

# Systems Engineering Case Study: Wafer Handling for Solar Cell Production Equipment

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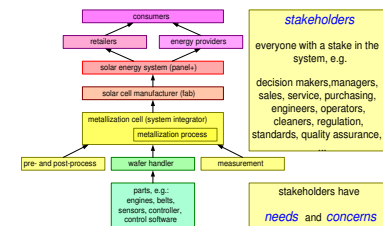
## Abstract

This presentation provides a case study of the application of Systems Engineering in cascade of companies. The case study is artificial to avoid confidentiality issues, where elements from multiple real case studies are combined.

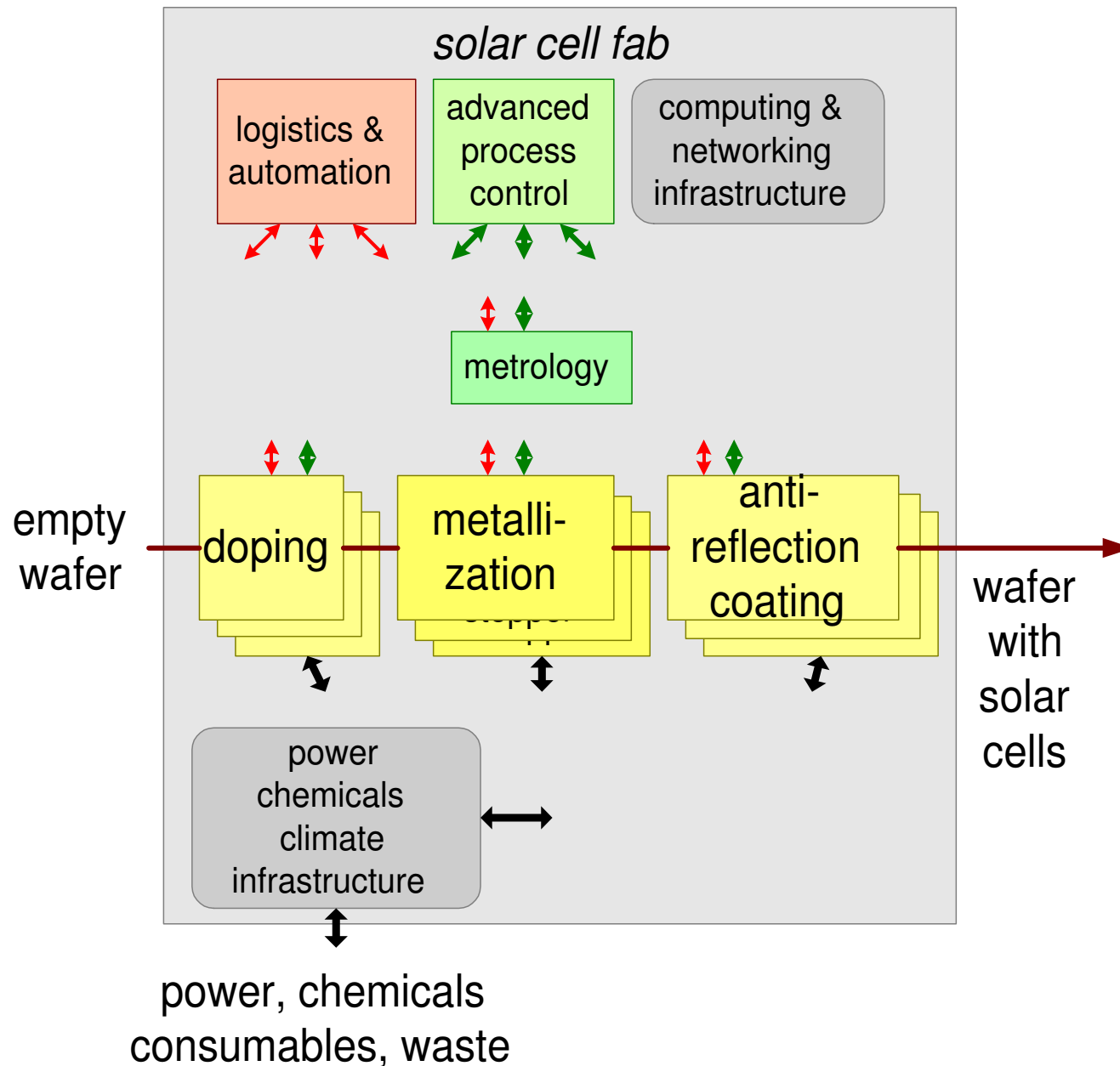
