Systems Engineering and Modeling at Start-Up Company

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Abstract

We have been assisting in applying Systems Engineering techniques and methods in a small (tens of persons) start-up company in the semiconductor process and equipment market. We report our observations in this start-up company with an innovative product operating in a dynamic environment. Start-up companies in general explore new applications or new technologies: an environment full of unknowns, uncertainties and other surprises. In the specific case of semiconductor process and equipment the system is highly multi-disciplinary, amongst others: high precision mechanical, control, optics, chemical, signal processing, and power electronics.

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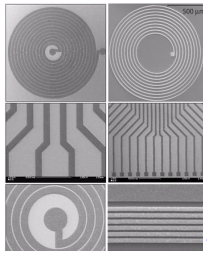

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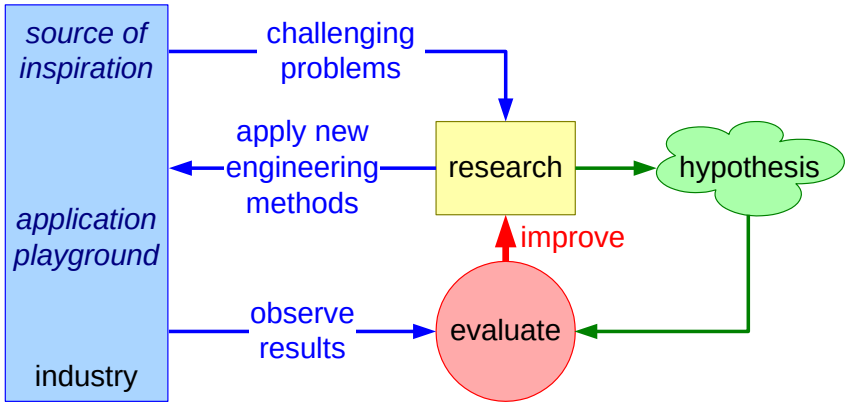
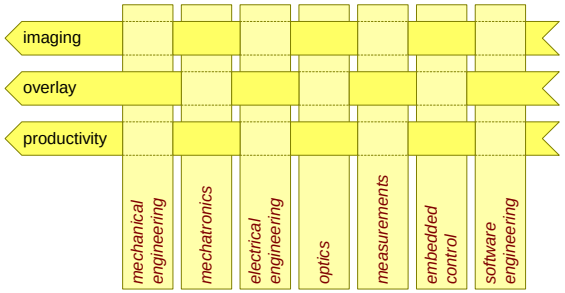
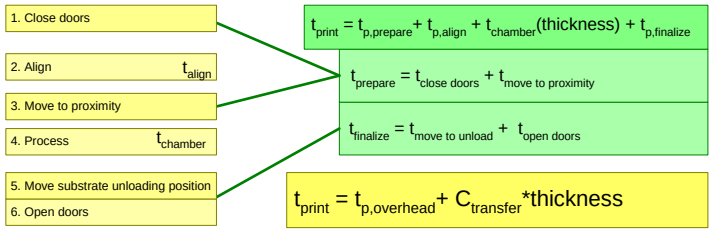
Figure Of Contents™



