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MANAGEMENT OF COST REDUCTION AND PROCESS IMPROVEMENT. IMPLEMENTATION OF INDUSTRIAL ROBOTS VERSUS COLABORATIVE ROBOTS

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Abstract: The scientific paper proposes a pragmatic perspective of analyzing the most important theoretical and practical aspects of industrial and collaborative robots in an industrial organization. The research presents in an elegant manner generalities, methods of operation, recommendations regarding the integrating areas of industrial and collaborative robots on the market and use in various manufacturing industries. Improving product quality, delivery time and the reduction of manufacturing costs is possible by building autonomous automatic manufacturing flows. In these manufacturing flows, industrial robots and collaborative robots play an important role and represent the future. Both industrial robots and collaborative robots are a viable and sustainable alternative for the product quality assurance, increased productivity and profit achievement by reducing manufacturing costs. An economic analysis has been achieved to determine which is the most cost-effective way of working with man, industrial robot or collaborative robot in a manufacturing automatic flow. In this scientific paper, the authors reunited multiple information about the existing and successfully implemented solutions.

Keywords: collaborative robots, industrial robots, robotics, cost reduction, management process improvement

1 INTRODUCTION

Management plays the most important role in the transition of organizations to automation, connectivity, and intelligent communication of manufacturing flows. This paper highlights, besides the theoretical considerations and the technical recommendations about the robotics science, the influence and the impact that a management decision has regarding profit generations.

Robotics is known as the science that is concerned with the study, design, plantation, and robot technology. Robotics is a science that combines and requires knowledge from mechanics, programming, and electronics.

The ideal of robotics is presented as the replacement of humans by complex automatic systems, with the capability of executing the requirements drawn by man, requirements that are successfully fulfilled without human intervention in time. [26]

Robotics is a complex science that can integrate the knowledge of mechanical engineering, information engineering, bioengineering, software engineering, electrical, and many other areas. Due to the varied range of knowledge in various technical areas, it can be concluded that robotics is a very complex science.

The developed equipment in the field of robotics has the role of replacing people by taking their activities and their replication. Due to the fact, there are many actions taken by people, robotics has given rise to several types of robots that are different depending on the area of activity, shape, and features. From the point of view of mechanical modeling, robots can take any form and numerous were designed similar to humans partially or entirely (robotic arm, robotic foot, etc.).

Defining the concept of a robot is a controversial one, even for robotic specialists known as roboticists. There are two ways to define the robot [9]:

- According to ISO 8373, the robot is designated by the International Organization for Standardization as a reprogrammable manipulator, with multiple functionalities that can be controlled, consisting of three or more axes;
- According to Noah Webster in the Merriam-Webster dictionary, the robot is defined as a machine that is similar to the human being that can perform certain varied and complex actions belonging to men, such as walking and speech;
- According to the Robotics Institute in America, the robot is presented being a manipulator with multi-functional functionality, reprogrammable, designed with the destination to move or manipulate devices, parts, tools, or material through scheduled and varied movements to perform different tasks;
- According to scientific-fantastic literature, the robot is defined as having a human or android form with similar characteristics to anthropomorphic organisms;

The mechanical or designing form of robots can also be inspired by nature. Depending on destination or necessity, robots have been conceived to reproduce human activities such as:

- Speaking;
- Thinking;
- Lifting weights;
- Walking;
- Many other activities associated or inspired by humans.

Robots are also conceived according to the area of activity. There are robots used in various areas of activity such as:

- Manufacturing area (takeover and placement, processing, logistics, etc.);
- Household area (robot vacuum cleaners, serving, etc.);
- Dangerous areas (radioactive inspection, explosive detection, and defamation, etc.);
- The medical area (replacement of amputated limbs or other organs to support life);
- Areas incompatible with human life (space, high temperatures, lack of oxygen, high water depths, etc.)

In the past, there have been frequent assumptions of the researchers, engineers, and inventors that robots will represent the future. There has always been the desire of man to conceive autonomous robots. The research index in terms of functionalities and their potential has remained low until the 20th century.

Currently, various robots can perform autonomous activities. Other robots can perform activities according to certain signals from the user, electrical or otherwise. The domain of robotics is constantly expanding. The potential of this science increases with technological advances that are possible thanks to investment in research, design, and construction.

In the future, authors believe that people will conceive robots that will become more and more autonomous, increasingly resistant, and intelligent. Robots will ease people's life, and it is possible that due to robots the life expectancy of humans to be increased significantly and prolonged. If the past ideas of researchers regarding robot autonomy have been materialized, today the authors consider there is a possibility that robotic mechanisms that are compatible and with replicable functionality for the humans internal organs will be developed and constructed. If this assumption will become reality, the existing crisis in medicine and the search for a compatible organ of people with health problems will be eradicated and maybe the death of man will be a subject of the past.

