



# The hidden life and potential of non product wafers - “test wafers”

Thomas Beeg  
CEO Fabmatics USA Inc.



# Agenda

- Speaker introduction
- Why are we talking about test wafers at all ?
- How to manage the “zoo”
- Summary

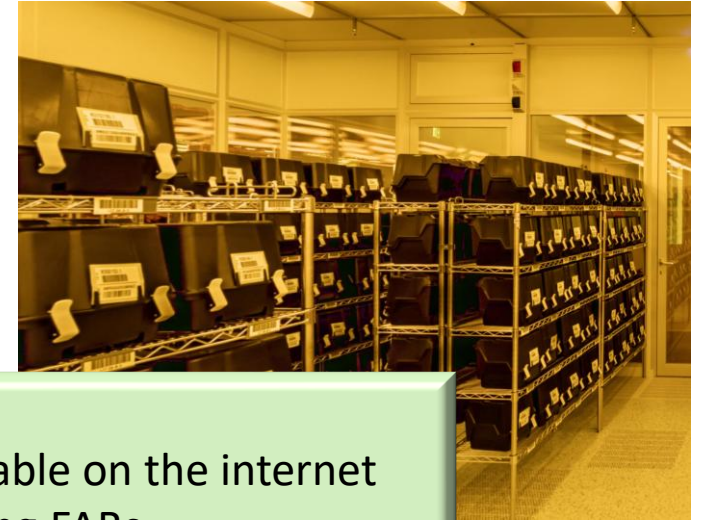
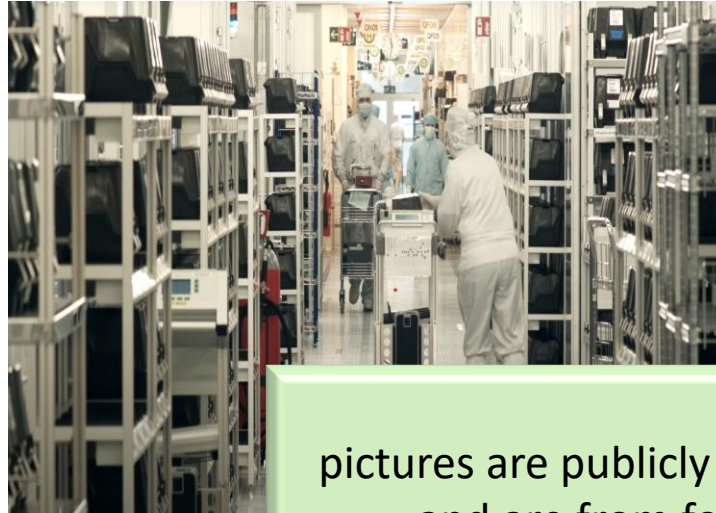
# Speaker introduction

- started career in semi in 1995 in Dresden (Siemens HL)
- worked in 30+ Wafer FAB clean rooms worldwide
- 150mm, 200mm, 300mm
- background: Operations, IE, AMHS, Equipment Engineering, WIP flow management, Simulation
- deeply involved in test wafer management in 3 FABs 150mm, 200mm, 300mm



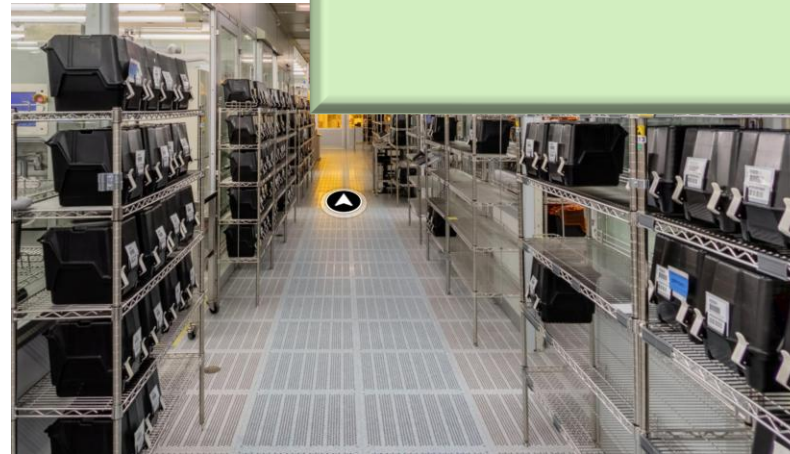
# Why are we talking about the topic ?

