Automatizacija strojarskih proizvodnih tehnologija

Miroslav Duspara, Dejan Marić, Josip Cumin, Antun Stoić, Ivan Samardžić
Mechanical engineering faculty in Slavonski Brod
Trg Ivane Brlić-Mažuranić 2, HR-35000 Slavonski Brod, Croatia
mduspara@sfsb.hr

Automation of mechanical manufacturing processes

This paper presents an overview of production technologies and describes the issues that arise in the production of goods through different production technologies (chip removal, welding / cladding and metal forming), a brief overview of the automation torch height control of the laser cutting machine, the production of metal gratings / deformation, automated welding process of the Ni alloy to the P91 pipe (describes the most frequent nickle alloy overlay welding procedures in protection of boilers as well as automated overlay welding machine. In most cases, long overlay welding is done on machines, describes the basic pieces of equipment, as well as the principle of their work (for each of the manufacturing processes, there are structural design solutions and their automation). At the end of the conclusion, the benefits were given by introducing automation into the production process.

Kratek pregled prispevka

U radu je opisan pregled proizvodnih tehnologija i opisana je problematika koja se javlja prilikom proizvodnje dobara različitim proizvodnim tehnologijama (obrada odvajanjem čestica, zavarivanje/navarivanje, oblikovanje metala deformiranjem i lijevanje), dan je kratak pregled automatizacije proizvodnje rešetaka/sita za kombajn tehnologijom oblikovanja metala deformiranjem, automatizirano navarivanje Ni legure na cijev od P91 materijala, automatizirano održavanje visine rezne glave lasera od obratka (za svaki od proizvodnih procesa su dana konstrukcijska riješenja strojeva i njihova automatizacija). Na kraju u zaključku su navedeni benefiti koji su se dobili uvođenjem automatizacije u proizvodni proces.

1 Introduction

The development and automation of production and manufacturing machines must also be developed by the people who manage them, as shown in Figure 1, except for the personal development of manpower, mechanical engineering has become a multidisciplinary area (where more and more employees are Electrical Engineers and programmers)

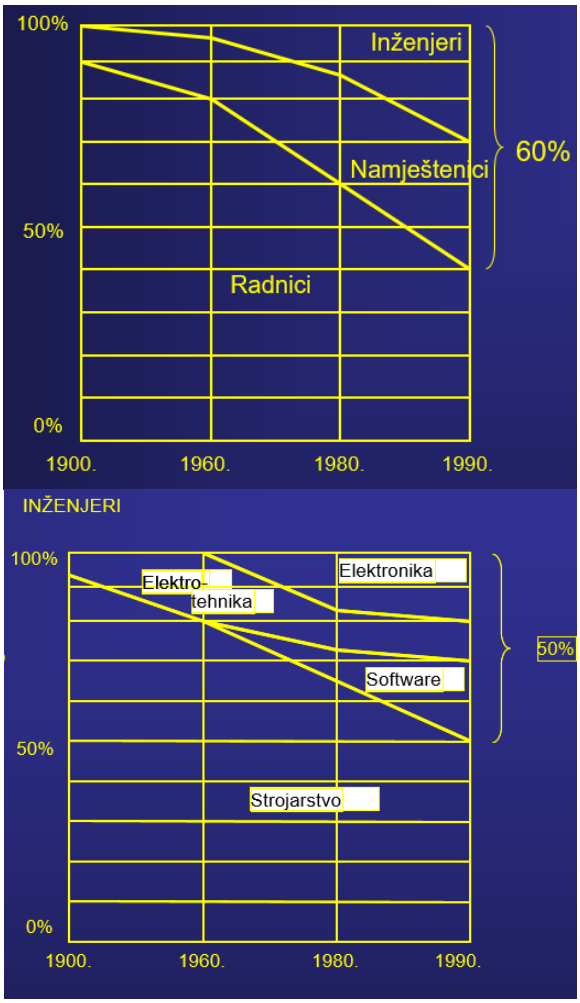

Figure 1: Employee structure in production systems during time.