1. SE research → 2. Start-up at Kista → 3. System Modeling → 4. Evaluation





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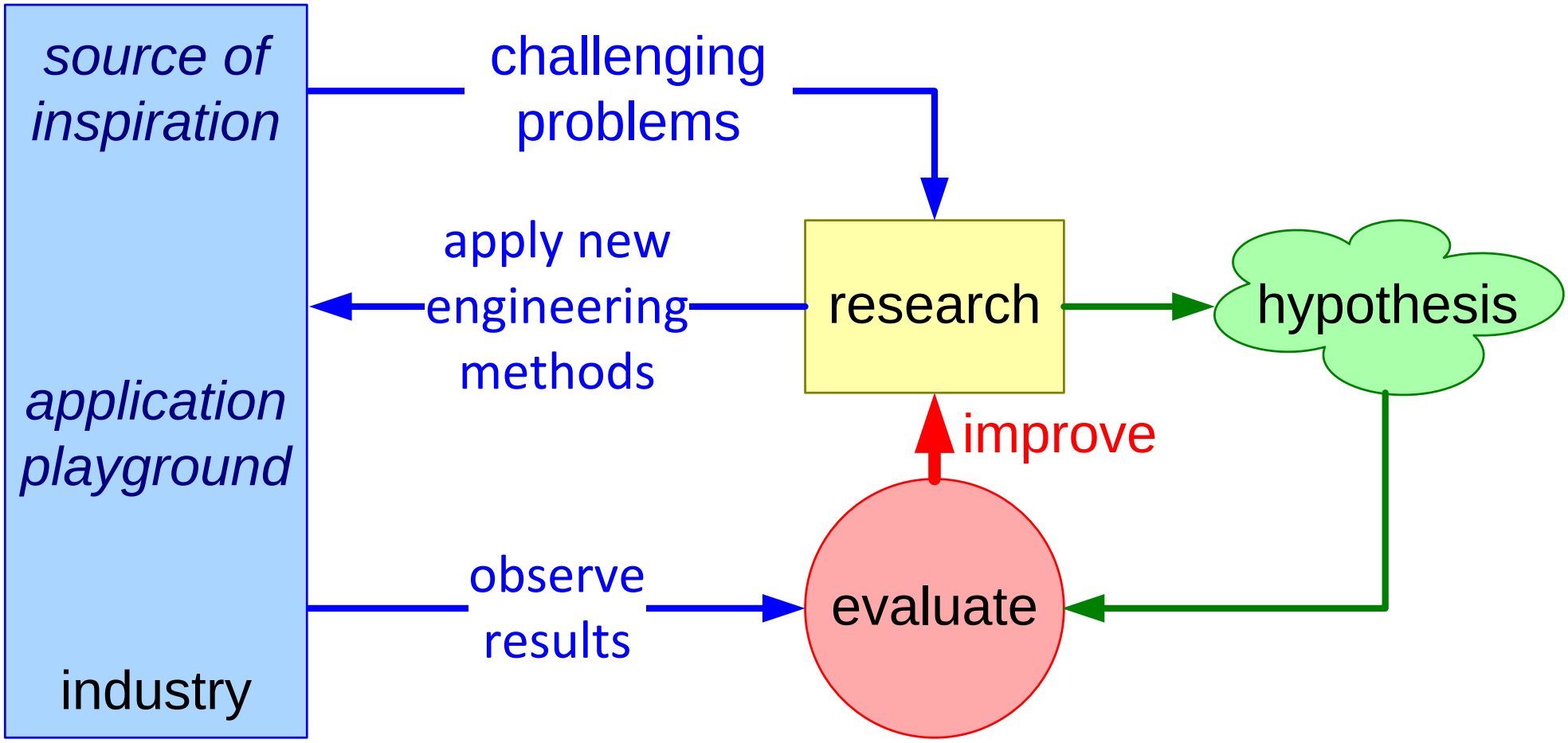
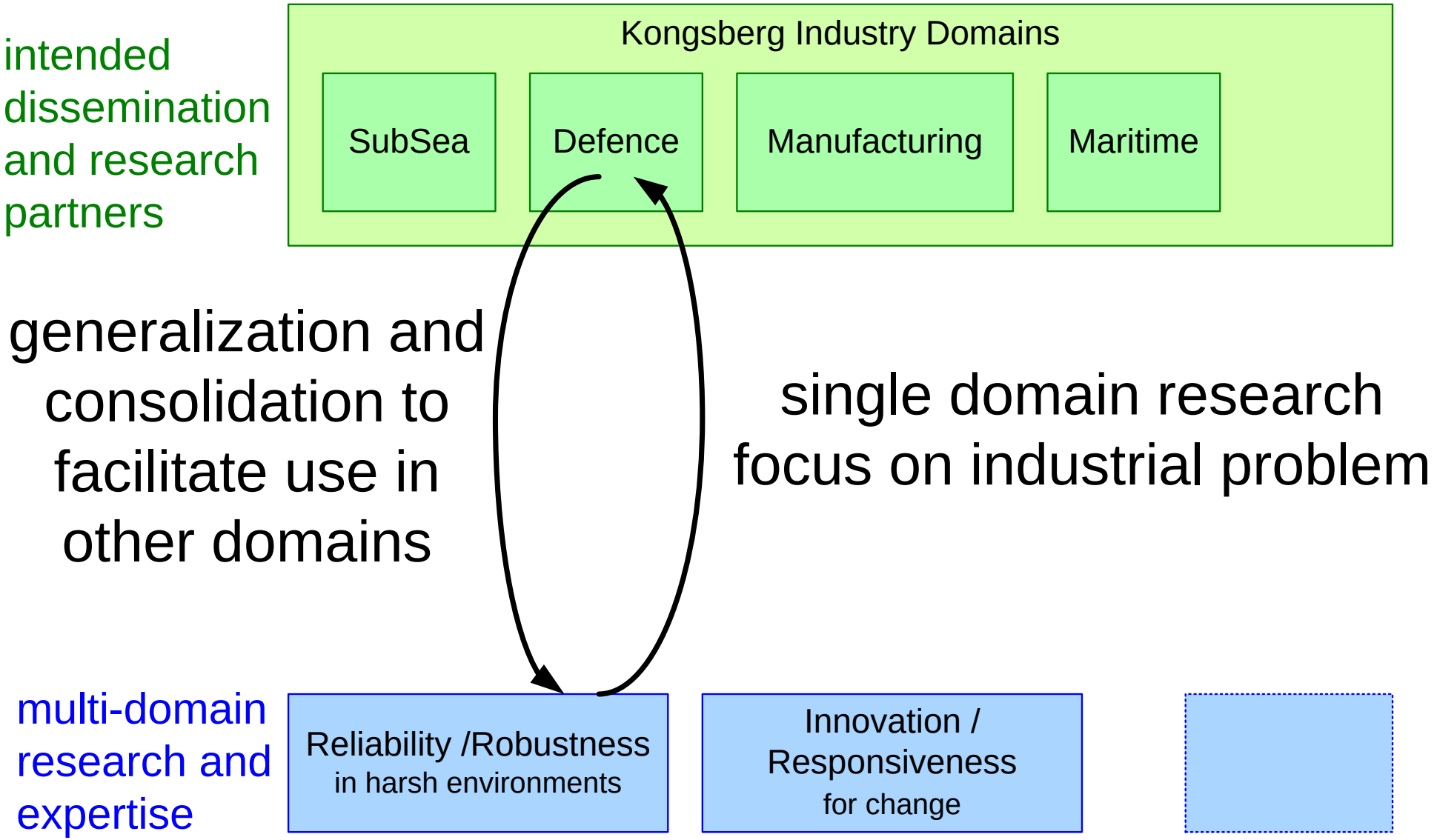
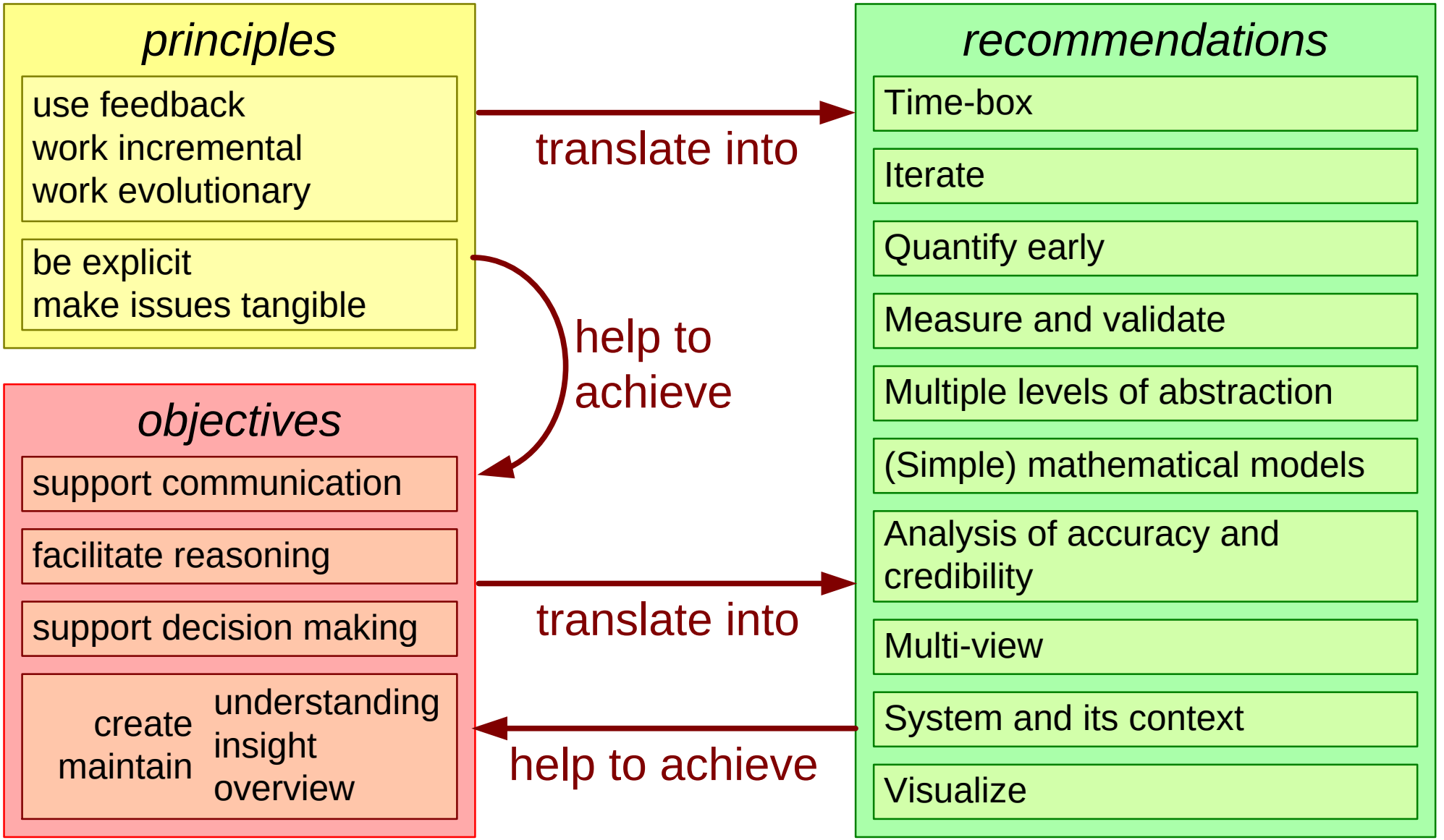
Industry as Laboratory



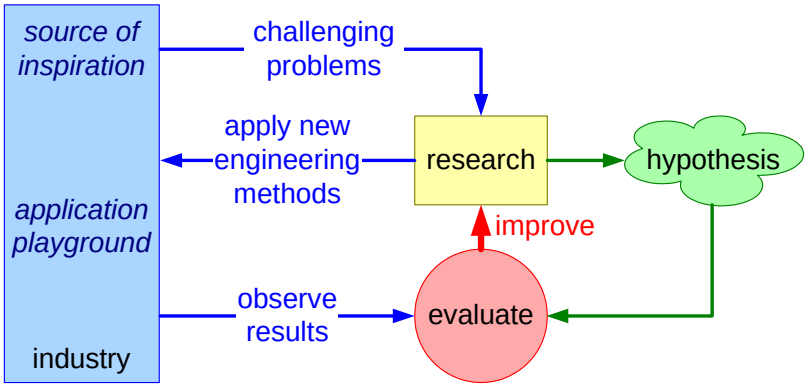
Industry as Laboratory (2)