2 INDUSTRIAL ROBOTS. MANAGEMENT, FUNCTIONALITY AND THEIR IMPLEMENTATION AREAS

Industrial robots are programmable and capable automatic systems that can execute complex, repetitive or variable movements. The robot program can be modified as needed without implementing changes to their physical system. As the name suggests, they are used in the industrial or manufacturing field. [26]

Industrial robots have varied forms according to the area of activity. Due to this can distinguish mobile robots, destined for the logistics area, and stationary robots, intended in the production area.

Mobile industrial robots are intended for the transport of materials from the warehouse in production, the transport of the final parts in the warehouse and even loading or unloading the goods on or from the existing shelves in the company's warehouse.

Stationary industrial robots are designed to manipulate or execute certain process operations such as assembly, welding, pickup and placement, paste application, and many other applications. This type of robots is formed from articulated bars structures or assemblies consisting of translation and rotation couplings from a mechanic point of view.

Figure 1. Autonomous Mobile Robot knew as AMR [25]

Depending on necessity, management may decide to choose different solutions. Mobile industrial robots are integrated into warehouses or production areas. AMR robots must be provided with sensors to avoid collisions and freight manipulators that are developed according to application. AGV robots follow fixed routes, which are guided by sensors, magnetic or lines.

AMR robots also have the advantage of being able to be integrated into a fleet. Thus, they prioritize and traffic is controlled. Although in terms of the battery they have high autonomy, there must be areas where there are electric loading stations in which they can dock when the battery level decreases. Freight manipulators are provided with complex systems that can align, focus and position the cargo transported so that the loading and unloading are made smoothly. Also, these mobile robots must be provided with devices that ensure the safety of the materials during transport so that their integrity is not affected during this process.

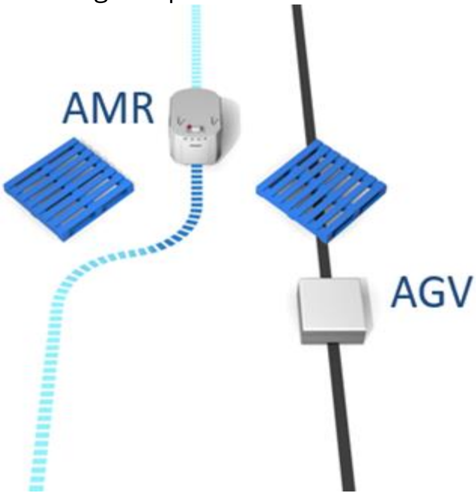

Figure 2. Types of robots used in logistics [10]

The programming of both systems, both AGV and AMR, is a simple one. However, the implementation time of an AGV robot is higher than AMR systems due to the needs to change the environment so that its navigation is possible.

Stationary industrial robots can be found in production areas. Since these robots are not conceived to share the workspace with man, they are integrated into cages or cells to meet the safety requirement. With a complex design, they are chosen according to the application criteria and can be used in numerous areas of activity.

Stationary industrial robots can perform assembly, welding, screwing, paste application, plasma cleaning, wrapping and many other applications, its potential is also unlimited.

The payload of stationary industrial robots can handle may range from small to very high. Nowadays, the speeds and accelerations that industrial robots can achieve are very high. It is considered, from a theoretical point of view, that an industrial robot has a higher working speed, being faster by about 500% than a human worker.

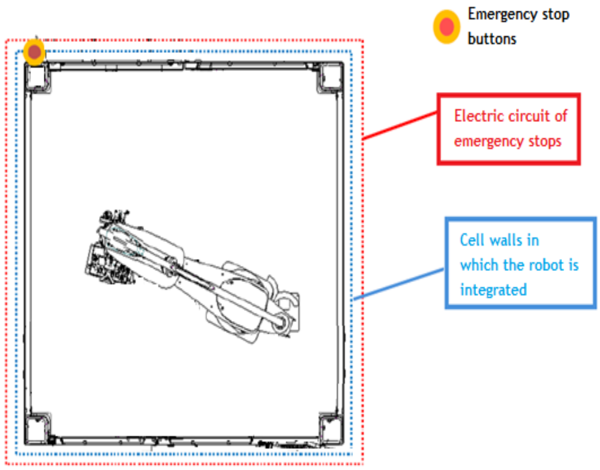

Figure 3. Industrial SCARA robot integrated into an assembly cell

Thus, depending on the type of robot, management can opt for different solutions. Thereby, stationary industrial robots it is distinguished in:

- SCARA recommended and used in industrial assembly applications due to high precision of lateral movements;
- Articulated industrial robots recommended and used in processing applications, handling, processing, cutting, dyeing, application of sealing paste, welding, assembly;
- Linear industrial robots are recommended and used in the handling, processing and assembly of parts or materials;
- Cylindrical industrial robots which are recommended for handling and assembly operations;
- Delta industrial robots, also known as parallel industrial robots, are often integrated into packing applications in the pharmaceutical, electronic or food industry due to precise movements.

