# FOCUS ON...
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# CONTENTS




**IMPRESSUM**

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# DEAR READER!

Welcome to the latest issue of Focus ON digital magazine! This issue focuses on machinery, equipment and innovations in the printing and packaging industry. And here you'll also find the continuation of the design/packaging article from the previous issue. In the ever-changing world of the sector, it is vital to keep up with the latest technological developments and industry innovations. Our aim is to provide a comprehensive overview of industry trends, cutting-edge manufacturing solutions and showcase the machines that are revolutionising printing and packaging.

The magazine covers new technologies, machines, materials and their applications to help you make the best decisions, whether it's a new investment or an increase in production efficiency. Discover the latest industry innovations and stay up to date with the future of the printing and packaging industry!

**WISHING YOU USEFUL READING!**

**LASZLO CSABA**
editor-in-chief

PACK MARKET

# PLASMA AND CORONA TREATMENT TECHNOLOGIES AND MACHINERY

In the modern printing and packaging industry, surface preparation plays a critical role in ensuring the quality of prints. Various surface treatment processes are required to achieve proper adhesion of inks and adhesives on the surface of materials, especially plastics, metals and composites. Among these, plasma and corona treatment technologies are the most commonly used methods, which allow to increase the energy of the material surfaces during the printing and laminating processes, thus optimising the adhesion properties of the surface.

## THE PURPOSE OF SURFACE TREATMENT: TO IMPROVE ADHESION

Many materials, particularly polymers (such as Polyethylene and Polypropylene), have low surface energy, which prevents inks and adhesives from adhering properly. However, by increasing the surface energy, the contact between the surface and the ink can be significantly improved, thus ensuring the durability of the print. Plasma and corona treatment increases the surface energy of materials without damaging the structure of the material.


## CORONA TREATMENT TECHNOLOGY

Corona treatment uses a high voltage electrical discharge that changes the surface properties of the material, increasing the surface energy. The ionised air created by the corona discharge increases the surface polarity of the material, which improves the adhesion of inks and adhesives.

## THE CORONA TREATMENT PROCESS

The following steps take place during corona treatment:

- **Application of high voltage**
  a discharge created between a high voltage electrode and a grounded cylinder ionises the air.

- **Oxidation processes**
  the ionised air oxidises the surface of the material, increasing its polarity and wetting properties.

- **Surface energy increase**
  oxidation processes result in a surface with improved adhesion properties.

## BENEFITS AND APPLICATIONS

Corona treatment has many advantages:

- **Fast and efficient treatment**
  corona treatment can treat large surfaces quickly and cost-effectively, making it perfect for continuous production processes.

- **Wide range of applications**
  widely used to prepare packaging materials such as films, plastics and papers, and to improve the adhesion of inks and adhesive layers.

## CORONA TREATMENT OF DEGRADABLE (PLA) FILMS

Tests carried out by Ferrarini & Benelli Srl. show that PLA material has good reactivity to impact of corona treatment process. The level of surface tension achieved is quite high, which means good wetting properties. The tests also show that the wettability of the PLA material cannot be further increased after a certain value is reached, even with higher power input.

Treatment with aluminium electrodes requires a lower power factor than ceramic electrodes (25% lower power).

However, plasma torch treatment proved to be impractical due to the very high temperature of the plasma discharge, which deforms the material.

At the Drupa 2024 trade fair, the focus of the Ferrarini & Benelli's booth had on a new treatment system, Format, which allowed visitors to test samples that they brought in live. Format is a corona treatment system designed and manufactured to treating of different sizes and thicknesses. This equipment efficiently handles the lightest and finest sheets without the risk of jamming.

> "Our aim was to show the difference in adhesion increase before and after treatment"
>
> – says *Ms. Benedetta Pedrini.*

## SOME TYPES OF EQUIPMENTS FOR CORONA TREATMENT

- **RotoTEC and Corona Plus series**
  These machines are compact and extremely versatile, suitable for handling a variety of materials such as films, foils and fabrics.

- **Vetaphone Corona machines**
  Vetaphone machines are specialised in handling a wide variety of materials and are optimised for applications that require high-speed production, such as the printing and packaging industry.

- **Ferrarini & Benelli Srl.**
  Since 1965, the company has been designing and manufacturing corona and plasma treatment systems for extrusion, printing and laminating, aimed at improving printing and adhesion processes. In particular for a wide range of plastic substrates for flexible packaging.

- **Cason Elettrotecnica S.r.l.**
  is an Italian family business that has been designing and manufacturing corona treatment, antistatic and electrostatic systems since 1984. With over 40 years of experience, they specialise in the treatment of plastics, papers and textiles.

## PLASMA TREATMENT TECHNOLOGY

Plasma treatment, like corona treatment, increases surface energy, but unlike relying on the ionisation of air, plasma treatment uses a controlled gas mixture that allows precise adjustment of treatment and precise manipulation of surface properties. This treatment is particularly useful when the material requires special surface treatment, such as biocompatibility or chemical resistance.

## SOME TYPE OF MACHINES FOR PLASMA TREATMENT

- **Diener and PlasmaTreat equipments**
  These machines provide high quality surface treatment and work with different plasma mixtures to meet specific needs.

- **Plasmaster series**
  These machines are ideal for laboratory and industrial applications, as they are optimised to treat a wide range of materials and surfaces.

Pioneers of the atmospheric pressure plasma process since 1995, Plasmatreat's Openair-Plasma® systems are used in a wide range of industries such as mobile phone manufacturing, automotive and packaging. These systems improve surface adhesion, cleanliness and other properties, promoting quality production and reducing waste.

## THE PLASMA TREATMENT PROCESS

Plasma treatment involves the following steps:

- **Gas ionisation**
  Plasma is formed by the ionisation of specific gases (such as oxygen, argon or nitrogen), which bombard the surface of the material with high-energy particles.

- **Surface oxidation and creation of functional groups**
  Plasma particles modify the surface molecules of the material, oxidising them and creating new functional groups. This improves polarity, increases adhesion and allows the application of durable inks, coatings.

- **Increased surface energy and biocompatibility**
  Plasma treatment is beneficial for biocompatible materials such as medical devices or sensitive surfaces.

## BENEFITS AND APPLICATIONS

Plasma treatment is particularly suitable in areas where a more precise and durable surface treatment is required:

- **Treatment of special materials**
  Plasma treatment allows surface preparation not only of plastics, but also of glass, metal and composite materials.

- **Selective treatment**
  Capable of treating specific areas without modifying the entire surface, it is also optimal for the electronics and medical industries.

- **Long-lasting effect**
  Plasma-treated surfaces provide a more durable adhesion, which is particularly beneficial for durable printed and laminated materials.

## COMPARISON OF CORONA AND PLASMA TREATMENT

| FEATURE | CORONA TREATMENT | PLASMA TREATMENT |
|---|---|---|
| Increase of surface energy | Fast, excellent for large surfaces | Allows precise, selective surface modification |
| Compatibility of materials | Plastics, films | Plastics, metals, glass, composites |
| Process cost | Cost-effective for high-volume production | Recommended for more expensive, special and delicate surfaces |
| Durability | Shorter term (lasts weeks or a few months) | Long lasting effect, long term stability |

Both corona and plasma treatment are effective methods for increasing surface energy, but they offer different application benefits

## CONCLUSION

Preparation of surfaces is essential to ensure high quality and long-lasting prints. Corona and plasma treatment technologies offer the possibility to increase surface energy and improve adhesion properties, which contribute to better bonding of inks and adhesives and thus more durable prints and laminates.

# BEFORE START DESIGNING THE PACKAGING...

The packaging represents the whole brand. It informs the customer about the product, but also associates the product as part of the brand. So the product and the brand should be linked on the packaging. This requires the brand logo.


**TIP**

Use a good quality vector file to avoid pixelation!

## COLOURS

In addition to the logo, there are probably a handful of colours associated with the brand. Echoing these colours on your packaging is a great way to quickly convey your brand presence. Using the same colour palette across the store, product, website and packaging is an essential element of brand consistency.

## FONTS

Fonts are tricky, as a brand's logo is often nothing more than its name in a particular font. But you may use a particular font to differentiate your products from those of your competitors on your product packaging. In this case, it is known exactly what the ideal weights and spacing are. You should also make sure that the font has the necessary native characters. For example ę, ¿, ß, œ and so on.

To read the first part of our article on design / packaging design **click here!**

## OTHER IMAGE ELEMENTS

Do you use a special logo for products for different countries or markets?

These small elements are often overlooked, but in fact the overall image determines the overall design.


## DESIGN INSPIRATIONS

### INNOVATIVE PACKAGING

Whether it's "traditional" or sustainable packaging, innovative product packaging helps showcase your brand's ingenuity and creativity. Transparent windows to show off your product will always be interesting!

Reusing packaging is also a great way to innovate and extend its life. It also brings the brand message and logo to the customer's eye again and again.

### MINIMALIST DESIGN

Minimalism is a design movement originating in Scandinavia and Japan that favours bare forms where nothing is removed at the expense of functionality.

From craft beer branding and wine bottle cans to e-commerce shipping boxes, minimalism is a versatile and popular design trend. It's an easy design concept to implement and a great way to reduce design costs. Take a cardboard box with a "handwritten" logo as an example.

### DESIGN INSPIRED BY THE VINTAGE AESTHETIC

The term vintage is difficult to define. In the case of packaging, it is a channelling of design elements that were prevalent in the late 19th and early 20th centuries. Vintage packaging is a clever way of saying to customers: "We are the brand your grandparents loved".

Many men's cosmetics also go down this route, as it appeals to the 'masculinity' of the man. Part of this image conveys the confidence that comes from decades of operation and the sale of proven, high-end and popular products.

In turn, foods such as chocolate, tea and coffee are regular users of the vintage aesthetic, sometimes with modern, contemporary overtones. Vintage design evokes nostalgia and gives an immediate impression of tradition and craftsmanship.

## PHYSICAL PACKAGING

The physical form of product packaging is as important as its graphic design. There is no point in creating great packaging for products if it does not actually keep the product safe. Keeping the contents of the package secure is key, whether you are distributing in a local retail store or sending the product halfway around the planet.

## CULTURALLY INSPIRED DESIGN

Using shapes, patterns and images that are linked to the culture of a region or a group of people is a great way to appeal to this market. Limited editions and products associated with cultural celebrations are very well suited to packaging with this theme.

## CONTEMPORARY DESIGN AND PACKAGING

The term contemporary is difficult to define, but in its simplest form it is a trend or fashion, wit and humour that is happening here and now.

## CREATING THE UNBOXING EXPERIENCE

Materials, design, shape - the most fundamental parts of custom packaging design. They help to create the unboxing experience.

Unboxing is a process that the customer goes through when they first encounter the product. This is when the attention to the product (and the brand) is at its highest. Which gives it the opportunity to make a great first impression - a powerful marketing channel, an aspect that can give the brand the professional image it needs to survive and grow.

## BRAND LOYALTY

If your brand offers value and delivers products that solve customers' problems - they will remember. Which is where the unboxing experience plays a big part in building brand loyalty.

Packaging design plays a key role in increasing brand awareness and product success. Well-designed packaging not only protects the product, but also makes it visually appealing to consumers. Packaging gives a first impression of the brand and influences the consumer's decision.

With the rise of digital marketing and social media, packaging is increasingly becoming an integral part of a brand's communication strategy. Consumers can easily share products with attractive packaging on social media sites, so packaging has a direct impact on a brand's online presence and awareness.

Overall, packaging design not only serves to ensure that the product reaches the consumer safely, but also plays a key role in brand building. Creative, well-designed packaging can help brands capture consumer attention, influence purchase decisions and increase awareness.

# PREPRESS SOLUTIONS, SOFTWARE

The preparation process plays a crucial role in the printing industry, as correct preparation ensures smooth implementation of designs, quality of prints and optimisation of production costs. Preparation includes graphic design, image processing, colour management, preparation of print files and final proofing. In the modern printing industry, this process is supported by a range of software and technologies designed to support each stage of the work accurately and efficiently.


## THE MAIN STEPS IN THE PREPARATION FOR PRINTING

Pre-press consists of several key steps. These include the design process, image processing, colour resolution, file checking and proofing. These steps and the main software used at each stage are described below.

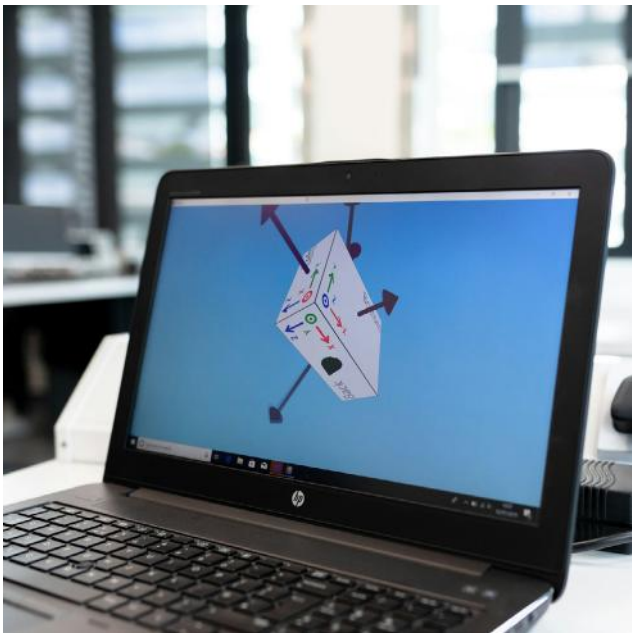
## DESIGN

The first step in the preparation for printing is graphic design. This is the phase where the graphic designer designs the materials to be printed, such as posters, books, packaging or brochures. Software that offers versatile options for managing graphic elements, text and images is needed here. Esko's ArtiosCAD software offers solutions for this. From the design of a stencil to 3D visualisation. Alternatively, 3D visualisation can later be a complementary solution to soft proofing. And for the design of the logistics of the finished packaging, Esko's CapePack software. Other popular software used in the design process:

- **Adobe InDesign**
  Adobe InDesign is one of the most popular publishing software, widely used for designing magazines, books and brochures. It is one of the most widely used in the world for layout of text and image content, and also offers advanced typographic tools.

- **Adobe Illustrator**
  Its vector format allows graphics to be scaled without loss of quality, making it particularly useful when accurately scaled graphics are required in the printing process.

- **CorelDRAW**
  CorelDRAW is also popular, especially with smaller printers, for example in logo design and packaging graphics. The software is easy to use and offers a number of export options to easily create the file formats needed for printing.



## IMAGE PROCESSING

Image processing is also an essential part of the prepress process, as images need to be sharp, detailed and appropriately coloured. The most important software used for image processing are:

- **Adobe Photoshop**
  Adobe Photoshop is perhaps the best-known image editing software, providing a range of options for manipulating, sharpening, colouring and retouching images. Photoshop is excellent for optimising the resolution, colour and sharpness of images, which is essential to ensure print quality.

- **Affinity Photo**
  Affinity Photo is a relatively new software that offers a wide range of image editing features and can be an alternative to Photoshop. It is also suitable for print image editing work such as colour correction, image sharpening and image retouching, and the latest version of the free image editing program GIMP has recently been released.

## COLOUR MANAGEMENT

Accurate colour management is one of the most important steps in the prepress process. In order to accurately reproduce colours on printed materials, colour resolution must take into account the printing technology and the type of paper or another substrate used.

- **Adobe Acrobat Pro**
  Adobe Acrobat Pro can help not only in the category of PDF rendering, softproof checking, but also to some extent in post-editing. But for more in-depth editing of PDF, it should be complemented with Enfocus' PitStop plugin.

