FLEXIBLE PRODUCTION PROGRAMMING IN A CERAMIC COMPANY

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1. GROUP I: MANUFACTURING. PRODUCTION MANAGEMENT.

The present study presents a software prototype for flexible production programming, which has been developed in the frame of the collaboration between the firm Cerypsa Cerámicas S.A., and the Group for Operational Research, GOR, of the Polytechnic University of Valencia, UPV, through the Research and Technological Development Projects financed by the UPV, the Ministry of Science and Technology, and the European Regional Development Fund (FEDER).

As is known in the sector, there is currently no general purpose software available in the market, which provides production programming while taking into account concrete features of the ceramic companies, such as the existence of sequence-dependent production lot changeover times, production alternatives or limited storage capacities for the product in course. Although certain techniques address production planning, such as Material Requirement Planning, MRP, or Material Resource Planning, MRPII, they do not allow obtaining executable production programmes. There is therefore a gap between presently available techniques and the techniques that are actually needed, taking into account moreover the current tendency towards diversification and product differentiation.

Within the frame of this collaboration, the GOR Research Group has developed a latest-generation prototype software equipped with programming and sequentialization techniques for finite capacity production. Specifically, the software is based on the use of genetic algorithms, as well as other advanced techniques. This prototype, called the ProdPlanner, is able to plan the production of several production lines, from pressing to sorting and packing, taking into account the existence of hundreds of products, heterogeneity in machine speeds and capacities, production lot changeover times, limited storage capacities for the production in course, lapses or overlapping in production (possibility of firing part of a lot without having completed the glazing), production priorities, eligibility of machines (products that can only be processed in a given machine, or products that can be processed in every machine but one), as well as many other aspects that condition tile production programming. At present, the prototype incorporates a total of 40 different methods for production programming and reads data from text files, spreadsheets, SQL databases and even HTML files for interoperability with Internet and Intranets.

Figure 1 shows the result of a complex production programming exercise in a plant with three production lines, in which 3 pressing and glazing lines, 4 kilns and three sorting and packing lines have been considered. The black coloured blocks that appear between some of the tasks are the changeover times; to calculate these the programme performs a great number of verifications regarding sizes, plates, decorations, colours and other features, to subsequently calculate the time necessary to change over from one type of tile to another in production. Further to be observed is the overlapping that exists between the different production stages, as Prodplanner, with line speed data, is able to calculate the time required to fill the boxes and transport them to the kilns, for example.

Prodplanner can generate all types of lists, which can be printed directly or exported to great variety of formats, including documents, spreadsheets, HTML, text, etc.

The Prodplanner features a series of additional characteristics, which makes its use in ceramic sector companies very interesting. The internal structure and production programming methods it contains are highly flexible, so that additional restrictions to can easily be incorporated, for example like the existence of a limited number of boxes at the kiln entrance and/or exit, number of simultaneous lot changeovers, timetable restrictions on the use of machines, overlapping and/or lapses in production and use of machines, special products, etc.

