

Introduction to Industry 4.0

Assignment 1

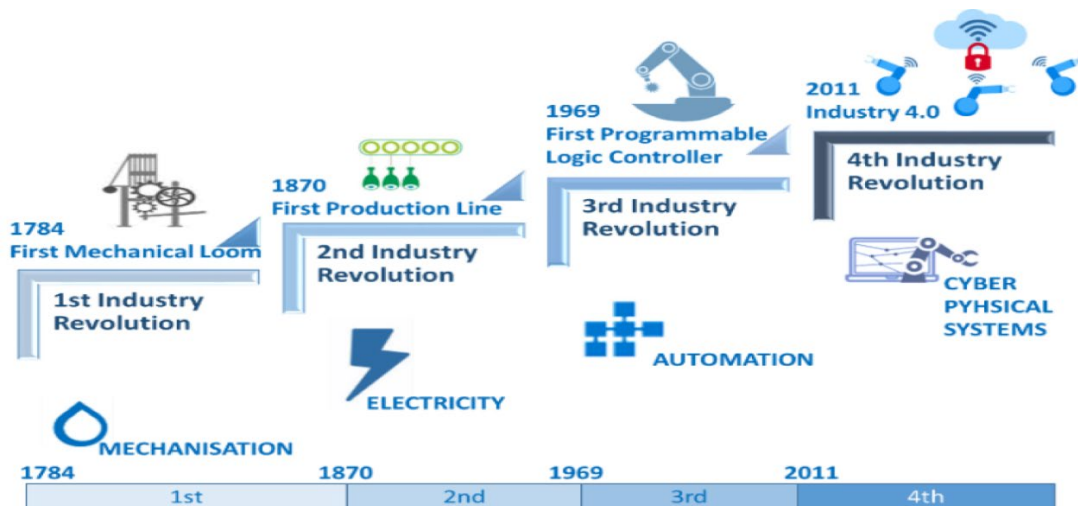
Casks filling – “Caskmaster”



Penderyn Distillery

July 2022 , by Aista Phillips

Before reviewing the specifics and importance of "Industry 4.0", it's appropriate to reveal the concept of this idea similarly because the essential features and key applied technologies, the influence of which is that the initiation of replace that affect quite just the manufacturing industry. At the start of 21st century of the second decade, the planet was on the brink of the 4th industrial changes (Gabriel and Pessl, 2016), but the economic sector has already counted quite one century of history. For better understanding for the explanations for these industrial changes, we will look how it started and what changes it's been. The start of the primary age is counted from 1784. (Berger, 2016), when the development of railways began, mechanical machines were used for the primary time in industrial production, driven by the then new technology of steam engines. The second age happened within the 20th century. At the start, and its pleasantness is that the discovery of electrical power and capable to use for a replacement production - for production. All the new innovations that was exhausted the industry at around 1970s push towards the 3rd Industry revolution. All of it followed by the link of technology and also the first computers that created the automation of production processes (Gabriel and Pessl, 2016). Within the 21st century, because of improving information technologies, the fourth technological revolution was also entered, which was characterized by such technological possibilities: Internet, clouds computing, automation, robotics etc. (Berger, 2016). Industry 4.0 shows that Innovations spread within the industry much faster and in bigger scale than the previous industry revolutions (Schwab, 2016). "Industry 4.0" it's the 4th historic period that use new technologies as that followed with the new Innovations like robotics, electric vehicles, drones etc. In keeping with Schwab (2016), the Industry 4.0 is different because it uses connectivity between billions of various devices. New technologies are combining with data that's available within the real time, it can change manufacturing and operations within the global supply chain and make a difference within the interaction between people and machines. plenty of production is attempting to find ways to using Industry 4.0 technologies. As per the McKinsey Global Institute, optimizing operations and equipment alone within the manufacturing sector could create up to \$3.7 trillion in value by 2025 (Tang, & Veelenturf, 2019). By asking many manufacturing companies, plenty of them identified computerized manufacturing as a main factor for the success. Although computers and digital technologies are not any longer a news within the daily activities within the industry, "Industry 4.0" may be a big move within the development of digitization processes and therefore the use of the technologies. This step may well be described as "a significant transformation of the manufacturing industry by combining digital and online technologies in conventional manufacturing" (Stancioiu, 2017).



