20th UITIC
INTERNATIONAL TECHNICAL FOOTWEAR CONGRESS

Porto 2018

16th–18th MAY

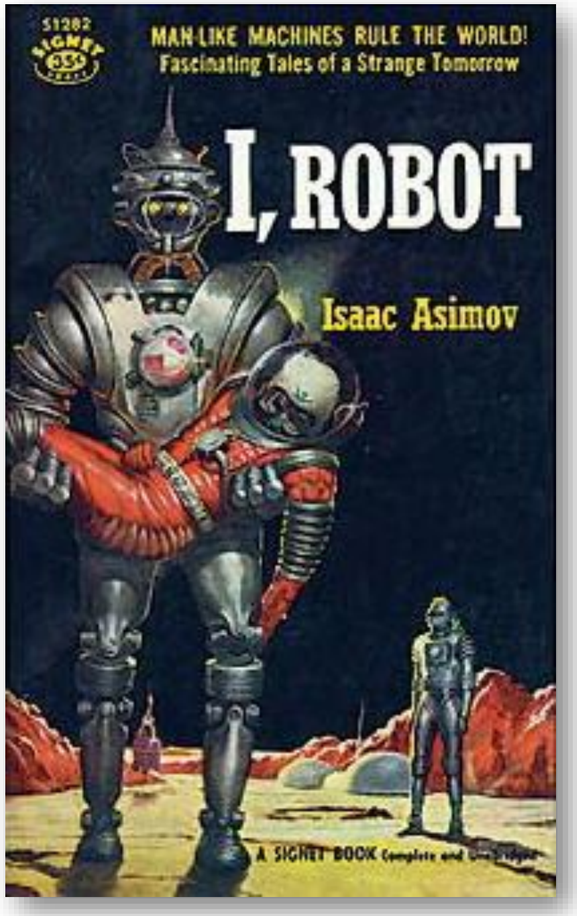
FROM FASHION TO FACTORY

A New Technological Age

RAMS
Robot Assisted Manufacturing System

Sergio DULIO ATOMLab

ASIMOV laws of robotics



Isaac Asimov, in his 1942 short story Runaround (later included in the 1950 collection I Robot), devised for the first time a set of rules , called the Three Laws of Robotics, quoted as being from the Handbook of Robotics, 56th Edition, 2058 A.D (in 40 years from now). These laws form the ethic foundation for (humanoid) robot behavior (at least in the science fiction world).

ASIMOV laws of robotics

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm
2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law

The Fourth or Zeroth law

- A robot may not harm humanity or, by inaction, allow humanity to come to harm

ROBOTICS IN FOOTWEAR MANUFACTURING

Up to now, the application of robotics in the footwear sector has been based on two operational models

- robots as operating machines, therefore equipped with end effectors specially designed for a given task (e.g. roughing or gluing) that execute their job on the last firmly held in a fixed position
- robots as manipulators, which handle the last and perform the task by putting it in contact with a given tool in a fixed position (e.g. by placing it on a roughing head)

