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An information system for the furniture industry to optimize the cutting process and the waste generated

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Abstract

Due to the current European economic stagnation and to face the increasing competition from emerging economies, significant changes in the European furniture industry need to be undertaken. Several institutions have produced reports showing that the European furniture industry must innovate the products, the production processes, the promotion strategies and the organizational structure in order to attain flexibility and productivity. The most relevant factor for the decrease in market share in the European furniture industry is the production cost, mainly due to labour and raw materials costs. The proposed information system aims to reduce the waste of raw materials generated in the production process, optimizing their purchase and consumption, boosting corporate profitability and sustainability.

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1. Introduction

Currently, the Western Europe forest-based industry is facing a fierce competition from emerging economies, such as, China, Brazil and some European countries in the former Eastern Bloc (e.g. Poland, Czech Republic and Romania). The main factor affecting the competitiveness of the Western Europe's furniture industry is the production cost, mainly due to labour and raw materials cost. On the other hand, Eastern Europe presents some characteristics (e.g. lower labour cost, qualified workforce, large forest resources and proximity to emergent

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markets) that are changing the Western Europe's furniture industry with an increasing number of imports from Eastern Europe of lower-priced raw materials and semi-finished components and an increasing number of production units transferred to Eastern Europe. Another observed phenomenon is the consolidation of the European furniture industry into larger units (through the merger or acquisition of production units) to face the growing market share of worldwide countries in this sector. This consolidation and the increasing investment in automation and computerization by some leading enterprises are compromising the sustainability of smaller enterprises. The growing importance of emerging economies in the forest-based industry and the stronger policies for legal and sustainable wood products drove several European organizations to release reports and outlooks[1–4] focusing the profound structural changes that this industry must perform in order to face these new challenges and opportunities. The main conclusion of these reports is that this industry must enhance competitiveness through product quality and design, increasing productivity and innovating processes, products, organizations and promotion in order to face the new market trends.

This industry is changing drastically, forcing the need for a more flexible but efficient production process to face the diversity of product's demand and market trends. Technology can play a fundamental roll in this context, mainly by providing high reductions of production costs and increasing competiveness and productiveness. The annex to the Strategic Research and Innovation Agenda[5], released in 2013 by the Forest-based Sector Technology Platform, presents some required research and innovation activities, such as, "*Use information and communications technology (ICT) to meet highest process efficiency, improving material flow, resource efficiency, process stability, machine productivity, etc.*" and "*Design new decision support systems for the optimal utilization of recovered material of used wood and paper products*". When technology is mentioned in this industry, people instantly think in new machinery and equipment but, as can be seen, information technology must also be considered. From the Strategic Research and Innovation Agenda for 2020[2], we highlight the following observation "… *current manufacturing and processing technologies use far more resources than is theoretically necessary. Technologies that radically reduce specific energy* and *material consumption have to be developed* …" which is the main driver for this project as it aims to provide an information system for the optimization of purchase and consumption of raw materials in the furniture industry. The objective of this information system is to answer to this new paradigm providing a tool that allows the reduction of production costs while increasing enterprises' flexibility and productivity.

The target industry of this project is the cluster of furniture enterprises in the Portuguese North Region, which is mostly composed by family-owned small and medium-sized companies, with fragile strategic planning procedures, no information systems to support their daily activities and no Research and Development departments. In this industry it is natural that when submitted to the cutting process, the raw material is not fully used, producing material losses. These losses raise the need to think carefully about the cutting plans to be executed in order to minimize the costs that result from the waste created. This problem is best known in the literature as the Cutting Stock Problem (CSP).

This paper is organized as follows. Section 2 introduces the CSP and in section 3 an overview of this project is presented. In section 4, we present the results accomplished by our information system in terms of waste reduction. In the last section, we present some conclusions and further research.

2. The Cutting Stock Problem

The Cutting Stock Problem (CSP) considers the existence of two groups of data, namely, the stock of available objects and the set of items that is intended to be obtained from those objects. The result expected when solving this problem is a cutting plan that consists of cutting patterns, wherein the items are allocated to objects. The residual parts (figures that occur in patterns that do not belong to the set of items) are considered losses, commonly referred as trim loss. The wide variety of cutting stock problems that can be found led some authors to create typologies in order to aggregate these problems by their common characteristics. For example, the typology introduced by Dyckhoff[10] classifies the problems considering four main characteristics (dimensionality, kind of assignment, assortment of large objects, assortment of small items). Wäscher *et al.*[11] improved this typology presenting a new categorisation criterion to deal with some "*severe drawbacks*" found in the Dyckhoff's typology.