

# The Waferstepper Challenge: Innovation and Reliability despite Complexity

by *Gerrit Muller* University of South-Eastern Norway-NISE

e-mail: `gaudisite@gmail.com`

`www.gaudisite.nl`

## Abstract

The function of the waferstepper is explained and its most important characteristics. The dynamic market provides continuous technological challenges, resulting in ever increasing performance, but also complexity. Despite the exponential increase of performance and complexity, the reliability must be good. The reliability is crucial when the stepper is used in volume production.

The ASML engineering style plays a central role in tackling this challenge. Three key aspects of this style are: Feedback, Focus and Future awareness. The concurrent application of these three aspects has so far been proven to be effective.

### Distribution

This article or presentation is written as part of the Gaudí project. The Gaudí project philosophy is to improve by obtaining frequent feedback. Frequent feedback is pursued by an open creation process. This document is published as intermediate or nearly mature version to get feedback. Further distribution is allowed as long as the document remains complete and unchanged.

August 16, 2025  
status: finished  
version: 1.0

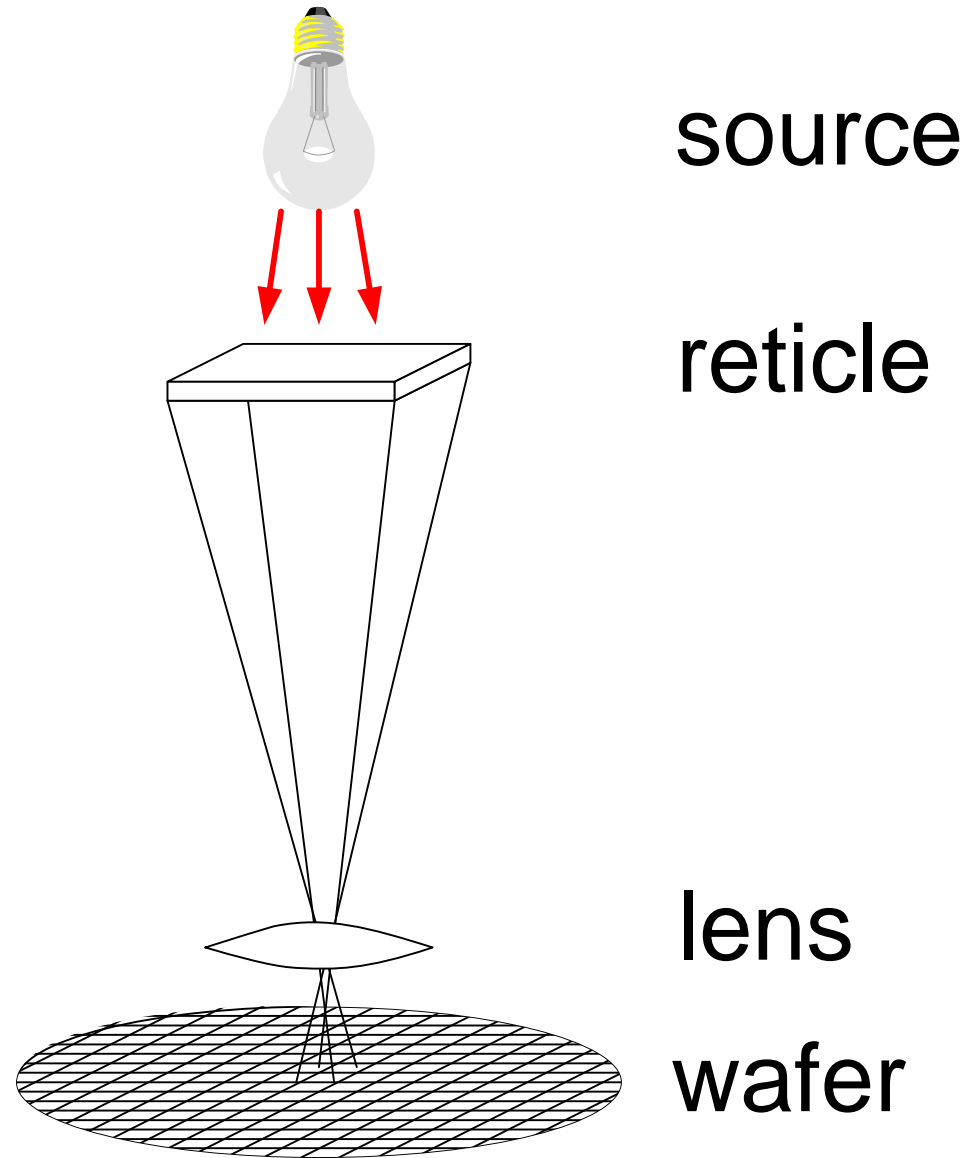


# Twinscan AT1100

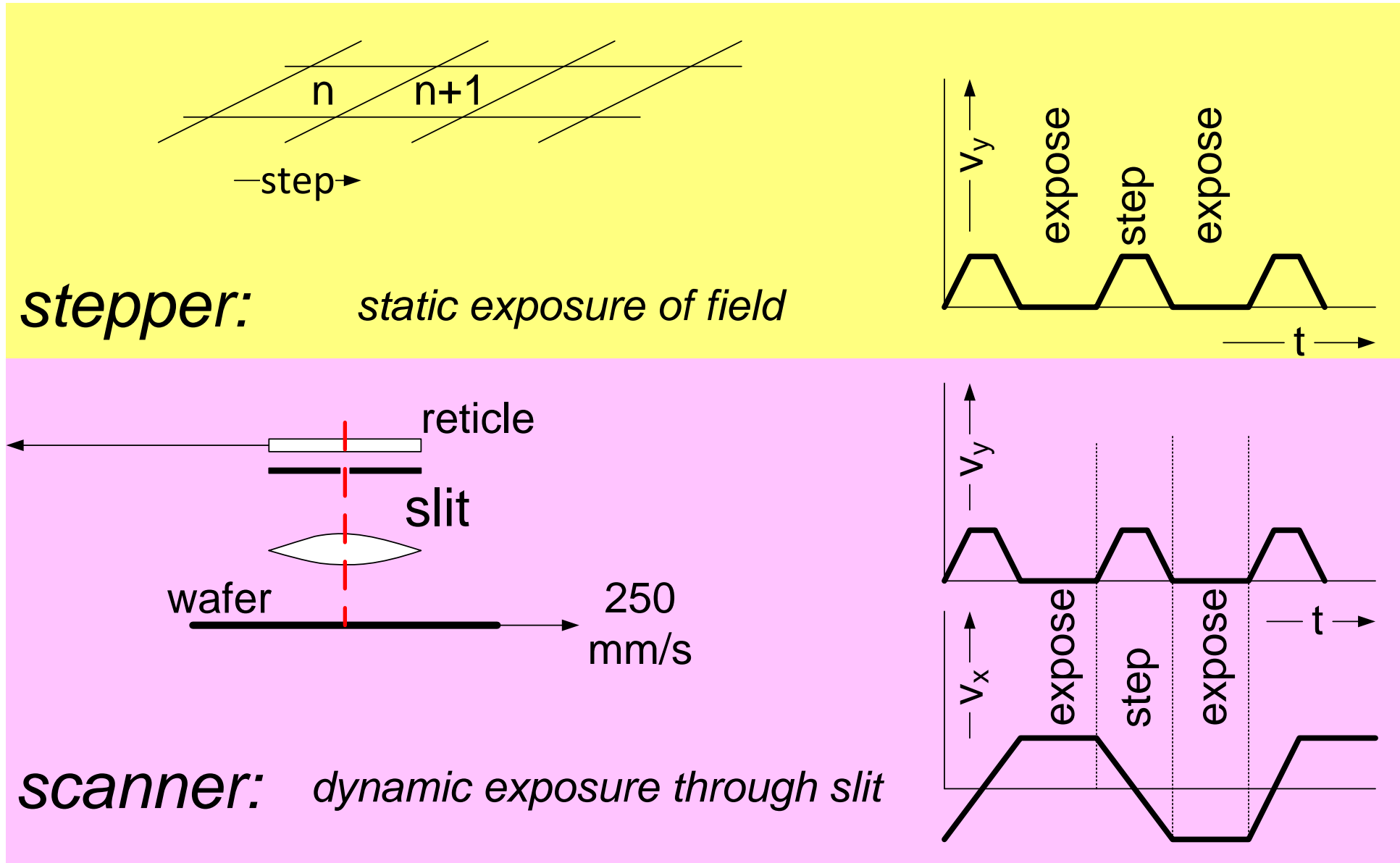


# What is a waferstepper

---

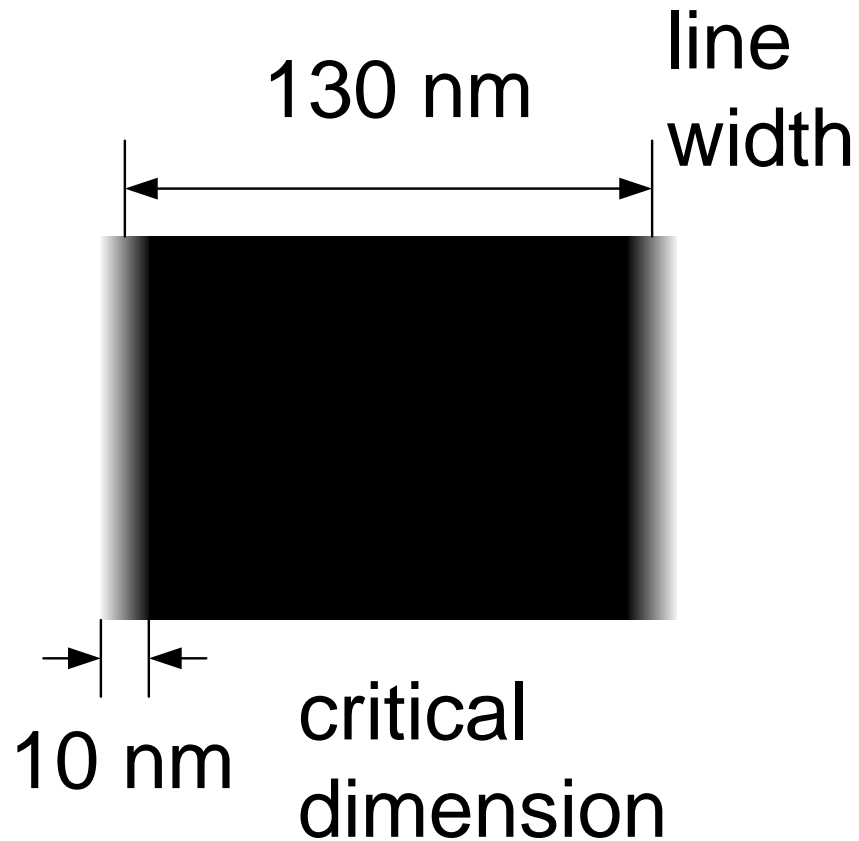


# From stepping to scanning

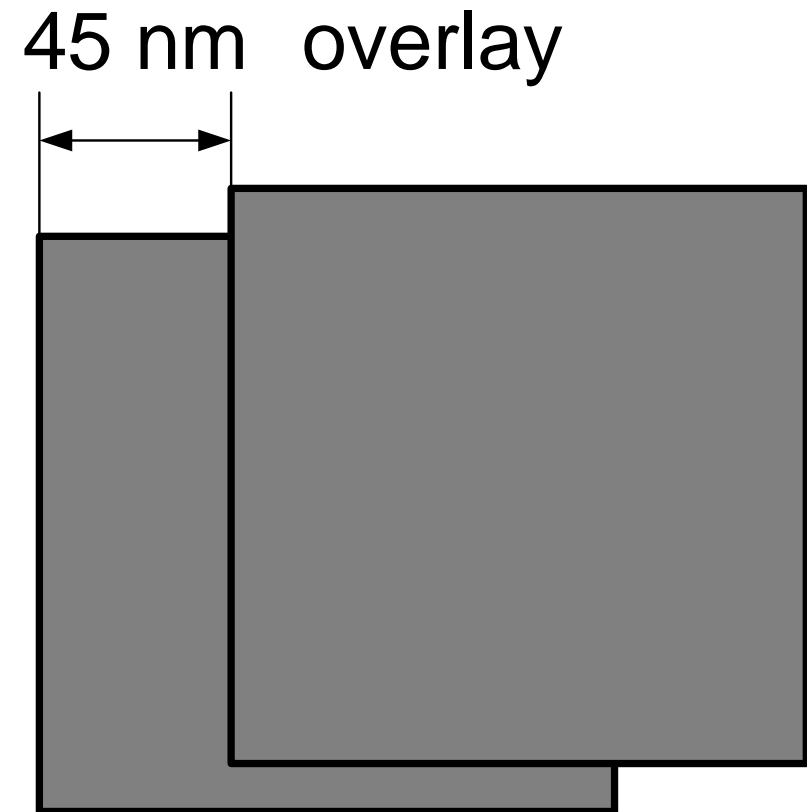


# Key specifications waferstepper

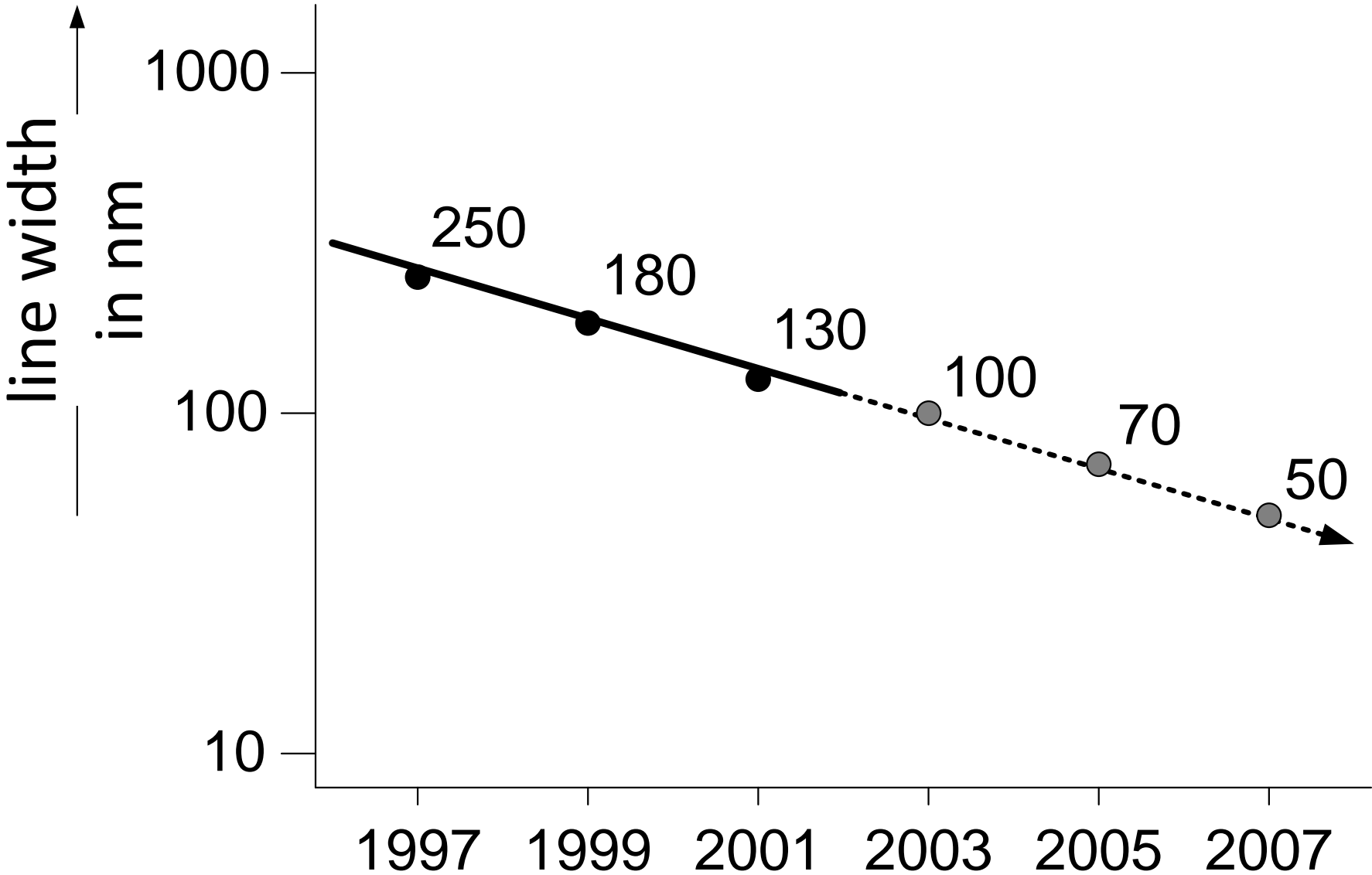
## imaging



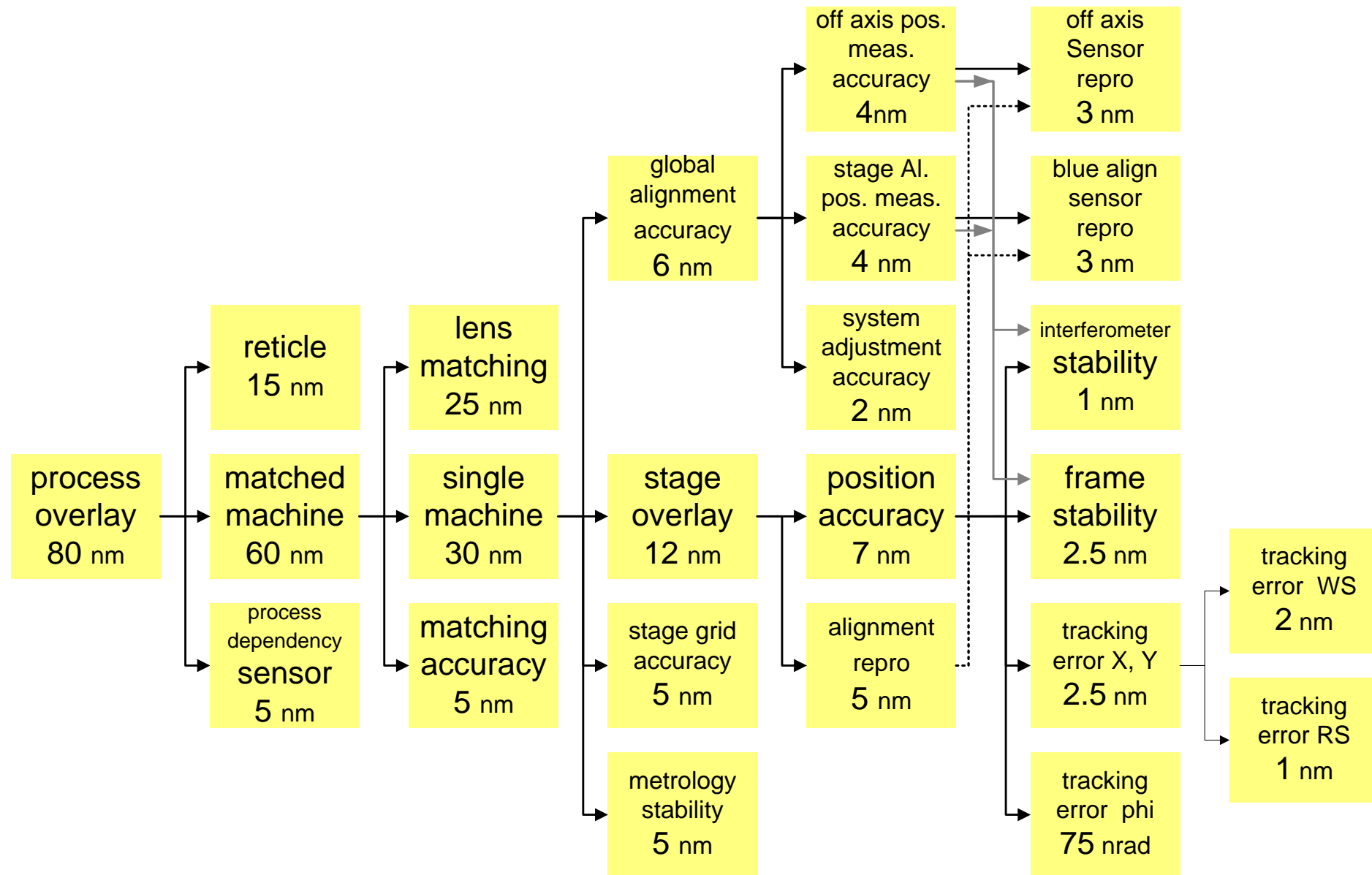
## alignment



# Moore's law




# Overlay budget (1999)

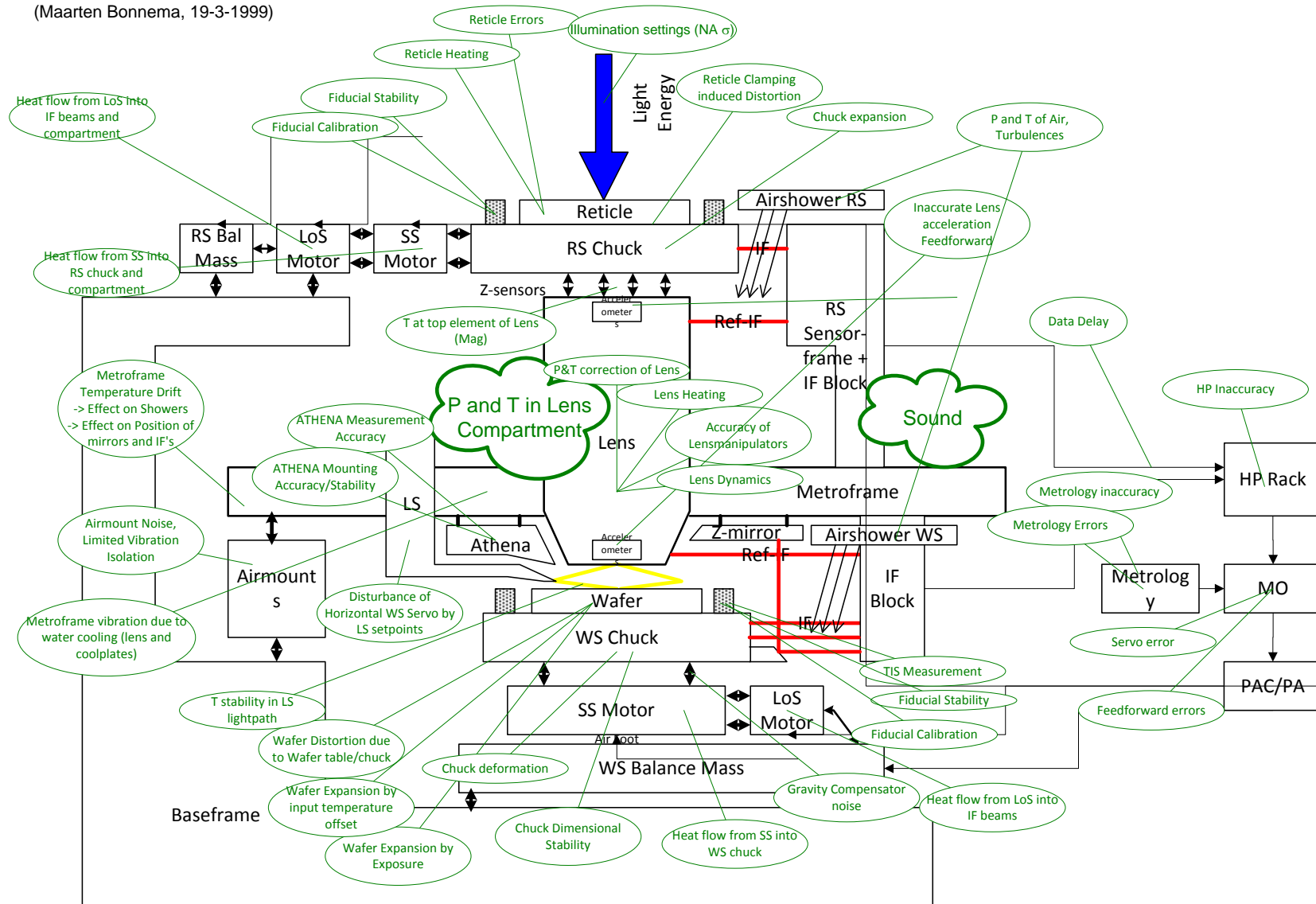


# Everything influences overlay

## Overlay Influence Diagram.

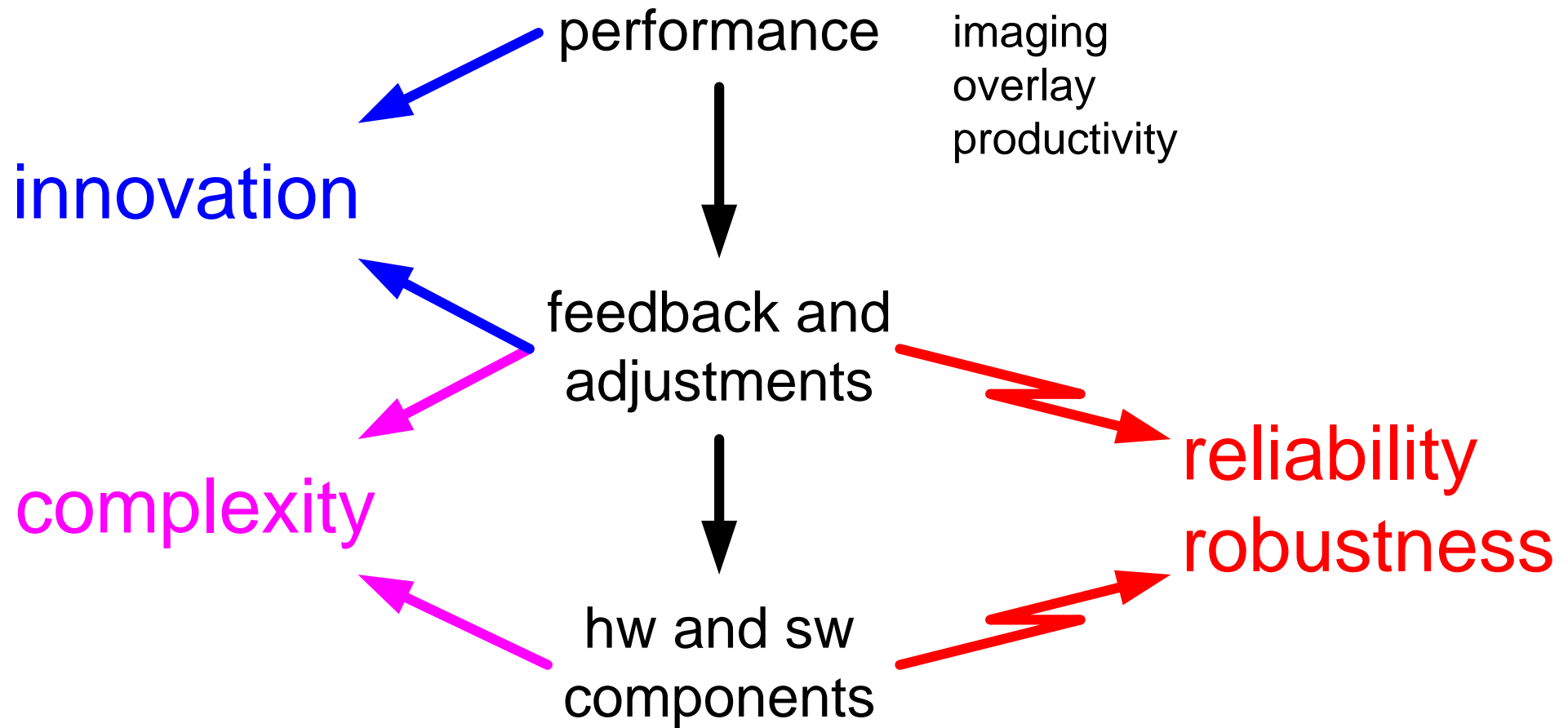
(Maarten Bonnema, 19-3-1999)

