Digitalization of the printing industry – challenges, technologies, and opportunities
## Digitalization of the printing industry

### Contents:

- A challenge for revolutionaries 3
- Print 4.0 – why the Smart Factory is just one milestone 4
- Digital technologies and their significance for printing 5
  - 1. Artificial intelligence 5
  - 2. Cloud computing 6
  - 3. The Internet of Things 7
  - 4. Big data and analytics 8
  - 5. Blockchain 9
  - 6. Robotics 10
  - 7. The platform economy 11
- Digitalization strategies for printing companies 12
- The conclusion – now is the time to act 19
- How am I doing? Determining your digital maturity 20
A challenge for revolutionaries

When people talk about the digital transformation, they like to draw comparisons with the introduction of steam engines or assembly lines. Reference is rarely made to the invention of letterpress printing with movable type by Johannes Gutenberg, and yet the media revolution triggered by printing houses nearly 600 years ago has far more parallels with the current digital transformation than steam engines or assembly lines ever could.

Just like Bill Gates, Steve Jobs, or World Wide Web inventor Tim Berners-Lee, the early printers were also revolutionaries. After all, their work provided impetus for countless other innovations by making existing knowledge freely available – a highly productive source that ultimately also laid the foundations for today’s new digital world order. Letters, images, and other symbols still ostensibly play a key role in this world, but everything actually revolves around data. It is regarded as the oil of the 21st century, because it fuels the development of new digital technologies while at the same time creating the basis for data-driven decisions and new business opportunities.

The printing industry is particularly affected by the associated changes for two reasons. On the one hand, printed media have become less important in the face of digital communication. On the other, the digital transformation is moving the goalposts when it comes to competition. In the future, the most successful commercial and packaging printers will be the ones who make their processes leaner and faster, who get more out of their data, and who can adapt more effectively to the needs of customers with an increasingly digital setup. All that requires new ways of thinking and working, which in turn demands an understanding of the key technologies and their potential for the printing industry.

This white paper describes how the digital transformation is affecting the sector and outlines the technologies print shops should consider when establishing or expanding their digitalization strategy. It also highlights the main aspects involved in developing a digitalization strategy.
Digitalization of the printing industry • Print 4.0

Print 4.0 – why the Smart Factory is just one milestone

Ever since the introduction of computer-to-plate (CtP) technology in the 1990s, digitalization has been a recurring theme in the printing industry. However, a common overall concept combining the various new digital developments and integration efforts to good effect only emerged some 25 years later with Print 4.0/the Smart Print Shop and the associated vision of a fully digitalized print shop where intelligent machines and automated workflows complete any job with any desired run length in a fully autonomous process.

There are several reasons why this appeals to print shops. For years, the industry has been facing shrinking runs and fierce competition on prices. At the same time, the skills shortage is growing, while businesses also need to cope with job structures that are increasingly customized and complex. Margins are all about process quality and the degree of automation, and this is exactly where a huge amount of potential remains, because prepress and postpress operations still take too much time in a large number of businesses. In many cases, that means just 25 percent of press capacity is utilized, even though sufficient jobs are available. All this generates unnecessarily high costs that further squeeze margins.

Digitalization also requires new business models
Concepts such as the Smart Print Shop offer a solution to this dilemma. They take a holistic approach to the value chain and demonstrate how the combined use of efficient workflows, intelligent machines, and data-based performance optimization can unlock potential in terms of productivity and costs. Despite that, the objectives associated with Print 4.0/the Smart Print Shop can meet only some of the challenges thrown up by the digital revolution. Even companies that are already operating what is, to all intents and purposes, a Smart Print Shop, will be stuck in a halfway house if they focus exclusively on digitalizing their production and business processes.

