Digitisation, DigitALisation and Process Safety

Where Are We, And What Can We Expect in the Next Years

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These days we hear talk about digitalisation in about every human activity area. Of course, asking how and when digitalisation will affect process safety is a very valid question. In this paper we express a few of our ideas about the answers.

Digitisation vs. DigitALisation – What Do We Mean Exactly?

"Digitalisation" is of course one of the mega-trends of every business sector in these first decades of the 21st Century, and most likely one that will accelerate in the coming years. However, it has become a buzzword: something that individuals and organisations have to write or say every now and then to demonstrate that they are "à la page." In this paper we attempt a more rigorous dissection (an engineer's analysis if you will) of digitalisation, its present development in the process safety sector, and what can we expect from it in the future.

Let us begin by defining clearly what we mean by digitalisation and a similar concept often confused with it: digitisation. To make very clear which of the two we are referring to, we will spell "digitALisation" and "digitisation" to emphasise the difference. There are of course many different definitions of digitalisation. We prefer the definitions offered by Gartner, for example:[1]

"Digitalisation is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business."

The above definition also implies changes in modes of engagement with the operation processes.

Digitisation, on the other hand, is defined as (same source as above):

"Digitisation is the process of changing from analog to digital form, also known as digital enablement. Said another way, digitisation takes an analog process and changes it to a digital form without any different-in-kind changes to the process itself."

Gartner being a business consulting firm, they focus on the business model. However, we can find a perfect analog in the world of process safety. We can consider that the business of process safety is to prevent major accidents that involve the release of hazardous materials or energy sources from happening.