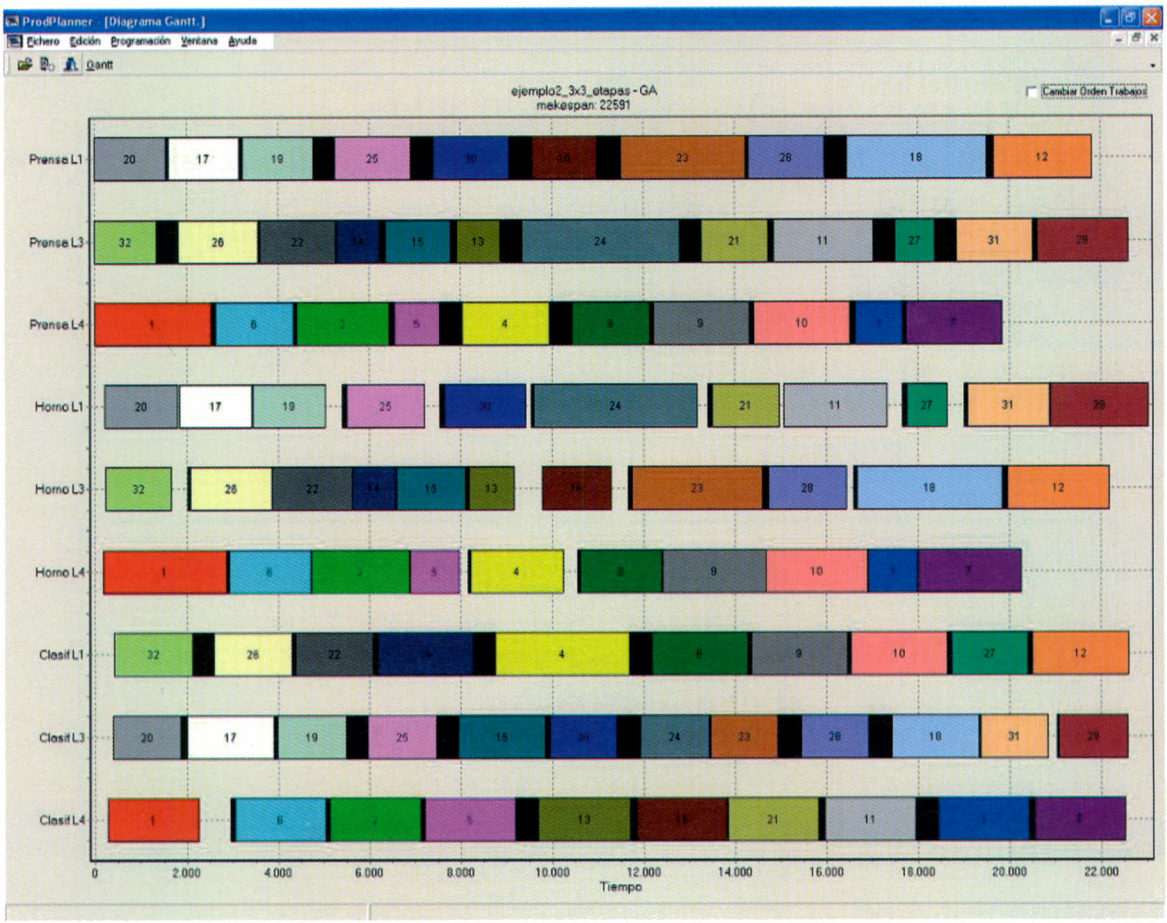

Figure 1. Example of a Gantt diagram.

The initial results of the prototype are promising. The optimisation criterion considered is the minimisation of the time that elapses from processing start of the first order of a production sequence until completing production of the last lot. Various real production cases have been evaluated, for which all the data such as process times and changeovers were available. In each case, the company head of production programming at CERYPSA, S.A., worked out the production programmes in the usual way. These were subsequently compared with the programmes obtained by the ProdPlanner. The results indicate that the ProdPlanner is able to generate production programmes that are almost 9% shorter on average, and sometimes even over 17% shorter (32 products and 3 production lines). Greater differences are expected in cases involving larger sizes. In every case, the resolution times were less than five seconds on standard desktop computers. These results are graphically displayed in Figure 2.

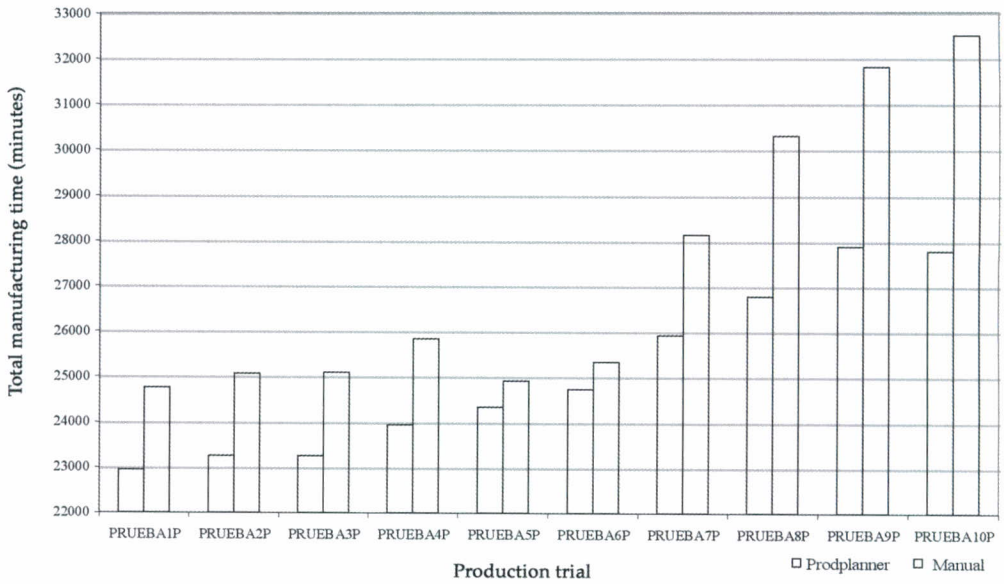

Figure 2. Graphic results of the comparison between programming by manual methods and Prodplanner programming.