MTConnect Overview

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Chair of ASME Use Case and Model Base Standards Development WG

Chair of IOF MTConnect WG

ADOPTION

100,000+
GLOBAL INSTALLS
AS OF 2020

275+
MTCONNECT
INSTITUTE
MEMBERS

75,000+
DEVELOPMENT
MAN HOURS

CONTENT

200+
DATA
DEFINITIONS

300+ TYPES, SUBTYPES, & OTHER CONTEXTUAL QUALIFIERS

TOOLS & SUPPORTING SOFTWARE

30+ GITHUB
REPOSITORIES

AGILE

OPC UA OFFICIAL COMP SPEC

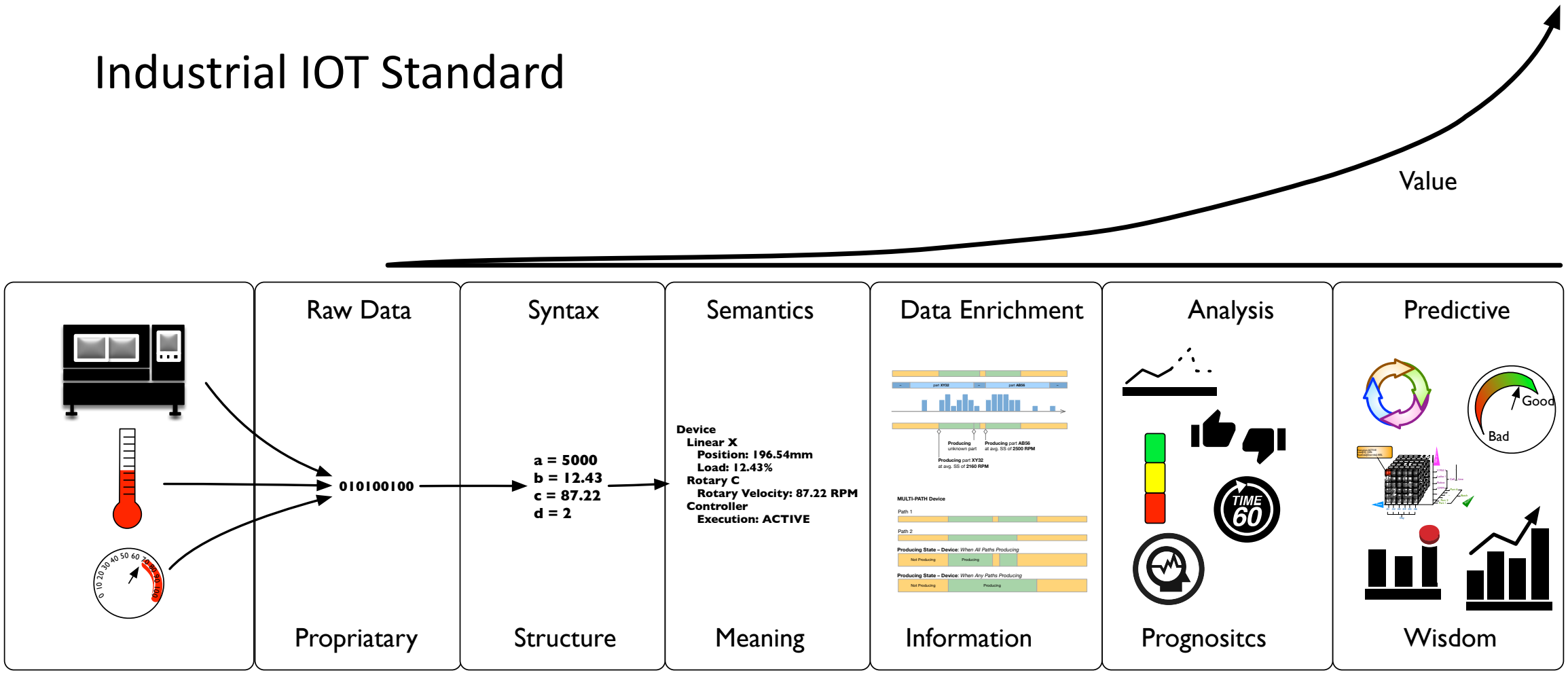
MODEL-BASED

ONTOLOGY ALIGNMENT

What is MTConnect?
Manufacturing Technology Connectivity

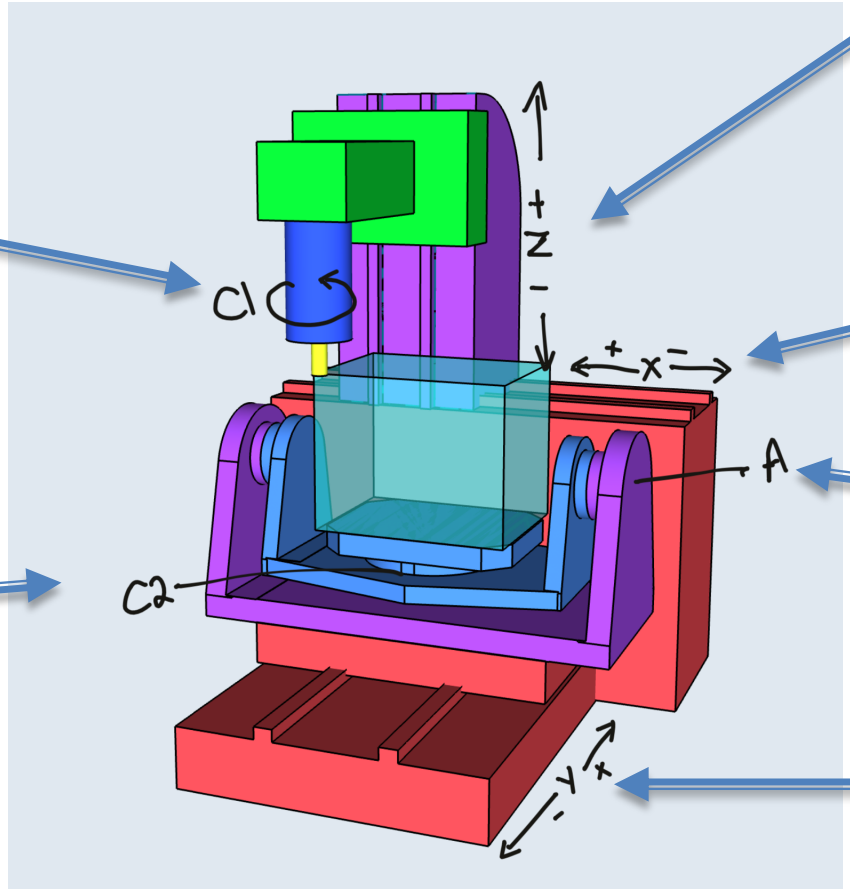
Industrial Data Value Addition

Industrial IOT Standard



Vocabulary & Semantics

Axes



Linear Z
Position (mm)

