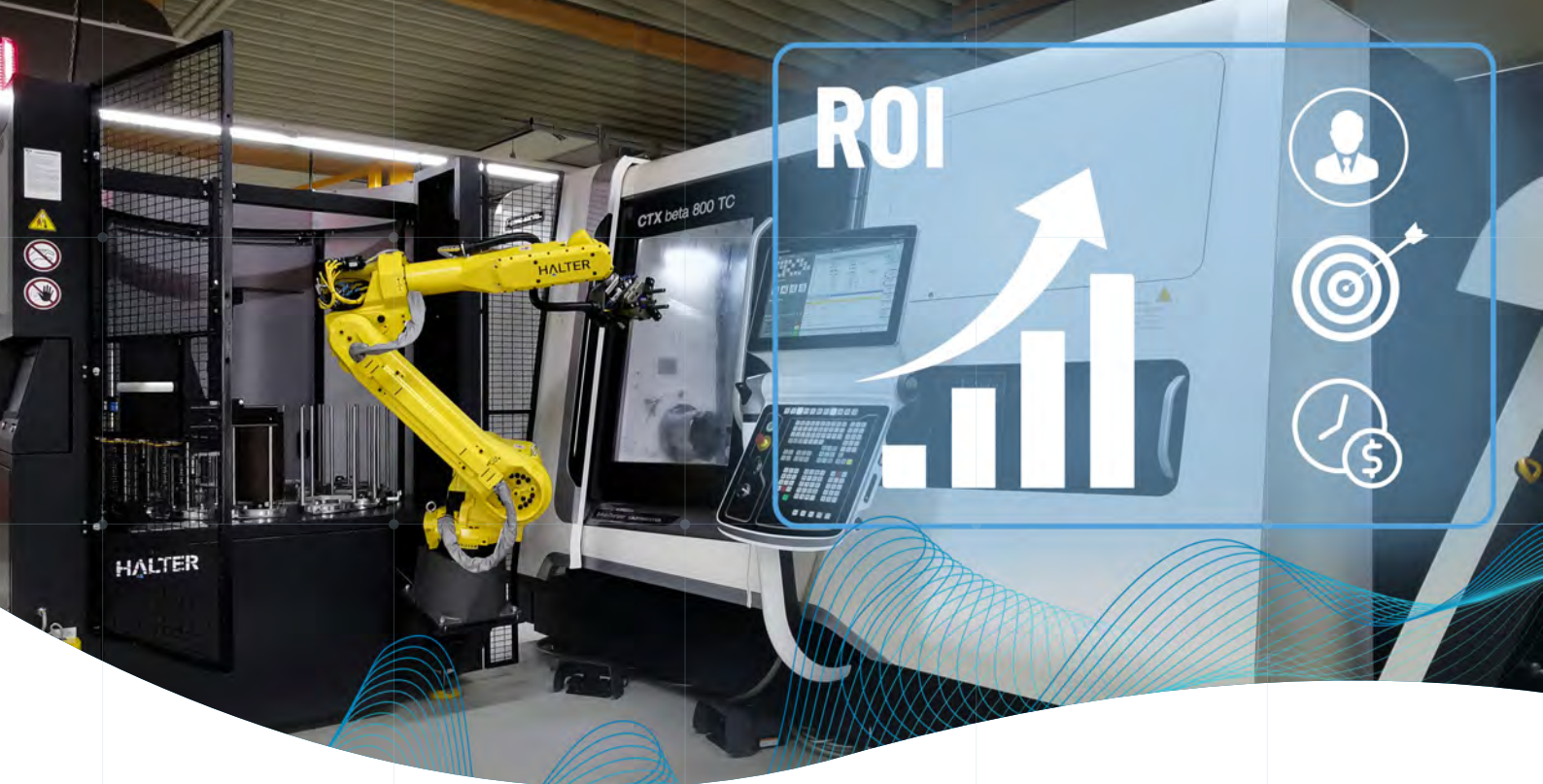

RETURN ON INVESTMENT OF A ROBOT CELL

MORE THAN JUST SAVING ON MAN-HOURS:

AUTOMATION OF CNC MACHINING REDUCES COSTS AND INCREASES TURNOVER



INTRODUCTION

Automatic loading of CNC machines has been on the rise for years, especially since the introduction of plug-and-play robotic systems. A lack of skilled workers, a desire to increase flexibility and, in particular, the need to reduce the labour cost factor in the end product are the main reasons why machining companies are automating.

