



Universidad Nacional
de San Martín

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Instituto de
Calidad Industrial



**Enseñanza de Industria 4.0 y sus tecnologías
habilitadoras, incluyendo M4DT**

**Teaching Industry 4.0 and its enabling
technologies, including M4DT**

Joaquín Valdés

National University of San Martín

Institute for Industrial Quality

Dean



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1992

1957

1995

Institute for Industrial Quality

facing the Quality paradigm



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M

Medir
(metrology)

N

Normalizar
(standardization)

P

Probar
(testing)

Q

Quality
(assurance)



Postgraduate titles (Specialization, Master, Doctor)

- ← Specialization degree in Industrial Quality (2 years)
- ← Specialization degree in Industrial Quality i (2 years)
 - Including **MNPQ** contents + **QM**
 - Quality Management Certification
- → + **Master's thesis** → **Master degree in Industrial Quality**
(some thesis related to Industry 4.0 and its enabling technologies)





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PhD in Quality and Industrial Innovation

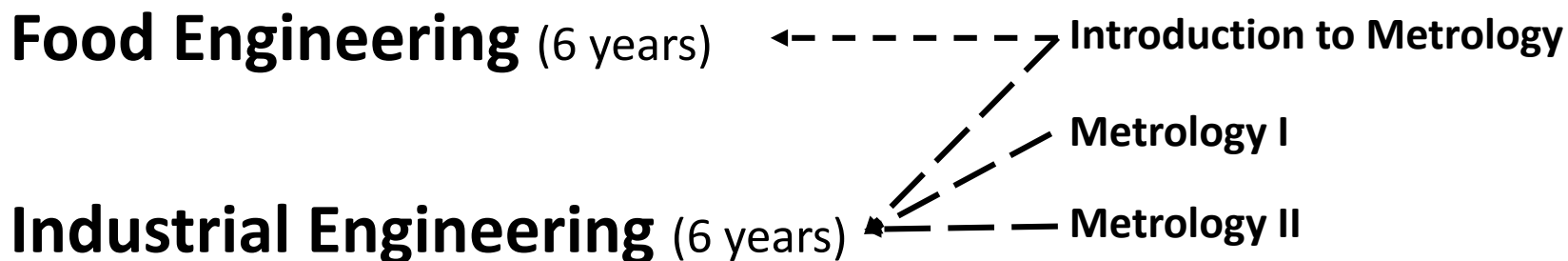
Doctorado en Calidad e Innovación Industrial

30 doctoral thesis on the way

(some related to Industry 4.0 and its enabling technologies)



Undergraduate degrees



Subjects including contents 4.0

Automation and Control + **Several elective subjects**
Distant measurements and
systems operation

It would take a long time to formalize accredited modifications in engineering careers to be able to include compulsory subjects with Industry 4.0 topics



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Introducing new elective subjects in engineering

- 1. Industrial Design Management and Additive Manufacturing**
- 2. Artificial Intelligence**
- 3. Industrial Internet of Things and Cybersecurity**
- 4. Advanced Robotics**



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University Diploma courses (120 h)

In addition to undergraduate and postgraduate courses we offer shorter courses for different audiences interested in obtaining a University Diploma

Diploma in “Quality in Integral Management of Processes”

Diploma for “Assistants in Metrology with Quality Orientation”

Diploma in “Textile Industry Processes”

New!!

Diploma in “Industry 4.0 and its enabling technologies”



Facing specific education for the new paradigm

1. **Introductory course to “Industry 4.0 and its enabling technologies”** (36 h)
2. **Diploma in “Industry 4.0 and its enabling technologies”** (120 h)
3. **Master degree in “Industry 4.0 and its enabling technologies”** (600 h + thesis)

planning



Diploma in “Industry 4.0 and its enabling technologies”

Subject	
1	Introduction to Industry 4.0
2	A Learning Factory
3	Industrial automation
4	Industrial Internet of Things (IIoT)
5	Cloud computing
6	Cibersecurity
7	Big data & Analytics
8	Artificial Intelligence

Subject	
9	Augmented reality
10	Additive manufacturing
11	Blockchain
12	Metrología 4.0 & Quality 4.0
13	Simulation
14	Productivity 4.0
15	Advanced Robotic



