Automate your way to lean manufacturing

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Almost all industries are becoming increasingly competitive. This is particularly true in the food and beverage industry where the traditional market shape has altered irrevocably. The advent of private label products, the dominant role played by the major supermarket chains, legislative requirements for product traceability, the push for longer shelf lives without compromising product palatability or consumer safety are just some of the issues that are adding layers of complexity to food manufacture.

The companies that are best at managing in this environment are those that are innovative and this innovation is not limited to the food or drink being produced.

Companies implementing continuous improvement programs in their manufacturing processes are reaping benefits. Lean manufacturing is actually adding to the profitability of the successful companies.

One of the simplest and most productive ways to make your manufacturing processes more competitive is through automation. Having all the equipment on your line talking to each other can mean problems are rectified in real time before backlogs and breakdowns develop.

There is no doubt that automated online or at-line testing is a boon for manufacturers who can see in real time when products are moving away from their required specifications. By reacting quickly to these variations, product loss can be minimised and raw material consumption optimised. There is also no need for holding times while waiting for lab clearance before releasing product.

Packaging lines can also benefit from the automation systems that are readily available. Vision sensors can check fill levels, label placement and orientation, missing or damaged product etc and have out-of-spec items removed from the line without affecting line speed.

Online, real-time quality control and system automation is now readily and inexpensively available with the latest sensors and vision systems. Why not look at your processes and see what you could achieve by installing some automation?

Janette Woodhouse
Editor – *What's New in Food Technology and Manufacturing*

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Machine vision for quality assurance

Glenn Johnson, Editor, What's New in Process Technology

Machine vision (MV) is the technology and techniques used in industrial environments to provide imaging-based automatic inspection, detection and analysis. The most common uses for machine vision are automatic inspection and industrial robot guidance, while in recent times, vision-based sensors for detection purposes have become available to replace sensors such as photoelectric sensors. Common MV applications include quality assurance, sorting, material handling, robot guidance and optical gauging.

Machine vision outputs

The most common output from a machine vision system is a pass/fail decision. Such an output may in turn trigger mechanisms that reject failed items or sound an alarm. Other common information that can be provided by an MV system includes object position and orientation information, which is commonly used for guidance systems, as well as numerical measurement data, data read from codes and characters, displays of the process or results, stored images, alarms from automated space monitoring MV systems, and process control signals.

General operation

The first step in the MV sequence of operation is acquisition of an image, typically using cameras, lenses and lighting that has been designed to provide the differentiation required by subsequent processing. For example:

- Different types of lighting (different colours or infrared for example) render different qualities of objects that may be of interest for detection or inspection.
- Strobe lighting synchronised with the rate of flow of objects past the camera allows fast snapshots to be taken of each object without motion blur.

MV software packages then employ various digital image-processing techniques to extract the required information and often make decisions (such as pass/fail) based on the extracted information.

While conventional 2D visible light imaging is most commonly used in MV, alternatives include imaging in various infrared bands, line scan imaging, 3D imaging of surfaces and X-ray imaging.

2D visible light imaging can be performed in monochrome or colour, and various resolutions. The use of colour and the depth of resolution affect the performance requirements of the image processing hardware and software, and therefore the cost of the solution.

The imaging device (usually a camera) can either be separate from the main image processing unit or combined with it, in which case the combination is generally called a smart camera or smart sensor. When separated, the connection may be made to intermediate hardware, such as a frame grabber, using either a standardised (Camera Link) or custom interface. There are now also digital cameras available that are capable of direct connections (without a frame grabber) to a computer via FireWire, USB or gigabit ethernet interfaces.

Processing methods

After an image is acquired it is processed. Machine vision image processing methods include:

- Pixel counting: Counting the number of light or dark pixels.
- Thresholding: Converting an image with grey tones to simply black and white or using separation based on a greyscale value.
- Segmentation: Partitioning a digital image into multiple segments to simplify or change the representation of an image into something that is more meaningful and easier to analyse.
- Blob discovery and manipulation: Inspecting an image for discrete blobs of connected pixels (such as a black hole in a grey object) as image landmarks. These blobs frequently represent optical targets for machining, robotic capture or manufacturing failure.
- Pattern recognition and template matching: Finding, matching or counting specific patterns. This may include the location of an object that may be rotated, partially hidden by another object or varying in size.
- Barcode, data matrix and 2D barcode reading: Reading codes for data input or simply to check correct labelling on finished products or shipping boxes and pallets.
- Optical character recognition: The automated reading of text such as serial numbers.
- Gauging: The measurement of object dimensions (in pixels or millimetres).
- Edge detection: The finding of object edges to detect their presence and orientation.

Quality assurance applications

The main uses of vision systems for quality assurance are to analyse images to perform appearance inspection, character inspection, position detection and defect inspection. Some of the main applications are:

- Detecting the presence, position and formation of a code such as a date code or barcode

- Validating the presence and positioning of labels, such as checking that front and back labels match the product and other elements such as caps.
- Checking closures for tamper seals, correct caps by colour and dimensions
- Inspecting product for fill levels, product content or other parameters
- Sorting products based on marking

Advantages for quality assurance

The major benefits of machine vision inspection solutions are:

- Cost savings due to reduced rework, more reliable product quality and less wasted product
- Automation of quality to provide more objective QA compared with manual inspection
- Greater transparency throughout the inspection process and improved process control
- Real-time quality metrics can be made available for OEE data

Examples of QA applications

Code validation

Machine vision solutions for code inspection are used to verify code presence, position and formation, and sometimes to also provide code reading and matching. Such systems can also automatically

identify and reject containers or packages with missing, incorrect or unreadable codes to ensure only properly coded items are produced.