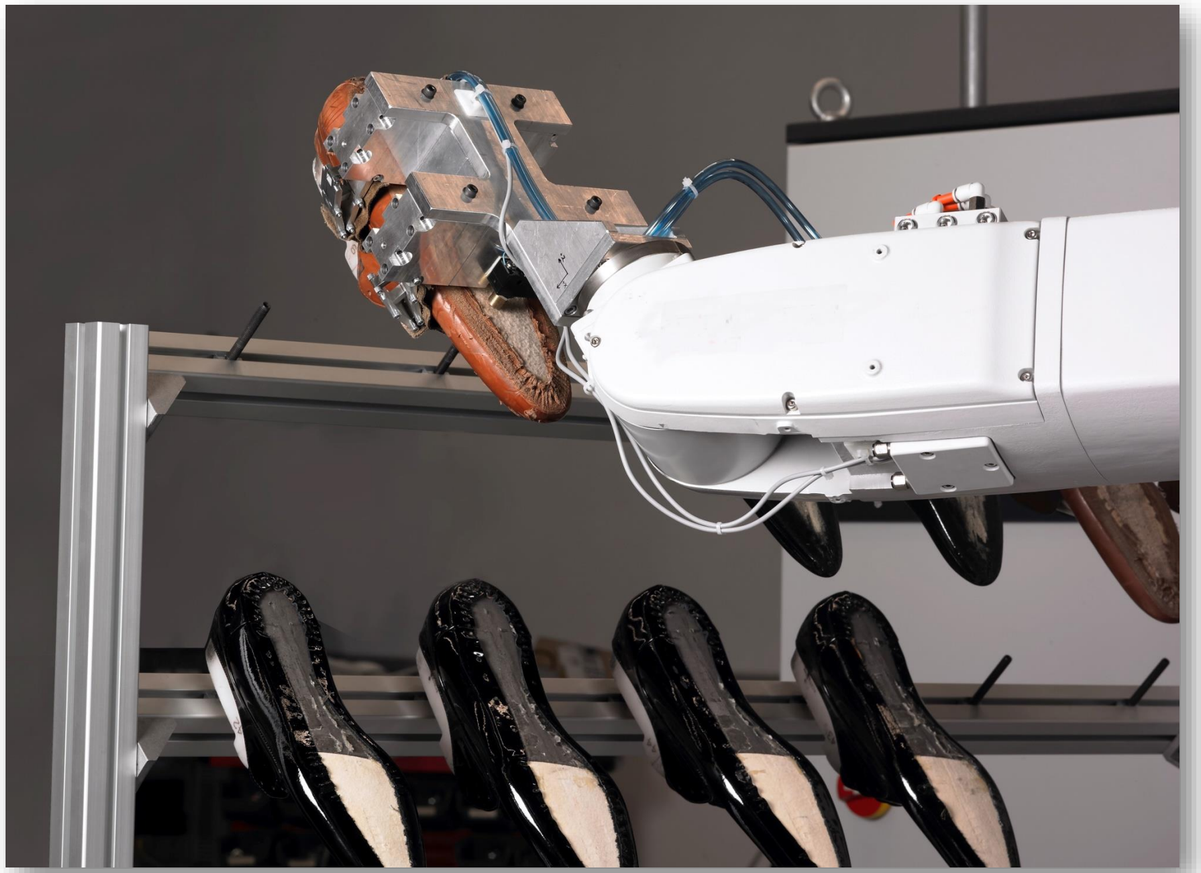
These solutions are less than optimal because:

- They imply the use of palletized or otherwise modified lasts to allow the robot to process them precisely
- They do not exploit the actual capabilities of the existing machines (e.g. roughing machines, gluing machines, etc.), developed and consolidated over the years with the long lasting experience of the machine manufacturers themselves

2018 : the three laws of *footwear robotics*

1. Adaptability
2. Flexibility
3. Safety, co-existence and valorization

LAW # 1 : adaptability



*A **robot** must be seamlessly integrated in the footwear manufacturing process adjusting to its peculiarities and its specific demands.*

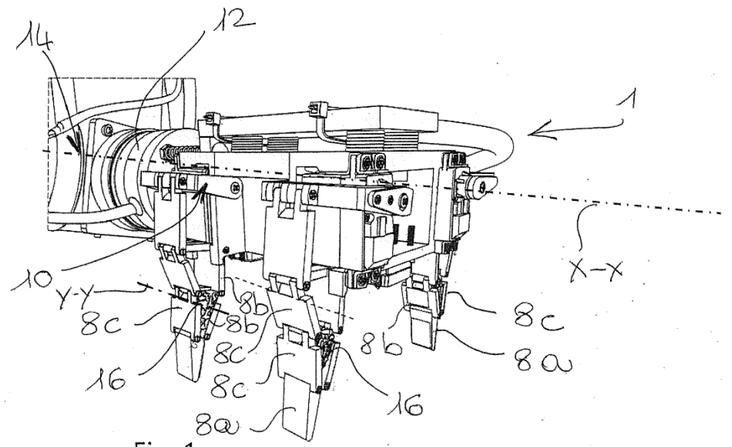


Fig. 1

Four finger adjustable gripper to manipulate standard lasts with no fixtures or special features

