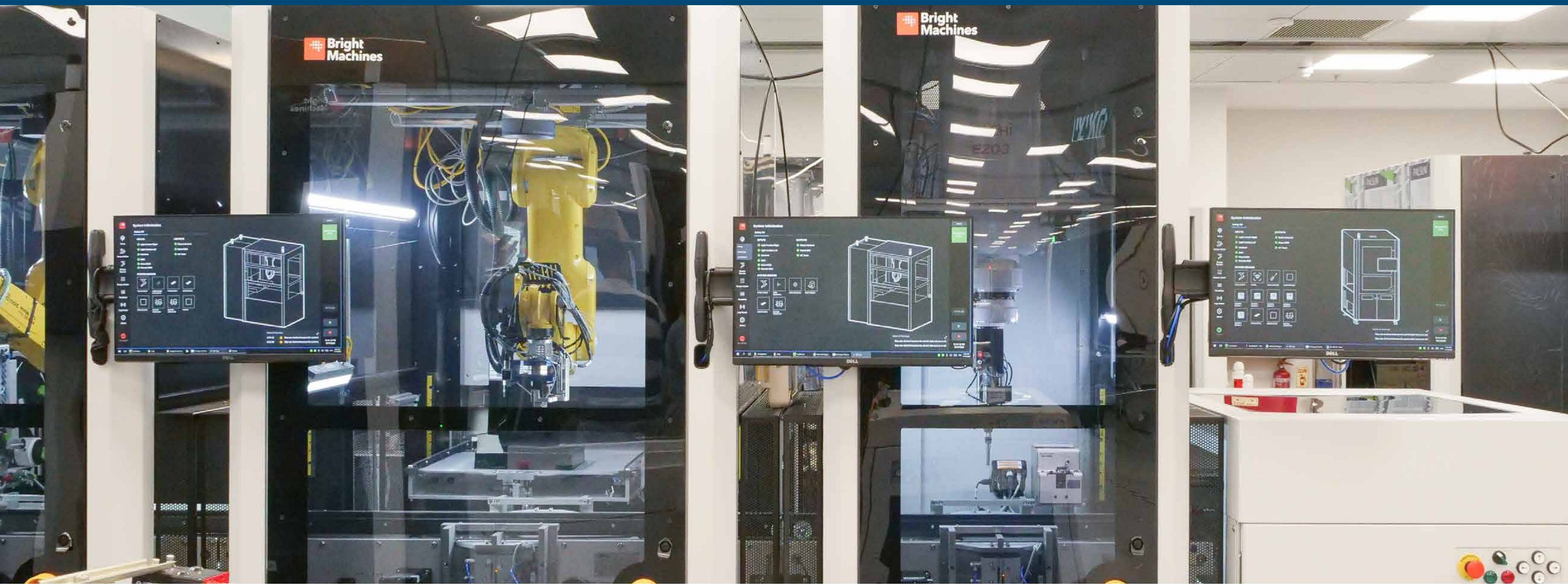


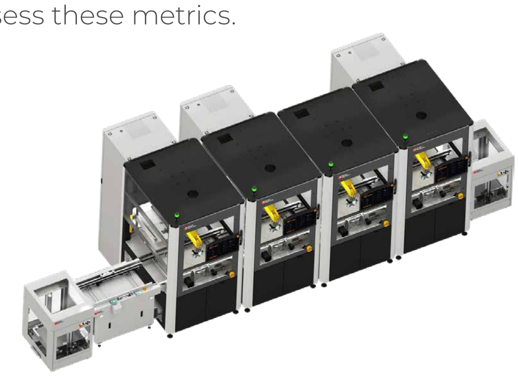
Rationalizing Investment in Software-Defined Automation Equipment

White Paper

Modern automation equipment leverages software to improve deployment time, provide flexibility for product changeovers, and enhance continuous improvement efforts by using production data.

Clearly this helps a factory gain competitive advantage, but how can you evaluate whether this type of investment makes business sense for your specific situation?

Two guiding metrics are the payback period and the cost per unit produced. The case study presented in this paper will show how to quickly assess these metrics.