(Gökalp et al., 2017)

Process picked for this assignment is casks filling. When company started distilling in year 2000 amount of the casks filled was around 2 per day. At that stage Distillery was not looking for any improvement in the filling were simple pump and nozzle done a job. Growing productions Distillery expanded introducing additional 2 stills and started filling 17 casks per day. So, in 2016 we started looking for more better way to fill casks, that would be more efficient, saving time and losses.

We went to visit Distilleries in Scotland to see what they were using at that time. After viewing few and having conversation with the filling operators we have chosen Caskmaster Traditional Filling Machine Issue 2.0.

Caskmaster is PLC controlled machine with an ATEX certified low-pressure sensor for the spirit level sensing and two pneumatically operated butterfly valves for the fast and slow filling control.

The pressure sensor analogue signal is converted in the PLC to give 4 digital set points:

1. filling head out of the cask but low signal to confirm the pressure sensor is working. If no signal, filling prevented.
2. Casks is at the level to change to the slow fill
3. Casks full. Stop filling and lift from cask
4. Sensor is blocked. Filling is prevented

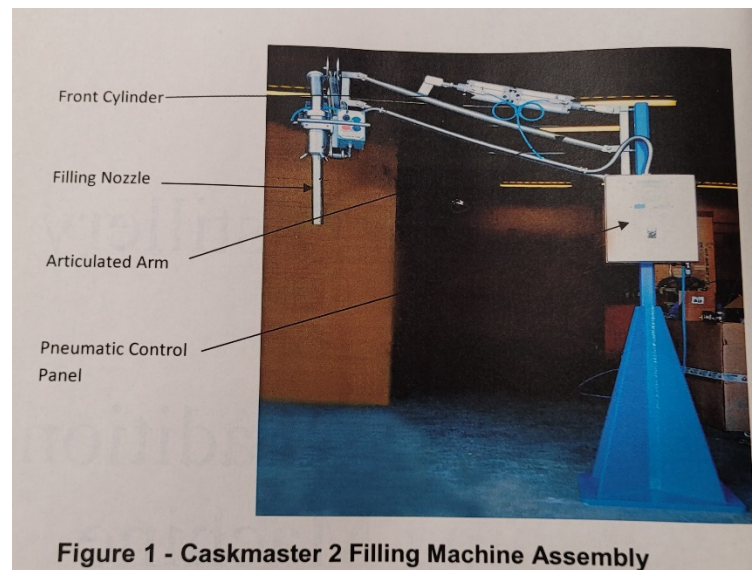
Filling nozzle is connected to the S/S pipework by an electrically conductive flexible hose. The filling head assembly is mounted on a stainless-steel support pantograph arm. The insertion of a positioner rod in a multi-hole quadrant plate is used to adjust nozzle height to suit to the different cask sizes.

We went from filling cask in 3min to filling cask in around 1 min. The other advantages were: time not needed to tare cask and weight after filled and as well it saved on the losses that it happened when we used to fill using nozzle, as we needed to watch closely not to over fill. It saved on the human error on calculating LPA as with the Caskmaster it is all calculating on the PLC by the flow meter.

From



To



With the other 2 distilleries opening we will be doubling in the amount of the spirit we will produce, so need to start looking for the more upgraded version of the casks filling. Filling that would save us more time.

Doing some research, we can see that there are few options in what we could upgrade our Caskmaster. One of them is upgraded version of Caskmaster 4.0. It will:

Give us better accuracy (Siemens Coriolis flow meter can measure fill volume to ± 0.1 tolerance).