- **Esko ArtPro+**
  Esko ArtPro is a software specifically developed for the packaging industry, providing complex colour resolution and soft proofing functions. Esko's software is capable of optimising colour profiles, colour correction and supports the accurate adjustment of special colours such as Pantone colours.

- **GMG ColorProof**
  GMG ColorProof is one of the most accurate proofing software on the market, allowing to verify the colours with confidence. It helps ensure the desired color reproduction is achieved during printing.


## PRINT FILE PREPARATION AND PDF MANAGEMENT

Material for print is usually prepared in PDF format, as this format supports high resolution and print specifications such as colour profiles, resolution and crop marks. The software used to prepare and check the files are:

- **Enfocus PitStop Pro**
  PitStop Pro is a plug-in for Acrobat software specifically designed to check and enhance PDF files. Developed by Enfocus, PitStop allows automatic error correction and customization of PDF files, so that problems encountered during prepress can be quickly resolved.

- **Callas pdfToolbox**
  is also a useful tool for preparing PDF files, offering advanced checking and correction functions and allowing to optimise PDFs for printing.

## PROOF PREPARATION AND VERIFICATION

The proof, or pre-print proof, is an opportunity to check designs before they are sent to live production. During proofing, colours, graphics and layout are checked to ensure they meet the client's expectations and printing requirements.

Print proofing is an essential step in ensuring quality printing. The proof helps to verify that the final printed material - colours, text, graphics - will appear exactly as envisioned during the design process. The proofing process allows to catch errors before production, avoid costly repairs and ensure customer satisfaction. This process consists of two main steps: soft proofing and hard proofing.


The advantage of soft proofing is cost-effective, fast and easy to share digitally, but it is not a substitute for printed proofs, especially for colour-critical work, as monitor colours can differ from the exact appearance of print colours.

## SOFT PROOFING: MAKING A DIGITAL PROOF

Soft proofing is a digital version of the proofing process, where the proof is displayed on a screen (monitor or tablet) rather than printed. It is fast, cost-effective and easy to share with the client, especially over long distances. The following software is used for soft proofing:

- **Adobe Acrobat Pro**
  Adobe Acrobat Pro has Proof Setup and Output Preview tools that allow you to view and simulate color profiles. In Acrobat, you can also check CMYK colours and custom colour profiles, which will show you how colours will appear in print.

- **GMG OpenColor**
  GMG OpenColor software offers the possibility to create accurate colour previews that simulate the effects of different printing technologies and materials. It is particularly useful in the packaging industry where a wide variety of substrates need to be printed.

- **Soft-Proof systems for monitors**
  To be effective, soft proofing requires calibrated, high colour accuracy monitors such as those from Eizo and NEC. These monitors are able to accurately display the colours and details that need to be taken into account during prepress.

## HARD PROOFING: PRODUCING A PRINTED PROOF

Hard proofing is the production of a physical print that can be touched and held in the hand, thus providing a true representation of the colour and quality parameters of the final print. Hard proofing uses the following tools and software:

- **GMG ColorProof**
  is an industry standard for the creation of colour proofs. The software can handle different printing colour profiles, accurately simulating the colours of the printing process. It is particularly useful in cases where Pantone direct colours or other special colours need to be used.

- **EFI Fiery XF**
  is another professional proofing software with wide colour profile support and fast proof printing. And it is optimized not only for proofing, but also for full large format and industrial printing. The software can simulate different printing technologies and allows fine-tuning of colour, contrast and detail.

- **Epson Proofing Printers**
  Epson printers (such as the Epson Stylus Pro series) and proofing printer systems are specifically designed for hard proofing and have accurate colour management. These printers use special proof papers that simulate the surface of the print substrate to help accurately reproduce the look of the final print.



## PROOF CHECKING: QUALITY ASSURANCE AND APPROVAL

The final step in the proof production process is the verification of the proof and the approval of the client. This step ensures that the final proof is in line with the original design and the client's expectations. The following aspects are taken into account during proof checking:

- **Colour accuracy**
  The colours of the proof must match the colours of the designed print, with particular attention to colour profiles and colour resolution. Calibrated proof printers and colour grading monitors help in this check.

- **Resolution and detail**
  The sharpness of images, the detail of graphic elements and the appearance of typography are all important when checking proofs. Low resolution images and inaccurate details can be detected and corrected at this stage.

- **Cut marks, run-outs and margins**
  The proof check should take into account the exact positioning of cut marks, run-outs and margins. These adjustments are essential to ensure accurate cutting and final size.

- **Fonts and text formatting**
  Proofing should check the correctness of fonts, text size, positioning and legibility to ensure that it matches the original design. Incorrect formatting and missing letters can be detected at this stage.

Once the proof has been approved by the customer, the printing process can begin. The approved proof documents the quality expected by the customer and the final appearance of the finished material, so the printer will produce the entire run exactly as expected. The accepted proof is therefore an important quality assurance document that can be referred to at any time when reviewing the quality of the finished material.

The production and checking of the proof is a key step in the prepress process, ensuring that the finished print meets the customer's expectations, both in terms of colour reproduction and quality. Soft proof and hard proof processes complement each other, while the use of software and tools allows errors to be detected and costs to be reduced. Quality proofing and its control not only increases the efficiency of the printing process, but also ensures customer satisfaction and accuracy of the final result.

Pre-press is the process of preparing designed materials for printing to ensure they are produced to the desired quality and efficiency. Prepress solutions and software help automate design processes, digitise materials and prepare them for printing. If automation and collaboration are also a consideration, then the Esko Automation Engine platform is definitely worth mentioning, as it can be an important player in building up print processes, increasing speed and efficiency.

These solutions ensure the efficiency of printing processes, reducing errors and costs while speeding up workflows and improving the quality of the end result.

We would like to thank **Partners Ltd.** for their assistance in the preparation of this article.

# INNOVATIONS IN PRINTING PLATE TECHNOLOGY

Printing plate technology has undergone a number of revolutionary innovations in recent years, which have not only increased production speed and print quality, but have also brought more environmentally friendly solutions to the industry. New materials, digital technologies and developments in sustainability are all contributing to making the printing process faster, more accurate and cost-effective. This article discusses the innovations that are changing the traditional practices of producing and using printing plates.

## DIGITAL PRINTING PLATE MAKING TECHNOLOGIES

One of the most significant advances in pre-press is the emergence of digital printing plates, which allow traditional film and chemical-based development processes to be abandoned. The Computer-to-Plate (CTP) process offers a number of advantages such as faster plate preparation, reduced potential for errors and excellent accuracy.

## LASER ENGRAVING

Laser engraving technology allows for high precision digital works. In flexographic plate making, laser imaging transfers the print design from file to plate. The image is not yet polymerised, it exists only as a mask.

Unlike conventional plates, which use film for image transfer, digital photopolymer plates contain an embedded mask layer. This black mask or LAMS (Laser Ablative Mask System) is able to block UV light during the main exposure. This black mask is selectively removed by lasers.

## LED UV TECHNOLOGY

LED UV CTP systems also offer faster exposure times and UV light treatment ensures excellent resolution and durability. This technology enables fast, cost-effective production of printing plates, particularly suitable for small and medium sized printing businesses.

## ECO-FRIENDLY PRINTING PLATES AND SUSTAINABLE SOLUTIONS

Sustainability has become a key focus for the printing industry and new eco-friendly printing plate solutions have been developed.

## CHEMICAL-FREE PRINTING PLATES

So-called chemical-free printing plates, such as Agfa Azura and Kodak Sonora, offer new possibilities for sustainable printing. These plates are made without chemical development, reducing the use of hazardous waste and chemicals.

## WATER-WASHED FLEXO PLATES

For those looking for an environmentally friendly flexo plates solution, water-washed plates are an excellent choice. These photopolymer plates are designed to be solvent-free washable, reducing VOC emissions and environmental impact. They use tap water for the washing process. Toyobo, a pioneer in water-washed photopolymer plates, offers solutions that use the latest Computer-To-Plate (CTP) technology, ensuring consistent plate quality and durability.

## FLEXIBLE PRINTING PLATES FOR THE PACKAGING INDUSTRY

With the growth of flexible packaging and increasingly varied printing jobs, there is a need for innovative printing plates that are flexible, quick to produce and adaptable to different substrates.

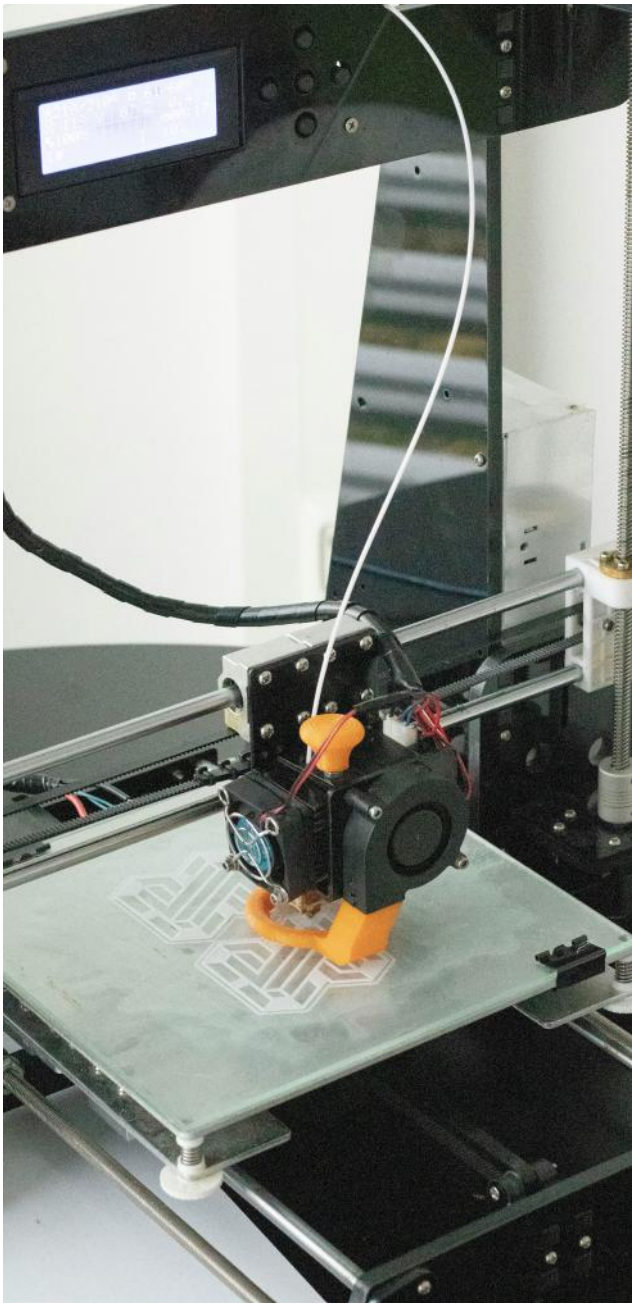
## 3D PRINTING PLATES

The use of 3D printing in the printing industry offers a new approach to making printing moulds, reducing material consumption and manufacturing waste.

Previously used for prototyping only, 3D printing technology is now growing in the printing industry. 3D printing allows the creation of custom plates for testing and experimentation, accelerating product development and time to market. At the same time, it provides accurate sizing and material usage, minimising wasted material and reducing waste.

## CUSTOMIZABLE SURFACE STRUCTURES

3D printing can be used to create different surface structures and textures on the printing plates, providing a rich visual effect and a unique tactile experience on the final print.



## INTELLIGENT PRINTING PLATES: AN INNOVATION OF INDUSTRIAL DIGITALISATION

Intelligent printing plates offer a possibility to automatically track, store and analyse data during the printing process, which also supports integration with printing presses. This technology is proving particularly useful for monitoring the life of printing plates and optimising the production process.

## RFID AND SENSORS IN PRINTING PLATES

The embedding of RFID chips and other sensors in the printing plates allows them to be tracked, their status monitored and automatically notified when maintenance is required. Intelligent printing plates help prevent faulty prints and reduce downtime by providing real-time information on their status.

## PRINT ERROR ANALYSIS AND MACHINE LEARNING

Monitoring the condition of the printing plates allows the detection of printing errors, which can be used to make predictions using machine learning algorithms, thus preventing quality problems. This approach is particularly useful in high-volume and continuous production processes where print quality is critical.

## AUTOMATIC PLATE WASHING SYSTEMS

The increasing speed and productivity of modern printing technologies require fast and efficient cleaning of printing plates. Automatic plate washing systems, which use a variety of environmentally friendly cleaning agents, minimise downtime and improve the efficiency of the production process.

## RECYCLABLE AND BIODEGRADABLE PRINTING PLATES

Printing plates used in printing, like all printing materials, wear out over time and become waste. In the spirit of sustainability, printing plate manufacturers are developing materials that are more easily recyclable or biodegradable.

For example, with the right recycling chain, materials from aluminium printing plates can be reused.

- **Biodegradable photopolymers**
  Some manufacturers are developing biodegradable photopolymer materials, mainly used for flexo printing plates. These materials allow the printing plates to be disposed of with less environmental impact or to degrade naturally.

## PHOTOPOLYMERS

Photopolymer-based printing plates are ideal for flexographic printing due to their flexibility.

## THERMAL FLEXO PLATES

Thermal flexo plate is popular in the flexographic industry due to its ease of production and fast turnaround time. This method no requires water or solvents, making it a low maintenance solution. Thermal processors can improve print quality by creating printing plates with better edge definition and consistency for repeat printing. One leading solution is the XSYS nyloflex® Xpress thermal processing system.

## PRODUCTION OF SOLVENT WASHED FLEXO PLATES

The production of solvent washed printing plates has been an essential part of the flexographic industry for many years. Although it involves chemicals, recent developments have introduced more environmentally friendly and less hazardous options. Solvent washed printing plate production is known for its productivity and efficiency in a variety of applications.

## FLEXOGRAPHIC PLATES WITH LIQUID PHOTOPOLYMERS

Printing plates by liquid photopolymers can be an ideal solution for corrugated packaging applications such as pizza boxes. This method includes a UV exposure unit and a washing system to create high quality plates. Liquid photopolymer resins offer a cost-effective and efficient solution for a variety of printing needs.

## SUMMARY

Revolutionary innovations in the field of printing plates have contributed significantly to the development of the printing industry. In the case of offset plates and flexographic plates, digital technology, environmentally friendly solutions and material developments have all contributed to improving the efficiency, quality and sustainability of printing. These innovations have made printers more flexible, faster and more cost-effective, while the quality of the end product has also improved significantly.

# EVOLUTION OF PRINTING MACHINES, TECHNOLOGICAL INNOVATIONS

Advances in printing technology have revolutionised the printing industry in recent decades. While traditional printing methods such as offset and flexo continue to lead the way, new digital and 3D printing technologies are opening up new opportunities for faster, more flexible and cost-effective production. In this article, we review how different types of printing presses are evolving and what new solutions have emerged in the industry to meet growing demands and requirements for sustainability.

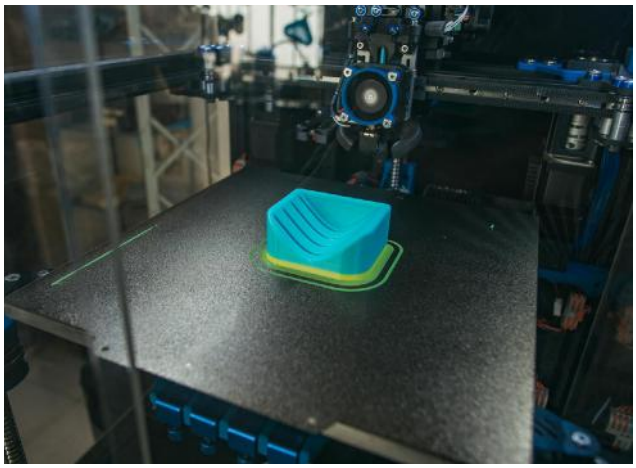
## TRADITIONAL PRINTING PRESSES: INNOVATIONS IN OFFSET AND FLEXO PRINTING

Traditional printing presses, especially offset and flexo, are synonymous with high volume and high quality printing. Improvements in these technologies aim to increase energy efficiency, improve production speed and ensure sustainability.