 : Fiducial

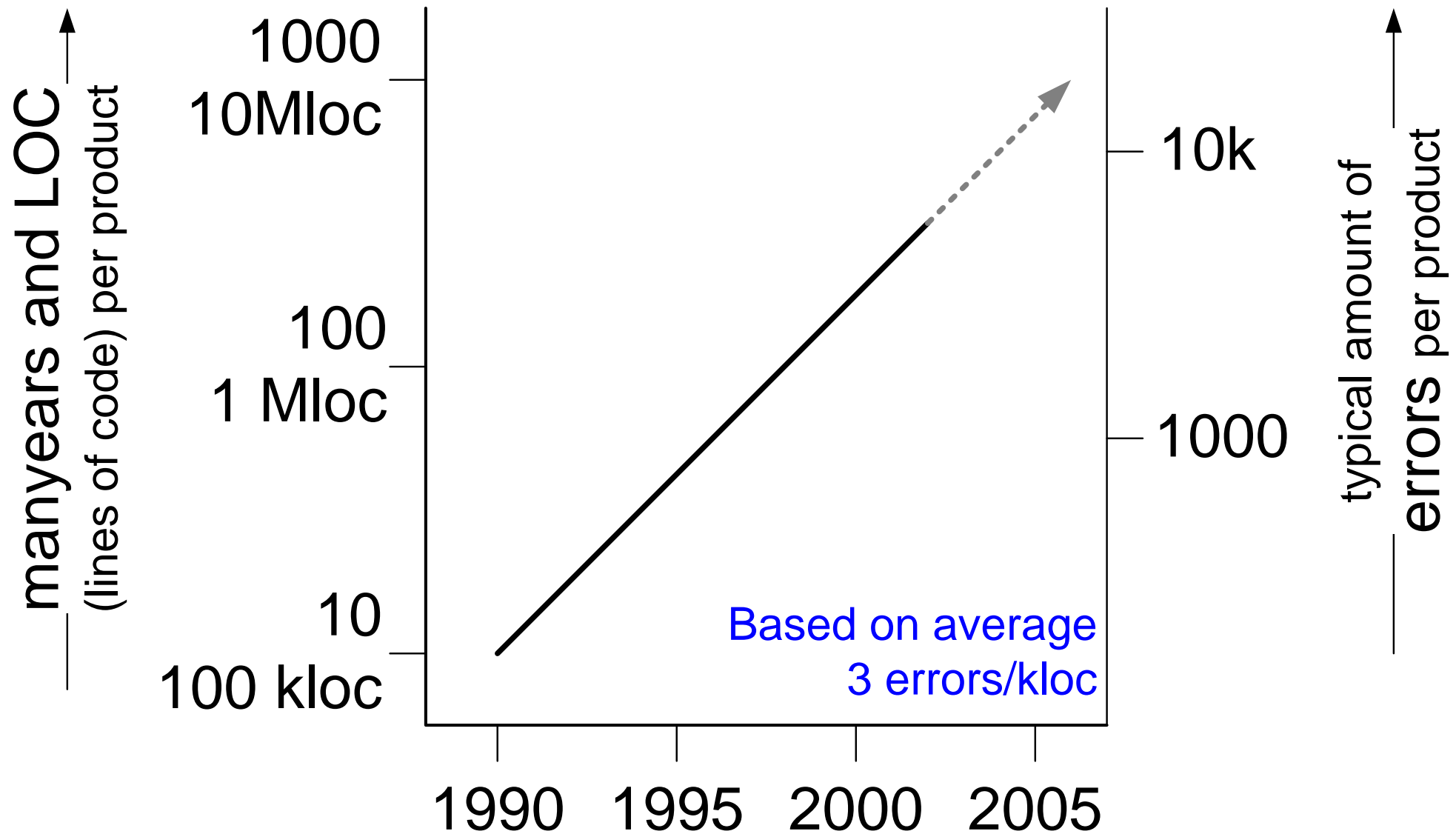


# Challenge: Exponential Increase

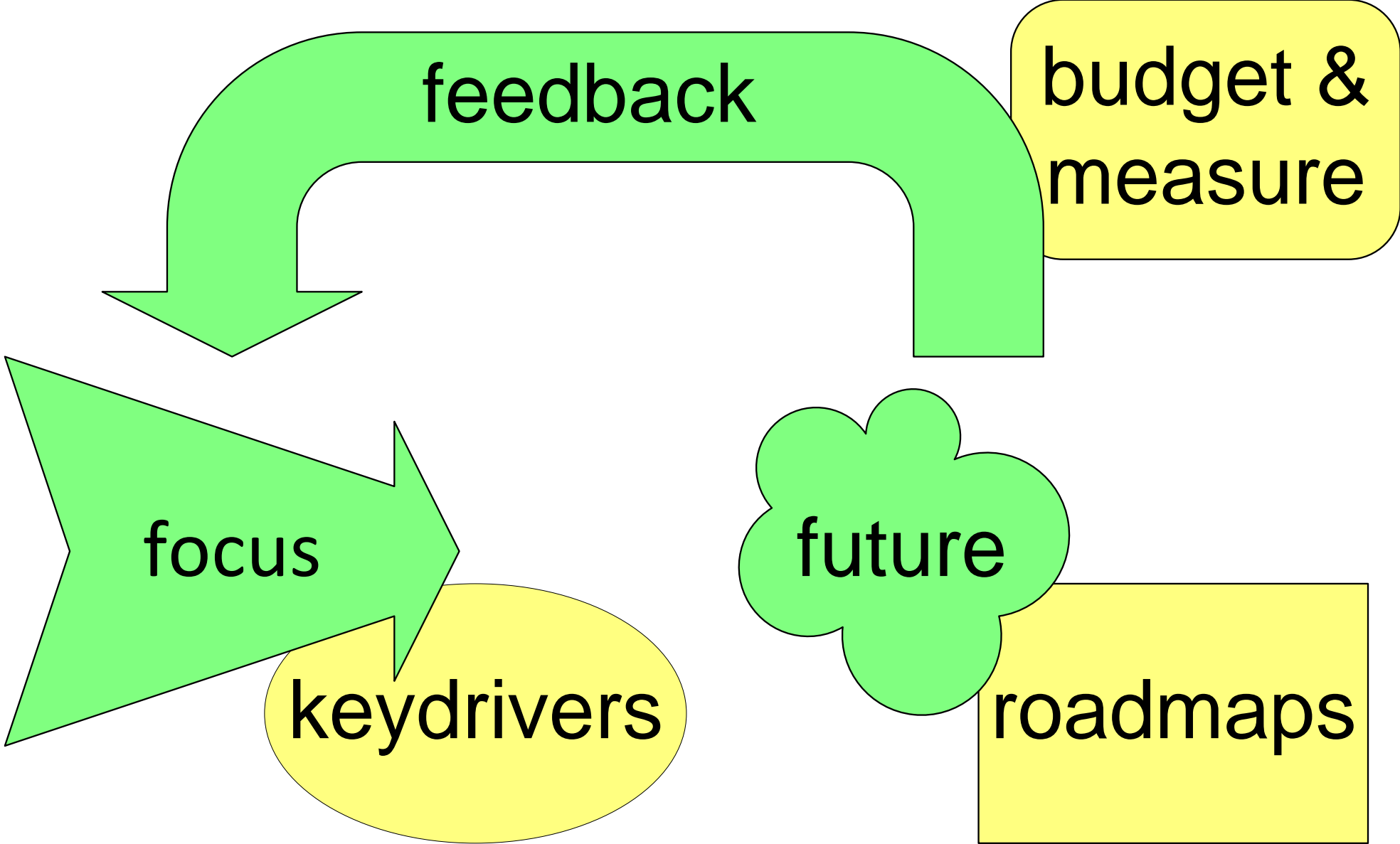
