

# European initiative: MICROMAN – European Training Network on Process Fingerprint for Zero-defect Net-shape Micromanufacturing

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The International Academy for Production Engineering (CIRP)

65th General Assembly (Cape Town, South Africa)

August 28<sup>th</sup> 2015, STC 'P'

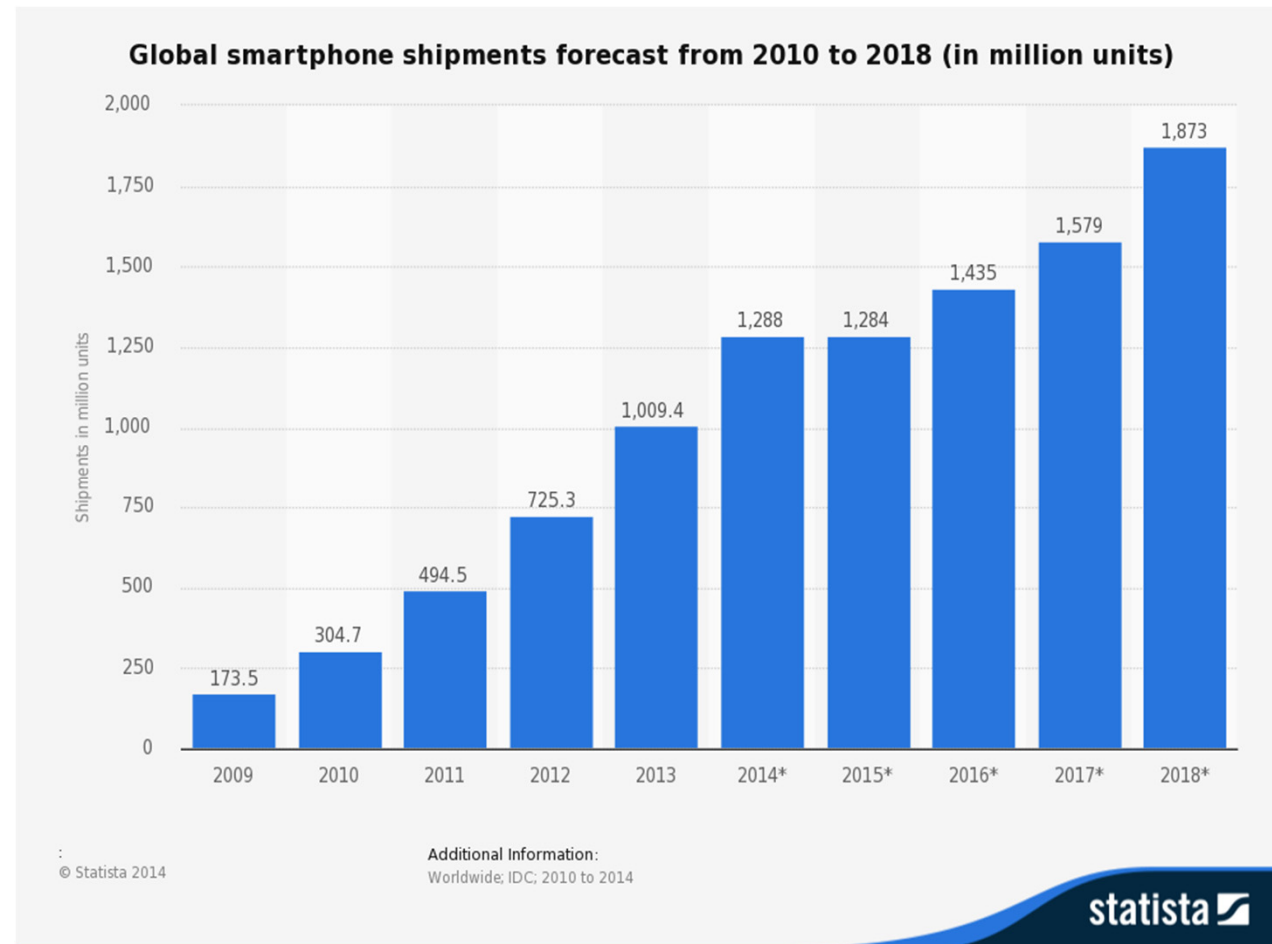
**DTU Mechanical Engineering**  
Department of Mechanical Engineering

