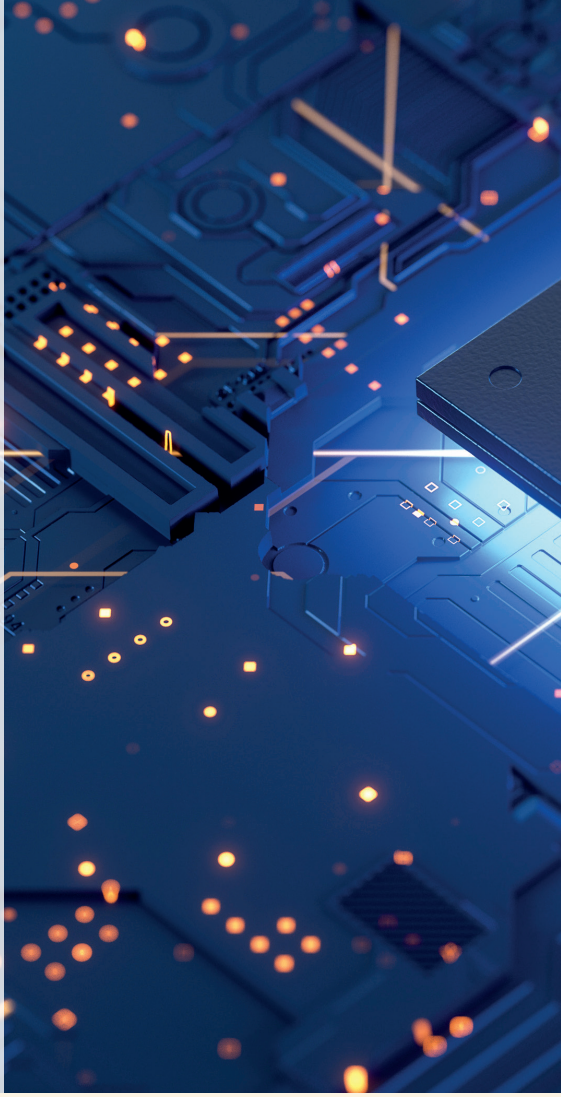
Artificial Intelligence is a big talking point, but what does this relatively unknown technology mean for the glass industry? Some say it will improve efficiency, while others fear its impact. We speak to experts for their views on this pivotal technology.



Burak Büyükfirat – Chief Research Development and Quality Officer

Artificial Intelligence (AI) isn't just a trend for us; it's a pivotal part of our evolution.

The concept of AI in glassmaking evokes a vision of a highly integrated, technologically advanced manufacturing environment where AI technologies such as machine learning, computer vision and data analytics play pivotal roles.

In this area, the application of AI goes beyond simple automation, delving into enhancing efficiency, elevating quality control standards, fostering sustainability and driving innovation within the glass manufacturing sector.

Viewing data through AI transforms it into a vital tool. It underpins algorithms and intelligent systems that analyse complex data, predict trends, improve operations and aid decision-making throughout production. The utility of AI in glassmaking impacts every production phase, from raw material selection and process optimisation to final product inspection and supply chain logistics.

Additionally, by leveraging AI's predictive power, glassmakers can reduce waste, lower energy consumption and use resources more effectively, thus supporting the industry's sustainability objectives.

Core technology

In our glass manufacturing facilities, the core of our technology lies in harnessing AI to refine operations across several critical dimensions - optimisation, prediction and decision support. These applications span an array of focus areas, including enhancing energy efficiency and elevating product quality.

Our approach leverages the deep expertise of data science professionals stationed at our headquarters, who collaborate closely with engineers on the production floor to implement AI-driven strategies. The insights and improvements derived from these AI applications are monitored and acted upon by operators in the field. This process ensures that the theoretical advantages of AI translate into tangible benefits in our daily operations. To facilitate this, operators receive training designed to expedite their familiarity with the AI tools.

Additionally, integrating AI technologies from various companies within a single glass plant demands an understanding of how these systems can effectively blend.

