

Customization of parquet production by naturally designed hardwood floors

Alfred Teischinger¹, Manfred Gronalt²

¹Institute of Wood Science and Technology, Department of Material Science and Process Engineering, University of Natural Resources and Applied Life Science, BOKU Vienna, Peter Jordan Strasse 82, 1190 Vienna, Austria

²Institute of Production and Logistics, Department of Economics and Social Sciences, University of Natural Resources and Applied Life Science, BOKU Vienna, Feistmantelstrasse 4, 1180 Vienna, Austria

ABSTRACT

The current appearance grading system of hardwood does not meet the specific demands for the appearance of the wood in the final products such as parquet floors or furniture. The standards are aimed at reducing the number of characteristics which define the various grading classes with regard to appearance. The “customized wood design of parquet floors” aims at the transfer of natural patterns of wood into the final product by involving the customer in the design process. Natural patterns and features which would not be used in a standard driven production process shall be allowed. Within the production process parquet lamellas with various features are to be arranged in a way so that certain, individually designed patterns are achieved. The target and advantage of the system is the higher added value of a low grade material and probably fewer complaints about defects of the final product by the customer.

INTRODUCTION

In the wood process chain most of the material is sorted according to standards or acknowledged grading rules. In most cases grading is performed by categorizing the wood into a certain grading class. Each grading (appearance) class is characterized by a number of features (knots, discolouration, textures etc.) which are allowed in different variations within a specific class. Therefore each grading class has an upper and a lower limit of specific features and all pieces graded

within one class show a certain variability of features. This structure of grading does, however, not take into account the great natural variety of wood properly, especially the variety of hardwood.

Thus this grading system does not always meet the specific demands for the appearance of the wood in the final products such as parquet floors or furniture.

OBJECTIVES

Our project of “customized parquet floors” aims at the transfer of natural patterns of wood into the final product by involving the customer in the design process. These natural patterns and features are randomly distributed in a traditional standard driven production process. Within the production process parquet lamellas with various features are to be arranged in a way so that certain, individually designed patterns are achieved. The target and advantage of the system is the higher added value of a low grade material and probably fewer complaints about defects of the final product by the customer. With this system also the percentage of stem wood to be used as parquet lamellas or furniture components can be increased dramatically.

STATE OF THE ART

The current sorting criteria and appearance classes of wooden floors are strongly related to the former Austrian parquet standard ÖNORM B 3000. This standard describes four classes, called “exklusiv” (excellent), “natur” (natural),

“gestreift” (striped) and “rustikal” (country-style) as shown in fig 1. Even typical trademarks from a specific company are derived from this system, sometimes using transient classes such as “selekt” (select) which is between “exklusiv” and “natur”.



Figure 1: Typical appearance classes from excellent (left) to county style (right)

Although the above mentioned standard has already been replaced by European standards such as EN 13489 the companies stick to these established classes and also the company labelling is based on that system. But also sorting according to the EN 13489 is based on four classes (three specified classes and one open class) where each class specifies the amount of certain features of the lamella which is allowed in the various classes. A survey of modern parquet floor manufacturing based on the new European standards is given by Kruse et al. (2002).

On the other hand the idea of mass-customization proposes the use of individualized products in high volume manufacturing for a large market without tradeoffs in cost, delivery and quality (McCarthy 2004). Examples and applications of mass customization and postponement strategies as well as customized product configurations in the woodworking industry can mainly be found in furniture productions (Sigg et al. 2003) but not in parquet floor manufacturing.

Up to now the aesthetic properties of wooden surfaces with natural patterns and their connections to people’s preferences have not yet been examined thoroughly in a scientific way. Broman (2001) describes people’s preferences to be affected by a balance between the degree of harmony and activity, and the importance of avoiding a state of disharmony when composing wood surfaces.

Nordvik et al. (2005) discuss the need of visualizing wood interiors by computer visualization and describe a qualitative assessment of what people react to in the course of a visualizing approach.