Depending on necessity, management can opt for different solutions of industrial robots in terms of integration and making an automated, smart and capable manufacturing process.

3 COLLABORATIVE ROBOTS. MANAGEMENT, FUNCTIONALITY AND THEIR IMPLEMENTATION AREAS

Compared to stationary industrial robots which are strictly conditioned by being integrated into a cage or cell isolated from a human workspace, collaborative robots have the advantage of being successfully integrated to share the workspace with man.

Compared to stationary industrial robots which are strictly conditioned by being integrated into a cage or cell isolated from a human workspace, collaborative robots have the advantage of being successfully integrated to share the workspace with man.

- Work areas where are executed repetitive movements;
- Work areas with reduced ergonomics;
- Dangerous working areas for humans;
- Work areas with high manufacturing costs in human labor;
- Work areas with low productivity and quality.

Thus, collaborative robots are implemented into any area of activity for human assistance or direct replacement. Collaborative robots will take over with ease monotone jobs, in which man sequentially executes the same steps for 8 hours or 12 hours of work. Moreover, man will easily give up to collaborative robots repeatable or monotonous jobs and take over other responsibilities which bring a significant amount of quality or added value to the product.

Collaborative robots can also take responsibility in working areas with reduced ergonomics. Repeating reduced ergonomics activities during a day of work can lead to premature fatigue of man or even injury. Because of this, productivity yield will decrease significantly, even health problems can be caused in long term. A collaborative robot can take these activities and repetitively execute, without any problem. The speed and a degree of repeatability of the executed sequence are made in terms of remarkable coordination.

It is recommended that collaborative robots are integrated into the place of man, especially, in dangerous areas where man's life is endangered, where low or high gravity work can occur or where it may happen. Collaborative robots can load and download hydraulic presses, cutting equipment and can take activities in chemical and high toxicity in which the worker may be adversely affected in terms of health.

Collaborative robots have the advantage of significantly reducing the manufacturing costs of a product, especially in areas where human labor costs are high. It is analytically proven that the integration of a collaborative robot into manufacturing flows is a profitable decision for the organization. Although there will be some investments at first to integrate the collaborative robot and transform a normal line into a collaborative line, the cost will be amortized in time successfully, and the profit will not be delayed to appear shortly after the investment depreciation.

The concept of productivity and the term of the quality index in manual production areas with operators are variable because and how man work is variable. Even if the habit or automatism of man can sometimes lead to increased efficiency in productivity and quality index, over time, problems may arise due to human fatigue, monotony or emotional state. Productivity is variable because human speed is variable during a working exchange. Also, even the quality index is variable in a workflow with operators due to fatigue, monotony from repetitive or low-ergonomics, inadvertent moves, etc.

Following the implementation of a collaborative robot, productivity will be significantly improved and will stabilize because the collaborative robot is able to perform over

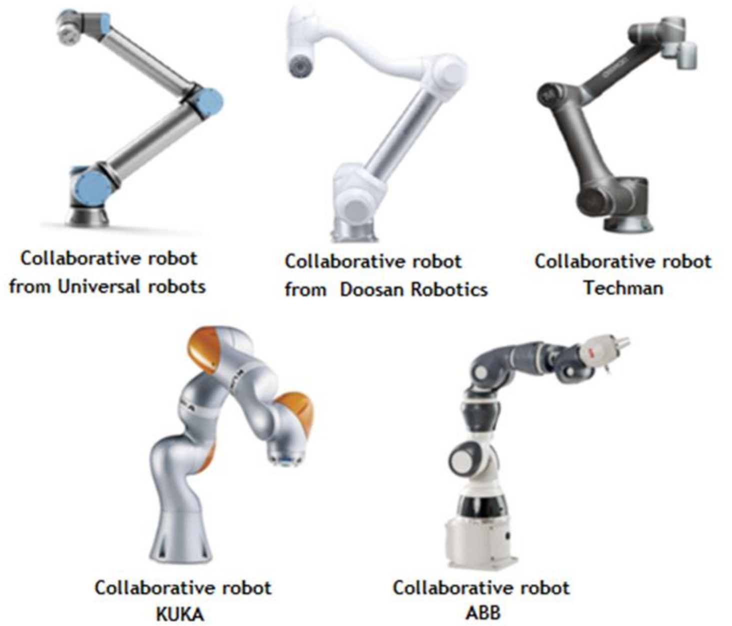

Figure 4. Collaborative robots

time and sustain the same working speed without stopping. Also, the qualitative index will increase significantly due to the fact that many irretrievable wastes will completely disappear.