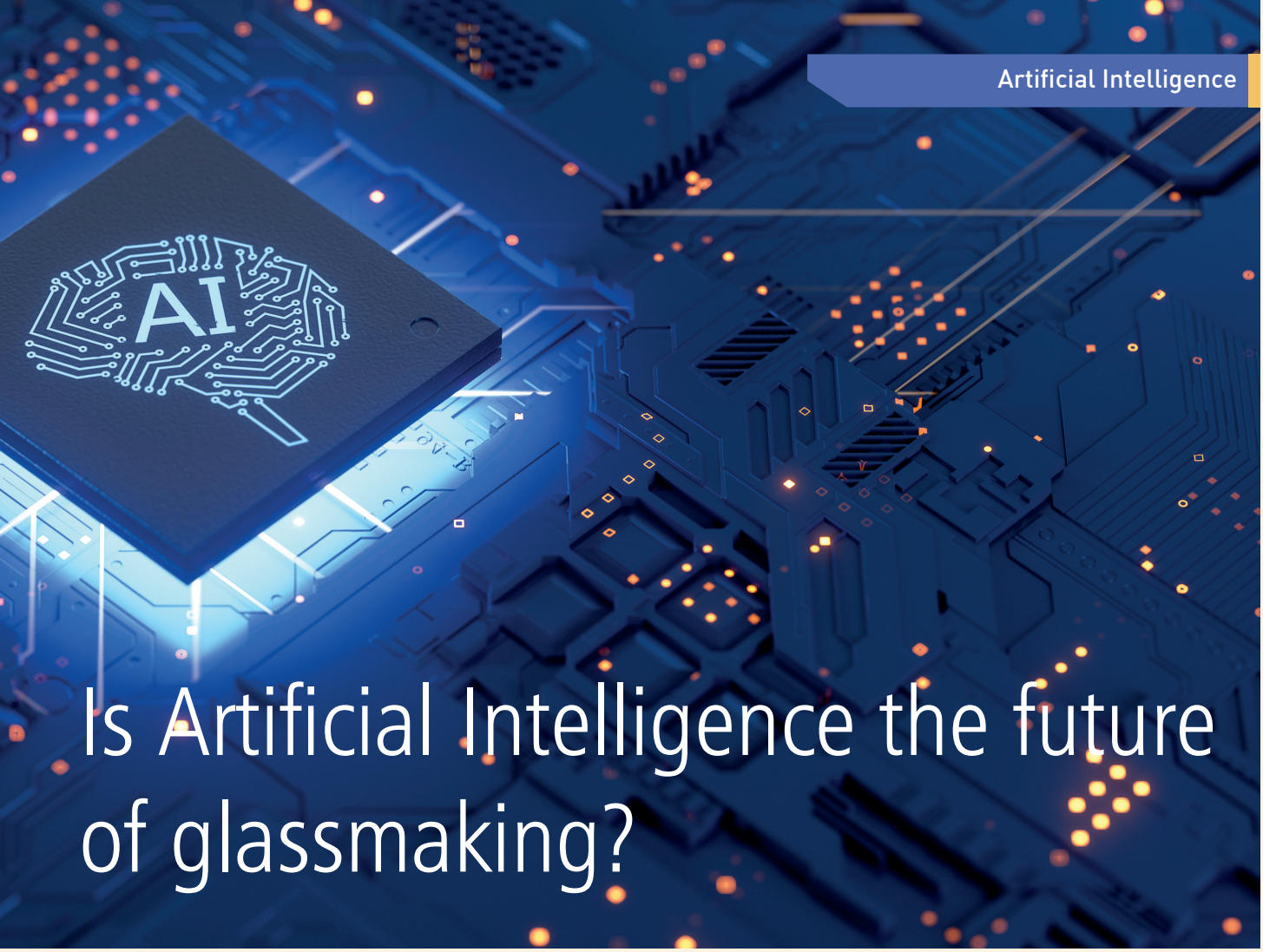
The successful interaction between these technologies depends on several factors, such as their compatibility, the ability to work together, and the distinct functions each AI solution brings.

Plant of the Future

For one and a half years, we have been working on a project that will serve the whole ecosystem: the 'Plant of the Future'. The platform is not only intended to meet our own needs, but is being formed with the vision of establishing Best in Class facilities in relevant business areas.

Preparations are underway for this platform, which is created in collaboration with our suppliers, considering customer feedback and sustainability goals. We are in the process of finalising discussions with companies for the establishment and implementation of the platform.

Several of best-in-class facilities will undoubtedly have all their processes optimised. In this sense, one of Sisecam's main goals is optimisation with the



Is Artificial Intelligence the future of glassmaking?

use of AI. This doesn't just include on-site process optimisation, but also an optimised supply chain, from the supplier providing raw materials to the end user of the product. Therefore, one of the most important tools required to achieve this facility of the future will be AI.

Advantages and disadvantages

Improved efficiency is one advantage, as AI optimises manufacturing processes, leading to increased productivity. Additionally, AI enables real-time monitoring and analysis, ensuring consistent quality control.

Predictive maintenance is another benefit, as AI predicts equipment failures, allowing for proactive maintenance. Moreover, AI-driven optimisation reduces energy consumption, contributing to energy efficiency.

It also provides valuable insights for informed decision-making, and AI-powered monitoring systems detect safety hazards, enhancing workplace safety.

However, there are also some disadvantages to using AI in glass manufacturing. Implementing AI technology requires substantial upfront investment, which can be a barrier for some companies. Integrating AI systems into existing processes can also be challenging, leading to complex implementation processes.

Additionally, the use of AI involves collecting and analysing sensitive data, raising concerns about data security and privacy. Moreover, reliance on AI for critical operations may lead to dependency issues, which could pose risks to the manufacturing process.

Shaping the industry

The use of AI in the manufacturing sector is expected to continue evolving, playing a pivotal role in shaping the industry. Numerous trends and advancements, such as collaborative robots, digital twins, human-AI collaboration and supply chain optimisation, will characterise the future landscape of AI in manufacturing.

It's crucial to recognise that the progress of AI in manufacturing will be influenced by advancements in technology, regulatory frameworks, and the evolving requirements of manufacturers. Companies that strategically embrace AI technologies and adapt to these emerging trends are poised to gain a competitive edge in the dynamically evolving manufacturing arena.

