

# Importance of effective and efficient data analysis and visualisation

Kit-based 'out-of-the-box' dashboard solutions address many industry challenges, both in making better and faster decisions and simplifying and accelerating solution delivery

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Throughout history, scientists have observed our world and its processes primarily out of natural curiosity and to improve things. The ability to visually see performance and graphically analyse it is, today, a powerful method to drive performance of an asset and reduce carbon emissions and energy consumption.

Regulatory compliance, including environmental and health and safety regulations, mandates certain aspects of performance analysis and reporting. Currently, for example, there is an increasing emphasis on monitoring a company's direct and indirect carbon emissions (operated facilities and supply chain). Thus, analysis and reporting are crucial in complex process industries, such as refining, to ensure performance stays on target. This information enables operators and engineers to take pre-emptive action to prevent process performance from straying from the expected operating window. The performance of equipment, catalysts, instruments, and humans can all contribute to negative deviations from expected performance.

Many companies have already taken steps to make data widely available for analysis. Although digitalisation initiatives are driving automation of analytics and shortening decision times, integrating these analytics into key work processes remains a challenge.

## Business challenges

Business and engineering teams face many common challenges when analysing their processes to keep them on target and improve them. Understanding these challenges is essential to designing effective data analysis and visualisation tools.

### Productivity

Accessing data and analysis tools from disparate systems can cause highly skilled staff to waste time on routine data collection and analysis tasks. Instead, this time could be better spent on higher-value tasks. Also, handover efficiency is reduced if engineers have to learn a new set of analytics tools and/or methodology for each new unit.

### Missed or slow opportunity identification

A lack of a systematic approach to data analysis can lead to slower decision-making:

- Business teams may disagree on which key performance

indicators (KPIs) to use, their relative importance, and how to calculate them. This can result in unnecessary rework, rechecking data, and additional discussions before decisions can be made to improve performance.

- Inefficient and ineffective dissemination of insights can impede the efficiency with which decision-makers act.
- Tools tailored to the process or process engineer may become difficult to use when the 'expert' is unavailable due to sickness, vacations, or urgent business. In such circumstances, only safety-critical work may be performed, leaving non-critical but otherwise significant untapped opportunities.

### Knowledge transfer

An ageing workforce and frequent staff rotations can make process expertise a highly valuable yet scarce resource. However, teams must have appropriate process insights to make the best business decisions. Incorporating best practices and encapsulating process knowledge into analytics tools could mitigate the problem.

### Developing a solution

In today's industrial environment, monitoring and analysing manufacturing processes is no longer a question of whether to do so but how to do it best. As data availability becomes less of an issue, data quality and connectivity still pose challenges. Solutions range from the well-loved but highly problematic engineering tool of first resort – the Excel spreadsheet – to company-wide information management systems with sophisticated data analytics.

Ideally, the solution should be:

- **Fit for purpose:** many engineers and IT professionals are tempted to choose the latest, most detailed solution right away because they love technology for technology's sake. Although designs need futureproofing, conducting a simple cost-benefit analysis should help determine whether all the 'shiny new toys' in the box are worth using now, should be saved for later, or are simply inappropriate for this case
- **Scalable:** attempting to 'digitalise' a complete site all at once is challenging for all businesses except the most well-resourced and well-organised. Digitalisation solutions can be delivered stagewise (starting with the unit that will provide the most benefit), leaving provisions for future complexity (starting with simpler data analytics and progressing to a rigorous process simulator-based digital twin

and artificial intelligence/machine learning in a subsequent update). Furthermore, the solution can be improved as the rollout progresses.

These solutions need three common elements:

- Reliable, integrated data sources and storage systems (starting with an on-premise plant historian, extending to data lakes and cloud-based storage).
- Analytics aligned with the company's management needs.
- Insights gleaned from the data disseminated to the actors and decision-makers.