There’s no doubt about it – automated processes are vital prerequisites to secure a company’s long-term livelihood. However, the further the economy’s digital transformation progresses, the clearer it becomes that business models rather than technology and production represent the real revolution. For example, the fact that companies such as Airbnb and Uber are shaking up traditional markets without owning a single hotel or taxi demonstrates how powerful new ideas can be in the age of digitalization. Innovative commercial and packaging printers in particular should therefore act quickly, thinking about how they can use the digital opportunities to develop a data-based business model and which technologies will help them offer their customers and business partners relevant added value.
Digitalization of the printing industry

Digital technologies and their significance for printing

Artificial intelligence

Artificial intelligence (AI) is the generic term for digital applications where data “trains” software or machinery to recognize patterns and correlations. The more thorough this training, the more effective AI’s subsequent decision-making and problem-solving. One typical application that also illustrates the current limits of AI is autonomous driving with the help of machine learning (ML). In this case, training data in the form of many millions of images ensures artificial intelligence can recognize traffic signs and other road users thanks to a variety of sensors and, on this basis, make real-time adjustments to how the vehicle is being driven. Navigational data and geodata are also taken into account for predictive autonomous driving.

In production, AI is increasingly being used where large volumes of data are collected in machines or MIS, CRM, and ERP systems. Print shops utilize AI, for example, to detect defects and eject waste sheets, in the form of digital assistants such as Performance Advisor Technology (PAT) from Heidelberg for process optimization, to make sales forecasts, and to minimize stocks levels. However, AI also has great potential when it comes to sales and marketing. For instance, AI-based standard tools help to analyze industry trends and implement personalized marketing campaigns or measures to ensure the best possible customer experience.

AI is a key technology for automating complex end-to-end processes, all the way through to the entire digital business model. In most cases, AI projects use AI tools and services that are normally available via the cloud.
Cloud computing

Cloud computing is increasingly also being used by smaller companies as the solution of choice to benefit from state-of-the-art IT applications and services without investing in hardware or IT expertise. Most companies and organizations that need to meet strict data protection requirements opt for a hybrid cloud approach. In other words, to retain control over security-relevant tasks, these are handled within their own IT landscape. Less critical workloads, on the other hand, are migrated to the public cloud, which has the flexibility to scale capacities and can therefore respond quickly to new business requirements or growth potential.

In the case of providers such as Heidelberg, Amazon Webservices (AWS), and Microsoft Azure, companies rent computing power/infrastructure, storage space, or applications and services. Since these companies normally pay a usage-based charge for services, taking their first steps into the public cloud is relatively inexpensive. This approach also eliminates the costs associated with hardware investments and system maintenance. Hundreds of services are available – from infrastructure solutions and databases to specific software solutions for AI, data lakes, and the Internet of Things. Heidelberg also offers a rapidly growing number of industry-specific cloud services, including benchmarking, process optimization, remote services, and virtual control of print production or entire operations.
In the Internet of Things (IoT), it’s not just computers that have their own IP address. Any object with the necessary chips can have one. The networked objects collect data relating to their transactions, status, or surroundings – either individually or in combination – and can be controlled and/or monitored online using a wireless, Bluetooth, or Wi-Fi connection. There are currently over 27 billion networked devices in use around the globe. These can be everyday items such as TVs, radios, and electric garage doors or complex objects such as machines, driverless vehicles, and urban infrastructure, including lighting. The Heidelberg Internet of Things alone already has more than 10,000 connected presses. Together with over 15,000 Prinect software modules, they supply a continuous flow of status and performance data for various digital applications and apps.

Popular IoT applications in the printing industry are based primarily on RFID technology. Items such as print products, pallets, and consumables use this technology to control their own logistics, thereby making a key contribution to in-house automation. In combination with printed RFID chips, labels for premium products are now additionally tagged for logistics control purposes or, in the case of items such as pharmaceutical and food packaging, to check whether the cold chain has been maintained. Machines, storerooms, transport robots, and drones are now also an intrinsic part of the Internet of Things and a key prerequisite for the virtual control of print shops or entire value networks.
Big data and analytics

As a company’s level of digitalization increases, huge volumes of data are generated. This is referred to as big data. If big data is to be used to control operations or to develop and monetize digital business models, the available data needs to be complete, centralized, and of a high quality. Only then does it provide a true picture of the actual circumstances, which is in turn a prerequisite for reliable analyses and forecasts, and for efficient operational control.