Speed filling – it will fill cask in 40 seconds (modulating slow fill valve allows control of spirit level as it reaches the top of the cask)

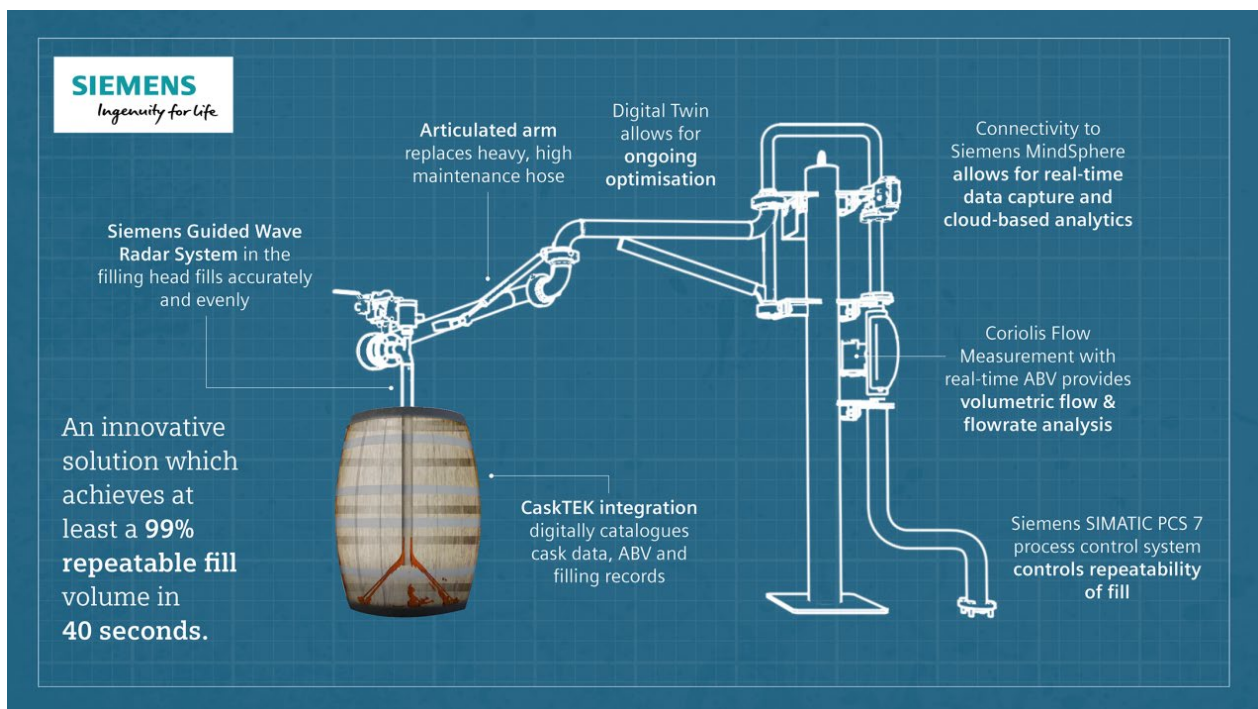
The Caskmaster 4.0 software and control integrates seamlessly with the DRAMS ERP.

Caskmaster 4.0 Filling Management System

- cloud connectivity for filling data – can be interrogated in real time by management, filling progress can be monitored remotely by supervisor/management and alarms set if parameters outside expected performance
- use of ATEX rated wifi tablets for operator controls – filling batches can be created and managed whilst not near the filling system
- real time filling data – volume, ABV, cask filling time, OEE, preventative maintenance
- optimization of filling controls – opportunity to adjust modulation of slow fill valve to minimize fill times whilst still controlling fill volumes

- integration of filling system controls with vat/tank level detection – identification of any spirit losses, automated adjustment of fill volumes to prevent partial casks at end of run, prediction of cask volume required
- RFID technology integration – cask management along with spirit management, traceability of casks in warehouse management system
- Integration with HPLC/GC profiling of spirit – analysis of spirit profile going into cask which can be used as comparison for when taken out of wood

The Caskmaster IBC filling machine may be fitted with a vibrating fork level switch for an additional level of overfill protection. The lifting mechanism is modified to suit the vertical lift operation required, and palletized cask filling may be designed to the customer's requirement for single, two, three and six-headed systems. (cockayne.co.uk, n.d.)