LAW #2 Flexibility

*A **robot** must take the utmost advantage from the existing automatic process machines, allowing maximum flexibility, modularity and rapid setup for low costs and quick returns*

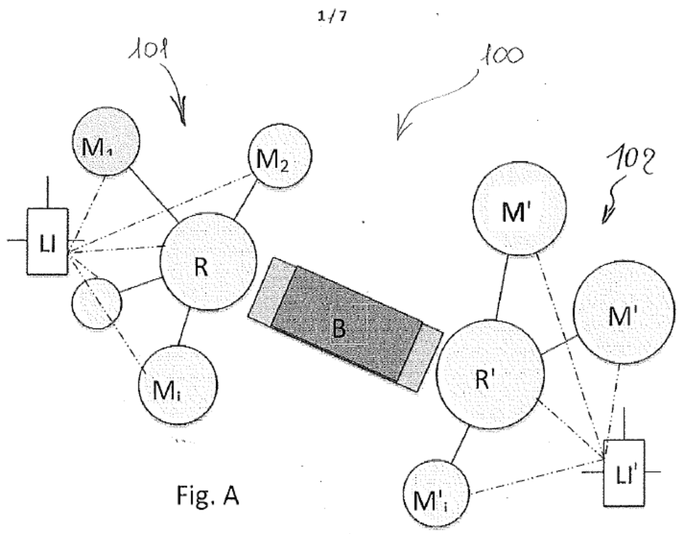
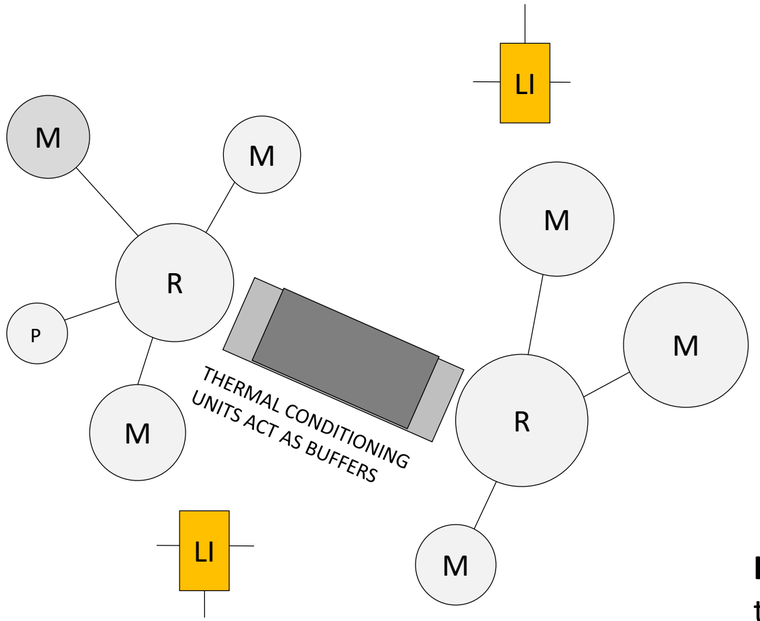


Fig. A

A new physical and logical architecture from the machine to the cell and system level