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# Global trends – Society

- Ubiquitous connectivity



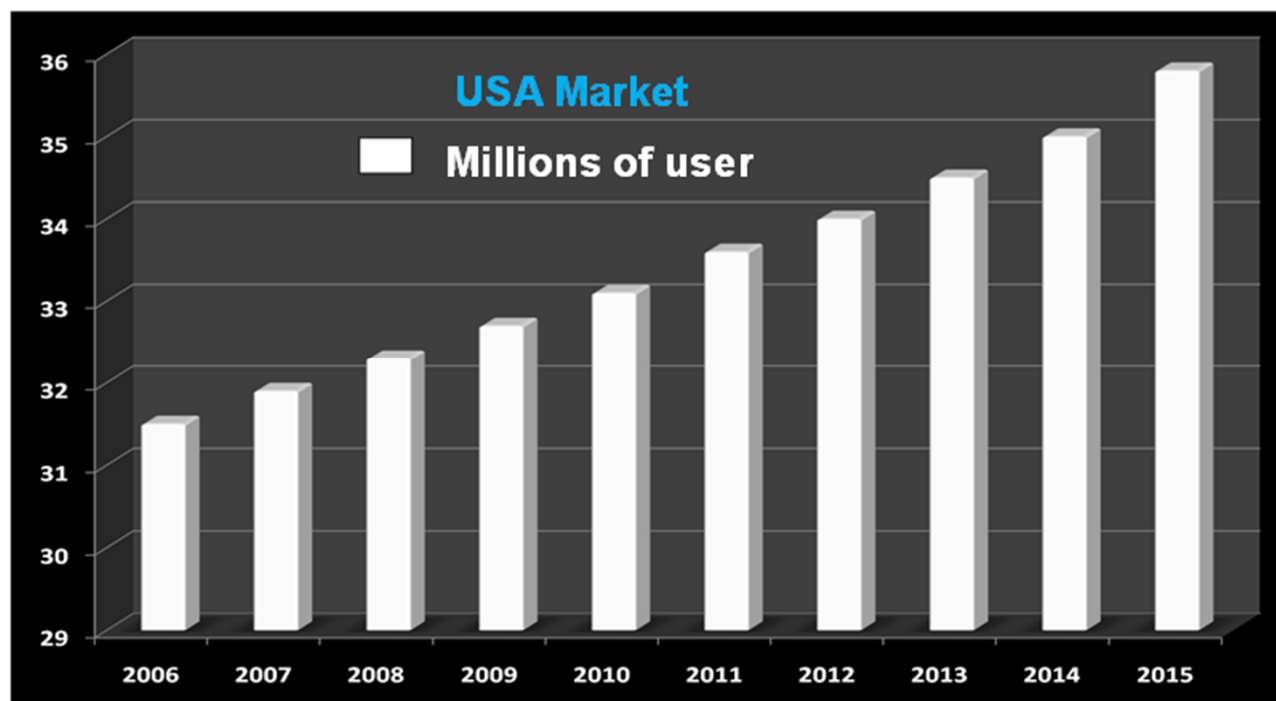
# Global trends – Society

- Ubiquitous connectivity



# Global trends – Ageing population

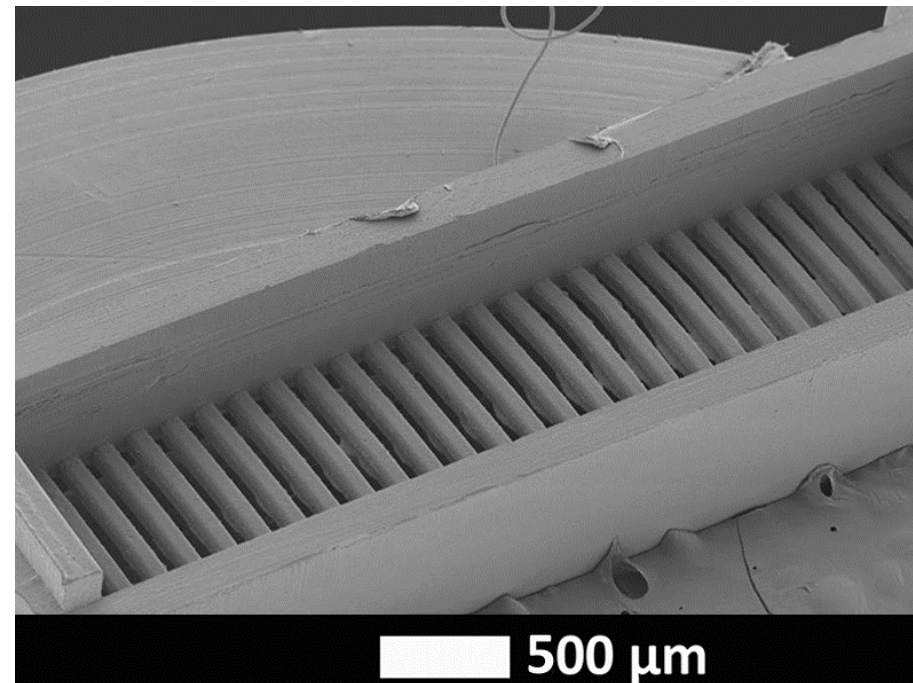
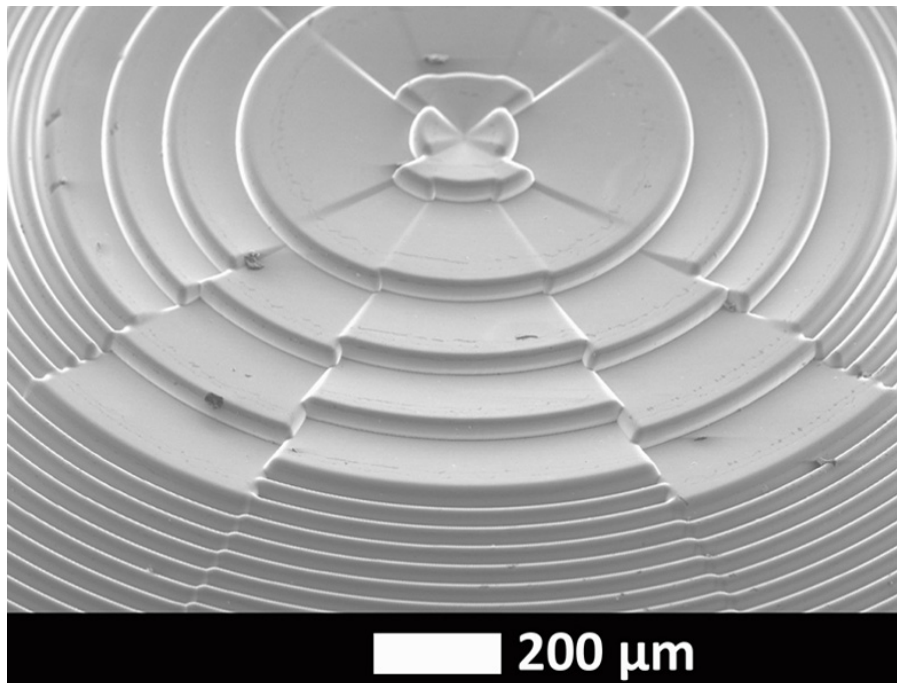
- Hearing ability, communication, well-being



28/08/2015

# Global trends – Miniaturization

- High precision micro manufacturing
- Mass fabrication
- Quality assurance
- Skills & expertise

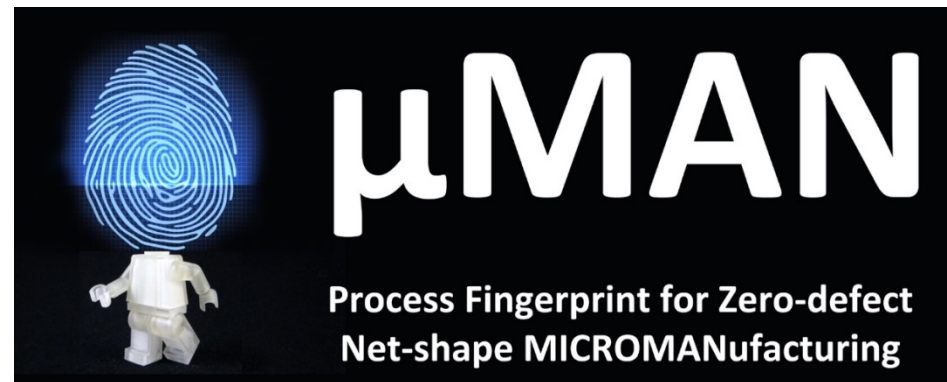




# Project Identity Card

## EU H2020 MARIE SKŁODOWSKA-CURIE ACTION

### European Innovative Training Network



Starting date:	01/10/2015
Duration:	48 months



## Project objectives

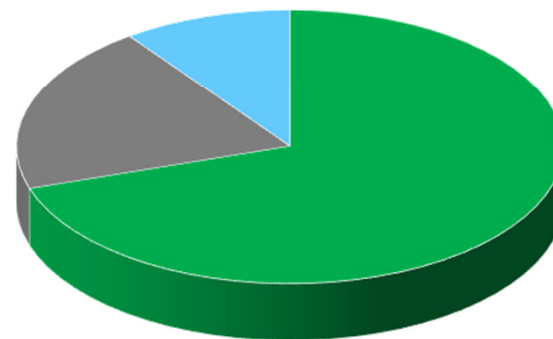
- Micro manufacturing **processes development**
- Process/product **finger print** establishment and validation
- Process/product **monitoring and quality assurance**