Examples of the use of code validation are the validation of date codes, batch codes, barcodes and 2D data matrix codes.

Date code verification verifies that a code is present and is completely formed in the correct location, while batch code verification checks the quality of the printed batch information, ensuring it cannot be misread, possibly resulting in product recalls.

Barcode verification checks that barcodes are readable and correct, helping to ensure correct product tracking through the supply chain. 2D data matrix validation verifies that information which is not human readable is still valid, and is properly decoded and understood by the quality system.

Label inspection and validation

High-speed labelling of products, of all types, shapes and sizes, can result in a wide variety of possible defects. These defects can lead to label errors that can be harmful to a brand or even present liability issues for a brand owner. Labels can be inspected for label presence, wrinkles, tears, skewed labels, double labels, flagged or missing labels, as well as incorrect label pairs on containers and packages.

Machine vision technology for label inspection can be set up to help ensure perfect product presentation and correct labelling. Packages and containers with incorrect or defective labelling can then be automatically rejected in the production line.

Label presence and pairing can be checked, both to ensure labels are present and also that front and back labels are paired correctly with each other.

Skewed and dog-eared label detection ensures that labels are applied correctly and straight, and in the correct position, while double label inspection can make sure that only one label has been applied to the same location on the package.

Overwrap alignment is another form of label inspection in which wraparound labels are checked for straightness and proper position. With appropriate MV system design, a 360-degree inspection on round bottles can be performed.

Confirming that the correct label has been applied is often performed using graphical label verification (in which a unique graphical item on the label is used to confirm that the proper label has been applied) or by using 2D data matrix code verification where 2D dm codes are being used on the labels. Similarly, barcode verification: confirms that the proper label has been applied by verifying that the correct barcode is present.

Closure and seal validation

Obviously the integrity of closures and seals on bottles and other containers is important for the quality of the product and the safety of the consumer. MV systems can be used to visually check the closures and seals for integrity.

Checking the closure's colour and dimensions verifies that the right closure has been applied to the container, while visually checking liner formation and placement ensures the product is properly sealed and protected from contamination and leakage. In the same way, tamper seals can be checked to make sure they are not broken.

Packaging and filling

Machine vision systems can inspect filled bottles, trays, pouches, cases, cartons and other packages to verify that the packaging process was completed to the specifications required.

Bottles can be inspected to ensure that they are properly filled, labelled and capped to minimise product spoilage and ensure perfect product presentation, and case quality inspection can also be performed to verify that cases are properly sealed and undamaged, to allow fast and reliable palletising and packing.

MV technology can also be used to check the content of products made of discrete items, confirming that the specified contents are present, thereby demonstrating due diligence and reducing the costs associated with missing or additional components, parts or other items. ■

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Automating your way to greater efficiency

Modern control and automation systems which combine management and production levels are helping companies automate their way to success.

The simplest change to a production line, even just an operating system update, can cause havoc, since the slightest change can impact the entire operation. However, by having an intelligent link between the products being manufactured, the facilities doing the manufacturing and the IT systems controlling things, factories can be automated to react more or less autonomously to any changes.

The key thing is to put in place intelligent links between the manufacturing facilities and the IT systems.

Often if a product is changed, the first step is to rearrange the production line. Only then is the IT system reconfigured. What's more, the details of each machine that belongs on the line have to be entered manually into a computer. This work is tedious, time-consuming and error-prone. And frequently mistakes are only identified when the line is back up and running.

These conventional 'island' solutions, based on manual processes, do not provide a cost-efficient way to manage a food or beverage plant where batch tracing, cost pressure and sustainability - along with the product consistency and diversity demanded by the customer - have to be facilitated.

Managing, controlling, monitoring, visualising and analysing

Modern production control systems manage, guide, monitor and visualise the entire production process. Ideally, the operator can see on the screen at a single glance whether the production processes are running as they should. The control systems also log, analyse, compress and archive a range of data from the process chain from delivery of raw materials through to the completed, packaged end product.

On the one hand this secures the legal requirement for batch tracing. And on the other, the production figures thus acquired enable the company to conduct a detailed analysis of the processes.

Production control systems can also pass on data to the higher-level ERP (enterprise resource planning) system, which integrates planning and commercial functions. In this case the company management and production levels are then combined in a single transparent data platform.

Operators, technicians, operational managers, controllers and executive managers all have access to the information they require in order to make quantitative and qualitative statements about the current situation. And they have this access at a glance, and in real time, regardless of company size.

From cables to networks

The heart of an automated control system is the programmable logic controller (PLC). This is connected to the machine or system via sensors or actuators that are linked to the PLC inputs and monitor the processing stages.

Examples of sensors are temperature sensors, light barriers and limit stop switches. The actuators in turn are connected to the PLC to control the machine or system. Examples of actuators are contactors to switch on electric motors or electric valves.

Traditionally, in the field level, the signals are exchanged between sensors, actuators and control modules via parallel lines. Increasingly, however, fieldbus systems are being used to permit digital communication between the automation unit and the field devices via a single serial line. Accordingly, this reduces the requirement for cabling and input/output hardware, which brings significant cost savings.