METHODS

The current feasibility study of customized floor designs (Teischinger 2006) is based on three main objectives and tasks:

1. Analyzing the current parquet floor manufacturing process with regard to mass customization.
 2. Analyzing the current grading systems and approach for a customer-oriented design process (Teischinger et al. 2007).
 3. Development of a computer model which supports a customization by providing templates to the customer so that the customer can develop his/her own design. This model has to be implemented in the process control, too, which was evaluated by a case study company. Within the production process the customization has to be integrated in the latest possible stage of the production which is explained by the “Product Postponement” theory. This process model was developed by Gronalt et al. (2006) in the course of the project. In order to simulate the production process, the various appearance features of wood had to be categorized and their statistical frequency of occurrence, which forms the basis for the design templates, were calculated. In order to make manufacturing feasible, these characteristics had to be summarized in 20 to 30 appearance classes (fig. 2). In addition certain suggestions for special natural floor patterns in a room were presented based on a systematic survey of the optical effect of the natural features in wooden floors.
- In a case study a sample of proponents had to design their own floors, each of them had the same amount and quality of parquet lamellas. These lamellas consisted of a typical variety of natural patterns such as colour variations, discolourations, various textures etc. In order to conduct simulation experiments, implementing real-life production data, the simulation software Arena[®] was used.

RESULTS AND DISCUSSION

The following wood characteristics were taken into account when creating new individual designs.

Texture: radial cut, tangential cut, transient cut

Colour: dark, medium and bright within a certain species

Growth pattern: knots in different appearances, discolouration, partial colour differences, etc.

All these characteristics were summarized in 30 appearance classes as shown in fig. 2.

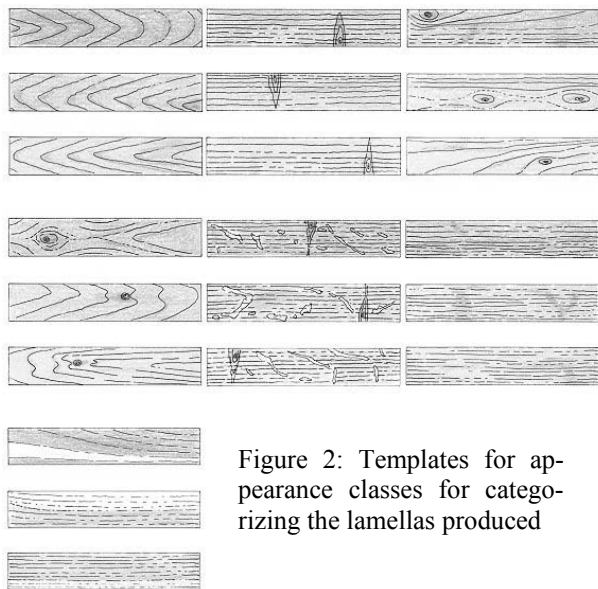


Figure 2: Templates for appearance classes for categorizing the lamellas produced

Based on these appearance classes various designs as shown in fig. 3 were introduced so as to achieve special appearance effects in a room.

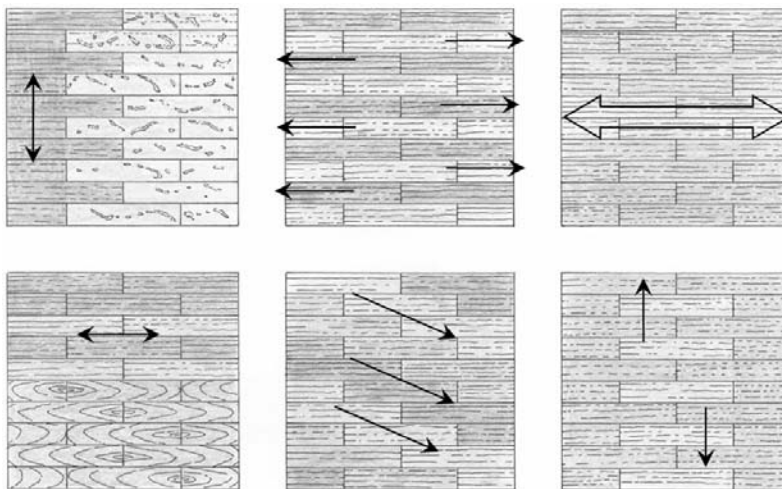


Figure 3: Typical floor pattern to be achieved by a specific assorting of lamellas with categorized appearance features

The different variations of bright and dark lamellas or radially or tangentially cut lamellas etc. provide different impressions to the people staying in a room with such a parquet floor. These designs may also lead to certain impressions in the three dimensional impact of a room such as making a room look smaller, larger, longitudinal etc. Special patterns in a certain part of the room may also focus the view of the observer to the window, to a wall with a painting, to the door etc. These designs should also match with the findings by Broman (2001) in order to develop a certain degree of harmony and activity in wood surfaces.