Modeling Recommendations as Applied



Start-Up Company Replisaurus in Kista (Sweden)



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2. Start-up at Kista

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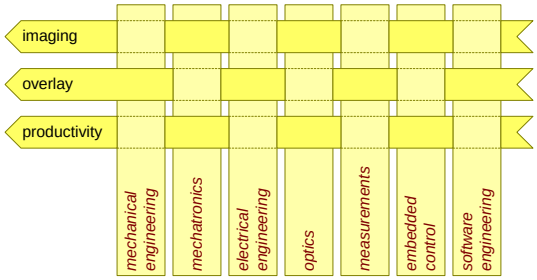

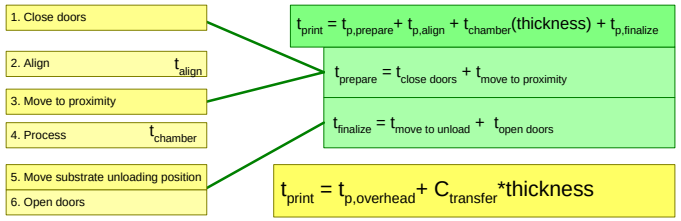

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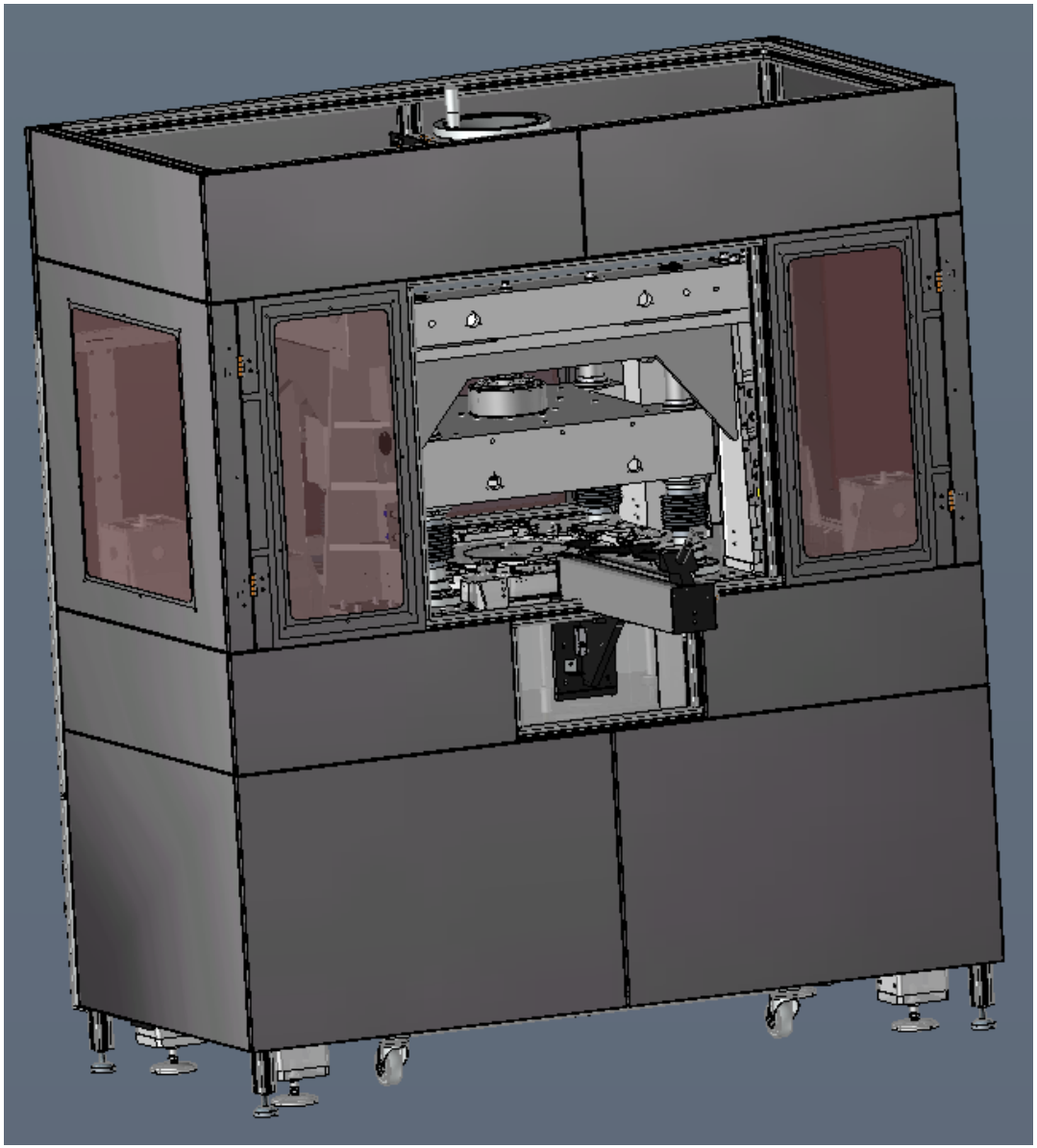
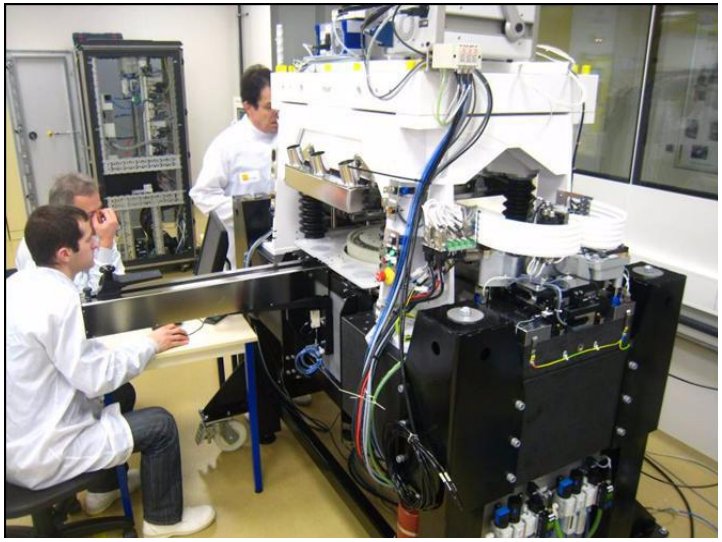
The Copper Printer