- **Automated systems**
  Automation in offset presses allows for more efficient control of the printing process, automatic ink volume adjustment and faster colour calibration. Systems such as Heidelberg Push to Stop technology automatically initiate the next print job, minimising downtime.

- **Flexible flexo printing**
  New flexo presses, such as the Bobst MASTER CI, have fully automatic ink management systems that can be quickly changed between different prints and reduce waste. And the use of new water-based and LED-UV inks reduces environmental impact.

- **Hybrid presses**
  Hybrid presses that combine offset and digital printing, such as the Komori Lithrone G40, allow to combine the flexibility of traditional offset quality with the flexibility of digital technology, optimising costs and reducing lead times.



## DIGITAL PRESSES: FLEXIBILITY AND CUSTOMISATION

Digital presses offer new possibilities, especially for short runs and customised print jobs. Inkjet and electrophotographic technologies are becoming increasingly popular in digital printing because they offer a fast and cost-effective solution.

- **Advances in inkjet technology**
  Industrial inkjet presses, such as the HP Indigo and Canon Océ Varioprint series, produce high-resolution images and are highly flexible, making them ideal for customised or short-run print jobs. New UV-resistant inks and water-based inkjet inks help to promote environmental sustainability, while technologies that boost print speed and accuracy improve productivity.

- **Electrophotographic printing (toner-based printing)**
  Manufacturers such as Xerox and Ricoh offer advanced electrophotographic printing machines that deliver excellent image quality at high speeds. These systems allow for quick switching between different print jobs and support variable data printing, displaying information in a personalised way.

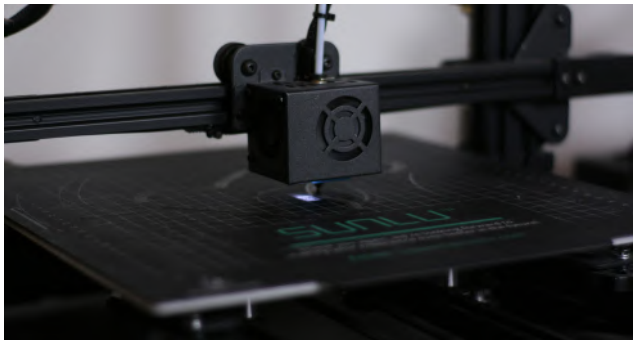
- **Sustainable printing solutions**
  Digital printing machines require less raw material and minimise waste. Recyclable toner cartridges for electrophotography systems and water-based inks for inkjet technology all aim to reduce the environmental impact.

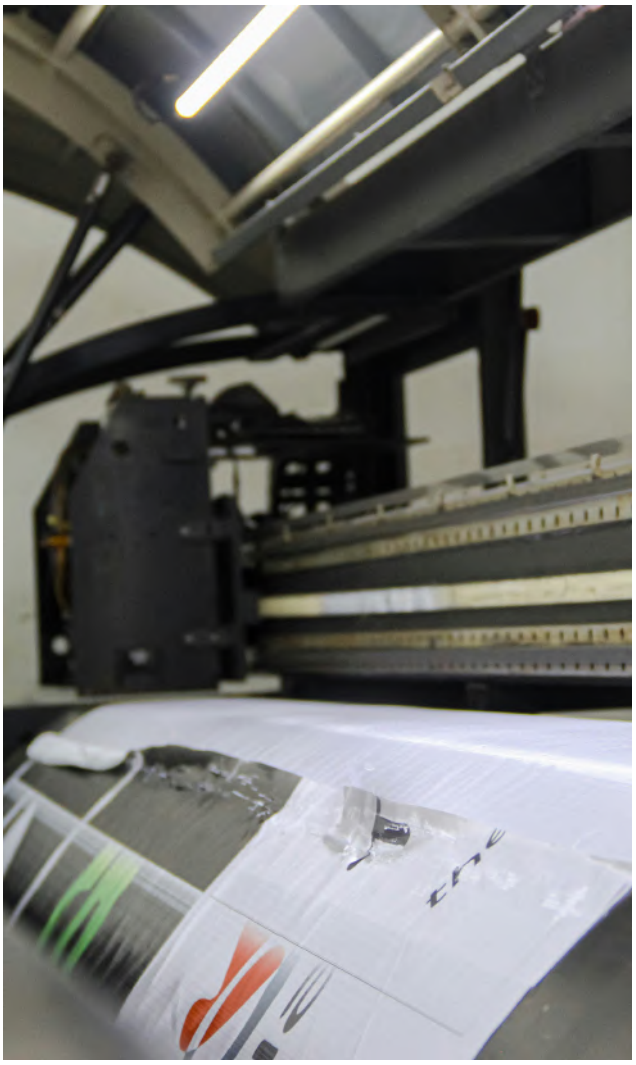
## 3D PRINTING, THE RISE OF ADDITIVE MANUFACTURING

3D printing, or additive manufacturing, opens up new dimensions in printing, allowing the creation of complex, three-dimensional objects. This technology is particularly useful for prototyping, custom manufacturing and industrial applications.

- **Polymer-based 3D printers**
  Polymer-based 3D printers, such as SLA (stereolithography) and FDM (fused deposition modelling) machines, are particularly popular for lightweight and rapid prototyping. SLA printers provide high precision, making them suitable for detailed models, while FDM printers offer a more cost-effective solution.

- **Biological and ecological applications**
  3D printing opens up new areas such as printing biological materials that can be used for medical purposes. 3D printing from organic materials offers the possibility of producing biological tissues, which is particularly useful in research and medicine. In addition, the use of environmentally friendly filaments such as PLA (polylactic acid), which is biodegradable, also contributes to sustainable practices.





## SAMPLE PRODUCTION ON A HUGE SCALE

The unique printing dimensions of the Massivit 3000, which we have seen on live at Drupa 2024 fair, measuring approximately 1.2 x 1.5 x 1.8 metres, allow for example sample production on a huge scale for advertising agencies, the furniture and automotive industries, and many more. Industrial 3D printing solutions include a wide range of 3D-printed models in various sizes. Among them, those made of flame retardant material according to ASTM E84.

We also found out that, in addition to a wide range of creative applications, the Massivit 3000 is based on the same reliable Gel Dispensing Printing (GDP) technology that has been used in 40 countries so far. Delivering exceptional value and performance. Generally white, but also available in a variety of colours, some types of UV-curable material can also be used for thermoforming. In fact, a solution has been made available that injects a two-component material into carefully designed channels in the printed frame structure. After the special water-soluble material of this frame removed get the desired shape.

## INTELLIGENT PRINTING AND IOT INTEGRATION

The use of IoT (Internet of Things) and smart devices enables more efficient control and automation of printing presses, increasing productivity and reducing energy consumption.

- **Automatic error correction and machine learning**
  Machine learning allows printing presses to learn from previous errors and automatically optimise settings.

## THE BENEFITS OF INDUSTRY 4.0 IN THE PRINTING INDUSTRY

The Industry 4.0 revolution is also taking hold in the printing industry, where smart printing machines and IoT (Internet of Things) integration are transforming manufacturing processes. Intelligent printing machines enable real-time data collection, automated maintenance and machine learning, which help to increase efficiency, reduce waste and optimise production costs. IoT technologies offer a new level of precision and reliability that is now almost essential to stay competitive.

## REAL-TIME DATA COLLECTION AND ANALYSIS

Intelligent printing presses are equipped with sensors and data collection systems that continuously monitor press performance, temperature, print speed, ink level and many other parameters.

- **Production process optimisation**
  Real-time data allows machine operators to react immediately to problems and optimise settings for productivity and quality. For example, if a sensor detects low ink levels, it automatically sends a warning to the operator or even automatically refills the ink to avoid downtime.

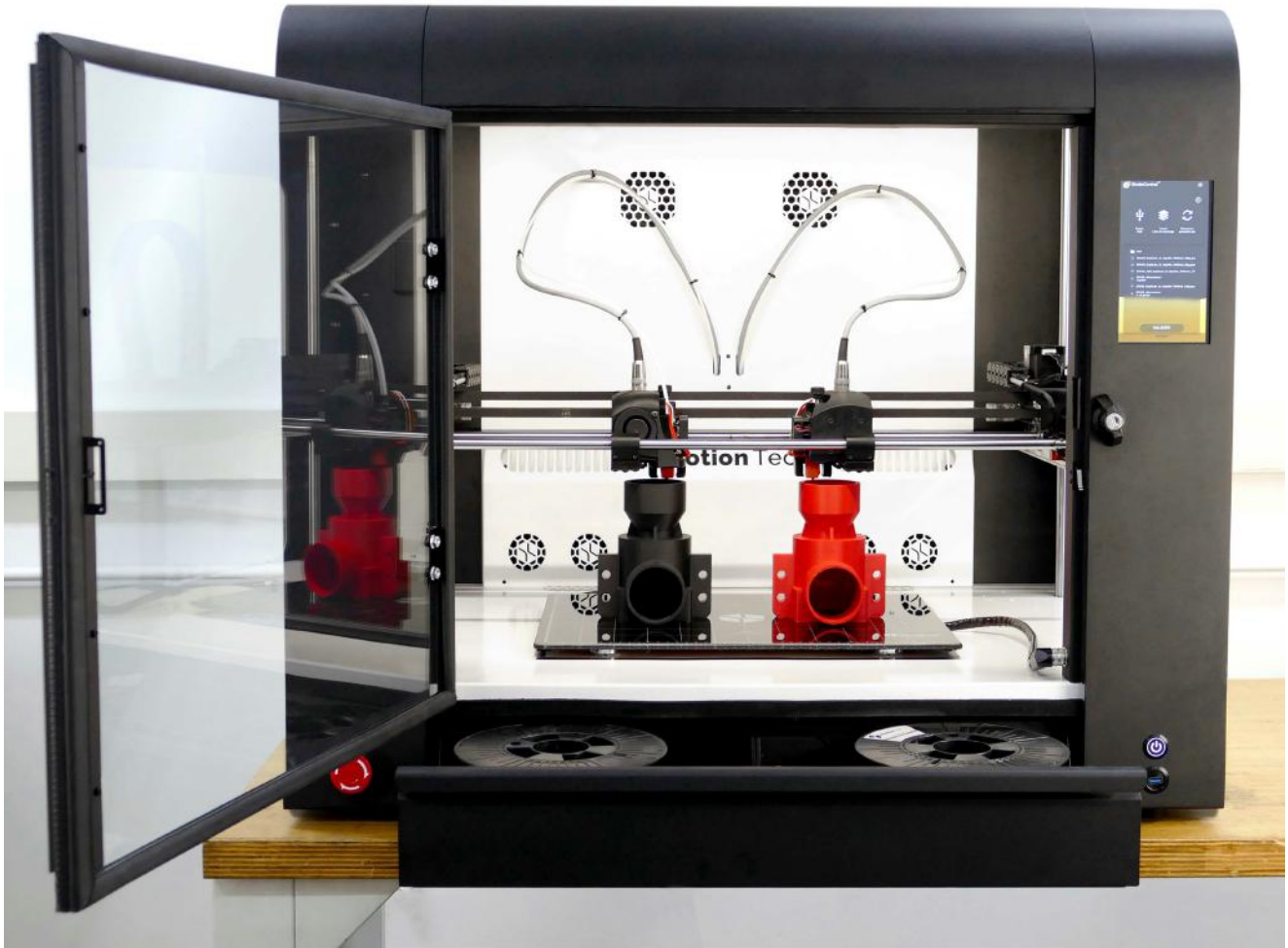
- **Quality control**
  Cameras and sensors installed to continuously monitor the quality of the print allow immediate detection of printing defects such as colour deviations, which can be automatically corrected by the system.

## PREDICTIVE MAINTENANCE AND AUTOMATIC TROUBLESHOOTING

Using collected data by the IoT, smart printing presses can predict maintenance needs in advance, avoiding unexpected downtime and failures that can lead to costly downtime.

The data captured by sensors is instantly analysed by the system, using artificial intelligence (AI) to identify patterns that could indicate a failure. For example, if the temperature of the machine's engine is above average, can alert the operator or maintenance team in time.

- **Automatic troubleshooting**
  Smart presses can automatically resolve certain errors, such as restarting, changing settings or starting the ink cleaning cycle, without human intervention. This reduces downtime and ensures continuous production.



## MACHINE LEARNING AND CONTINUOUS OPTIMISATION

Machine learning allows printing machines to continuously learn from data and become more efficient over time. Intelligent machines are able to learn and apply optimal settings to perform every print job to the best of their ability. For example, by optimising each type of material and pattern, the machine can learn which settings provide the best quality and the least waste.

- **Reducing cost and material use**
  Machine learning optimises material use and energy efficiency, reducing production costs and environmental impact.

## DIGITAL CONTROL AND REMOTE MONITORING

IoT-based central control systems for printing presses enable remote monitoring and management of machine status and performance, making it easier to monitor production processes and intervene quickly.

And remote access to press data allows technicians to quickly diagnose problems without having to be present in person. This can be particularly useful for globally operating printing houses, where technical support is available remotely and offers immediate intervention when needed.

- **Integration with Enterprise Resource Planning (ERP) systems**
  Intelligent printing machines can be easily integrated with companies' ERP systems, making production data directly available and allowing better coordination of inventory management, production and logistics. Such integrations help to manage material stocks, delivery and timing more efficiently.

## FINAL WORDS

Smart presses and the advancements offered by IoT integration are revolutionising the printing industry. Real-time data collection, machine learning, automated maintenance and remote control are helping to increase the efficiency of print production and promote sustainability. Such solutions enable the printing industry to respond faster to changing customer needs, reduce energy and material consumption and ensure long-term competitiveness. The development of intelligent printing machines is therefore one of the most promising innovation trends in the printing industry.

# THE ROLE, OPPORTUNITIES AND BENEFITS OF AI IN THE PRINTING AND PACKAGING INDUSTRY

Artificial Intelligence (AI) is becoming a central element in a growing number of industries to increase production efficiency, optimise costs and improve the customer experience. The printing and packaging industry is no exception, where the application of AI technologies can bring significant benefits in a number of areas. Let's look at the main areas and benefits of applying AI in the printing and packaging industry, and the future opportunities that could further transform this industry.

## HOW CAN HUMAN WORKFORCE AND AI WORK TOGETHER SUCCESSFULLY IN THIS SECTOR?

The rapid rise of artificial intelligence is transforming the printing and packaging industry, but not replacing human labour. Instead, it offers the potential to improve efficiency and production quality while taking the skills of the human workforce to new levels. The collaboration of AI and humans in this industry is particularly important because creative decision making, quality control, and the supervision of machines and systems remain areas where human experience and knowledge are key.

Printing industry has challenges such as rapidly changing customer demands, controlling costs and ensuring continuous quality. AI-based solutions can help overcome these challenges by increasing automation and providing more accurate, faster decision-making.


## QUALITY CONTROL AND FAILURE DETECTION

Artificial intelligence-based image processing technologies enable automatic monitoring of print quality, ensuring fast and accurate defect detection. Machine vision allows AI to detect ink smears, colour variations or printing errors during the production process, significantly reducing waste rates. This not only improves quality, but also reduces costs, as less material has scrapped and less rework has required due to complaints.