While the timing seems favourable for such advancements, the successful implementation of AI in this sector will depend on several critical factors. These include the industry's readiness to embrace technological innovations, its ability to overcome potential hurdles, and its commitment to investing in the necessary infrastructure and skilled workforce. At this stage, it's worth considering the concept of lights-out manufacturing, where manufacturing processes are highly automated, thus reducing the need for direct supervision.

However, it's important to note that while automation can streamline certain aspects of production, it doesn't necessarily mean the elimination of human roles. Instead, it can create opportunities for employees to focus on more specialised tasks, such as maintenance, quality control, and innovation.

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GLASS SERVICE

Erik Muijsenberg – Vice President

AI is often perceived as a buzzword, leading many to believe that we're delving into something mysterious or even extraterrestrial. However, this couldn't be further from the truth. Rather than dealing with phenomena beyond our understanding, AI primarily involves creating software programmes that enable machines to process data in a manner akin to human cognition.

Unlike traditional programming, where software routines are fixed, AI allows us to train algorithms using data, enabling them to recognise patterns much like the human brain does. Our AI Vision software exemplifies this concept by empowering operators to monitor and even oversee activities inside the combustion chamber of a glass melter around the clock, every second. This capability not only demands less time and attention from operators but also ensures a level of accuracy far surpassing human capabilities. It's reminiscent of self-driving cars identifying objects amidst traffic, showcasing the transformative potential of AI in various domains.

This is how we use AI to train a software algorithm using numerous furnace images: we educate and acquaint it with various elements such as batch material, refractory, foam, glass, flames and other objects; after sufficient exposure to a diverse array of images, it becomes adept at recognising these elements in future images consistently. This process is commonly referred to as Neural Network Image Segmentation.

We provide the software with images sourced from a range of furnaces including float, container, fibre and special glass furnaces. Subsequently, it becomes proficient in identifying all discernible features captured by our High-Resolution Near Infrared GS Cameras. This wealth of information is then integrated into our Model-Based Predictive Expert System, which facilitates decision-making processes for operators.

While operators require some training and understanding of how to use this technology effectively, they need not grasp the intricacies of the AI routines underpinning it.

Advantages and challenges

Advantages abound with AI software, as it can process vast amounts of data with intricate detail and at a faster pace than any human could manage.

AI has the capability to effortlessly handle multiple cameras simultaneously, whereas a human operator can only focus on one object at a time. This parallels the situation in self-driving cars, where most accidents stem from human error. With advancements in AI imaging techniques, I'm confident it will prove more reliable than humans who may occasionally lose focus or fail to pay attention.

Consequently, integrating AI into production processes will enhance efficiency, while mitigating risks and minimising defects.

Perhaps it's more challenging for the older generation of glassmakers to comprehend and place trust in AI technology, but I don't view this as the most significant issue. The greater challenge lies in sourcing an ample number of software programmers from the market. These programmers are needed not only within the glass industry but across all industrial sectors.

In addition, different suppliers have their own platforms and areas of expertise, along with unique communication techniques, and the challenge lies in effectively integrating these disparate elements. Surprisingly, achieving seamless integration across these diverse areas remains a hurdle.

The next step

I anticipate that AI will see increasingly widespread application, particularly in imaging techniques like defect detection. Moreover, its utilisation extends beyond mere glass melting furnaces to actual glass forming processes.

Additionally, AI can contribute to a deeper understanding and prediction of furnace corrosion, thereby enhancing the lifespan of furnaces as we progress towards decarbonisation.

I am confident that we will witness the pervasive influence of AI across various industries and within society as a whole. AI offers unparalleled capabilities in addressing production challenges, surpassing any previous techniques.

Have you noticed the improvement in speech recognition by platforms like Google? This advancement is attributable to AI solutions, a departure from traditional software programming methods used to interpret speech. Thus, AI represents a revolution akin to the introductions of electricity or computers, if not greater in scale.

A prime illustration of this revolution is the emergence of self-driving cars. Interestingly, many fail to recognise that self-driving trucks for long-distance journeys may become a reality sooner than expected, given the relative simplicity of highway driving compared to navigating city streets. I often draw parallels between these advancements and other transitions, such as the shift from hybrid to electric cars, which mirrors the evolution anticipated in glass furnace technology.

The glass industry is poised to take this next step, aligning itself with the principles of Industry 4.0 and the imperative of decarbonisation. The readiness to embrace AI techniques underscores the industry's commitment to rapid adaptation and innovation.

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EMHART GLASS VISION

Niki Estner
Manager of Software Development

In general, AI means automating tasks that require human intelligence.

Previously, vision and natural language understanding could be partially automated. However, in the last 15 years, technology has reached a level where AI / Deep Learning systems are now capable of solving tasks that require human intelligence.

Today, this technology is being widely used in the cold end inspection industry. Vision inspection systems benefit from easier setups, more accurate classifications and less false rejection rates.

Emhart Glass Vision inline inspection machines are placed in a container glass plant, at the cold end on a conveyor line. The inspection machines are set up during a job change and then detect and reject defective containers before they reach the palletiser.

Our inspection machines combine AI and conventional technology.

The advantages of conventional technology are that it can be set up for any container without training, and it uses less processing power. For simple tasks like 'find the outline of a container', conventional technology is still the way to go.