Software-Defined Automation

Investment Summary

Year	0	1	2	3
Investment	**($0.9M)**			
Savings		**$1.3M**	**$1.3M**	**$1.3M**

0.7 years

Payback period

76% lower

Cost per unit produced

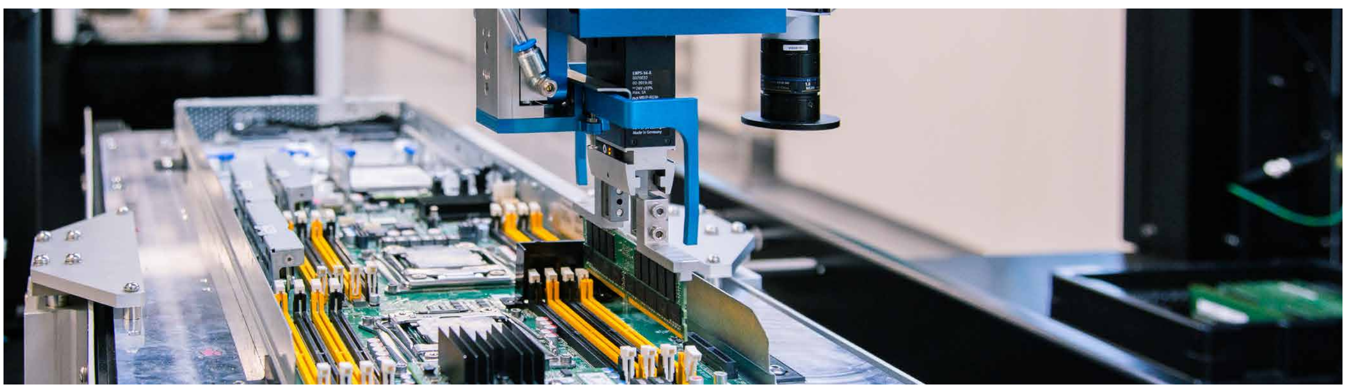
Factory skills such as component assembly, fastening, welding, dispensing, pressing, labeling, inspection, and testing can be automated using robotic cells which are configured and operated with software. Of course, the cost required to implement the automation depends on the number of skills to be automated and the complexity of the skill itself. For example, implementing a line with soldering, sealing, and testing is likely to be more expensive than implementing a line with press fit and screwdriving.

Case study

Computer networks rely on firewalls to protect them from the growing risk of cybersecurity attacks. Firewalls are complex products which require many steps during the assembly process. Two important factory skills which need to get implemented on the firewall assembly line are the installation of heat sinks and DIMM cards onto the firewall circuit board.

The firewall manufacturer in this case was producing 72,000 units per year to meet their current demand. They were running multiple shifts with ten human operators doing the installation of the heat sinks and DIMM cards on each shift. The ten human operators could assemble 18 units per hour. With their US-based plant, this was a significant operating expense, and they were evaluating options for moving to a strategically lower cost framework to support their growth moving forward.

Bright Machines used their software platform, Brightware, to quickly configure an automated assembly line consisting of four robotic cells, end of arm tooling for heat sink and DIMM card installation, material feeding and material conveyance systems. The automated line could produce the 18 units per hour needed. The business metrics, which helped the manufacturer determine whether this investment would achieve their financial goals, will now be reviewed.



Investment evaluation

When making capital investments, it's common to evaluate the payback time. To do this, the annual savings must first be estimated. In the firewall case, the fully loaded annual cost per operator was estimated to be $39,000, $42,900, and $44,850 for the first, second, and third shifts. To meet their growing demand, the manufacturer would need to use three shifts, each with ten operators, which would result in an annual operator cost of $1.3M. For an automation investment of $0.9M, this yields a payback time of 0.7 years which falls within the industry recommendation for automating.

Payback time = Investment / Annual savings

Payback time	Recommendation
0-1 years	Definitely automate
1-2 years	Probably automate
2-3 years	Possibly automate
> 3 years	Don't automate

Knowing that the investment will payback within a year provides a good indication that the investment is low risk. The next key metric to evaluate is how the investment will impact the firewall cost structure. A crew of ten operators running one shift would have an annual labor cost of $390,000, and at a rate of 18 units per hour, could make 36k units per year. This translates to $10.83 per firewall unit. If two shifts are used, the cost per unit increases because the labor rate for the crew on the second shift is higher. Similarity, the cost per unit increases for the three-shift scenario resulting in a cost of $11.74 per unit produced.