LAW #2 Flexibility

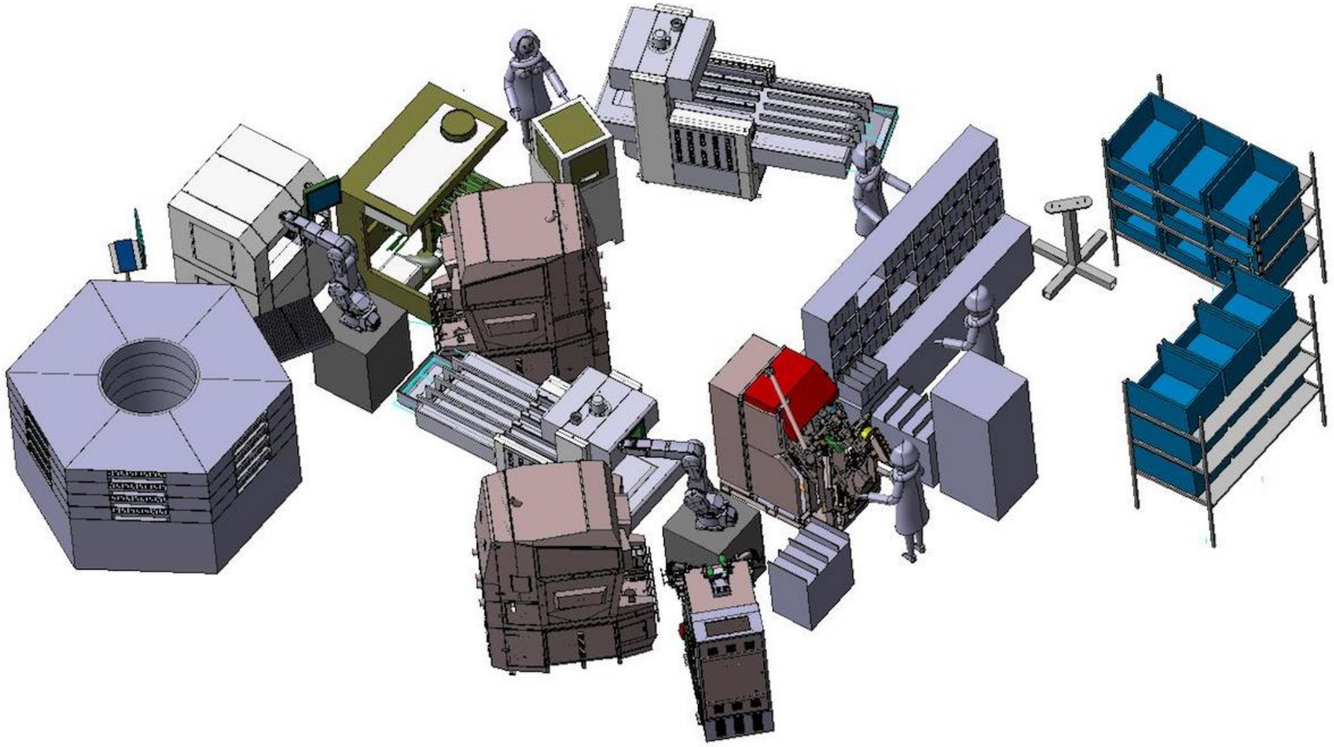


The central element of the RAM architecture is the **CELL**; the hub of each cell is a **handling robot** (R). It provides manipulations tasks (**missions**) from machine to machine or from machines to work posts. Each CELL incorporates two or more machines (M). They can be either specialised automatic or semi automatic shoe machinery or robots performing specific processing tasks on the shoe. Machines are connected logically to the **Local Intelligence** (LI) of the CELL and physically to the hardware device that hosts it (PLC or FPGA). CELL can include a combination of machines and work posts with human workers or be composed only by work posts attended by workers. Machines are connected to LI through a **Universal Machine Connector** (UMC) that ensures easy configuration of the cell and plug and produce compatibility.

CELLs are linked one to the other through **BONDS.** Such bonds provide both a cell to cell transfer capability and buffering between cells. Typically they are thermal conditioning units such as heat setters, dryers, reactivators and chillers performing in process thermal stabilising or activation functions; complex systems can be created combining any number of CELLS and BONDS.

LOCAL INTELLIGENCEs communicate with each other through a bus for process synchronisation and supervision; field data, machine status and product tracking data are fed to a SCADA supervision system and visualised through an appropriate HMI