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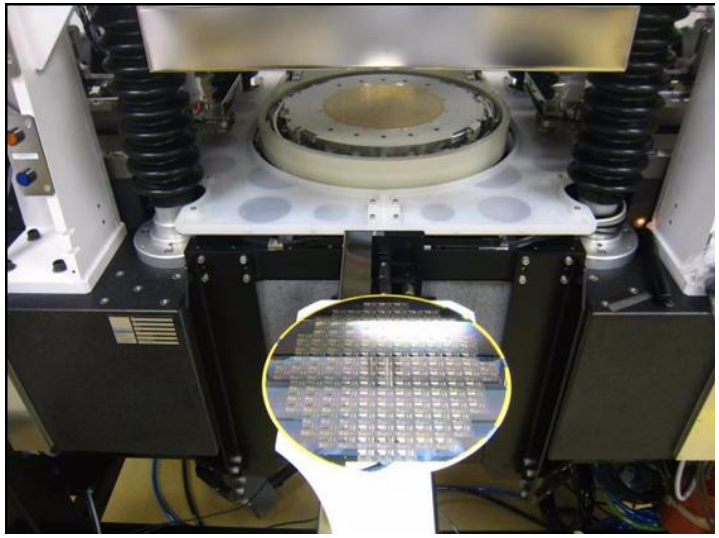
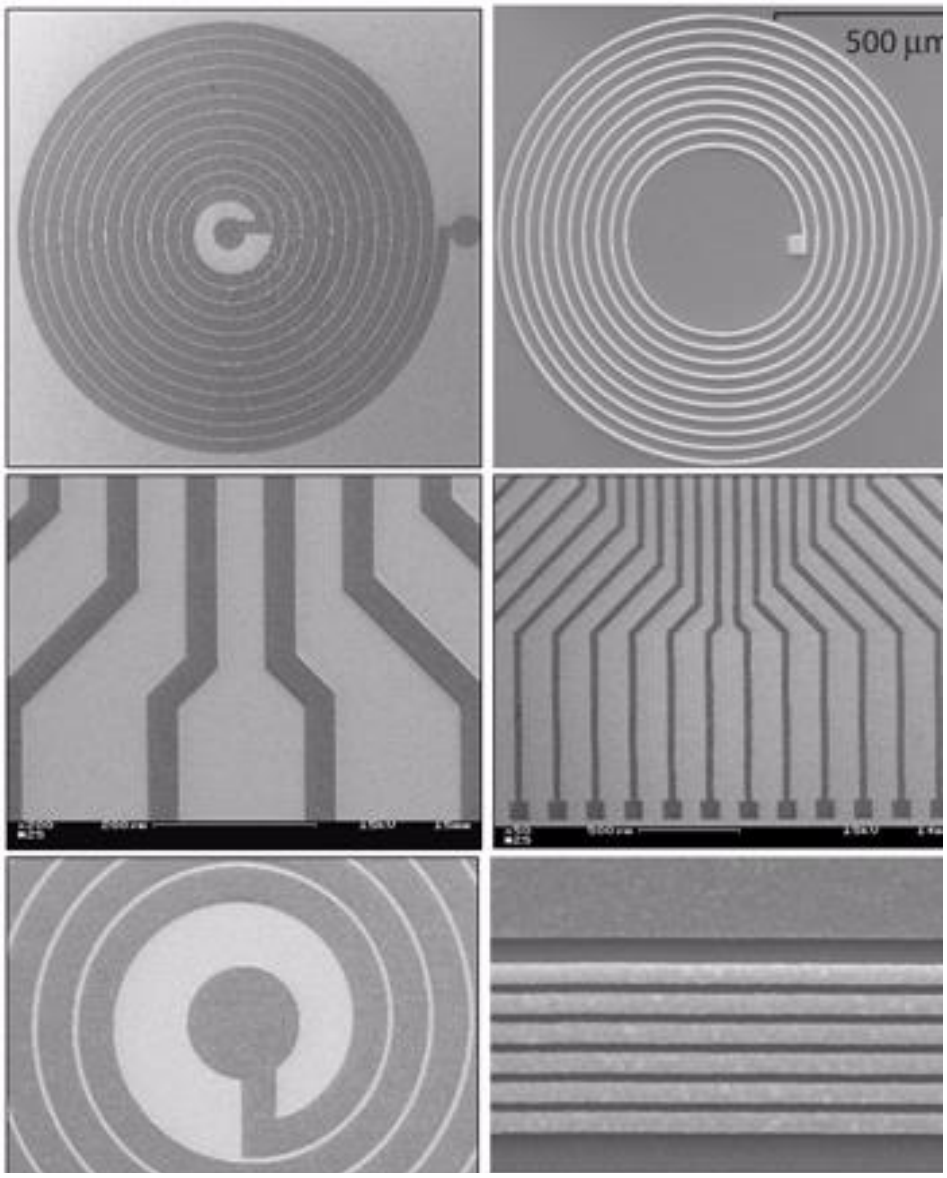


Example of printed copper structures



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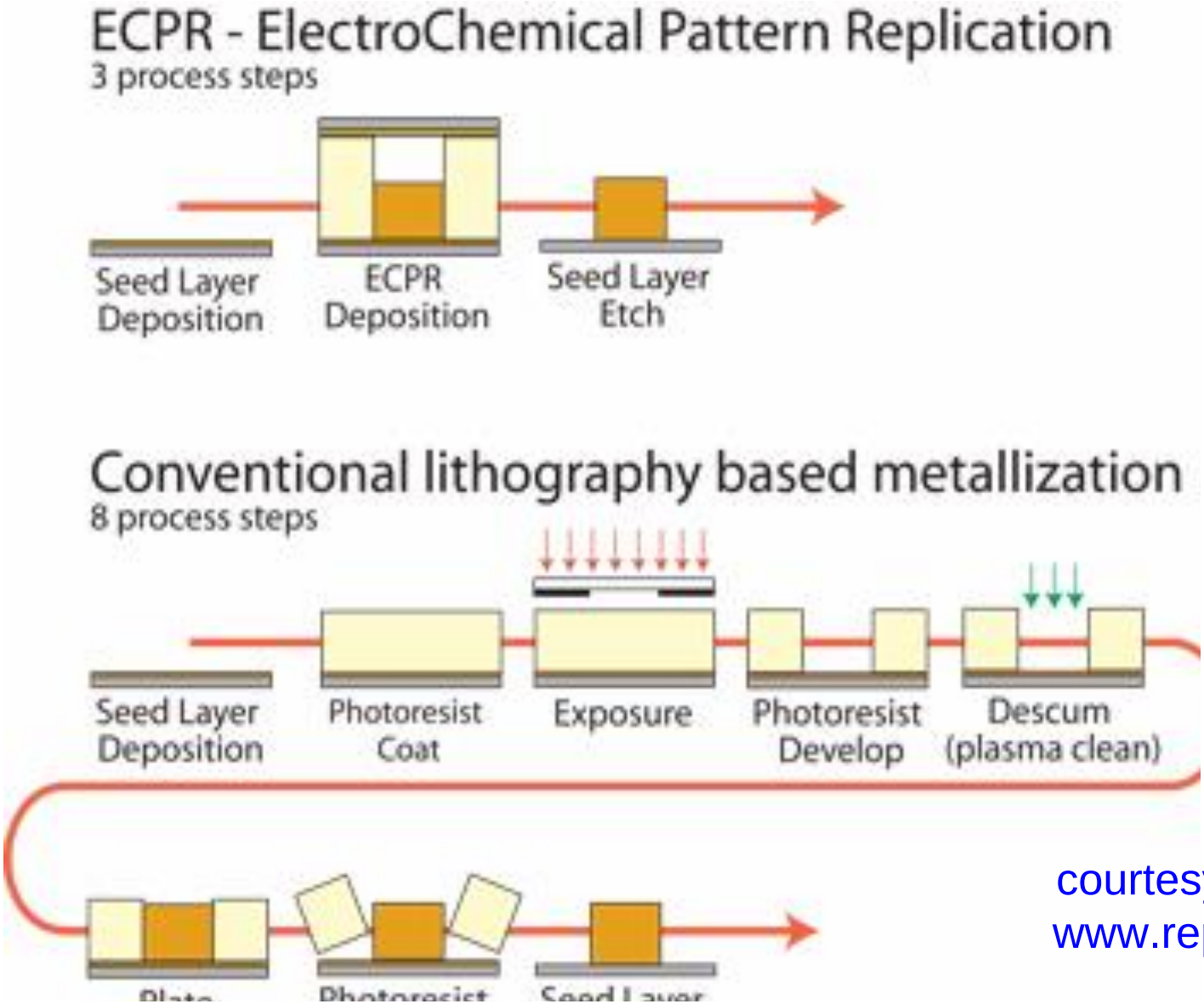
ECPR technology replaces 6 process steps by 1 step