The connection to higher-level control and management levels is represented via networks such as ethernet. Wireless communication systems such as WLAN make it possible, using a hand scanner, to scan product data on incoming goods, feeding the information into the production control system that follows these goods through the entire manufacturing system.

Benefits of 'smart' systems

'Smart' systems don't want holidays, never get sick, don't ask for pay rises and keep working 24 hours a day with minimal human intervention. Machine-to-machine (M2M) communication reduces the likelihood of human error as it is based on automated wired or wireless communication between mechanical or electronic devices. This allows networked machines to exchange information and perform actions without human assistance.

Physical conditions that can be monitored include temperature, fluid leaks, energy spikes, location, consumption, heart rate, stress levels, oxygen levels, light, movement, altitude, speed and many more.

Wireless carriers have partnered with service delivery platform providers to make their networks more accessible to M2M applications. Globally connected solutions can be created using wireless communications such as GSM, CDMA and satellites. Some of these connections occur over a relatively short range, some over many kilometres.

When looking at the advantages and disadvantages of wireless M2M applications, it is important to consider how the design factors of the data link can play a most important role in terms of real-time guarantees, energy efficiency, scalability, throughput, latency and reliability. Such varied design implications have increased the complexity of finding the ideal balanced and cost-effective solution across a wide range of diverse applications.

In the past, the effective polling, monitoring, storing and fusing of vast quantities of data coming from hundreds and sometimes thousands of network devices have been challenging. Now, with smarter devices, software and more reliable networks, new M2M applications are possible and reliable. The widespread availability and decreasing cost of wireless communication is making M2M applications more cost-effective to implement.

The key components of an M2M system are sensors, RFID, a Wi-Fi or cellular communications link and autonomic computing software programmed to interpret data and make decisions while remaining transparent to the user.

The most well-known type of M2M communication is telemetry, which has been used since the early part of last century to transmit operational data. Pioneers in telemetrics first used telephone lines - and later radio - to transmit performance measurements gathered from monitoring instruments in remote locations.

Currently, M2M does not have a standardised connected device platform and many M2M systems are built to be task- or device-specific. It is expected that as M2M becomes more pervasive, vendors will need to agree on standards for device-to-device communications.

The OPC Foundation is using the fundamental standards and technologies in the general computing market to adapt and create specifications that fill industry-specific needs.

OPC is all about open productivity and connectivity in industrial automation and the enterprise systems that support industry. Interoperability is assured through the creation and maintenance of open standards specifications. There are currently seven standards specifications completed or in development.

The first standard (originally called simply the OPC Specification and now called the Data Access Specification) resulted from the collaboration of a number of leading worldwide automation suppliers working in cooperation with Microsoft. Originally based on Microsoft's OLE COM (component object model) and DCOM (distributed component object model) technologies, the specification defined a standard set of objects, interfaces and methods for use in process control and manufacturing automation applications to facilitate interoperability. The COM/DCOM technologies provided the framework for software products to be developed. There are now hundreds of OPC Data Access servers and clients.

Automatic production processes mean automatic measurements

Full automation of production processes also has another facet: if you automate your production processes, then you can also automate your quality control.

By moving away from labour-intensive sampling and time-delayed analysis in the decentralised laboratory towards inline measurement, large improvements in productivity and efficiency can be achieved.

Not only are sensors available for measuring physical parameters such as flow and pressure, but also the parameters necessary for quality control; for instance pH, conductance, original wort, brix, turbidity, CO_2 and O_2 can all provide information in real time and even recognise trends and trigger corrective actions before the product goes out of specification.

With inline measurements and inline sampling you remove the two biggest risk factors in quality control - the human being and the statistically inconclusive random sample. And it's all done without interrupting the production processes, without significant product losses and, not least, without spending too much time or personnel input. All of which result in real economic advantages.

Even microbiological issues - so very important in the food sector - can be addressed using a sterile inline sampling system.

Smart systems are not prohibitively expensive and with wireless communications they do not have to be hard wired, so installation is also simple, flexible and affordable. ■

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Down and dirty with data

Significant manufacturing and business efficiency gains are possible by implementing automated systems but they won't be achievable unless the data they depend on is accurate and reliable.

Last year the GS1 Australia Data Crunch Report revealed that retailers are working with data that is inconsistent more than 80% of the time. And, over the next five years, Australian grocery retailers and suppliers are expected to experience over AU$350 million in profit erosion and AU$675 million in lost sales as a result of bad data. The total cost of bad data in the Australian grocery supply chain will be AU$1.035 billion over five years.

In the study, researchers compared data on grocery products held by three major supermarket retailers (Woolworths, Coles and Metcash) and matched this against product data from four major suppliers (Kimberly-Clark, Nestlé, Procter & Gamble and Unilever). It was prepared in conjunction with IBM and highlights the impact of bad data on profits and consumer service in the Australian grocery industry.

The study also showed that retailers and suppliers using data synchronisation through GS1net had significantly better data quality results than those who did not (fully) adopt data synchronisation. GS1net lets manufacturers and suppliers enter, validate, store and maintain product, pricing and other related trade information in a single location so it can be shared with their trading partners.

