The importance of video technology to improving foundry processes and operations

White Paper

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Introduction

The foundry industry is one of the oldest manufacturing processes in the world. Some artifacts based on foundry processes date back as far as 3000 BC. A foundry usually refers to a factory or plant where various metal materials such as aluminum, iron, and steel are melted down and poured into a cast to produce a solid object. More recently new materials – based on plastics and polymers that get ever closer to replicating metal properties – are becoming increasingly more common. There are many types of foundry furnace, fuel and casting methods depending on the application. The most common casting processes include die casting, sand casting and injection molding.

In today's modern world, almost all manufactured products – around 90 percent - involve some form of foundry-made components. Typical applications and industries that use foundries are, among others, vehicle construction, mechanical engineering, and medical equipment manufacturing.

Technology is having a major impact on the industry in terms of making processes more efficient, reducing costs, and improving safety. For instance, computer aided manufacturing applications can simulate foundry processes helping to shorten production time and make processes more efficient.

Industry Challenges & Opportunities

Like many industries, the foundry sector is facing extreme pressure on costs driven primarily by decreasing prices for end products and competition from regions where wages are low, and governments provide high levels of financial support. This means foundries have to find more innovative and imaginative ways to cut costs and increase efficiency.

Tougher regulations around health and safety, employee care and the workplace are also forcing the industry to seek innovative ways to make work environments cleaner and safer, as well as more efficient.

Foundries are also looking at how they can become more sustainable and reduce their reliance on fossil fuels. Pressure on costs, regulations, and the need to be more sustainable are making foundries take a much more in-depth look at operational process, reducing waste and maximizing energy use. Despite these pressures on the foundries (and the impact of COVID-19), the industry is expected to grow over the next five to ten years. And it is likely that technology innovations will be a key to that growth and helping businesses meet these challenges.

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The Case for Video Technology

Thermal imaging – using video to detect temperature - is an indispensable part of many monitoring surveillance applications especially in industrial environments. As well as protecting assets and personnel, thermal imaging technology is ideally suited to improve efficiency of production and processing, resulting in a greater return on investment.

Thermal solutions can gather data or threats early on in a process or in obscure environments (dust, smoke etc.) long before human or conventional systems identify an issue.

What is thermal imaging

Thermal imaging is a non-contact technology that makes the thermal radiation (mid-infrared) of an object or body visible. In thermal imaging, temperature distributions on surfaces and objects are recorded and displayed.

The bolometer matrix (image resolution) is considerably lower in terms of the number of pixels than in cameras for the visible spectral range. In contrast to cameras with optical image sensors, a thermal