AI-based quality control systems can significantly reduce errors, but final inspection and sensitive quality decisions still require human intervention. Machine vision can identify printing errors or packaging inaccuracies, but human eyes and hands are still essential for detecting fine details, such as visual requirements for specific brands or the tactile quality of packaging.

Quality controllers can then use the data generated by AI to decide more quickly on the corrections needed, or even identify specific problems that AI cannot (yet) detect. This cooperation results in significant time savings and reduces the scrap rate.

## COLOUR MANAGEMENT AND AUTOMATED CALIBRATION

AI-based systems can automatically calibrate printing presses to accurately reproduce the desired colour tones, even on different materials and in different environmental conditions. This is particularly important for brands that want to ensure the same colour look on different packaging for their products. Predictive analytics and machine learning algorithms allow the system to continuously optimise itself based on previous work, which can result in significant time and cost savings.

## PRODUCTION OPTIMISATION

In the printing industry, AI is increasingly being used to optimise the production process, with intelligent systems able to predict material requirements, optimise print sequences and minimise downtime. AI-based production planning can reduce energy consumption and waste, which is not only economical but also environmentally beneficial.

## THE APPLICATION OF AI IN THE PACKAGING INDUSTRY

The packaging industry can also benefit from the application of AI in a number of areas, especially in processes where extra speed, accuracy and a high degree of flexibility are required. AI enables manufacturers to respond faster to changing consumer needs and new product introduction requirements.

## SUPPORTING CREATIVE DESIGN

In the packaging industry, listening to consumer needs and designing creative, eye-catching packaging is vital. AI can analyse market trends, competitor packaging styles and consumer preferences at high speed, providing designers with valuable data to work with. This gives packaging designers an accurate picture of which trends are popular or which colours and shapes grab consumers' attention. With AI support, they can save time in the design phase and focus their creative energies on enhancing the visual experience.

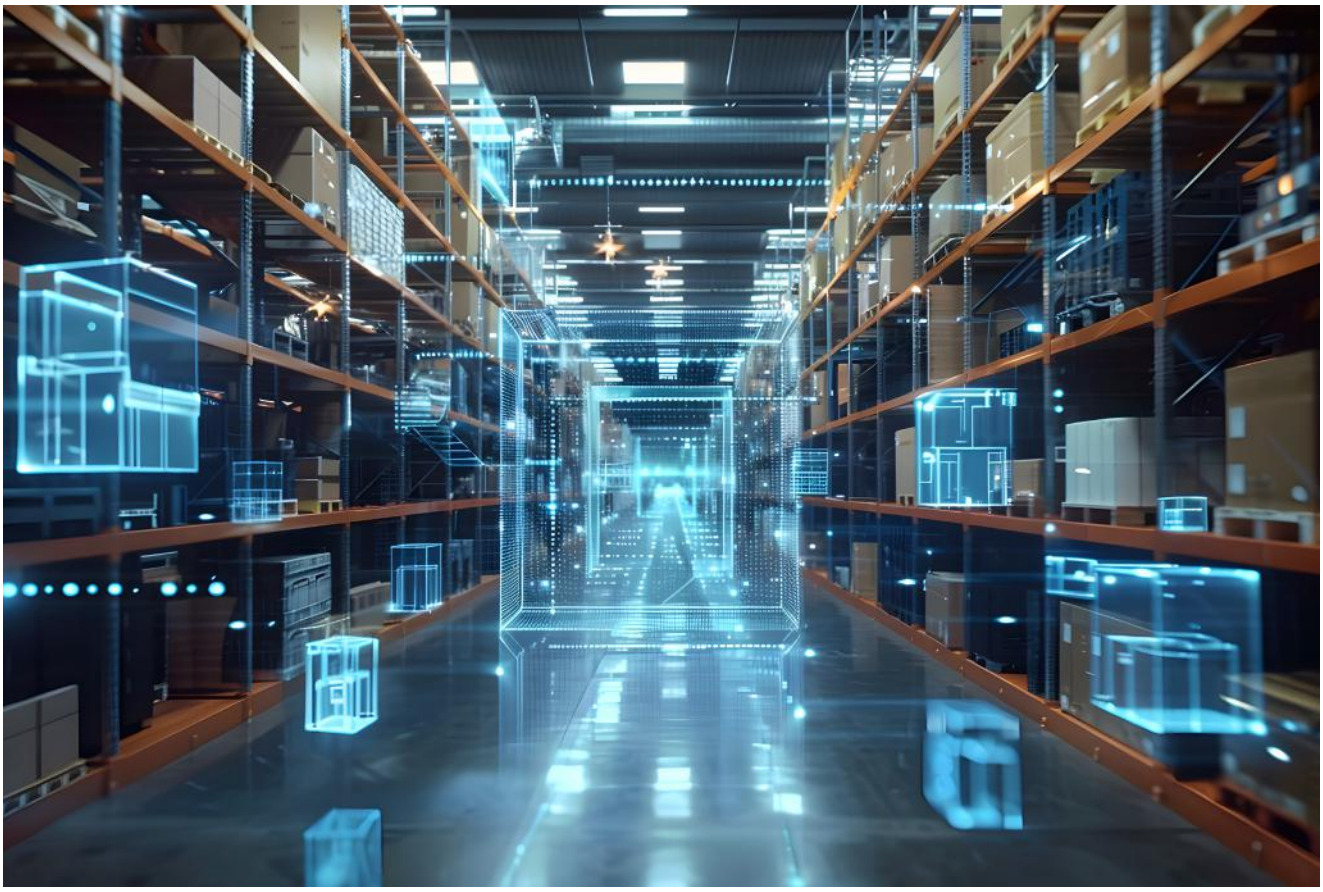
AI can even provide creative ideas, such as suggesting how to improve existing designs, but the final decision and visual implementation is made by human designers. This makes the creative process faster and more efficient, while allowing designers to maintain the uniqueness and brand compatibility of the packaging.

## PREDICTIVE MAINTENANCE AND INCREASING MACHINE EFFICIENCY

The packaging industry often uses expensive machinery, the breakdown of which can lead to significant losses. AI-based predictive maintenance systems allow continuous monitoring of machine operation and predicting failures. Based on data analysis, the system will indicate when a part is worn out and needs to be replaced. In this way, unplanned downtime can be avoided and machine life and efficiency can be increased.

## LOGISTICS AND INVENTORY MANAGEMENT

Sourcing, stocking and managing packaging materials is a major challenge in the packaging industry. AI-based systems can optimise inventory management and procurement by predicting the amount of material required based on demand data. Automated processes can reduce the cost of maintaining inventory while avoiding problems caused by stock-outs.



## ENVIRONMENTAL BENEFITS

Sustainability and environmental considerations are important for both the printing and packaging industries. And AI-based technologies can contribute to more sustainable operations by optimising printing and packaging processes to minimise waste. Accurate forecasts and efficient use of materials result in less wasted raw materials. In addition, with the support of AI, it is easier to introduce more sustainable, recyclable or biodegradable materials that reduce the industry's ecological footprint.

## REDUCING ENERGY CONSUMPTION

AI helps reduce energy consumption by optimising manufacturing processes. Intelligent systems can predict energy demand and consumption during production stages, so that energy consumption at peak times can be reduced. More energy-efficient operations contribute to cost reduction and sustainable operations.

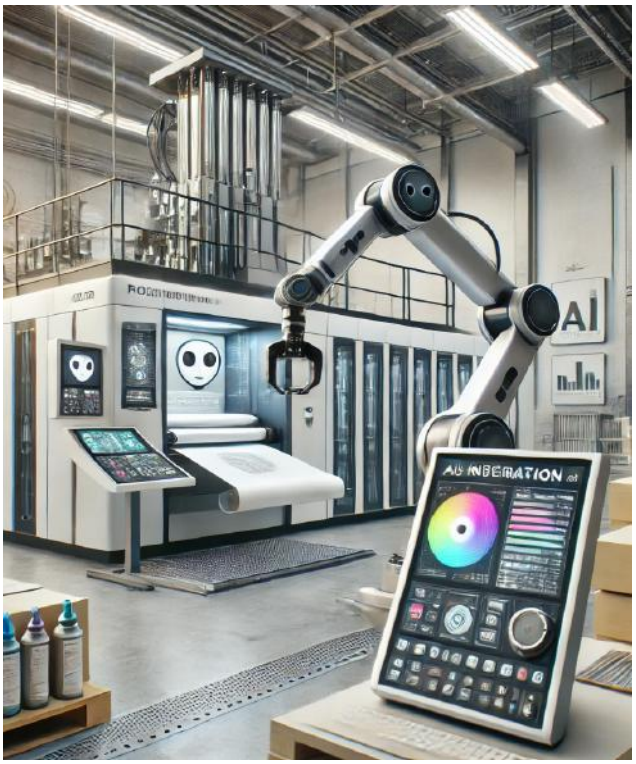
## OPPORTUNITIES AND CHALLENGES FOR THE FUTURE

The application of AI in the printing and packaging industry offers many opportunities, but also challenges. Technological advances require continuous investment, and retraining of the workforce is an important part of successful adaptation, as skilled staff are needed to operate and fine-tune intelligent systems. In addition to AI system operators and analysts, there is also a need for AI results interpreters who can understand the data and make appropriate decisions based on it. AI can thus not only increase work efficiency, but also encourage continuous learning and development of employees.

It may therefore become increasingly important for workers in the printing and packaging industry to master the use of AI-based systems and be able to interact with these new technologies. Many companies are therefore placing increasing emphasis on AI-based training of their workforce, which can provide a competitive advantage in the long term, as well-trained workers can efficiently manage and optimise production processes.

## ETHICAL AND DATA PROTECTION RESPONSIBILITIES

The use of AI also raises ethical and privacy issues, as it requires the analysis and storage of a large amount of data. When using AI, the human workforce has an important role to play in monitoring and ensuring compliance with ethical guidelines and data protection rules. In the printing and packaging industry, AI systems often handle customer data, purchasing trends and production data, so human oversight is essential to ensure data is secure and used in compliance with regulations.


## THE HUMAN INTELLIGENCE AND AI

Human and AI can complement each other, especially in situations where human judgement and creativity are essential. AI is excellent at analysing data and performing monotonous, repetitive tasks, but in tasks where a high degree of flexibility, innovation and complex decision-making are paramount, the role of human labour remains inescapable.

## SUMMARY

The collaboration of AI and human workforce in the printing and packaging industry can bring many benefits. It can increase productivity, reduce errors and rejects, support quality assurance and drive innovation. Human experience and creativity, coupled with AI's data processing and automation capabilities, may will become a powerful tool that will enable companies to operate more efficiently and sustainably in a rapidly changing market environment.

# INNOVATIONS IN UV PRINTING

## CONVENTIONAL, LED, INERT UV AND ENERGY-SAVING TECHNOLOGIES

UV energy-based printing technologies are becoming increasingly popular in the printing industry, especially due to their fast drying times and durable prints. UV printing technology is based on the fact that inks or varnishes are instantly cured and hardened by UV radiation, resulting in faster production and, at least in the case of LED UV, lower energy consumption. The following is an overview of the developments in conventional, LED and inert UV systems, as well as solutions that promote energy efficiency.

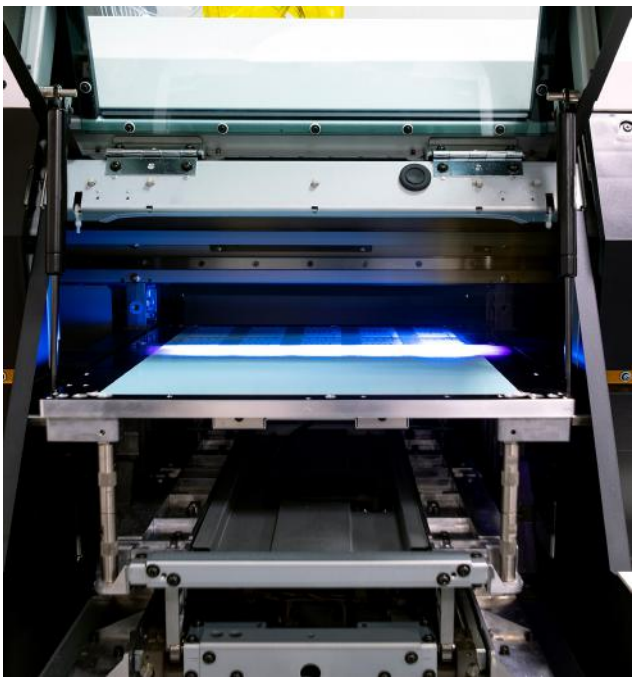
### CONVENTIONAL UV PRINTING SYSTEMS

Conventional UV printing technology provides fast and efficient drying, allowing the creation of high quality prints on a variety of surfaces.

- **Conventional UV lamps**
  These systems use high-power mercury vapour lamps that emit powerful UV-A and UV-B radiation. Although effective and widely used, they have the disadvantage of high energy consumption and heat generation, which can be harmful to certain materials such as heat-sensitive films or plastics.

- **Fast drying time**
  Conventional UV printing systems provide very short drying times, allowing immediate further processing of prints, such as cutting or laminating.

- **Environmental impact**
  Lamps containing mercury vapour are a potential environmental risk and maintenance and replacement of such systems is challenging. Therefore, the printing industry is increasingly turning to alternative solutions.



### LED UV SOLUTIONS

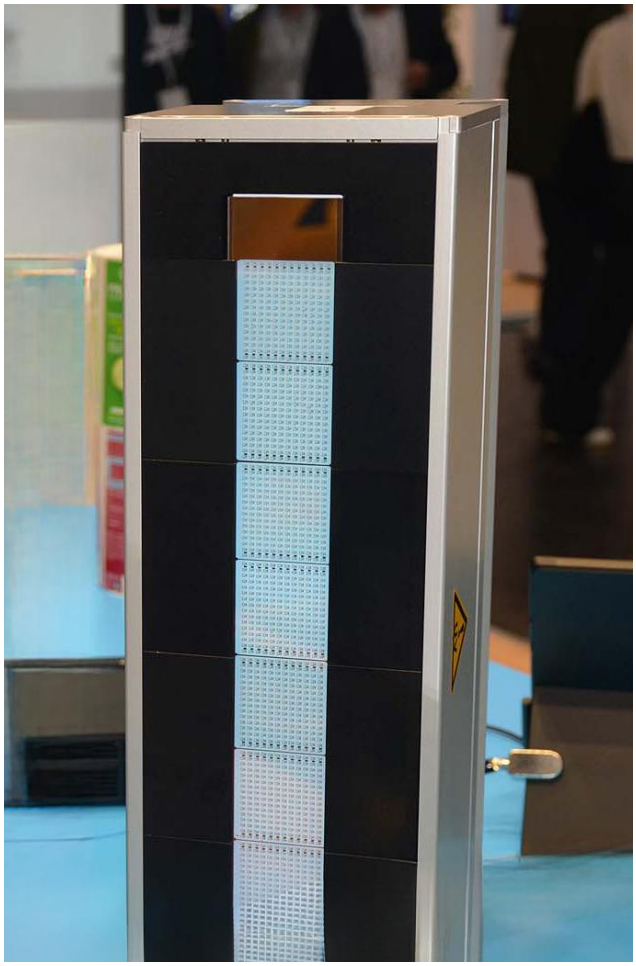
LED-UV technology is a more energy-efficient and environmentally friendly alternative to traditional UV systems, offering a number of benefits to the printing industry.