Achieving global data synchronisation

GS1 Australia and Nestlé Australia have trialled a Global Data Synchronisation (GDS)-based process which enabled Nestlé Australia to make its extended product data available to consumers on the new GS1 GoScan iPhone application that is launching in late 2012.

Incorporating the GS1 Global Data Synchronisation Network* (GDSN), the local GS1 data pools in Australia and the United States, plus Nestlé Australia's own databank in Australia, the end-to-end process is an example of GDS working seamlessly around the world to deliver trusted, high-quality and extensive product data to consumers, on demand.

Mark Fuller, Chief Operating Officer at GS1 Australia, says this is a world first for GS1 using GDSN for the benefit of consumers.

"To date, efforts in this space have been only pilots. Our project with Nestlé Australia is a significant milestone that demonstrates how advanced the GS1 GDS system is and how it can work at its best to enable us to advance and deliver trusted data to consumers," Fuller said.

Driving this project was Nestlé Australia's goal to make its extended product information available on the new GS1 GoScan application. GS1 GoScan is the first whole-of-industry endorsed application to deliver trusted extended product information to consumers, direct from the brand owners.

For Nestlé Australia, this data includes nutritional and ingredient information, allergen declarations and other consumer advice, dietary information and much more.

Nestlé Australia has been part of the GS1 GoScan project from the beginning, assisting GS1 Australia with the development of the application alongside industry associations, national health organisations, universities, major retailers, and other local and global food manufacturers.

"It's a huge accomplishment to see our product data appear on the GS1 GoScan app. It adds a new dimension to how we communicate with consumers and ensure they always have the most accurate and up-to-date information at their fingertips," said Mandeep Sodhi, B2B & Supply Chain Technology Manager, Nestlé Australia.

"Because we are a global company and our product information is held in various databanks around the world, the process was more complex," Sodhi said.

Nestlé Australia's product data is managed and maintained in SAP and Nutribank. Nutribank is an Australian database designed to assist the organisation manage detailed product composition and formulation data, such as ingredient lists, nutritional information, allergen declarations and other key product data. Nutribank data is integrated into Nestlé's global master data management platform.

Data is automatically loaded as part of Nestlé's existing GDS processes into 1SYNC**, the GS1 US data pool, from where it travels back to Australia to GS1net - GS1 Australia's data synchronisation data pool.

The data is validated for completeness and accuracy during Nestlé's label approval process and also when it is loaded onto GS1net, and then processed through to GS1 GoScan's database where it becomes available to consumers via the iPhone application.

"These systems and standards that form the foundation of GS1 GoScan have been used by the Australian industry for more than 14 years. GS1net is used by food, grocery, liquor and healthcare suppliers to share master product data with trading partners, retailers, government agencies and now consumers. More than 500,000 product records from almost 1400 suppliers are available on GS1net today," Fuller said.

Sodhi said working with GS1 Australia on this project has enabled Nestlé to further realise the benefits data synchronisation can bring to the organisation.

"With so many elements involved, we wouldn't have been able to achieve this result without the GS1 GDS standards, the support from 1SYNC and the dedicated work of the Nestlé, Nutribank and GS1 teams in Australia, and the Nestlé head office in Switzerland," he said.

"At Nestlé, good data is of great importance to us and is critical to the reputation of our brand and our products. From the start, we have been deeply committed to working with GS1 Australia to make GS1 GoScan a reality."

Dan Wilkinson, Vice President, 1SYNC said, "Nestlé's industry leadership in this effort will help others see the value in leveraging the GDSN for tangible business benefits. We're honoured to support Nestlé in achieving this important milestone and ultimately helping them leverage product data to maintain their exceptional brand reputation."

GS1 GoScan is expected to be launched in October 2012. GS1 Australia continues to work with brand owners to upload their data for use in GS1 GoScan and invites companies to participate for the benefit of consumers.

Automatic identification and data capture

Before you can synchronise your data you have to collect it. Automatic identification and data capture (AIDC) is a broad category of technologies used to collect information without manual data entry. AIDC systems can be used to manage inventory, delivery, assets, security and documents.

AIDC applications typically fall into one of a few categories: identification and validation at the source, tracking and interfaces to other systems. The actual technologies involved, the information obtained and the purpose of collection vary widely.

In the majority of cases, AIDC systems work without any human involvement. Where human involvement is required, this is normally confined to a user scanning an AIDC-equipped item (such as a can of food which is barcoded or an RFID-equipped door entry pass).

AIDC has advanced greatly over the years and it is now possible for users around the world to interact with millions of business processes and systems using AIDC-equipped electronic devices. Despite this, there is still room for improvement in supply chain visibility and development of internal business processes.

Current AIDC technologies

Barcodes

Since the invention of barcodes over 50 years ago, they have been widely used and are key to accurate data capture and facilitating the rapid movement of goods, and all types of automation.

Now, not only are there the well-known 1D barcodes and 2D barcodes, but 3D barcodes also exist. Unlike 1D and 2D barcodes, the bars in a 3D barcode are read by a scanner that reads the differences in the height of each line. Other types of barcodes are read by the variances in reflected light as the light scans the code. The 3D barcode scanner uses a laser that calculates the height of the barcode's lines based on the distance and time it takes for the laser to read it.

The labelling of items with 3D barcodes is called direct part marketing (DPM) and is used in situations where 1D and 2D barcodes are unsuitable. Limitations caused by high temperatures, chemicals and solvents that would easily destroy a barcode printed on paper or a sticker can be overcome with 3D barcodes.