The following discussion assumes that data have been logged and stored efficiently (whether on-premises and/or in the cloud) and are easily accessible. Data silos still exist to a greater or lesser extent in most organisations for historical operational and/or technical reasons. Siloed data can be a major barrier to efficient decision-making. When decision-makers lack access to all the relevant information, or if access is delayed, such as by manual steps to synthesise data, decisions will be suboptimal and/or late. Both situations result in lost opportunities.

In terms of analytics, the first step starts with understanding what should be monitored, analysed, and why. In a typical process unit, this means identifying KPIs and their relative importance. A seemingly limitless supply of data and the computational power to process it are no replacement for engineering and scientific expertise. At the least, data quality should be checked. Poor data offer little value, and inconsequential correlations and relationships in the data should not cause distractions. Engineering skill is also needed to ensure that the scope and complexity of the analytics match the size and nature of the problems.

Data analysis and process monitoring only yield value if they lead to action. Real-time optimisation and automated optimisation solutions minimise the need for human intervention in plant optimisation but are often the most expensive option and unsuitable for many processes. Also, it may be more appropriate (financially and technically) to start with a less complex solution to develop over time. So, to enhance the decision-making process, what are the best ways to present information when considering an advisory solution?

The use of dashboards has become ubiquitous across industries and extends into the consumer's personal life through mobile device apps to monitor bank balances, fitness, and domestic energy use. Dashboards, a powerful industry tool where user-persona dashboards can be linked to a 'single source of truth' data source, can be customised to specific consumers and enable all decision-makers to access the same core data. When displayed, it enhances individual decision-making functions.

The right combination of impactful graphics backed by figures and notifications allows the consumer to absorb key information quickly to drive decision-making. Conversely, a poorly designed dashboard, loaded with too much information and indiscriminate notifications, is, at best, annoying and, at worst, will be ignored.

### Challenges of building effective dashboards

If dashboards are the future, what are the challenges of designing and building them for maximum impact?

- **Resource availability – both business and IT:** The business must decide what information it needs (the KPIs). Both parties need to be available within a given timeframe to design the solution to ensure it works with the business processes to optimise decision-making.

- **Time and money:** Defining and building such solutions can be time-consuming and, therefore, costly. This is particularly true with 'one-of-a-kind' dashboards such as those for specialised processes or smaller organisations. While a multinational oil company could build a dashboard for a fluid catalytic cracker (FCC) operation that could be reused across several refineries, a single refinery organisation cannot benefit from such economies of scale.

- **Time to complete:** Even if the organisation can afford to build bespoke dashboards, the elapsed time from project conception to completion may be significant. In KBC's experience, a typical unit bespoke project using a commonly deployed real-time data and analytics platform will last around 6-12 weeks, allowing time for stakeholders to agree and define the solution as well as build and test it.

- **Maintaining solutions:** Business objectives change, and software platforms evolve and should have the latest security updates. It is a false economy to forget maintenance when selecting a dashboarding solution.

To conclude, any solution developed must align with business processes and address current challenges facing the business (maximise work efficiency, transfer knowledge, and identify opportunities) while being fit for purpose, scalable, and extendable.

### Case study

KBC has been exploring whether 'out-of-the-box' dashboard solutions can address the challenges of building effective dashboards rather than individually tailored solutions. These 'kits' also capture process-specific analysis to enhance the decision-making process.

Below are some advantages of these kits compared to a customised solution.

#### Faster and lower investment route to value

Across the refining industry, units of the same kind at different sites are reasonably similar. With access to the right expertise, it is possible to draw a list of common KPIs for, for example, an FCC and build a set of visualisation templates to display this information in a compelling and logical manner to enhance decision-making.

KBC has built a 'kit' structure that supports contextualising and analysing data. The solution was developed to enable easy customisation for different units (of the same kind) across the industry. The kit can easily be configured to display the correct number and name of feed and product streams and the differences in the unit configuration, such as whether the FCC has one or two risers and/or regenerators. The kit is designed to be installed on the client's existing data/analytics platform.