The setup itself is automated using our AI-based Self-Adjusting technology. More difficult tasks like 'detect wire edges' or 'classify defects' use AI technology during inspection time. This way, the operator gets the best of both worlds: first-time job setup is easy and AI-automated, and, at runtime, processing power is used for the high-value classification task.

Regardless of the technology supplier, AI-powered inspections still perform the same tasks as before and support the same interfaces – the data they provide is just more accurate. This means that they all inspect containers, determine if the articles inspected are acceptable, or not, and provide the detailed results that can then be used to identify problems, calculate trends, and supply the needed information to correct and control the manufacturing processes.

The main advantages of AI are less human intervention, more accurate classifications, and less training for operators.

The biggest disadvantage is that AI technology typically requires more processing power and a large training database. This used to be a limiting factor, but with computers becoming more powerful and less expensive, these disadvantages have little impact for inspection technology.

Reliability

As a cold end inspection vendor, our products have a high impact on the quality of the end product – and the well-being of the end consumer. We do not take this lightly!

Reliability is one of our core values. That means we do not release products unless we are sure they fulfil the highest quality standards of the container glass industry.

Computing power and massive databases may be the only obstacle to advancing the technology further. Apart from that, the sky is the limit: we see exciting new applications of AI popping up in many sectors every day. Carefully adapting these new ideas to help the glass industry will keep us busy for years to come.

Trends

The trend we've been seeing over the last 5-10 years is that AI is entering increasingly niche challenges while the "teething troubles" of using AI are being resolved. For example, in early AI systems, training could only be done offline by the vendor, using expensive hardware, and re-training the database took a long time – up to days. Modern AI systems can be trained online, at the machine, by the user, in seconds.

We expect this trend to continue – so this technology will become more useable as we adapt it to our industrial environment.

We will begin to see more AI technology applied in container glass plants. Today, a lot of areas in a glass plant require permanent human supervision, and often quick reflexes are needed to limit damage. This requires operators to be present 24 hours a day to keep production running.

In 10 years' time, much of this 24h-operation will be automated. Most processes will be stabilised by closed loop-control, and out-of-control situations will be detected by anomaly detection technology. When that happens, the out-of-control machine section will be safely stopped, until an operator comes to fix the situation.

The move towards AI is coming at the right time for the glass industry. Many glass plants have trouble finding and keeping qualified operators. AI is a key part of the solution for this shortage.

At the same time, better closed loops, better classification and faster reaction to out-of-control situations will increase yields and improve sustainability and our industry as a whole.

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AI in glassmaking represents a significant paradigm shift. It goes beyond just being a technological advancement; it is a game changer.

The ability to leverage AI means that we can now correlate vast amounts of data from various points along the production line, including inspection systems and electronic control systems. This correlation empowers us to optimise processes and maximise yield in ways that were previously unimaginable.

Our technology plays a pivotal role in the glass plant, particularly in the inspection area. Its primary function is to detect and learn from quality issues, subsequently enhancing both speed and yield within the production process.

At its core, our technology employs advanced algorithms and machine learning capabilities to analyse vast amounts of data generated during the inspection phase. By identifying patterns and anomalies, it can pinpoint potential defects or areas for improvement with remarkable accuracy.

In terms of operator involvement, basic training is required to operate the system effectively. This training is designed to familiarise operators with the interface, functionalities, and the process of signalling the system when a new defect needs to be learned. This collaboration is crucial as it allows the system to continuously evolve and adapt, improving its accuracy and effectiveness over time.

A closed loop system

When multiple AI technologies from different companies are installed in one glass plant, their interaction is vital for achieving optimal performance and efficiency. The goal in such an integrated setup is to establish a full closed loop system where all the AI systems collaborate seamlessly with shared data and insights.

The successful interaction of AI technologies in a shared environment relies on standardised communication protocols, interoperable designs, collaborative decision-making frameworks, feedback mechanisms, and centralised control where necessary. This integration fosters a cohesive and efficient AI ecosystem within the glass plant, driving improved performance and outcomes.

Further advantages of AI include:

- Optimised process efficiency: AI can analyse vast amounts of data in real-time, leading to optimised forming processes. This can result in increased production efficiency, reduced cycle times and higher throughput.
- Enhanced quality control: AI algorithms can detect defects and anomalies during the forming process with high accuracy. This leads to improved product quality, reduced scrap rates and fewer rejections, ultimately saving costs.
- Predictive maintenance: AI can predict equipment failures and maintenance needs based on data analysis, enabling proactive maintenance strategies. This helps in minimising downtime, extending equipment lifespan, and reducing unplanned disruptions.
- Continuous improvement: AI-driven insights allow for continuous process optimisation and refinement. By learning from historical data and performance trends, AI systems can suggest improvements to enhance overall forming operations over time.

The biggest obstacle to advancing technology further is the industry's risk-averse nature, which often leads to slow implementation processes.

Other key challenges include high initial investment costs, complexity of integration with existing infrastructure, data quality and availability issues, regulatory compliance concerns, skills gap for operating AI systems and cybersecurity risks.

The future

The move towards AI is coming at the right time for the glass industry. Given the industry's traditional nature and risk-averse tendencies, starting to adopt AI technologies sooner rather than later is beneficial.