MCGowan Engineering machinery designed for the casks filling and draining. All ATEX rated and fully automation that allows to do work as it's max. it can be designed to fill casks on the pallet or on its own.

The other updated robotic example of the Industry 4.0 it would be Robot Filler Series from AiCROV. It's more efficient to fill not just casks but drums, IBCs and smaller containers. The model is designed for high productions featuring a high level of automation and much flexibility in changing the type of container.



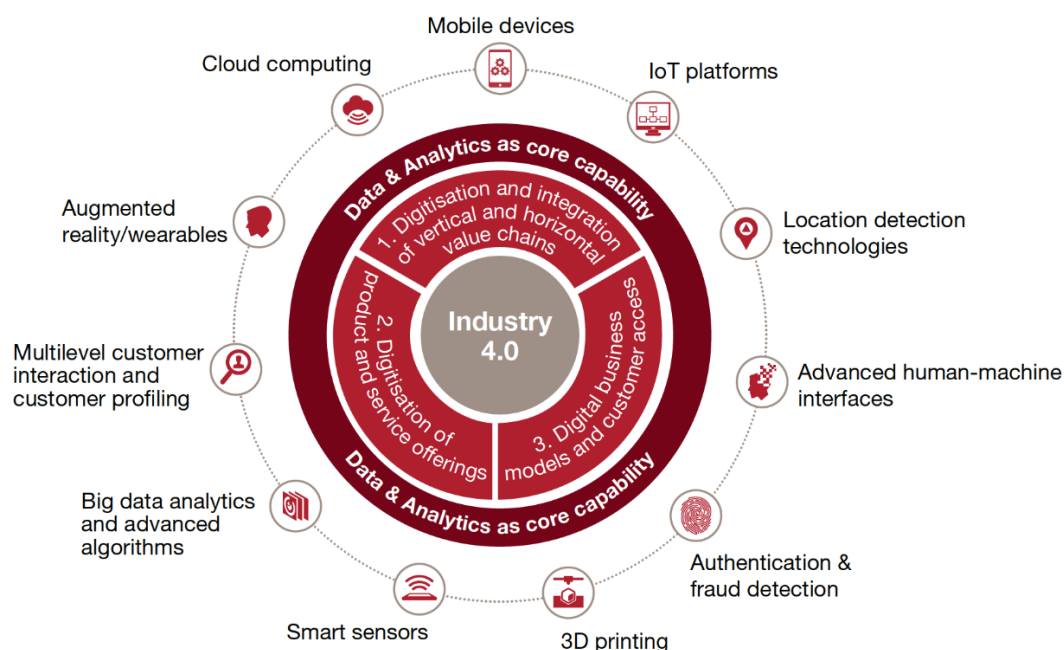
- A) High reliability and sturdiness of the equipment.
- B) Automatic containers feeding and evacuation.
- C) It allows for multiple filling stations.
- D) Suitable for production lines.
- E) It allows for controlling a full line of conveyors.
- F) Automatic alignment of the dosing lance and therefore the bung hole.
- G) Weighted, mass or flow filling.
- H) Electro-pneumatic system.
- I) System control filling flow as well.

- J) Easy configuration and entry into operation, for top production level with high level of automation.
- K) Adjustable filling height for filling containers of various sizes.
- L) Possibility of producing in several materials and finishes.
- M) Available in an anti-explosion version for dangerous areas. Possibility to work in a very assembly line.
- N) Quick format change with no need for tools.
- O) Interchangeable dosing lances.
- P) Possibility of placing using a man-made 3D viewing system.
- Q) Configuration flexibility and multiple automatic workstations: Bung-hole Centering / Searching. De-capping. Inertisation Filling Capping Sealing. (www.aicrov.com, n.d.)