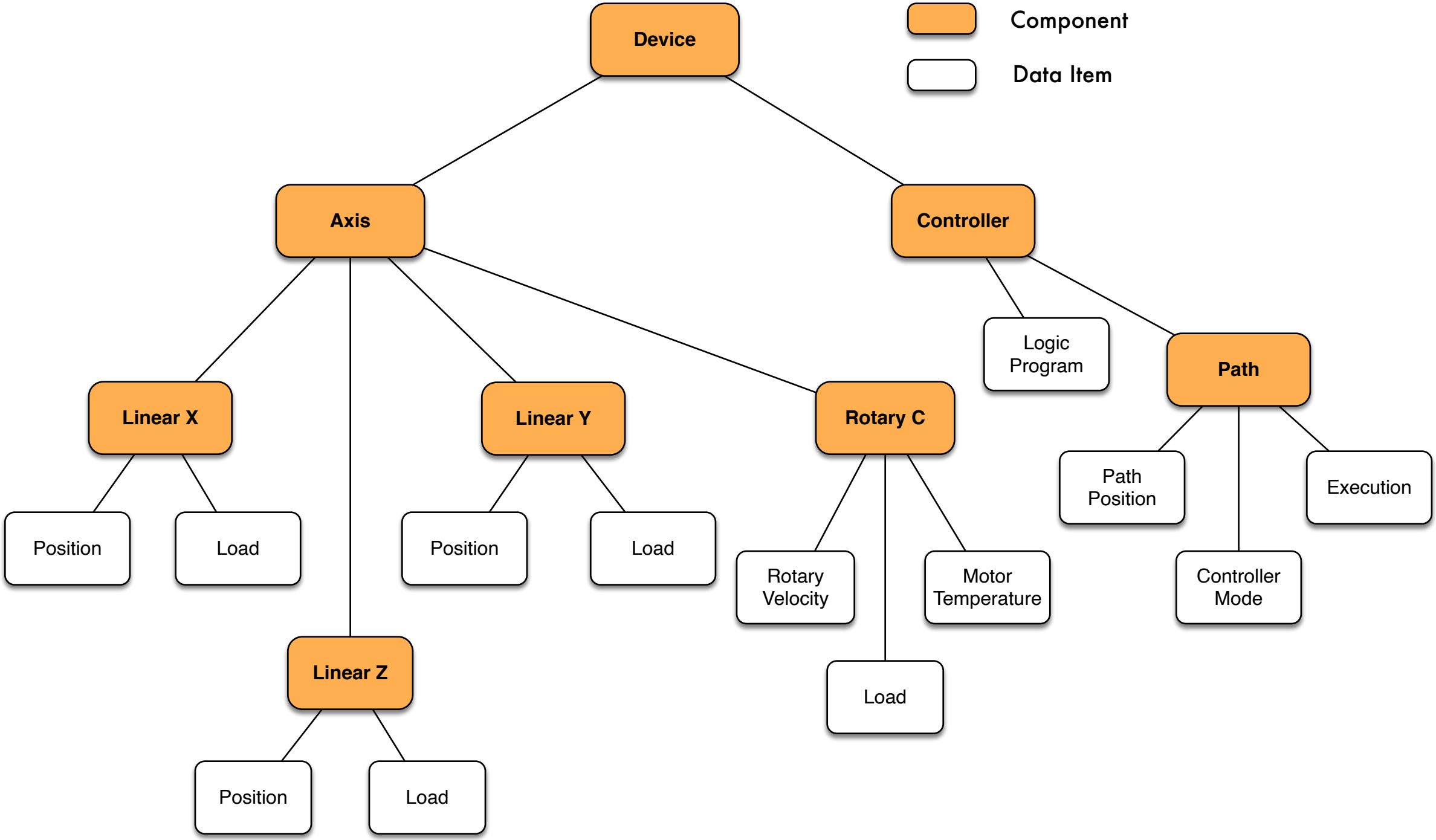
Rotary C1
Angle (Deg)
Rotary Velocity (rpm)

Linear X
Position (mm)

Rotary A
Angle (Deg)

Rotary C2
Angle (Deg)
Rotary Velocity (rpm)

Linear Y
Position (mm)


Component
Data Item
Device
Axis
Controller
Linear X
Linear Y
Rotary C
Logic Program
Path
Position
Load
Position
Load
Rotary Velocity
Motor Temperature
Load
Path Position
Execution
Controller Mode
Linear Z
Position
Load

MTConnect Concerns

- Components represent Logical Parts of a machine
  - The device is decomposed into telemetry, control, system, etc…
- Data items represent observable data
  - Machine Stasis
  - Events and messages
  - Sampled data that can be interpolated between observations
  - Conditions represent something related to the health and function
    - Normal – working within operational parameters
    - Warning – trending towards failure
    - Fault – failure requiring external intervention
- Configuration, Specifications, Coordinate Systems, and Interfaces
- Assets and Cutting tools