- **Lower energy consumption**
  LED-UV lamps require up to 50-70% less energy than conventional UV lamps, as LED light sources are much more efficient and can be controlled more precisely. The energy savings of such systems also reduce production costs.

- **Less heat generation**
  LED-UV systems produce significantly less heat, which allows heat-sensitive materials such as plastics or films to be printed without damage.

- **Longer lifetime**
  LED lamps have a longer lifetime, typically running for thousands of hours, which reduces maintenance costs and machine downtime. In addition, LED lamps provide maximum output immediately after switching on, resulting in additional energy and time savings.

- **More environmentally friendly solution**
  LED-UV systems do not contain mercury, so they do not pose an environmental hazard and do not require special precautions during maintenance.



## INERT UV PRINTING SYSTEMS

Inert UV printing technology uses a special environment during the curing process that allows printing in an oxygen-free environment. This printing system typically uses a protective gas, such as nitrogen, to prevent the presence of oxygen during crosslinking.

## THE BENEFITS OF INERT UV TECHNOLOGY

- **Higher quality and durability**
  In an oxygen-free environment, inks are fully cross-linked, resulting in more durable, weather-resistant and scratch-resistant prints.

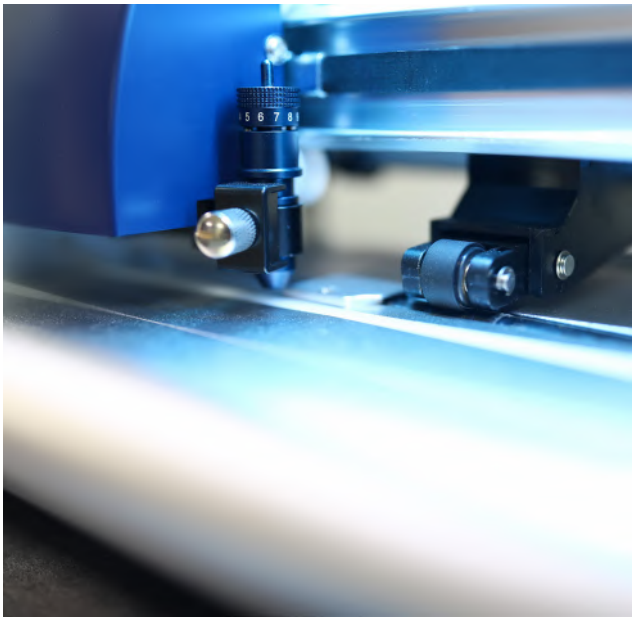
- **Less photoinitiator**
  In an oxygen-free environment, fewer photoinitiators are required, which helps reduce the amount of chemical components in the inks, providing a more environmentally friendly solution.

- **Application on sensitive materials**
  Inert UV printing systems are ideal for food and pharmaceutical applications where it is particularly important that inks are fully cross-linked and do not release harmful substances.

We have seen the extensive product portfolio of Dr. Hönle AG at the Drupa 2024 trade fair. This includes not only LED-UV but also conventional UV, inertUV and IR systems. Including customised UV curing solutions for retrofitting into printing presses. One of their developments with significant potential is inertUV, where UV curing takes place in a nitrogen atmosphere, which, even with a lower photoinitiator dosage, results in better curing than conventional systems. As their experts explained, odourless labels

and packaging materials produced in this way could also provide a fast and efficient solution for the food and pharmaceutical industries.

And the modular design of the LED Powerline LC HV system allows the ideal length to be set for the application or to work only on the useful track width, resulting in significant energy savings.



## ENERGY-SAVING AND SUSTAINABLE SOLUTIONS

Energy efficiency and sustainability are increasingly important considerations in the printing industry, and UV printing technology has seen a number of innovations that contribute to reducing energy consumption and mitigating environmental impact.

- **Automatic energy control**
  New UV printing systems increasingly feature automatic energy control, which adjusts lamp output depending on print speed and substrate, so that only as much energy is used as is absolutely necessary.

- **Combined LED and conventional UV technology**
  Some printing presses combine conventional UV lamps and LED-UV light sources, allowing systems to take advantage of both technologies. This allows higher print speeds while significantly reducing energy consumption and heat generation.

- **Controlled cooling systems**
  The cooling systems in the new generation of UV printers are designed to minimise lamp temperatures while optimising energy efficiency. Such systems reduce energy loss and extend lamp life.

- **More sustainable inks and varnishes**
  Manufacturers are developing more and more environmentally friendly inks and varnishes that contain fewer harmful substances, such as photoinitiators and solvents. These inks offer a more environmentally friendly alternative and are easily crosslinked by UV energy.

## INNOVATIVE APPLICATIONS AND FUTURE OPPORTUNITIES

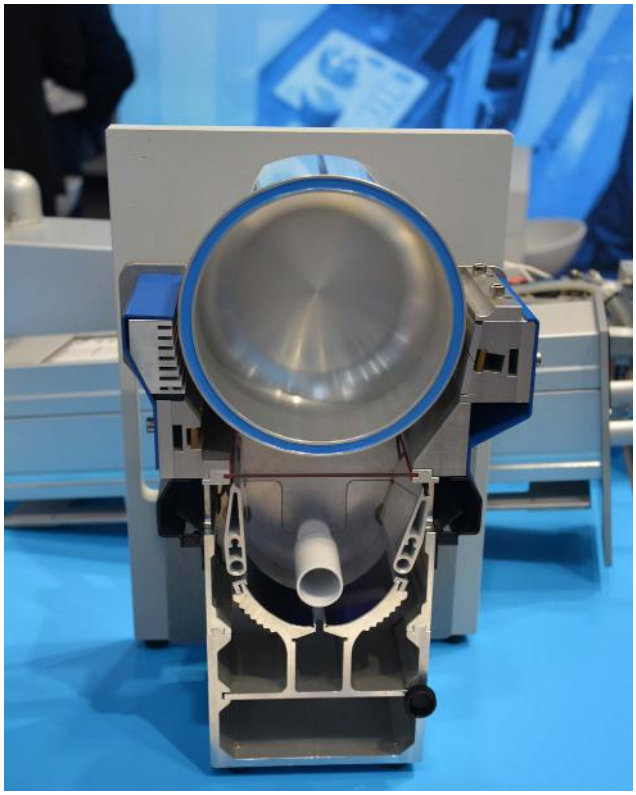
Innovations in UV printing solutions have spread across different areas of industry and are opening up new application opportunities.

- **Special prints**
  UV printing is ideal for creating a variety of special effects such as matt or glossy surfaces, metallic or textured prints, and these decorative options are also popular in the packaging and advertising industries.

- **Shorter lead times**
  Instant drying capabilities make UV printing particularly suitable for projects requiring short lead times.

UV printing has become an increasingly common technology in the printing industry, not only because of its fast drying time and high quality, but also because it offers a wide range of applications. UV printing solutions are constantly evolving and new innovative opportunities are opening up in different industries.

Below we present some of the innovative applications and future opportunities of UV printing.



## PACKAGING INDUSTRY

UV printing is particularly popular in the packaging industry for the production of labels, where a fast production process and outstanding print quality are essential. New innovations allow, for example, the creation of personalised packaging. As digital UV printing allows short runs and customisation, it becomes easier for brands to meet customer needs.

## ADVERTISING INDUSTRY

Applications of UV printing have also expanded into the advertising industry, where aesthetics and durability are paramount.

- **Large format printing**
  UV printing is ideal for large format advertising, banners, signs and other promotional materials. The excellent colour reproduction and durability of these materials make them highly resistant to weather conditions and external influences.

- **Innovative finishes**
  UV printing allows printing on a variety of surfaces, such as glass, metal, wood, and acrylic materials, offering new possibilities for advertising designers. This can be particularly attractive in the marketing of premium products where a unique look is an advantage.

## FOOD AND PHARMACEUTICAL INDUSTRY

The use of UV printing is also becoming increasingly common in the food and pharmaceutical industries, where safety and hygiene are particularly important.

- **Safety**
  Using inert UV printing technologies, possible to ensure that inks do not emit harmful substances, making packaging safer for food and medicines and their users.

- **Fast printing**
  UV printing allows for instant customisation of packaging and reduced production time, which can be an advantage on distribution of fresh food.

## 3D PRINTING AND UV TECHNOLOGIES

The combination of 3D printing and UV printing technology opens up new possibilities for creative design and prototyping.

- **3D UV printing**
  The use of UV printing in 3D printing enables the rapid production of detailed and colourful models, ideal for product development and marketing.

- **Detailed surfaces**
  Using UV printing, the surface of 3D printed products can be enriched with different textures and patterns, significantly increasing the visual appeal of products.

## FUTURE INNOVATIONS AND DEVELOPMENTS

UV printing technology is constantly evolving and many new innovations are expected in the future.

- **New materials**
  The printing industry is constantly developing new materials that are suitable for UV printing, such as biodegradable or recycled inks that reduce environmental impact.

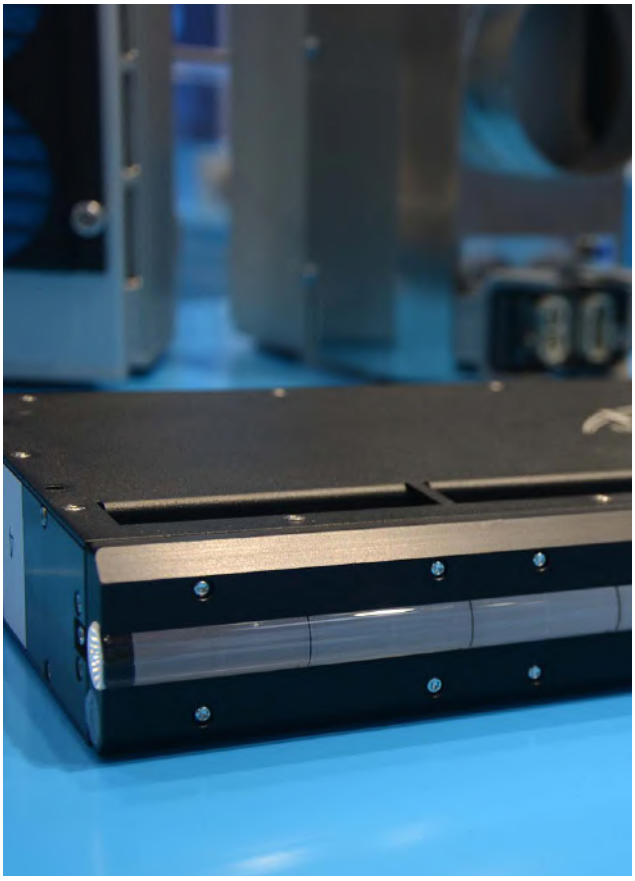
- **Combined technologies**
  Combining printing systems, such as hybrid UV and digital printing, allows for faster and more efficient production processes and greater creativity in design.

- **Automation**
  The introduction of automated printing systems allows production processes to be optimised, reducing the potential for errors and increasing production efficiency.

- **Sustainable production processes**
  The introduction of environmentally friendly solutions, such as energy-saving systems and waste minimisation, is essential for the development of future printing technologies.

## SUMMARY

Innovative applications and future opportunities for UV printing offer a broad spectrum of possibilities for the printing industry. The continuous evolution of the technology and the introduction of new materials allow manufacturers to respond to market needs and offer competitive solutions. UV printing is not only revolutionising production processes, but also offers the potential for creative design, sustainability and customisation that are expected to be key elements of the printing industry of the future.



# LABEL PRODUCTION AND PRINTING TECHNOLOGIES

## OFFSET, FLEXO, DIGITAL AND HYBRID SOLUTIONS

Labels play an important role in product identification, marketing and information transfer. Labels can be produced and printed using a variety of technologies, each of which has a number of advantages and disadvantages. Let's look at offset, flexo, digital and hybrid technologies and their applications.

### OFFSET PRINTING

Offset printing is one of the most common printing technologies and is often used in the production of labels, especially for large orders. The process involves transferring the ink from a roller onto a rubber substrate and from there onto a print substrate (such as paper or film).

### BENEFITS

- **High quality**
  Offset printing delivers excellent colour reproduction and sharp, detailed images.

- **Cost-effective for large print runs**
  Offset technology is cost-effective when large numbers of labels need to be produced.

- **A wide choice of substrates**
  Different types of labels such as paper, vinyl and film substrates can be used.

### DISADVANTAGES

- **High initial cost**
  Not ideal for small runs, as the production of printing plates and machine set-up can be expensive.

- **Longer preparation time**
  Offset printing can be time-consuming to prepare, which can slow down the production process.

## FLEXOGRAPHIC PRINTING

Flexographic printing (or flexo for short) is a printing technology that uses flexible printing plates that transfer inks to a print substrate. The process can be ideal for applications such as labels, packaging and cardboard boxes.

### BENEFITS

- **Fast printing**
  Flexo printing is fast, making it ideal for high-volume products.

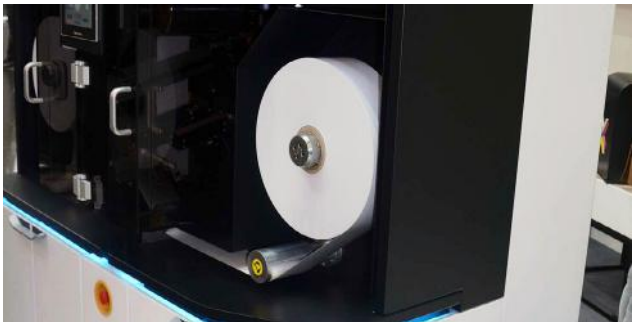
- **Low cost**
  Lower material and running costs make it a cost-effective option for high volumes.

- **Wide range of inks**
  Flexo printing works with different types of inks (water-based, solvent-based, UV), allowing for a variety of applications.

### DISADVANTAGES

- **Limited colour depth**
  Flexo printing is not always able to achieve the required colour depth or detail, especially at low and near 100% screening.

- **Ink drying time**
  Ink drying time can prolong the production process, especially when non-UV inks are used.




## DIGITAL PRINTING

Digital printing produces prints directly from digital files, without the need for printing plates. This technology has revolutionised the way labels are produced.

### BENEFITS

- **Flexibility**
  Preparation time can be minimised, allowing for fast production.

- **No minimum order quantity**
  Small quantities can be economical, allowing for the production of test pieces or custom labels.

## DISADVANTAGES

- **High volume cost**
  Digital printing can be more costly when large quantities of labels need to be produced than traditional methods.

- **Variability in quality**
  The quality of digital printing depends on the printing technology, inks and substrates used, which can sometimes lead to variations.

## HYBRID PRINTING

Hybrid printing combines digital and traditional printing technologies, allowing you to take advantage of the best features. This is often achieved by combining flexo and digital technologies.

## BENEFITS

- **Cost-effective**
  Hybrid systems allow high volume printing at lower costs, while offering the flexibility of digital printing.

- **High quality**
  By combining the best features, hybrid printing delivers high-quality prints that are easy to customise.

- **Innovative solutions**
  The integration of new technologies allows for the use of a variety of effects such as textures and embossing.