1 Gartner's Glossary (www.gartner.com).

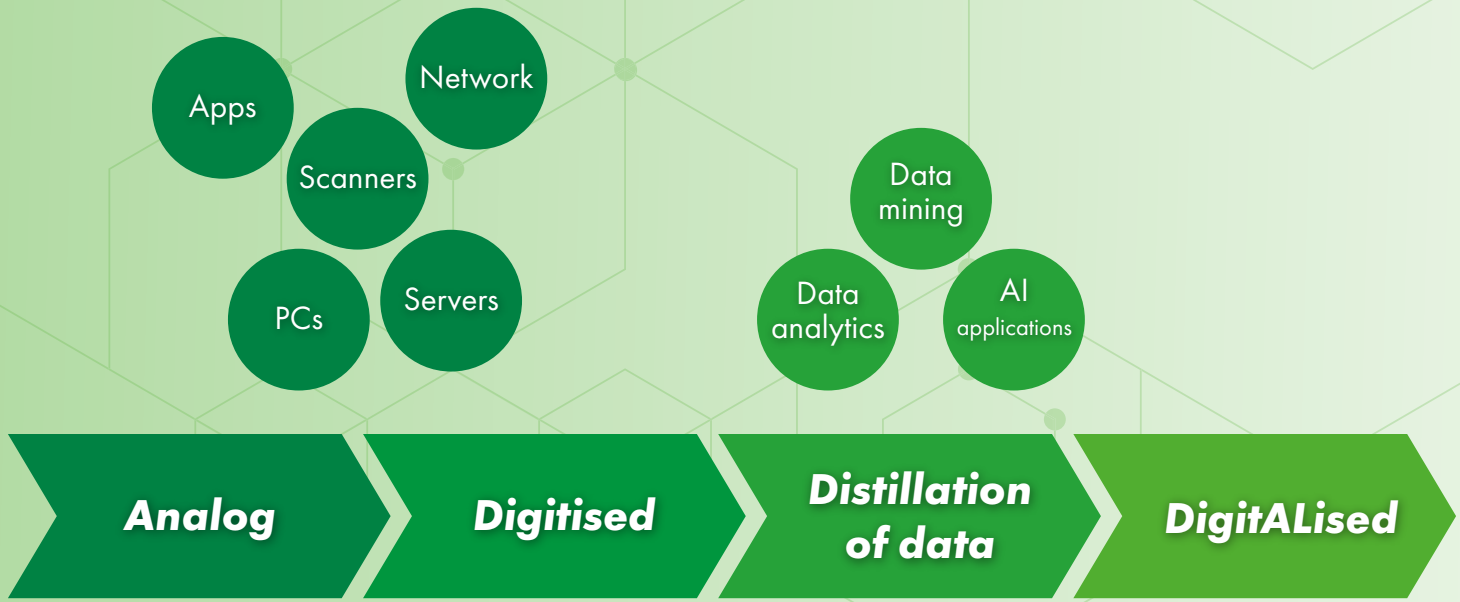


Figure 1. Evolution from Analog to digitALised.

Of course, this is an evolution, from analog to digitised to digitALised, as shown in Figure 1. Each transition requires some enabling technologies. At the interface between analog and digital we find some "hard" enablers, such as computers, servers, networks... and some "soft" enablers (software applications). At the interface between digitised and digitALised, on the other hand, we find a transition phase where data are further operationalised through "soft" enablers such as data mining, artificial intelligence, data analytics, as well as human capacity to leverage the data for actions and decision-making.

And even within the operationalisation of data, there are a few levels of value and purpose as depicted in figure 2 (see page 4):[2]

- ***Descriptive analytics*** lets us know *what happened* through summarising and visualising historical data.
- ***Diagnostics*** identify possible problem areas by recognising patterns and dependencies in available data, explaining *why something happened.*
- ***Predictive*** analytics go one step further by helping us anticipate *what may happen in the future.*
- ***Prescriptive*** analytics provide optimisation options, decision support and insights on *how to get the desired results.*

Data visualisation can be considered, in this context, an enabler of the evolution.