Compared to a bespoke solution, such a kit solution can be delivered faster and at a lower up-front cost. The time savings, leading to early value identification, can make the kit route appealing for either a permanent or temporary

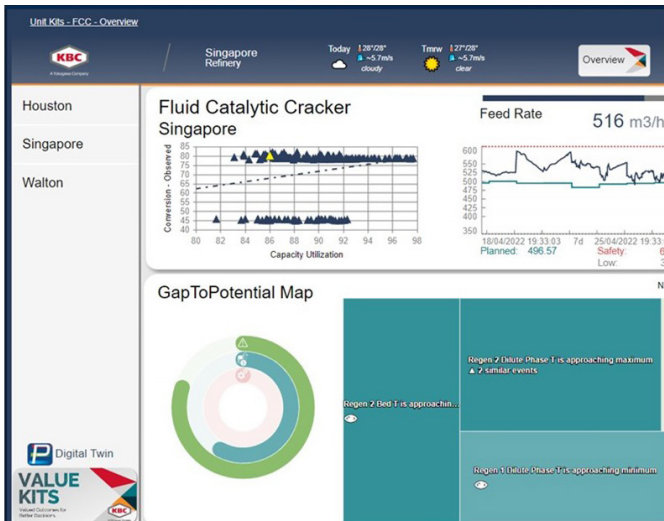


Figure 1 GapToPotential Map

solution while working on a customised one. The dashboards in the kits are not designed to replicate or replace the detailed aspects of screens, such as the control system.

They deliberately contain what KBC believes to be the essential KPIs, so the decision-maker is not distracted by too much information, which is of secondary importance. There will always be debate amongst individuals as to how much detail is needed to make a decision. While the kits can always be customised, too much customisation will cancel some of their advantages.

**Impactful graphics enhance decision-making**

Impactful graphics have been developed that reinforce the figures behind the unit performance being presented and support decision-making. As shown in Figure 1, the larger and more intensely coloured rectangles on the 'GapToPotential' map indicate the more important data and opportunities for improvement.

In all the kits, the information follows a logical and consistent format to take advantage of these graphics. This consistency in how data are analysed and displayed across multiple units on a single site, or multiple units of the same type can improve the speed and accuracy of decision-making.

Figure 2 shows an overview of the kit architecture. In

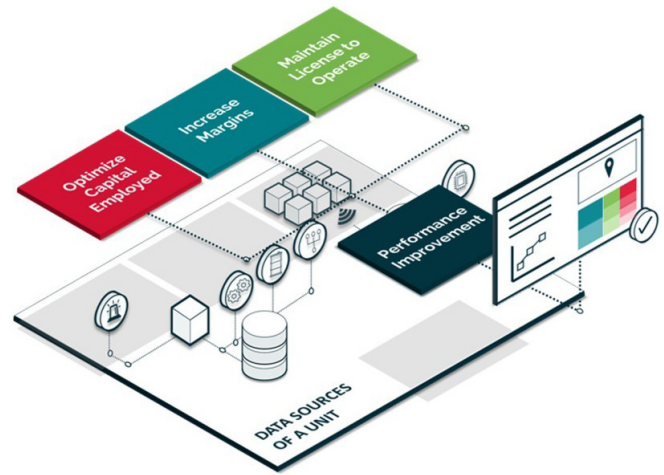


Figure 2 Kit architecture

all the kits, opportunities are colour-coded according to whether they are related to maintaining a licence to operate (green), improving margins (teal), or optimising capital employed (red). KBC's analysis of businesses uses these three categories to give a holistic analysis of how individual focus areas (from health and safety to energy optimisation) interact for overall performance.

**Incorporating process-specific knowledge – KPIs and knowledge base**

In addition to gathering standard KPIs for each unit type, the kits incorporate unit-specific analytics via a knowledge base that provide the relevant information and messaging to build the GapToPotential map. Each opportunity on the map has a message highlighting a potential issue or improvement opportunity, plus a suggested course of action (see Figure 3).

