Roboticas para la fabricacion avanzada
ROBOTICS IN TECNALIA

HEALTH Division

INDUSTRY AND TRANSPORT Division

ROBOT as a PRODUCT

ROBOT as a Tool to automate process

ROBOT Autonomy as a key to Flexibility
Of course... you’re interested in ROI... but it’s not the only question!

• Why robotize?? -> What counts more for your business:
  – Flexibility to produce multiple product variants?
  – Cycle time to increase throughput?
  – Quality improvements or guarantee?
  – Bad ergonomics of current manual stations?
  – Marketing/image of innovation for you company?
  – Difficulties to find and retain skilled people?

• Probably you don’t need/can’t automate ALL the process... think about What makes sense to robotize

• Have you audited your manufacturing processes and identified repetitive, onerous, or dangerous tasks done by humans that could be carried out by robots?

• What are your parts and is the parts supply/logistics and the tooling ready for automation?

• Do you have lots of product variants and small batches? Or stable production?

• Do your process requires a high online adaptability of the robot ? -> use of sensors and online adaptation (even for standard robots and high productivity)

• Would your robot need to move along your part? Or from cell to cell?

• Are you ready to change things in your product/process to allow for automation? (tooling, jigs, logistics, packaging...)

• Have you skilled staff to run and program robots?

• Are you ready to discuss with your staff and manage their fear? Convince them of the benefits of robots for your company? How will They benefit from it (and only your bank account), how will they be trained and gain valuable experience...
How do I program a robot?

https://youtu.be/9lz4oPPLKzM

Online Programming

Teach Pendant  Lead Through

https://youtu.be/EA6pWwNI_wg

https://youtu.be/jzR5NZeZSu0
A ROBOT IS A MACHINE.... AND SO THE ROBOTIC CELL MUST COMPLY WITH NATIONAL LAWS AND DIRECTIVES

- **Leyes y directivas**
  - EU 2006/42
  - RD 1644/2008

- **Nivel A**
  - IEC 61508
    - Seguridad funcional
  - ISO 12100
    - Evaluación de riesgos

- **Nivel B**
  - ISO 11161
    - Sistemas de fabricación integración
  - ISO 13849-1:2008
  - IEC 62061:2012

- **Nivel C**
  - ISO 10218-1
  - ISO 10218-2
  - ISO/TS 15066
ALL SAFETY ASSESSMENT IS BASED ON A RISK ANALYSIS

Robots and Safety...

Identificación, evaluación y estimación de los niveles de riesgo involucrado en una situación
**A COLLABORATIVE ROBOT IS “JUST” A ROBOT WITH SPECIFIC CHARACTERISTICS...**

**¿QUÉ ES UN ROBOT COLABORATIVO?**
- ROBOT DISEÑADO PARA LA INTERACCIÓN DIRECTA CON HUMANOS EN UN ESPACIO COLABORATIVO DEFINIDO (ISO 10218-2)

**¿QUÉ ES UN ESPACIO COLABORATIVO?**
- ZONA DE TRABAJO DENTRO DEL ESPACIO PROTEGIDO DONDE UN ROBOT Y UN HUMANO PUEDEN REALIZAR TAREAS SIMULTÁNEAMENTE DURANTE EL PROCESO DE PRODUCCIÓN (ISO 10218-1)

**¿QUÉ INTERACCION CON PERSONAS ES ACCEPTABLE EN TEMAS DE RIEGO?**

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![Diagram of a human body with robot interaction zones](image)
ROBOTICS
Still lost of hard challenges to overcome!
Trends: Change in the Society needs

- A need for products always more **personalized**, towards short series.
- An increasing requirement for **modularity and flexibility**
- Factory work considering **painfulness of operations**
- Ageing working workforce, that must work in habitual stations
- Competitiveness pressure imposes **automating new processes**

When Boeing dreams about its production system:

« One day a fuselage, the next day a wing: same place, same production means: flexible, reconfigurable. »

Conference AMAF 2008, Keynote session: Mr. Frank DOERNER (Vice-President and head of manufacturing technologies); Boeing Phantom Works
Many manufacturers working towards smaller, more friendly and more autonomous robots
An autonomous and flexible robotic system must:

- Provide advanced perception to cope with uncertainties
- Provide easy programming
- Provide easy reconfiguration
- Provide autonomous mobility
- Provide decision autonomy whenever this doesn’t alter Productivity and Quality
- Allow Human and robots to work in the same area
ROS – ROS-Industrial as an Enabler for Versatile Robots?
How does Tecnalia pretend to provide flexibility, autonomy and adaptability towards product variants or small lot-size?

1. Software architecture to support and combine the robot skills to execute the Assembly operations.

2. Easy Programming skills: Automatic adaptation of the robot program to adjust itself to the product variants.

3. Advanced Perception to cope with the low constraints on toolings.

4. Manipulation: Trajectories real-time planning and online adjustment to avoid humans and obstacles.

5. Mobility of the robotic system. To work on large parts or reconfigure the production cell based on production requirements.

6. Integration in industrial robots and production cells/lines.
In traditional programming industrial processes are a sequence of operations, sometimes reusable but generally specific to each process.

We model system capabilities in simple and intuitive symbolic units. Forming a hierarchy which is composed by Primitives, Skills and Tasks.

Industrial processes are composed by Tasks, which are divided into Skills. Skills are composed by Primitives, i.e., robot simple operations such as movement, gripper operation, etc.

The operator will only concatenate and parameterize skills and tasks; Primitive layer is meant to be used by experts.

Applications are stored in XML format.
The operation process is extracted directly from CAD. No Programming

Setup your CAD with manufacturing information

Execute the Skills directly on the robot
Production-oriented Pilot Station for the Deburring of A380 HTP ribs’ drillings
100 variants of parts per airplane model
The toolings also are impacted
The toolings also are impacted

https://youtu.be/tCss_TjSs7Y
The toolings also are impacted