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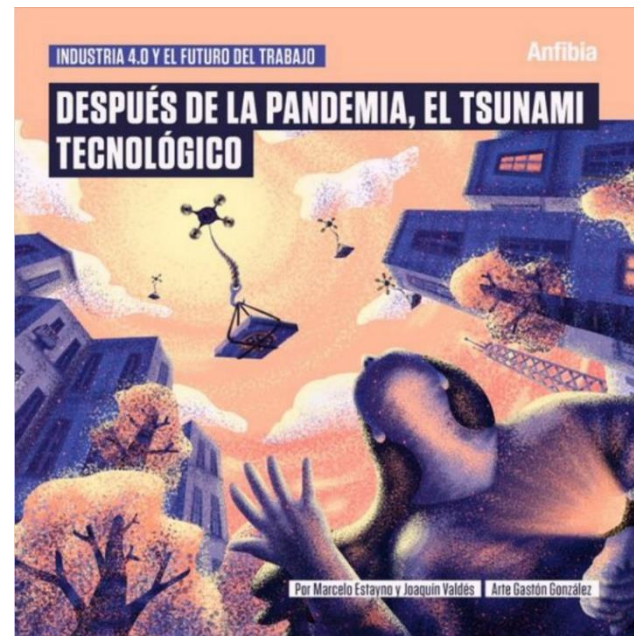


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... it is essential to train highly qualified human resources, operators, technicians and professionals who are inserted throughout the production chain ...

UNSAM
Revista
Anfibia

M. Estayno
J. Valdés



How do we develop the skills demanded in highly automated environments of the Industry 4.0



