Lithocell Productivity: Scanner versus Track

The coat/develop track perspective…
& How to change the game so tracks are not limited by scanner throughput ?

SOKUDO Lithography Breakfast Forum 2007

Historical RULES of LITHOGRAPHY Productivity

- **Never, Ever let the low-cost Track slow down your high-cost Scanner throughput !**
  - Ratio changes from immersion ArF → ArF→ KrF → i-line
- **Always buy 10%-20% more track throughput just in case you underestimate scanner throughput**
  - Unless you want to risk your engineering job next year
- **No-Fault Insurance Policy**

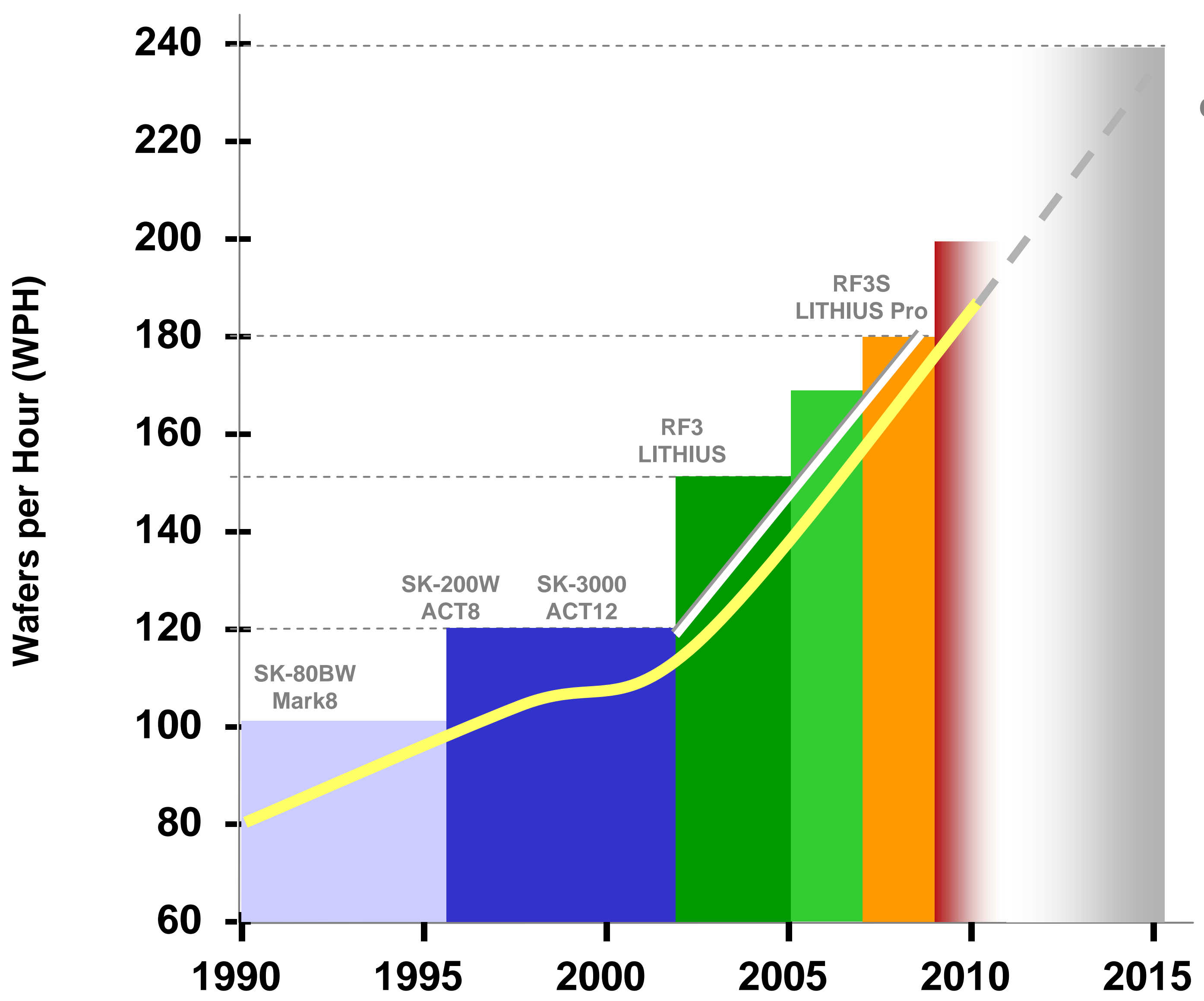
If you're the photo engineer and lithocell output is low

