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MODERNIZATION OF PUNCHING TECHNOLOGY, PUNCHING MACHINE EPU32

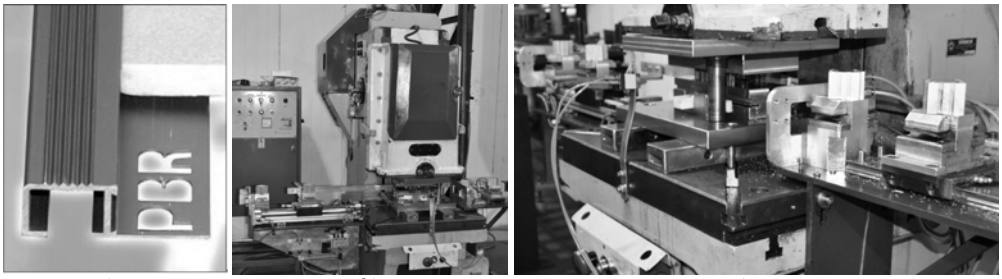
Darko Martinovic
FEAL d.o.o.
Trnska cesta 146, Široki Brijeg
Bosnia and Herzegovina

Adisa Vucina
University of Mostar, Faculty of Mechanical Engineering and Computing
Matice hrvatske bb, Mostar
Bosnia and Herzegovina

ABSTRACT
The globalization of different levels complexity product markets, communication and transport links and outstanding ease and availability of delivery services impose a simple question - how enterprise in Bosnia and Herzegovina can remain competitive in a seaway dynamics of an economy? Specific challenges have been set to small and medium enterprises that used to be competitive in the local market, which in this day and age is no longer an applicable strategy for survival. To maintain their share in the global market, companies must create a sound methodology and systematic approach to product development. Precisely such an important and essential role plays concurrent engineering methodology as a relatively new approach to product and/or process development. The paper presents the practical example of the EPU32 machine redesign from Jelsingrad manufacturer, in order to increase its productivity.
Keywords: punching technology**,** EPU32

1. INTRODUCTION
Bearing in mind the dynamic and demanding market that is constantly changing, company Feal d.o.o has answered with the modern equipment of the plant for aluminum extrusion, electrostatic powder coating and anodizing anode, as well as machinery for the processing of aluminum profiles [1]. Their own professional teams manage to redesign and adapt one part of the old good quality machines to today's market needs. A concurrent engineering methodology is introduced, ie a systematic approach to integrated product development that emphasizes the response to customer expectations. It embodies team values of cooperation, trust, and sharing in such a manner that decision making proceeds with large intervals of parallel working by all life-cycle perspectives early in the process, synchronized by comparatively brief exchanges to produce consensus [2]. One such example is a machine EPU 32 with simple pneumatic feeder, which has been used in the company for many years now for punching aluminum decorative and protective ceramic tile trims [3]. Previous work on the machine demanded a high focusing of workers on the process, a lot of handling, so the final quality and capacity depended on the skill of workers.
Before modernization, machine process flow diagram was as follows: operator manually inserts aluminium tile trim profile through the feeder and sets it into the start position for punching, starts the machine, after the initial cycle automatic feeding device moves tile trim profile in order to achive PBR logotype punching (Figure 1a), the process is repeated until unilateral automatic feeder (Figure 4a)

runs out of tile trim profile (Figure 2.). The rest of the tile trim profile that has remained untreated had to be manually pulled through while punching, and disposed of manually. Operator stops the machine and inserts the new profile.
The machine is used for stamping of extruded aluminum profiles with the length of 6.5m. Before the modernization, machine capacity in accordance with the block diagram presented on Figure 2 was 200pcs/shift.



a) b) c)

Figure 1. PBR ceramic tile trim (a), EPU 32 machine (b), automatic feading device, die, puller (c)

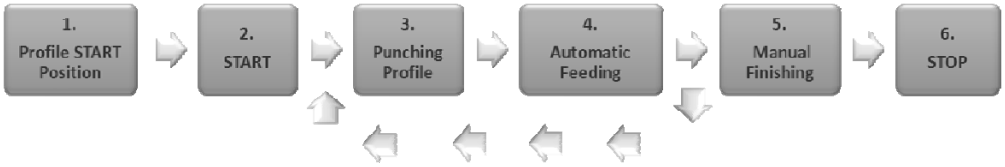
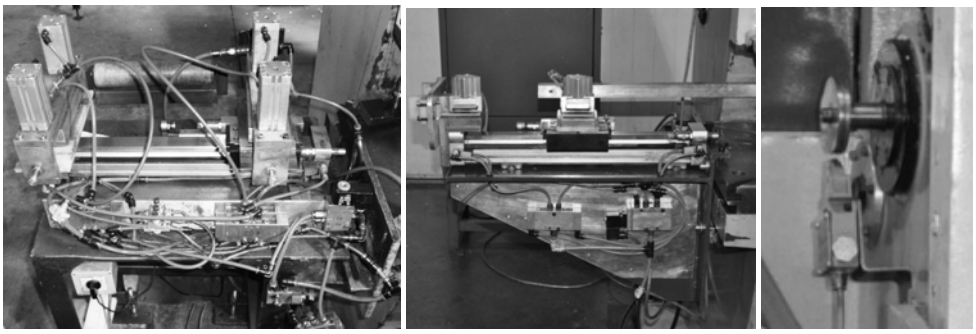


Figure 2. Mechanical process of production of one ceramic tile trim profile before modernization of machine EPU 32