Collaborative robots can be integrated into several ways in terms of:

- The number of grippers;
- Positioning in the workspace;
- Payload or working weight to be lifted.

The number of grippers can be variable. Depending on the application, one or more gripper can be integrated which the robot can control in parallel. However, a restriction is represented by the weight that the robot can lift, which decreases with the addition of the weight of each gripper to be supplemented. From a mathematical point of view, this restriction can be expressed by the following formula:

$$Pl \geq Wg \; x \; Ng + Wp; \qquad (1)$$

Where:

Pl, represents payload or total weight that collaborative robot can lift;

Wg – The weight of a grippers;

Ng – The number of grippers;

Wp – The weight of the product;

If this mathematical formula is not respected, the application will not be a functional one. If, however, this will be functional, the robot joints may be worn prematurely, and the robot's precision will be significantly affected.

The collaborative robot can be positioned in different positions as required. It can be placed horizontally on the ground normally, it can be positioned vertically, for example on a wall and can be suspended in a horizontal plane on the ceiling, metal scaffolding or metal structure. The horizontal suspension has the advantage of easily release the area during maintenance to provide a high degree of accessibility to the technician. Thus, the collaborative robot can rise above the metal or ceiling scaffold if access to the line must be facilitated to man.

In the past, payload or working weight to be lifted was a constraint in the possibilities of integration of collaborative robots. However, collaborative robot manufacturers continued the research, and there were new models of collaborative robots as follows:

- In 2019 it was launched by UR, the UR16 robot that can lift a weight of 16 kilograms;
- In 2020 the H Series was launched by Doosan Robotics, a series of H2017 collaborative robots that may lift 20 kilograms and H2515, respectively, which may lift 25 kilograms;
- In 2021, the UR organization announced increasing the payload for the UR10 robot from 10 kg to 12.5 kg.

Surely, over time, standard collaborative robots will appear that will be able to handle payloads of a much larger weight, but until then solutions have emerged from various companies. Among these companies is the Cobot Lift company that sells devices capable of raising the potential Collaborative robots in terms of handling higher payloads. Due to these devices, the weight that can be lifted by a collaborative robot can be improved up to 45 kilograms.

The organization's management may choose different solutions for the integration of collaborative robots. Integration of collaborative robots into the manufacturing flows of a product is the most viable alternative to profit.

4 MANAGEMENT OF COST REDUCTIONS BY IMPLEMENTING INDUSTRIAL AND COLLABORATIVE ROBOTS. THE COST-EFFICIENCY ANALYSIS OF MANUFACTURING FLOWS WITH PEOPLE, INDUSTRIAL ROBOTS AND COLLABORATIVE ROBOTS

Industrial organizations seek the possibilities to produce much cost-effective, at a higher quality and at a higher speed so they can ensure a competitive place on the market. [6]

Due to this aspect, in order to demonstrate the profit, a cost-effective analyze was necessary to be done between the workflow with operators and the workflow with industrial robots.

The application presented is in the automotive domain. The initial application data is as follows:

1) The processing time of a piece on a final assembly line is 23 seconds;

2) The industrial robot placed in a cell must take two types of housings to load in assembly cells, unload the processed parts in the assembly cell, place them in the final test cell, unload the processed parts in the final cell and sort them on the conveyor with different belts for OK products or NOK products;

3) The production runs in four shifts, on every shift being two existing people working on the entire line. The workers, practically, is responsible for the loading and unloading of machines. The worker located between the assembly and final test cell executes the same repetitive movements without a direct impact on the quality of the product;

4) The equipment existing on the technological flow are previously ordered.

The study is necessary, from an economic point of view, to bring significant reductions in the cost of manufacturing the product. The study will be considered feasible if the invested amount will be recovered after three years.

For a feasible comparison to being made, an economic calculation between working with operators and industrial robots work. Taking into account that the line in the past was served by two operators, the calculations will only be made for the operator which needs to be replaced by the industrial robot. Prices are estimated in euro.

Economic calculation of working method with operators:

On the manufacturing flow, there is needed an operator on each shift. Taking into account that the line has 4 shifts, then the calculation shows that 4 operators will be needed.