- One of the most interesting things to look for during a clean room tour is the amount of wafer boxes (carriers)
- Impressions like on the right side tell:
  - either the FAB has very high WIP and runs slow (high X factor)
  - or there are massive amounts of test wafers
  - or both



pictures are publicly available on the internet  
and are from following FABs ...

(will of course not disclose)



# Impact of test wafers on FAB productivity

- stable equipment uptime is one of the biggest drivers of FAB productivity
- The solution seems easy:

**always have the needed test wafers available**

The interesting thing about test wafers:

**massive impact on the overall FAB productivity**

**a) in a positive way**

by being always available when needed

**b) in a negative way**

by being not available when needed

- for example: after maintenance of a process equipment missing qualification wafers will extend the equipment down time and therefore reduce the FABs capacity

# Impact of test wafers on FAB productivity

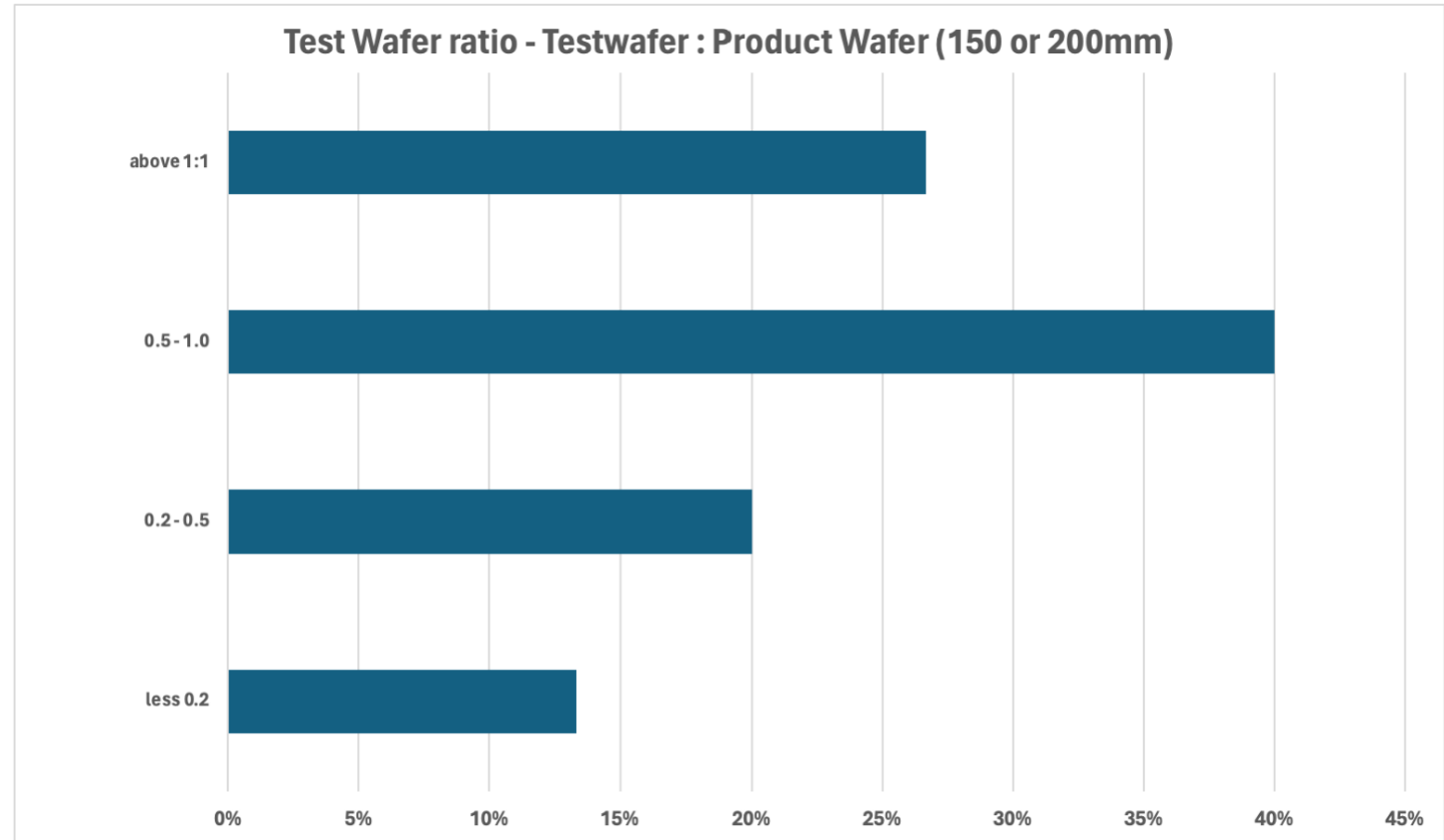
- More test wafers mean
  - higher cost
  - more clean room footprint consumption
  - not necessarily the right test wafers are available