The future of AI is characterised by increased intelligence, autonomy, integration, personalisation and continuous improvement. Embracing these advancements can empower forming plants to achieve higher levels of efficiency, productivity, and competitiveness.

In 10 years, glass plants, especially in container glass production, will be highly automated and driven by AI technology. Operations will be streamlined, with AI optimising processes, predicting maintenance needs, enhancing quality control, and enabling remote monitoring. Human-AI collaboration will be key for efficient and sustainable production.

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In container glass plants, glass production, forming and quality control machines are used. Therefore, we can evaluate the use of AI in glass packaging production under these three headings.

In glass furnaces, AI can provide the optimum product analysis with the scrutiny of mixing and melting parameters that will increase the mechanical strength and forming ease of glass packaging.

In terms of forming, parameters can be optimised with the information obtained from quality control. For quality control, defect detection rates can be improved with AI systems supported by deep learning in product quality analysis.

Consequently, AI technology with high usage rates can provide benefits such as higher quality packaging and faster production speeds when manufacturing glass.

In glass packaging plants, modernised machines can operate without the need for human support, except for operating parameters and equipment changes. Therefore, a glass packaging product can be stored in a warehouse without human intervention.

However, there is a need for experienced individuals in defect and problem solving. Their high level of know-how is crucial for production parameters, intervention in glass defects, and glass mixing and melting points. Therefore, it is crucial for employees to receive training and gain experience in the field.

Advantages & disadvantages

Using AI in glass container manufacturing offers several advantages:

- AI can optimise production processes, leading to increased efficiency in manufacturing operations. It can analyse large volumes of data in real-time to identify bottlenecks, predict equipment failures, and optimise production schedules.
- AI systems can monitor product quality throughout the manufacturing process, detecting defects and deviations from specifications more accurately and quickly than human inspectors. This leads to higher-quality products and reduces the likelihood of defective units reaching customers.
- By optimising processes and minimising waste, AI can help reduce production costs. Predictive maintenance enabled by AI can also lower maintenance costs by preventing unexpected equipment failures and minimising downtime.
- AI can aid in product design and development by analysing customer feedback, market trends, and production data to identify opportunities for innovation and optimisation. This can lead to the creation of new glass container designs that better meet customer needs and preferences.

However, there are also some disadvantages to using AI in container glass manufacturing:

- Implementing AI systems requires a sizeable initial investment in technology, infrastructure and training. Small and medium-sized manufacturers may find it challenging to afford these upfront costs.
- AI systems can be complex to implement and maintain, requiring specialised technical expertise. Manufacturers may need to hire or train employees with the necessary skills to develop, deploy and manage AI solutions effectively.
- AI systems rely on large amounts of data, including sensitive information about production processes and product specifications. Ensuring the security and privacy of this data can be challenging and may expose manufacturers to risks such as data breaches or unauthorised access.
- Relying heavily on AI systems can create dependency on technology, making manufacturers vulnerable to disruptions such as system failures, cyber-attacks, or technical glitches. This dependency can pose risks to production continuity and business operations.

Ethical considerations

There should be two main elements and one side element in the development of AI technology. One of the main elements is ethical values and privacy.

AI technology will further the ethical and societal challenges associated with its deployment. As AI systems become more sophisticated and integrated into various aspects of daily life, concerns related to privacy, bias, accountability and transparency are escalating.

The second reason is cost. With the advancement of AI technology, businesses may be intimidated by the idea of continuous billing through a subscription system rather than owning a product or service outright.

Additionally, the issue that acts as an obstacle to development is the division among people regarding AI technology. While one group supports its development and works on it, another group sees this progress as the end of humanity due to conspiracy theories and aims to stop it.

AI development

In the manufacturing sector, the trajectory of AI development is poised for exponential growth, with widespread adoption across diverse segments.

Advanced robotics will revolutionise factory operations, enhancing productivity and safety, while predictive maintenance systems will minimise downtime and optimise equipment performance.

AI-driven quality control and inspection processes will ensure consistent product quality, while supply chain optimisation algorithms will streamline logistics and inventory management. Furthermore, AI will enable mass customisation and personalisation of products, driving consumer satisfaction and market competitiveness.

As manufacturers increasingly prioritise sustainability, AI will play a pivotal role in optimising resource efficiency and reducing environmental impact. Overall, AI's integration into manufacturing processes will lead to increased efficiency, innovation, and competitiveness in the global market.

The right moment

Considering the difficulty of working conditions and the challenge of finding experienced (and inexperienced) workers, we believe that now is the right moment for AI technology to take an active role in glass packaging production.

In the glass packaging manufacturing sector, there are ongoing efforts and developments to utilise AI technology, and it has even started to be used in some machines applied in quality control processes.

I believe that within the next 10 years, AI will be actively used in all processes of glass packaging production, from the furnace to storage.

Furthermore, I think that this technology should be combined with VR and robot technology to process, implement, and transfer field-based tasks through these technologies.

It is important to clarify that when speaking about AI in the forming sector, that, in my point of view, we are referring to a solution that imitates the human cognitive abilities and even surpasses it significantly.

We are not talking about conventional data analysis systems that have been used for a long time, such as statistical solutions used to determine machine maintenance needs.