it's the track's fault

If you're the track engineer and lithocell output is low

it's the scanner's fault

Coat-Develop Track & Exposure Throughput



200mm wafer lithocells establishing productivity benchmarks & learning

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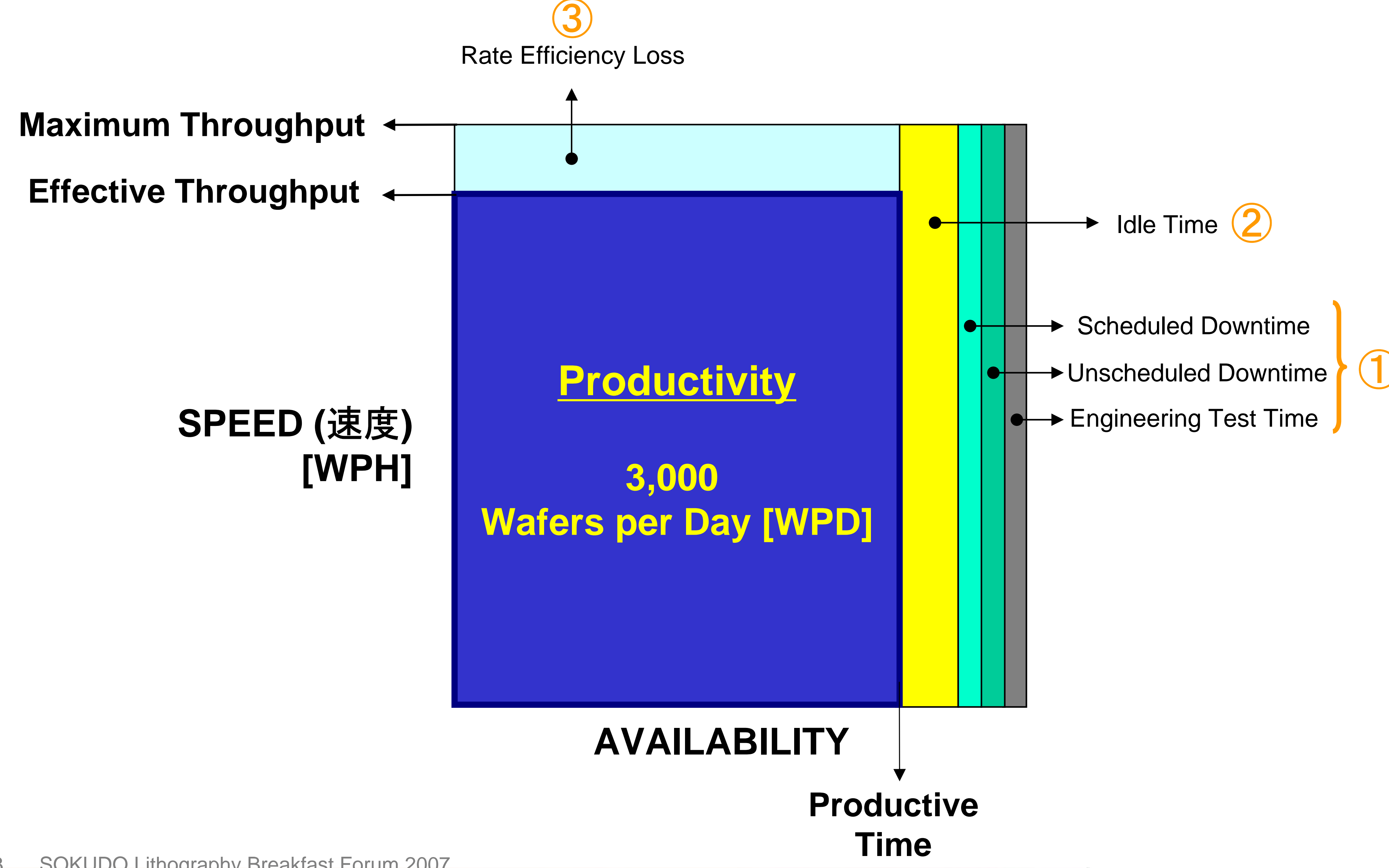
Productivity Chart