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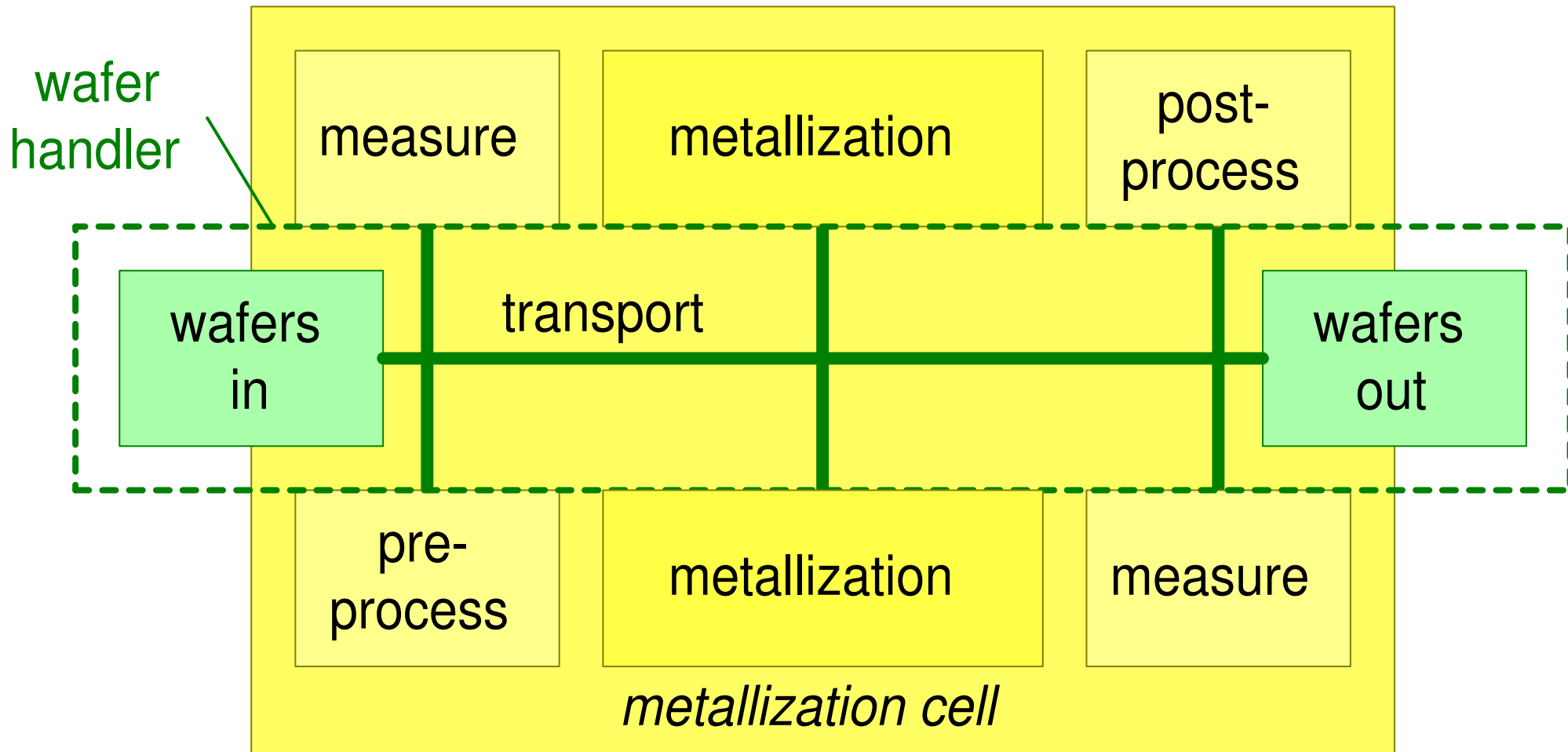
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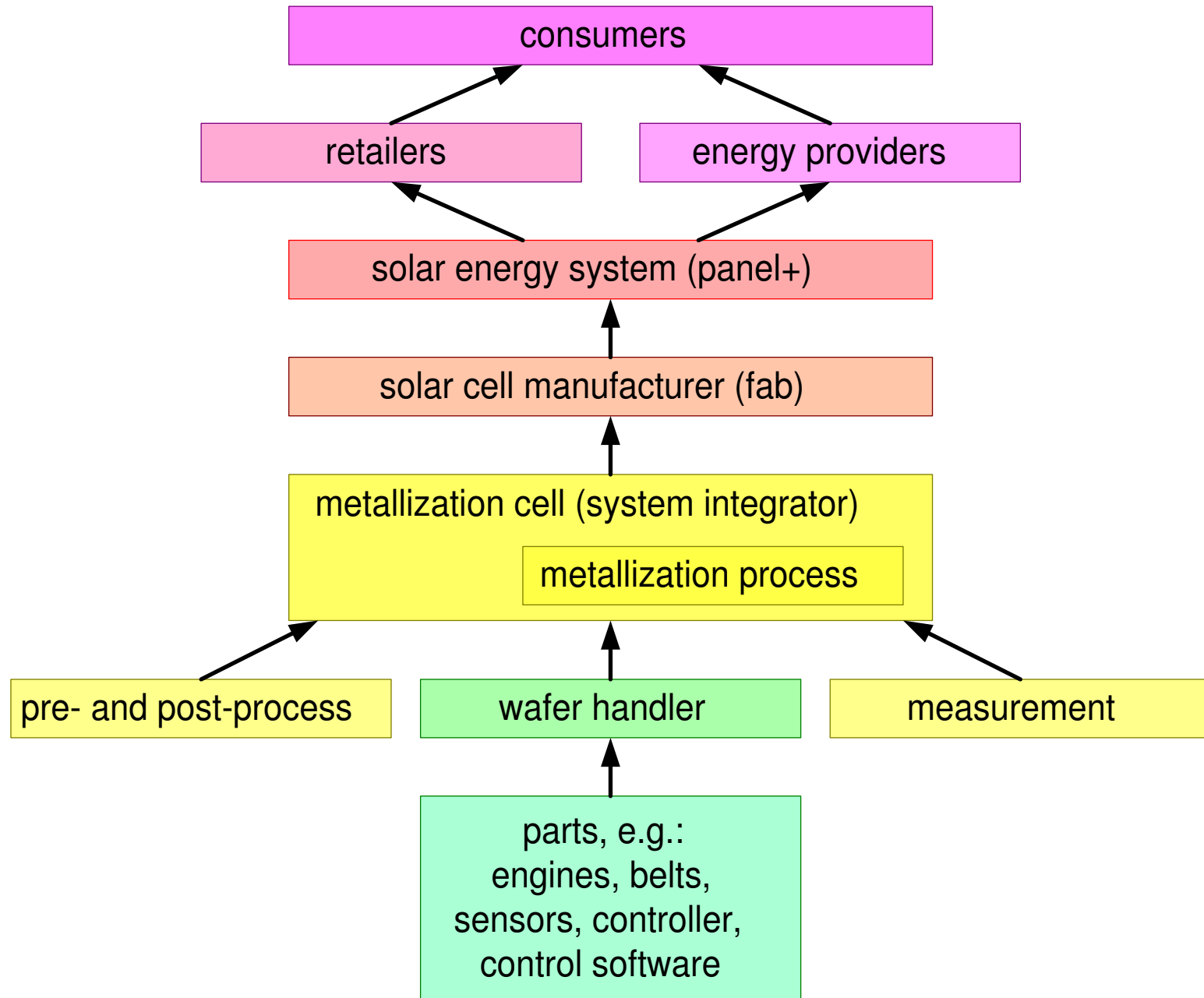
# Solar Cell Wafer Fab