However, customized designs featuring individual patterns are possible, too. These individual designs may take into consideration certain effects in a room such as artificial or natural lighting but may only be pure imaginary designs (e.g. for children's rooms) without any architectural aspects. With regard to manufacturing, such designs have to stick to the 30 basic features shown in fig 2. The project was focused on the principal technological feasibility of such individual designs, however, any further development of design will be left to professional designers.

Based on Kruse et al. (2003) and on the experiences of the case study company, a manufacturing model with a "Customer Order Decoupling Point (CDDP)" was developed (fig. 4). Three different scenarios were evaluated, where scenario "Status Quo" is the core model of all production environments tested and used as a reference to compare the new modularization concepts.

Today, customers can buy parquet floorings either as finished product in Do-It-Yourself-markets or they can visit producers' or retailers' show rooms providing sample areas and brochures etc. Those companies just sell but may also install wooden floorings on the building site. Applying the modularization concepts combined with a product configuration system, such as applied in the automotive industry (business to customer) and as described by Stormer (2007), allow more flexible supply chains and order fulfilment processes in the parquet industry.

Limits and competences valid in today's supply chains are dissolving, making customers co-designers or co-producers.

The first scenario completely leaves out the retail or wholesale processes. The customer orders his individually created floor directly from the producer via a configurator and the internet. The producer delivers it directly to the customer, including a detailed laying plan for the individual floor. Another possibility for the producer would be to offer the service of laying the floor at the customer's home himself or by a subcontractor. A possibility for the customer would be ordering via a specialized retailer. With the help of the trained professional, the customer can then create and

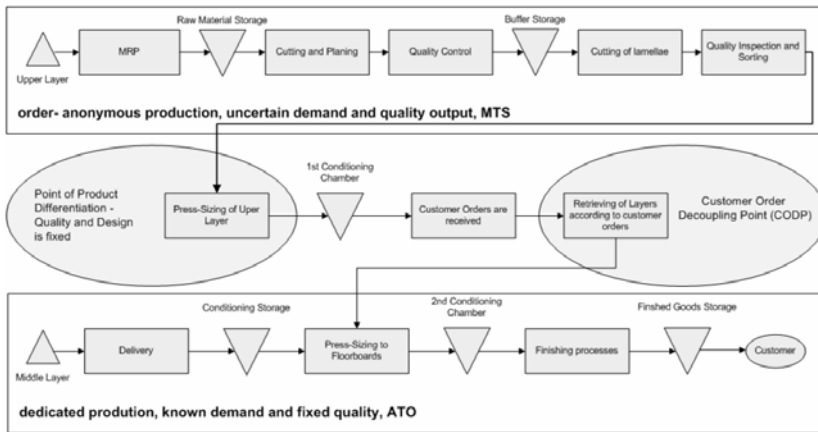


Figure 4: Production process including product differentiation Point (PPD) and Customer Order Decoupling Point (CODP)

order an individual flooring online. This concept has the advantage that customers who are not technically interested can also create and buy an individualized wooden floor.

Based on the concept of a product configuration system (product configurator) as shown in fig. 5, a number of scenarios can be developed for the parquet.

A further possible supply chain scenario implies the use of configuration terminals in DIY-markets. Customers who do not have the possibility of using internet applications at home or at work could then also order online.