Due to the increased demands of the market, company needs to increase production capacity by 40%. The management team has decided to form a crossfunctional product development team whose aim would be to propose an optimal solution of this problem. During the initial meeting of teams on which all members are introduced with the growing demands of the market and the existing production capacity, clear objectives of the company were set, all members were introduced to the commitments and team leader was appointed. Passing through each step of project planning phase of the methodology of concurrent engineering it was carried out detailed analysis of the existing technological process [4]. As this is a redesign of the existing solution, crossfunctional team analyzed the failures and disturbing factors of the existing solution. The task clarification was done and new specification was developed. The phase of conceptual design was adapted to redesign, and then evaluation and selection of the optimal principal solution were done.
After that, the phase of embodiment followed, which began with preliminary drawings in a scale based on a rough analysis of space requirements, and proceeded to take into account safety, ergonomics, manufacturing, installation, operation, maintenance, costs and deadlines. Working with these factors, designers found a large number of interrelationships, so that their approach had to be progressive and iterative (checking and corrections) [5]. It is important to note that the team composition changed depending on the steps of embodiment phase, engineers from the manufacturing teams were engaged as needed, and also suppliers, customers and field service were included as a support.

2. MODERNIZATION OF MACHINE, FEEDER AND PUNCHING DIE

During the phase of task clarification the team realized that there was a significant problem, the inability of unilateral feeder to add and finish up the entire profile. Specifically because feeder was located on the left side at a 400mm distance from the punching die center and was not able to finish up the whole profile.



a) *b)* *c)*

Figure 3. Automatic feeder before modernization (a), after modernization (b), position sensor (c)

This caused capacity and quality problems. Capacity was reduced because of interruptions while punching one tile trim profile (Figure 2.), and it was almost impossible to achieve uniform quality because of manual finishing.

At the phase of conceptual design, the team chose three possible principal solutions as suitable. Due to quality problems it was proposed to start with the design of additional puller that would be connected to leverage to existing feeder. In order to increase production capacity, two possible principal solutions were proposed. First was to double up feeding stroke, the second one was to punch two profiles at the same time. After the evaluation, the final decision of the team was the option that would incorporate all three solutions mentioned above.

This final principal solution can be achieved by improving machine control unit, designing of a new punching die and new profile holding elements for the feeder and puller (Figure 1). It was decided that additional modernization of machine, punching die and feeding system should be done. With machine redesign, mechanical problems should be resolved and machine control improved (Figure 3). Machine is equipped with Programmable Logic Controller (PLC) and crankshaft position sensor (Figure 3c). PLC expanded controlling possibilities and simplified possible new interventions on machine. Redesign of feeder structure resulted in simplifying the mechanism, reducing weight by 50%, and increasing of system response (Figure 3b).

Installing an additional position sensor was an important detail in solving the problem of continuous profile feeding, in the way that feeding begins at the moment when punches exit from the die and profile can be moved. This increased profile feeding cycle time by 35%. The redesign of punching tools for PBR logo is presented in Figure 5.

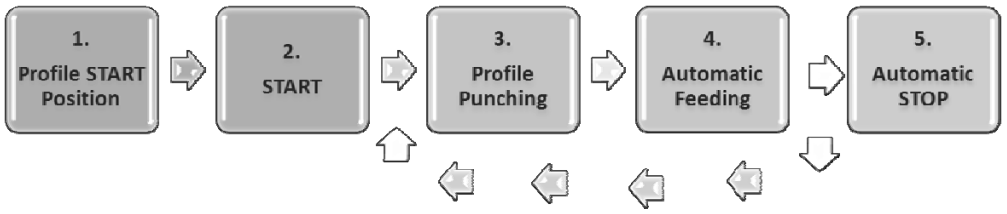
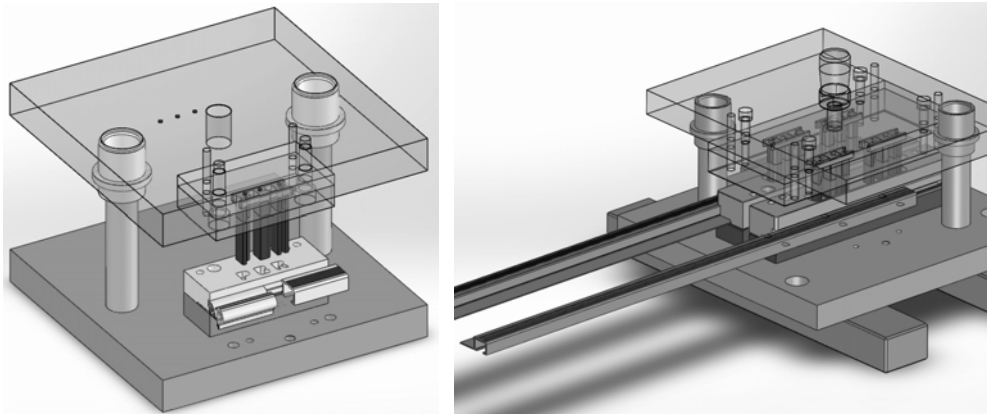


Figure 4. Mechanical process of production of one ceramic tile trim profile after modernization of machine EPU 32

In this way, punching of two profiles at a same time and increasing of feeding stroke from 73mm to 146mm is enabled. The final result of the redesign described in this paper is increase of the installed production capacities by 120%, which is considerably larger than originally set goal (40%).



a) *b)*

Figure 5. Punching die before modernization (a) and after modernization (b)

3. CONCLUSION

By implementing a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support it is possible to shorten the time of design/redesign, increase product quality with simultaneous cost reduction. This approach is intended to cause the developers to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule and user requirements. This paper is the example of the redesigning the existing machine in company Feal which demonstrates the achievement of these benefits by applying the methodology of integrated product development. Redesign has increased the capacity of the machine EPU32 by 120%, and thereby enabled the obtaining of high quality products that meet the requirements of the modern market. By implementing modern methodologies to product and process development such as concurrent engineering, companies in Bosnia and Herzegovina can get significant role in the global market.

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