



General view of pre-stitching and stitching lines managed by SmartSL. ALL CREDITS: CTCP

Another step forward

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Today we are faced with motivating challenges as footwear manufacture continues to evolve into a knowledge-based industry by the development of new paradigms such as 'digital production'. This includes automatic cutting and production systems, robotics and advanced logistic solutions, all of which are now being applied by leading Portuguese companies. This ecosystem now also embraces new technological, manufacturing, management and marketing possibilities enabled by cyber-physical systems (CPSs), sensors, internet of things (IoT) or hybrid clouds. As these become increasingly integrated, so we move ever further towards the 4.0 goal for the footwear Industry.

The Portuguese Footwear and Allied Trade Fashion and R&D Cluster bringing together mechanical, software, automation, robotics, physics, materials and footwear companies and institutes, and engineers and experts, has been working on specific systems, interfaces and standard formats development and application. Data coming from several of the component areas involved is already interfacing well, particularly in the form of cloud services designed to increase efficiency and to drive automation.

BEinCPPS PROGRAMME

There are however, many potential areas of intervention and a number of variables still remaining and so there is significant research and innovation

work yet to be done. One further step in the programme is being accomplished within the European Innovation Action BEinCPPS. This aims to investigate and integrate a CPS-oriented future internet-based machine-factory-cloud service platform at selected Smart Specialisation Vanguard regions within Europe and to then gradually extend the service to cover additional European regions in the future.

The Norte do Portugal (Northern Region of Portugal) is one of the five selected regions and footwear manufacturing the focus of BEinCPPS's first integrations and experiments. In this framework, the Portuguese footwear technical and innovation centre CTCP, the footwear manufacturer KYAIA and the InescTec development

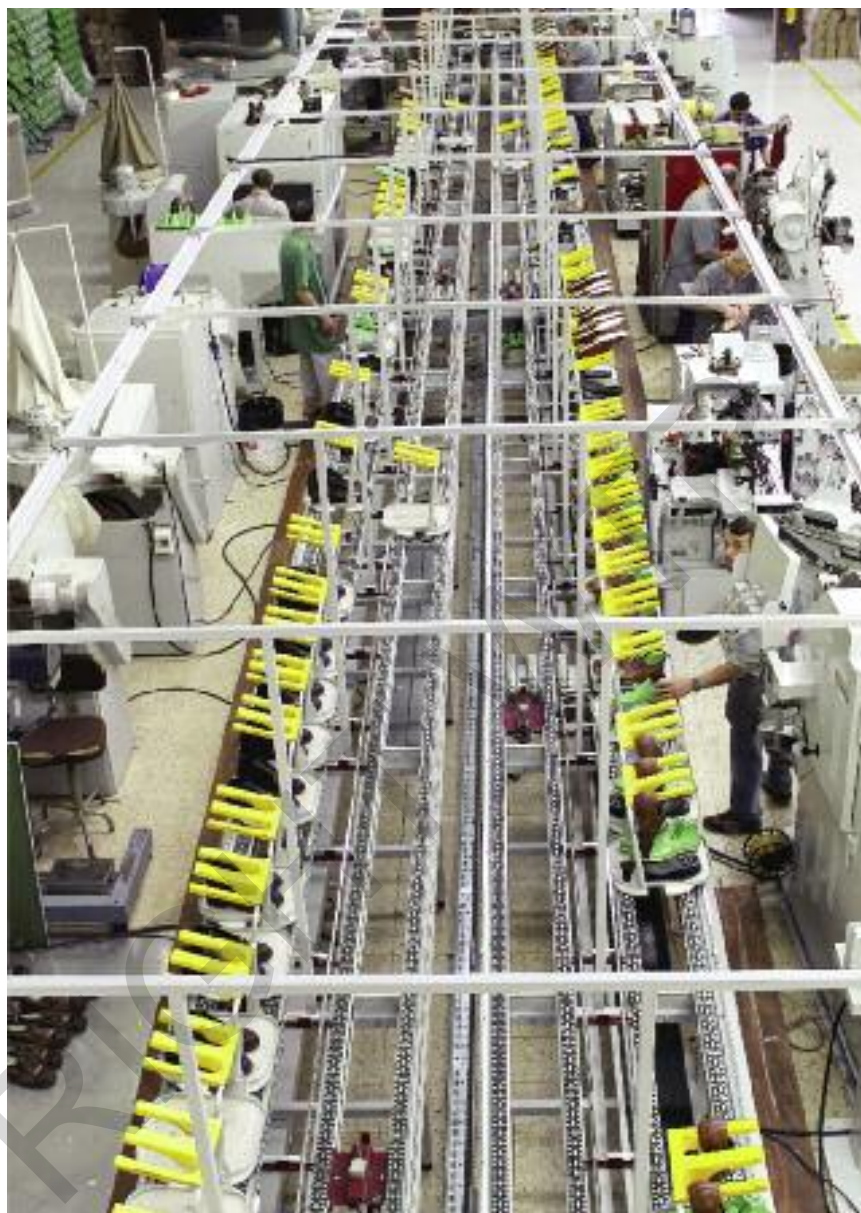
institute—all located in the Norte region—are working with an extensive team of technology developers and providers, and research and innovation centres. Overall coordination of the project is being undertaken by the Politecnico di Milano, with the intention of driving the previously developed High Speed Shoe Factory (HSSF) forward to a 'smarter' level.