It is crucial to acknowledge that the potential of AI in the glass industry goes beyond traditional data analysis systems, as it harnesses the power of machine learning and advanced algorithms to unlock unprecedented insights and capabilities for optimising glass manufacturing processes.

A good example in the forming area, in the long-term, would be having the settings of an IS machine modified automatically, without any human interference, accordingly to the information provided by our Manufacturing Execution System (MES) named SIL (System of Information on Line) to keep the process under control. Our SIL system collects data from the raw materials to the palletiser, alongside the laboratory, mould shop and mechanical parts shop. The relevant data is then sent to operators and managers in the plant.

SIL interfaces are specially developed to the need of operators. We do have interfaces for hot-end (HE) operators, cold-end (CE) operators, pallet audit operators, quality operators, mould shop operators, maintenance operators, managers, plant managers and so on.

This is one of the strengths of SIL interfaces: it's user-friendly and dedicated to its operators. It's not just a simple dashboard, as all these interfaces are installed on a common platform with the latest technology. It also provides an excellent exchange of information between the different departments of the plant.

On the operation side, our 30 years of knowledge in the field and adaptability is the biggest advantage for the management change in the plants. We also provide onsite, deep training sessions to all the users, which is necessary to use the system and all of its benefits efficiently.

Data quality

To be effectively used in the glass industry, AI must absorb a vast amount of data, and one of the main risks associated with AI in glass is related to the quality of data used for machine learning. As a MES software provider, Vertech' is highly aware of this issue.

If the data is biased or incomplete, it can lead to inaccurate predictions and to erroneous decisions.

To benefit from the use of AI, it will be essential to ensure the quality and maturity of the data when it is first collected, as well as guaranteeing that it is sufficient to feed the AI system. This is not a one-time effort, but an ongoing process.

Continuous monitoring and maintaining data quality will be imperative to avoid potential pitfalls and maximise the effectiveness of AI-driven solutions in glass production, allowing for real-time optimisation and informed decision-making throughout the production cycle.

Development factors

When contemplating how to develop the technology further, there are too many factors to consider, some of which are variable and even unpredictable, such as external temperature and atmospheric pressure.

The production of glass containers is labour-intensive and complex, requiring the analysis of a range of data, including composition and temperature, among others.

One of the most important points is the quality of the data collected. As the reference in that field and based on amassed data, we noticed that this is not always the case. There is an important improvement to be done by all the suppliers of sensors in the field. I do know that all our partners are working very hard to provide valuable data.

I think we are just at the beginning of using AI in the forming sector. We have to continue to learn first, to continue digitalisation, and to understand the data collected, then we will probably deploy something.

A symbiotic relationship

As we face a lack of workforce, of both experienced and inexperienced workers, AI is a helpful tool for operators to guide them in the choice of corrective actions.

However, the use of this new technology should not be employed excessively or completely replace the human factor. Operators should not become overly dependent on AI, as their ability to react and make decisions could diminish.

Instead, a combination of human and AI could be a solution for optimising production processes. It would be more beneficial to continue to leverage the expertise of qualified operators and the advantages of revolutionary AI systems simultaneously.

The expertise and tacit knowledge possessed by skilled operators in the glass industry play a crucial role in ensuring the quality and precision of the manufacturing process.

It's challenging to fully replace their skills and intuition with AI technology alone as glass professions follow much fewer rigid rules than other disciplines.

While it is possible to replace a doctor with AI quite easily, the role of AI in the glass industry's Industry 4.0 is still uncertain, however, in my point of view, the main objective is to move closer to an autonomous plant.

It is also essential to acknowledge that the realisation of a tangible AI impact within the glass industry appears to be a somewhat distant prospect at this moment in time. We shouldn't forget that 85% of all AI projects fail.

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IRIS INSPECTION MACHINES

Jean-Luc Logel, CEO,

and Majd Rahmani, Technical Director

AI is today an overriding theme in the glass industry. Boosting efficiency is a key challenge, meanwhile reducing carbon footprint and human skills dependence. As pioneers in the use of AI technology for glass inspection, we aim to bring lower costs and higher satisfaction to glassmakers around the world.

Adopting AI technology is a major step for glassmakers looking for the best productivity and quality. For us, AI-based solutions should become the best assistants in the plant, capable of ensuring the smooth running of the entire production chain. AI should bring an unprecedented level of peace of mind in glass plants.

Iris' intelligent solutions connect each of the individual players within a value creation network, to optimise costs and performance factors such as Pack to Melt.

With a complete overview of relevant production data, our approach relates to defect identification, as well as the creation of statistics by defect type. Local trend analyses are produced on the machines, with information presented in a user-friendly format.

Using deep learning, our Evolution NEO AI solutions provide reliable information about the defect itself, its origin and criticality level. We offer a detailed defect classification into more than 30 defect categories, to reject defective bottles. With embedded AI, boosting Pack to Melt ratio, and providing quick and easy set-up for operators, especially for job change, are our two major concerns.

In continuity with our latest developments, we now offer an innovation equipped with AI, called iBot, compatible with the complete Evolution range and most of the carrousel check inspection machines.

Like a super assistant, it does not simply monitor and manage the optimisation of settings, but it goes beyond this, by integrating the prediction of process defects.