It would be perfect to introduce AiCROV filling system in Penderyn Distillery but I feel that it will take too much room and company is not ready for this stage yet.

Looking at the all the options that can be introduced for the filling casks most suitable for Penderyn would be Caskmaster 4.0. As we already got Caskmaster 2.0 it will take shorter time to upgrader to the new version and as well will be less cost effective. Will do better job in the smarter way saving us what we will need; time on the filling and losses. Caskmaster 4.0 as well got full link to the software DARMS and that's were our new step is going from where we are now. Introducing Industry 4.0 every business will look at the efficiency and cost effective. I think from the researched filling system Caskmaster 4.0 will do that.

The main Industry 4.0 designed principles are: Interoperability, Virtualization, Decentralization, Real time capability, Service Orientation, Modularity.



(Geissbauer et al., 2016)

References:

- Bellamy, M. A., Basole, R. C. (2013). Network analysis of supply chain systems: A systematic review and future research. *Systems Engineering*, 16(2), 235–249.
- Berger, R. (2016). Skill Development for Industry 4.0. BRICS Skill Development Working Group. Whitepaper
- Chang, B., Chang, C. W., Wu, C. H. (2011). Fuzzy DEMATEL method for developing supplier selection criteria. *Expert systems with Applications*, 38(3), 1850–1858.
- cockayne.co.uk. (n.d.). Our Services. [online] Available at: <https://cockayne.co.uk/our-services>. [Accessed 25 Jul. 2022].
- Frank, A. G., Dalenogare, L. S., Ayala, N. F. (2019). Industry 4.0 technologies: Implementation patterns in manufacturing companies. *International Journal of Production Economics*, 210, 15-26.
- Gabriel, M., Pessl, E. (2016). Industry 4.0 and sustainability impacts: Critical discussion of sustainability aspects with a special focus on future of work and ecological consequences. *Annals of the Faculty of Engineering Hunedoara*, 14(2), 131.
- IoT Worlds. 2022. *Introduction to Industry 4.0: The Fourth Industrial Revolution - IoT Worlds*. [online] Available at: <<https://iotworlds.com/introduction-to-industry-4-0-the-fourth-industrial-revolution/>> [Accessed 26 July 2022].
- James McGowan Engineering. (n.d.). Cask Drain and Fill. [online] Available at: <https://www.mcgowaneng.co.uk/cask-drain-and-fill/> [Accessed 25 Jul. 2022].
- Juntao, L., Yinbo, M., (2016). Research on Internet of Things Technology Application Status in the Warehouse Operation. *International Journal of Science, Technology and Society* 4, 63–66.
- Kigtek. (n.d.). CaskTEK Filling System. [online] Available at: <https://kigtek.com/products/casktek/casktek-filling-system/>.
- Linkedin.com. 2022. Introducing Industry 4.0. [online] Available at: <<https://www.linkedin.com/pulse/introducing-industry-40-karl-blirando-phd-mba>> [Accessed 26 July 2022].
- Mussomeli, A., Gish, D., Laaper, S. (2016). The rise of the digital supply network: Industry 4.0 enables the digital transformation of supply chains. Deloitte Insights.
- Obitko, M., Jirkovský, V. (2015). Big data semantics in industry 4.0. In *International conference on industrial applications of holonic and multi-agent systems* (pp. 217–229).

Springer, Cham.

Oztemel, E., Gursev, S. (2020). Literature review of Industry 4.0 and related technologies. *Journal of Intelligent Manufacturing*, 31(1), 127–182.

Stăncioiu, A. (2017). The fourth industrial revolution „Industry 4.0”. *Fiabilitate Și Durabilitate*, (1), 74-78.

www.aicrov.com. (n.d.). RF drum filling System automatic - Drum Filling Machine Manufacturer. [online] Available at: <https://www.aicrov.com/en/our-products/drum-filling-systems/robot-filler?dataLayer=robot-filler-banner> [Accessed 25 Jul. 2022].