## Research methodology

Multi-disciplinary research approach

Research based training of 13 Early Stage Researchers

70%-20%-10% approach



- Core Micro Manuf. Technology 70%
- Complementary Micro Manuf. 20%
- Key-enabling technologies 10%

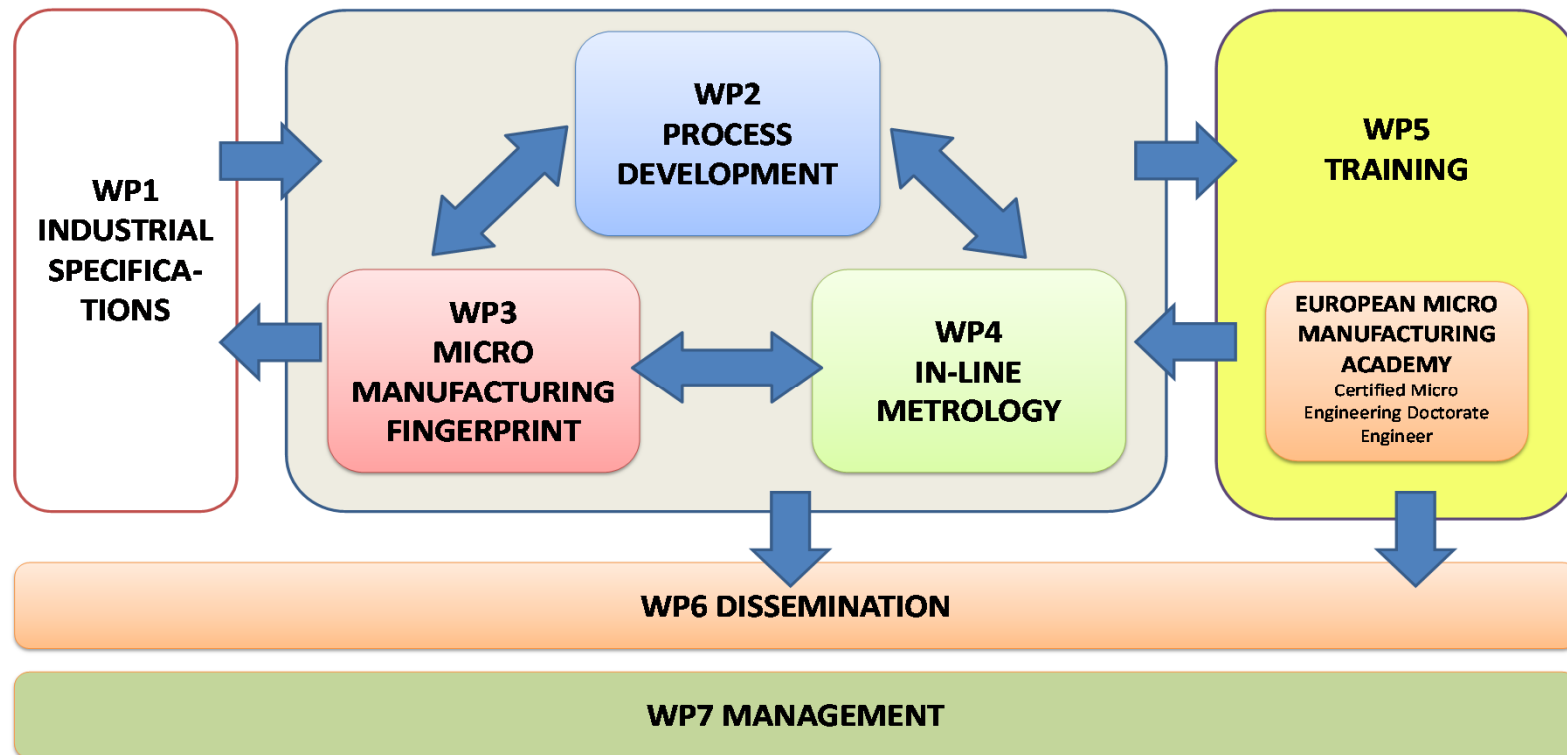


# Research methodology

ESR No.	Core Micro Manufacturing Technology	Complementary Micro Manuf. Technology(ies)	Key-enabling Technologies	Main Supervisor Partner	Industrial/ Research Partner(s)	Key-industrial application
	70%	20%	10%			
1.	$\mu$ -Injection Moulding	$\mu$ -Milling, $\mu$ -EDM	Process monitoring Micro metrology	DTU	ORTOFON	Non-invasive brain surgery
2.	$\mu$ -Mechanical Polishining	$\mu$ -Forming, $\mu$ -EDM	Process monitoring Micro metrology	DTU	STRECON	Machine tool, $\mu$ -die industry
3.	$\mu$ -EDM	$\mu$ -Milling	Process monitoring Micro metrology	KUL	SARIX	Machine tool, $\mu$ -tool industry
4.	$\mu$ -ECM milling	$\mu$ -EDM	Process monitoring Micro metrology	KUL	SARIX	Machine tool, $\mu$ -tool industry
5.	$\mu$ -ECM milling	$\mu$ -Jet ECM	Process monitoring Micro metrology	TUC	ECM TECHNOLOGIES	$\mu$ -tool industry, surgical instr.
6.	$\mu$ -Plasma Polishing	$\mu$ -Forming	Process monitoring Micro metrology	TUC	BTE, ECM TECHNOLOGIES	Machine tool, surgical instr.
7.	$\mu$ -Grinding	$\mu$ -Milling, $\mu$ -Polishing	Process monitoring Micro metrology	UBREM	SIOS	Dental impl., metrology
8.	$\mu$ -Injection Moulding	$\mu$ -Milling, $\mu$ -Polishing	Process monitoring Micro metrology	UBREM	DESMA, POLYOPTICS	Machine tool, surgical instr.
9.	$\mu$ -Forming	$\mu$ -Milling	Process monitoring Micro metrology	USTRAT	PASCOE ENG. LTD	Surgical instruments
10.	$\mu$ -Extrusion	$\mu$ -Milling, $\mu$ -Polishing	Process monitoring Micro metrology	POLIMI	ENKI, MARPOSS	Medical tech., metrology
11.	Integrated Micro Manuf. Metrology	$\mu$ -Injection Moulding	Process monitoring Micro metrology	UNOTT	ALICONA	Metrology instrumentation
12.	$\mu$ -Forming	$\mu$ -EDM	Process monitoring Micro metrology	IPU	DTU, STRAT	Machine tool, dental implants
13.	$\mu$ -Injection Moulding	$\mu$ -Grinding	Process monitoring Micro metrology	UBRAD	MICROSYSTEMS, ULTRASON	$\mu$ -drug delivery, machine tool