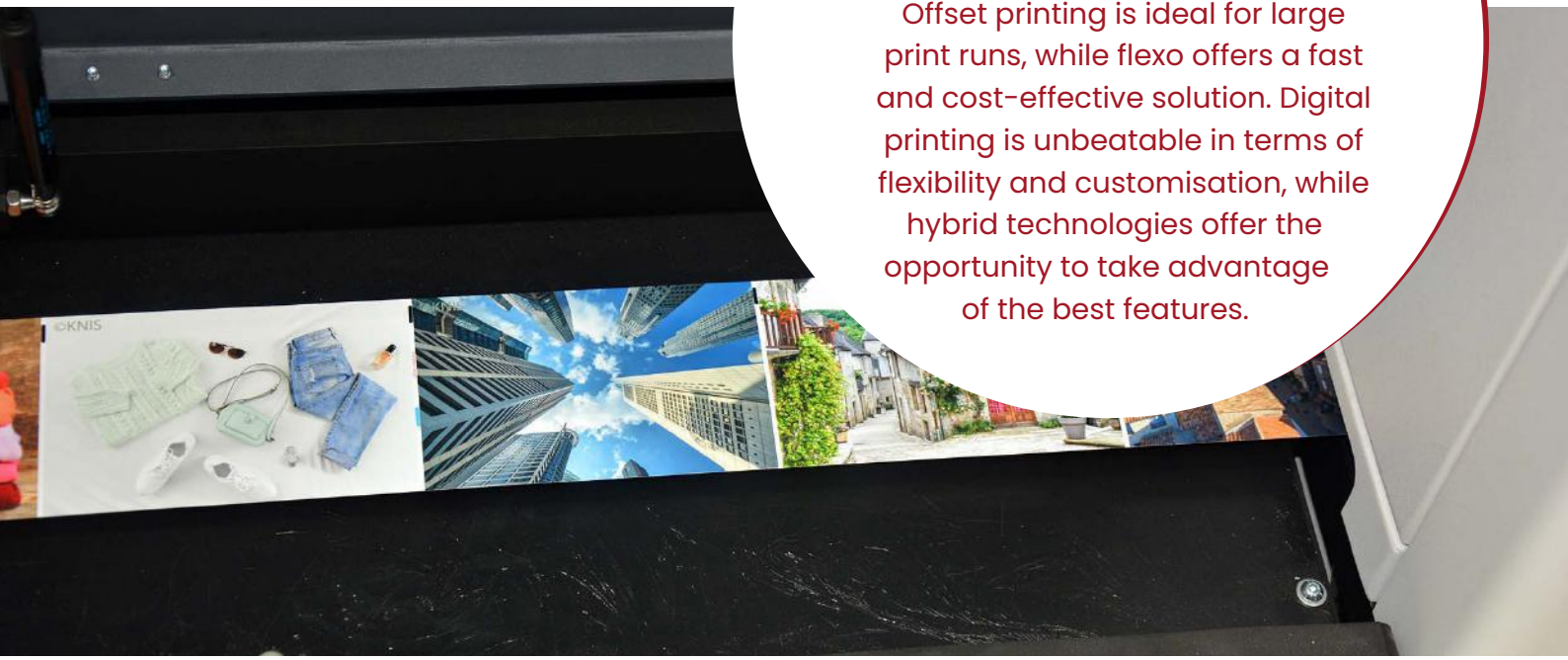
## DISADVANTAGES

- **More complex equipment**
  Hybrid systems are generally more expensive and more complex to maintain.

- **Need for pre-set-up**
  Setting up different printing systems when using hybrid technologies can be time-consuming.

## CONCLUSION

The production and printing of labels is achieved through different technologies, each with its own advantages and disadvantages. Offset printing is ideal for large print runs, while flexo offers a fast and cost-effective solution. Digital printing is unbeatable in terms of flexibility and customisation, while hybrid technologies offer the opportunity to take advantage of the best features.



# INNOVATIONS IN LABELS

The role of labels in product identification and marketing is not limited to the traditional communication of information. New technologies such as QR codes and virtual reality (VR) offer the potential to make labels more interactive and attractive. See how these innovative solutions are being integrated into the production and design of labels.

## WHAT IS THE QR CODE?

A QR (Quick Response) code is a two-dimensional barcode that can be quickly scanned by smartphones and other QR code readers. QR codes allow users to easily access digital content such as websites, videos, promotional offers or product information.

## APPLICATION OPTIONS

- **Information retrieval**
  QR codes allow shoppers to quickly and easily access detailed product information such as ingredients, instructions and origin.

- **Promotional offers**
  Companies can use QR codes to deliver special offers and discounts to shoppers, who can then scan the code to receive instant discounts that can encourage purchase.

- **Product traceability**
  QR codes can help track products through the supply chain, ensuring that customers can trace the origin of the product and the manufacturing process.

- **Environmental awareness**
  Labels with QR codes allow companies to promote environmentally conscious practices such as recycling programmes, sustainable resources and green initiatives.

## BENEFITS

- **Cost-effective**
  Creating and printing QR codes is inexpensive, making it an affordable solution for small businesses.

- **Can provide an interactive experience**
  It makes products with these labels more attractive to customers, providing an interactive experience.

- **Data collection**
  QR codes can help companies collect data on customer habits and preferences, allowing them to develop targeted marketing campaigns.

## WHAT IS VR?

Virtual Reality (VR) is a digital environment that allows users to interactively experience 3D content. VR technology is becoming increasingly available and is creating new opportunities in the design and production of labels.

## APPLICATION POSSIBILITIES

- **Interactive labels**
  VR solutions can help labels to offer interactive experiences. Customers can explore the product, the manufacturing process or the brand story.

- **Product demonstrations**
  Companies can use VR technology to virtually showcase products, allowing customers to try out products without having to physically go to the store. This can be particularly useful in online retail.

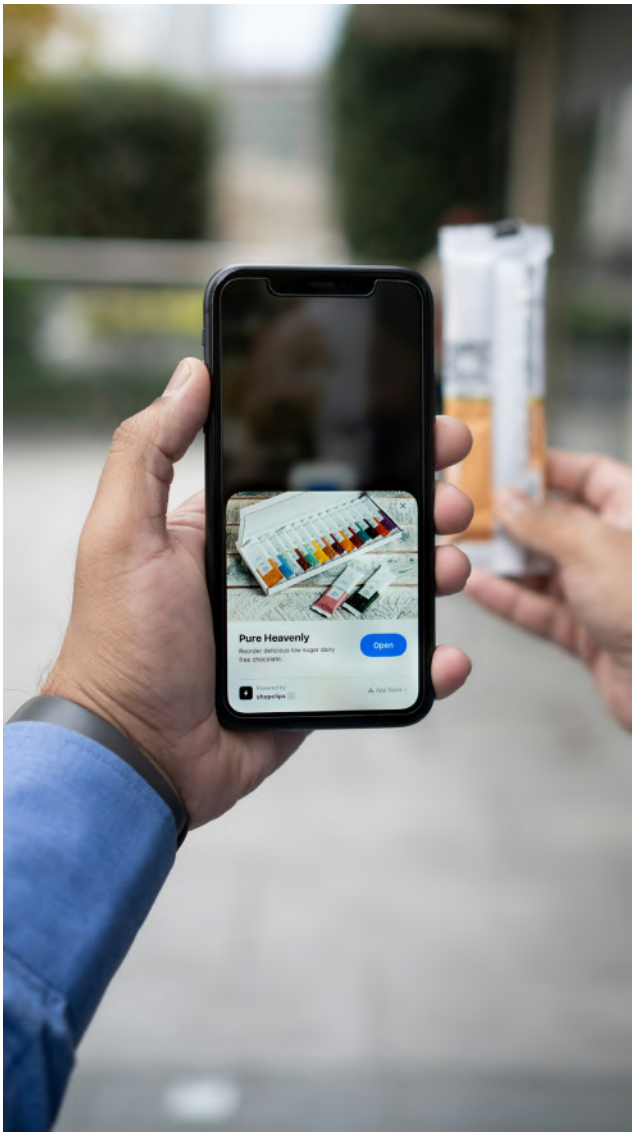
- **Training goals**
  Labels with VR solutions can help companies to educate people on the use and maintenance of products. Customers can learn virtually about product operation and instructions.

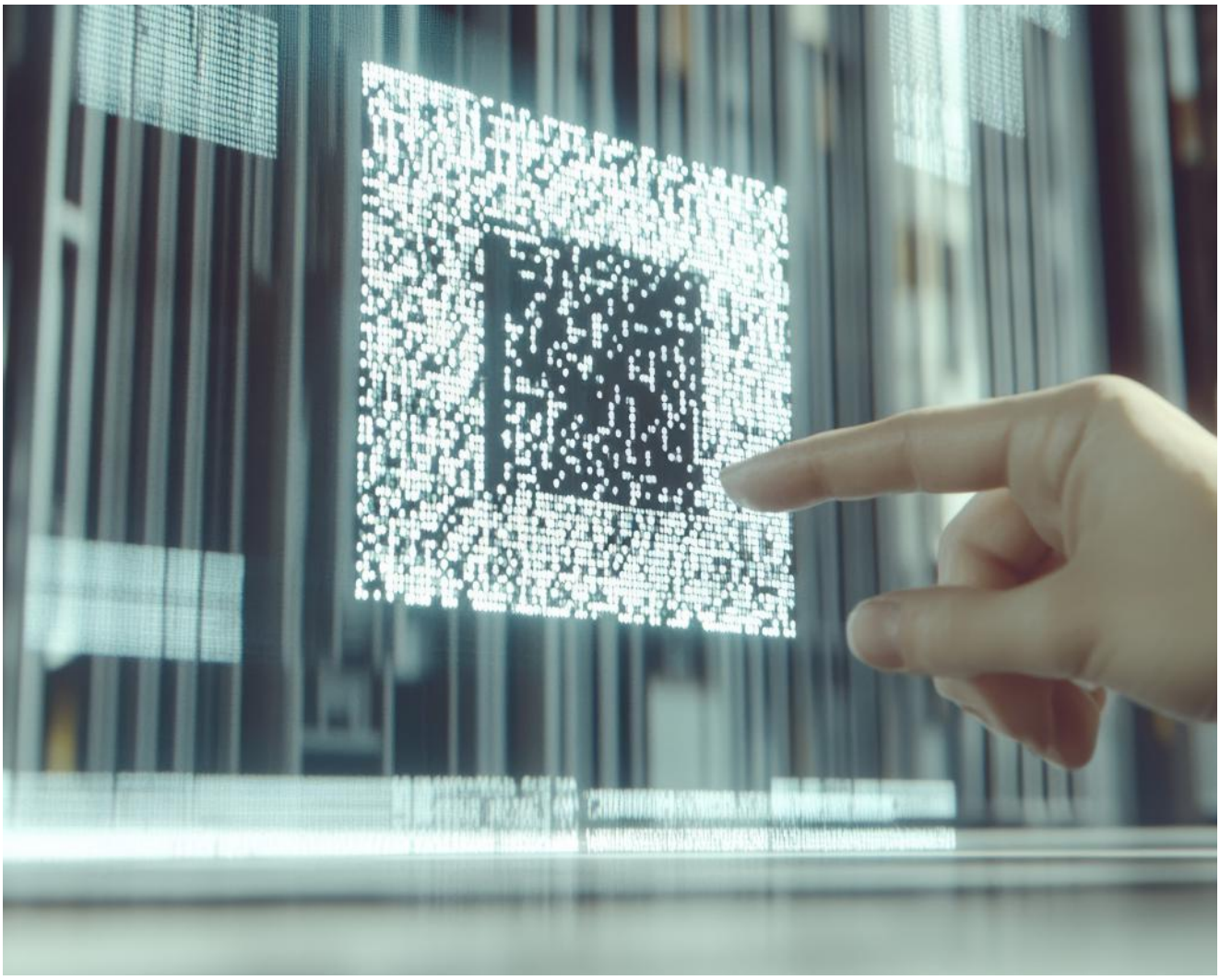
## BENEFITS

- **Experiential marketing**
  VR experiences can help to capture the attention of customers and strengthen the emotional connection to the brand.

- **Innovation and creativity**
  VR allows companies to present their products in new and creative ways, which can become a differentiator in the market.

- **Wide range of applications**
  VR technology can be applied to a wide range of applications, be it food products, fashion or technology devices.





## INTEGRATING QR CODES AND VR SOLUTIONS

By combining QR codes and VR solutions, companies can create more exciting and interactive labels. For example, a QR code placed on a label can give shoppers the opportunity to trigger VR experiences, further engaging them in the stories related to the product.

## EXAMPLE APPLICATION

Imagine a winery places a QR code on a wine label. Consumers can scan the code and enter a VR world where they can virtually tour the winery, see the vineyards, the winemaking process and meet the winemakers. This experience is not only informative but also fun and strengthens the connection with the brand.

## SUMMARY

The integration of QR codes and virtual reality in the production and design of labels is creating new opportunities for marketing and customer experience. Interactive and informative labels not only capture the attention of consumers, but also help companies differentiate themselves in the marketplace. As technology advances, the role of labels will become even more important in the future, and QR codes and VR solutions will play a key role in the success of brands.

# ROBOTICS IN THE PACKAGING INDUSTRY

Converting is a key step in the product manufacturing and packaging process, which has a significant impact on product appearance, protection and logistical efficiency. In recent years, a number of innovations and the use of robotics have revolutionised this area, enabling faster, more precise and cost-effective production processes. In this article, we review the key innovations in converting of packaging materials and the role of robotics.

## CONVERTING OF PACKAGING MATERIALS

Making-up is the process of processing and forming packaging materials, including cutting, folding, gluing, welding and other operations. The aim is to produce a final packaging form suitable for the safe storage, transport and point-of-sale display of products.

## INNOVATIONS IN PACKAGING

### AUTOMATIC CUTTING AND FOLDING EQUIPMENT

These machines are computer-controlled, allowing precise cutting and folding, minimising material loss and errors, thus significantly increasing the efficiency and accuracy of the converting process.

### GLUING AND WELDING TECHNOLOGIES

New bonding and welding technologies, such as ultrasonic welding and hot air bonding, provide faster and more reliable bonds for packaging materials. This results in stronger and longer lasting bonds, faster processing times, lower energy consumption and a wider range of materials to process.

## SMART PACKAGING MATERIALS

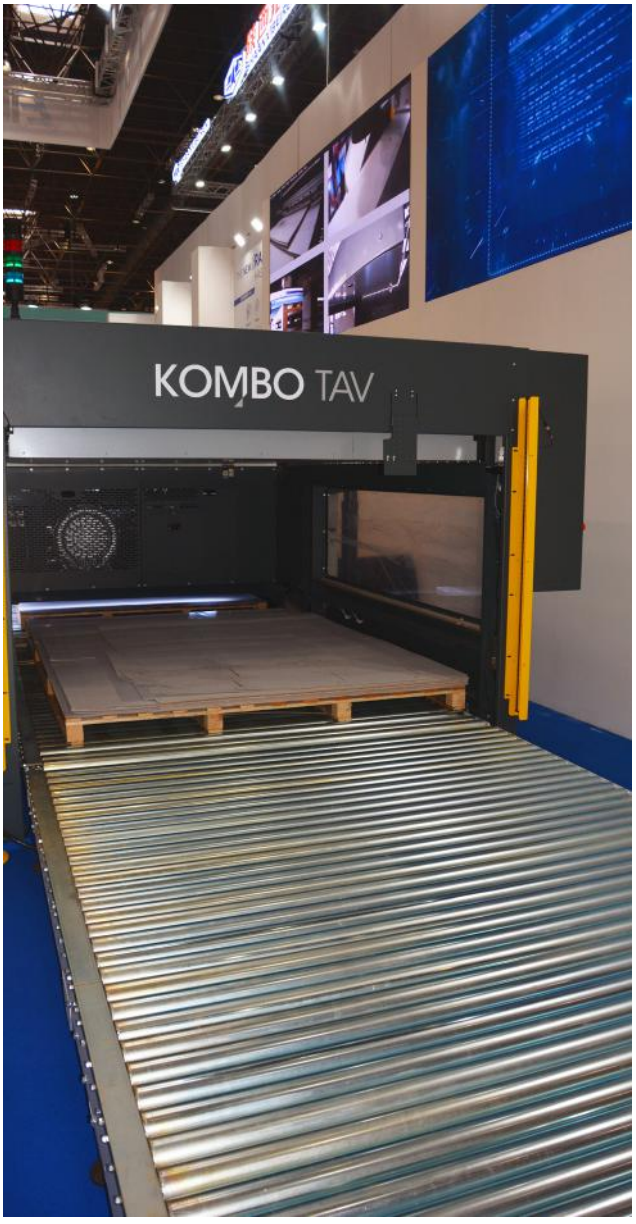
Intelligent packaging is the use of innovative materials and technologies that allow packaging to respond to environmental conditions, monitor product freshness and provide traceability.