Barcodes in common use are covered by international standards which include:

- rules for representing data in an optically readable format,
- rules and techniques for printing or marking,
- reading and decoding techniques, and
- rules for measuring the quality of printed/marked symbols.

Radio frequency identification

Radio frequency identification (RFID) is a technology that uses radio waves to transfer data between a reader and an electronic tag which is attached to a particular object. Typical uses are for object identification and tracking.

The use of RFID technology will, no doubt, continue to multiply as the use of barcodes has since their introduction over 40 years ago.

The major advantage of using RFID tags is that multiple RFID tags can be read at the same time, and they do not have to be visible, unlike barcodes which can only be read one at a time and need to be placed on the outside of items to be scanned.

Most RFID tags contain two parts: firstly, a circuit which stores and processes information and the other, an antenna for receiving and transmitting the signal.

Typically, two types of RFID tags are available: RFID tags which need to have a power source (active RFID tag) and RFID tags which do not need to have a power source (passive RFID tag) as they are powered by the RFID reader, at the time that the RFID reader reads the information from it.

Optical character recognition

Optical character recognition (OCR) is the electronic translation of scanned images typically handwritten, typewritten or printed text into machine-encoded text. This technique is often used to convert books or documents into electronic files, perhaps to computerise a record-keeping system or to publish the text on a website.

OCR makes it possible to edit the text, search for a word or phrase and store it more compactly. Further techniques can then be applied such as translation or text-to-speech recognition.

Smart cards

A smart card is typically a pocket-sized card that has a small chip attached which contains an integrated circuit. There are two categories of smart cards: memory smart cards, which contain non-volatile memory, and microprocessor smart cards, which contain volatile memory together with microprocessor components.

Smart cards are capable of providing identification, authentication, data storage and application processing. They are typically made of plastic and may be used to provide strong security authentication for single sign-on systems within large organisations.

The benefits of smart cards are directly related to the volume of information and applications that are programmed for use on a card.

Voice recognition

Voice recognition (or speech recognition) converts the spoken words to text. Voice recognition may also be used to refer to recognition systems that have been trained to a particular speaker. This is the case for most desktop (computer) recognition software - once the speaker has been recognised, it is simply a task of translating the spoken words of that particular person.

Speech recognition is a much broader classification and refers to technology that can recognise speech without being targeted at a certain speaker.

Speech recognition applications include voice user interfaces such as voice dialling, call routing, domestic appliance control, search, simple data entry, preparation of documents, speech-to-text processing.

Electronic article surveillance

Electronic article surveillance (EAS) is a technology used to identify items as they pass through a gated area. Typically, this identification is used to alert someone of the unauthorised removal of items from a store, library or data centre.

The underlying technology used in EAS is RFID and there are several types of EAS systems. In each case an EAS tag or label is affixed to an item. If the tag has not been deactivated before it passes through a gate an alarm sounds.

Often these days, an EAS tag is placed in the product at the time of manufacture or packaging,

which makes the labelling of goods unnecessary (in the store), saving time and money.

Real- time locating systems

Real-time locating systems (RTLSs) are typically fully automated systems that continually monitor the positions of objects and personnel.

An RTLS will often use battery-operated RFID tags and a mobile network-based locating system to detect the location and presence of the tags. The locating system will usually be deployed as a matrix of locating devices installed at a spacing of anywhere from 15 to 300 m. These locating devices determine the locations of the RFID tags.

RTLSs continually update a central database with current RFID tag locations at a predefined time setting.

Magnetic strips

A magnetic strip, typically found on a magnetic stripe card, is capable of storing data by modifying the magnetism of small iron-based magnetic particles on a strip of magnetic material. The magnetic stripe, sometimes called a swipe card, is read by physical contact and swiping past a magnetic reading head.

A number of international organisation standards (including ISO/IEC 7810, ISO/IEC 7811, ISO/IEC 7812, ISO/IEC 7813, ISO 8583, and ISO/IEC 4909) define the physical properties of the card, including size, flexibility and location of the magnetic strip, its magnetic characteristics and data formats.

Typical magnetic strip usages are for access control, ID cards and key cards (used to operate locks and storing a physical or digital signature which the door mechanism accepts before opening the lock, sometimes also containing an RFID proximity tag).

Biometrics

Biometrics is typically involved in establishing people's identities using a biometric template of the individual.

Biometric systems can work under two modes: biometric verification and biometric identification. In the former, a one-to-one comparison of a captured biometric with a stored template is used to verify identity. Whereas in the latter, the captured biometric is compared against a database in an attempt to identify a known or unknown individual.

The first time an individual uses a biometric system they have to enrol, during which time biometric information from the individual is stored.