Our machines are augmented by this new tool: iBot can monitor every inspection machine on each production line in real time. It uses data to improve settings and optimise fine-tuning, just like an expert operator would.

Seamless

Our AI-based solutions can be seamlessly integrated with existing systems, leveraging interoperability standards and compatibility frameworks.

The latest Iris software release improves the interoperability between Evolution NEO machines and hot end equipment, with the ability to share defect characteristics and defect images in real-time, alerting IS machine operators in case of critical defect detection.

The Evolution NEO AI machines increase repeatability and inspection accuracy, while offering a precise information about the defect's origin and criticality level. AI-based algorithms can also predict defects and alert the hot end to avoid producing future defects which may be section, or IS machine related.

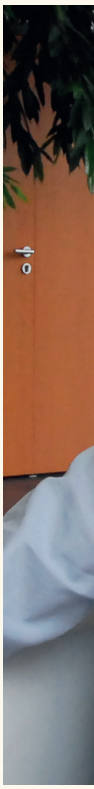
To summarise, AI offers in smart plants the creation of a highly automated and cost-effective glassworks.

Development

Thanks to reasonable implementation costs, AI will be adopted in the coming years by all glassmakers around the world.

And if we look further ahead, we will be capable of replicating human cognitive abilities such as intuition. After excelling at specific, repeatable tasks by exploiting rapid data processing, we strongly believe AI will have the potential to solve complex problems and make more human-like decisions.

The main obstacle is maybe conservatism. A disruptive technology is always a source of mistrust, and early adopters are often not the most numerous. But we are confident that mentalities are changing.



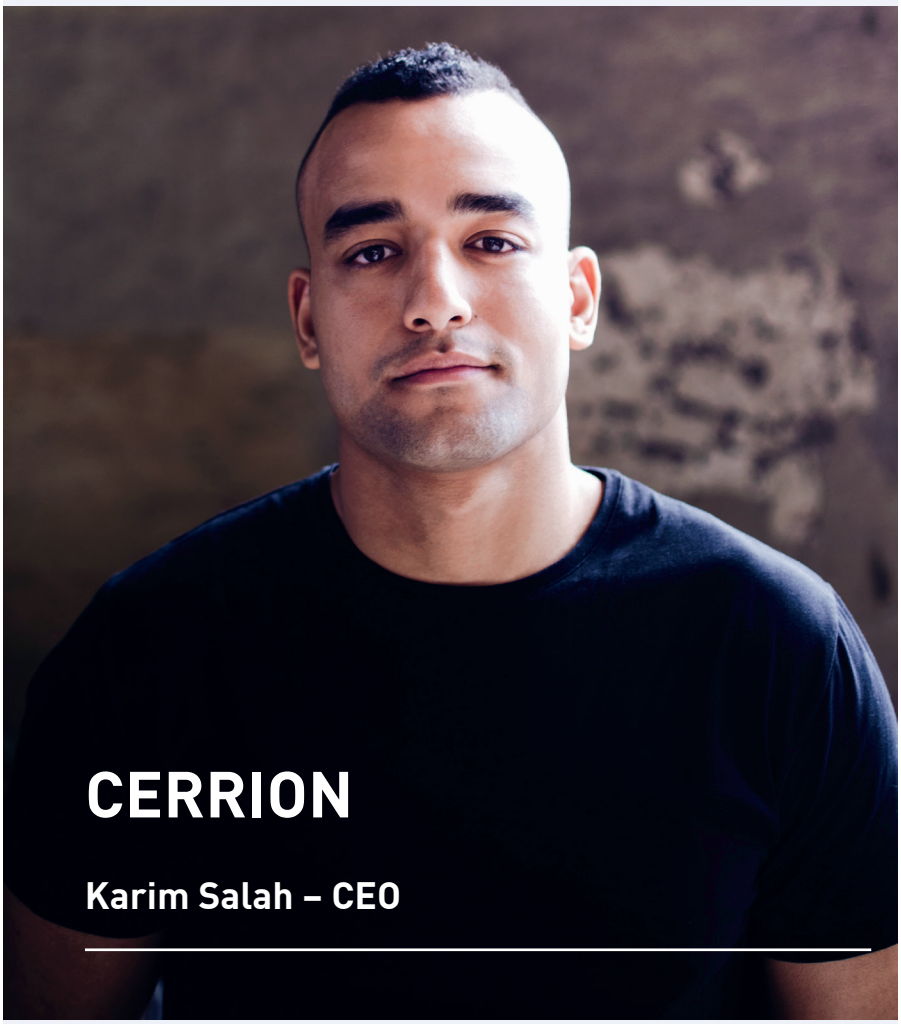
All our customers which have used Evolution NEO AI express satisfaction, and their positive feedback is an encouraging sign for the future.

In 10 years, a glass plant will resemble a highly technological place, with Advanced Intelligence playing a central role. Production lines will be fully automated and interconnected, featuring intelligent inspection machines, using AI to detect even the slightest defects with unparalleled precision, and even capable of making decisions.

Operations will be optimised to an unprecedented level, reducing costs, enhancing quality and boosting productivity. In essence, a true technological revolution will reshape the landscape of the glass industry.