---



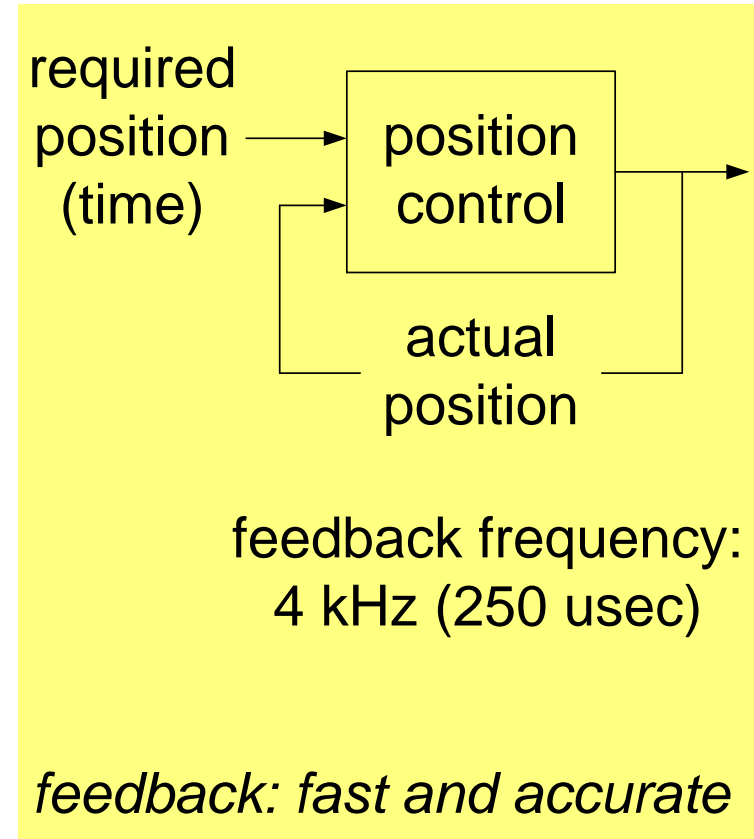
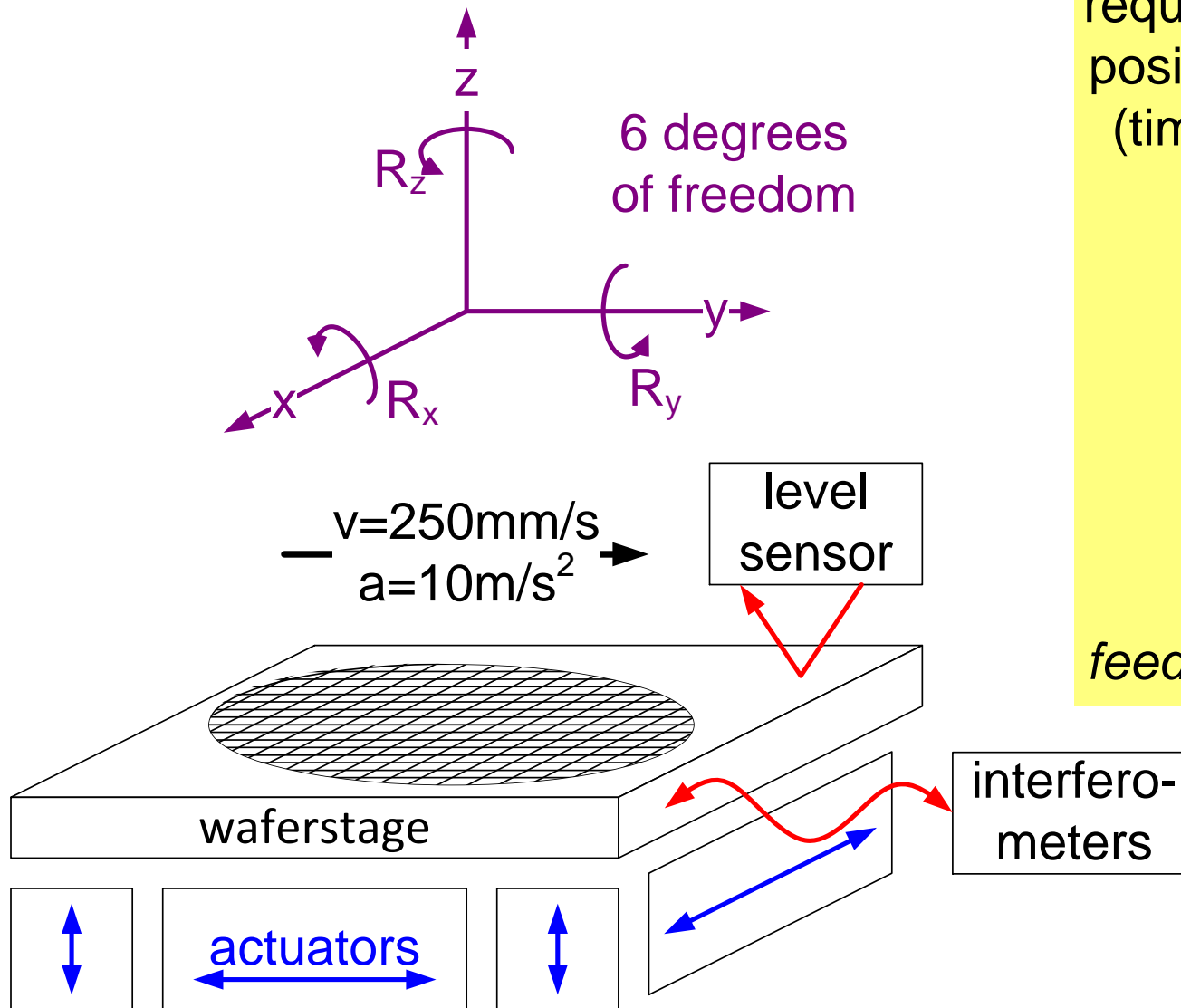
# The Software Reliability Threat