As previously mentioned, data analysis only yields value if it is acted on. The kit supports action directly by ranking unit opportunities clearly on the tool's front page and suggesting how to address each opportunity.

**Extendibility**

The kits are designed so that coding and configuration, which support the basic kit structure and tools, such as the

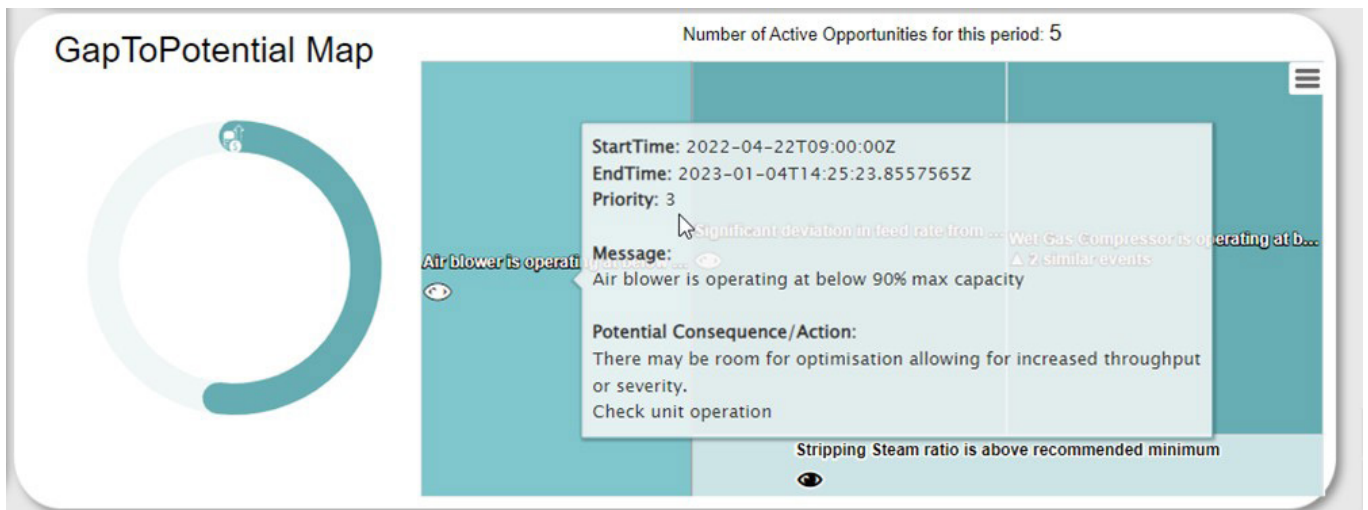


Figure 3 Data visualisation demonstrates course of action

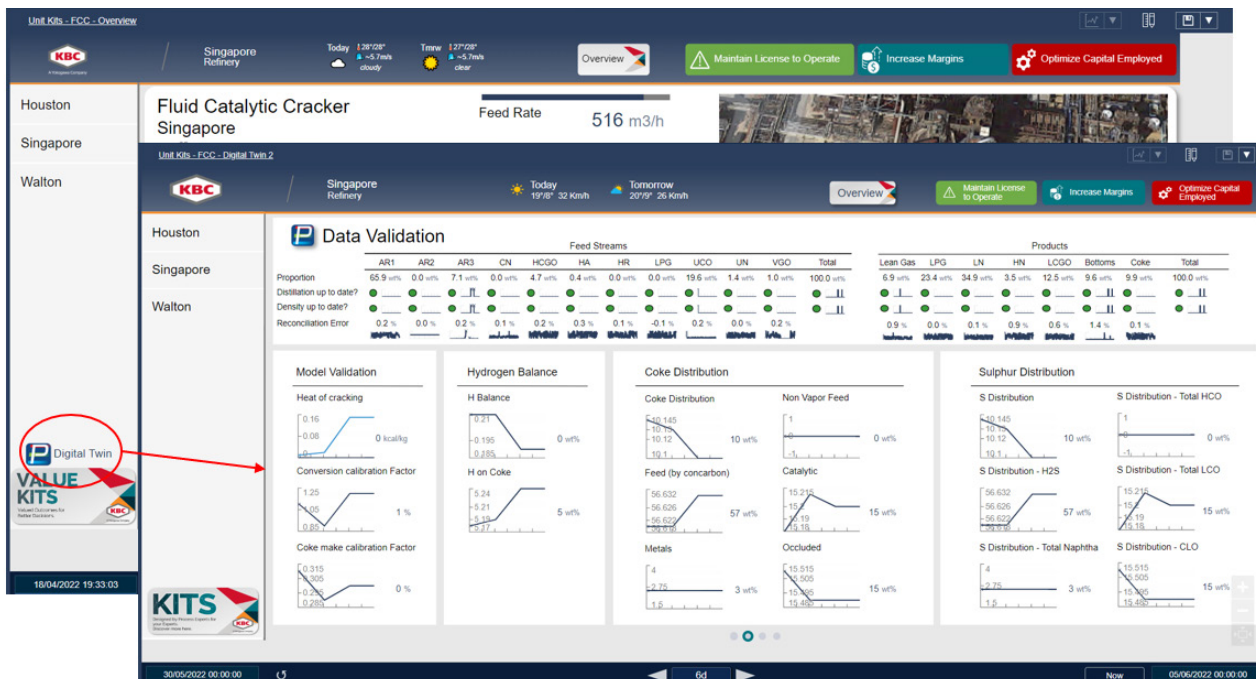


Figure 4 Kits support data visualisation

GapToPotential map, are common to multiple kits installed on the same server. It is thus simple and quick to add further kits for different process units or for additional sites over time. A navigation panel allows users to easily switch between viewing the performance of different units and/or sites.

The kit's analytics need to be reasonably generic, as the level of sophistication built into them can be limiting. At some point, it may be worth investing in higher fidelity analytics, perhaps in the form of a process digital twin (DT). The kits can be extended to support DT visualisation (see Figure 4) and provide a quick-to-install, out-of-the-box set of dashboards to help with simulation model and refinery linear program (LP) model assurance, along with enhanced process monitoring and opportunity identification.

### Future development

Initial feedback on this Value Kit approach has identified a need to make the knowledge base (which has been built with a degree of customisability) extendable by the business owner so it can identify scenarios specific to the unit and/or site in question.