- **Their benefits include**
  Improved product protection and safety, longer shelf life, real-time information on product condition, enhanced traceability.

## ENVIRONMENTALLY FRIENDLY MATERIALS

Due the growing demand for sustainability, environmentally friendly packaging materials are becoming increasingly popular. These materials are biodegradable, recyclable or compostable, reducing the environmental footprint.

- **Benefits**
  Reduced environmental impact, better compliance with regulatory requirements, positive brand image.




# ROBOTICS IN CONVERTING

## ROBOTIC ARMS AND AUTOMATED SYSTEMS

Robotic arms and automated systems are widely used in assembly, especially in cutting, folding, gluing and welding. These robots can perform tasks quickly and accurately, reducing human error and increasing productivity.

- **Benefits**
  Increased accuracy and consistency, reduced error rate, continuous operation (24/7), flexibility to perform different tasks.

## INNOVATION IN ROBOTIC CUTTING AND AUTOMATION

For more than 40 years, Elitron has been responding to global challenges with futuristic technologies. As a leading company in robotic cutting and automation, with a European headquarters in Monte Urano, Italy and a US branch in Atlanta. The company unveiled its new Kombo TAV system at Drupa 2024, which takes this state-of-the-art cutting system to a whole new level with redesigned electronics and a faster communication protocol for motion control.

Daniele Gallucci, President of Elitron America, highlighted how this means higher productivity. “It has +35% higher speed, +40% higher production efficiency and -30% lower energy consumption.”

Attracted a lot of attention at Fespa 2025 fair in Berlin, Elitron’s Stressless Working Technology solution, a high-performance video projection that using augmented reality . Also presented at this year’s fair was the patented automatic vision technology,

the Seeker System. This identifies printed reference points and images from above and below, automatically loading and aligning relative crop files. Promoting fast and accurate alignment for cutting operations with minimal waste.

## COLLABORATIVE ROBOTS (COBOTS)

Collaborative robots, or cobots, are robots that can safely interact with human workers. These robots can help perform difficult and monotonous repetitive tasks while human workers can focus on more complex tasks.

Their advantages include flexibility, easy programming and integration into existing systems.

## AUTOMATED QUALITY CONTROL

Automated quality control systems, using cameras and sensors, allow continuous monitoring of packaging materials during production. These systems detect and report defects immediately to ensure high quality.

- **Benefits**
  Immediate defect detection and correction, higher product quality, reduced scrap, continuous quality control.

## IMPACT OF INNOVATION AND ROBOTICS ON CONVERTING

### INCREASED EFFICIENCY AND PRODUCTIVITY

The use of innovative technologies and robotics significantly increases the efficiency and productivity of the converting process. Faster machines and automated systems reduce downtime and increase production speed.

### COST REDUCTION

Automation reduces labour costs and material wastage, resulting in significant cost savings in the medium term. In addition, faster production processes allow for higher volume production, which brings additional economic benefits.

## QUALITY AND ACCURACY

The precision and consistency of robots and automated systems ensure high quality packaging. The continuous monitoring of automated quality control systems further enhances product quality.

## SUSTAINABILITY AND ENVIRONMENTAL PROTECTION

The use of innovative and environmentally friendly packaging materials and energy efficient technologies contributes to more sustainable production processes. This not only reduces the environmental burden but also improves companies' environmental performance and compliance.

## CONCLUSION

Innovation and the use of robotics in the field of packaging converting has revolutionised manufacturing processes. Automatic cutting and folding machines, advanced gluing and welding technologies, intelligent packaging materials and environmentally friendly materials all contribute to more efficient, precise and sustainable production. Robotic arms, cobots and automated quality control systems further increase productivity, improve quality and reduce costs. These advances ensure that packaging converting meets modern market needs and sustainability requirements, while increasing competitiveness in the industry.

# ROBOTICS AND INDUSTRY 4.0 IN THE PRINTING AND PACKAGING

The printing and packaging industry is constantly evolving, and the integration of Industry 4.0 and robotics solutions is creating new opportunities to increase efficiency, quality and sustainability. Automation, data collection, machine learning and the use of intelligent systems are revolutionising traditional processes and enabling companies to be more competitive in the global market. This article shows how robotics and the concept of Industry 4.0 are being applied in the printing and packaging industry.

## INDUSTRY 4.0 AND AUTOMATION

### WHAT IS INDUSTRY 4.0?

Industry 4.0 represents the fourth industrial revolution, focusing on smart manufacturing, automation and data-driven decision making. Industry 4.0 aims to connect the physical and digital worlds, enabling real-time data exchange and communication between machines.

## APPLICATION IN THE PRINTING AND PACKAGING INDUSTRY

- **Smart manufacturing**
  Industry 4.0 solutions can help automate and optimise manufacturing processes. Intelligent machines can operate autonomously, monitor production and react to changes.

- **Data collection and analysis**
  IoT (Internet of Things) devices enable real-time data collection on manufacturing processes. Data analysis helps improve production efficiency, reduce costs and prevent errors.

- **Maintenance 4.0**
  By using predictive maintenance, companies can predict when machines are likely to break down or fail, minimising downtime and improving the reliability of production processes.

## ROBOTICS IN THE PRINTING AND PACKAGING INDUSTRY

- **Automated packaging**
  Robots can package products quickly and accurately, reducing labour and increasing production speed. Automated packaging lines are flexible to adapt to different products.

- **Automation of printing processes**
  Intelligent robots can automate parts of the printing process, such as loading paper or other print media, print error checking and quality control, increasing production accuracy and reducing errors.

- **Finished product handling**
  Robots can move, package and sort finished products quickly and efficiently, reducing the burden on human labour and increasing production speed.

- **Warehousing and logistics**
  Automated warehousing systems and robots optimise stocking and distribution of products, making logistics processes more efficient.

## THE IMPACT OF ROBOTICS AND INDUSTRY 4.0

- **Increased efficiency**
  Automation and robotics can significantly increase production efficiency, allowing faster production and fewer errors.

- **Improved quality**
  Intelligent systems continuously monitor production processes, enabling rapid error correction and quality control, which improves the quality of the final product.

- **Flexibility**
  Robots and automated systems can adapt quickly to changing needs, enabling cost-effective production even for small and medium batches.

- **Cost efficiency**
  Industry 4.0 solutions can reduce manufacturing costs in the long term by minimising labour requirements and improving production processes.

- **Sustainability**
  The use of automated systems and digital technologies contributes to more sustainable manufacturing practices, reducing energy and material consumption.

## AGEING SOCIETY, FEWER ACTIVE WORKERS - MORE ROBOTS

Japan is a good example of this, as its ageing society and the proliferation of industrial robots are closely linked, generating a range of economic and social impacts. Japan has a rapidly ageing population and a shrinking working-age population due to a declining birth rate. This poses a number of problems for the labour market.

The spread and development of industrial robots is a response to labour shortages and social challenges.

## THE JAPANESE PRINTING INDUSTRY

According to Yasukane Matsumoto, CEO and founder of Raksul, the Japanese printing industry is worth around USD 50 billion. In 2019, the commercial printing sector accounted for the largest share of the manufacturing value of printed products, at JPY 135.32 billion. The packaging printing sector had a production value of JPY 82.56 billion.

## THE PACKAGING INDUSTRY IN JAPAN

According to GlobalData, Japan's packaging industry reach 164.7 billion units output in 2024, a CAGR of 0.5% between 2019 and 2024.

For rigid plastic packaging, this represents a CAGR of 2.2% over 2019-2024, while the flexible packaging sector recorded a CAGR of 0.6% over the same period.

The food industry has the largest market share of 44.0% in packaging, followed by non-alcoholic beverages at 32.8% and alcoholic beverages at 12.0%.

- **Alleviating labour shortages**
  The working age population in Japan is shrinking, while the economy needs continued production and services. Robots, especially in manufacturing and logistics, play a major role in automating industrial work. But robots not only fill labour shortages, they can also reduce the physical burden on workers, which is particularly important in an ageing society.
- **Technological development and competitiveness**
  The development of robotics and artificial intelligence will help Japan maintain its global competitiveness, especially in industries such as automotive, electronics and precision engineering. Industrial robots not only alleviate labour shortages, but also contribute to economic growth and job retention, especially in industries where a high level of precision is required.


## SUMMARY

The integration of robotics and Industry 4.0 is revolutionising the printing and packaging industry, allowing production processes to be optimised, costs to be reduced and product quality to be improved. Smart technologies, automation and real-time data collection not only increase competitiveness, but also contribute to more sustainable industrial practices. As technological advances continue, the future printing and packaging industry is expected to rely even more on innovation and automation, creating a more efficient and sustainable environment.

# COLOUR MANAGEMENT SOLUTIONS

Colour management is key to the printing industry as it ensures accurate, consistent and high quality colour reproduction across a wide range of substrates and printing technologies. Proper colour management not only enhances the aesthetic value of the final product, but can also reduce production costs and errors by minimising errors. In this article, we will review the benefits of colour management in printing and also introduce some commonly used software solutions.

## THE IMPORTANCE OF COLOUR MANAGEMENT

The fundamental aim of colour management is to accurately and consistently represent colour from design to printed product. This is particularly important to maintain brand identity, where colours must match exactly those defined in the corporate identity manual.

## QUALITY CONTROL AND COST EFFICIENCY

By colour management processes, print quality can be continuously monitored and calibrated. This minimises printing errors, such as colour deviations, which can lead to costly reprints and material wastage.

## PANTONE MATCHING SYSTEM (PMS)

The Pantone Matching System is a standard colour management system that has provided uniform colour identifiers since 1963. Pantone colours provide accurate and consistent colour reproduction regardless of which printing technology or device is used. The PMS system covers a wide range of colours and helps designers and print professionals accurately identify the colours they want in colour communication, all over the world. The Pantone colour system allows the specification of direct colours that cannot be mixed from the traditional four primary colours (CMYK).

## HOW DOES IT WORK?

Pantone colours are described by the number assigned to them, for example PMS 205 pink. The Pantone Colour Matching System identifies thousands of colours, including metallic and fluorescent colours. And the suffix code refers to the paper/substrate on which the colour is printed. C is for coated paper or other non-absorbent substrate and U is for uncoated paper/absorbent substrate. For the production of coloured plastic parts, the Pantone Plastic Color reference number is used. Colour references are denoted by Q or T followed by a three-digit number identifying the colour. The letter Q refers to the colour printed on opaque plastic and the letter T refers to transparent plastic.

## WHY IS IT BENEFICIAL?

Different manufacturers, in different locations, can use the Pantone colour system without physically meeting, because the same colour code can be used to denote the same colour in another location. Standardising colours eliminates guesswork, providing consistent graphics or brand logos.

## COLOUR ACCURACY MONITORS

Colour accuracy monitors are displays that reproduce colours accurately and faithfully. These types of monitors have greater colour depth and colour accuracy so that designers can see exactly how colours will appear on the product.

## SPECTRAL COLOUR PERCEPTION

Spectral colour sensing technology uses the spectrum of light to measure colour more accurately and in greater detail. This allows for fine-tuning of colours and more accurate navigation across the entire spectrum during colour reproduction.

A spectrophotometer illuminates the sample with white light for measurement. The sample absorbs a part of the light and reflects a part of it. The reflected light passes through a detector, which splits the light into separate wavelength intervals and transmits these values to the instrument itself or to a connected computer. The reflectance of the sample is expressed as a fraction or percentage.

Ink and paper manufacturers, printers and others need the data provided by the spectrophotometer. Spectrophotometers typically measure every 10 nanometres at visible wavelengths (400-700 nm) and produce a spectral reflectance curve. These curves can be used to ensure that the colour meets a given specification.

## SOFTWARE SOLUTIONS FOR COLOUR MANAGEMENT

### ICC PROFILES

The International Color Consortium (ICC) profiles are essential tools for colour management. Their use ensures that colours are displayed consistently on different devices, minimising colour variations. These profiles describe the colour characteristics of different devices (such as monitors, printers and scanners), allowing colours to be accurately transferred from one device to another.

## SOME COMMONLY USED COLOUR MANAGEMENT SOFTWARE

There is a wide range of colour management software available to help to optimise the printing process and manage colours accurately. These include Adobe Photoshop, CorelDRAW, X-Rite i1Profiler and GMG Color.

### ADOBE PHOTOSHOP

Adobe Photoshop is an excellent choice for graphic designers and print professionals thanks to its extensive colour management tools. The software allows the application of ICC profiles, colour calibration and colour correction.

### CORELDRAW

CorelDRAW is another popular colour management software that offers a comprehensive set of tools for colour calibration and colour management. The integration of ICC profiles allows you to accurately display colours and improve the printing process.

### X-RITE I1PROFILER

X-Rite i1Profiler is a professional colour management software specifically designed for creating and managing colour profiles. The software provides accurate colour calibration and ICC profiles for different printing devices.

## GMG COLOR

GMG Color's colour management software is specifically designed for the printing industry and offers a comprehensive set of tools for colour management and optimisation of the printing process. The software supports ICC profiles and offers advanced colour calibration functions.

## COLOUR MANAGEMENT METHODS AND PRACTICES

### CALIBRATION

Regular calibration is essential in the colour management process. Calibration of printers, monitors and other devices ensures that colours are accurately displayed and remain consistent throughout the printing process.

### COLOUR MANAGEMENT SYSTEMS

Colour Management Systems (CMS) provide a comprehensive solution for colour management, allowing accurate management and calibration of colours from design to print. These systems integrate ICC profiles, colour calibration tools and other colour management functions.

## HIGH DYNAMIC RANGE (HDR)

HDR technology offers a wider colour gamut and contrast ratio, resulting more rich and sharp images. This is particularly important in today's high-quality packaging materials, but also in the media industry and digital content production, where high-quality colour reproduction is essential to enhance the visual experience.

## PROOFING

Proofing allows you to pre-check and calibrate colours before printing. This minimises errors and ensures that the colours of the final product match the design exactly.

## FINAL WORDS

Colour management is essential during printing to ensure accurate and consistent colour reproduction. The use of ICC profiles, colour management software and colour management systems enables print professionals to produce high quality products while reducing waste and optimising production processes. The use of advanced colour management methods and practices not only increases the competitiveness of printing houses, but also contributes to sustainable and efficient printing solutions.

# SUSTAINABLE PROTECTIVE PACKAGING IN THE LATE 1800S

By the end of the 1800s, the first wave of globalization had brought new challenges to trade. The increased international trade in the wake of the Industrial Revolution had forced new solutions not only for production but also for transportation. This was especially true for products stored in fragile bottles, such as Hunyadi János glauber salt curative water. This Hungarian-origin, laxative mineral water was in demand worldwide and required special protection in its conquest of overseas markets. The answer was the straw wrapping.

## WHAT IS A STRAW SLEEVE?

A straw sleeve – also known as straw wrapper – was one of the most common natural packaging materials for fragile goods in the 19th century. The process involved wrapping straw tightly around a glass bottle, often in multiple layers, to cushion the impact and prevent breakage.

