INSPIRING INNOVATION | INNOVANTE PAR TRADITION

Ecole Nationale Supérieure des Mines SAINT-ETIENNE

A novel approach to minimize the number of controls in the defectivity area

November, 18th 2010

J. Nduhura Munga[1,2], S. Dauzère-Pérès[1], C. Yugma[1], P. Vialletelle[2]

1-EMSE-CMP, 880, avenue de Mimet,
13120 Gardanne

2-STMicroelectronics Crolles
850 Rue Jean Monnet,
38926 Crolles,

AGENDA

- Introduction
- Problem formulation
- Algorithm description
- Results
- Conclusion and perspectives

1. Introduction

Controls in semiconductor manufacturing

FDC + **R2R** + **SPC** + … + **NPW (*Non Product Wafers)* Vs. Defectivity**

Question : Over- or under-control?

Introduction

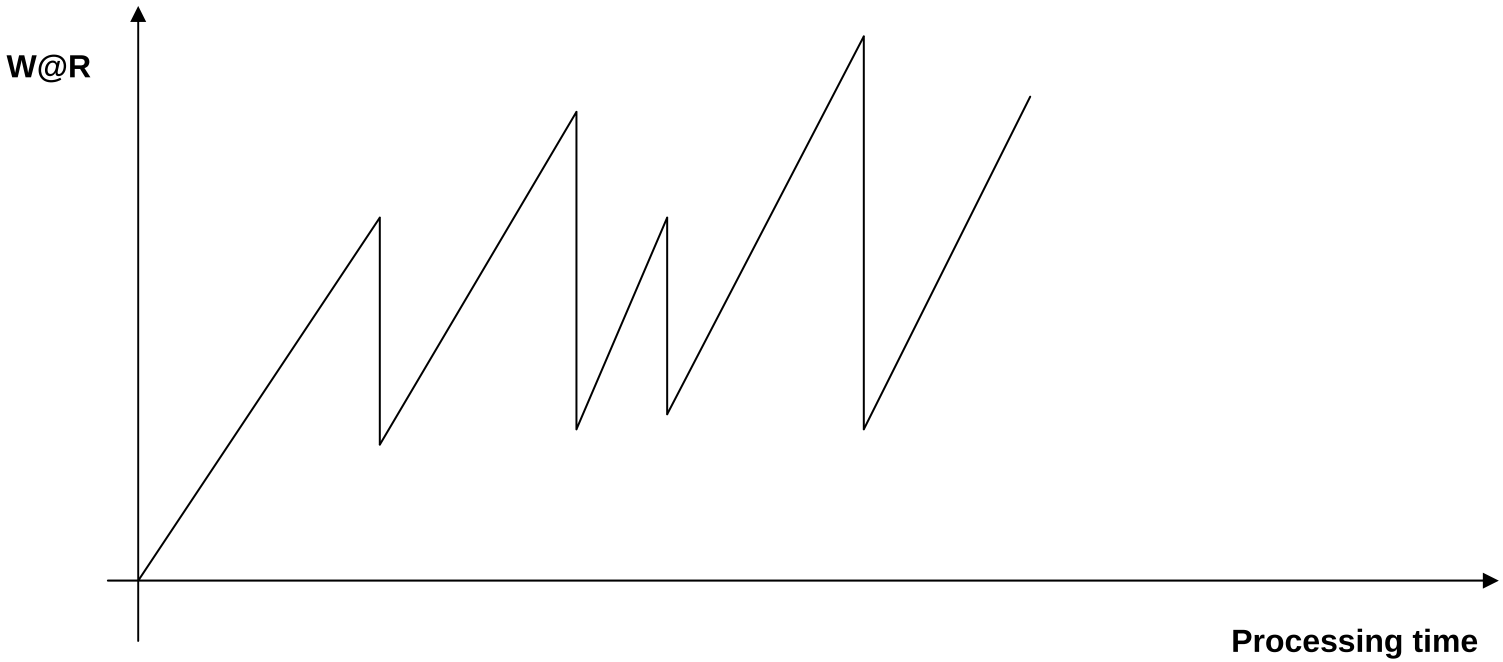
- **Focus : Defectivity controls**

- Objectives:
  - Assess the adequacy of controls in defectivity
  - Determine whether there is an over- or under-control
  - Master dynamically risk* on various tools of production through defectivity controls
  - Save capacity in defectivity through intelligent skip of product which do not bring relevant information