But what are the benefits of such an investment? How do you calculate the Return on Investment (ROI)? Anyone who makes this calculation will discover why it is important to choose the right automation for the right CNC machine. Simply choosing the automation option with the lowest purchase price can be much more expensive in the long run.

Strongest growth of automation in low-wage countries

Worldwide, sales of robots continued to increase during the corona pandemic. In 2020, exactly 383.545 industrial robots were sold, making it the third consecutive year of growth, according to the latest report by the International Federation of Robotics on the global industrial robots market. At the end of 2020, more than 3 million industrial robots were active. Perhaps the most striking figure in this report is that 71% of all new robots are now installed in Asia, with China leading the way on the continent.

Why in low-wage countries?

You may wonder why companies in so-called low-wage countries are investing in automation? Because the number of industrial robots is not only increasing in China, but also in other emerging countries.

The two most important reasons are to reduce the wage costs per product factor and to increase flexibility. After all, with a relatively small effort by the operator at the end of the day, the cell can continue to load workpieces for hours in the evening and at night. WorkMarket, the platform for deploying professionals, concluded in a 2020 survey that 54%¹ of employees believe that automation saves them 240 man-hours of work per year.

RETURN ON INVESTMENT

A robot cell that automatically loads the CNC milling or turning machine requires an investment. Depending on the size of the cell, the lifting capacity of the robot and any other options, a plug-and-play cell can range from roughly € 75.000 to well above € 150.000. In order to calculate the payback period and also to choose the right solution based on this, it is important to take a step back and look at the factors that influence the machining process and at the structure of the cost price of the workpieces that are milled or turned.

Process optimization or machining optimization?

The basis for economically viable production in the machining industry is a stable and reliable process, for which the work planner / operator has to look at all aspects: CNC machine, maintenance, CAM programming, tool holders, tooling and coolants, man-hours on the CNC machine and possibly the costs of automation. The more stable the process, the more predictable and lower the costs. 'The art of economic production focuses on ensuring maximum reliability and predictability of the production process, while maintaining the highest productivity and lowest production costs'².

Micro or macro approach

This implies that the costs are the sum of all facets of the process. If you want to reduce these costs, you can look at process optimization (the macro approach) or at optimizing the processing (micro). Higher cutting speeds can lead to shorter cycle times and therefore higher output from the CNC machine. But what if the higher speeds lead to a more unstable process and the risk increases that the CNC machine will malfunction or stop due to tool breakage? The small gain in processing time is then often more than cancelled out in one fell swoop.

Extra capacity

It is precisely at this point that robot loading adds a lot to the machining process. Apart from the fact that a robot does not ask for a break, days off, etc., robot loading mainly contributes to a higher reliability of the process, especially in the high-mix low-volume environment. This is because the robot is in fact available 24 hours a day. Companies that invest in robot loading increase their production capacity without the need for additional CNC machines and CNC operators.

Suppose a single-shift production company operates on the shifted-hours model and has multiple operators on average 12 hours a day to keep the CNC machines running. The installation of a robot cell on a CNC machine then almost doubles the capacity, because 12 extra hours per day become available. Machining is also possible outside regular operating hours. At that point, there is no need to keep the machining cycle as short as possible. After all, it makes no difference whether the automated CNC machine has finished the 50 workpieces in the cell at midnight or only at 3 a.m. The predictability and reliability of the process can now really come first. Automation contributes to a more stable and predictable process, which affects the cost price.

¹ InSight Report, conducted by WorkMarket in 2020

² Basics on production economics, Patrick de Vos, Seco, 2015

"EFFECT OF AUTOMATION ON PROCESS STABILITY IS AN UNDERESTIMATED PROFIT FACTOR."