2 Nonconventional cutting process - fiber laser cutting

In the process of laser cutting in order to ensure the quality of the cut, laser spot should generally be located in the workpiece surface at 1/3 the thickness (Figure 2), but for many reasons make the focal position of the laser deviates from the ideal position, resulting in the distance between the laser cutting head and the workpiece volatile and difficult to measure the problem, it is necessary in the real-time monitoring of a laser cutting process and a capacitance value between the processing target sheet, then determines the positional relationship between the laser head corresponding to the Z-axis, and to be real-time adjustment (Figure 3). [1]

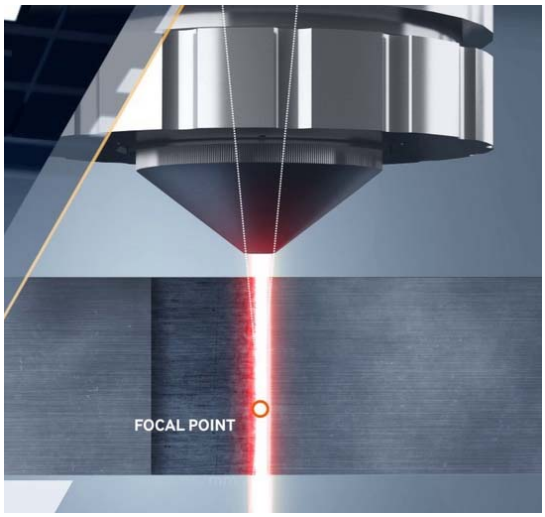

Figure 2: Fiber laser focal point and standoff between cutting head and workpiece [2].

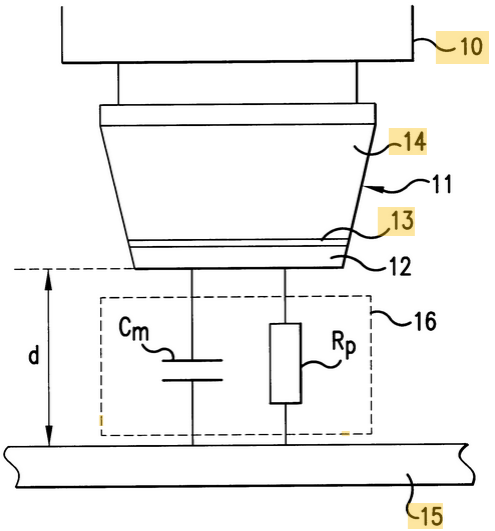

Figure 3: Capacitance value between the processing target sheet [3].

In figure 4 are described problem in surface roughness quality depends on standoff cutting head from workpiece figure a) standoff is to high figure b) standoff is to low

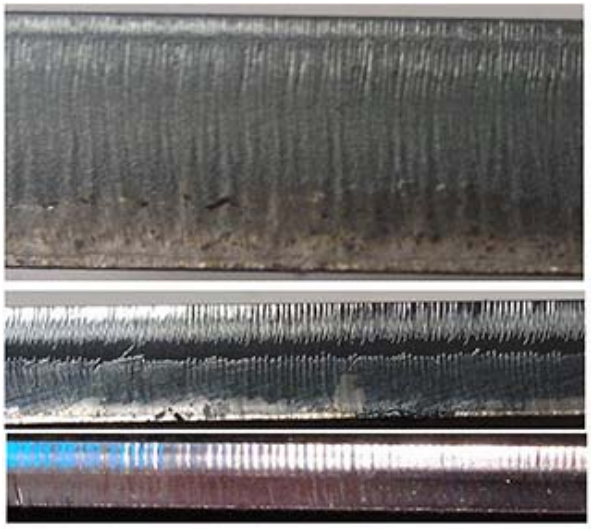

Figure 4: a) The standoff is too low.

Figure 4: b) The standoff is too high [4].

Optimizing the cut quality for any material should be done using the following steps.

Use the closest known settings to the material you are trying to cut.

Use a test part that has some interior and exterior features.

Verify that the lens and/or window is clean, and in good condition.

Verify that the nozzle is in good condition and is centered properly.

Adjust the Focus up and down until the cut starts to get bad, then set it to the middle.

Adjust the Gas Pressure up and down until the cut gets bad, then set it to the middle.

Adjust the feedrate up in increments of 5%, when the cut begins to get bad, set the feedrate 10% slower. [4]

Figure 5 shows capacitance measuring depends on standoff between cutting head and sheet of metal workpiece. Could be viewed value of capacitance when is cutting head near to the sheet of metal capacitance is zero when cutting head move up cause increase of value of capacitance, that value of capacitance is comparised with sent number of pulse from encoder on motor from Z-axis to the height controller.

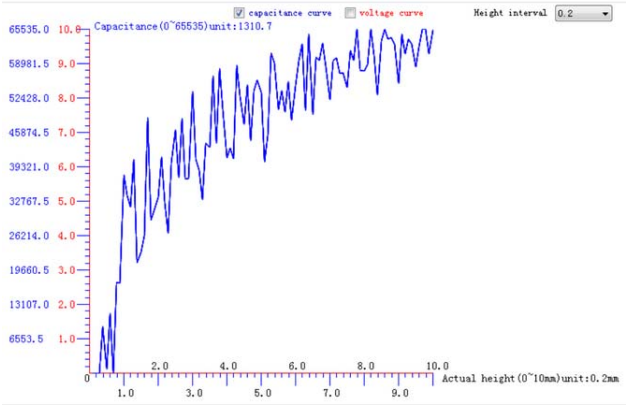

Figure 5: Capacitance measurements.