Typical biometric systems include fingerprint recognition, face recognition, palm print recognition and iris recognition (which has, in the main, replaced retinal recognition). ■

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**The Global Data Synchronisation Network enables companies to connect and communicate with their trading partners and improve the accuracy and efficiency of their collaboration. Using GS1 GDSN-certified data pools such as GS1net and 1SYNC, companies register and synchronise supply-chain information through the GS1 Global Registry, which serves as a centralised information directory. The elimination of informational inaccuracies helps companies achieve a wide range of business benefits, including reductions in out-of-stocks, incorrect deliveries, purchase order/invoicing errors and transportation costs.*

***1SYNC, the largest certified data pool in the Global Data Synchronisation Network, is dedicated to the implementation of standards-based, global supply chain solutions. 1SYNC offers a robust, easy-to-use solution that can reduce costly data errors and increase supply chain efficiencies for companies of all sizes. The growing 1SYNC community consists of 60 leading recipients and more than 7000 suppliers worldwide. These customers are synchronising product data on more than six million items in the GDSN.*

Implementing OEE measures
in the packaging hall to achieve operational excellence

Executive summary

On average, plants waste up to 40% of their capacity through stops, speed losses, interruptions and defects - yet managers often don't know the reasons causing the downtime. Nor do they know the factory's true performance, or how to improve it.

Implementing overall equipment effectiveness (OEE) measurement tools gives a much clear understanding of where improvements can be made. OEE is a globally recognised best practice measure to systematically improve processes for higher efficiencies and better productivity - ultimately leading to lower manufacturing costs and higher profitability.

This application paper examines OEE metrics and how to capture them. Not only must this data be captured, but performance data needs to be available in real time to everyone: operators, maintenance personnel, supervisors and managers.

iDSnet Manager provides an overall framework for capturing data that can feed into overall OEE metrics. iDSnet Manager can also feed data to production floor scoreboards for visual OEE and to the production office in the form of live dashboard reports. These reports show in-depth, real-time production-line performance monitoring, giving actual production efficiencies, including idle times and breakdowns, plus reporting on what's causing production stoppages.

What is OEE?

OEE - or overall equipment effectiveness - is a global best practice measure to monitor and improve the effectiveness of manufacturing processes (that is, machines, packaging halls, assembly lines, and so on).

OEE is frequently used as a key metric in TPM (total productive maintenance) and lean manufacturing programs to deliver operational excellence. It gives manufacturers a consistent way to measure the effectiveness of TPM, and other initiatives ('six sigma' and 'world-class manufacturing'), by providing an overall framework for measuring production efficiency.

OEE takes into account three factors:

1. Quality
2. Speed
3. Downtime

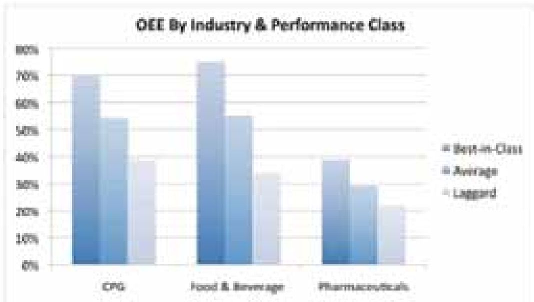
It is simply the ratio of fully productive time to planned production time. In other words, it represents the percentage of production time spent making good pieces (no quality loss), as fast as possible (no speed loss), without interruption (no downtime loss).

OEE benchmarks

As a benchmark, what is considered a 'good' OEE score?

- An OEE score of 100% is perfect production: manufacturing only good parts, as fast as possible, with no downtime.
- An OEE score of 85% is considered world-class for discrete manufacturers. For many companies, it is a suitable long-term goal.
- An OEE score of 60% is fairly typical for discrete manufacturers, but indicates there is substantial room for improvement.
- An OEE score of 40% is not at all uncommon for manufacturing companies that are just beginning to track and improve their manufacturing performance. It is a low score and, in most

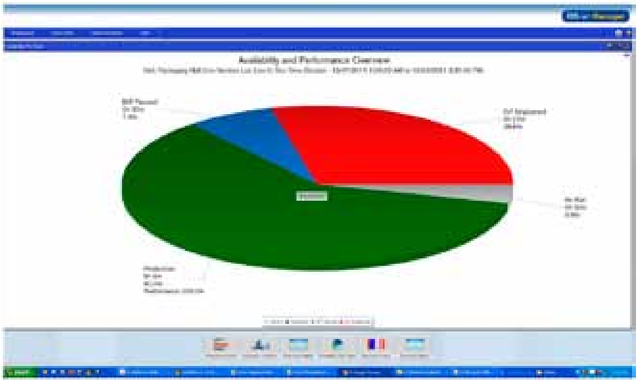
Industry specific OEE benchmarks



	Best in Class	Middle 50%	Laggards
Food & Beverage	77.7%	61.7%	42.4%
CPG	82.0%	54.9%	29.9%
Industrial	89.9%	55.5%	41.8%
Pharmaceutical	45.2%	30.8%	23.5%

Source: http://www.informance.com/benchmarks/

Benchmark your OEE score against industry standards for discrete manufacturing and strive for world-class results. Source: http://www.leanproduction.com/oee.html



The above iDSnet Manager dashboard provides production efficiency, performance, planned downtime, unplanned downtime as well as no run time. (Panned D/T: 7.3%; Unplanned D/T: 28.8%; No Run: 3.9%; Production: 60%; Performance: 132%)

The above iDSnet Manager dashboard provides information on causes of unplanned downtime assigned by the operators via reason codes.

cases, can be easily improved through straightforward measures (eg, by tracking downtime reasons and addressing the largest sources of downtime - one at a time).

Why should you measure OEE?

“You cannot manage what you cannot measure.” - Bill Hewlett, Co-founder of Hewlett-Packard

With global organisations looking to achieve higher manufacturing efficiencies by consolidating operations and encouraging lean manufacturing, measurement has become critical because the operation’s survival depends on the success of these programs.