LAW #3 Safety, co-existence and valorisation

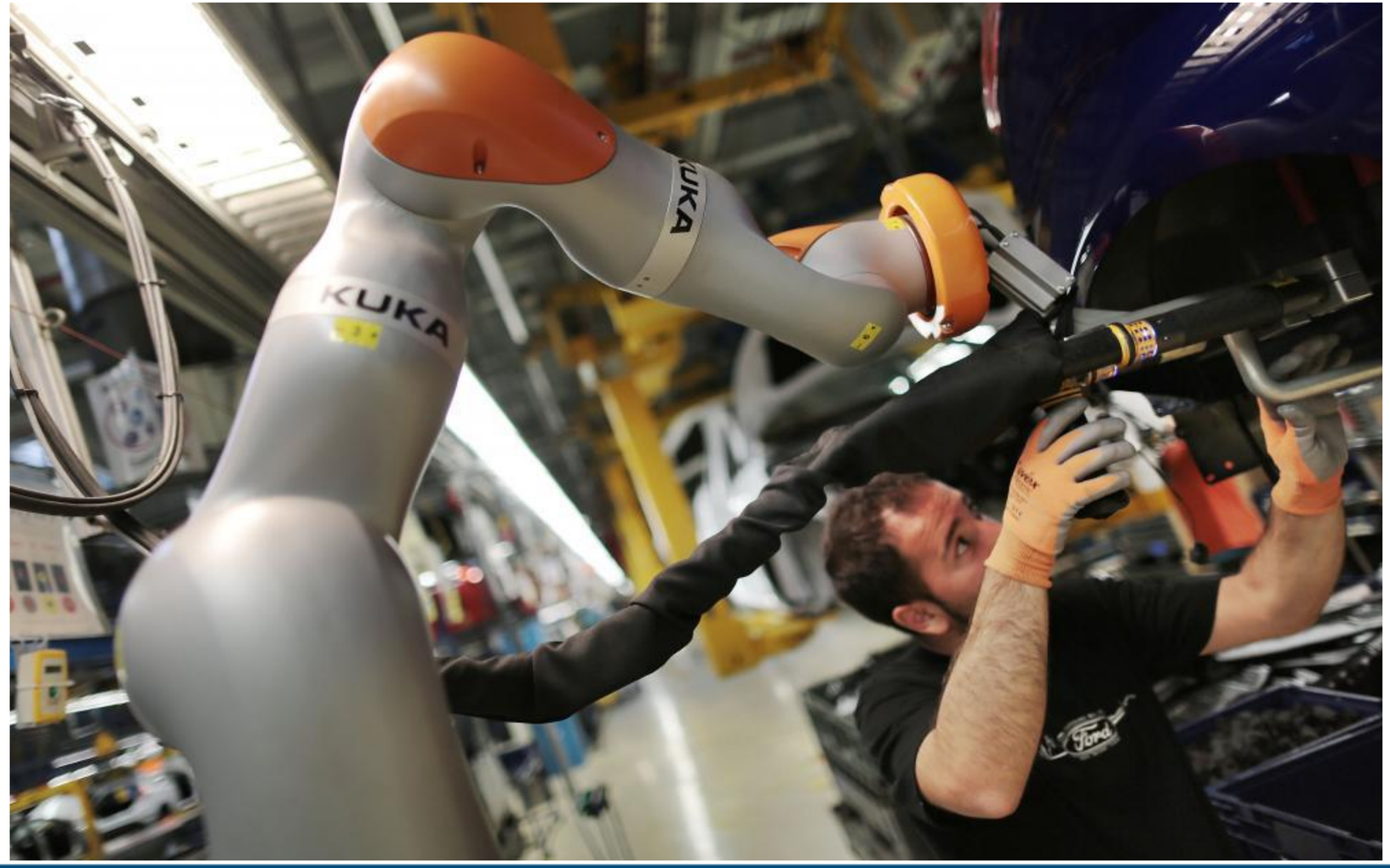


*A **robot** must fit in the manufacturing process with the highest safety standards for the operators and at the same time without introducing elements of rigidity*

RAMS the concept

The old concept of robotics: robots and humans in separate spaces. No interaction / no collaboration. Fixed barriers, high rigidity.