2 Adapted from Michael Walker "Analytics Maturity Model". July 20th, 2015. Blogs of the Data Science Association.

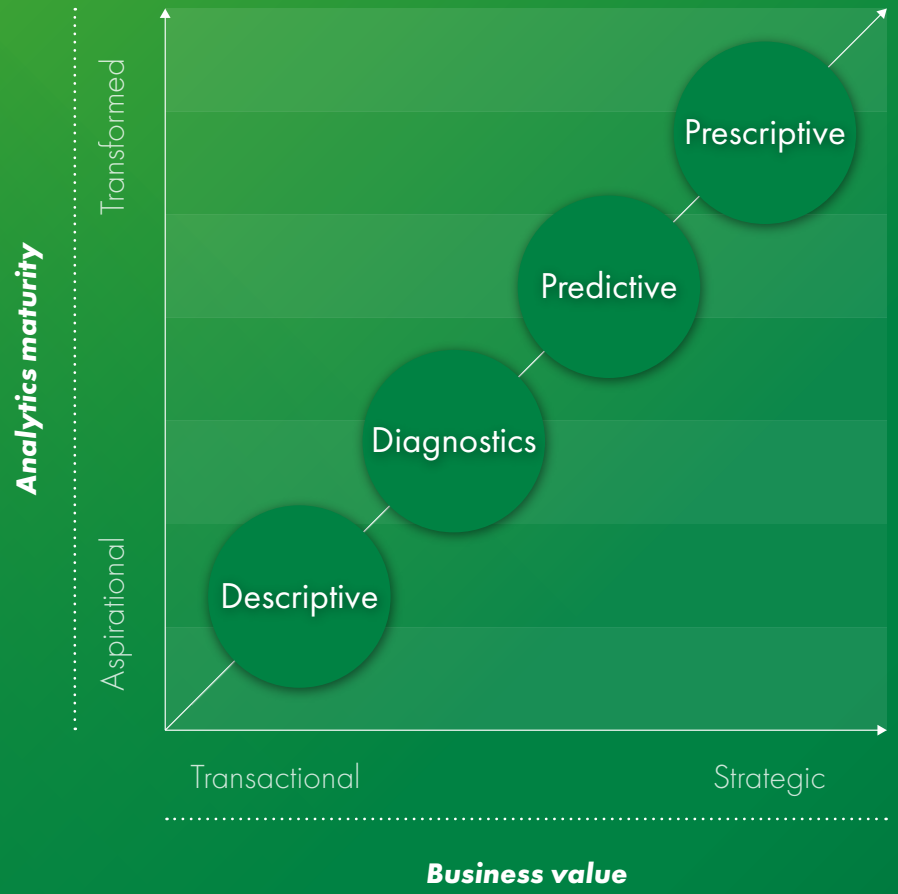


Figure 2. Analytics maturity model

Where Are We in Terms of Digitalising Process Safety?

To answer this question, let us take as an example Process Hazard Analysis (PHA). PHAs are a fundamental pillar of any process safety practice, since you cannot mitigate or manage a hazard that you have not even identified. PHAs come in many different flavors, such as HAZOP, HAZID, LOPA, What-If, and FMEA. Some large corporations even have their own proprietary methodologies. In any event, we can certainly say that PHAs are the most frequently conducted process safety-related activity. How far has this activity been digitalisd?

Some of us are old enough to have recorded HAZOPs using a pen and a blank sheet of paper. The introduction of laptops[3] then allowed HAZOPs to be recorded using a text editor. And shortly after that, some specialized PHA-recording software appeared on the market. Nowadays there are several well-accredited PHA software packages on the market, which have become de facto standards. That software certainly offers additional support to the HAZOP team by, for instance, suggesting potential failures from a look-up list, as well as providing some basic descriptive analytical capabilities.

However, to discern where we stand in the evolution course, we must ask ourselves whether these tools have introduced any different-in-kind changes to the process. In other words, by using those tools, do we

3 IBM introduced the PC Convertible, its very first laptop in 1986. It weighted 12 pounds. As a predecessor we can mention the Osborne I, weighting 24½ pounds and having a 5" yellow phosphorus display. One of the authors vividly remembers carrying one of those around to HAZOP sessions.

conduct PHA differently today versus 40 years ago? Do those tools enable us to obtain breakthrough information? The answer to both these questions is clearly no. We must acknowledge that they are closer to ***"[taking] an analog process and [changing] it to a digital form without any different-in-kind changes to the process itself" than to "[providing] new value-producing opportunities"***. Therefore, and despite some claims from software suppliers, PHAs are nowadays fully digitised, but barely digitALised.

The same is true, of course, in other areas of process safety, including:

> ***Work permits.***
> ***Management of change.***
> ***Action tracking.***
> ***Knowledge management.***
> ***E-learning.***
> ***Incident investigation.***

Of course, anyone can mention some examples of digitised tools in each of these areas; yet, as in the example of the HAZOP mentioned above, most of them are doing business in the same way as before. They are digitised, not digitALised solutions. There are some attempts to boldly go towards full digitALisation of the solutions using tools such as digital twins, data analytics, artificial intelligence, sensorics, and others. At DEKRA we have been working on these strategic visions for a few years. For instance, in 2019, DEKRA introduced the fully digitalised expert system based Organisational Process Safety (OPS) - DEKRA's interpretation of the CCPS risk-based Process Safety Management model. This solution embeds the collective knowledge, expertise, and experience of many DEKRA experts and literally from hundreds of process safety maturity assessments. Today, it supports DEKRA's experts in delivering precise and consistent assessments, as well as optimised suggested interventions for improvement.

What Do We Think Will Happen?

The first question we need to ask ourselves is whether the process safety world will evolve towards true digitALisation. In our opinion, the answer cannot be other than a resounding yes. Most likely process safety has not yet been digitALised because the combinations of the enabling and capable resources - data scientists and process safety experts - are scarce. The obvious "when" question answers itself: when those resources become more readily available and commit to working seamlessly together with digitalisation-minded process safety professionals. The rapidly growing cohorts of data analysts and scientists show promising signs that we are not far away from this point in time.