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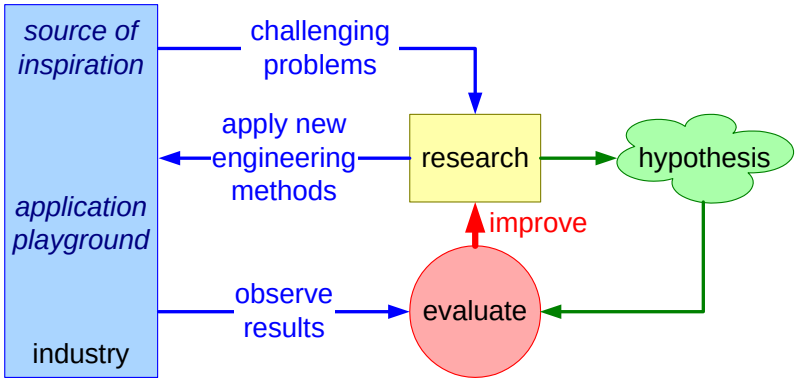
System Modeling



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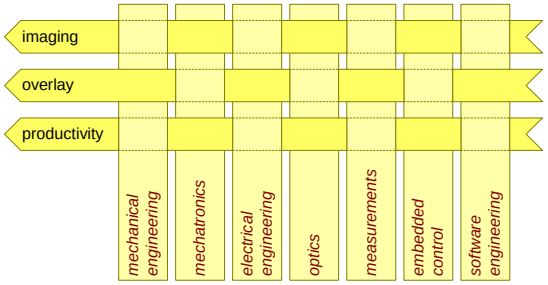
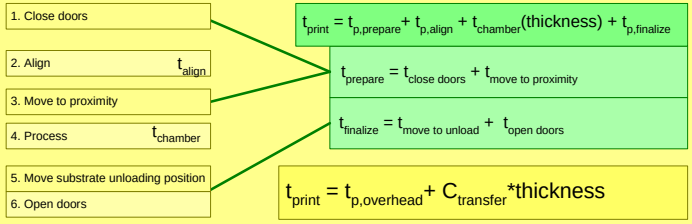
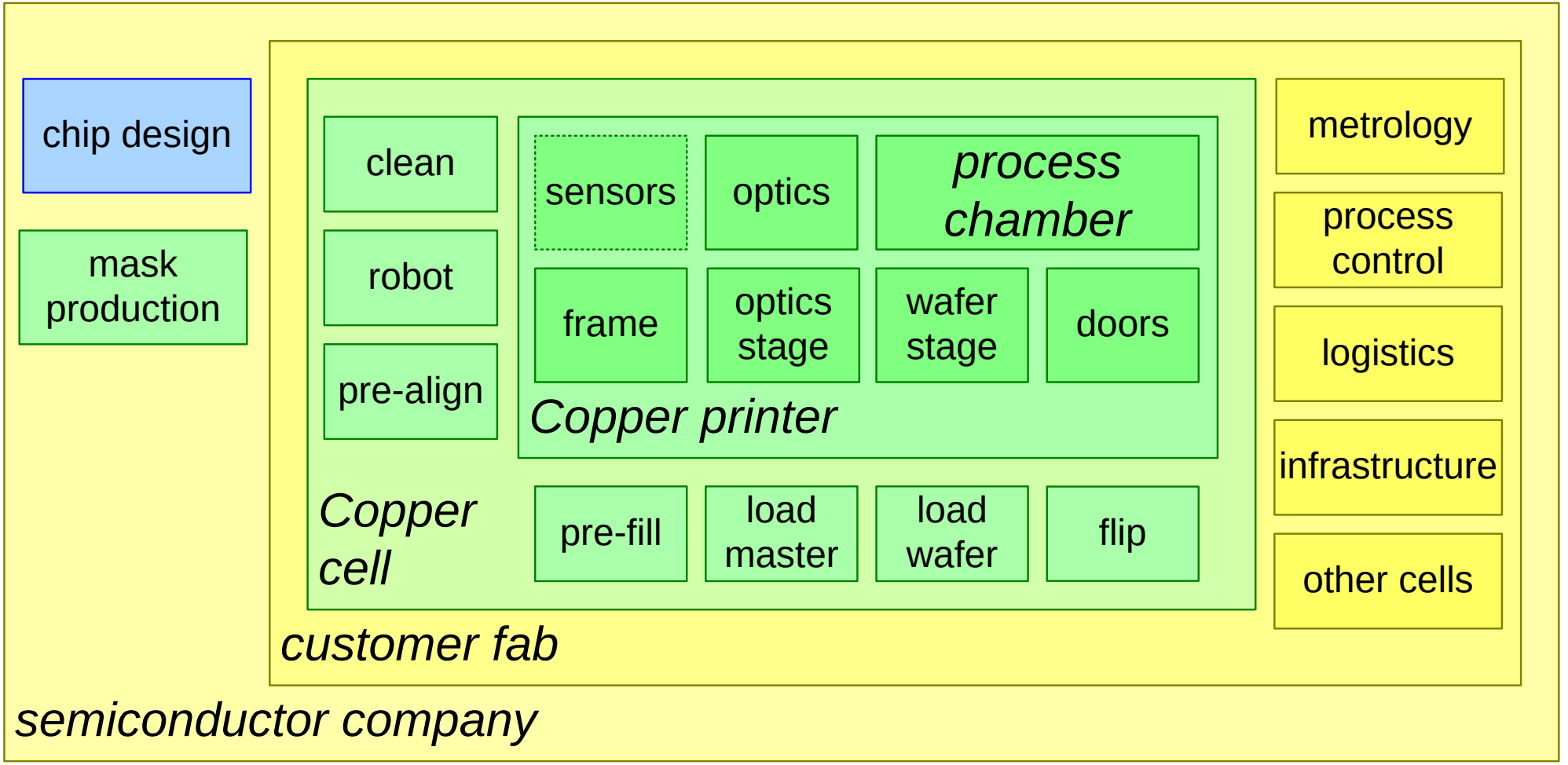
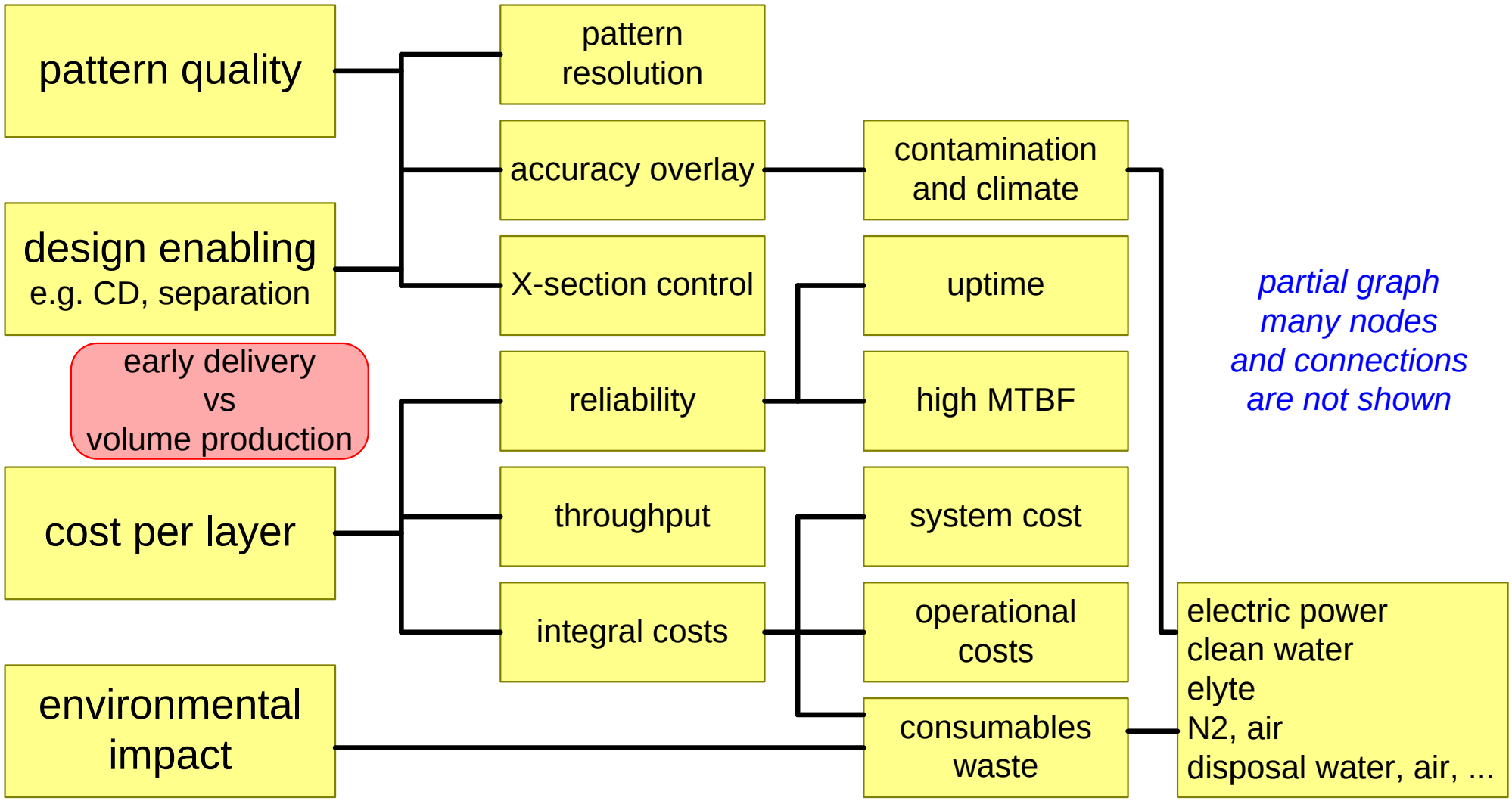