This simple but highly effective method became ideal for long, rough journeys – especially sea transport, where goods often traveled for weeks or months in the holds of ships in variety of conditions.

## THE CASE OF HUNYADI JÁNOS GLAUBER SALT CURATIVE WATER

Hunyadi János glauber salt curative water gained great popularity not only throughout Europe but also in the United States in the last third of the 19th century. However, its export has troubled: the carbonated, mineral water was sold in glass bottles, which could easily break during transportation.

Manufacturers therefore wrapped individual bottles in straw sleeves and then packed them in wooden crates. The inside of the crates was often filled with addition-

al straw or wood shavings to provide stability and shock absorption for the bottles. An average crate contained 12–24 bottles, and the straw sleeves not only provided protection but also allowed for natural ventilation, which was especially important when shipping to warmer climates.

In 1878, in Vác, Hungary, the straw sleeve factory of András Saxlehner began operating. Initially employing 20, later 40 – mostly female – employees, the factory was already producing several million straw sleeves by the turn of the century, exclusively for the packaging of Hunyadi János glauber salt curative water. In addition to the factory building, the area of more than 8,000 square meters also included a fire station and three large straw barns. The special foot-operated sewing machines for making straw sleeves were the company's own inventions, which were protected by a patent.

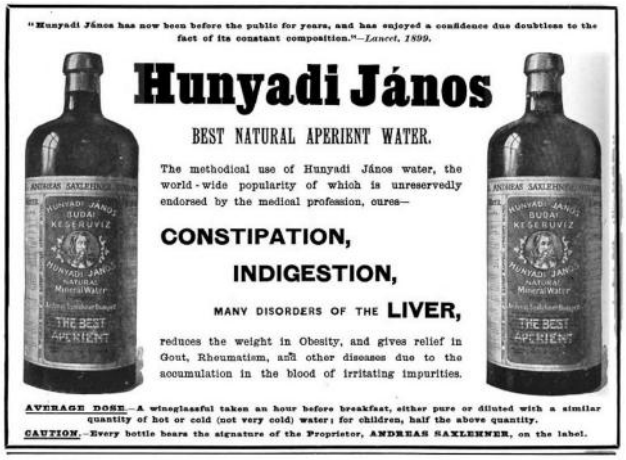
## WHY WAS IMPORTANT THE STRAW SLEEVE PACKAGING?

- **Economical**
  Straw was an abundant, cheap by-product of agriculture.

- **Biodegradable**
  Sustainability came naturally to 19th-century people – even if it wasn't called that at the time.

- **Effective**
  It had surprisingly good shock-absorbing properties.

- **Easy to handle**
  Storing and removing bottles in straw packaging was easy, and export partners appreciated this practical packaging form.


"Hunyadi János has now been before the public for years, and has enjoyed a confidence due doubtless to the fact of its constant composition."—*Lancet, 1899.*

**Hunyadi János**

BEST NATURAL APERIENT WATER.

The methodical use of Hunyadi János water, the world-wide popularity of which is unreservedly endorsed by the medical profession, cures—

**CONSTIPATION,**
**INDIGESTION,**
MANY DISORDERS OF THE **LIVER,**

reduces the weight in Obesity, and gives relief in Gout, Rheumatism, and other diseases due to the accumulation in the blood of irritating impurities.

AVERAGE DOSE.—A wineglassful taken an hour before breakfast, either pure or diluted with a similar quantity of hot or cold (not very cold) water; for children, half the above quantity.

CAUTION.—Every bottle bears the signature of the Proprietor, ANDREAS SAXLEHNER, on the label.

## THE DISAPPEARANCE OF THE STRAW SLEEVE

In the early 20th century, due the development of industrial packaging technology – such as the advent of corrugated cardboard and plastic foams – the straw sleeve was gradually replaced by new, mechanized packaging solutions. However, in its time, the straw sleeve played a key role in allowing this medicinal water to reach the overseas.

Around 1890, bottles labeled Hunyadi János regularly appeared in the windows of New York pharmacies - often in straw sleeves, so customers could be assured of the authenticity of the origin and safe transportation.

# TEST TOOLS FOR THE PRINTING A

# AND PACKAGING INDUSTRY

**DIN, FORD, ISO, ZAHN CUPS**
for viscosity measurement

**K HAND COATERS**
for easy, fast and accurate printing test

**TEST-INKS AND TEST-PENS**
for determining surface tension and printability


**PANTONE, RAL AND OTHER COLOR SCALES**
for color communication

# SUSTAINABILITY IN PACKAGING PRODUCTION AND PRINTING

Sustainability is playing an increasingly important role in the production and printing of packaging materials as global environmental challenges and consumer demands change. Sustainable packaging not only aims to minimise environmental impacts, but also takes into account economic and social considerations. This article presents the principles of sustainability in packaging manufacturing and printing processes, as well as the latest trends and innovations.

## THE CONCEPT OF SUSTAINABILITY

Sustainability is a model of development that allows us to meet the needs of the present without compromising the potential of future generations. In packaging production and printing, this means

- **Using environmentally friendly materials**
  Using materials in the manufacturing process that are recyclable, biodegradable or from sustainable sources.

- **Waste minimisation**
  Optimising production processes to reduce unnecessary waste.

- **Energy efficiency**
  Using production methods that require less energy, thereby reducing the carbon footprint.

## WHY IS SUSTAINABILITY IMPORTANT?

Packaging production and printing have a significant impact on the environment. Increasing and unfortunately not always responsible use of plastics, fossil fuels and deforestation contribute to global warming, biodiversity loss and pollution. Sustainability aims to minimise these impacts and find solutions that protect the planet for future generations.

## SUSTAINABLE PACKAGING, REUSABLE AND RECYCLED MATERIALS

When designing packaging materials, the use of reusable and recycled materials is key. The use of recycled paper, cardboard and plastics reduces the demand for primary raw materials, thereby reducing the environmental impact of production.

## BIODEGRADABLE MATERIALS

Biodegradable materials, such as corn starch or sugar cane-based packaging, can offer a more environmentally friendly alternative to traditional plastics. These materials can be degraded, albeit in many cases not in nature, but in industrial composting conditions, but at least reducing the burden on landfills. However, it is worth looking at their whole life cycle - their environmental footprint - to really assess how environmentally friendly they are as an alternative.

## SUSTAINABLY SOURCED MATERIALS

Sustainably sourced materials, such as FSC (Forest Stewardship Council) certified paper, ensure that the materials used are responsibly produced, protecting forests and biodiversity.

Paper-based packaging is becoming increasingly influential as the packaging material of choice for more and more food packaging, due to its perceived environmental and sustainability benefits for both consumers and brand owners.

## SUSTAINABLE PRINTING, MORE ECO-FRIENDLY INKS

Eco-friendly inks, such as water-based and biodegradable inks, reduce air and water pollution. These inks contain fewer harmful substances and are suitable for sustainable printing processes.

## DIGITAL PRINTING

Digital printing enables accurate and flexible production, reducing waste and raw material consumption. Digital technology is particularly advantageous for short-run printing, as it does not require the preparation costs and materials needed for traditional printing processes.

Digital inkjet printing can also contribute to sustainable paper packaging, helping manufacturers and brand owners thanks to the speed to market, flexibility and ease of use of prototype, low-volume/personalised packaging materials.

Using a water-based (food-grade) inkjet digital printing press (instead of traditional analogue presses such as flexo), can reduce the environmental impact ($CO_2$ footprint) in the overall LCA assessment due to: lower energy consumption, water-based inks (solvents [VOCs], waste reduction such as plates/cylinders, overproduction, etc.).


## WASTE MINIMISATION

Sustainable printing processes aim to minimise waste. Optimised design can reduce the amount of material used, while precision printing technologies result in less waste.

## INNOVATIONS AND TRENDS

### CIRCULAR ECONOMY

The circular economy model focuses on the continuous reuse and recycling of materials, reducing waste production. Increasingly, companies are looking for solutions that enable the cyclical use of materials.

### SUSTAINABLE PACKAGING DESIGN

Integrating sustainability into packaging design is a key. By incorporating ecological design principles, manufacturers are able to create packaging materials that have a minimal impact on the environment.

## TECHNOLOGICAL DEVELOPMENTS

New technologies such as 3D printing and automation are enabling more sustainable manufacturing processes. These technologies can reduce production time, material use and environmental impact.

## CONSUMER AWARENESS

Consumers are becoming increasingly aware of sustainability and companies need to take this trend into account. Sustainable packaging and printing is not only environmentally friendly, it can also provide a competitive advantage in the market.

## BENEFITS AND FUTURE PROSPECTS

- **Environmental benefits**
  Sustainable solutions reduce carbon emissions, water consumption and waste.

- **Economic benefits**
  Environmentally friendly materials and technologies can be more cost-effective in the long term by reducing the use of raw materials and energy.

- **Consumer demand**
  Consumers increasingly prefer sustainable products, encouraging companies to adopt green solutions.


## FINAL WORDS

Sustainability in packaging production and printing is not only a trend but a necessity. The use of environmentally friendly materials and manufacturing processes helps reduce environmental impacts and contributes to a more sustainable future. Companies should invest in sustainable solutions as they not only protect the environment but also provide economic benefits. As the world moves towards sustainability, may the green solutions will the future of packaging and printing.

# NEW EU PACKAGING REGULATIONS

Regulation (EU) 2025/40 of the European Parliament and of the Council on packaging and packaging waste was adopted on 16 December 2024 and published in the Official Journal of the European Union on 22 January 2025. To be applied from 12 August 2026.

The first version of the PPWR was published at the end of 2022, and its negotiation and adoption was a long process. The legislation is very comprehensive and complex, going far beyond the previous Directive 94/62/EC of the European Parliament and of the Council on packaging and packaging waste, which was adopted three decades ago. The level of regulation - which, unlike the Directive, implies an obligation to apply it in the Member States without transposition - has been promulgated in some 134 pages, defining 71 concepts and 71 subjects, with 13 annexes. Further related legislation and the obligation to develop a number of standards will also be included in the PPWR, so that the whole regulatory framework will be transformed in the coming period. This will be a major challenge for packaging designers and developers, manufacturers, product distributors and policy makers.

The European Union (EU) is constantly working to promote environmental protection and sustainable development, with a focus on new packaging standards. These standards not only aim to improve the efficiency and safety of packaging, but also focus on minimising its environmental impact. The following is an overview of the new EU packaging standards and the targets set for 2030-2040.

The new rules are expected to lead to much less packaging waste in the future. The regulation sets binding reuse targets, limits certain types of single-use packaging, requires industry players to minimise the amount of packaging material used and sets rules for the whole life cycle of packaging.

## SAFE, SUSTAINABLE AND RECYCLABLE PACKAGING

Among other things, the new rules set out the following packaging requirements:

All packaging placed on the market must be recyclable, i.e. packaging must be designed with recycling in mind, so that when

it becomes waste it can be collected separately and recycled to a significant extent. The PPWR Regulation also requires a minimum recycled content for plastic packaging. This is 30% for contact sensitive PET packaging and single-use plastic beverage bottles, 10% for contact sensitive plastic packaging other than PET and 35% for other plastic packaging other than PET. From 1 January 2040, these rates will increase significantly to 50% for PET contact sensitive packaging and 65% for single-use plastic beverage bottles.

However, there are exceptions, for example for certain medical devices, veterinary equipment, compostable packaging, packaging for dangerous goods. If the amount of recycled content poses a risk to human health, the above rates do not apply to plastic food contact packaging.

## DESIGN

The regulation also requires design changes to minimise harmful substances.By 1 January 2030, the manufacturer or importer must ensure that packaging is minimised, taking into account both its shape and material. This means that its weight and volume are reduced to the minimum necessary to ensure its functionality.

There are exceptions in this case, e.g. in the case of designs and protected geographical indications.

The presence of so-called 'substances of concern' should be minimised, including restrictions on the placing on the market of packaging that comes into contact with foodstuffs and contains per- and polyfluoroalkyl substances (PFAs) and heavy metals in excess of specified thresholds.

## LABELLING

Labelling, marking and information requirements (e.g. those relating to material composition or recycled content) are designed to help consumers sort waste more easily and make a more informed choice between products.

## REUSE TARGETS AND REFILL OBLIGATIONS

The Regulation sets new mandatory reuse targets for 2030, which vary depending on the type of packaging used by companies (e.g. 40% for transport and consumer packaging and 10% for collective packaging).

Most notably, at least 10% of alcoholic and non-alcoholic beverages must be marketed in reusable packaging. The 2030 target will rise to 40% by 2040. Significantly promoting the use and uptake of so-called 'multi-packs' across the EU.

Under the new rules, takeaway food and drink businesses will have to offer their customers the option of filling their own containers with the hot or cold drinks or ready meals they buy, at no extra cost.

## SINGLE-USE PLASTIC PACKAGING (SUP)

The new rules introduce restrictions on single-use plastic packaging for the following product categories:

- pre-packed fruit and vegetables up to 1.5 kg,
- food and drink served and consumed in hotels, bars and restaurants,
- condiments, sauces, coffee creamers and sugar offered in hotels, bars and restaurants in single portion sizes,
- small single-use cosmetics and toiletries (e.g. shampoo bottles, bottles containing body lotion) used in the accommodation services sector,
- very lightweight plastic bags, except where their use is necessary for food safety and hygiene reasons, e.g. for food sold in bulk in markets.

## EU TARGETS FOR 2030-2040

### TARGETS FOR 2030

- **Recycling rates**
  The EU aims to have packaging on the market that can be recycled by 2030, and sets performance targets for this. Packaging that does not achieve 70% recyclability will not be placed on the market. This rate will rise to 80% by 2040.

### TARGETS FOR 2040

- **Zero Waste target**
  The EU aims to minimise packaging waste, striving for a "zero waste" philosophy. To achieve this, packaging practices need to be transformed so that all materials used are returned to the economy in some form.

- **Sustainable packaging standards**
  This will help ensure that companies act in a unified way to promote sustainability.

- **Innovation and research**
  2040 targets include research and development of sustainable packaging solutions. The EU wants to stimulate innovation in the industry to develop new technologies and materials that are more environmentally friendly.

## IMPACT ON THE INDUSTRY

New packaging regulations and targets present many challenges but also opportunities for packaging manufacturers and the printing industry:

- **Developing new technologies**
  The industry will need to develop innovative solutions to meet the new regulations, which could also create new business opportunities.

- **Increased competitiveness**
  The adoption of sustainable practices and green solutions can improve the competitiveness of companies in the medium term as consumers increasingly prefer environmentally friendly products.

- **Training needs**
  To comply with new regulations, companies need to provide training for their employees to understand the importance of sustainability and the use of new technologies.

## BACKGROUND

While recycling rates have increased in the EU, the amount of packaging waste is growing faster than the amount of packaging waste recycled. In 2022, nearly 186.5 kilograms of packaging waste per person will be generated in the EU. Of this, 36 kg was plastic packaging. This means that the amount of packaging waste per person in the EU is nearly half a kilogram every day.

## SUMMARY

The new EU packaging standards and the 2030-2040 targets are important steps towards sustainable development. Achieving the targets will require companies, governments and consumers to work together to make the production and use of packaging more environmentally friendly. Increasing demand for sustainable packaging solutions will not only help the environment but can also create new opportunities for the industry.

We would like to thank the **Hungarian Association of Packaging and Materials Handling** and the **Hungarian Association of Environmental Enterprises** for their assistance in the preparation of this article.

## BACKGROUND INFORMATIONS

**Packaging** | **Circular economy** | **Green Deal**

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