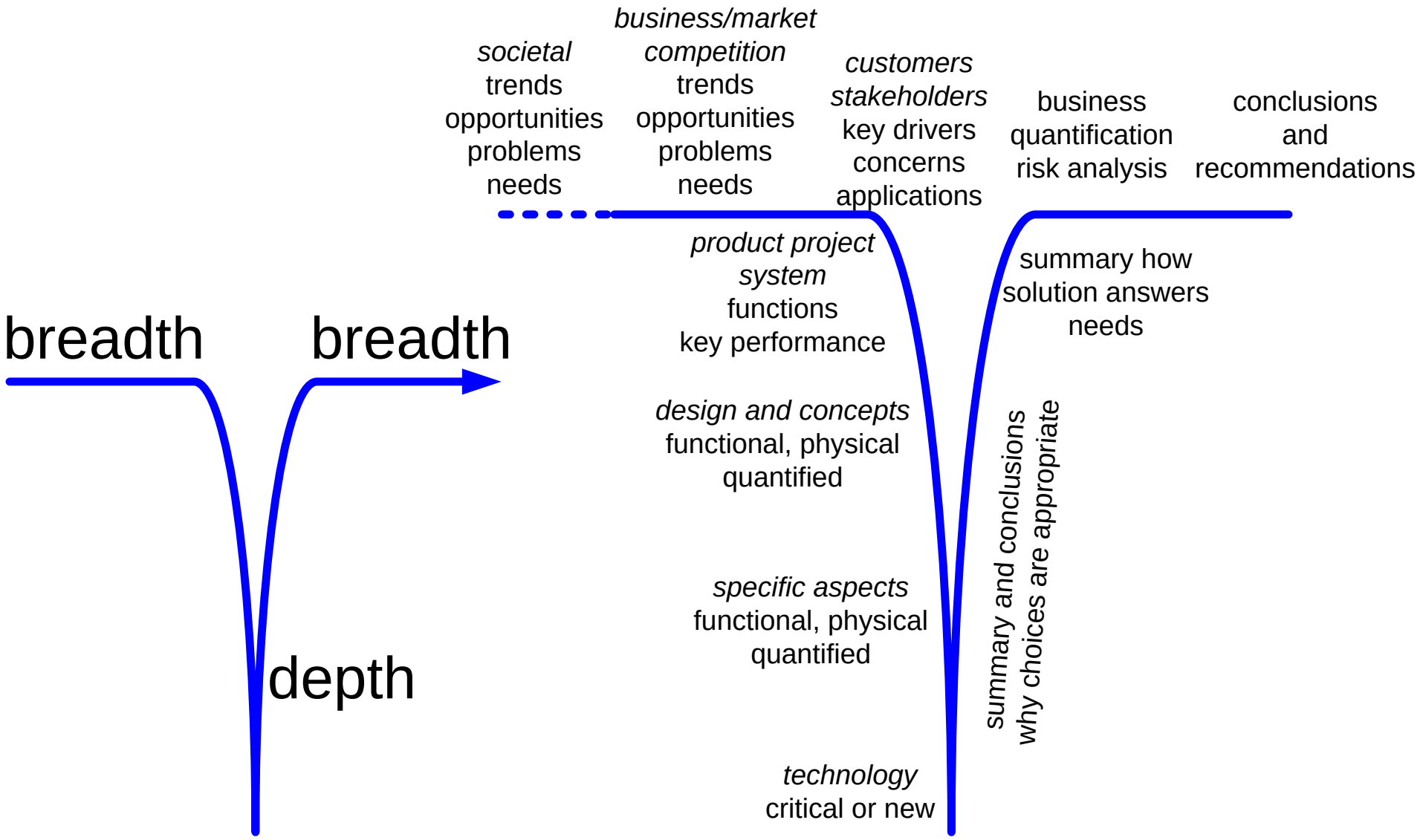
Bringing Order into Chaos



Recap: Levels and Partitioning



Recommended Flow for Management Presentation



Conclusions

To see the relevance of details (depth) sufficient understanding of the context (breadth) is required.

For a sensible understanding of breadth, the right details must have been touched

recommendations

- Time-box
- Iterate
- Multi-view
- Multiple levels
- Visualize
- Quantify early
- Use examples

My Questions:

Who wants to share an example of

a devilish detail (depth)

and/or

a lack of understanding of the context (breadth)?