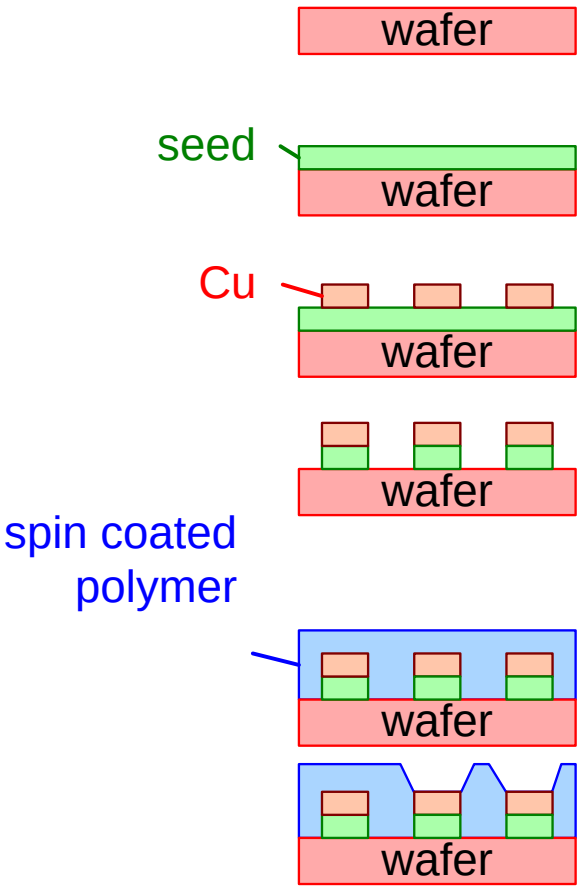
Overview of the different scopes



Customer key driver graph



Process flow at fab level, from inspection until testing



	throughput in minutes	wafer	FOUP	
1.	inspection			
2.	seed sputter	1	25	
3.	Cu print	2	50	target spec
4.	seed etch	1	20	
	dual layer only			
5.	coat/develop dielectrics	3..4	50	75..100??
6.	exposure or CMP for polymer vias	1..2	30	
7.	E-test			

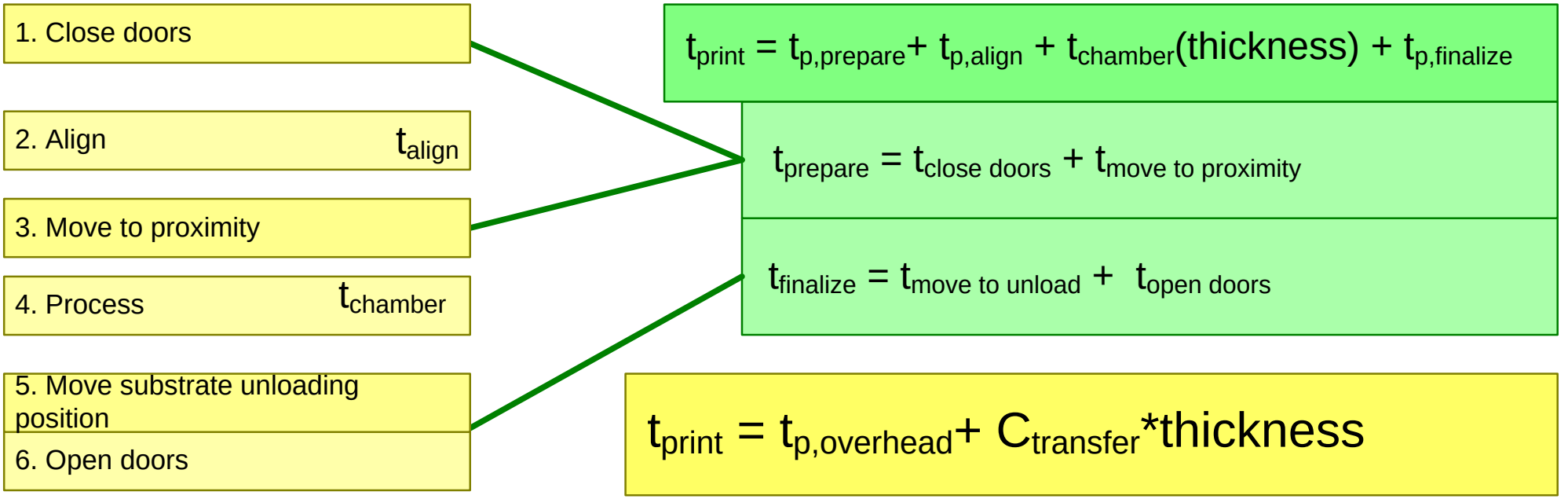
Work flow in the Copper Printer

0. Loading Master&substrate

1. Close doors
2. Align
3. Move to proximity
4. Process incl. rinse&dry
5. Move substrate unloading position
6. Open doors