# Project work plan





# 9 Beneficiaries

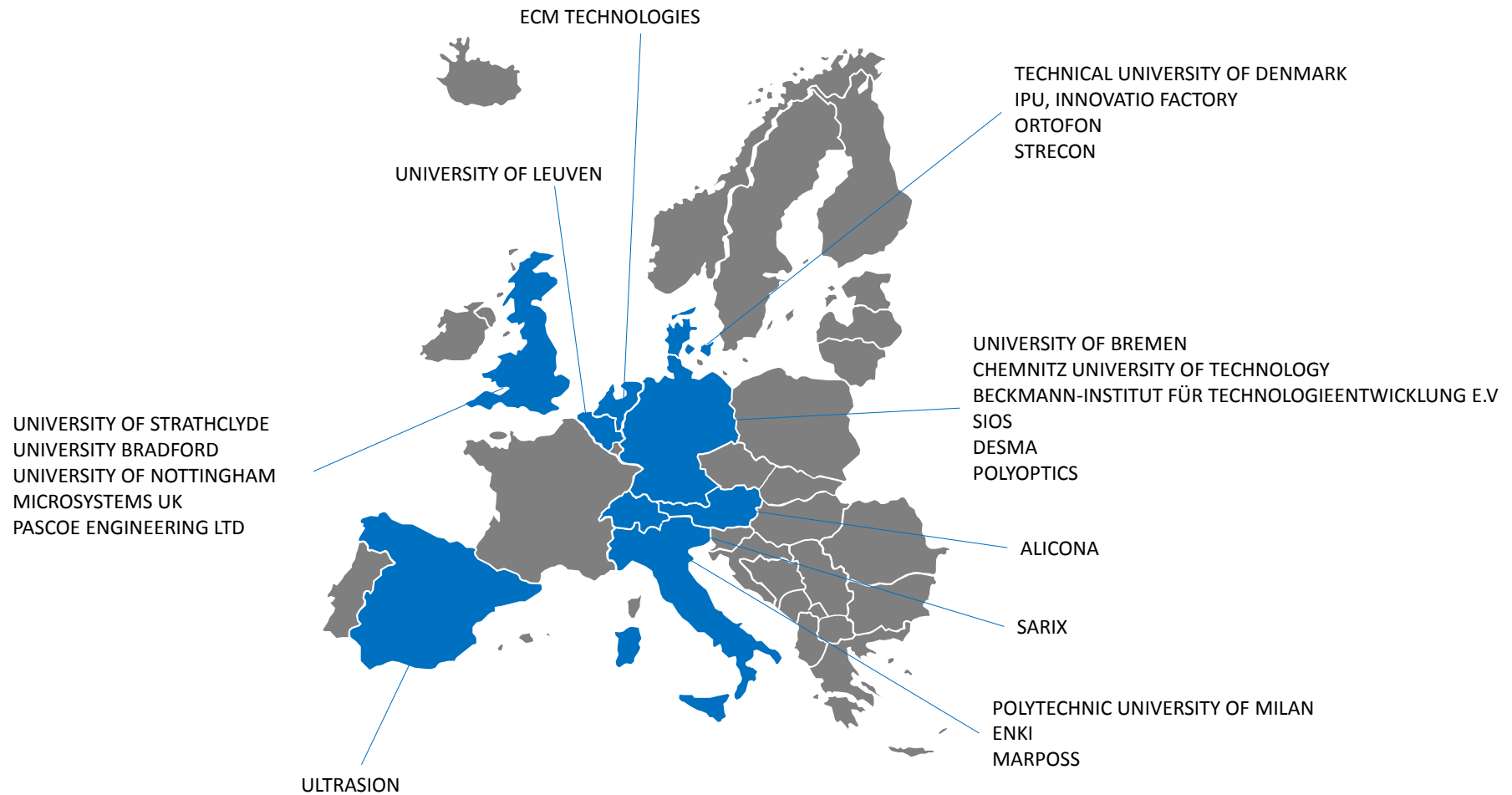


# 14 Industrial Partners

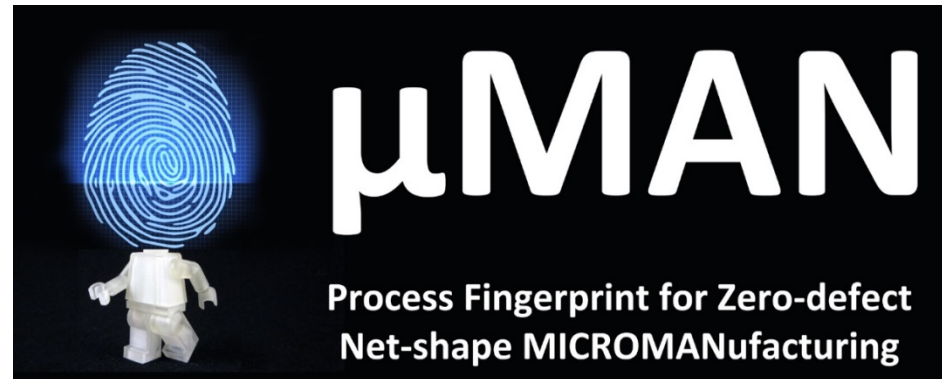




# Project consortium

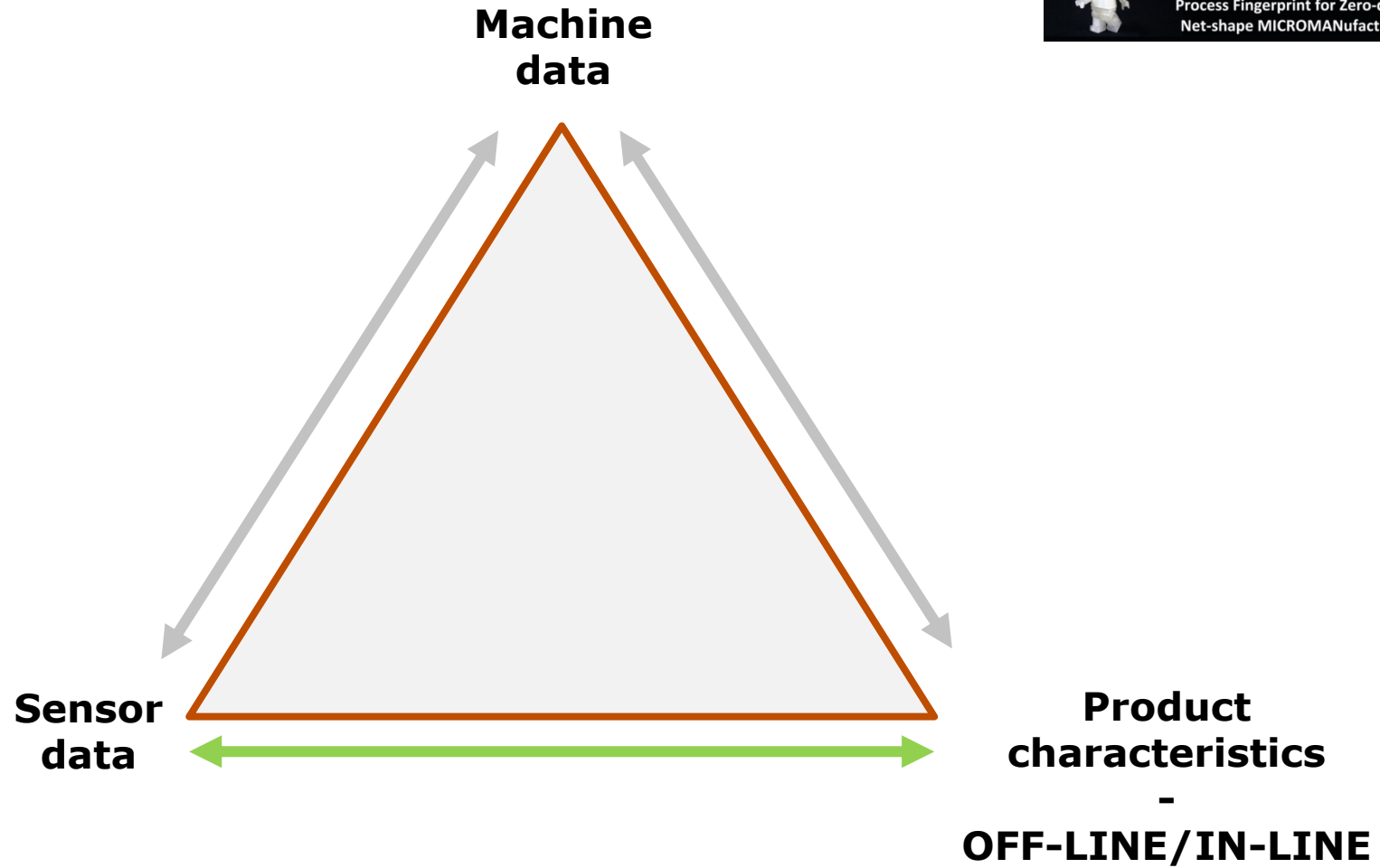