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INTI



practical laboratory activities



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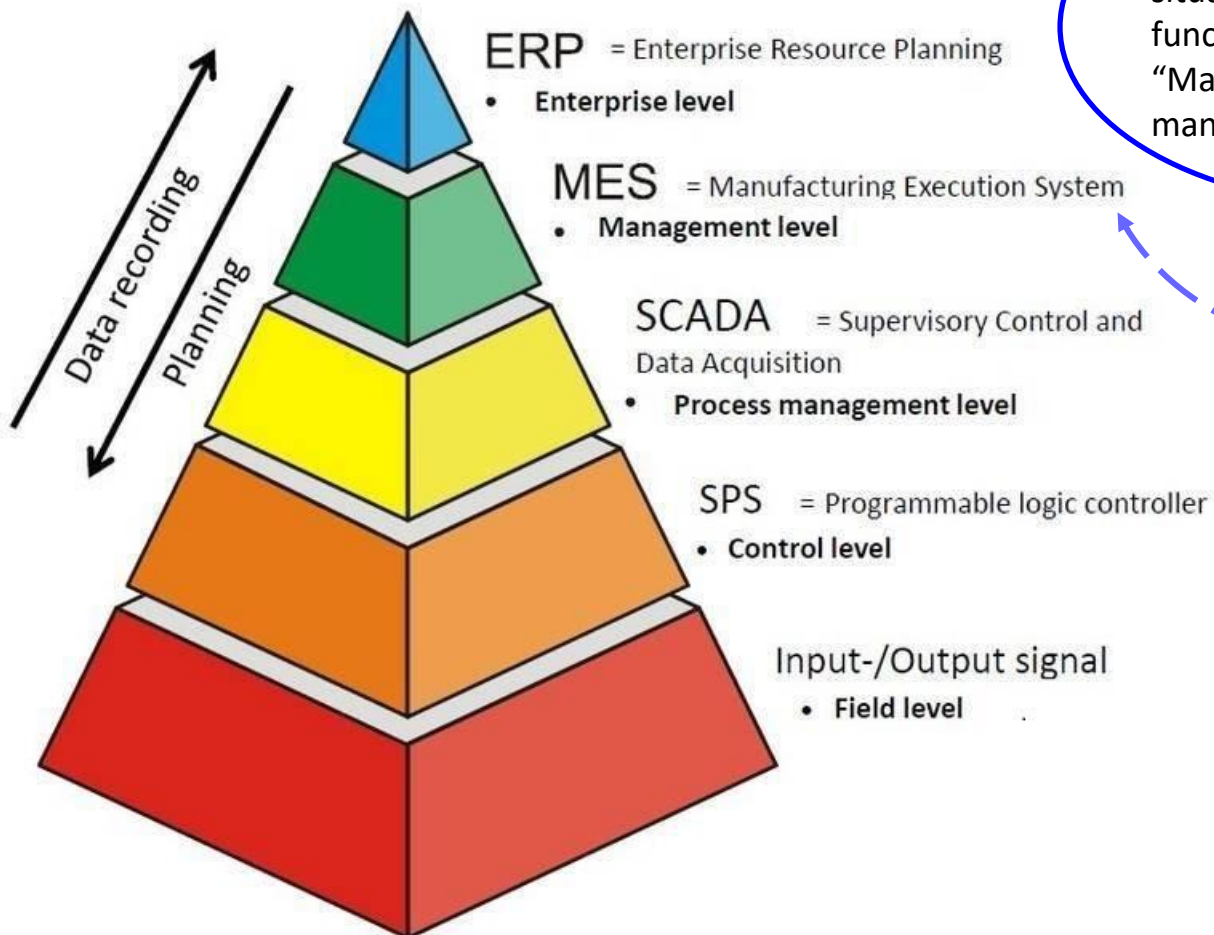
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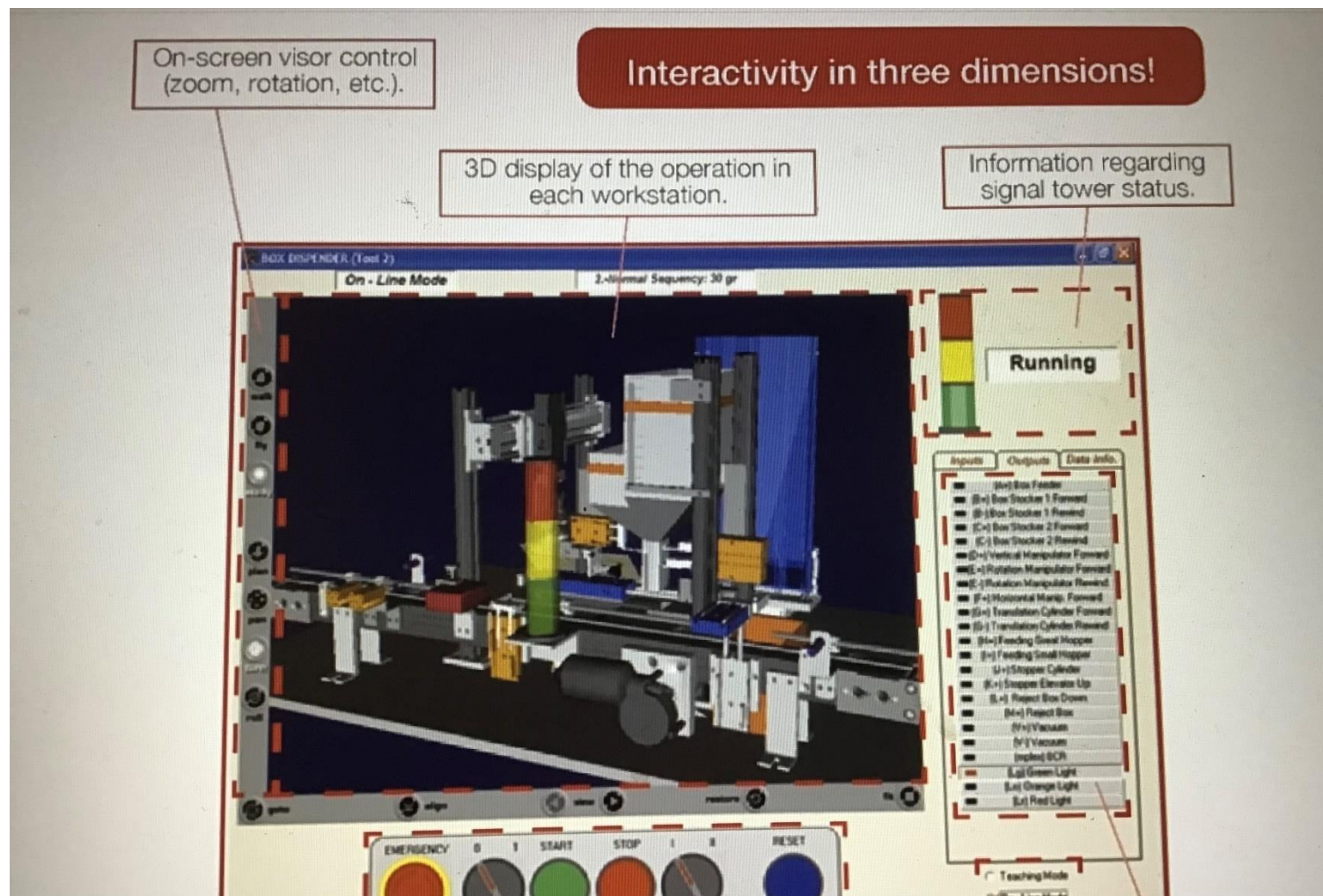
Learning Factory simulating a highly automated smart factory and the reality of the connected enterprise



