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# TechnoPORTA intelligent, customized technological line for the automated production of technical doors - selected technical and economic indicators

ZDZISŁAW KWIDZIŃSKI[1], JOANNA BEDNARZ[2], ŁUKASZ SANKIEWICZ[1], MARTA PĘDZIK[3], TOMASZ ROGOZIŃSKI[4]

[1]Porta KMI Poland, Bolszewo, Poland
[2]Department of International Business, Faculty of Economics, University of Gdańsk
[3]Department of Wood-based Products and Biocomposites, Łukasiewicz Research Network – Wood Technology Institute, Poznań, Poland
[4]Department of Furniture Design, Faculty of Forestry and Wood Technology, Poznań University of Life Sciences

**Abstract:** *TechnoPORTA. Intelligent, customized technological line for the automated production of technical doors - selected technical and economic indicators*. The development and implementation of innovative production of technical doors in a pilot technological line made it possible to automate the production process. It became possible to manufacture doors with dimensions and weight significantly exceeding the current technological capabilities of the company. An additional benefit resulting from the implementation of the TechnoPORTA line is the improvement of technical and economic indicators related to the consumption of basic materials, additional materials and energy. It relates to annual savings of material in the production line, the unit consumption of electricity and the unit application of the adhesive during postforming.

*Keywords*: technological line, mass customization, indicators, wood based material, doors, binders, energy

## INTRODUCTION

Innovations in production processes and methods affect the capital intensity of processes, change the proportions of fixed costs of production facilities, affect economies of scale and experience curve(Porter, 2006). The so-called key technologies, which underpin the competitiveness of products, play a particular role. They make it possible to generate high-quality products and reduce costs(Gierszewska and Romanowska, 2009).

TechnoPORTA technology line is a fully automated smart line ensuring the highest quality and efficiency of production. Designed for mass customisation with the required minimum production batch size (one door) it meets the highest technical requirements(Pędzik et al., 2020). This line has been developed using technologically advanced machines and devices which enable the greatest possible automation of work at each stage of processing, including positioning and feeding of the material and retooling of machines(Kwidziński et al., 2021). Parametric operational control shall be provided by automated systems allowing for the connection of the central planning level (ERP systems, etc.). This solution guarantees recurring high quality of the elements processed, which is consequently reflected in the high quality of the finished products. The production line consists essentially of 5 technological modules: section for formatting, milling, and edge banding, a postforming section, CNC section, drilling, and milling of hinges and locks, CNC section, individual milling and fitting section. The interconnection of these modules is shown in fig.1.

