

ENGINEERING REPORT

SHOULD THE BUSINESS INTRODUCE INDUSTRY 4.0 INTO THE WORKPLACE VIA A
CYBER PHYSICAL SYSTEM?

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INTRODUCTION

Whilst the business has spent a considerable amount of time and money over the last few years focusing on the introduction of Industry 3.0 which has been evolving since 1969, it's now time to use this technology to give us the data to move into Industry 4.0. The differences between these industries are, Industry 3.0 you look to automate your process, using processors and technology, these processes are operated without the need for human intervention, but still requires the aid of a human behind the scenes. Where Industry 4.0 comes in, is with the availability and use of the extensive data from the production floor. (Chan, 2019)

Looking ahead, to remain competitive in the market the business needs to ensure constancy of purpose towards quality (W Edwards, 1986) so ensuring the machines are working efficiently is definitely one way of striving towards this and the introduction of a new system will enhance the opportunities of getting this right from the start.

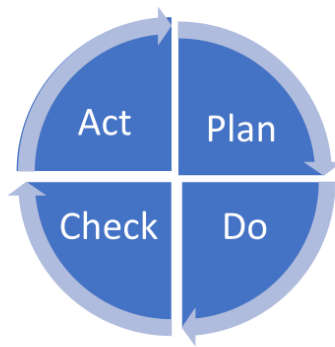
The purpose of this report is to talk you through the research and findings. Using the four step management method below, PDCA (Deming, 1950), the steps below show the thought process behind the research undertaken whilst looking at the possibility of introducing a system to be integrated with our injection moulding machines. The system would permit data to be transferred from the injection moulding machines to a control server. The main function of this report is to identify a company that offers this system, to review its full capability and what cost savings this could offer our business.

Act

- Should the business look to introduce this?

Plan

- To review and possibly introduce a method of Industry 4.0 in the form of data capture software.
- The main barrier in looking to do this could be the potential cost.
- Maybe look at the possibility of introducing this into one of the units, before the full introduction across the whole site.



Check

- What will this data give us?
- Prepare a price comparison for the Amico system against downtime / cycle time deficiency
- What are the overall findings from my investigations?

DO

- Locate suppliers for the necessary software
- Obtain costs for this system
- Another review could be on the cycle time parameters, are we running products as efficiently as we should be?

Investigations & Findings:

Starting with the software or system's the business would require and with the fact 17 out of the 18 machines the business currently operates are supplied by Negri Bossi, it would make sense to work with them on this project and having now approached this supplier, they can supply a system called Amico 4.0, which fully aligns itself to Industry 4.0. (Amico 4.0, n.d.) and would be fully compliant with our machinery.

The system features:

- A remote service
- IMM control Panel Control
- Alarms and IMM status checking
- Configurations parameters changing
- Setting to the IMM

Other important features:

- Software upgrades
- Remote support to eliminate IMM problems
- Data connection to the management information system
- Clamping force auto correction
- Feeding throat auto correction

The actual system:

The CAN (Controller Area Network) an intelligent technology that controls the machine functions by using an electronic card mounted into each injection moulding machine. Each machine would be directed to a reception point which is connected to a PC via a modem. The LAN (local area network) is connected to the (WAN) worldwide Area Network which operates through the internet. The transmitted data is collected in real time via the Negri Bossi Call Centre which immediately provides tele-assistance to our machines.

Potential impacts on the introduction of this system into our business

- Efficiency, a cyber physical system can work autonomously and interact with the production environment (Broy, 2010; Lee, 2008). As a result, a factory becomes 'smart'. There are several efficiencies this technology can bring to the business, for example:
 1. Preventative Maintenance – smart sensors with additional functionality provide a significant added value (Andreas Schitze, 2018), the sensors would inform the setting team of maintenance required on the machine before it's actually needed – preventing unnecessary downtime
 2. The data collection of cycle times– by monitoring this we can start to build a pattern on each product, making sure the most efficient cycle times are achieved.
- Labour – With its capabilities there is no reason why this technology shouldn't reduce the businesses employment commitments and the likelihood is, occupations within this department will start to diminish over the coming decades (Osbourne, September 2013). However, whilst cost savings could be made from a reduced workforce, it could be a good time for the business to review other departments and consider the utilisation of these

employees to review the data collected and establish how this department could use this information to its best advantage.

Cyber Security:

The potential threat for cyber-attacks is increasing as the world around us becomes more digitised. Cyber security should be at the forefront of everyone's business. The more technology that is introduced the more vulnerable the business becomes. It's crucial to ensure all the systems around us are safe and highly secure from hackers.