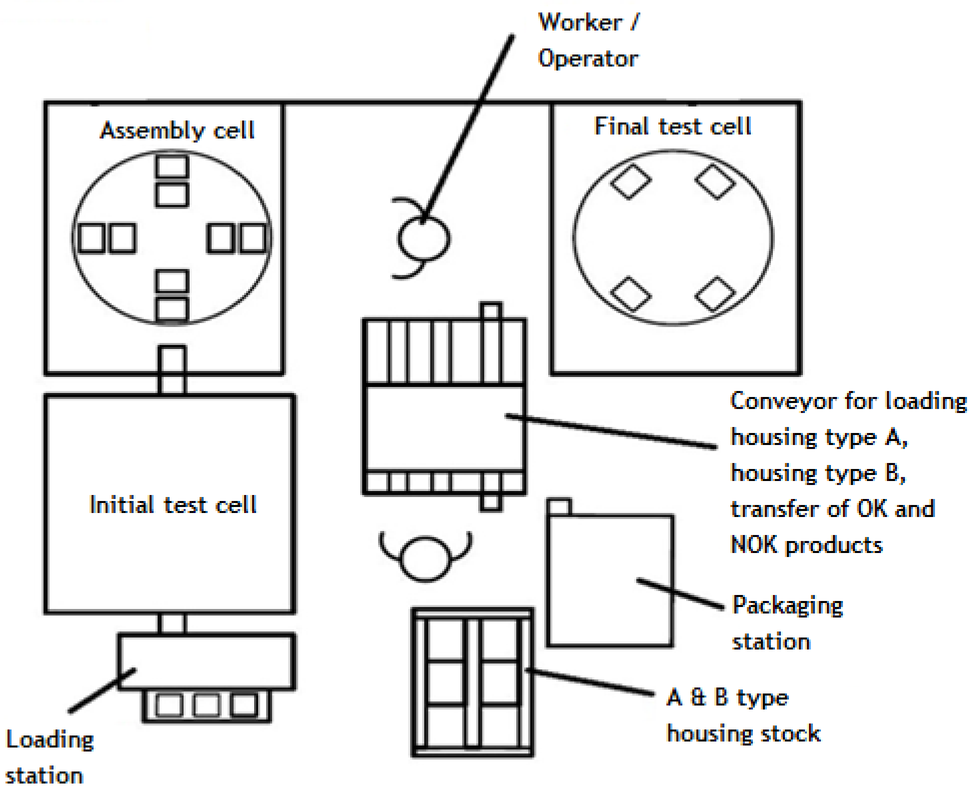

Figure 5. Manual manufacturing flow with operator

$$N = O \, x \, S = 1 \, x \, 4 = 4 \, operators \quad (2)$$

O represents the number of operators on shifts;

S – the number of shifts;

N – total number of operators.

The salary for each operator is about 920 euros per month. A total per month will be calculated for each operator who works on the line.

$$TS = N \, x \, € = 4 \, x \, 920 = 3680 \, Euro \, / \, month; \quad (3)$$

TS – total salaries on all shifts / month;

N – total number of operators;

€ - received salary awarded per month by an operator.

It will calculate the annual salary that the company pays for all operators:

$$TA = TS \, x \, M = 3680 \, x \, 12 = 44160 \, Euro/year \quad (4)$$

TA – total annual salary received by all operators;

TS – total salaries on all shifts / month;

M – number of months belonging to a year.

Economic calculation for investment in the working method with industrial robot:

The robot consumes electricity. First of all, it was a consumption calculation:

The following were considered:

The price is 0.27 Romanian lei (RON) on kW / hour;

Estimated consumption of an industrial robot is 4 kW per hour;

The day has 24 hours;

Only 1 industrial robot will be used;

They will not stop and work continuously 365 days a year.

According to the above, the calculation formula for industrial robot consumption per year (CPY):

$$CPY = 0.27\ RON\ per\ KW/hour\ x\ 4\ KW\ x\ 24\ h\ x\ 1\ robot\ x\ 365\ days = 9460\ RON\ /\ year; \quad (5)$$

By converting in euro, it results in a consumption of about 1940 euros per year.

The following investments to be made for integration were considered:

Price Industrial Robot SCARA: 49,000 euros per piece where it results:

$$PRi = 49000\ x\ 1 = 49000\ de\ EURO \quad (6)$$

PRi – Total price of the industrial SCARA robot purchased.

Gripper Price (Pg): 1500 Euro for a vacuum and vacuum generator. The industrial robot will use two such grippers.

The industrial robot will need to be integrated into a cell. The estimated price of a cell (Pc) is about 50000 euros. In this price is the integration activity of the industrial robot, cell automation, wrapping, delivery and installation.

