

Pushing woodworking into the digitization age: the WW4.0 project

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Abstract

Starting from the premise that technological advances in recent years have enabled the increase in industrial productivity then, industries that are more integrated into the technological environment tend to have more optimized and automated processes. Thus, they are able to offer more attractive prices to their customers, as well as greater control of their processes to make decisions that best fit the company's market strategy.

Currently, in the context of the small to the medium-sized furniture manufacturing industry, technological advances have brought an enormous contribution to the efficiency improvement of industrial-made products [1]. However, despite the extensive robotisation currently being felt in many of these industry activities, digitisation of the process loops is still in its early infancy.

In this frame of reference, the WW4.0 project, financed by the NORTE2020 Portuguese initiative, aims to develop a technological layer that aims to promote the digitisation of low throughput, high customization, and furniture industries. In particular, this project aims the development a methodology that will allow information aggregation from all the actions and operations associated with the manufacturing process. This will enable real-time knowledge regarding the current ongoing tasks, stock contents and raw materials existing on the "shop floor".

The WW4.0 project consortium is headed by the Mofreita and has, as partners, the CeDRI research centre, the MORE collab and NKA, an IT-based company NKA. Mofreita is carpentry located in "Macedo de Cavaleiros", a city in the northeast part of Portugal, and focuses on the development of customized furniture. Located in Bragança, Portugal, CeDRI is a multidisciplinary research unit fostered by the Polytechnic Institute of Bragança that promotes and applies technological solutions in the industry. MORE is a collab centre, also from Bragança, which provides scientific, technological and innovation consulting services to companies in both the public and private sectors. Finally, NKA is a technology company that designs and develops global IT solutions.

The management model, currently used in the company, is not fully digitised yet. Especially, on the company's shop floor where knowledge about processing times or real-time tracking of raw material is a very complex task. Those questions can be tackled through the actual concepts and technologies introduced by Industrie 4.0. This paradigm has leveraged the whole decision-making process by promoting information exchange and data analytics. In this frame of reference, the main goal of the WW4.0 project is to create a digital ecosystem that allows relevant information to be aggregated and employed to support the management tasks and promote a more integrated relationship with customers. In particular, this project is segmented into three major modules that, when integrated, constitute the proposed solution: Information aggregation and presentation platform, smart product, and finally, real-time tracking of furniture components and scheduling of raw materials.

The first module will be responsible for aggregating all relevant data for the production process, whether legacy data or new parameters, allowing complete information sharing between the various types of computer applications involved in the production process. In particular, the crossing of information about the raw material available in the stock at a given moment and the wood pieces to be processed. This will allow optimal management of the raw material, waste reduction and consequent minimization of production costs. The way this allocation will be done will follow the application of optimization algorithms whose main function will be the scheduling of the raw material.

The second is a digital representation of the product that will be achieved by applying the "digital twin" concepts, an emerging technology that has been widely developed within Industrie 4.0. The use of this technology will allow knowing, in real-time, at what stage the production process is, the remaining stages of the process, the materials spent and the materials still needed, creating the possibility of more efficient management. All the information will be processed using algorithms based on artificial intelligence in order to support decision making at various levels, from operational decisions (shop-floor) to strategic decisions (management).

The third module will lead to the implementation of real-time product tracking techniques (including bulk products). It is intended to update, in an automatic way, the stock database. These actions will have impacts at various levels, including the reduction of material that is considered waste and the reduction of the time required to look for a given material/product in the warehouse.

All this information, provided by the solutions devised during this project, will allow promoting decision making in such a way as to adapt production control to the company's market strategies.

Keywords: Digitization · Wood work processes · Information technology · Traceability

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