# Success factor: ASML system engineering style



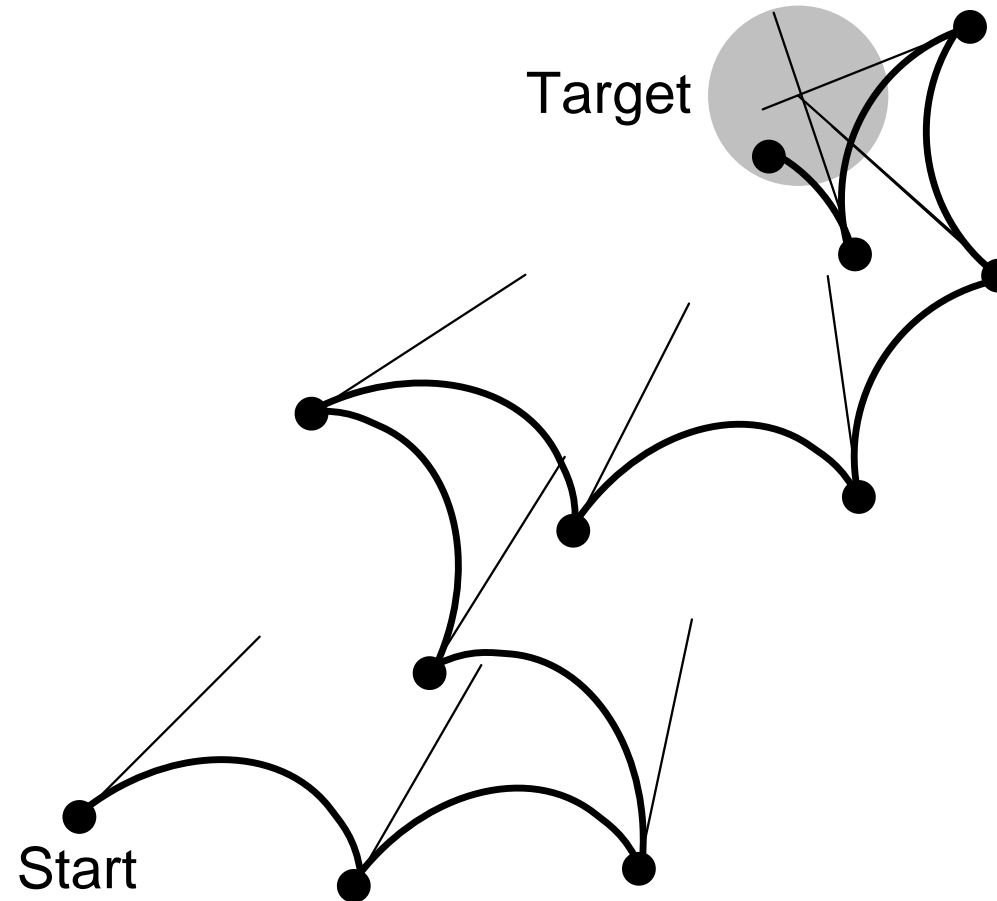
# Feedback as technical design pattern



# Feedback as development process pattern

---

stepsize: 3 months  
elapsed time: 25 months

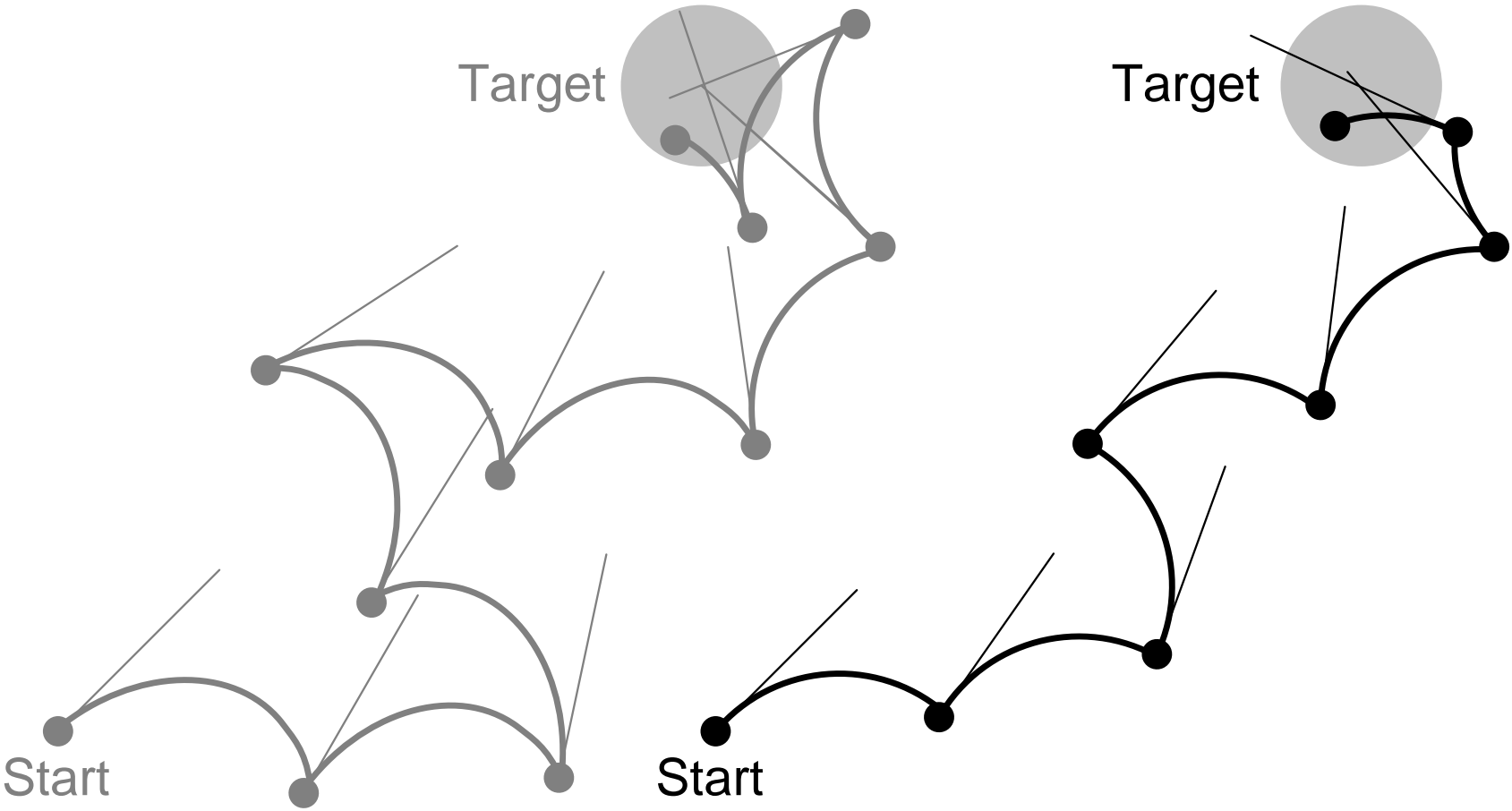


# Feedback (2)

stepsize:  
elapsed time

3 months  
25 months

2 months  
12 months



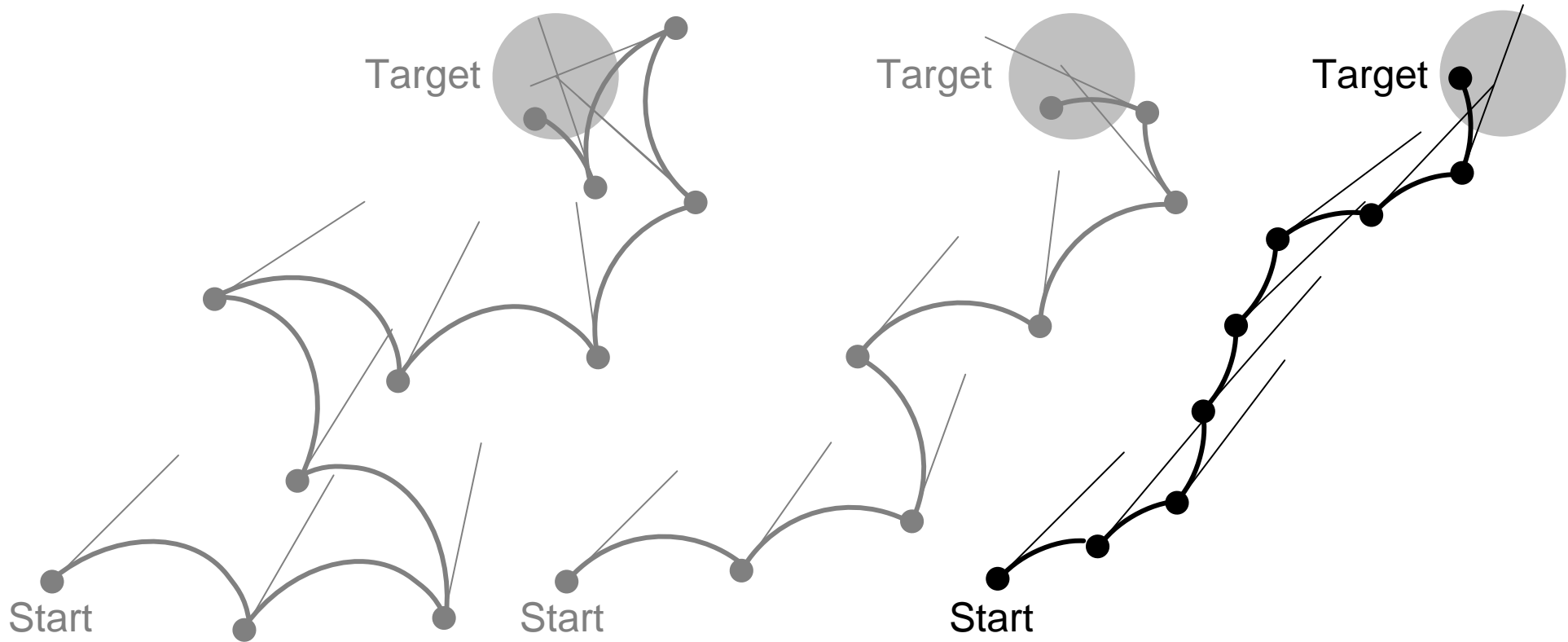
# Feedback (3)