Thereby, once gathered the above data, a calculation can be made to order an industrial robot cell (Ccr):

$$Ccr = PRi\ x\ 1 + Pg\ x\ 2 + Pc\ x\ 1 = 49000 + 3000 + 50000 = 102000\ EURO \quad (7)$$

This calculation (Ccr) will be added to both robot consumption per year (CPY) to achieve a total estimated investment cost in a cell with an industrial robot (CTiri):

$$CTIri = Ccr + CPY = 102000 + 1940 = 103940\ EURO \quad (8)$$

In conclusion, the following results were obtained according to the calculations:

- working with operators (TA): 44160 euro / year.
- investing in a cell with an industrial robot (CTiri): 103940 euro investment.

Annual operators will receive 44160 euros / year, while the industrial robot integration price is paid once.

According to the calculation below, it may be deducted that in that year the organization will invest with 59780 euros (I) more than if it would continue working with operators, but in 3 years (Y) the organization will recover the following amount (RT):

$$CTIri - TA = 103940 – 44160 = 59780\ EURO \quad (9)$$

$$RT = TA\ x\ Y = 44160\ x\ 3 = 132480\ EURO\ in\ three\ years \quad (10)$$

According to the RT index, 132480 euros will be recovered in three years, and the investment of 103940 euros will be amortized.

Considering the economic analysis, it results that the working mode with an industrial robot will reduce the cost of manufacturing. The company that will choose this solution will have a cost reduction of 28540 euros in the third year of integration, and from the fourth year, the reduction will be 44160 per year. Both working methods are effective. Therefore, both working methods, with the operator and industrial robot, achieve, successfully, the proposed objectives. However, the working method with an industrial robot is the most efficient work method, because in time, with fewer monetary resources can be achieved the same objectives.

Due to the fact that the work method with industrial robots is more profitable than the operator, it was considered that comparison in terms of profitability for the same applications, but with the integration of a collaborative robot, it is necessary to be performed.

Economic calculation for investment in working method with collaborative robots:

The collaborative robot consumes electricity. Therefore, it was necessary a consumption calculation:

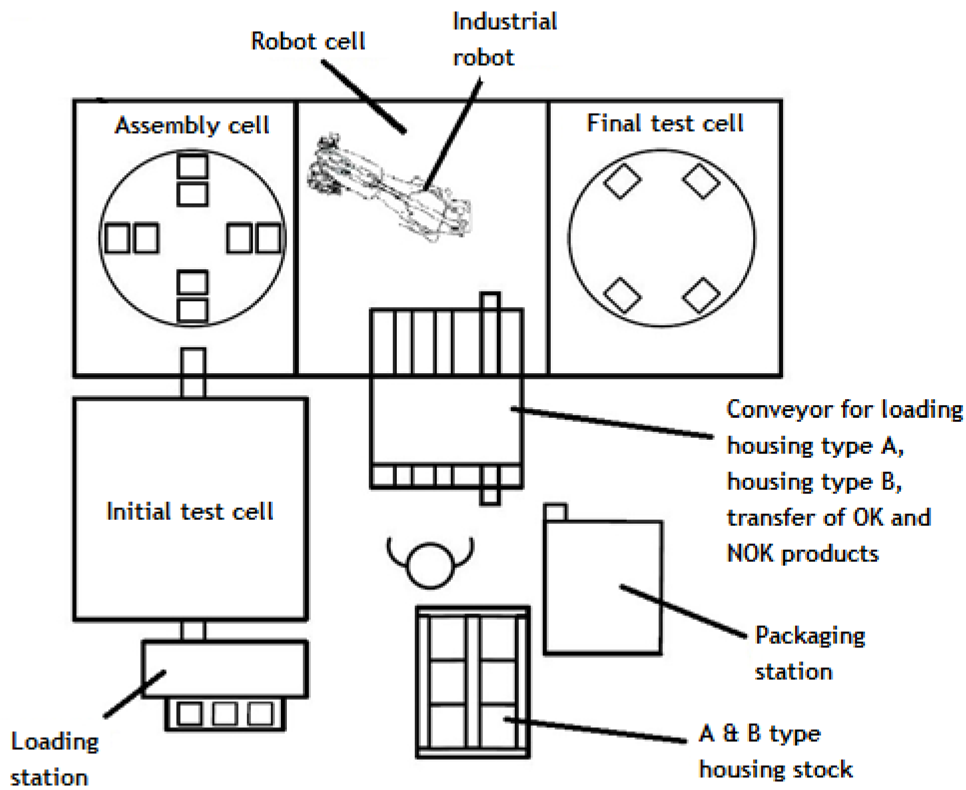

Figure 6. Flow of manufacturing with industrial robot SCARA

The following were considered:

The price is 0.27 Romanian lei (RON) on kW / hour;

The estimated consumption of a collaborative robot is 2 kW per hour

The day has 24 hours;

Only 1 collaborative robot will be used;

The robot will work non stop for 365 days / year.

