Managing Intellectual Capital and Innovation for Sustainable and Inclusive Society
27–29 May 2015
Bari • Italy

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TIIM

Management, Knowledge and Learning
Joint International Conference 2015
Technology, Innovation and Industrial Management

MANAGEMENT AND OPTIMIZATION OF MATERIALS FOR THE FURNITURE INDUSTRY

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Abstract:
Our project targets the small and medium-sized companies in the furniture industry. In these companies the cutting process is responsible for more than 15% of waste of raw materialmainly due to the lack of an information system to support their daily activities. Although there are information systems that seek to optimize isolated processes, such as, supplier relationship management, advanced production planning and even for the cutting process itself, there is no integrated information system that takes into consideration the enterprise global context in order to reduce the purchase and consumption costs of materials.

The proposed information system aims to reduce the waste of raw materials,optimizing the purchase and consumption of materials,boosting corporate profitability and sustainability.This information systemhas three levels of integration: no integration, working as a standalone application; partial integration, importing data from existing systems; and full integration, receiving the necessary information from othersystems, making the calculations required to createthe cutting plans for orders in progress and returning the solution generated to the system. This information systemcan be easily adaptedto other industries where the cutting process is a critical area.

Since the production planning is a highly dynamic process (e.g. introduction of high-priority orders) the information systemmust be capable to produce efficient cutting plans very quickly, but also must provide a mean tothe decisionmaker that enablesthe creationof high qualitycutting plans, although more demanding in computational resources.

Known in the literature as theCutting Stock Problem (CSP), the problem of waste reduction originatedby the cutting processassumes two basic setsof data:the stock of available objects and the information about the items that have to be extracted from those objects.

The cutting process itself consists in a set of patterns where the demanded items are allocated to objects.If the dimensionsof the waste(leftover)ina pattern are within the ones specified by the decisionmaker, this waste is classified as retailandreturns to stockin order to be used in future cutting plans.

Thisinformation system considerstheone and two dimensional rectangular CSP with usable leftovers (Dyckhoff, 1990). In the two dimensional case the cuts are guillotined (straight cuts from one side of the object to the other) with *n*possible rotations (stages).

The heuristics proposed to solve the two CSP cases have threeobjectives: minimization of trim loss; minimization of the number of patterns; and minimization of retail in stock.This heuristics are based in the Greedy Randomized Adaptive Search Procedure(GRASP) (Resende & Ribeiro, 2002)that have already obtained very good results in a wide variety of optimization problems (Festa & Resende, 2004). Each iteration ofthis metaheuristic comprise two phases:the constructionof initial solutionsand the local search phase. In the construction phase, a randomized greedy procedure is used to create

the initial solutions. In the local search phase, these solutions are improved until a local optimum is found.

To provide the decisionmaker with high quality cutting plans, an improvement method, based in Tabu Search (Glover, 1986), is applied to the best solution found with the GRASP heuristic. The Tabu Searchextends the concept of local search, allowing the exploration of different areasofthe solution space. This metaheuristic uses memory structures to guide the searchto allow intensification and diversification in the exploration of the solution space.

To evaluate the performance of our heuristics we have created a set of multi-period instances that emulates the focused industry. Both algorithms(GRASP and GRASP with Tabu Search) were able to achievehighquality results withreduced runningtimes, in both one-dimensional and two-dimensional cases. The GRASP heuristic was able to generate cutting plans that reduce significantly the waste generated in reduced computational times and themore intense exploration ofthe solution space

achieved by the Tabu Search was able to produce, as expected, superior resultsin reasonable computational times considering the sizes of the instances.

Since this is an ongoing project, computational tests in real scenarios have not yet been performed, but this preliminary studyanticipatespromising results.

Keywords: cutting stock problem, heuristics,information technology,production technology