TECHNICAL AND ECONOMICAL ANALYSIS ON THE IMPLEMENTATION OF ROBOTS IN THE MANUFACTURING PROCESS

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Rezumat. *Acest articol prezintă o analiză realizată în interiorul unei linii de fabricație privind evoluția unor indicatori (la nivel de Departament Cutii Viteze - randament operațional, ppm, FIP OC) datorită introducerii roboților industriali (ABB) pe linia de fabricație Pinioane Fixe. Mai mult, este esențial pentru linia de fabricație să fie schimbată datorită creşterii capacitare (la momentul de față se realizează 10000 de pinioane pe săptămână, iar la creşterea capacitară se va ajunge la 12000 de pinioane pe săptămână). De asemenea, pe această linie există probleme de securitate: cantitatea de ulei existentă pe sol este mare şi operatorii sunt în mare pericol. Pentru aceasta, se vor propune diferite tipuri de exemple pentru a avea un bun nivel de măsurare al indicatorului 5 S.*

Abstract. *This article presents an analysis realized inside a manufacturing line: it refers to the evolution of certain indicators (at the level of the Gearboxes Department – operational efficiency, ppm, FIP OC) by introducing industrial robots(ABB) in the line of Fix Gears manufacture. Furthermore, it is essential for the manufacturing line to be changed because the capacity will increase (now they are making 10,000 gearboxes per week and at the increase moment the capacity will be of 12,000 gearboxes per week). Also, in this Manufacturing line there are security problems: the amount of oil is high on the ground and the operators are in great danger. For that reason, different kinds of examples for having a great score in the measurement of the 5 S indicator will be proposed.*

Keywords: operational efficiency, robots, gears, costs.

1. Quick Presentation of Renault Mechanical Romania

Renault Mechanical Romania, situated on the industrial platform of Mioveni as a component of Mechanical and Chassy Dacia Factory, produces gearboxes for Renault – Nissan Alliance. They are used in the Renault factories in France (Maubeuge, Douai, Sandouville), Japan (Oppama) and Turkey (Oyak) [14].

The TL4 gearbox produced at Renault Mechanical Romania is the first conceived and used in common by the Renault Nissan Alliance. It is a manually produced

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gearbox of the latest generation, with six speeds capable to transmit 240 Nm, adapted to the new engines gas and diesel.

Fig. 1. Costumers of gearboxes produced at Dacia around the world.

2. Current Situation on the Fix Gears Line

In the manufacturing line of fix gears there is a variety of machines [1]: Famar (Italy) and Murata (Japan) for turning processes, Ekin and Aumat for broaching, Liebherr (Germany) for cutting, Sanyo and Werra for chamfering, Sicmat, Gleason for shaving, Icom (Italy) for washing the gears and Axorys for shocking control. Figure 2 presents an industrial location of the machines in the line with each workstation. The shocking control workstation is not exhibited in the figure because it is situated in the opposite part of the building (here we have black gears, after treatment at high temperature).

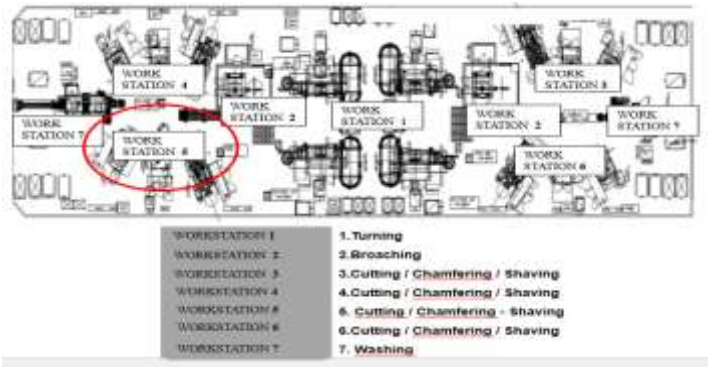

Fig. 2. Presentation of the fix gears line.

The workstation 5 is in red. There are many quality problems (shoots on the toothing), cycling time and reliability (sensor problems, valve control). This is the reason why a robot is to be introduced here [9].

In Figure 3 we can see the types of gears made on this manufacturing line. All in all, there are 26 types for different kinds of gearboxes: TL4, TL8 and TS4 (the only gearbox assembled automatically at Dacia).

Fig. 3. Fix Gears.

2.1. Indicator at level of Gearboxes Department

Operational efficiency (1) is one of the most important indicators. This is a report between the Tr (total time of work in 8 hours, excepting the breaks) and the Tcy (cycling time for the machine in cause) multiplied with the number of pieces realized)[5].

$$OEE = Pieces * \frac{Tr}{Tcy} \quad (1)$$

In figure 4 is the situation with the OEE. It is a decrease in the months March and April because the workers were changed and there were real problems with the machines [13]. The target wasn't accomplished, neither the commitment. In September is goanna be introduced the robot in the workstation 5 and the estimation is that the value of the OEE will be 88% [4].