7. Unloading Master&substrate

Formula of printer throughput time



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Optical path to measure marker position

measurement accuracy
determines
required resolution

camera

#pixels ~= 5M

pixel resolution
versus
maximum Field of View
read-out and processing time

microscope

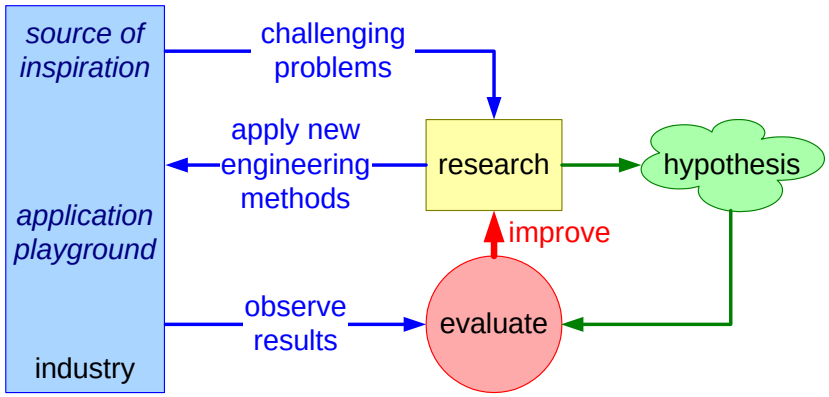
optical resolution
magnification

DoF

wafer

displacement
determines
required Field of View

Evaluation



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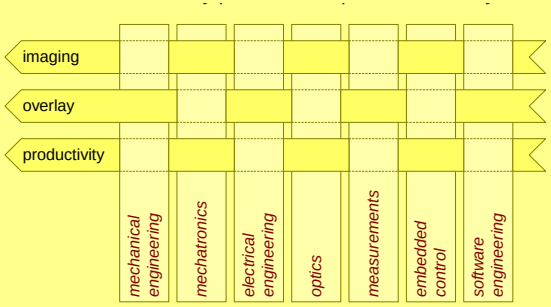

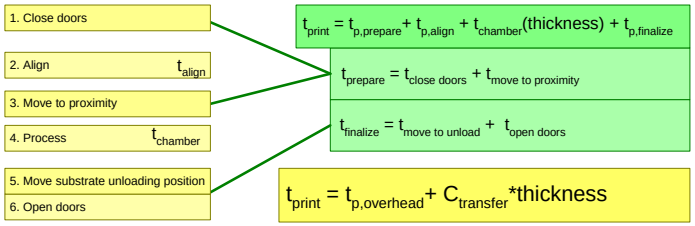

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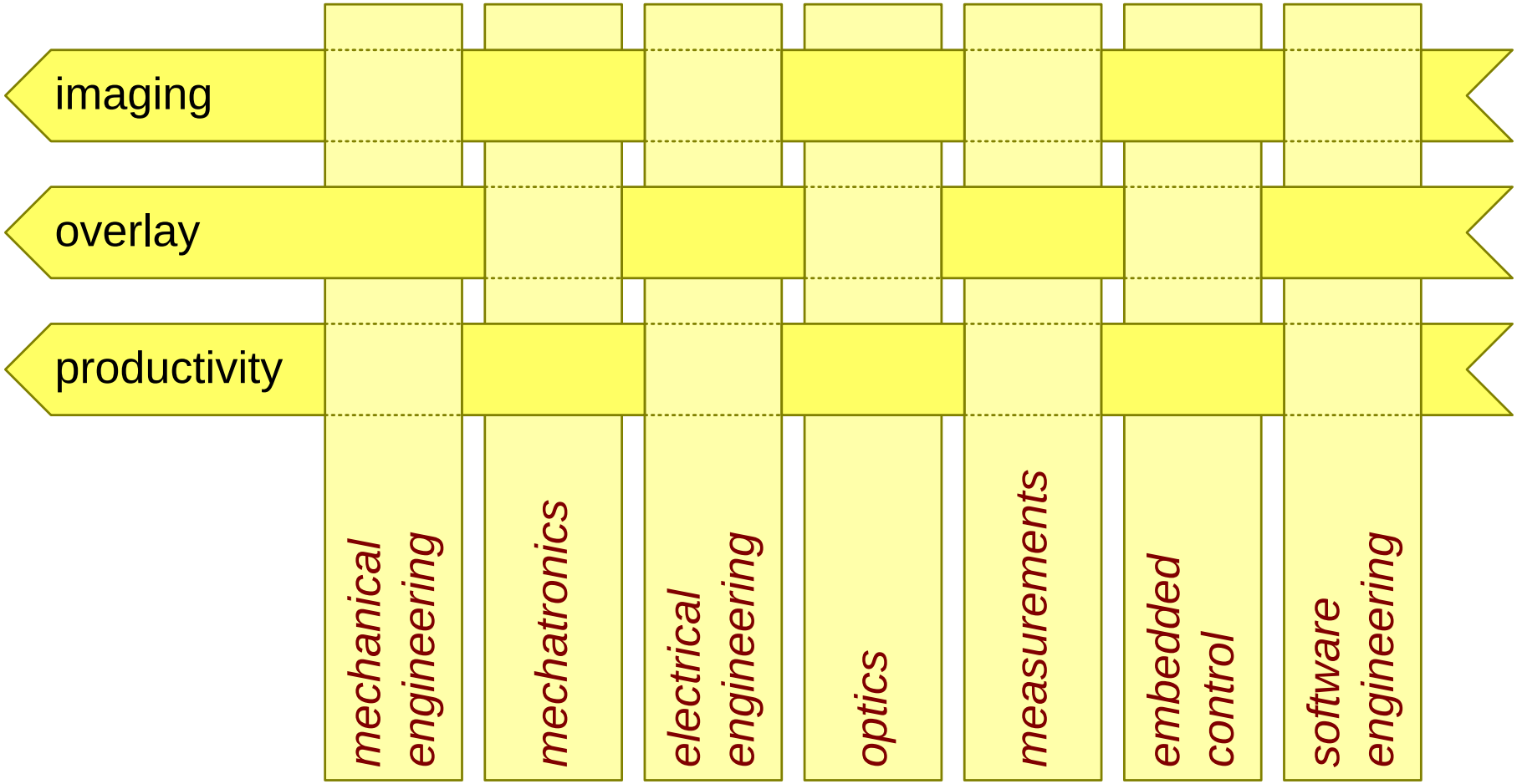
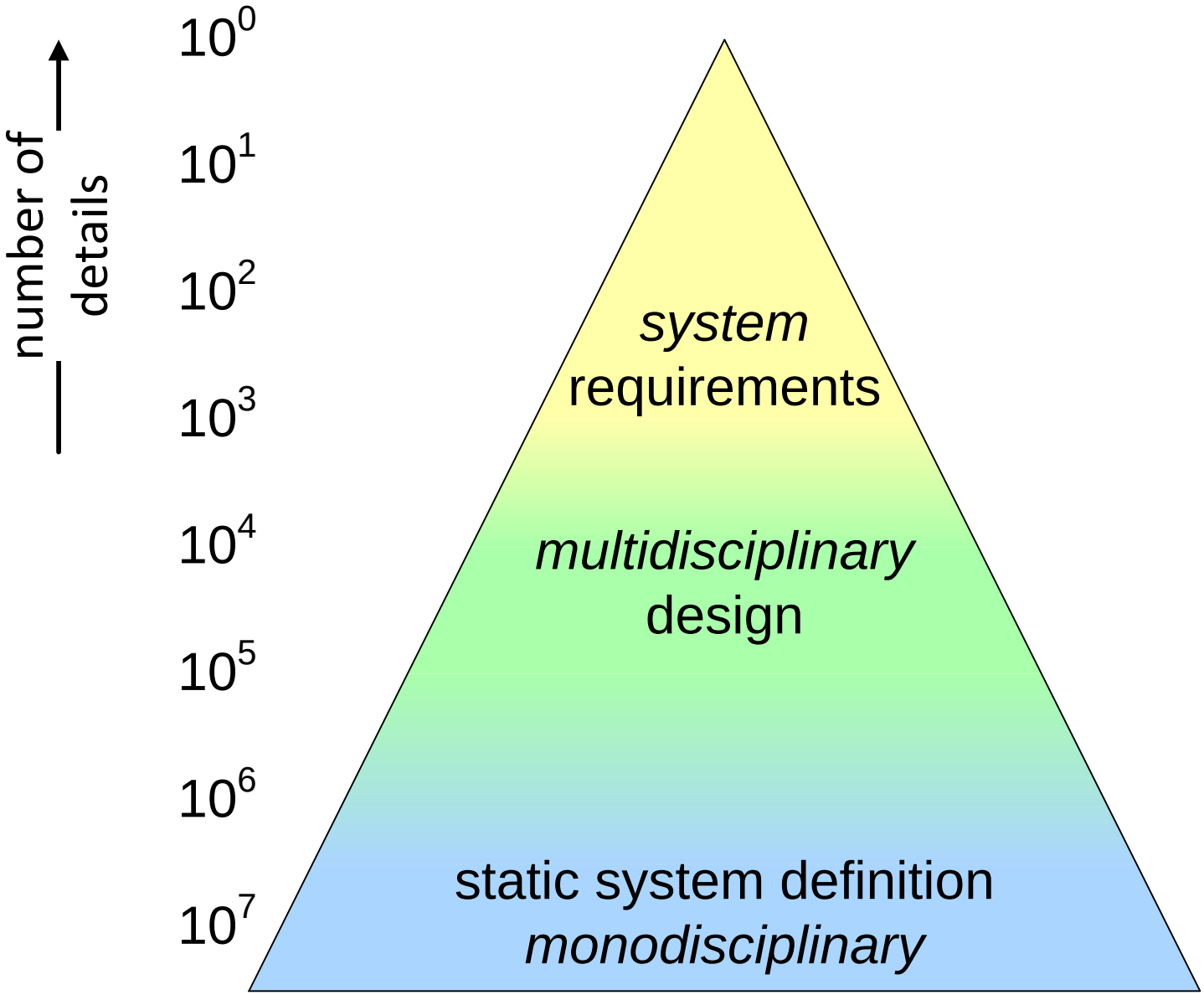
From Engineering Disciplines to System Qualities