Even the most basic manufacturing operation is extraordinarily complicated. Factories have thousands, perhaps millions, of variables moving around at the same time. Just about every event has multiple drivers. Actions taken to optimise one variable often come at the expense of another. Performance metrics at the activity level can be traded off against other performance measures. Labour efficiency can be increased to the detriment of quality; machine utilisation can be maximised in the short term to the detriment of machine life; delivery performance can be increased to the detriment of inventory levels and overhead expenses … and so on.

Management cannot possibly measure thousands of variables with equal attention and diligence. When one or two are elevated to the top - and treated as overall process outcome metrics rather than event metrics - then the motivation to optimise those few variables is created. However, this is usually to the detriment of variables that are not elevated to high-level status.

Your performance measurement system should:

- provide timely feedback to determine the operation’s successes,
- determine improvement areas, and
- enable quick decision-making.

OEE measurement does just that.

How can you measure OEE?

The industry-standard OEE metric is defined as follows: Availability x Performance x Quality and is designed to quantify stoppages, speed losses and wastage.

The diagram below shows the required measurements to enable the OEE calculation.

Plant Operating Time: is the amount of time the facility is open and available for equipment operation.

$$Availability = \frac{Actual\ Running\ Time}{Planned\ Machine\ Production\ Time}$$

Planned Machine Production Time: is the amount of time you intend to run production (plant operating time minus breaks, lunch, scheduled maintenance, or periods where there is nothing to produce).

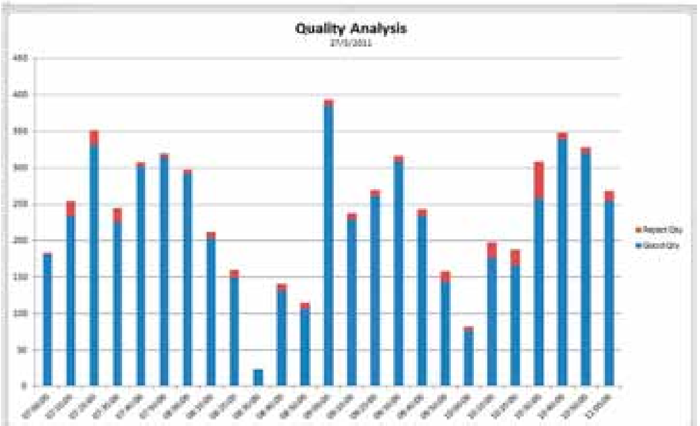
Actual Running Time: the amount of time the plant or line actually runs (planned machine production time minus stoppages).

Stoppages (breakdowns, set-up and adjustments): these include any unplanned downtime, such as equipment failures, breakdowns, material shortages, changeover time, adjustment time, warm-up time and so on.

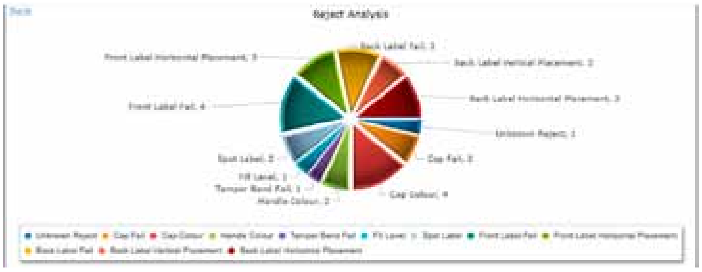
$$Performance = \frac{Actual\ Production\ Rate}{Machine\ Production\ Rate}$$

Machine Production Rate: is the plant’s stated potential, or Ideal Cycle Time, being the theoretical fastest possible time to manufacture one piece. When multiplied by Total Pieces, the result is Net Operating Time - the theoretical fastest possible time to manufacture the total quantity of pieces.

Actual Production Rate: is the actual time that the plant or line is producing goods.



This chart includes a bar chart showing the Production Count for each timeblock across the selected period split into Good Count and Reject Count (via iQVision system).



Clicking on one of the Reject sections of the Quality Analysis chart above expands it to show a breakdown by each Reject code.

Speed Loss (small stops and reduced speed): this includes loss due to obstructed product flow, rough running, under nameplate capacity, under design capacity, machine wear, substandard materials, misfeeds, cleaning, checking and operator inefficiency.

$$Quality = \frac{Good\ Parts}{Pieces\ Produced}$$

Pieces Produced: is the total number of goods produced.

Good Parts: is the total number of 'good' items produced (without rework) that can be shipped to the customer.

Wastage: goods that need to be re-run, need rework, received in-process damage, expired in process, were assembled incorrectly and so on.

Quality takes into account Quality Loss, which accounts for produced pieces that do not meet quality standards, including those needing rework.

The remaining time is called Fully Productive Time.

Out of all the above metrics, Quality is probably the hardest to measure and quantify. This is only because product is often re-run while on the line and therefore small wastage is hard to measure, as opposed to an entire batch being re-run, which is far more likely to be captured.

Rejects that are scrapped and not re-run is real Wastage.

The goal is to maximise Fully Productive Time.