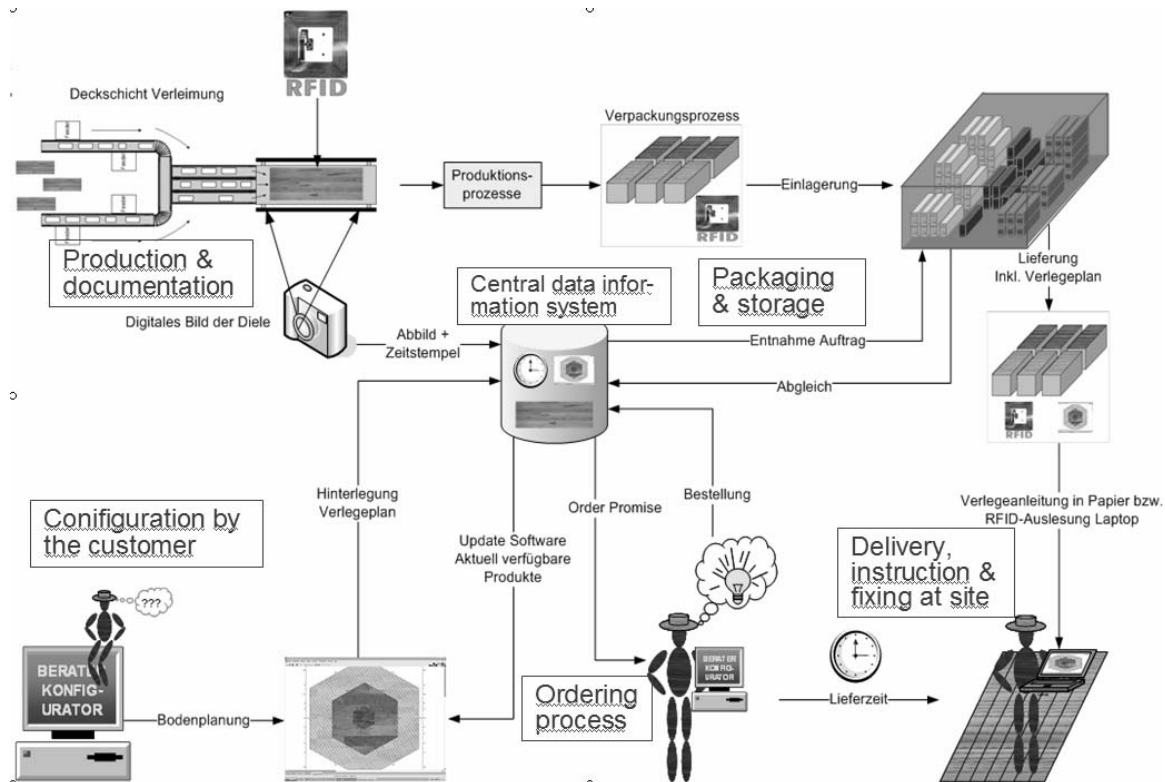


Figure 5: current and future supply chains in the parquet floor industry

Another possibility of using a configuration terminal in a DIY-market or at a retailer could be a function of the software, which automatically creates suggestions for take-away floors. This concept would need a direct

communication between the configurator and the inventory management system. The customer can state his preferences and the configurator then presents solutions and examples of individual floorings which can be created with the products the DIY-market has in stock. This concept could be extended to a vendor managed inventory application, which allows for a direct filling of the DIY-markets inventory by the producer.

CONCLUSION

For many years mass production was the dominant manufacturing strategy where production techniques pushed companies to have standardized products, rigid manufacturing systems focused on low cost over flexibility. Today's consumers are becoming more selective. They want quality, value, and products specially tailored to their needs at the lowest possible prize.

Considering the high natural variability of the raw material wood, especially of hardwoods, a business strategy of mass customization was introduced. The grading and manufacturing system presented makes a more efficient use of wood for parquet floors possible. The suggestions for special patterns have taken into account the natural structure of wood, which then provides a natural appearance of the parquet floor. With the current grading classes the design of floor patterns with lamellas taken at random creates some kind of disharmony in a room. The new approach to design floor patterns creates a certain activity but still the kind of harmony (shown in fig 3) requested by the customer.

A product configurator is considered as a very powerful tool by implementing a mass-customization. A production model with several process variations developed by Gronalt et al. (2006) proved the economic perspective and competitiveness of the new grading and production system.

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