## Approach – Fingerprint / Zero-defect / Net-shape

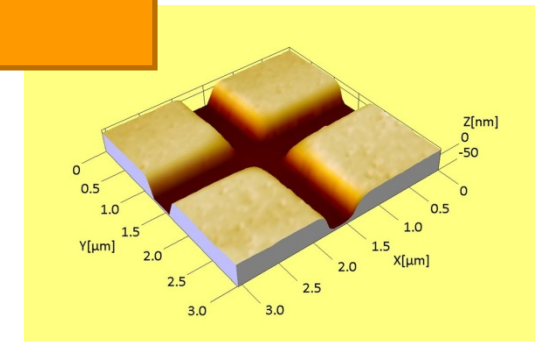
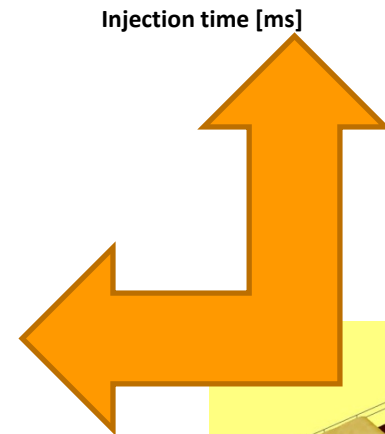
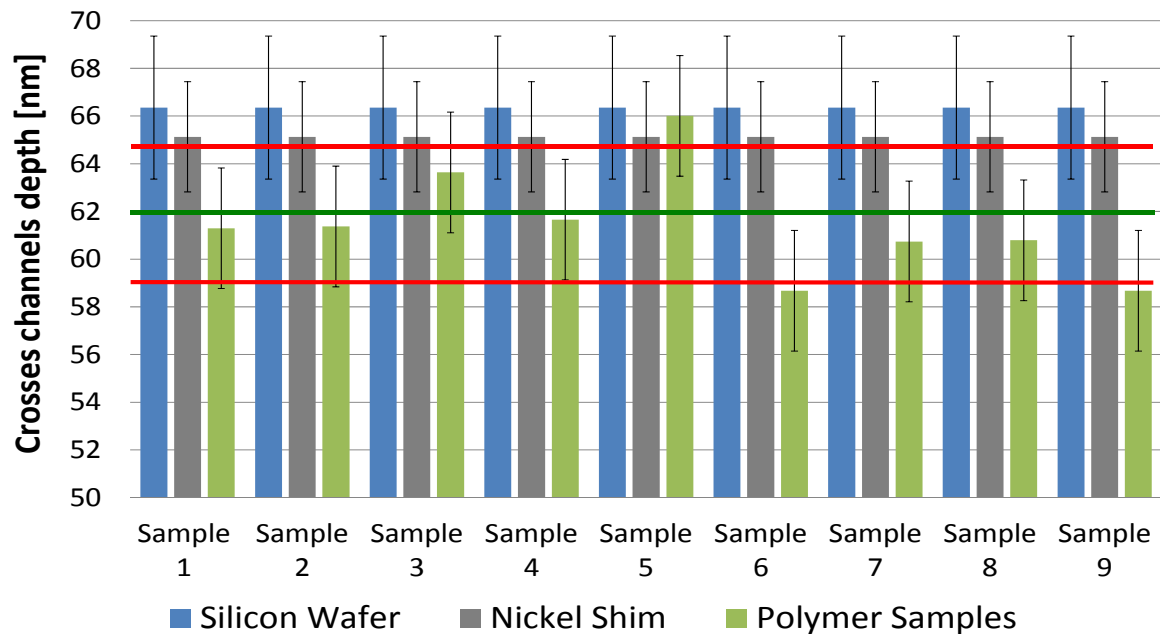
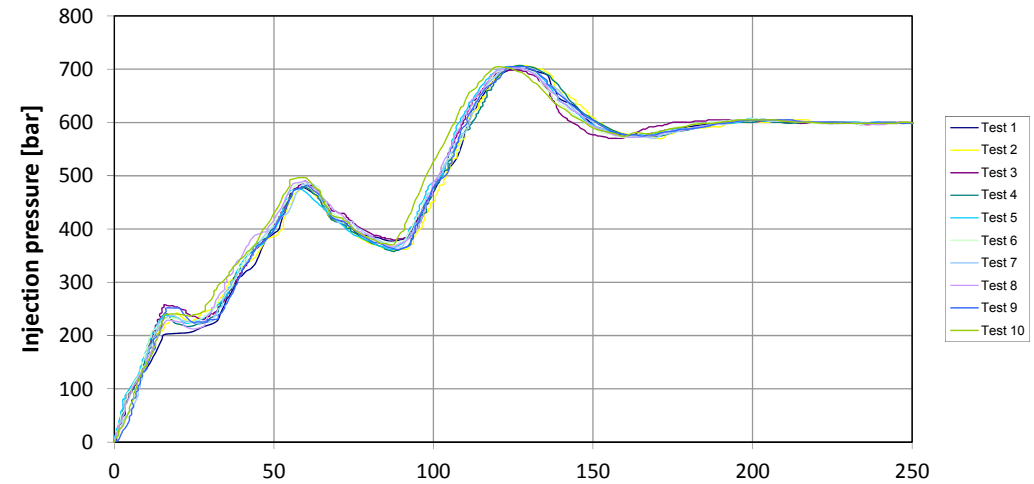
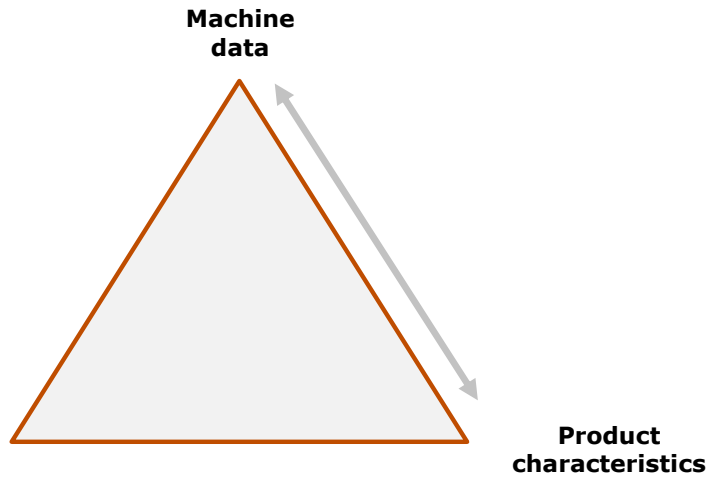