What will it look like? We can envision a prescriptive system. Imagine that your digital solution "knows" not only the hazards and risks associated with your plant (hence, your PHA), but also its current status, including things like:

> ***Which*** interlocks are by-passed.
> ***Which*** equipment is off line (being maintained, calibrated, tested...).
> ***Which*** work permits are active and where.
> ***What*** the likelihood is that a certain piece of equipment will fail in the next few days (based on the history, maintenance and inspection records and other information of that specific piece of equipment, but also on the insight provided by a universe of similar pieces of equipment).

Then, your digital solution could support operational decision making in such a way that the process safety "business" (preventing major accidents) is optimised. Is this a pipedream? We don't think so. All the necessary technologies are already available, so it is a question of integration.

What will it take to solve such a problem? In addition to the needed analytics, we believe digitALisation of the process safety system requires integrating and leveraging the following attributes of the modern technologies: accessibility, configurability, scalability and security.

By integration we mean that an isolated solution will not solve the digitALisation problem. We need an ecosystem of different solutions "talking" to each other. Of course, in the previous example, your digital risk management solution needs to receive information from several sources, including work permit management, interlock management, digital PHA and a few more.

Accessibility has to do with getting the data readily available, and being able to extract useful information out of it. Of course, this does not mean storing all data in the same data base, or following the same taxonomical rules if the solutions are sufficiently smart to "fetch" the required data at the time they need it or request this information from other solutions. For instance, data on a pressure vessel (e.g., inspection reports) may be collected and stored in a cloud-based database. Using predictive analytics, such data may be accessed and used for projecting failure rates that can in turn be fed into a risk management tool for risk modeling and for formulating interventions. Application Programming Interfaces (APIs) definitely play a critical role in ensuring accessibility of data.

Scalability allows the solution to increase its capacity by adding new resources so it can serve a single site as well as multiple sites of a global enterprise. Clearly, this is also a must-have feature to ensure digitALisation.

Figure 3. Schematics of the DEKRA Safety Platform

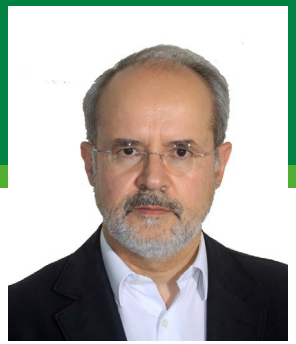
Finally, configurability, along with support by a defined and extendable data structure, allows the digital solution to be configured to meet the client's needs. This is critical for integration purposes.

The vision and the requirements toward digitalisation naturally lead us to the idea of a platform. By this we mean a system that includes a data engine at its core, which supports and integrates an ecosystem of solutions. DEKRA is turning such a vision into a reality by offering the DEKRA Safety Platform (see figure 3, page 6), which is designed exactly with those functionalities in mind.

Conclusions

In this paper we have briefly reviewed the current status of process safety in its journey from analog to digitALised. We believe most process safety-related activities are fully digitised, but still very far from digitALisation. On the other hand, we have no doubt that full digitALisation will happen and, when it does, it will be a game changer.

A truly digitALised risk management solution will undoubtably be based on a platform to ensure integration, accessibility, configurability and scalability - fundamental pillars of digitALisation. The DEKRA Safety Platform is being developed precisely with those targets in mind.



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Mei-Li has over 20 years of experience in engineering, research and academics with a focus on integrating safety, environmental and sustainability goals into business strategy. She serves as the Senior Vice President of Innovation, Solution & Strategic Partnership at DEKRA. Mei-Li is responsible for leading her team to combine science, technology, and DEKRA's expertise and knowhows to create innovative safety solutions for the Industry 4.0 era. Previously, she specialised in operational risk management in conjunction with human and organisation performance.

DEKRA Process Safety and Chemical Safety

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