Live MTConnect Agents

https://smstestbed.nist.gov/vds/

http://mtconnect.mazakcorp.com:5612/

http://mtconnect.mazakcorp.com

https://www.mtconnect.org

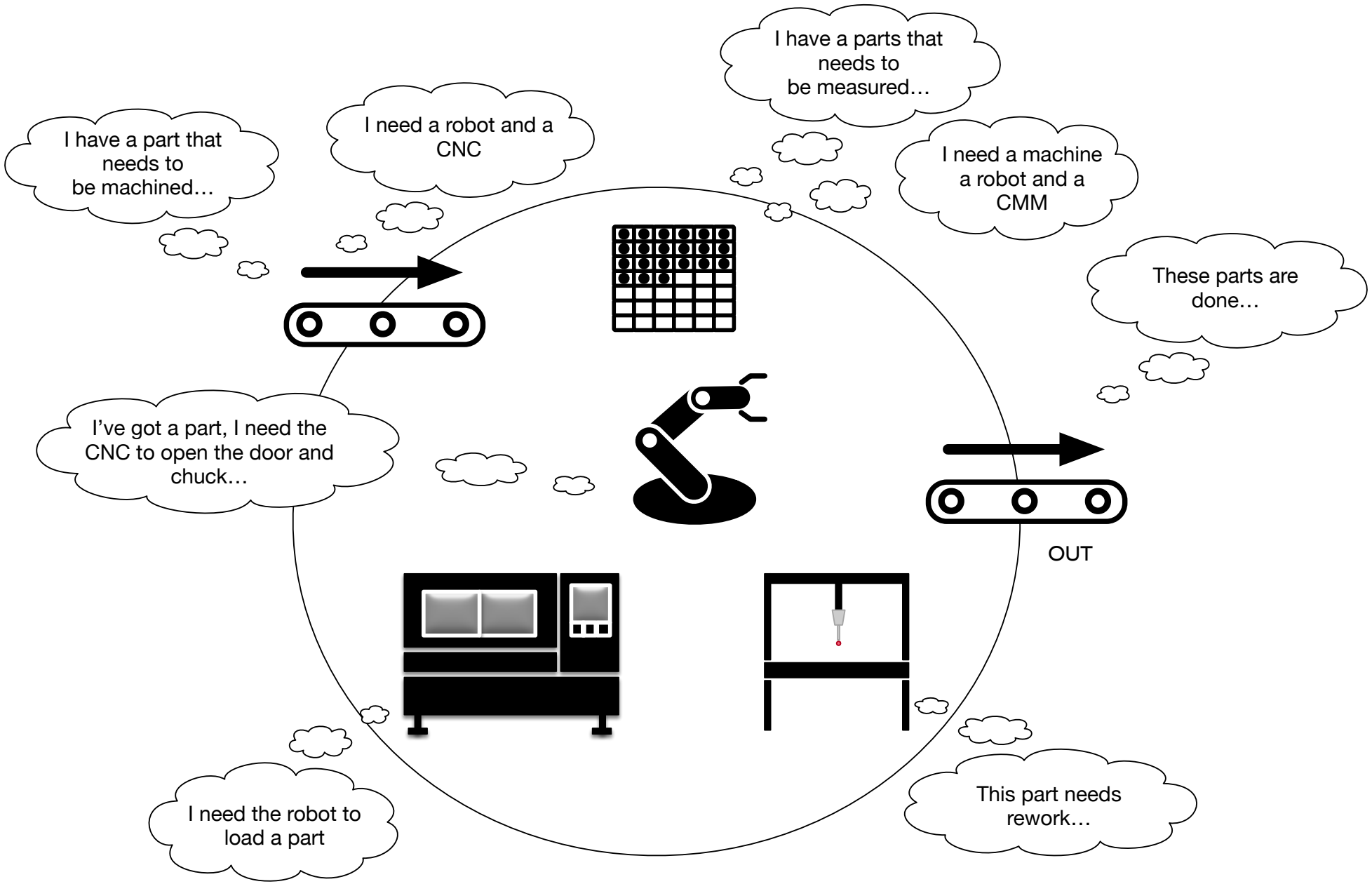
Focus

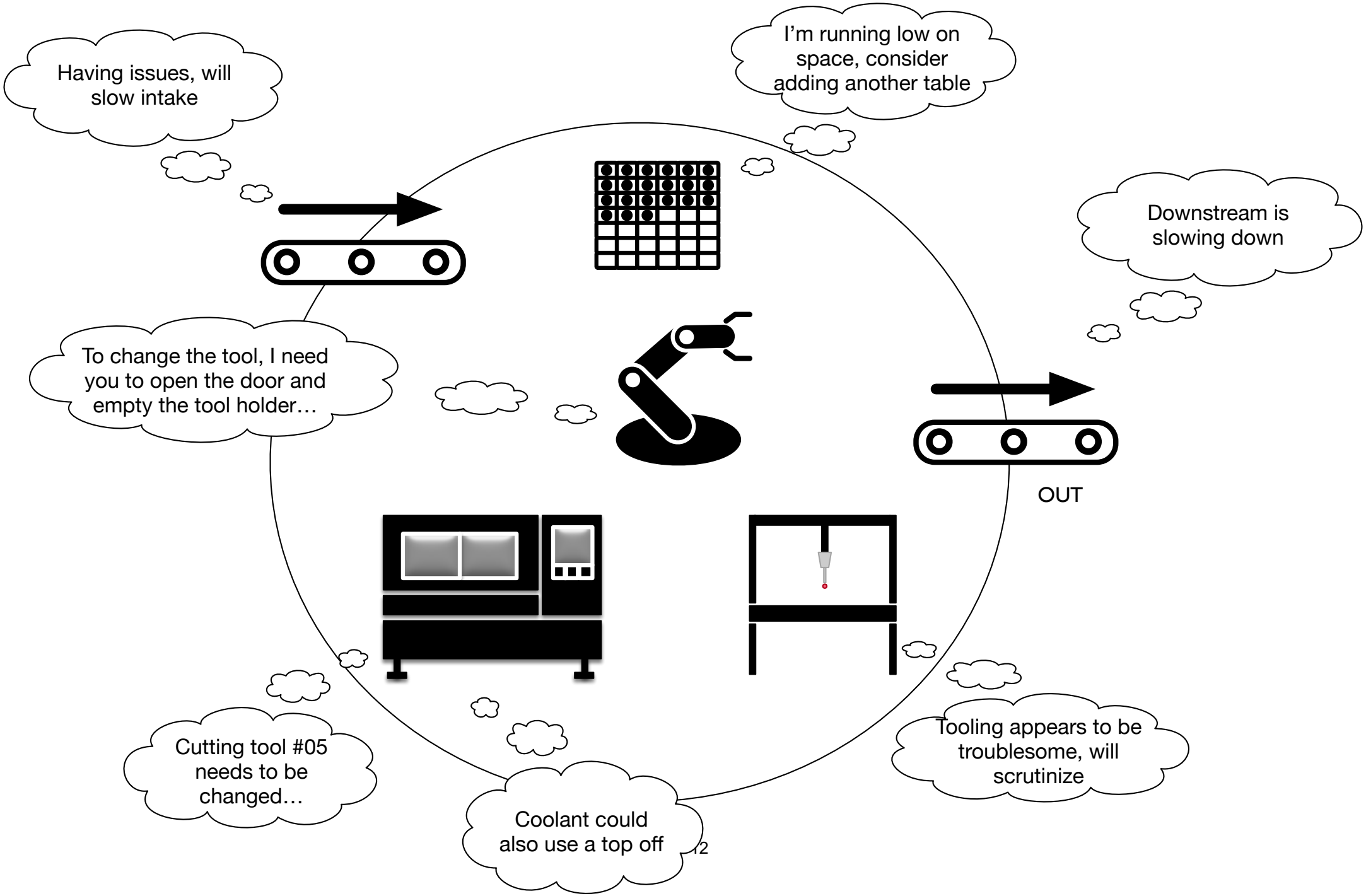
- We care about
  - Standardized semantics and metadata – SysML Abstract Model