Wouter van Halteren, CEO of HALTER CNC Automation

ROBOT LOADING AND THE COST PRICE PER WORKPIECE

COMPONENTS OF THE COST PRICE PER MILLED OR TURNED WORKPIECE

- ✓ Work preparation / CAM / programming costs
- ✓ Hourly price of the CNC machine
- ✓ Material costs
- ✓ Tool costs
- ✓ Costs for coolants
- ✓ Costs for additional operations, such as measuring on a CMM
- ✓ Man-hours on the CNC machine (e.g. setting up, manually loading the machine)

Some of these factors are probably fixed. The choice of material is made by the customer, as is the choice for additional processing. The hourly price of the CNC machine is also a fixed factor, as soon as one knows on which CNC machine a workpiece can best be produced. The two factors with which manufacturing companies can influence their price the most are work preparation and the man-hours on the CNC machine.

Work preparation costs decrease with increased capacities

The work preparation and set-up costs are spread over the total number of workpieces. As the numbers of one workpiece that are milled or turned increase, these costs per workpiece decrease. This happens quickly: from 5 or 10 pieces, the costs can be less than 20% of the costs for single-piece production. With 1.000 pieces, the costs per piece are up to 88% lower than with single-piece production of the same workpiece³.

“AT FIRST I THOUGHT THAT THE TOTAL INVESTMENT IN A HALTER ROBOT CELL WAS HIGH. NOW THAT WE HAVE USED THE ROBOT FOR A YEAR, I HAVE TO CONCLUDE THAT THE INVESTMENT HAS CERTAINLY PAID OFF, BECAUSE WE NOW HAVE MANY MORE UNMANNED MACHINE HOURS. THE ROBOT THEREFORE COSTS ONLY € 4,25 PER HOUR.”

Thomas Böttcher, Managing director at Metallverarbeitung Thomas Böttcher GmbH (Germany)

Man-hours exchanged for unmanned production

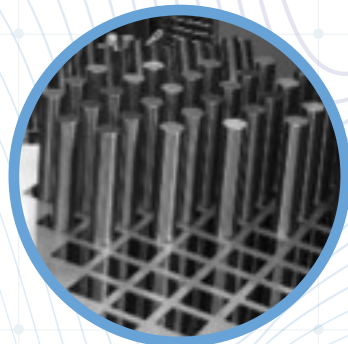
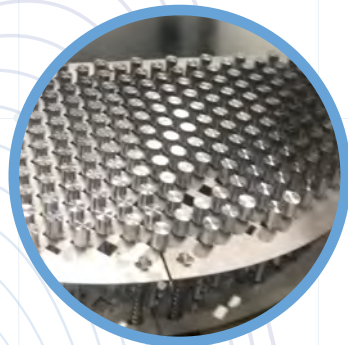
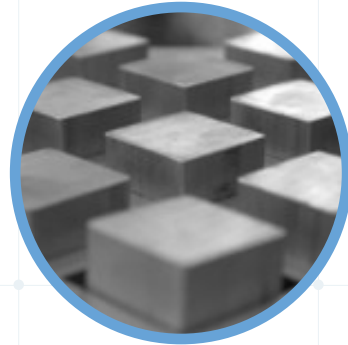
The hours the operator spends on the CNC machine clamping and removing the workpieces have a significant influence on the cost price per piece. Smart automation helps to reduce these costs because small series can be produced unmanned. Once a CNC machine has been set up, only the machine hours count, and the operator can do other work.

Predictable automation costs

The costs of automation are more than just the purchase price of the robot, warned the Boston Consulting Group in a study a few years ago⁴. Investing in a plug-and-play robot cell eliminates this uncertainty. These cells offer a total solution, including integration with the milling or turning machine, at a price that is known in advance. Plug-and-play often literally means installing, connecting the robot cell and CNC machine via the correct interface and starting production. This makes calculating the payback period easier.

³ Source: Xometry based on their Quoting Engine for an aluminum milling part

⁴ Calculating robot ROI, A3 Association for Advancing Automation <https://www.automate.org/case-studies/calculating-robot-roi>





ROI CALCULATION

How quickly can you earn back the investment in a robot cell? Of course, that depends on the effort involved in production, but there are always two ways to earn back. Firstly, by reducing the proportion of man-hours, and secondly, by means of the extra turnover generated by a robot.