- **(1) Product Manufacturing Fingerprint**
- **(2) Process Manufacturing Fingerprint**
- **(3) Integrated Product and Process Manufacturing Fingerprint**
- MICROMAN aims at reducing the off-line metrology effort by at least 40-50% ensuring at same time zero-defect micro manufacturing processes

# Approach – Fingerprint / Zero-defect / Net-shape



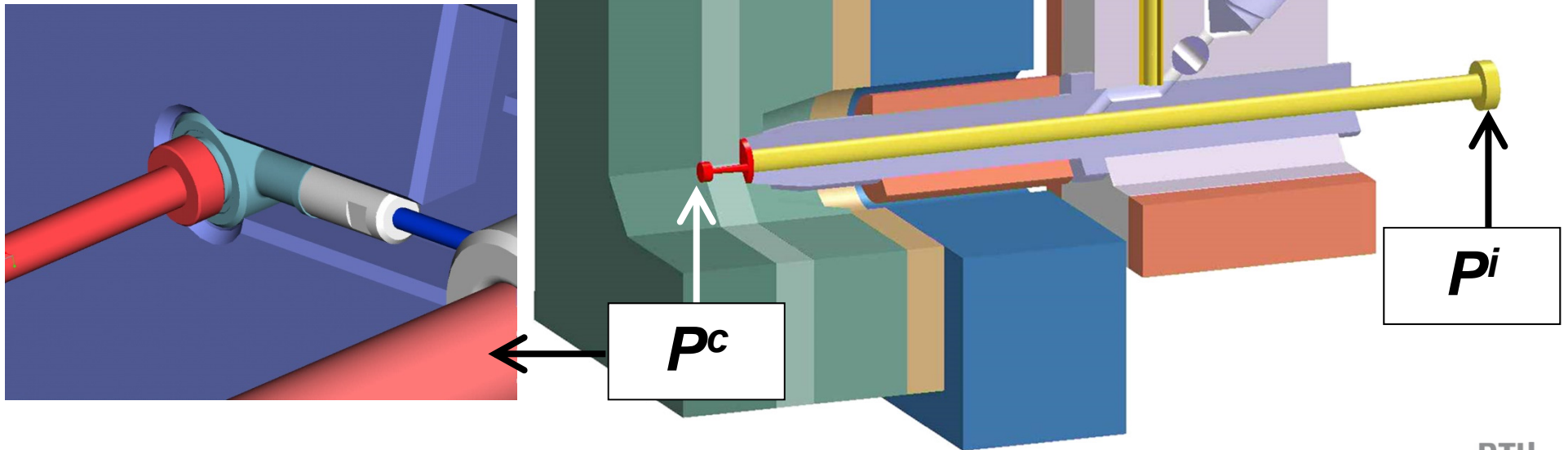
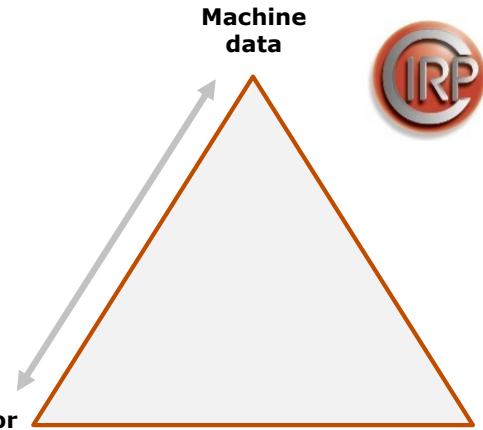
# Product/Process monitoring $\Rightarrow$ Dimensions & Injection pressure (based on machine measurements)



[Calaon, Tosello, et al. (2015) *Microsys. Technol.*, DOI10.1007/s00542-013-2025-3]