How can iDSnet Enterprise and Manager capture OEE measures?

iDSnet Enterprise captures data from all coding and labelling machines, as well as all other end-of-line equipment such as vision systems and scanners, and has the potential to collect data from other packaging equipment on the production line. iDSnet thus has a count of every primary product, every carton and pallet via the network, while vision systems and scanners help capture the measurement's quality aspect. Vision inspection checks elements like code presence, label position, tamper seals, label match, barcodes and so on, to ensure that the product is shelf ready. They can also verify that cartons have the right number of products, if orientation of products is correct, etc. Scanners check if all barcodes are scannable, hence avoid products being rejected by the customer (or distribution centre).

Target run rates are easily set up in iDSnet Manager, hence it is easy to track production in real time versus the targets.

Measuring 'downtime' not enough

It is not only important to know how much unplanned downtime your process is experiencing (and when), but also to be able to attribute the lost time to the specific source or reason for the loss (tabulated through reason codes). With downtime and reason-code data tabulated, root-cause analysis can be done, beginning with the most severe loss categories. iDSnet Manager allows the operators on the line to immediately select and put in fault codes/reason codes easily to assign the unplanned downtime, which ultimately helps in analysing the root cause.

Micro stoppages and reduced speed are the most difficult to monitor and record. iDSnet automatically records them. Companies can set parameters of what a micro stoppage is and what needs to be accounted for with reason codes that the operators can easily enter via a communication interface module (CIM) on the production line.

Eliminating unplanned downtime is critical to improving OEE: other OEE factors cannot be addressed if the process is down.

Tracking set-up time is critical to reducing loss, together with an active program to reduce this time. By networking all coding, labelling and other devices back to a central database, product changeovers are effected down an entire production line with one simple operator action - thus reducing set-up time.

iDSnet can differentiate start-up rejects and production rejects via reason codes, since often the root causes are different between initial and steadystate production. Parts needing rework of any kind should be considered rejects and can easily be picked up by scanners or vision systems. Tracking when rejects occur during a shift and/or job run can help pinpoint potential causes and, in many cases, patterns will be discovered.

Categorising data makes reject analysis much easier. A key goal should be fast and efficient data collection, with data put to use throughout the day and in real time. This is exactly what iDSnet is designed to do.

Acceptable tolerance levels can be set up in the system, and if the reject rates go over the limit, an alarm can be raised or the line can be stopped. This gives operators the ability to take immediate action when there is a major quality issue, such as the wrong label roll has been loaded, so all products have the wrong label.

iDSnet Manager helps in the realm of 'Continuous Improvement', and aids the faster flow of value by providing greater visibility of production data and product flow in the packaging hall in real time through OEE metrics, charts and reports.

Scoreboards

iDSnet Manager produces live dashboards, with in-depth, real-time production-line performance monitoring. It gives actual production efficiencies, including idle times and breakdowns, plus detailed reports on what's causing production stoppages.

Along with these reports, iDSnet Manager connects with shop floor scoreboards for visual OEE. This real-time information makes operators and line supervisors instantly aware of current production efficiencies against known targets, as well as alerting them to issues, allowing the operators or managers to quickly address the issues and avoid any significant productivity losses.

The scoreboards are set up such that the data in green means set targets are being met, orange denotes warning while red data reflects that performance is below targets.

This can be used to encourage competitiveness between lines and shifts leading to better performance from the shop floor.

Summary

Unplanned factory downtime impinges on profit. Measuring 'downtime' is a beginning, but to really improve productivity, the plant must understand the reasons for each and every occurrence. Implementing OEE gives everyone in the factory a much clearer understanding of where these improvements can be made. iDSnet collects and analyses data quickly and efficiently, putting it to use throughout the day and in real time.

iDSnet Manager does this by providing real-time reports and dashboards, as well as storing the data for historical analysis. The customised, web-based dashboards and reports give plant managers visibility and insight into production efficiencies, by date, by line and so on.

iDSnet Manager:

- provides real-time feedback to enable quick decision-making,
- highlights improvement areas, and
- determines the operation's successes.

It gives operators and managers the ability to take immediate action to reduce downtime, as well as the confidence to make long-term strategic decisions to improve productivity based on the historical data by eliminating unplanned downtime.

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Matthews Intelligent Identification Pty Ltd

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Matthews
INTELLIGENT IDENTIFICATION

About Matthews Australasia

Matthews Australasia, a family business, is Australia's leading provider of intelligent product identification and product-traceability solutions. Whether your application is for a basic date code or batch code on a product or a sophisticated integrated solution requiring the design and install of networked hardware and software systems, Matthews will have the right solution for you.

Right Product

We are a full-line supplier, providing all coding and labelling technologies as well as quality assurance. Our extensive range includes laser coders, small character continuous inkjet (CIJ), large character drop on demand inkjet (DOD), high resolution inkjet, thermal transfer overprinters (TTO), label print and apply (LPA), label applicators and desktop barcode printers. We also have barcode scanners and machine vision inspection solutions. We carry this wide range of technologies in order to provide you with a solution that best fits your application and production environment.

Quality Assurance

Machine vision inspection solutions can inspect packaging quality and aid process control to ensure any products that are not shelf-ready are rejected or redirected. This guarantees that only products that meet all the quality criteria are shipped to your customer to avoid recalls.

iQVision (www.iqvision.com.au) is a Matthews Australasia affiliated is a dedicated visions solution provider.

Read more about:

Avoiding Recalls Due to Packaging Faults

Compliant SSCC Pallet Labelling

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