Saving on man-hours

The first calculation that needs to be made is to determine the hourly rate of the operator who is still loading the CNC machines. If the operator spends hours working on one CNC machine because the cycle times are short, automation immediately yields a significant cost advantage. The new generation of robot cells are easy to program and changing to another workpiece only takes a few minutes, especially if you plan in such a way that the same clamping device can be used.

More spindle hours

What is often overlooked in an ROI calculation is that the robot and CNC machine will use the available machine hours more efficiently. The higher process stability of an automated process ensures peace of mind in production with the additional advantage of predictability of the output and a much higher delivery reliability. This increases the spindle efficiency.

Suppose an operator normally works 1.783 hours per year (the European average). In those working hours, he ensures, for example, that the CNC machine can run 800 spindle hours without automation. If, thanks to the loading robot, the operator can increase the number of spindle hours to 1.400 spindle hours, this means at a commercial hourly price of € 80, an extra turnover of € 48.000, without any additional wage costs.

“AN OPERATOR WHO WORKS 8 HOURS A DAY, MONDAY TO FRIDAY, CAN KEEP TWO CNC MACHINING CENTERS RUNNING WITH THE HALTER LOADASSISTANT, MORE THAN 200 HOURS A WEEK.”

**Peter Church, Managing Director at
FB Chain Ltd (United Kingdom)**

Selling extra capacity

The biggest gain from automation comes from the extra spindle hours that can be sold. In the research Benchmark Verspanen 2016 (Koninklijke Metaalunie, Made-in-Europe and Jaarbeurs)⁵, the average number of spindle hours per CNC machine at Dutch machine shops is stated as 42 hours per week. For the companies that achieve the best returns, this is almost 60 hours. One in five of the machine shops indicated that they produce 24/7 unmanned, which is not even necessary for the investment in robot loading to pay off. Even with a limited number of extra hours of production per week, the payback time of a robot installation is shortened. The higher the hourly rate of the CNC machine, the shorter the payback time because much more work can be produced with the same man-hours.

The right automation

In order to realize these short payback times, it is, above all, necessary to choose the right automation. The automation must match the CNC machine and the type of workpieces that have to be loaded, in order to be able to run as many unmanned hours as possible. In addition, the automation must be easy to operate, so that changeover times are short. After all, it is precisely because of the short changeover times that people are more likely to produce small series unmanned. The more spindle hours the CNC machine can make, the shorter the payback time will be.

⁵[https://metaalunie.nl/Portals/1/Bestanden/Nieuws/BenchmarkVerspanen_2016%20\(lr\).pdf](https://metaalunie.nl/Portals/1/Bestanden/Nieuws/BenchmarkVerspanen_2016%20(lr).pdf)

An example with - let's say - only 2 extra hours a day of milling or turning, thanks to automation

Suppose the hourly rate that one can charge for a CNC machine is € 80. If a company can produce an extra 2 hours every day after the employees have gone home, this results in 10 extra production hours in the week. The turnover (without material costs that are passed on) therefore grows by € 800 per week. Based on 48 working weeks in a year, these 2 hours generate € 38.400 extra annual income. And unmanned production for 2 hours a day is really very little. If you realize not 10 but 18 extra spindle hours every week (the difference between the average number of spindle hours and that of the top performers in the Benchmark Machining 2016), the extra turnover is already € 69.120 per year. Including the better utilization of the production hours during the day, the increase in turnover will be well above this amount. Keep in mind that this extra turnover does not require an extra investment in more machine capacity or more professionals. Only maintenance and the costs for tools and coolants will increase slightly. In practice, the payback time of a robot cell is often less than 12 months. With CNC machines with a higher hourly rate, the investment is often recouped after 6 to 8 months.

CALCULATE THE PAYBACK PERIOD AND THE ANNUAL RETURN IN YOUR PRODUCTION

HALTER CNC Automation has developed an ROI calculator with which any machining company – based on its own data, such as hourly rate of the CNC machines, hourly rate of the operators and the current number of spindle hours – can quickly gain insight into the payback period of a robot cell and the annual return.

Look at: haltercncautomation.com/ROI-calculator