What is a FAB's test wafer ratio ( $TW_{ratio}$ )?

$$TW_{ratio} = \frac{\text{sum of all test wafers}}{\text{sum of all product \& R/D wafers}}$$

# How is the industry (150 & 200mm) looking ?

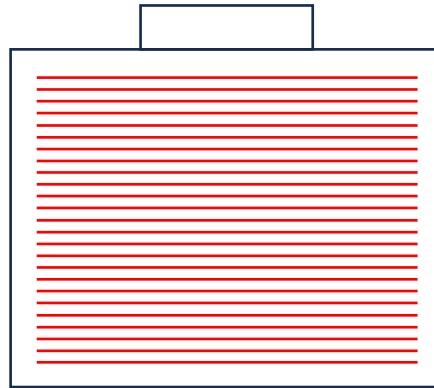
- 2/3 of the FABs have significant amounts of test wafers
- 25% of the FABs have more test wafers than product wafers



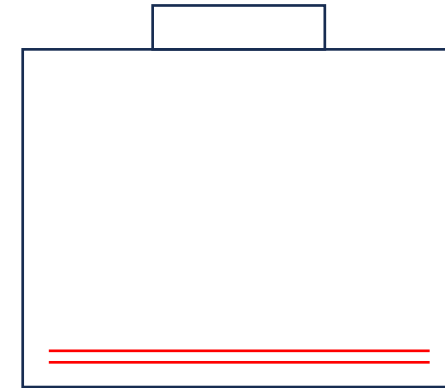
based on 15 survey feedback

# Another test wafer specific challenge

- Test wafer carriers often have only 1-3 wafers
- High number of test wafers in a FAB lead typically to very high number of test wafer carriers



Cassette with  
normal production wafers



Cassette with  
test wafers



# Test wafer ratio – with example numbers

- Number of test wafer carriers can “explode” very fast
- Strong management system needed
- Likely a lot of “wafer to carrier exchanges” needed to consolidate test wafers into less carriers
- in 150mm and 200mm often multiple lots in one carrier (MES) capabilities are not available

10,000 WSPW FAB (production)

2 DPML FAB speed

30 mask layers

85,000 wafers WIP

→ 3,400 carriers (cassettes, boxes, ...)

Test wafer ratio of 0.8

→ 68,000 test wafers

→ at 3 wafers per cassette → 22,666 carriers

→ at 10 wafers per cassette → 6,800 carriers

→ at 15 wafers per cassette → 4,500 carriers

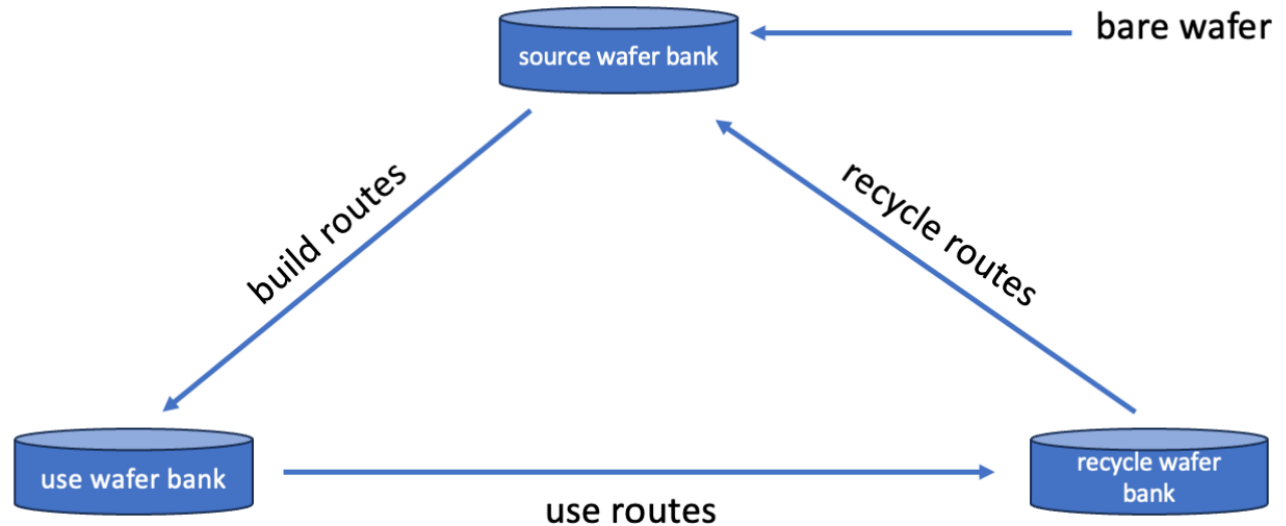
# Test Wafer Management

**to be successful - the general FAB mindset needs to be that test wafers have the same importance as production or engineering wafers.**