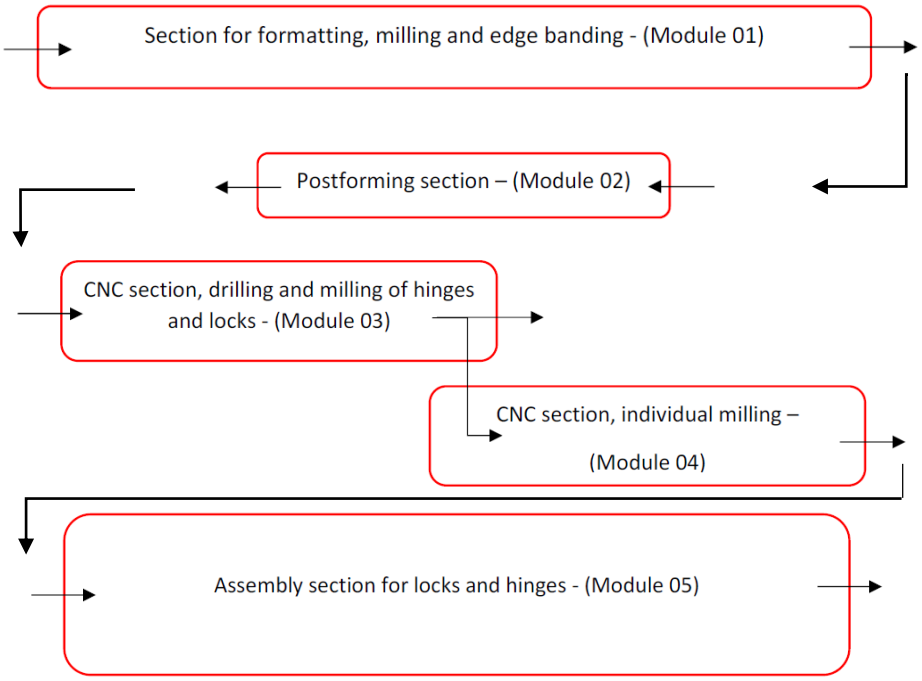


**Figure 1.** TechnoPORTA line functional diagram

The TechnoPORTA line offers the possibility to produce door leaves of dimensions and weight significantly exceeding the existing technological capabilities (up to 200 kg), while at the same time reducing resources in the form of the consumption of basic and auxiliary materials, as well as energy and working time. The purpose of the work is to estimate, on the basis of the results of the TechnoPORTA trial operation, technical and economic indicators concerning the consumption of wood materials, auxiliary materials (binding/bonding measures) and electricity.

## MATERIALS AND METHODS

Basing on reduced machining allowances concerning door stiles used in the TechnoPORTA line, material savings were calculated. The calculation consisted in the calculation of the difference in the quantity of wood materials needed to produce the annual assumed production of door leaves before and after the introduction of reduced processing surpluses for semi-finished products. Reduction of the machining allowances while maintaining the required quality of processing in the TechnoPORTA line was possible by the fact that the automatic material positioning, and feeding and parametric control of the operation and changeovers of the machines were used at each stage of processing.

A power clamp meter and harmonic UT243 model (UNI-Trend Technology, Dongguan City, China) were used to perform energy measurements. The measurements were comparable using the current reference technology and TechnoPORTA demonstration technology. Approximately one-hour measurements of electrical parameters of voltage and intensity of nodes supplying the line were performed. 28 door leaves were used for measurements on the reference line, while 47 pieces were used for measurements on the demonstration line. On the basis of the reference of total energy input from the process to the number of processed door leaves, the energy consumption with reference to the processing operations carried out on one door leaf was calculated.

In order to determine the consumption of EVA glue used to stick narrow door surfaces with the ABS edge, 3 sets of edge samples were taken. The weight of the adhesive was

measured using both technological lines (reference and TechnoPORTA) by means of laboratory scales. All samples had the same dimensions of 67×100mm.

## RESULTS AND DISCUSSION

The results of material savings resulting from the reduction of processing surpluses on the TechnoPORTA line are presented in the form of an indicator referring this value to the annual expected production of door leaves of 480 thousand pcs. (Fig. 2).