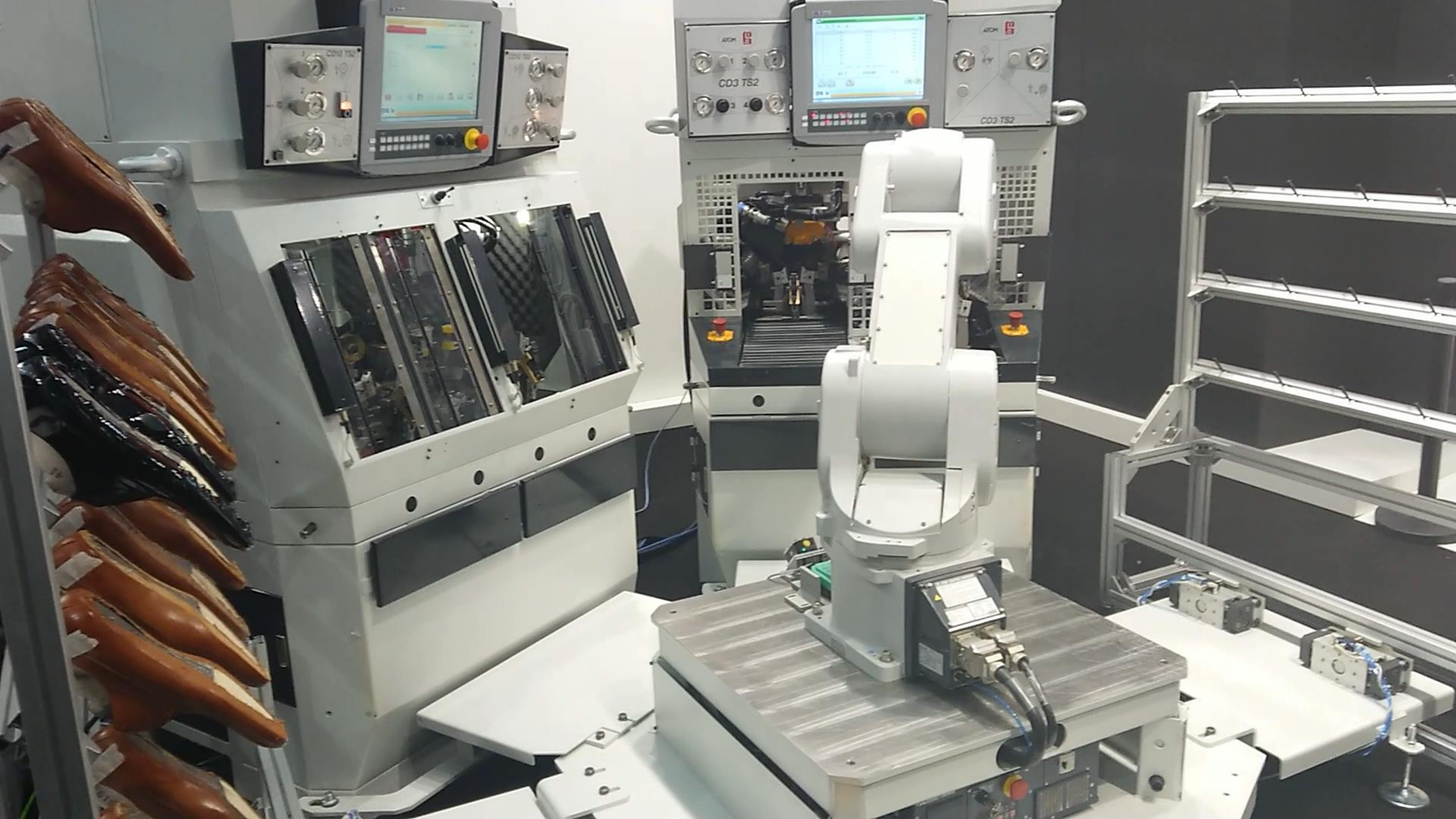
RAMS the concept



The new paradigm : human – robot collaboration. Elimination of non added value tasks, maximum valorisation of human skills