However, the majority of big data is nothing more than raw data. Only if this wealth of data is provided on a cross-company basis for data analytics solutions does it become valuable information and the driving force behind a data-driven organization. And only then can decision-makers use evaluations to react to changes quickly and confidently. The structured collection and analysis of data also creates transparency regarding purchasing processes and customer activities throughout the digital customer journey. The resulting in-depth understanding of customer behavior and expectations can be used to optimize offerings, products, and business ideas on an ongoing basis.
Blockchain

Although blockchain technology is relatively new, it could play a key role in Industry 4.0 in the future because, for example, it automates legally compliant and secure micro-transactions between machines, such as order and payment processes.

Blockchain was originally developed as a transaction platform for the cryptocurrency Bitcoin. Transaction data such as account movements is no longer stored and verified by a trustworthy central entity (such as a bank), but on the servers belonging to everyone involved in the transaction. Since the latest status of a transaction is stored on these servers, each and every party has a complete copy of all blockchain data. The decentralized basic structure makes blockchain data virtually impossible to tamper with.

In the industrial environment, using blockchain technology is a good option whenever tamper-proof documentation of product, contract, transaction, or delivery data is required for all parties. On this basis, processes between everyone involved in a value chain can be further automated. For example, suppliers can ensure reliable batch tracking or use blockchain to automate the sharing of information with their customers, such as the material properties of their products that have been tested in a supply chain. Further potential applications include smart contracts that automate transactions between the production facilities of entire value networks or within the supply chain. Such contracts also make it possible to implement new business models. Based on blockchain contracts, for instance, print shops can enable their presses to sell free capacity to other print shops or purchase surplus capacity.
Robotics

As a link between the digital and real worlds, robots are increasingly becoming indispensable autonomous assistants in Industry 4.0. These cobots no longer take over simple production or inspection tasks behind safety guards. Instead, they work alongside production and logistics staff. In the process, they collect data that they transmit in real time to IT systems. This is then transferred back to production in a closed information circuit that results in the ongoing optimization of production operations.

Robots and cobots are essential for printing companies that are in the process of creating a Smart Factory, because they automate in-house transport logistics and, thanks to their continuous data transfer, plug critical information gaps for virtual control of production. One important point to note in this context is that the development of robotics benefits directly from progress in the areas of AI and machine learning. Besides completing highly complex tasks in the future, these “digital human twins” will therefore also be able to make a growing contribution to the collective intelligence of companies.
The platform economy

Platforms constitute the core business model of the digital economy, which is currently dominated by seven companies in the United States and Asia that are among the most valuable in the world. Day in, day out, the likes of Amazon, Microsoft, Alibaba, and Tencent provide a platform for millions of suppliers and consumers, with the aim of offering everyone involved the best possible user and customer experience. The origins of the digital platform economy lie in B2C markets, but the coronavirus pandemic has made the B2B sector aware, if it wasn’t already, of how relevant these platforms are when it comes to selling their products and services.

The success of digital platforms is essentially based on the number and quality of the services on offer. Ideally, the user experience is so good that users share their data, which the platform provider then utilizes to make ongoing service and process improvements.

Unlike traditional linear markets, platforms are exceptionally efficient thanks to their high level of automation and their use of artificial intelligence. Platform operators therefore achieve high margins, even if they offer products and services at lower prices than the competition. Since they provide all services digitally as an intermediary, they can also benefit from unlimited scaling options at no great expense.