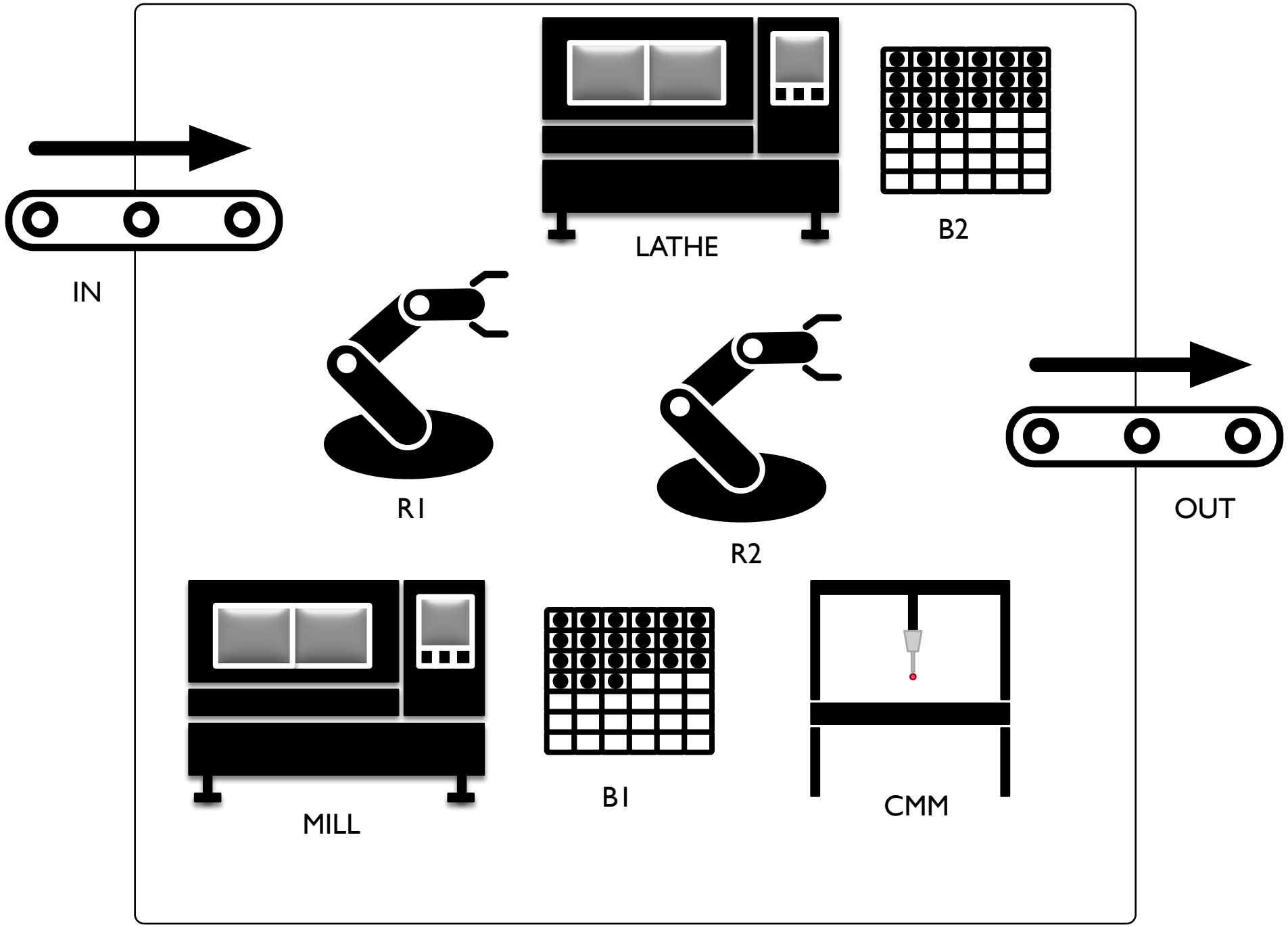
- We **don't** care about
  - Protocol
    - Support normative industry standards
      - **HTTP REST**, **OPC UA**, MQTT, AMQP, DDS, …
  - Representation
    - **XML**, **JSON**, **OPC UA**, IDL, RDF, …