The HSSF implemented an agile, flexible and quick response production system that promptly responds to market demands by integrating an advanced cutting system plus internal logistic and management tools to ensure the automatic transportation of materials, components and final product along the whole process chain. This solution eliminates a relevant level of stock of intermediate work-in-progress and dramatically reduces product lead time from three or four weeks to one or two days. At the same time, it allows the production of several shoe models of different constructions and, by this means, the effective production of small batches of different styles.

CPPS APPROACHES TO PRODUCTION

Within BEinCPPS, one of the HSSF results was selected to introduce CPPS approaches within production and maintenance processes. The system is composed of three connected production lines with a manipulator robot in each one and multiple working posts. The HSSF information and communications technology (ICT) architecture contains several programmable logic controllers (PLCs) connected to production line sensors which can be configured by using the proprietary SmartSL program. All the automation software connects to sensors and actuators by a commercial component. At present, the working posts and the manipulators are the component parts producing signals that can be used for analysis. The addition of new sensors (vibration, temperature, etc.) is expected to assist further in achieving the project's objectives.

Using BEinCPPS partners' cyber-physical systems such as sensors, communication tools, software components and new solutions developed in complementary projects launched by BEinCPPS, these signals



Assembly production line.

are read and then sent for storage in a database. All this data can then be mathematically, statistically and technically analysed, treated and then resent via the Internet, Cloud, Big Data or IoT in order to provide alerts and information about delays, deficient planning, impending failures and causes of failures among other things.

ANTICIPATING SYSTEM FAILURES

The project aims to use these results to feed relevant production key performance indicators (KPI) and train a machine learning model capable of recognising and sending an alarm when component degradation is likely to occur, prior to the actual failure occurring. Appellative, interactive and

easy-to-use interfaces are also expected, allowing Kyaia personnel to readily use the information deployed and perform their tasks supported by knowledge enabled by CPPS, IoT and Cloud based solutions and services. The BEinCPPS applications should reduce non-operational time of each production line and system, increase efficiency of the work posts and generally reduce maintenance costs. It is estimated that the successful implementation of the project will contribute to significantly increased work post activity time and reduce operator downtime by around 40%.

The final aim of BEinCPPS is to improve the adoption of cyber-physical production systems (CPPSs) in Europe by means of the creation and nurturing



The new logic system structure and manipulator.



The robotic manipulator in action at a work post.



of CPS-driven regional innovation ecosystems, made up of competence centres, manufacturing enterprises and information technologies (IT) SMEs. In this framework and under the I4MS European Initiative, the Norte region is also launching a digital innovation HUB located at CTCP the Competence Centre for the footwear and allied trade sectors. At the same time, CTCP is making every effort to identify the training challenges and needs posed by this '4th industrial revolution' at different levels, from formal education at

technical, high school and universities levels on to professional training courses specifically directed to engage the actual work force, thus contributing in a smooth evolution towards adopting this new manufacturing paradigm. 🔄

BEinCPPS will run until 31/10/2018 when a further article will give final details and conclusions regarding the Norte Footwear experiment and complementary initiatives.