****risk = number of products processed on an equipment between two controls in defectivity***

2. Problem formulation

W@R : Wafers at risk = Number of wafers processed on a tool since the process of the lastest control



- **When does the situation starts to become critical?**
- **Which kind of action should be taken?**

Ecole Nationale Supérieure des Mines SAINT-ETIENNE

Problem formulation

www.emse.fr

INSPIRING INNOVATION | INNOVANTE PAR TRADITION

- How to evaluate the w@R in real-time as quickly as possible?
- How to define limits above which the situation starts to become critical?
- Is it possible to avoid critical situations? How?
- How to gather all information and how to present them for an easy interpretation?

Permanent Index per Context (PIC) computation

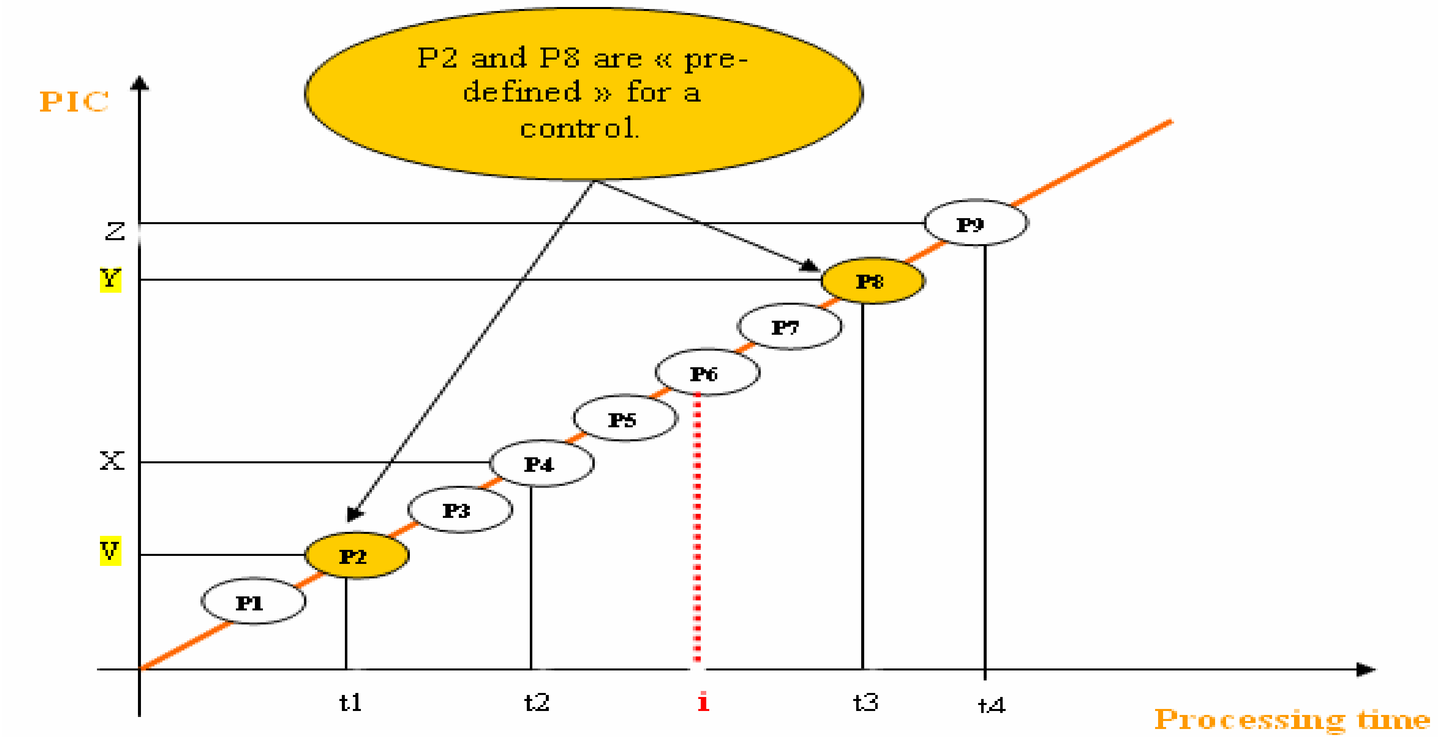
- A PIC is a counter which is incremented each time the context is verified
- The counter is never decremented but can be reset after a special event (Preventive Maintenance, Non Product Wafer, etc.)
- It allows quick and easy computation of the context
- The context for the PIC can be:
    - An equipment
    - A chamber
    - A recipe
    - Etc.