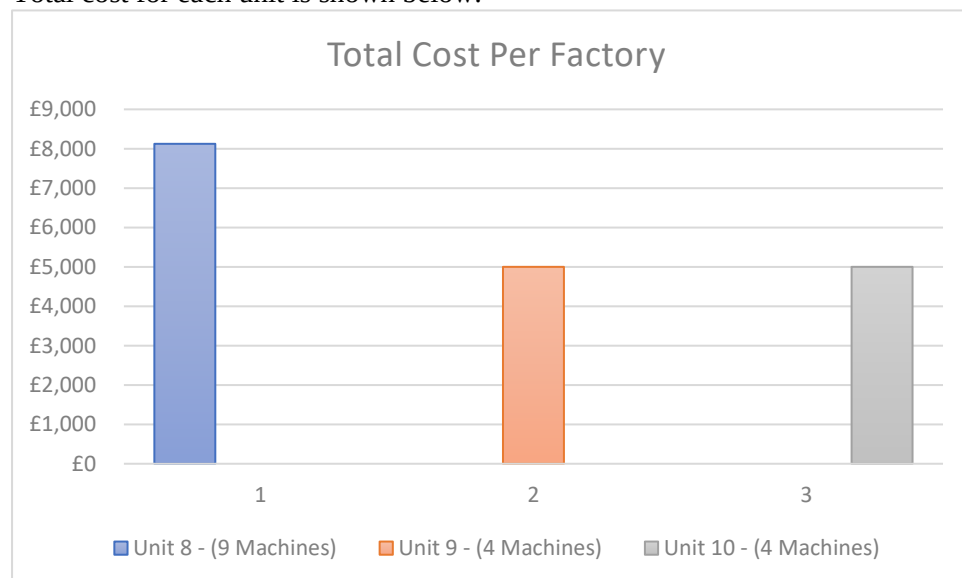
Improvements such as these can be helpful when looking to introduce new technology (King, 2019) and should definitely be a focus of the company when pursuing systems like Amico:

- Be Proactive
- Lock Down Everything
- Set the Correct Permissions
- Budget
- Planning
- Updates
- Testing
- Regular Reviews
- Training

Costings:

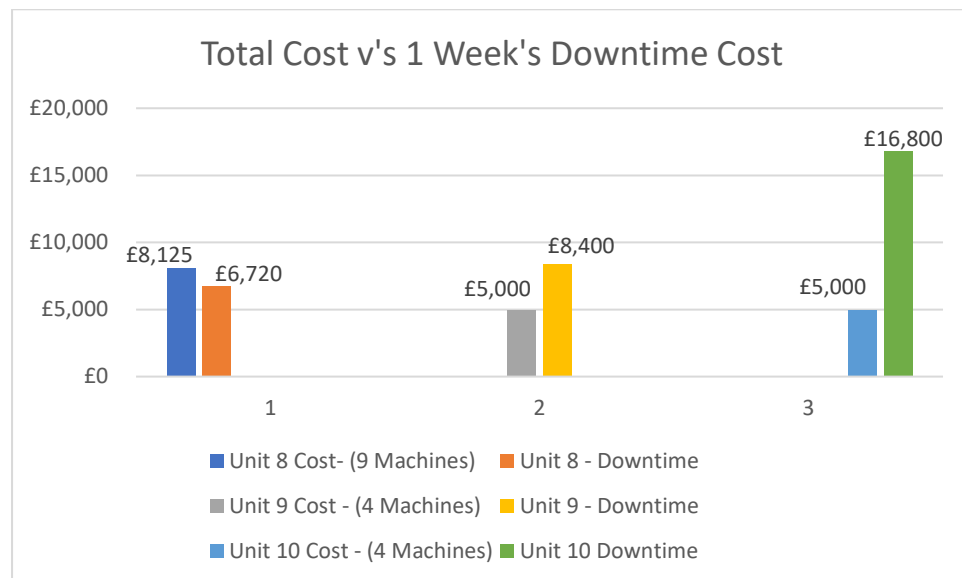
Each factory unit would cost £2500 plus a further £625 per machine for the electronic card and connectivity set up.

Total cost for each unit is shown below:



Cost Comparison

Looking at this from a downtime perspective over anything else, the graph below shows a comparison of the total cost against the cost of a machine being down for a minimum of 1 week in each unit.



Review and Conclusion

The evidence has shown that the computerisation on the machines is no longer just there for set up purposes but instead to perform a wider range of tasks and most importantly to capture data. As backed up by Brynjolfsson and McAfee, the scope of what computers do has recently expanded, and will inevitably continue to do so (Osbourne, September 2013)

Whilst the business has become heavily dependent on the technical team to insure all the maintenance on the machines is carried out on a regular basis it has been proven that even with this in place unforeseen breakdowns can still occur. For example, most recently, Machine 19, a machine recently bought (albeit 2nd hand), this was given a full service on arrival but 4 months later the screw and barrel failed. This leaves the question of was this missed whilst servicing the machine or was this undetected in the background, According to Poka Yoke, technical installations help employees to avoid mistakes (1988, 2019) based on this theory, the potential risk for human error could have been avoided as the Amico system would have detected this and reported it accordingly. The machine was down for 3 weeks, due to waiting for parts to come from Italy, an unnecessary cost to the business.

As another example, machine 15, when the tie bar broke, the machine was out of use for 6 weeks, waiting for another tie bar to be delivered from Italy. A cost to the business of over £50k in machine chargeable time.

On top of this the other functionalities of this system must not be forgotten about, it can also detect and report back if the production run was not kept to cycle, questioning if there was human interference on the machine and why?

Based on the information researched above, the business could look further into this as a model, to take the business into the next stage of its progression, utilising Industry 4.0. The cost savings shown in the graph are purely based on 1 machine breaking down for 1 week and even with those calculations the business would definitely see a great benefit and that's not to include the breakdown as demonstrated above where the tie bar broke and the machine was down for 6 weeks and cost the business over £50K in downtime. Even with the savings aside, the functionality of the machine running and not being down provides the production line with a consistency for quality.

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