RAMS the concept

SIMAC 2018 – Robotic cell for pounding , pre-roughing, roughing and cementing; one robot , two machines , input buffer, output buffer; approximately 600 pairs / day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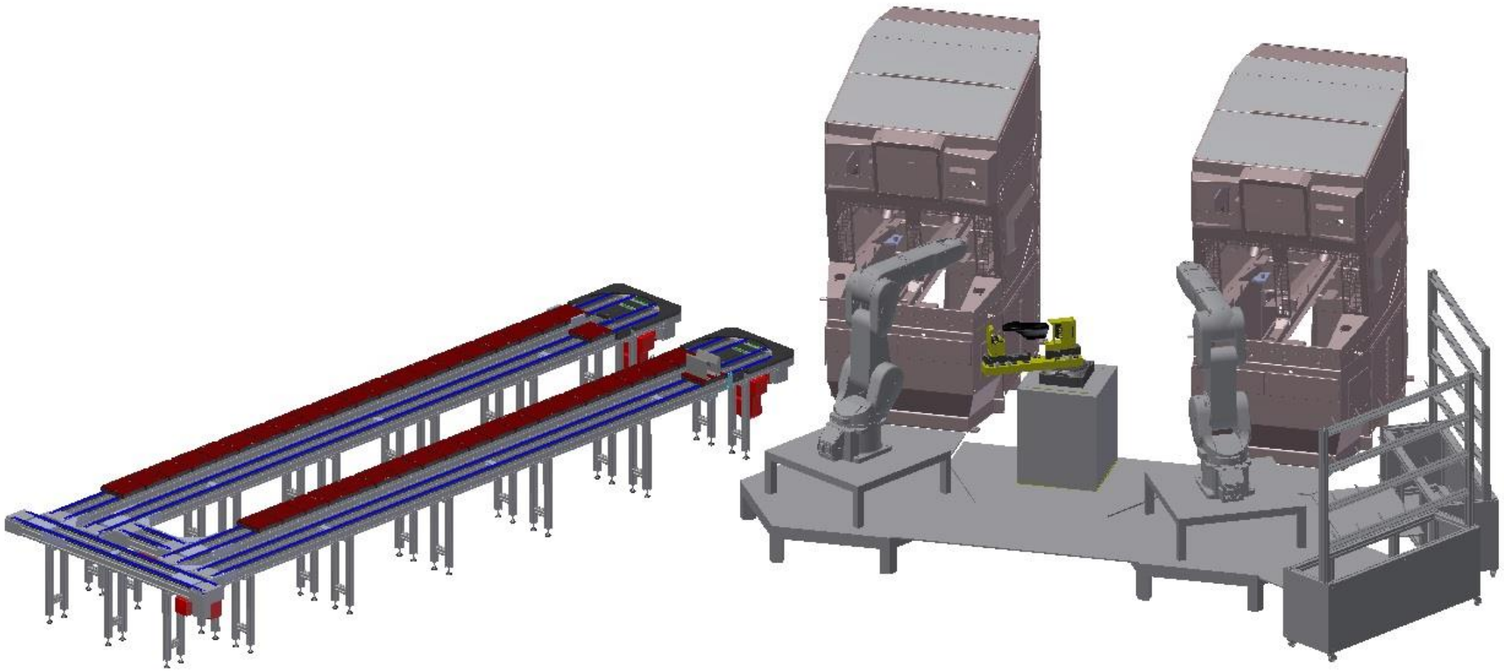
CD3 TS2

RAMS the concept

The full concept: manufacturing line for lasted shoes with cemented outsoles, 3+2 robots, 4 workers. Estimated : approximately 600 pairs / day