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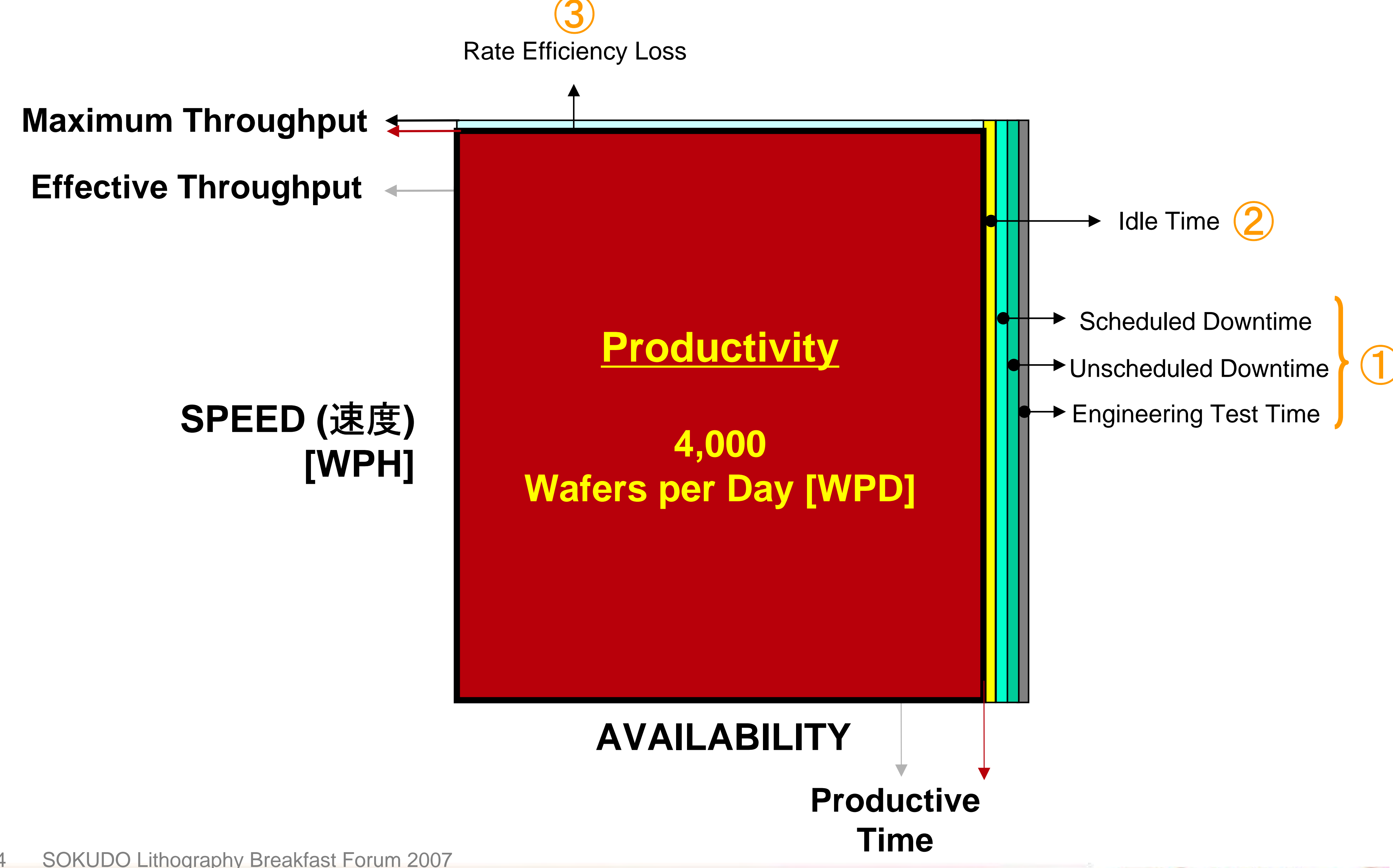
Productivity Chart



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180WPH Throughput in Production Qualified on

- **180WPH throughput achieved on the existing RF3 linked with ArF scanner at the volume fab with key modifications for:**
  - SCANNER: Hardware upgrades and interface software revision
  - TRACK: Hardware upgrades and interface software revision

Litho. Process of Record (POR) Change while maintaining Yield:
  - SCANNER: Exposure illumination, dose conditions
  - TRACK: BARC, Coat, and Develop process time optimization for 20 sec. cycle time