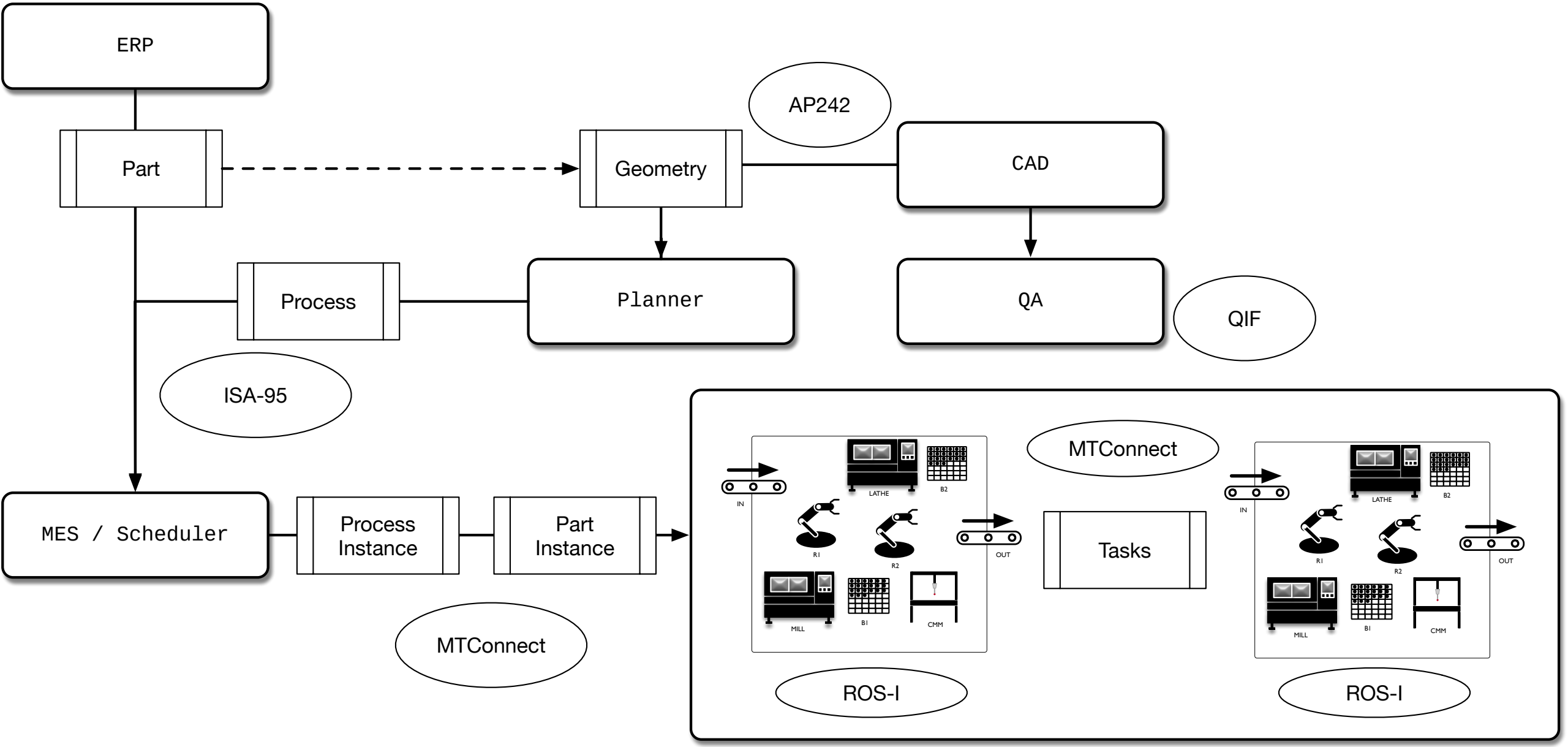
Device Interaction Use Case

Choreography – Decentralized Task Collaboration



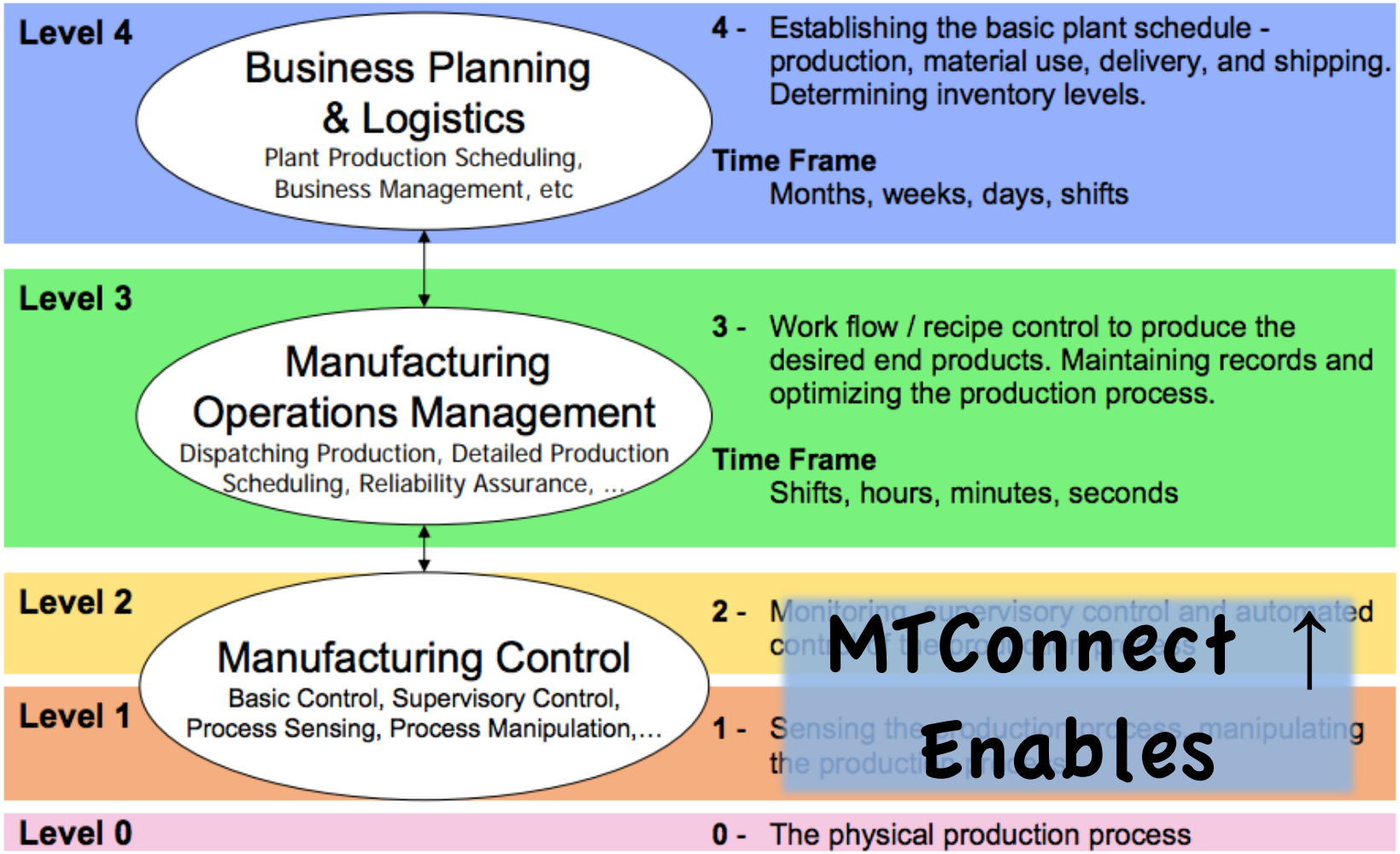

Having issues, will slow intake
I'm running low on space, consider adding another table
Downstream is slowing down
To change the tool, I need you to open the door and empty the tool holder…
OUT
Cutting tool #05 needs to be changed…
Coolant could also use a top off
Tooling appears to be troublesome, will scrutinize


IN
LATHE
B2
R1
R2
OUT
MILL
B1
CMM


ERP
Part
AP242
Geometry
CAD
Process
Planner
QA
QIF
ISA-95
MES / Scheduler
Process Instance
Part Instance
MTConnect
IN
LATHE
B2
R1
R2
OUT
MILL
B1
CMM
ROS-I
MTConnect
Tasks
IN
LATHE
B2
R1
R2
OUT
MILL
B1
CMM
ROS-I

Model to Model

- Liaisons and Alignment
  - QIF
  - MIMOSA
  - OAGi
  - ROS/I
  - TC 184/SC4
  - IOF
  - B2MML
  - ISA-95
  - IPC-CFX



No *Model* To Rule Them All

What's Next?

Digital Twins
Harmonization
Closing the Loop
MBE Integration

MTConnect Ontological Conundrums

- Observations and Time Series Data
  - Does it make sense to make all observations individuals, even for telemetry?
  - Should MTConnect be concerned with aggregate stasis, events, & conditions?
  - What is the best way to manage time-series data?
- Machines are temporal
  - Tooling adds and removes realizable functions from the machine
  - A Machine's realizable function depend on maintenance and accessories
- Mapping Logical Components to Physical Model
  - Can we still abstract the model and represent components as logical abstractions?
  - Example: A linear X axis represents motion perpendicular to the C axis of the machine control point (tool in a CNC) and the workpiece.
    - It is made up of motors, encoders, and machine structure (like the table)