camera can detect extremely small temperature differences and visually display them with colors. Some thermal cameras can monitor temperature differences as low as 0.1 °C. Systems also function as automatic alarms for temperature limits or ranges.
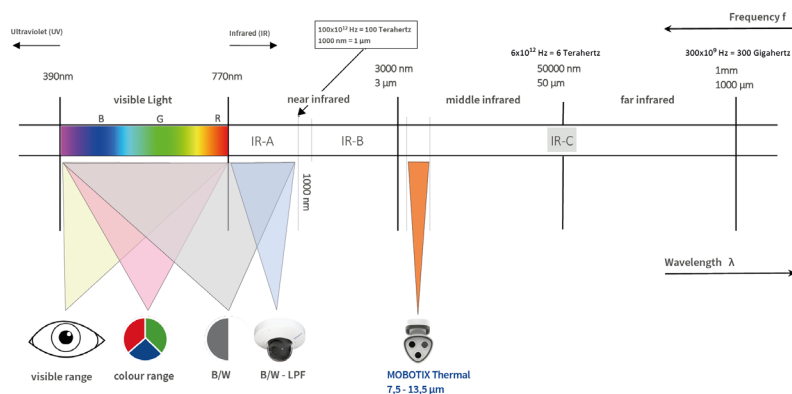
Video in the Foundry
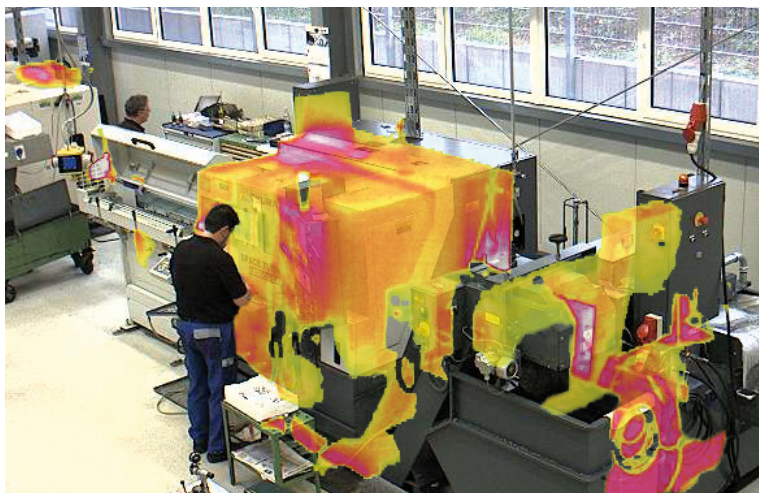
Until recently video technology has been largely overlooked as a technology that can improve foundry operations. Although video is common in functions such as making industrial sites secure, the use of video in the production process itself is not so often used. This misses out on a huge potential to transform how foundries operate. Those businesses that have started to deploy video solutions are reaping significant benefits especially in key areas like cost reduction, quality improvement, employee productivity and safety. Video addresses several key areas of the foundry environment:

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Perimeter Protection

It is likely that most foundry sites and plants already have some form of video-based perimeter protection in place. With a lot of expensive, high-value materials and equipment, industrial plants like foundries offer an attractive attack surface. Because of their size and complexity, some sites are difficult and costly to protect. It is often done using sophisticated alarm systems and 24-hour security guards. Video technology offers a more efficient, cost-effective, and often more efficient way to provide always-on, 24/7 site security either replacing or complementing existing solutions.

Access Control

Industrial companies maintain a very discreet approach to internal information and processes and so access for employees and visitors is strictly controlled. In addition, there are special safety-critical work areas to which only authorized/trained personnel may have access. This is as much about ease of access and efficiency as it is about security.

Video technology integrated with other access control systems enable a range of different access control solutions. These include simple person or vehicle identification at an entrance through to automated barriers opening activated by pre-qualified face and number plate recognition.

Foundry Monitoring

Especially in safety-critical areas of industrial plants, the protection of employees and the safeguarding of production processes are top priorities. The efficient use of resources by reducing unproductive monitoring measures increases the overall quality.

Employee Management

Closely related to employee safety and employee management, organizations across the board are leveraging video (especially ones already in place for security) to help with employee training and accurate incident recording. Foundries can use video to capture best practice processes to help train new starters and even capture mistakes to show how not to do things. Video is also a useful tool in capturing workplace incidents and providing evidence for follow-up analysis.

Function-specific applications

The areas where the use of video is much less prevalent is monitoring the various types of foundry process. Here video technology, especially thermal imaging, can play a significant part in process efficiency, quality, and productivity. One of the key factors in ensuring quality is temperature of processing environment, material, and mold. Here we consider two common foundry processes to show how video technology can improve operations.

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Die Casting

Die casting is a metal casting process where molten metal is forced under high pressure into a mold cavity. The mold cavity is created using two hardened tool steel dies which have been machined into shape and work similarly to an injection mold during the process.