Customized product, filling, weighing, capping, labelling, warehousing and dispatch



EdMES software reproduces real situations and the most relevant functions associated with the “Manufacturing execution / management system





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Learning Factories across the value
chain – from innovation to service –
The 10th Conference on Learning
Factories 2020

CIRP sponsored 11th Conference on Learning Factories

July 1st - July 2nd, 2021

Online Event

**Host located in Graz University,
Austria**

*** Machine Learning and Artificial
Intelligence in Learning Factories**

*** IoT in Learning Factories**



From MNPQ 3.0 to MNPQ 4.0

M

Medir

Metrology 4DT

N

Normalizar

Standardization 4DT

P

Probar

Testing 4DT

Q

Quality

Quality 4DT



Teaching Metrology 4DT – topics

- **M4DT: DCC, metrological clouds, digital twins, distant calibrations, etc.**
- **Integrated Metrology, In-process measurements, In-line measurements, Off-line measurements, On-machine measurements (see Catapult, Integrated metrology)**
- **The New SI - More suitable for Industry 4.0?**



At INCALIN we teach the revision of the SI since 2005. Several papers on educational matters and critical review (*J. Valdés, Reviewing the revised SI, Elsevier 2019*)

- **NIST on a chip**



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Responding to new M4DT challenges

How will quality infrastructure evolve in the new context of digital transformation?

Master thesis presented last week:

Impact of digitalization on accreditation processes



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Responding to new M4DT challenges

Smart cities

Master thesis presented in June 2021:

Integration of data in a multiplatform ecosystem of distributed generation sources on a smart grid, with injection of renewable energy

Beyond the developments originated in the NMIs, some universities have given birth to others very important for metrology, e.g. in relation to technologies used for the new SI

Steven Chu



Stanford Univ.

Claude Cohen-Tannoudji



Paris Univ.

William Phillips



NIST

Nobel Prize 1997 laser cooling

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Universidad Nacional de San Martín

**Dr Honoris Causa
with SIM presence**

Entrega del título de Doctor Honoris Causa

Prof. Claude Cohen-Tannoudji



atomic clocks

....

atom interferometry

Stanford-Berkeley + LKB in Paris

We also use educational material for a wider audience, such as general technological interest through a state cultural channel. And we hope to repeat this experience with new material for awareness raising in 4.0 technologies.

Metrology by CANAL ENCUESTRO

<http://encuentro.gob.ar>



En Su Justa Medida

[http://encuentro.gob.ar/programas?keywords=&category=Ciencia+y+Tecnolog
%C3%ADa&sort=&page=16](http://encuentro.gob.ar/programas?keywords=&category=Ciencia+y+Tecnolog%C3%ADa&sort=&page=16)



Qué es medir

<http://encuentro.gob.ar/programas/serie/8561/6331?temporada=1>

Historia de las medidas

<http://encuentro.gob.ar/programas/serie/8561/6332?temporada=1>

El SI

<http://encuentro.gob.ar/programas/serie/8561/6337?temporada=1>

Tiempo y frecuencia

<http://encuentro.gob.ar/programas/serie/8561/6334?temporada=1>

Longitud

<http://encuentro.gob.ar/programas/serie/8561/6333?temporada=1>

Unidades de masa

<http://encuentro.gob.ar/programas/serie/8561/6335?temporada=1>

Fuerza, presión, volumen y flujo

<http://encuentro.gob.ar/programas/serie/8561/6336?temporada=1>

Electricidad

<http://encuentro.gob.ar/programas/serie/8561/6338?temporada=1>

Temperatura

<http://encuentro.gob.ar/programas/serie/8561/6668?temporada=1>

Intensidad luminosa

<http://encuentro.gob.ar/programas/serie/8561/6667?temporada=1>

Acústica

<http://encuentro.gob.ar/programas/serie/8561/6669?temporada=1>

Química ambiental

<http://encuentro.gob.ar/programas/serie/8561/6666?temporada=1>

Química de los alimentos

<http://encuentro.gob.ar/programas/serie/8561/7208?temporada=1>



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Muchas gracias por su atención!

**Thank you very much for your
attention!**

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Dean