# Metallization Cell



# Value Chain

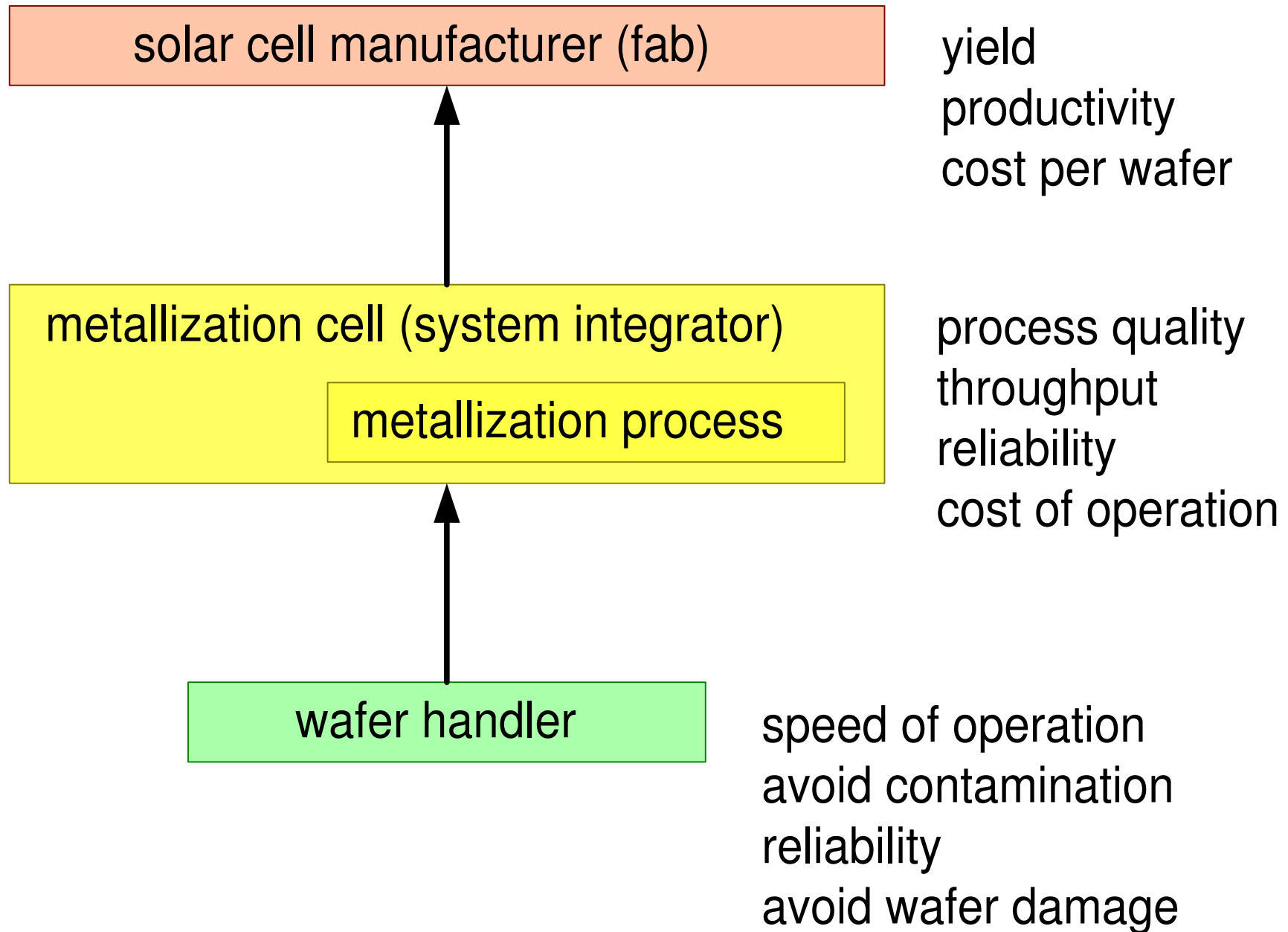


# Trends of past Decades

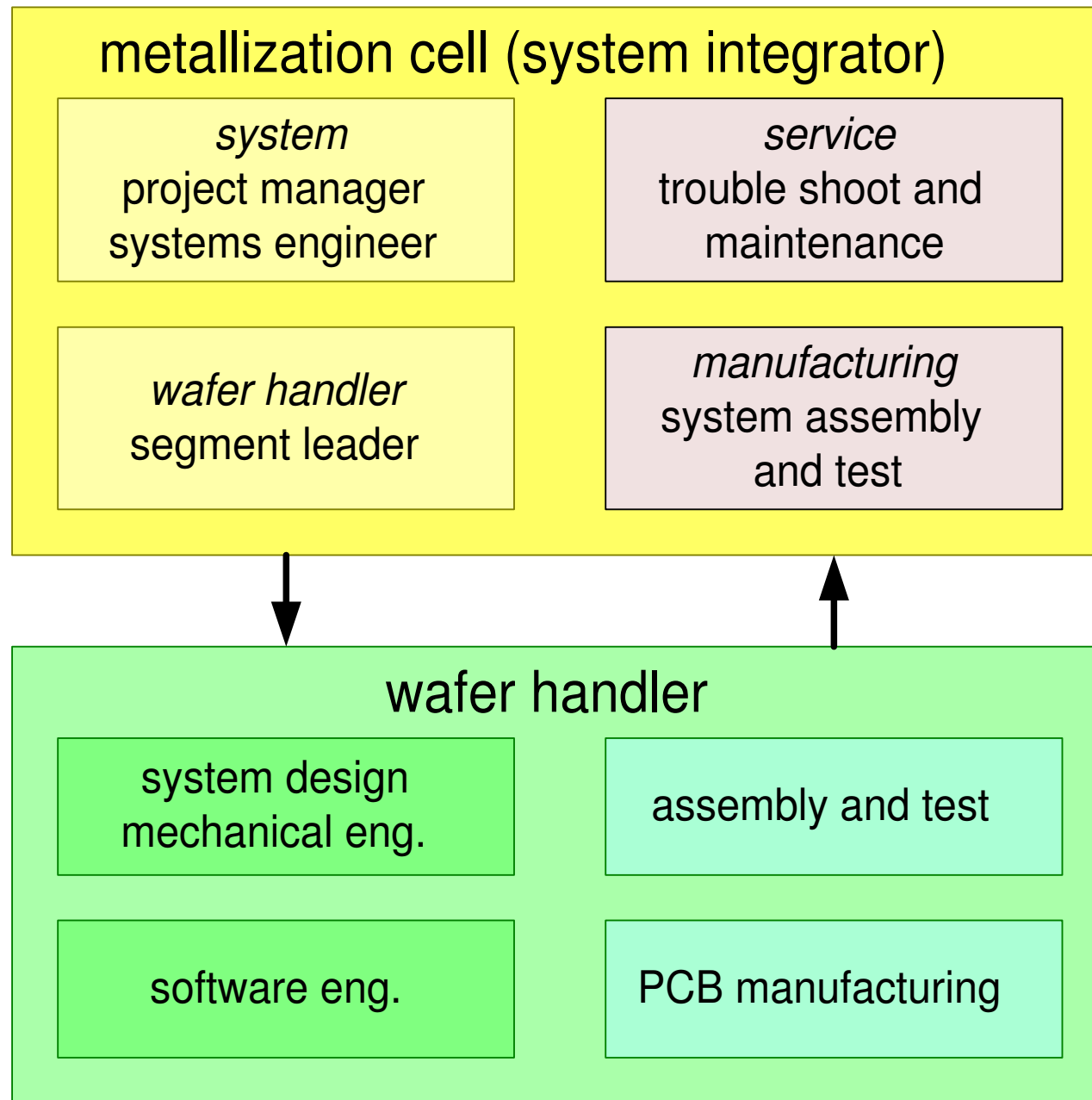
|                           | 2000<  | 2000-2010   | >2010                        |
|---------------------------|--------|-------------|------------------------------|
| transportation            | manual | semi-manual | automated                    |
| operation                 | manual | remote      | automated                    |
| process control           | expert | statistical | advanced                     |
| process complexity        | medium | medium-high | high                         |
| contamination and climate | strict | stricter    | very strict<br>microclimates |

|                                 |                               |                                     |
|---------------------------------|-------------------------------|-------------------------------------|
| technology disciplines          | chemical, mechanical dominant | much more<br>electronical, software |
| number of people in development | tens                          | hundreds                            |
| integration                     | loosely                       | tight; also at fab                  |
| rate of change                  | years                         | months                              |