It is essential that there are consistent process and holding temperatures for the material, mold, and molded item to avoid any degradation of material quality and integrity during the die casting process.
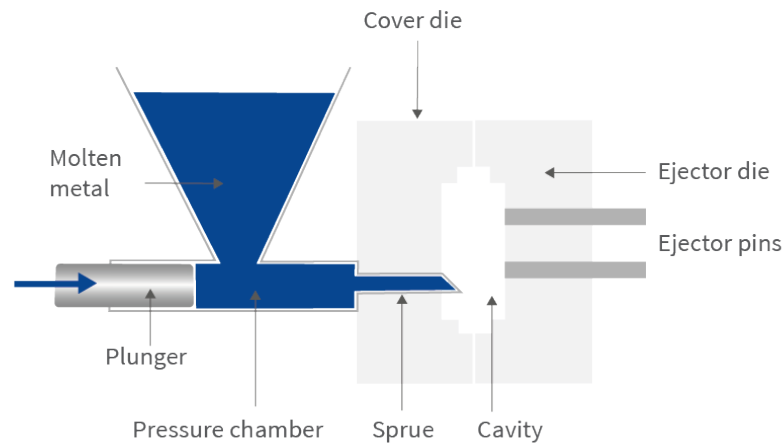

Injection Molding

Injection molding is a manufacturing process for producing parts by injecting molten material into a mold. Injection molding can be performed with a host of materials including metal, glass, elastomer and, most commonly, thermoplastic and thermosetting polymers.

Here low temperature ranges require high sensitivity in ensuring correct process and holding temperatures. Adherence to the process temperature ranges and corresponding cooling periods is key to meeting constantly increasing quality and productivity requirements.

Once thermal imaging was a clever way of seeing in the dark. Now it has evolved into a sophisticated technology used to automate protection, warning, and asset management.

By using heat signatures and applying ranges based on the environment and the application, thermal video can mitigate overheating, risk of fires, and identify temperature changes. The specific features and benefits of thermal imaging are:

- Detection of objects that "stand out" in terms of temperature

- Display of temperature differences from 0.1°C (3.4°F)

- Identify temperatures exceeding or falling below defined limits to trigger events (alarm, network message, active associated systems)

- Screening via special thermal radiometry windows or the complete sensor image

- Temperature range from -40 to 550°C (-40 to 1022°F)

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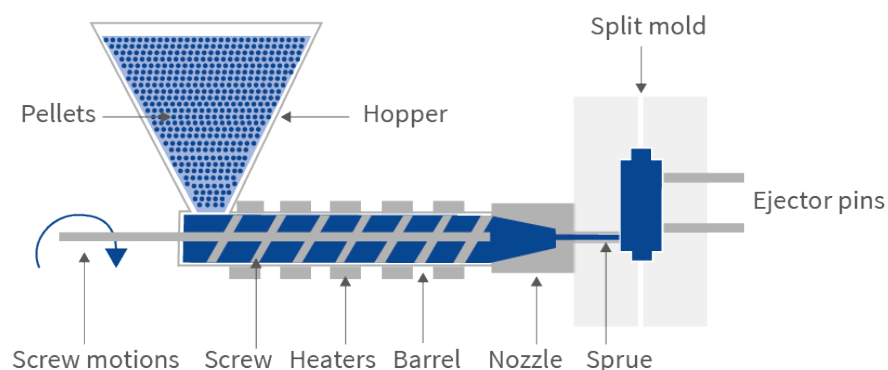
Benefits of Video Technology

Video technology has the potential to transform foundry operations enabling businesses to reduce cost, reduce waste, increase efficiency, and improve productivity. These benefits also help the industry move towards more sustainable operations.

Video ROI Analysis

Feature	With video
Investment	5.000€* p. camera
Efficiency gains per month (automation, productivity, avoiding losses, etc.)	2.500 € p. camera
Amortization time	2 months
Efficiency gains (1 year)	30.000 € p.camera
Efficiency gains (over 5 years)	150.000 € p. camera
Estimated ROI (1st year)	**600 %**
Estimated ROI (over 5 years)	**3.000 %**

*Typical system comprising 1 camera and software for 1 aluminum pressing unit

Benefits that video technology can bring to foundry operations:

✓ Make operations more efficient and productive

✓ Make sure quality is not susceptible to high ambient temperatures

✓ Reduced power consumption

✓ Fail-safe with no single point of failure

✓ Scalable and future-proofed

✓ Reduces spending on new network infrastructure to a minimum

✓ Employee safety and workplace management

✓ Reduce waste to improve sustainability

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Case Study: How video saves foundry business 720,000€ a year

One company that is using video technology to enhance operations is a global foundry business that produces a wide range of products for some of the world's leading automotive, technology and consumer product brands.