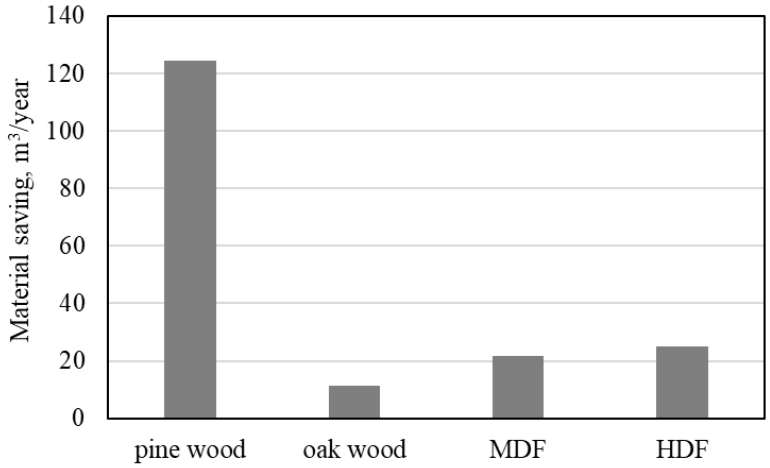


**Figure 2.** Estimated material savings

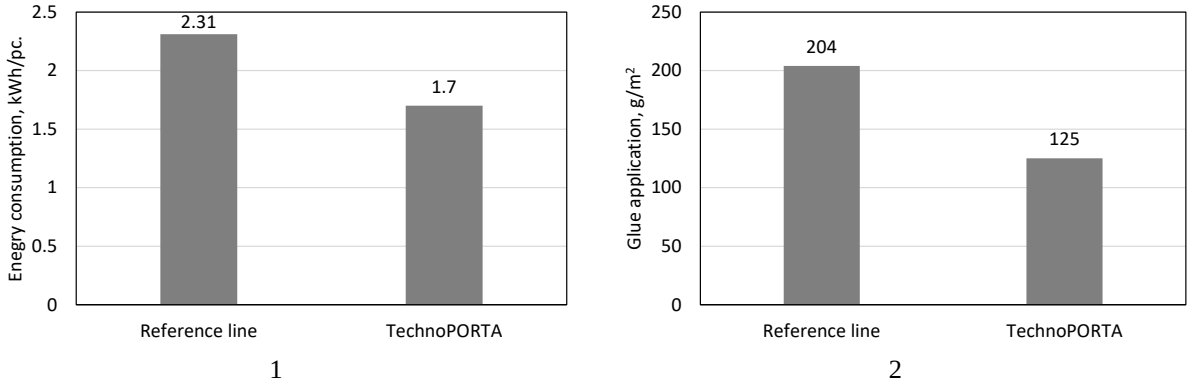


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**Figure 3.** Energy consumption (1) and glue application (2) in the reference line and TechnoPORTA demonstration line

The results of measurements of indicators related to energy consumption and adhesive application are presented on fig. 3. In the case of electricity consumption, 2.31 kWh/pcs for the reference line and 1.7 kWh/pcs for the TechnoPORTA pilot line were obtained. The result for the pilot line is 26% better. This is due to the higher efficiency of the pilot line which has made 19 more elements at a comparable time.

During the measurements, the average EVA adhesion application result was obtained for the reference line at the level of 204 g/m$^2$ and 125 g/m$^2$ for the TechnoPORTA pilot line. The technologies used and the settings of this line have made it possible to achieve 39% savings in glue application and have thus contributed to reducing the environmental burden on the part of the company.

The competitiveness of the enterprise is influenced by both internal and external factors. From the point of view of the study, it is worth pointing to internal factors such as: expertise, key competences, quality, innovation, intellectual property rights, business organisation, business model, selection and implementation of the appropriate strategy and

external factors: economic infrastructure, capital resources, human capital, technology, customer preferences, market structure and rivalry between competitors (Bednarz, 2013; Śliwiński, 2011).

The enterprise can achieve a cost advantage on the market when it knowingly designs its flexible production process. It is intended to provide the possibility to produce diverse varieties of products in small batches meeting the individual needs of purchasers(Porter, 2006) in line with the trend of mass customisation. This is supported by rational management of materials, raw materials and energy sources, employee involvement and motivation, increased innovation, implemented changes in the way the production department and the entire company work is organised. This requires the use of advanced IT systems enabling the management of reliable information and efficient planning and making decisions profitable from the business perspective(Kraszewska and Pujer, 2017). It is also important to make significant changes to the quality of the analysis and control of costs in the enterprise. It is worth adding that the cost advantage is closely linked to the time competitiveness achieved by optimising production and distribution processes (time savings) and further innovations in processes and products(Adamkiewicz-Drwiłło, 2010).

## CONCLUSION

The obtained values of technical and economic indicators concerning the use of materials, energy and adhesive in door production confirm the assumption that the implementation of the innovative TechnoPORTA line contributes to: reduction of production costs, improvement of work ergonomics, increase of product margin, development of specialist knowledge of production and technology personnel, increase of product quality and possibilities of customising them and thus better meeting customers' needs. Consequently, this contributes to strengthening the competitive advantage of PORTA KMI Poland in the industry.

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**Summary:** *TechnoPORTA. Inteligentna, zindywidualizowana linia technologiczna do automatycznej produkcji skrzydeł drzwiowych – wybrane wskaźniki techniczne i ekonomiczne.* Opracowanie i wdrożenie innowacyjnej produkcji drzwi przemysłowych w pilotażowej linii technologicznej było możliwe dzięki automatyzacji procesu produkcyjnego. Stało się możliwe wykonanie drzwi o wymiarach i wadze znacznie przekraczających dotychczasowe możliwości technologiczne firmy. Dodatkową korzyścią z wdrożenia linii TechnoPORTA jest poprawa wskaźników techniczno-ekonomicznych związanych ze zużyciem zarówno materiałów podstawowych, materiałów dodatkowych jak i energii. Dotyczy to rocznych oszczędności materiałowych w linii produkcyjnej, jednostkowego zużycia energii elektrycznej oraz jednostkowego naniesienia kleju przy postformingu.

Corresponding author:

Tomasz Rogoziński,
ul. Wojska Polskiego 38/42,
60-627 Poznań, Poland
email: tomasz.rogozinski@up.poznan.pl
phone: +4861 8487483