# Key Drivers and Parameters

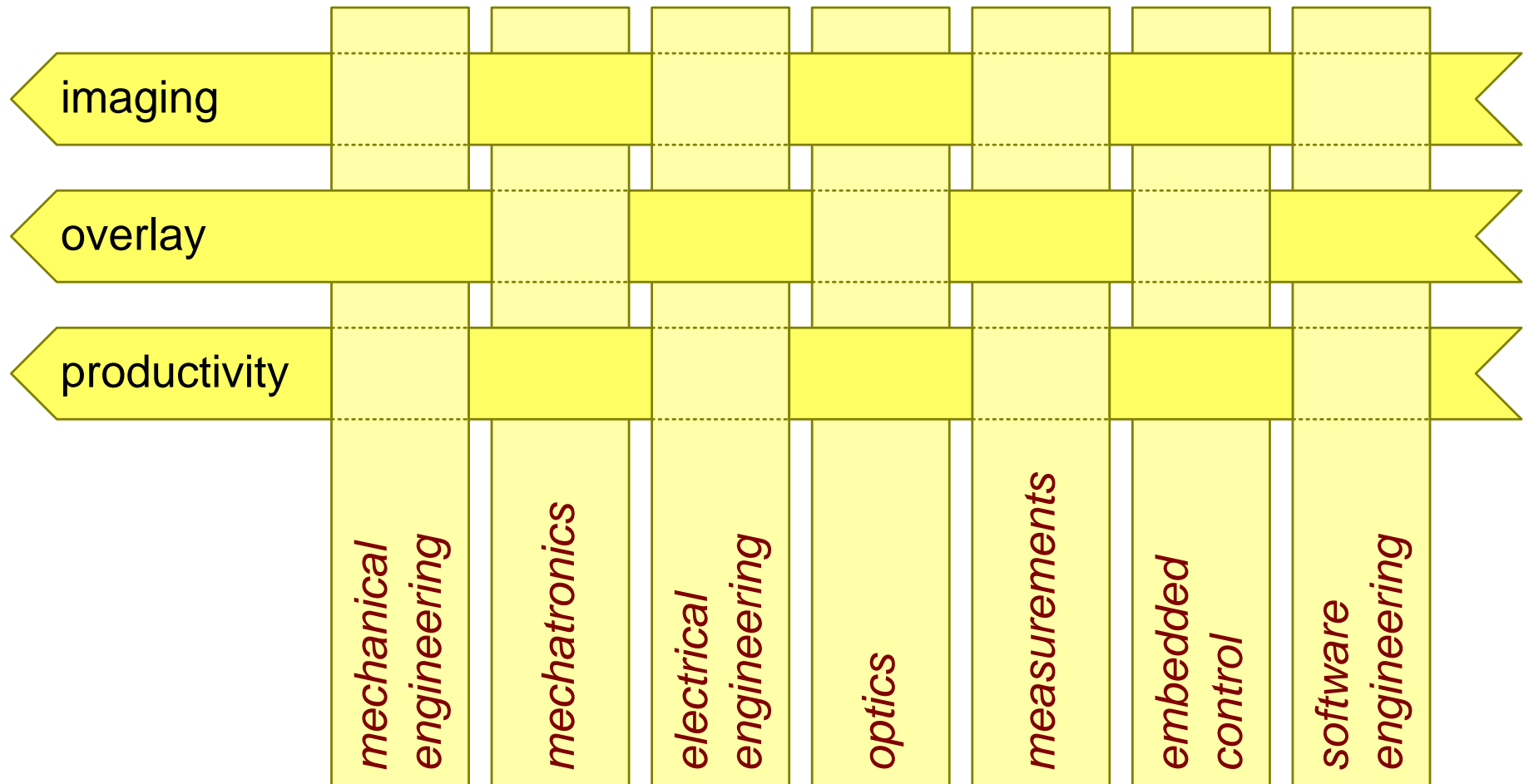


# Suppliers involved in Wafer Handler



# From Engineering Disciplines to System Qualities

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





# Multiple Life Cycles