The integration of AI into the glass industry comes at a crucial moment. With increasing demands for efficiency, quality, carbon reduction and sustainability, AI technology offers solutions to address these challenges. By harnessing AI-driven inspection systems like those developed by Iris, glassmakers can enhance their operations, streamline processes and ensure higher product quality.

Images: CEO Jean-Luc Logel (above) and Technical Director Majd Rahmani (below).



I see AI in glass manufacturing as a transformative path for the industry, shifting from reliance on human experience to data-driven decision-making.
This transition allows human workers to focus on high-value intellectual tasks, made safer by AI-enabled automation that handles mundane and dangerous tasks such as monitoring production or interacting with production anomalies.

Glass manufacturing faces the challenge of being perceived as an art, with experienced production teams often seen as superior to better technology.

But as experienced workers retire and it becomes harder to attract young talent, this mindset poses a risk. AI addresses this by increasing productivity in the short term and preserving knowledge in the long term.

In the short term, AI achieves productivity gains through closed-loop automation, minimising direct human involvement in risky situations such as production jams.

In addition, AI-powered software offers standardised data analysis, providing insights and suggestions for continuous improvement in a streamlined and efficient manner.

This enables inexperienced operators to take the same decisions and drive the same improvements as experienced operators, increasing the sector's resilience and ensuring it can compete with other industries for years to come.

Technology

Our technology helps glassmakers cut downtime and reduce the safety risks of their production as well as eliminate the need for constant human presence using video-based AI.

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Our system employs video cameras to monitor the most critical points of the production line both on the hot-end as well as on the cold-end. Examples are the machine sections, conveyors, stacker, palletiser etc.

Our AI analyses these video streams in real-time, learning normal production patterns like a human operator would. It automatically detects any visible process anomalies, such as fallen containers or glasses, conveyor jams or glass accumulation in moulds.

Upon detecting an anomaly, our system triggers either a sound alarm for operators or sends an immediate stop signal to the equipment for faster problem resolution. Supervisors receive alerts regarding problematic production trends, such as multiple fallen container incidents in a specific section within a set timeframe, along with solution recommendations for prompt action to prevent escalation.

Furthermore, all aggregated anomaly data and anonymised incident videos are accessible to production teams via our web-based platform. This facilitates expedited root cause analysis and enables data-driven corrective and improvement measures.

Our solution is designed for ease of implementation and operation, requiring minimal human intervention. It automatically adapts to various production scenarios, eliminating the need for operator training.

Customers using our solution have reported results, including a reduction in jams by over 60%, and a 1.5% increase in pack-to-melt efficiency.

Different vendors

Ideally, AI systems from different vendors should be designed to be interoperable. This means they should be able to share data and communicate easily.

One way to achieve this is by using standard protocols or APIs that allow different systems to connect with each other.

At Cerrion, we make sure our system can share data seamlessly through our Application Programming Interface (API) with a customer's MES system.

We can also directly send signals to customer's equipment, such as IS-machines, palletisers or reject systems. This allows different systems in the glass plant to benefit from each other's insights and analysis, improving overall value for glassmakers.

By integrating with a supervision/monitoring system, machines become safer and more stable, and MES/data platforms become more insightful through integration with various data generation and AI-based sensor technologies.

Advantages and disadvantages

The main advantage of AI is its ability to automate tasks and boost productivity. By handling mundane tasks that were previously done manually, AI frees up time for humans to focus on more important activities. This not only reduces errors but also significantly increases individual productivity, allowing them to accomplish more with less effort.

For instance, instead of spending hours analysing machine data or monitoring equipment for issues, AI can handle these tasks and provide actionable suggestions, transforming operators and supervisors into 'super' versions of themselves.

However, there are drawbacks to using AI. AI algorithms are probabilistic, meaning they can't guarantee outcomes with 100% certainty.

While top-notch AI solutions aim for 95+% accuracy, there's still a margin for errors. Although AI errors are typically lower than human errors, people tend to be more forgiving of human mistakes compared to those made by machines, as evidenced by attitudes towards self-driving cars.

Glassmakers must be prepared to acknowledge the possibility of occasional AI mistakes. At Cerrion, we address this challenge by offering production teams full transparency and control over the AI's behaviour through our AI governance module.

Obstacles

Technology, including AI, improves with practice. The more it's used, the more feedback developers receive, enabling them to enhance and expand the technology for the industry. Early adoption increases the industry's involvement in shaping the technology to address its current and future challenges.

The main hurdle for advancing AI in the industry and preventing the glass sector from lagging behind is early adoption. Glassmakers are currently navigating substantial challenges, from shifting market trends to workforce shortages. These times call for openness to new technologies and proactive adoption and implementation.

As someone deeply involved in AI development, I'm incredibly excited about its potential, especially for the glass industry. It's not a matter of whether AI will be applied in glass plants, but rather when and by whom action will be taken to avoid falling behind.

In the next decade, AI will likely automate high-risk and physically demanding tasks in glass plants, making the work more intellectually stimulating than physically exhausting. Additionally, most technologies in glass plants will be interconnected, enabling closed-loop production, which is more stable, efficient and safe. This evolution will make working in glass plants more attractive and ensure the industry remains competitive for years to come.