# Precision injection molding and monitoring

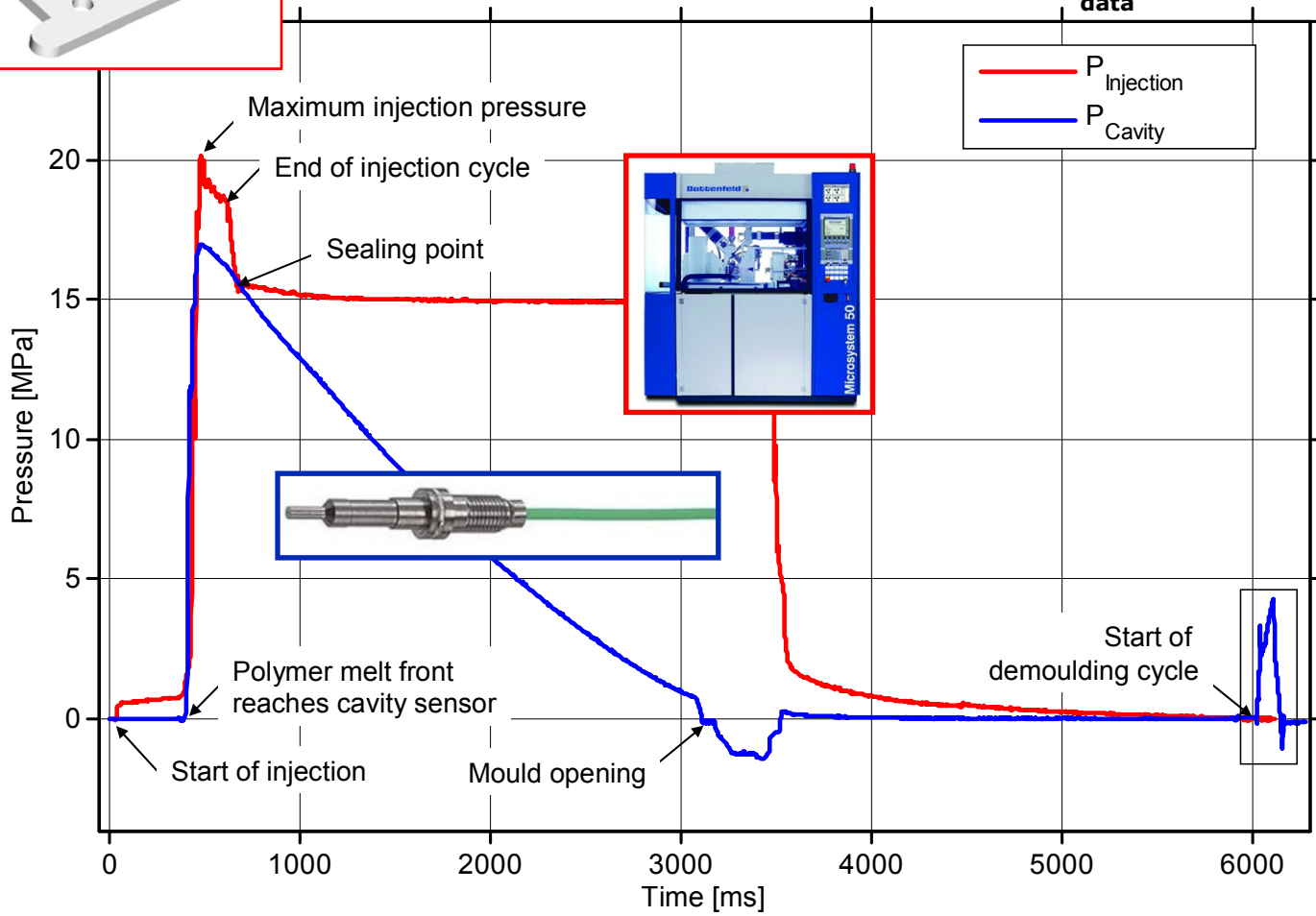
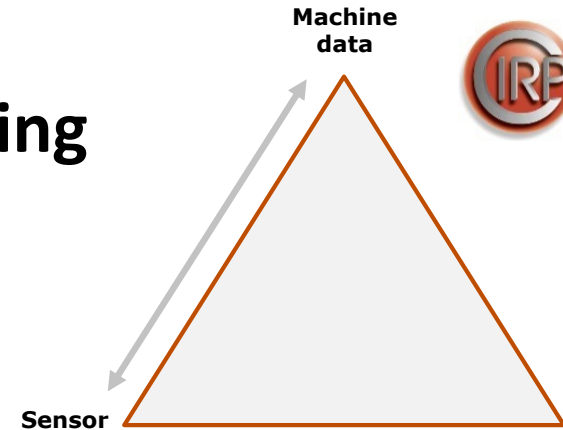
## Machine data and sensor data correlation



[Griffiths, Tosello et al. (2011), Trans. Of ASME, doi:10.1115/1.4003953]

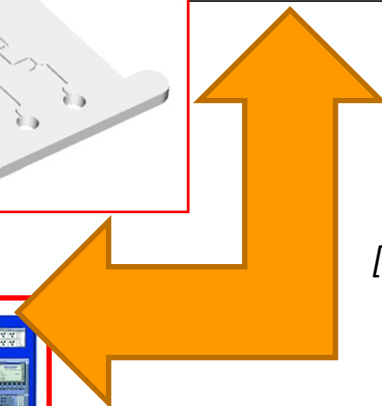
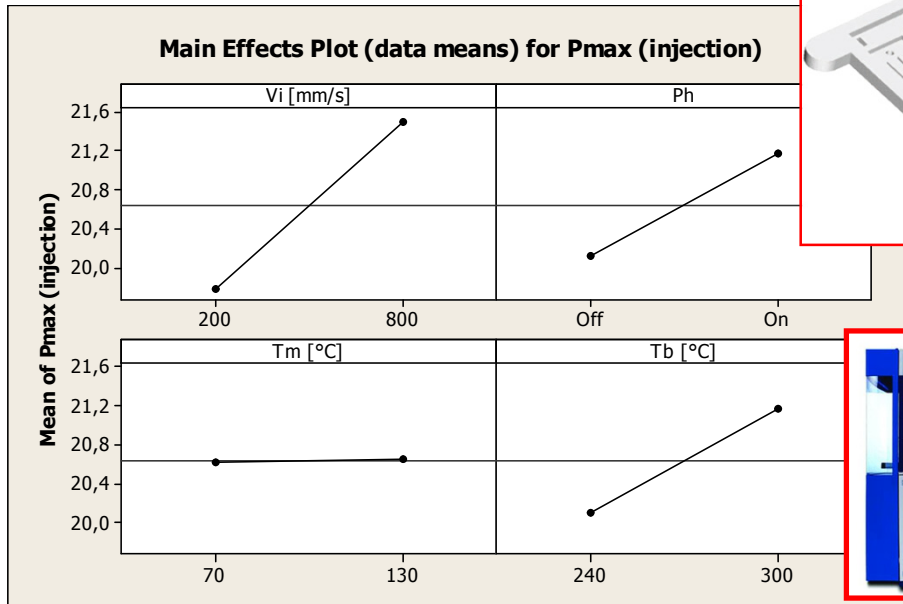
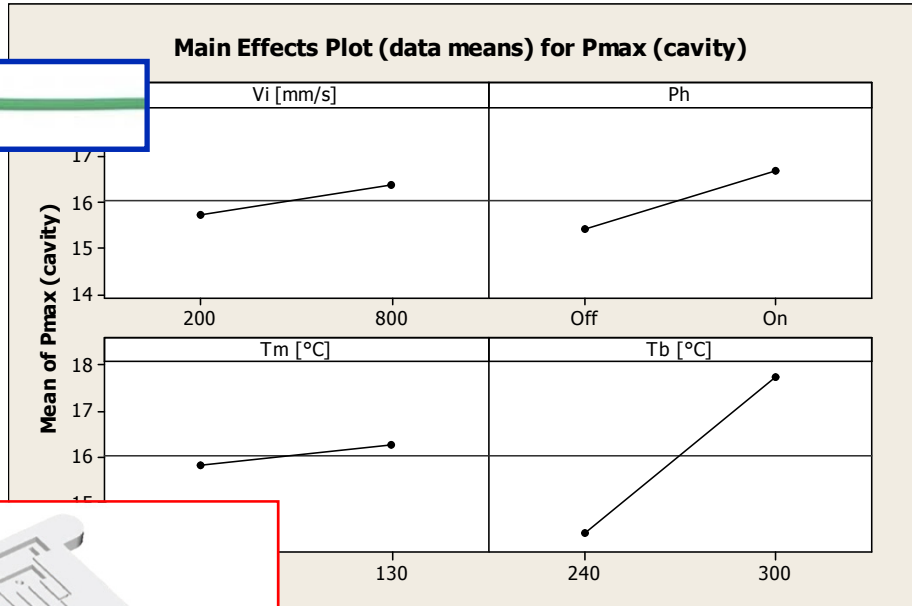
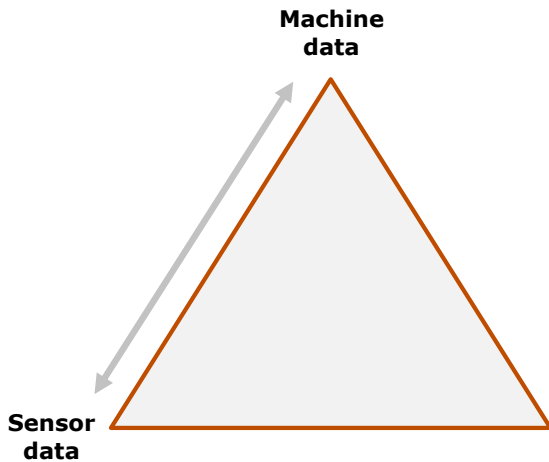