According to the above, the calculation formula for the consumption of collaborative robot per year (CRcy):

$$CRcy = 0.27\ RON\ KW / h\ x\ 2\ KW\ x\ 24\ h\ x\ 1\ robot\ x\ 365\ days = 4730.4\ de\ RON / year \quad (11)$$

By converting in euro, it results in a consumption of about 970 euros per year.

There were considered the following investments to be made for integration:

Considered price of a Collaborative Robot UR10 E Series: 25,000 euros per piece. The next calculation results:

$$PRp = 25000\,x\,1 = 25000\,EURO \qquad (12)$$

PRp - the total price of the UR10 collaborative robot purchased.

Gripper Price (Gp): 1500 euros for a vacuum and vacuum generator. The collaborative robot will use two such grippers.

The collaborative robot will not need to be integrated into a cell. For the line to become "Cobot friendly", certain costs were considered:

Safety system (Ss) that will include safety PLC and perimeter scanners. The considered

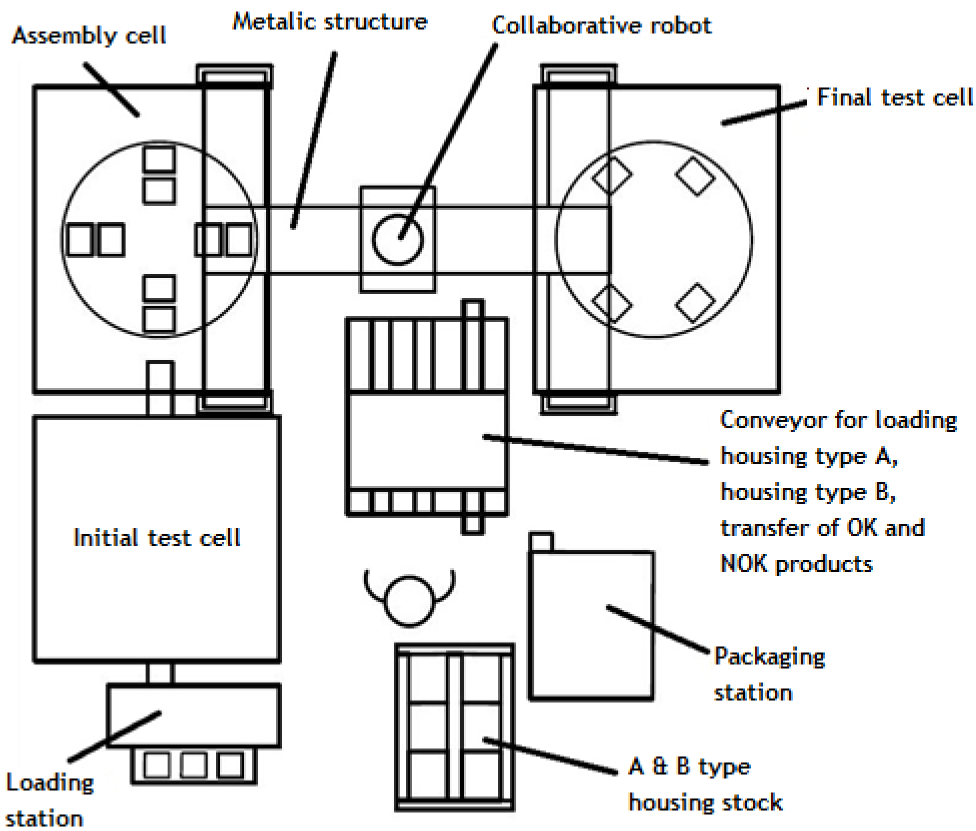

Figure 7. Manufacturing flow with collaborative robot

price is 5000 Euro to transform it into a "Cobot friendly" line.

The price for the metallic structure necessary for mounting collaborative robot (Ms): 3000 Euro.

Therefore, once the above data is collected, a calculation for the production line re-engineering (PLR) can be made:

PLR = Ss x 1 + Gp x 2 + Ms x 1 = 5000 + 3000 + 3000 = 11000 EURO (13)

To the PLR result, will be added the robot consumption per year (CRCy) and the total price of the purchased robot (PRc) to achieve a total investment cost in working with the collaborative robot (TICcr):

TICcr = PLR + CRCy + PRc = 11000 + 970 + 25000 = 36970 EURO (14)

In conclusion, the following results were obtained according to the calculations:

- Working with operators (TA): 44160 euro / year.
- The total investment for the integration of a collaborative robot UR10 is 36970 Euros investment.

The total annually salary which the operators will receive is 44160 euros / year, while the integration price of the collaborative robot is paid once.