Algorithm description

- If the context is an equipment ➔ The PIC will represent the number of products processed on the equipment
- If the context is a chamber ➔The PIC will be the number of products processed in the chamber
- If the context is a recipe ➔The PIC will be the number of products processed with the same recipe
- Etc.

Algorithm description

Assumption: In the start of the production, some products are « pre-defined » for a control ➔ given by the control plan of the production and the sampling rate (e.g. one product each two)

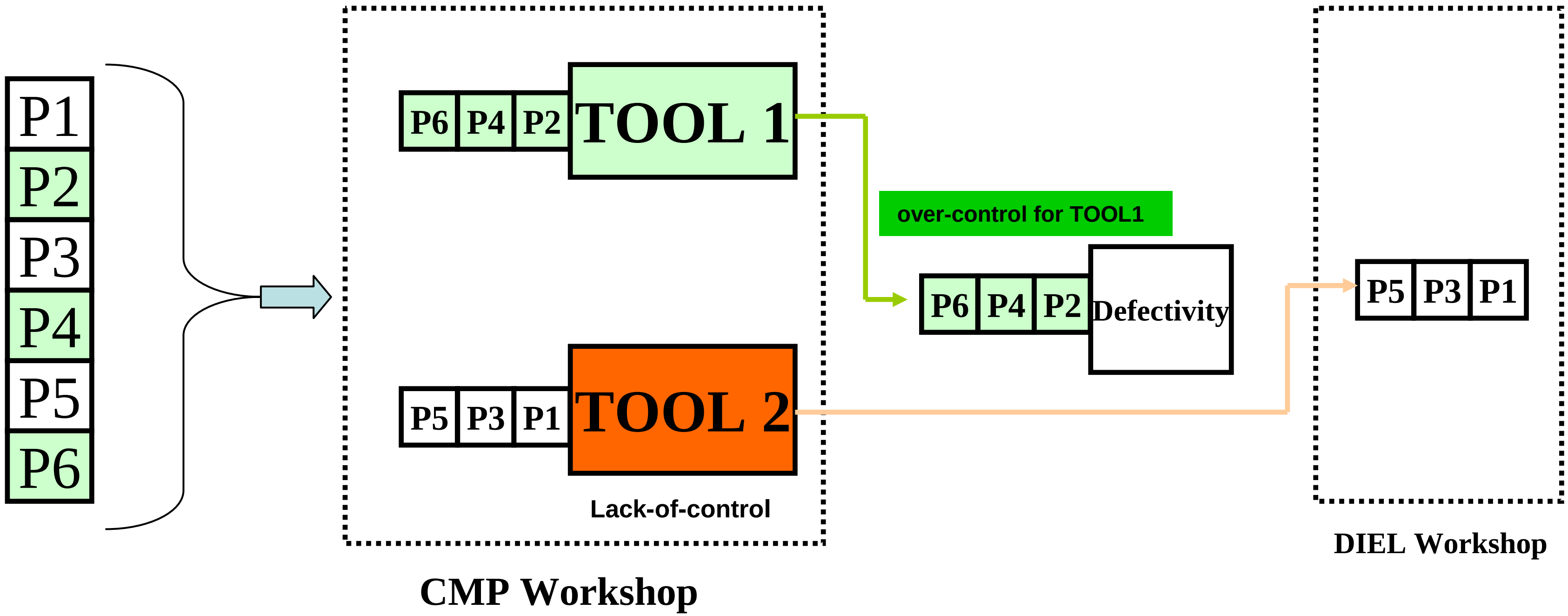


At time t3, the risk value is: Y - V

Algorithm description

Real-time risk evaluation

P2, P4 and P6 are « pre-defined » for a control in the defectivity area



Algorithm description

- The combination of steps 1 and 2 of the algorithm give us information such as :