3 Welding Ni alloy with pipe

Hard facing is the application of a hard material resistant to wear by a welding process. Most commonly used materials for corrosion resistance are carbon-based steels and low-alloyed steels with low carbon content, but more and more are required for high-density martensitic steels.

Very high temperatures and chemical reactions arising from combustion of fuel in the boiler furnace are among the biggest steel enemies. The most corrosive parts of the boiler furnace are membrane tubular walls which are directly affected by flue gas, soot and products of combustion, as well as overhead water

vapour on which soot deposits are formed. There are a number of inconvenient chemical reactions in the combustion of fuel that produce layers of impurities that favour the formation of high temperature corrosion on the steel. [5]

3.1 Description of the machine for single tube overlay welding

The automated MAG process has a mechanized wire lead in the electric arc and mechanized conduction of the welding torch. In the boiler construction, this welding procedure is applied for overlay welding of the single tubes of the membrane walls, connecting pipes, heating surfaces and the headers of membrane walls (Figure 6.).

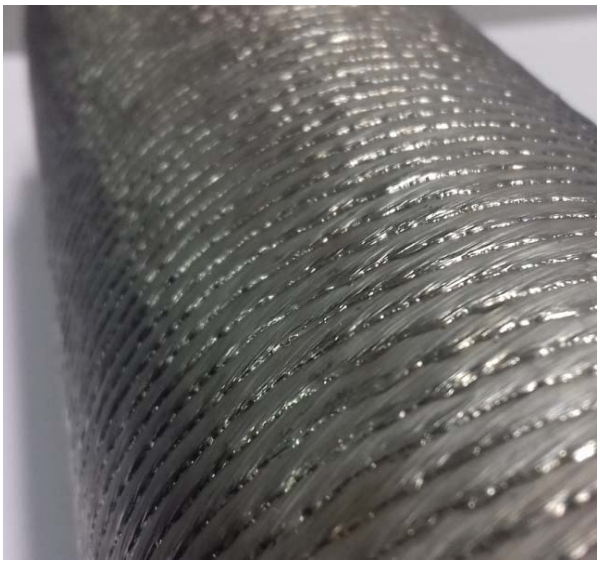

Figure : Sample overlay welded in protection of four-component gas mixture.

The welding source is a classic TPS source (Trans Pulls Synergic 5000i) with wire feeders. The welding machine (Figure 7) consists of two sources each having one welding torch. Torches makes linear motion over the tubes length while the tube is rotated. Other parts include sliding guides, rigid drive positioners, cab displacement motors and welding torches, operator cab, control cabinet, process cooling system, gas supply system, and an additional material transport system. [6]

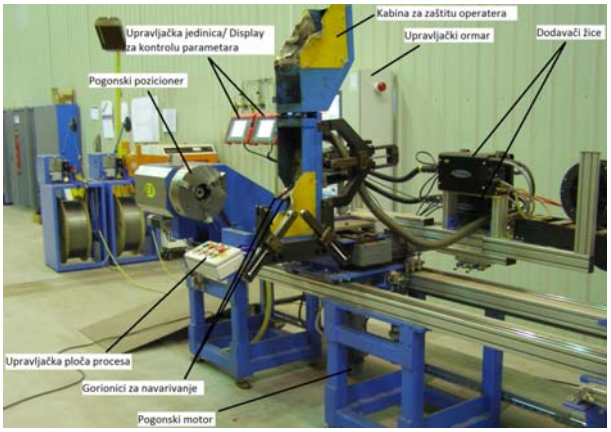

Figure 7: Automat for single tubes overlay welding.

4 Automatization of production line for sheet metal forming

The line for the production of parts for combine harvester for harvesting maize from the sheet thickness of 1mm and 2mm. The first mechanical tools for production (Figure 8) "Slamotres " which is used to 300 tons presses meets all the technical specifications of the product (the dimension of tolerance products, product shape...). The tool as such is quite complicated to do because everything is working out a pressure / stroke presses (tool's large size and large weight). All parts of the tools are moved by mechanical links or springs. And as such there is no big productivity.