# Injection and cavity pressure monitoring



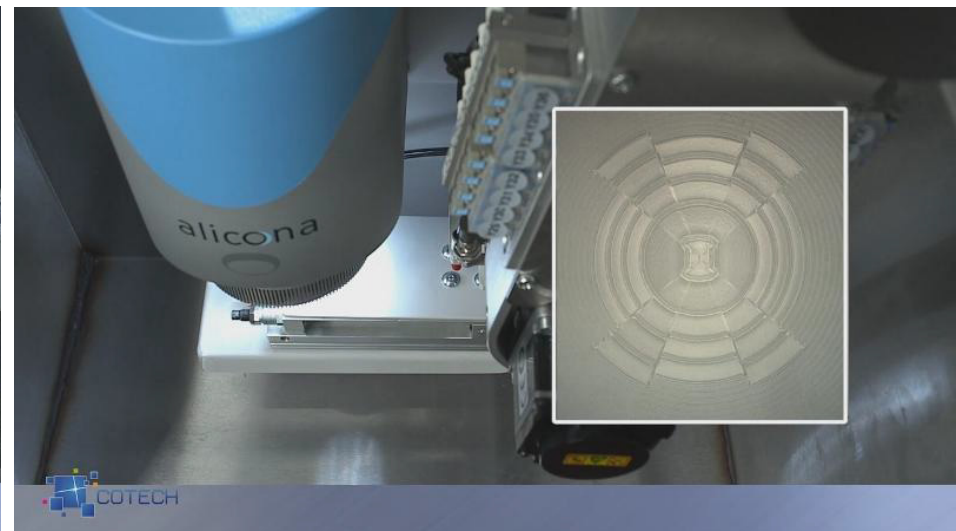
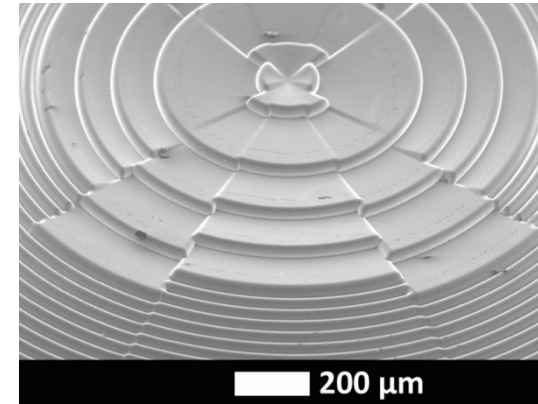


# Correlation between cavity pressure and injection pressure



[Griffiths, Tosello et al. (2011)  
 Trans. Of ASME  
 doi:10.1115/1.4003953]

# Integrated in-line metrology and micro manufacturing



<http://www.fp7-cotech.eu/179/>

# MICROMAN Micro Manufacturing Workshops Programme

<http://www.microman.mek.dtu.dk/Workshops>

- Workshop 1 – Micro Manufacturing PhD Summer School / DTU
- Workshop 2 – Micro/Nano Metrology PhD Summer School / Univ. of Nottingham
- Workshop 3 – Micro Moulding Workshop / University of Bradford (UK)
- Workshop 4 – Micro Tooling and Grinding Workshop / Univ. of Bremen
- Workshop 5 – Micro Electrical Discharge Machining Workshop / KU Leuven
- Workshop 6 – Micro electrochemical Machining ( $\mu$ ECM) / TU Chemnitz
- Workshop 7 – Micro Forming Workshop / University of Strathclyde (UK)
- Workshop 8 –  $\mu$ -Milling and  $\mu$ -Extrusion Workshops / Politecnico di Milano





## MICROMAN highlights

- Micro manufacturing process fingerprint, zero-defect net-shape  $\mu$ -manufacturing
- Multi-disciplinary training
- Industrial validation of  $\mu$ -manufacturing processes
- Industrial applications → bio-medical, health-care, machine tool, pharmaceutical, quality control and metrology sectors
- Integrated PROCESS/PRODUCT monitoring and quality assurance

University of Strathclyde  
University of Bradford  
University of Nottingham  
Microsystems Ltd  
Pascoe Engineering Ltd

Katholieke Universiteit  
Leuven

ECM Technologies

Technical  
University of  
Denmark  
IPU Innovation  
Factory  
Ortofon  
Microtech  
Strecon A/S



University of Bremen  
Chemnitz University of  
Technology  
Beckmann-Institut für  
Technologie-  
Entwicklung E.V.  
SIOS Meßtechnik GmbH  
DESMA TEC  
Polyoptics GmbH

Alicona Imaging  
GmbH

Ultrason, S.L.

Politecnico di Milano  
Enki S.r.l.  
Marpos S.p.A.

Sarix SA

Danmarks Tekniske Universitet



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More information about MICROMAN:

[www.microman.mek.dtu.dk](http://www.microman.mek.dtu.dk)

# MICROMAN

EU H2020 MARIE SKŁODOWSKA-CURIE ACTION

European Innovative Training Network

## MICROMAN

"Process Fingerprint for Zero-defect  
Net-shape MICROMANufacturing"

**Opening of 13 Early Stage  
Researcher (ESR) positions in the field of  
Micro Manufacturing**



THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

# HORIZON 2020

**Recruiting takes place during January – February 2016  
ESRs PhD projects start: 01/04/2016**



***Thank you for your attention***



**DTU Mechanical Engineering**  
Department of Mechanical Engineering



**Guido Tosello**  
*Associate Professor, Ph.D.*  
Manufacturing Engineering

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**<http://www.microman.mek.dtu.dk/>**



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65th General Assembly (Cape Town, South Africa)

August 28<sup>th</sup> 2015, STC 'P'



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