- test wafers are completely modeled and tracked in the FAB's MES system
- test wafer lots are "running" on test wafer routes or flows – exactly like production wafers.
- this will enable real time monitoring of the test wafer status but also creates the capability to schedule and dispatch test wafers automatically using the FAB's scheduling systems.

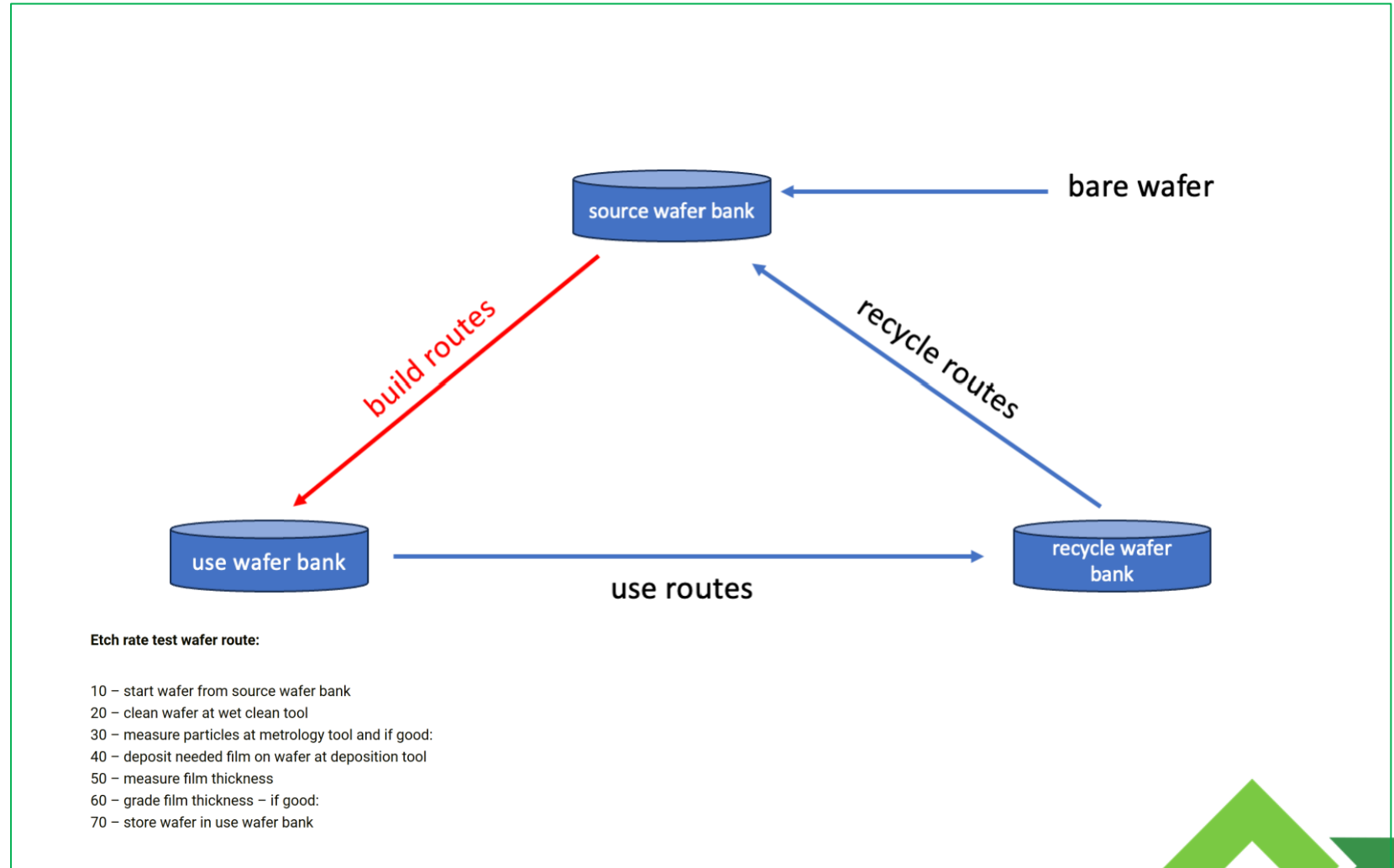
# High level model “how to manage test wafers”