stepsize:  
elapsed time

3 months  
25 months

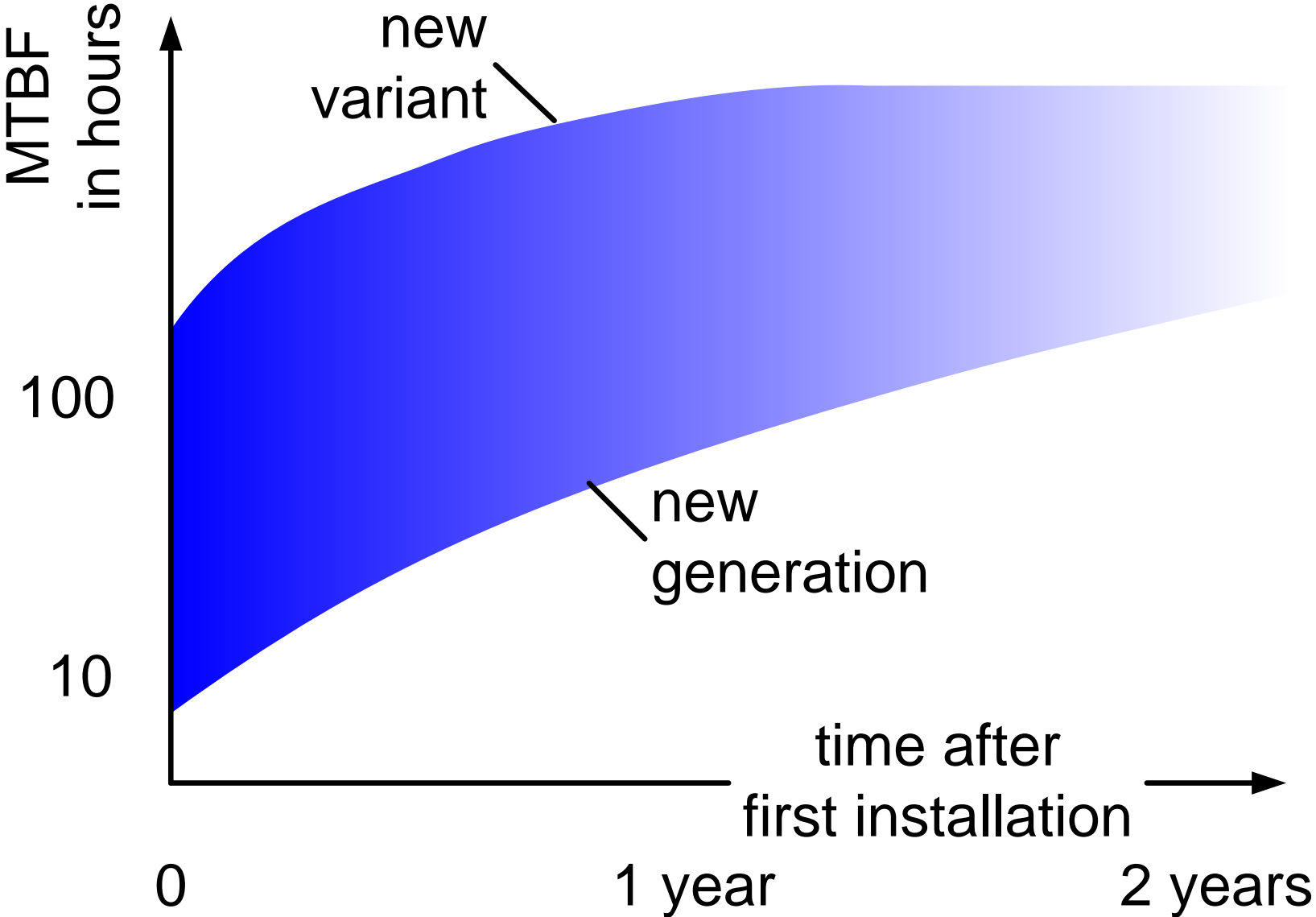
2 months  
12 months

1 month  
8 months



Small feedback cycles result in Faster Time to Market

# MTBF as function of time



# Focus via key drivers

Mission statement

Value of Ownership

Cost per function

Critical Dimension

Overlay

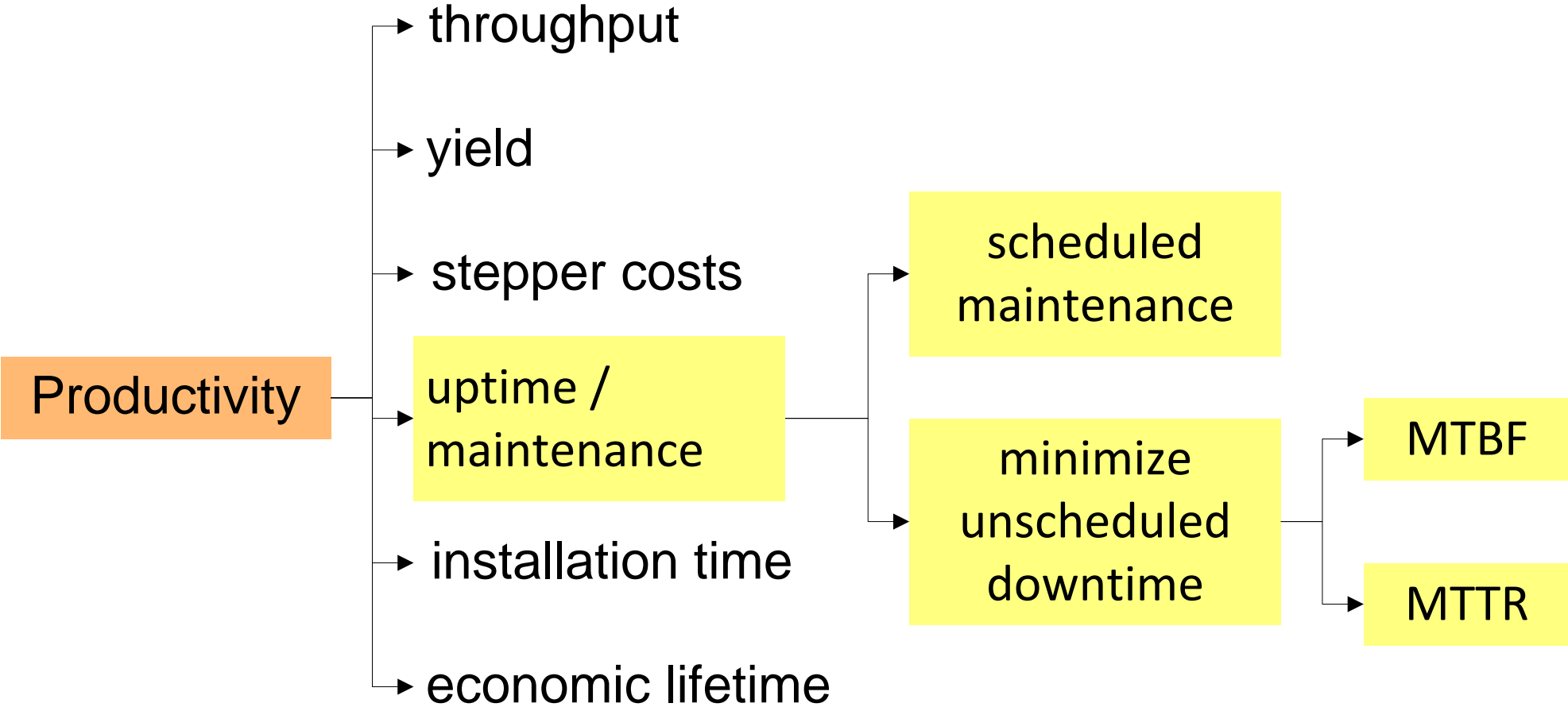
Productivity

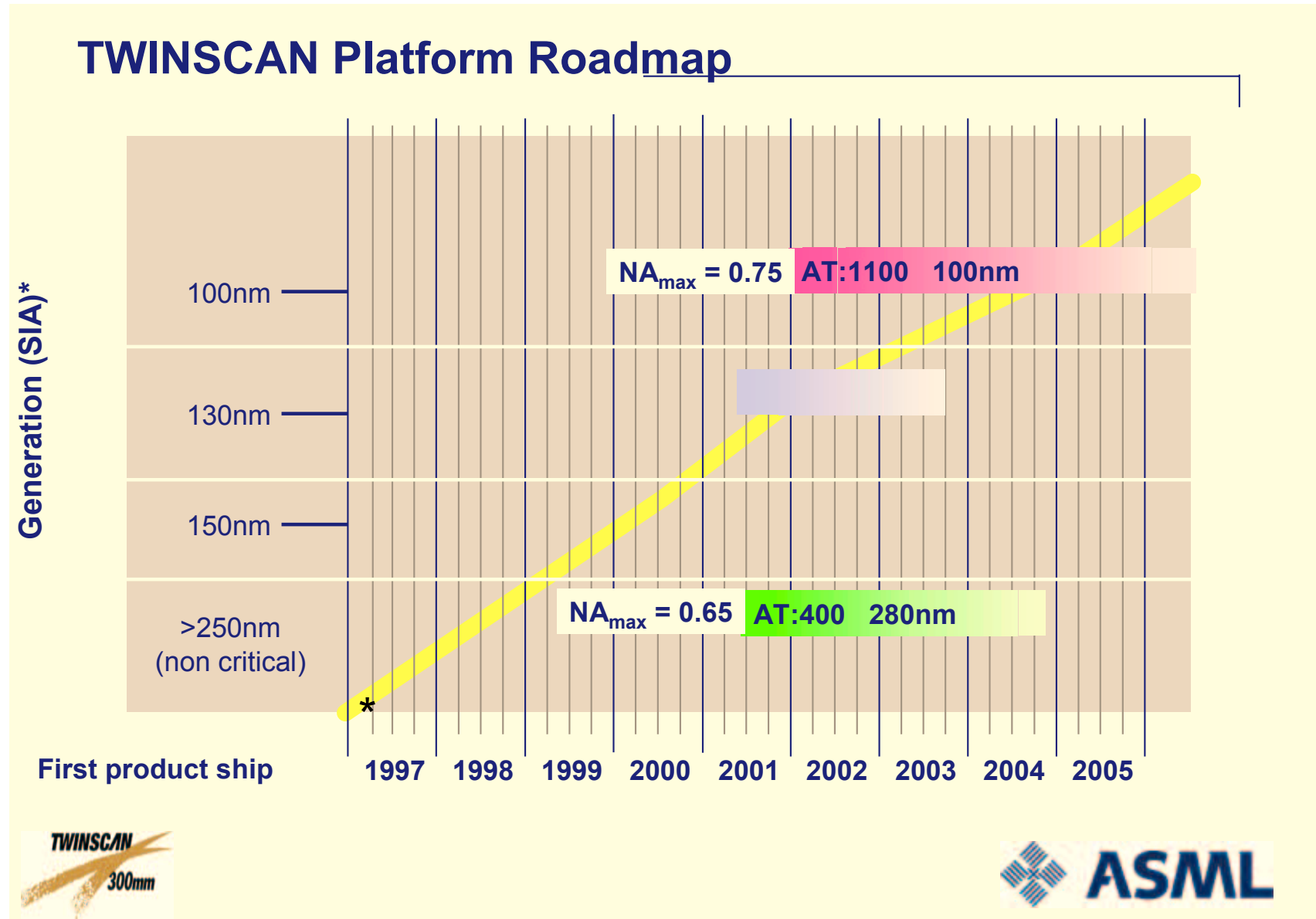
Customer satisfaction

Product added value

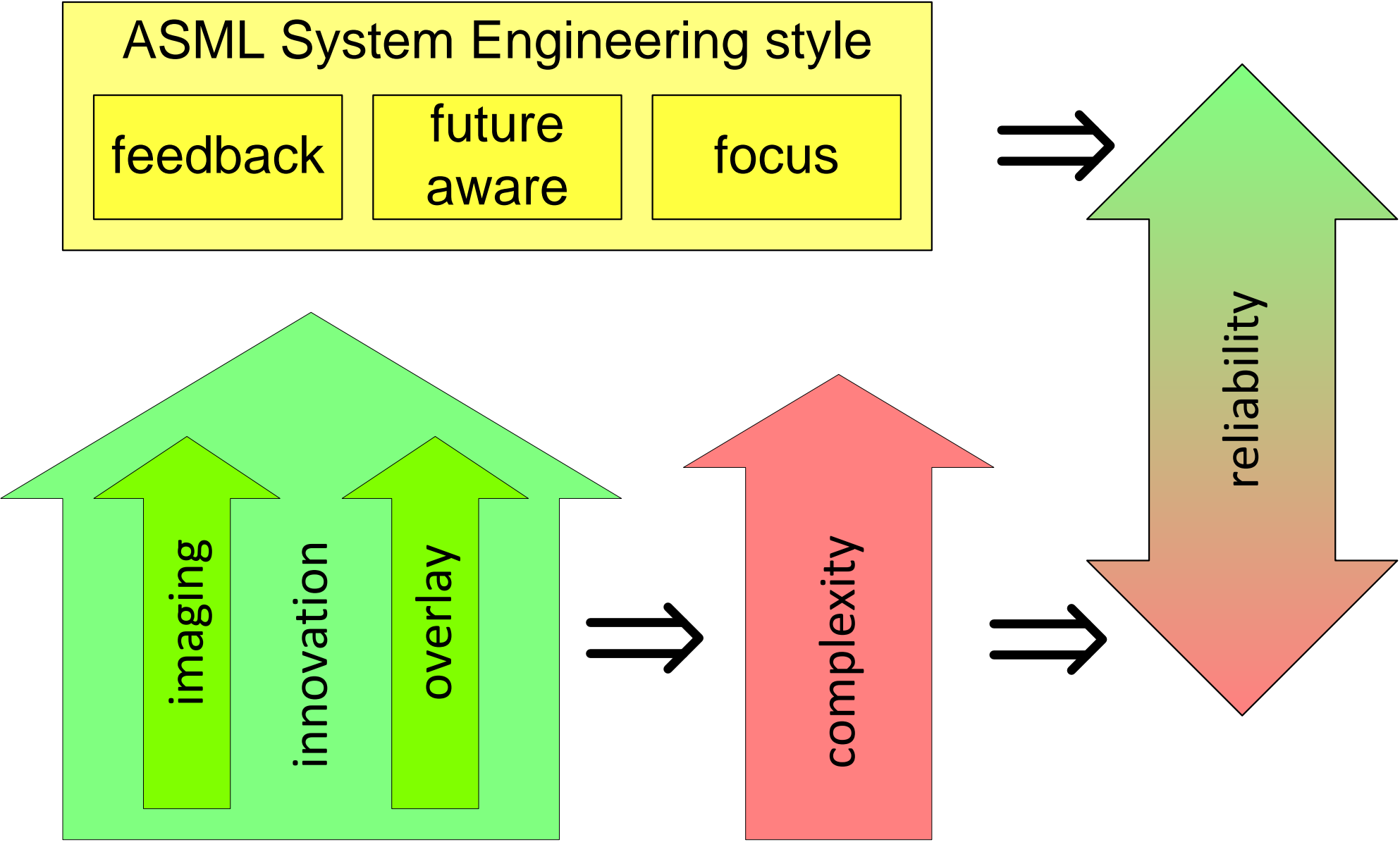
First year's shipment

# Productivity decomposed





# Conclusion



## disclaimer

The case material is based on actual data, from a complex context with large commercial interests. The material is ***simplified*** to increase the accessibility, while at the same time ***small changes*** have been made to remove commercial sensitivity. Commercial sensitivity is further reduced by using relatively ***old*** data (between 5 and 10 years in the past). Care has been taken that the illustrative value is maintained