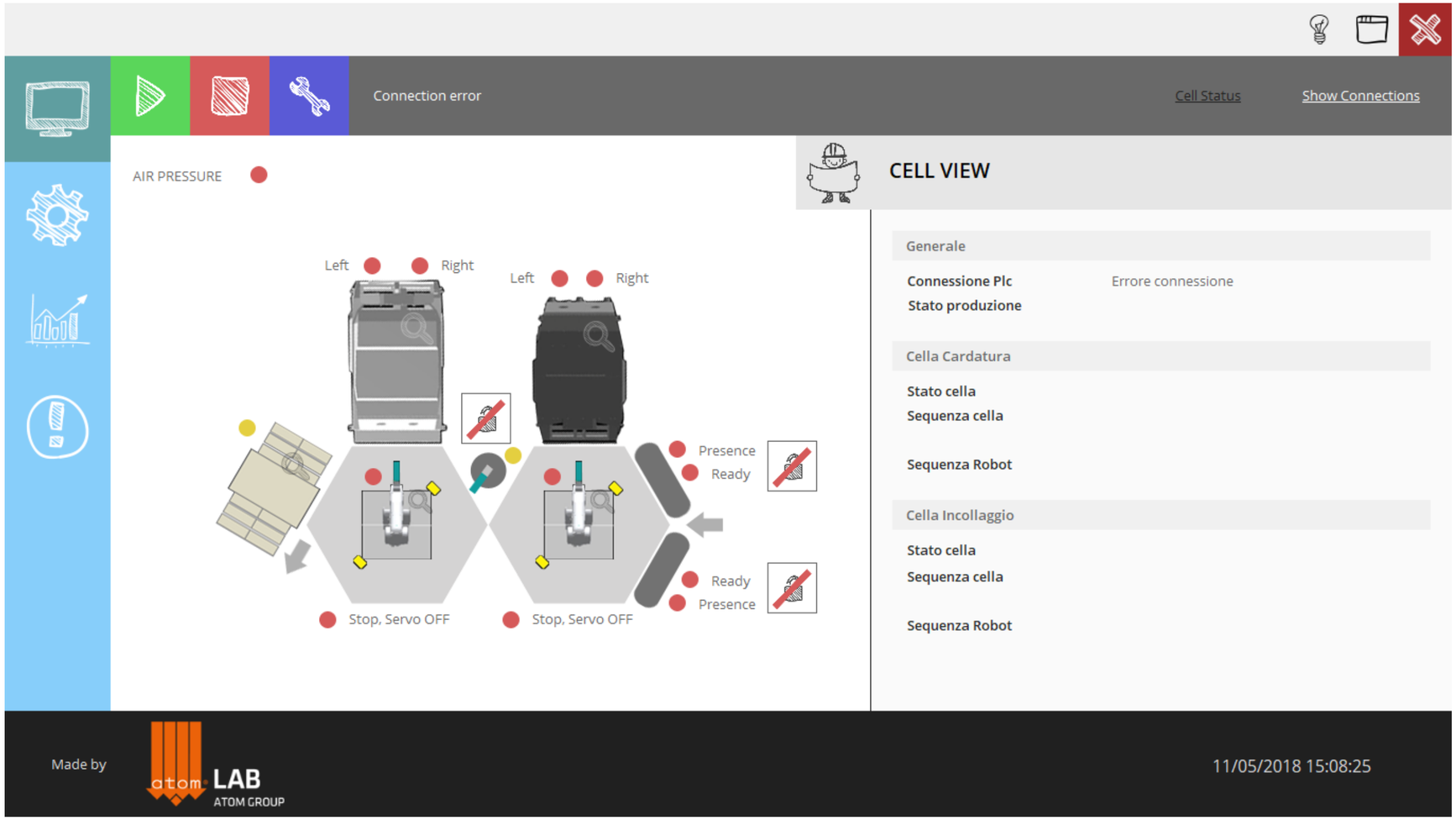

Technology
Transfer System
Time
8.51
Worked Pairs
656
Lasts in plant
37.0
Productivity
74.1 P/h
8:51:01.700
-
PAUSE
+
VIEW
CHART
CLOSE

Pilot installation



Robotic cell for pre-roughing and roughing, priming and cementing operations of high quality man shoes ; two robots, two machines, robot to robot exchange buffer, input buffer on wheel trolleys, output palletized line. Estimated throughput : approximately 750 pairs / day. Expected installation : June 2018. Totally unattended.

HMI - SCADA



Modular and reconfigurable HMI – SCADA environment for the complete supervision of the manufacturing cell, data presentation, machine control and setup

Future developments – IoT Integration – Industry 4.0

Future developments – AUGMENTED REALITY

Migration of the HMI / SCADA functionalities on wearable devices (Microsoft Hololens ©) to replace displays and other equipment to provide the operators with the information they need with a context-sensitive approach and allowing them to remain focused on the assignment

Future developments – From RFID to Blockchain

RFID for in process tracking of components (lasts, uppers, insoles, outsoles and heels)

RFID / NFC multi purpose tracking for supply chain verification and authenticity checks through blockchain

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SHOPS BECOME FACTORIES
FACTORIES INVADE SHOPS


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THANK YOU

DULIO SERGIO
MANAGER ATOMLAB

Via Morosini 6 27029 Vigevano (PV) Italy
Tel. +39 0381 302293 Fax +39 0381 344303
Email: sergio.dulio@atom-lab.org
www.atom-lab.org

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