- Concept of holding test wafers in “banks” ready to be used
- 3 main phases of a “test wafer life”
  - build (prepare for use)
  - use
  - recycle



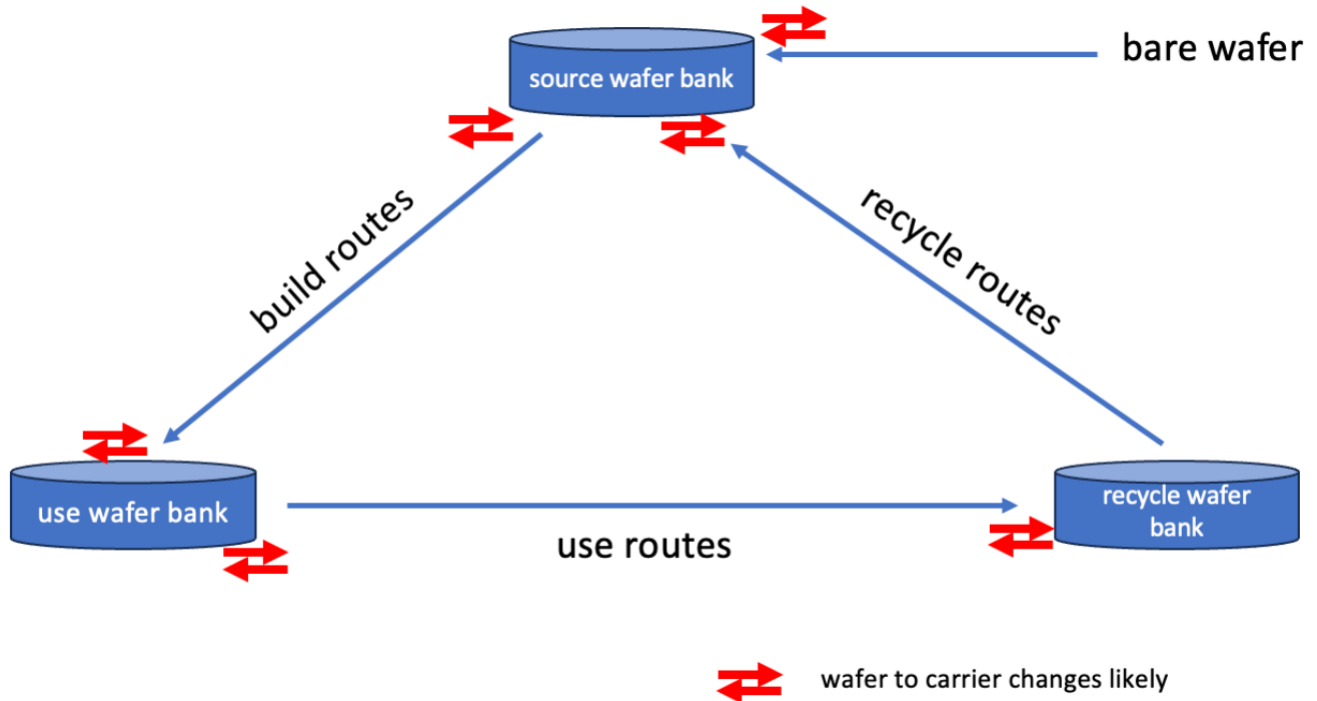
# Example how to build (prepare) a specific test wafer

- Different test wafer use cases will have different build routs
- “building” test wafers consumes time and will need equipment capacity (often on regular production equipment)
- Test wafer often compete with production lots for capacity (and priority)



# Test wafer will drive carrier exchanges up in a FAB

- in 150mm and 200mm FABs carrier exchanges often involve:
  - high number of operators
  - lots of transportation
  - lots of storage capacity
  - lots of wafer sorter capacity
  - empty carrier logistics



# Summary

- How well is it done in your FAB ?

1. test wafers need to have the same importance as any other wafer in the FAB
2. a well-defined set up in MES is needed
3. ownership needs to be defined
4. engineers need to be allocated / dedicated
5. automating the kitting, de-kitting and transport of test wafer carriers will significantly improve efficiency

- Read more here:

[www.factoryphysicsandautomation.com](http://www.factoryphysicsandautomation.com)



# Thank you.