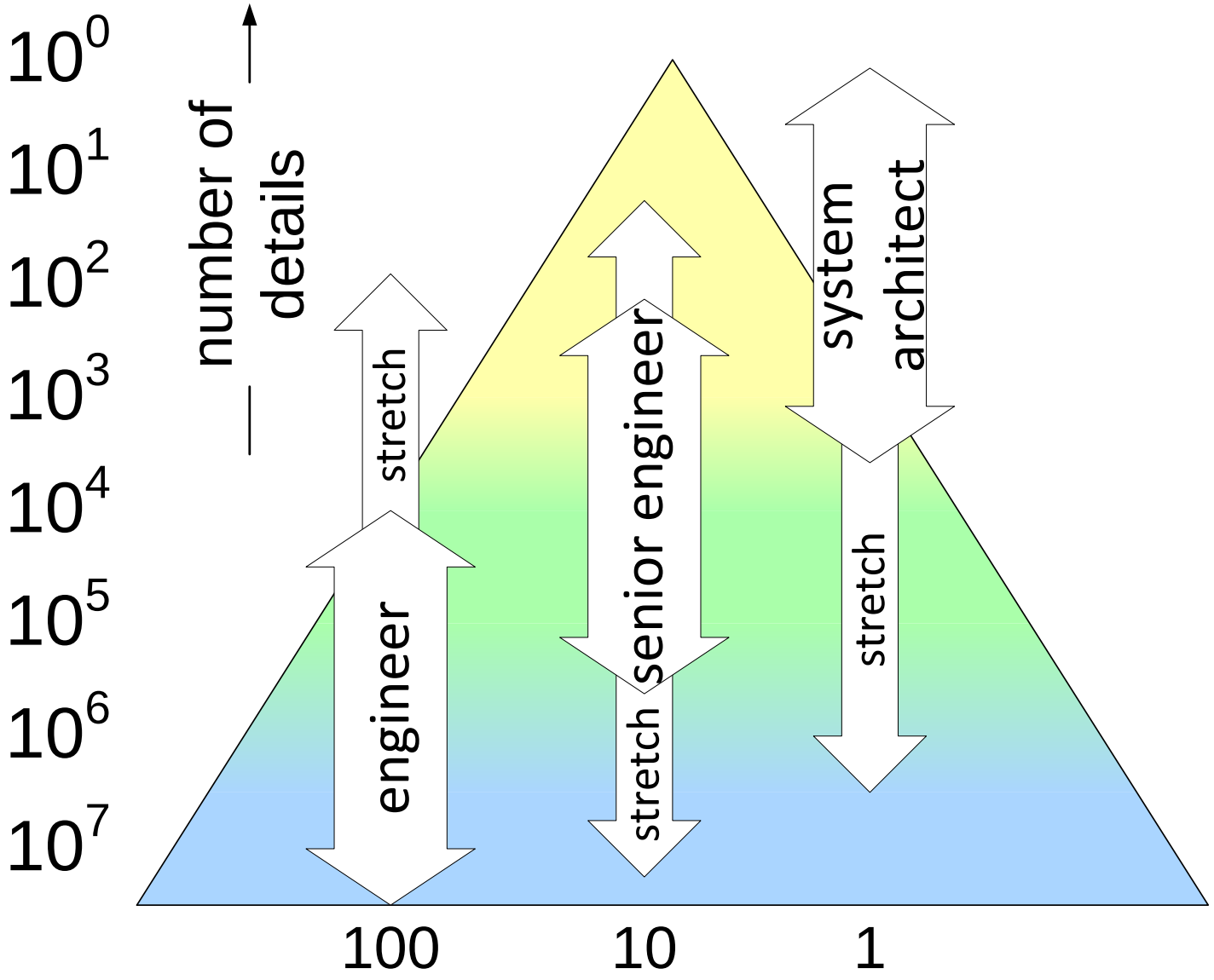
Systems Engineering: responsible for customer key drivers and key performance parameters of system



Levels of Abstraction



Lifting Engineers to System Concerns



Conclusion SE applicability

Systems Engineering at Start-Up companies is applicable

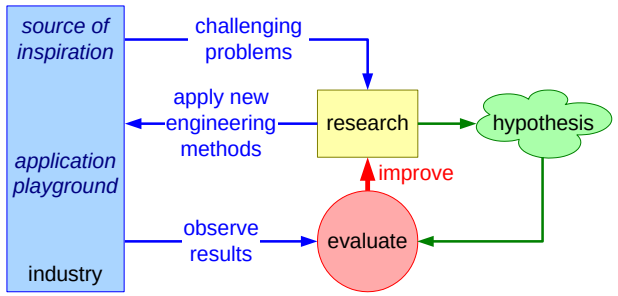
customization is required to adapt to:

- company size
- market and technology maturity

system models help to "lift" engineers to system level concerns

Conclusion Research Model

Application of **theory** in **practice**



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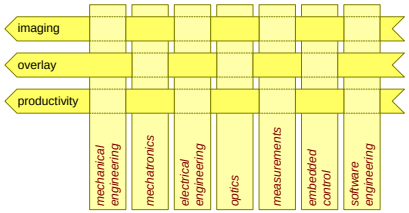

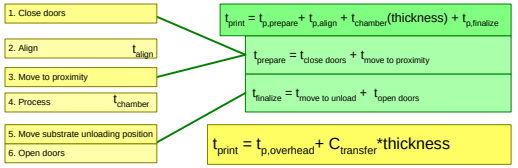

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is required for **learning** and **validation**