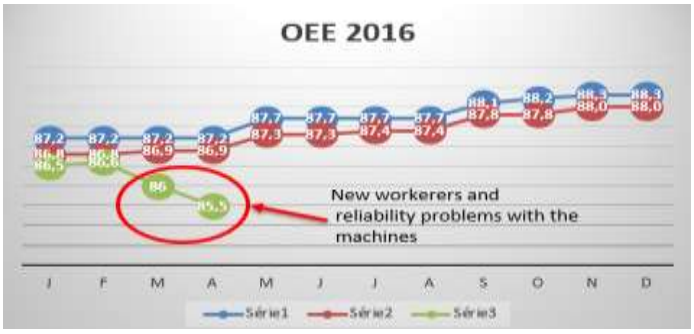

Fig. 4. OEE situation for 2016.

Another important indicator is PPM (million per pieces). The bad pieces realized in the fix gears manufacturing line are produced by the workstation 5. The actual value of the PPm is 4350 and the target in September will be 3400 [3].

FIP OC is the latest impacted indicator. The equipment necessary for the Gleason machine is expensive, also the interventions of the maintenance team (one time per day at least the maintenance team is at the machine and makes adjustments).

It is essential for the Gearboxes Department to make this change (i.e. to introduce robots) because the difference between other departments is big.

2.2. Advantages of robots

Today, an estimated 90% of the manufacturing tasks still can't be practically handled by traditional industrial automation – and many companies have outsourced labour to low-cost regions to complete those tasks. But as labour rates rise, and availability falls, manufacturers struggle to find cost effective ways of keeping up with quickly changing consumer demands [6, 7].

Let's talk about the 10 reasons why robotics automation should be implemented [12]:

1) Reduced operating costs - robots help reduce direct and overhead costs, making a dramatic difference to competitiveness (Renault Mechanical Romania has a big opponent: the Factory in Seville, Spain).
2) Improved product quality and consistency - the inherent accuracy and repeatability of robots mean that the line can achieve a consistently high quality. Robots eliminate the problems associated with tiredness, distraction and the effects of repetitive and tedious tasks.
3) Improved quality of work for employees – with robots, it is an improvement of working conditions for the staff. They will no longer have to work in dusty, hot and hazardous environment. In addition, by teaching them how to use robots they can learn valuable programming skills and do a work that is more stimulating and challenging.
4) Increased production output rates – robots can be left running overnight and during weekends with little supervision, so the output level will be increased and it will meet costumers' order deadlines. A robotic solution will not need time away from production for breaks, sickness of lapses of concentration.
5) Increased product manufacturing flexibility – robots can add flexibility to the production line. Once programmed, they can easily switch between processes, helping to meet changes in product design or customer demand with the minimum effort.
6) Reduced waste – by using robots, the quality of the products will increase. The products finished on the first run to the standard required by customers and reduce the amount of breakages and waste produced as a result of poor quality or inconsistent finishing.
7) Improved workplace health and safety – robots can take over unpleasant or health-threatening tasks that may be currently undertaken by manual workers.

8) Reduce turnover and recruitment difficulty – good workers are becoming harder to find.
9) Reduced capital costs – by moving products faster in production, businesses can better predict the production rate and ensure that a fast and efficient service is delivered.
10) Save space in manufacturing areas - robots can be mounted in multiple configurations to help save highly valuable space in manufacturing areas.

In Figure 5 there is a drawing of the robot that will be introduced in the manufacturing line [2].

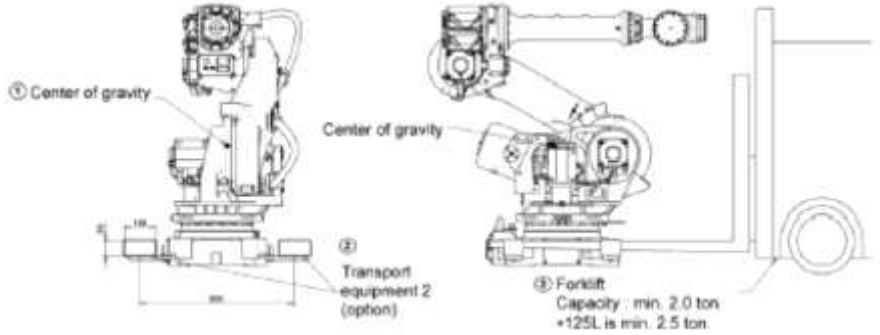

Fig. 5. Industrial ABB robot.

2.3. 5 S indicator

At the present time, the score of the 5 S indicator on the fix gear manufacturing line is of 78% (the target is 88%). This is the reason why a technical solution is searched. The oil being spread on the ground, it could cause accidents. A blowing equipment will be installed at the same time with the robot on the Gleason machine in the workstation 5. After the shaving, the gear will be introduced in the blowing machine and the oil will be eliminated. After that, the manufacturing process will continue without any intervention on the cycling [10, 11].

3. Conclusion

After introducing the ABB robot on the fix gears manufacturing line 3 workers will be eliminated. Robots are financially affordable and offer long-terms savings (45.000 KEuro/ year, the cost of 1 worker is of 15.000 Keuro/year) [8]. After several analyses the indicators will achieve the target and the profit of the company will increase.

All in all, these technical solutions offer the economical stability of Renault Mechanical Romania and make the factory stronger as to the competition.

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