Objectives

- Digitize the production process and monitor integration of multiple types of IoT (Internet of Things) systems

- Adjust die casting process by analyzing temperature behavior

  - Contactless measurement helps to permanently monitor the temperature tolerance of the permanent die casting mold of 1%
  - Corresponds to average process temperature of 200°C - 300°C approx. 2-3°C

- Increase efficiency by monitoring temperature increases and decreases to enable precise adjustment of process duration

- Use historical observation of the temperature behavior before, during and after the process to inform and fine-tune future operations

Production Requirement

- High pressure aluminum castings for parts used in the automotive industry

- Produce around 40 tons of material using almost 100 separate machines located around the world

Video Technology Solution

- 24 MOTOBIX cameras with build-in thermal sensors that gather raw temperature data

- The cameras are integrated with an event stream processing (ESP) application developed in-house

- The ESP application manages and processes the stream of 'event' data (in this instance continuous temperature readings)

MOBOTIX Proposition

MOBOTIX was used by the foundry because of its high-quality and reliable thermal imaging technology. As well as the cameras, MOBOTIX was able to provide software that integrated seamlessly with the ESP system. Also, there was no other comparable solution available.
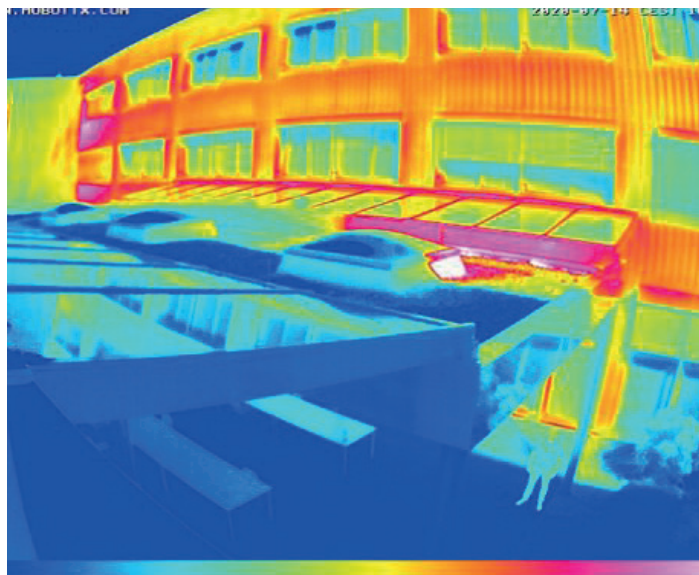
Benefits

✓ Saves 720,000€ a year by reducing material waste in the casting process

✓ Increases operational efficiency and productivity

✓ Provides a low-cost, automated way to monitor and control temperature

✓ Data used to enhance and improve processes

The business carried out an analysis of material waste from defective die cast parts because of undetected temperature changes. It found that each machine was producing around 2,500€ worth of defective parts per month. By using the MOBOTIX thermal imaging solution, the business could identify temperature fluctuations and adjust them so that defects where minimized. With a total of 99 machines (currently 24 machines equiped) each saving 2,500€, this would equals an annual saving of 2.970.000 € !

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Thermal imaging and MOBOTIX

MOBOTIX offers a complete solution specifically for foundry environments based on reliable, high-quality and 'German-made' hardware and software. Solutions include thermal imaging cameras and sensors such as the MOBOTIX thermal radiometry M16/73, S16/74 and S16/74 PTMount devices. These are supported by software used to control and monitor the devices and manage data collection. Software applications and industry-specific APIs ensure that the MOBOTIX technology integrates seamlessly with special foundry and manufacturing systems to provide highly customizable and adaptable solutions.

Alongside its technology, MOBOTIX has a network of specialist business partners who can provide expert industry advice. Using the MOBOTIX thermal imaging technology plus their industry knowledge they can develop, implement, and support a range of foundry-specific solutions.

For more information about MOBOTIX thermal imaging solutions contact
https://www.mobotix.com/en/solutions/solution-packs/foundries

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