The platform economy is reinforcing the trend of companies that find themselves in a highly competitive global environment no longer being able to operate on a solely autonomous basis, but instead becoming part of a networked ecosystem with competitive advantages resulting from ongoing collaboration with the best and most innovative partners.
Digitalization strategies for printing companies

While a large number of print shops have made significant progress with their digitalization efforts, smaller companies in particular are still struggling to find and implement a workable digitalization strategy. Accordingly, the challenges they face are different, too. The task confronting those companies that are lagging behind is normally to bridge fundamental digitalization gaps by replacing outdated technology and modernizing processes that are still analog. Other businesses have been investing in the relevant technology for years but are struggling to adapt their business model, while others still, despite having the latest technology and an innovative business model, are unable to find a viable operating model. These few examples alone demonstrate that there can be no one-size-fits-all digitalization strategy. Each company needs to find its own way based on its strengths and its goals. Often, the best way of establishing what is possible and makes sense is to bring in external experts with proven industry experience.

However, it’s vital to aim for a holistic strategy from the outset – even if a new or modified digital organization initially takes shape little by little and point by point, which is strongly recommended. Digitalization should start with manageable projects and defined subgoals so as to limit the expense and the resources required. This approach removes any risk to ongoing operations, while also encouraging acceptance among management and other staff. Rather than being achieved through single ground-breaking solutions, a successful transformation is based on the orchestrated interaction of various solutions.

Another important consideration is that lean processes first need to be implemented to unlock the full potential of digitalization. If these prerequisites are met, nothing further stands in the way of successful digitalization. The following steps serve as a rough guide to developing the necessary strategy.
1. Goal definition

Before any measures can be taken, the ultimate goal needs to be clarified. Where do the company’s strengths lie? How can digitalization at process, product, and business model level help increase this competitive advantage and bring it to the attention of new target groups? During this initial phase, it’s not the details that count, but rather the big picture – an overall concept that helps the company set its course and stay on track. Where does the business see itself in five years’ time? What is essential and what is perhaps not quite so important? What is necessary to achieve the defined goal?
2. Status analysis

The second step is a status analysis to identify the main in-house bottlenecks or obstacles – in all areas of the company, i.e. production, logistics, sales and marketing, cross-departmental business processes, and the partner network. What is the company’s status in each of these areas and what interactions need to be considered? What digital infrastructure already exists and how efficient is it? Where is a completely new approach required and how could digitalization help solve the problems identified?
3. Prioritization

The result of a status analysis of this kind is often a list of countless priorities. Naturally, neither the budget nor the resources are available to deal with all of these at once. It's therefore vital to narrow down the need for action. One way of doing this is to distinguish between business-critical items on the list and items that have no direct negative impact on the company. Once the critical items have been identified, the ones that will achieve the greatest benefits with the least outlay need to be prioritized.
4. Project planning

The next step is to plan the organizational, technical, financial, and HR requirements for the prioritized project. When doing so, it’s important to bear in mind that the efficiency of digital solutions is directly linked to the quality of the available data and that a centralized data pool is normally required to harness existing potential. Successful digitalization is based on the necessary data architecture. Once this is in place, the technical equipment required for the defined project goals, the level of financing, and the manpower needed for implementation can be clarified.

The company's own staff aren't the only ones to be affected by the changeover processes during digitalization. Such processes also have an impact on customers, suppliers, service providers, and cooperation partners. The needs of these stakeholders must also be included and taken into account at the planning stage.
5. Planning the roadmap and defining responsibilities

The next step is to develop a digital roadmap for the relevant project that precisely specifies what is to be done in which order and when each milestone should be reached. Once the order of tasks has been established, the next question to answer is what should be done independently and where a partner is required. Contacts, project teams, and responsibilities then need to be defined.
6. Involving staff

Numerous studies confirm that most digital projects fail after rather than prior to implementation, because staff are overwhelmed by the associated transformation and don’t accept the new ways of working. Targeted change management and needs-based training are essential to overcome internal opposition. The starting point of any transformation is to use open, intensive communication to get people to buy into a vision.
The conclusion – now is the time to act

Even after 30 years of the Internet economy, print shops still have time to switch to systematic digitalization. Time is running out, though, because increasingly – unlike in the analog business world – the winner takes it all in the Internet economy. Anyone who fails to make the transition or delays doing so runs the risk of becoming a victim of the digital era. For industrial companies, that means the time to act is now!