TOOL A
W@R = 500

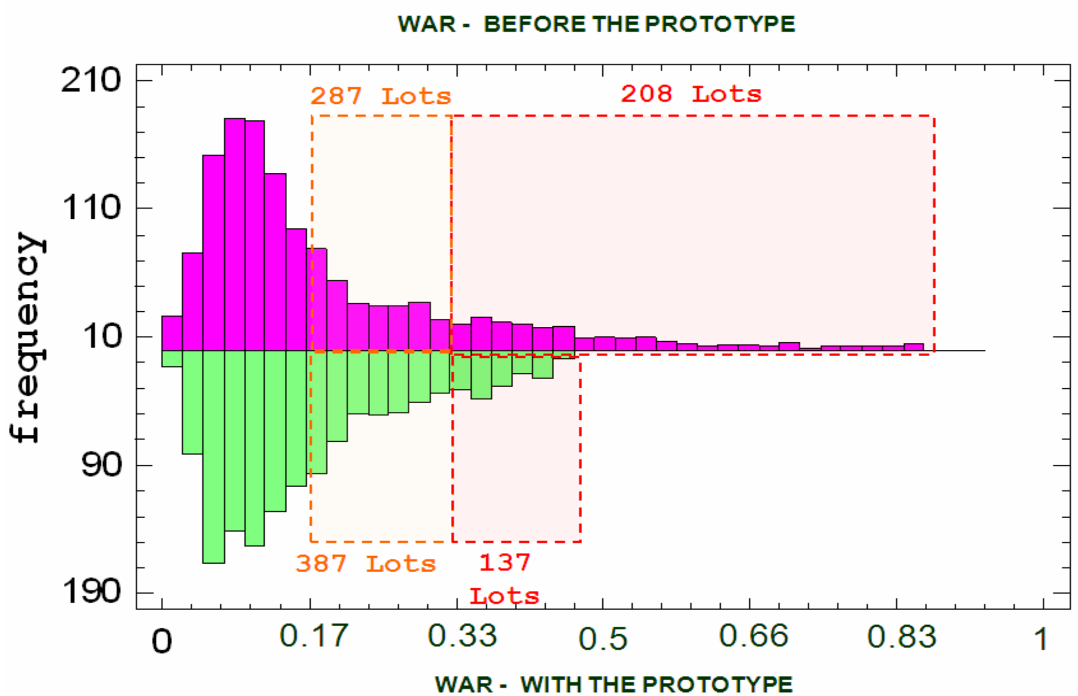
Lot XXY.01

- The information on the real-time state of the production is given directly thanks to the PIC.
- If the context is the equipment ➔ it represents the W@R

The information on the best product(lot) that can help to reduce the risk is deduced directly from the historical data

4. Results

➢ The algorithm has been embedded in a prototype for a direct use in the production line.



➢ After two weeks, the number of lots with a risk higher than 0.33 were strongly reduced (137 Vs. 208).

Conclusion

- Major cases of over- and under-control have been pointed out
- Capacity in metrology could be saved through intelligent skips of lots which do not bring relevant information
- Some types (places) of controls have been reviewed
- The algorithm has been deployed and validated for one workshop ➔ need to consider the depth of the control and impact of other workshops (GSI – Global Sampling Indicator)
- The time between process and measurement should be considered to determine when the situation starts to become critical

Conclusion

- This work is supported by the ENIAC project IMPROVE (Implementing Manufacturing science solutions to increase equiPment pROductiVity and fab pErformance)
- Collaboration : ST-Crolles and EMSE
- The algorithm described in this presentation has been developped and implemented within the framework of a PhD CIFRE.

THANK YOU FOR YOUR ATTENTION