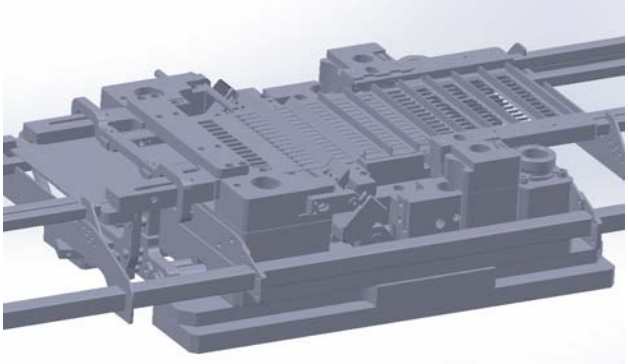

Figure 8: Mechanical tool for sheet metal forming.

The productivity of this type of tool is 50 products in the shift. As the ordered batches increased, it was necessary to construct a new automated tool with higher productivity (Figure 9)

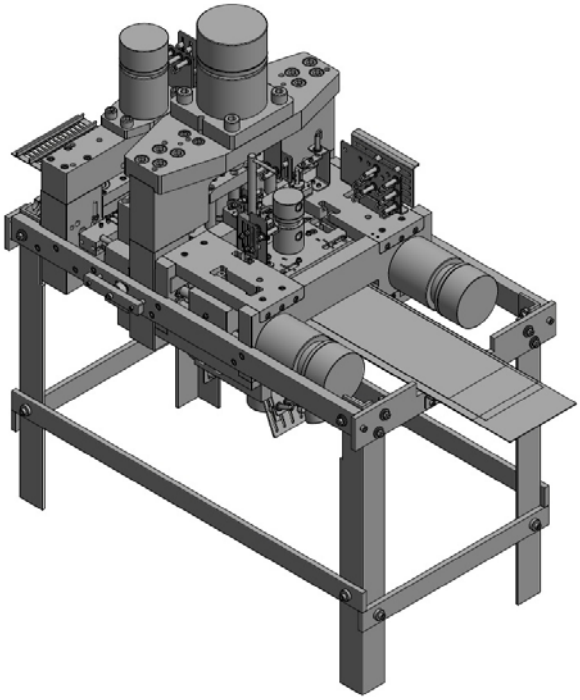

Figure 9: Automatic tool for sheet metal forming.

Each segment of the production line of "Slamotres" is automated and independent with hydraulic cylinders ie each operation is performed independently of each other. Figure 10 (3D model) and Figure 11 shows the detailed operation cuts a hole in the product.

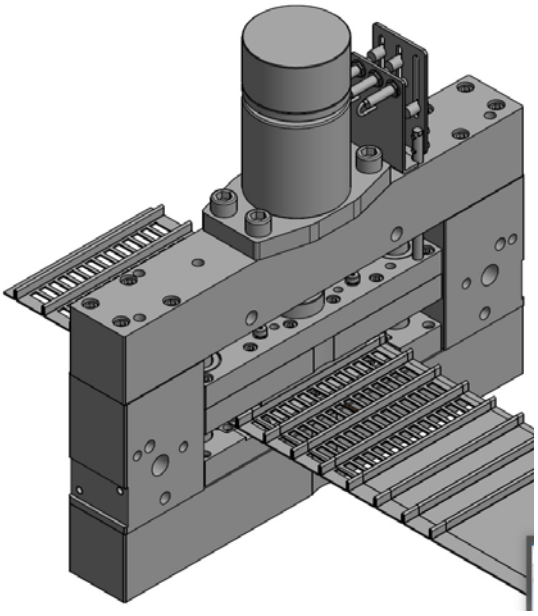

Figure 10: Detail of automatic tool for sheet metal forming.

Figure 11: Detail of automatic tool for sheet metal forming.

The introduction of an automated system in production of productivity has increased twice without the influence and work of man. Humans work is reduced only to replace the coil when it is used.

5 Conclusion

By introducing automation into production processes, the quality of the treated surface, the production process without the human influence on the quality and the number of finished workpieces, were obtained. The product number is increased twice for the same unit of time. The molding tools are smaller and easier to construct and are therefore simpler to make, and therefore the cost of making tools is far more favorable. As a result, there is a reduction in the cost of production and the increase in profits of manufacturing companies and product users.

6 Literature

[1] https://patents.google.com/patent/CN106885948A/en.
[2] https://www.ipgphotonics.com/en/products/beam-delivery/process-heads/cutting/flc-30-cutting-head
[3] https://patents.google.com/patent/US6509744B1/en
[4] Hyperterm; *Laser O2 cutting guide for mild steel,* 04.01.2016
[5] D. Marić, D. Žubrinić, T. Šolić, M. Duspara, A. Stoić, I. Samardžić; *Machine overlay welding of single tubes,* TEAM conference, 2018
[6] James Evans, Fronius UK Ltd; „*Cold Metal Transfer – Robotics*“, 2012