When using automation, the same equipment can be leveraged over multiple shifts. So, the cost remains roughly the same whether one shift, two shifts, or three shifts are used. However, for each shift added, more units can be produced. Therefore, with automation the cost per unit goes down as more shifts are added. In the case of the firewall, the cost per unit is only $2.77 when running three shifts. This represents a 76% lower cost when using automation as compared to human operators.

10 x human operators

vs.

Software-Defined Automation

Estimated cost to do the heat sink & DIMM card installation for firewall assembly

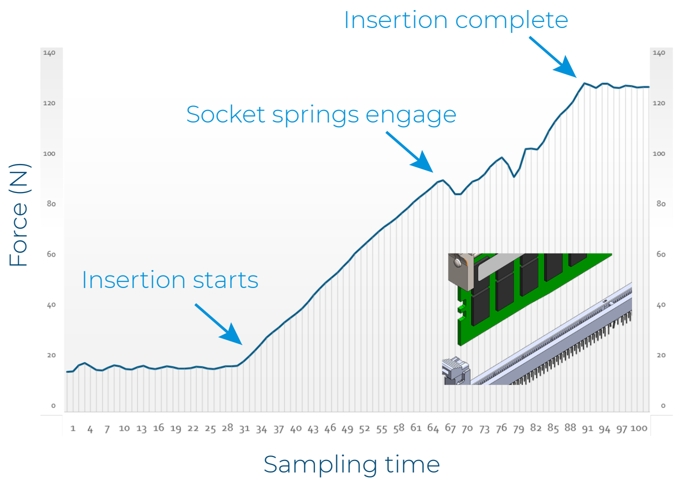
1 shift:	$10.83 per firewall	vs.	**$8.32** per firewall
2 shifts:	$11.83 per firewall	vs.	**$4.16** per firewall
3 shifts:	$11.74 per firewall	vs.	**$2.77** per firewall

76% Lower cost per unit

Other benefits

Although payback time and cost per unit are often used to quickly assess the potential return of an automation investment, there are other important benefits which can either strengthen the argument or be enough of a reason by themselves. For example, inserting DIMM cards onto the firewall circuit board are problematic for humans to do successfully. Errors result in costly scrap and repairs. With automation, the force can be monitored and controlled during the insertion process. This not only ensures a successful insertion but also enables catching potential errors caused by bad DIMM sockets or warped DIMM cards.

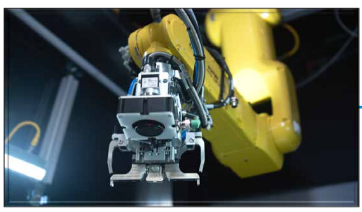
Data-driven insights



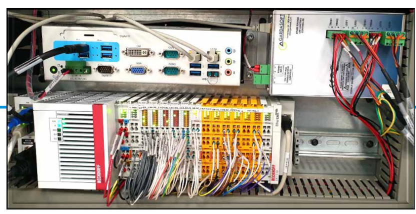
With automation, machine vision can also be used to improve product quality. A vision system typically consists of cameras, lighting, computer processing hardware and advanced software algorithms. In the case of the firewall assembly example, machine vision is used to accurately guide the installation of the heat sinks and DIMM cards. It's also used to inspect that each step is completed correctly. For example, after the DIMM slot is vacuumed, the vison system checks to make sure no debris is left behind as that could cause an insertion issue resulting in a product defect. These types of problems are nearly impossible for humans to catch. Vision is also used to scan the barcode on the firewall circuit board, and based on it, pick the correct DIMM card to install on the specific board. After picking up the right DIMM card from the tray, vison is again used, this time to check for proper orientation of the DIMM card as it's possible the vendor placed it in the tray backward. If needed, the DIMM card orientation is corrected prior to installation.

Because the automation equipment is software-driven, it enables the use of advanced vison and sophisticated algorithms operating on production data to drive higher levels of continuous improvement on the assembly line. This results in higher product quality and additional product cost savings both of which are further compelling reasons for investing in software-defined automation equipment.

Machine Vision



Camera, lighting, robot arm



Computer processing

Software user interface