According to the calculation below, the author concludes that, in the first year, the company will invest a sum (Is) of the amount with 7190 euros less than if the company will continue working with operators. If the company will choose to invest in a working method with collaborative robots, in 3 years (Y) it will receive the following amount (AR):

Is = TICcr - TA = 36970 – 44160 = -7190 EURO (15)

To calculate the total cost reduction (TCr), it is also necessary to sum the difference invested (Is) in the collaborative robot working method.

TCr = TA x Y + |Is| = 44160 * 3 + 7190 = 139670 EURO (recovered in three years) (16)

According to the TCr index, 139670 euros will be recovered in three years of working with the new method. Since the first year, it can be seen that the organization will take advantage of implementing collaborative robots in the manufacturing flow.

Economic analysis for the working method with collaborative robots demonstrates that this type of implementation is a profitable one, in particular, for companies that produce components on a serial manufacturing flow. It can be seen that the investment in working method with the collaborative robot is profitable since the first year a profit of 7190 euros is obtained from the first year. It can be concluded that working with the collaborative robot is an effective one because the proposed objectives are successfully achieved. However, according to the calculations of economic analysis, it is also demonstrated that this is the most efficient method in terms of monetary resources invested over time.

5 FINAL CONCLUSIONS

The scientific paper offers theoretically and applied certain important concepts for working methods with industrial robots and collaborative robots.

There have been carried out studies on the place, role, advantages and conditions of exploitation of industrial and collaborative robots. Studies have been conducted on the types of mobile and stationaries industrial robots. The role, place and functionality of mobile and stationaries industrial robots were exposed.

Collaborative robots were presented as news designed to share the environment and workspace with man. There are many types of collaborative robots. The collaborative robot solution may vary and depend on the existing suppliers on the market.

The place and role of industrial robots and collaborative robots were presented. It was concluded that industrial robots have varied forms according to the activity area. From the main class of industrial robots, mobile robots can be distinguished for the logistics area, and stationary robots, destined for the production area.

Mobile industrial robots are intended for the transport of materials or goods from the warehouse in production and backwards, the transport of the final parts in the warehouse and even loading or unloading the materials or goods on or from the existing shelves in the company's warehouse.

Stationary industrial robots are designed to manipulate or execute certain process operations such as assembly, welding, pickup and placement, paste application, and many other applications. From a mechanical point of view, articulated bars structures or assemblies are consisting of translation and rotation couplings.

Also, the unlimited potential of collaborative robots was presented. These are complex automatic systems that can be integrated into any type of activity sector. They are recommended to be integrated into areas where workers in the past have to repeat the same movements over a whole shift or in areas where the activities do not add any value to the product quality. Thus, it has been concluded that collaborative robots are recommended to be integrated into areas where repetitive movements, reduced ergonomics, hazardous areas, areas of human labor, areas with low productivity or quality are executed.

Both stationary industrial robots and collaborative robots can be integrated with multiple grippers of the same constructive form or different constructive forms. Thus, complex automated applications can be built that can be successfully integrated into any manufacturing area.

The first way to work method which was described was with a human. It is calculated, step by step, the total amount that an organization pays annually for such a method of work. This method of work with operators is quite costly for an industrial organization, especially after comparison with the subsequent working modes.

The second working mode that was taken into account is the method of work with an integrated industrial robot in an automatic cell. The industrial robot proposed for such an application is a SCARA robot, which generally is used in industrial assembly applications due to the high precision of lateral movements. It was demonstrated that the method of work with an industrial robot is more profitable for the organization, and even if the company has to invest in the beginning, the amount invested will be amortized. According to the analysis between the first working mode and the second way, it has been demonstrated that the industrial organization that will opt for the second solution will benefit from a reduction in manufacturing costs of 28540 euros in the third year since integration and following the fourth year to be 44160 euros per year.

However, the third way of working has been shown to be the most profitable from the analytical point of view for the organization. This is the method of work with a collaborative robot. With the depreciation of the RON to the euro, working with a collaborative robot is becoming more attractive to industrial organizations in Romania. It can also be seen that investment in working with a collaborative robot is profitable since the first year a profit of 7190 euros is obtained from the first year. The management of an industrial organization that will opt for such a solution will successfully reduce after three years of EUR 139670 euros.

In the research, it has been presented that the implementation of collaborative robots in a production process may have real benefits in the matter of cost reduction. However, this is only one of the benefits which collaborative robots bring after the implementation. After the implementation of the collaborative robots has been finished, the improvements in productivity, ergonomics and in the quality of products from the manufacturing flow will not hesitate to appear.

The conclusion is a simple one, collaborative robots have the advantage of easy integration, zero maintenance costs and high productivity. The benefits impact after the integration will be always detected in the economic, product quality, labor ergonomics and high productivity of an organization.

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