→ RF3 Track modifications are standardized on RF3S model to achieve 180WPH Throughput

180WPH Throughput Benchmark

4 stack coat cell

Speed optimized MHU per wafer move

Overhead time reduction SC/SD unit

Overhead time reduced for Bake-Chill unit

ECO nozzle for develop process time – 60%

High speed IFB for 180WPH with integrated CP

Fab Lithography Equipment Transitions

1980 – 1990 –
4”- 5”- 6” wafers
g-/h-/i-line lithography

Stand-alone coaters,
exposure steppers,
& developers…

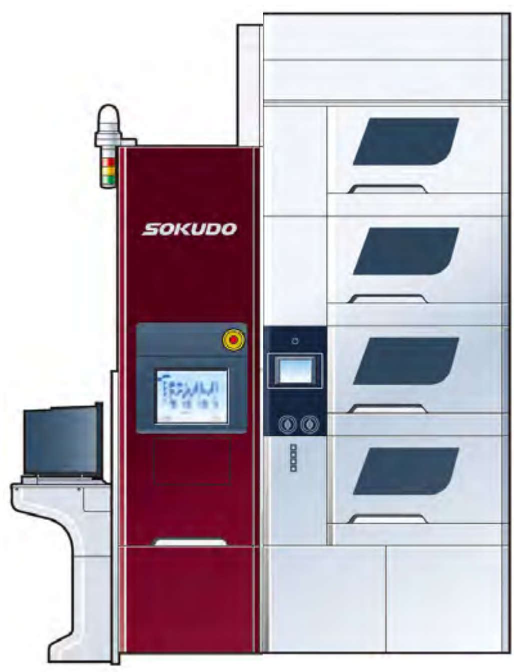
1990 – 2000 –
- 6”- 8”- 12” wafers
i-/KrF/ArF lithography

in-line scanner
& track lithocell

2010 –
12” wafers
i- / KrF / ArF / imm.
& EUV lithography

STAND-ALONE
RETURNS !

Delinked Coat, Develop Track Advantage



- **Increase Track Availability +5-10%**
- **Increase Track Utilization +10-20%**

  Bottom-Line = +15-20% Wafers Out/Day

- **Expect same benefits for SCANNER Productivity**

- **FLEXIBILITY in Utilization:**
  - No longer necessary to dedicate tracks by lithography node (ArF, KrF, i-line)
  - Mix-and-match litho-levels in single track

- **Overall Availability Improves**
  - If one machine down, can easily switch over to next coater or developer tool
  - Machine downs not linked to scanner (and vice-versa)

- **Allows Stand-Alone Track Throughput to be independent of Scanner**
  - 180WPH → 200WPH

Stand-Alone Coat, Develop Tracks

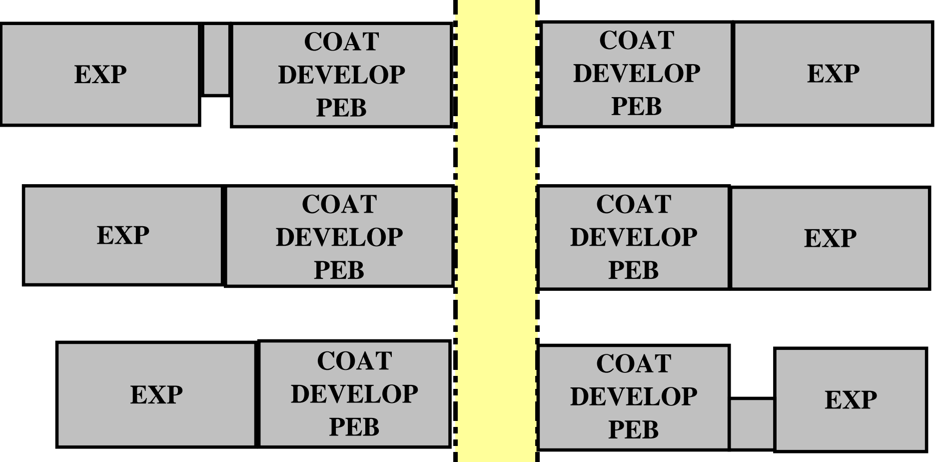
- **Forces new 300mm litho-bay layout**
  - CoO: Capital Equipment, Running Cost Savings?
  - Increased Productivity / m^2 fab space?
  - Wafer cycle time optimization?
- **All litho-level processes?**
  - BARC Stand-Alone = OK
  - i-line process = OK
  - KrF, ArF, & immersion = TBD
  - Mix-and-match between levels on single coat track

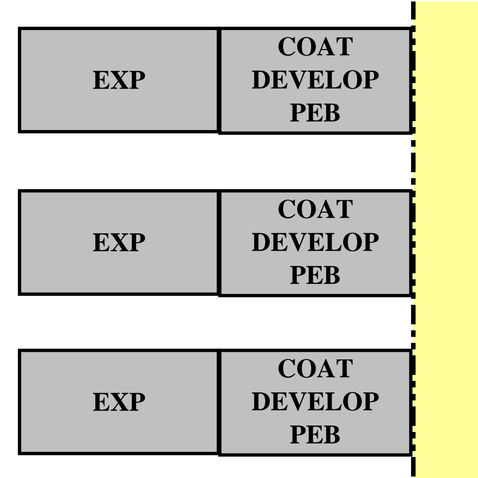
Requires PEB Only Front-End Module for Stand-Alone Scanner

Scenarios	Lithocell Throughput (WPH)	Actual Wafer Outs per Day	Track Capacity Utilization, %
Linked Lithocell Output (Typical)	165	3900	83
Optimal Lithocell Output Today	180	4200	90
Maximizing Track Capability Today	200	4700	100

Fab Layout Concept for increased productivity…

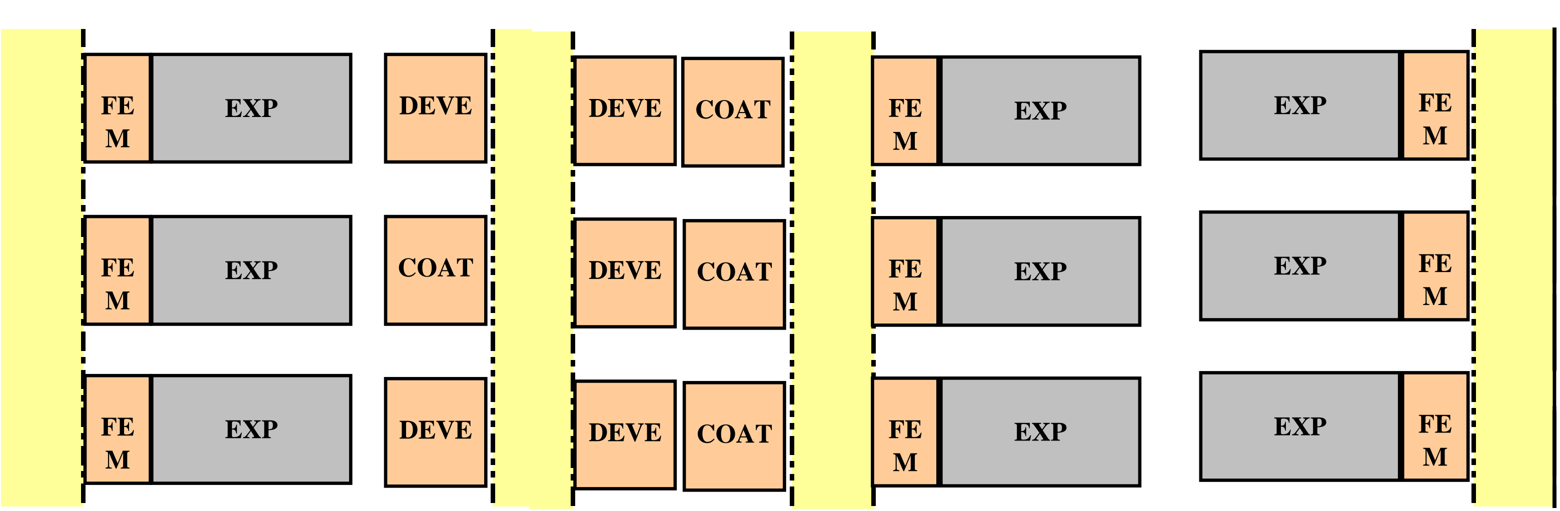
Typical 300mm Linked Lithocell Fab Layout





Future 300mm Delinked Lithocell Fab Layout

Stand-alone Coat
Stand-alone Develop
Exposure with FEM



The coat/develop track perspective …
& How to change the game by delinking scanners and tracks for higher productivity