The knowledge base could be customised to include, for example, information on the operating envelope of a unit and to issue relevant advice when the operation moves outside that envelope. The analytics required to do this are typically not challenging. More challenging is automating a way to extend the knowledge base without the need for an IT professional and implementing the appropriate level of security to ensure only authorised personnel make the changes.

KBC has seen most refiners preferring to keep data on-premise or in their company cloud. However, this kit-based approach to data analytics and visualisation is just as appropriate for cloud-based solutions as for on-premise systems. Currently, KBC is developing a solution for remotely monitoring green hydrogen production facilities where data are

sent to the KBC/Yokogawa cloud (via remote telemetry) from where the client will be able to access the Value Kit solution via a portal. The same advantages of scalability, cost and time to implement, and embedded value-added analytics exist for a cloud-based kit as for an on-premise one.

### Conclusion

The best way to evaluate the cost-benefit of process monitoring solutions in terms of the level of analytics used and the amount of data analysed will always be a source of debate among industry professionals.

Using a kit-based approach, which focuses on the key data and incorporates analytics and impactful graphics in a standardised package, is a pragmatic starting point to improve decision-making and add value to process operations. These kits address many industry challenges, both in making better and faster decisions and simplifying and accelerating solution delivery.

There will always be a need for bespoke solutions. For certain situations, custom analytics may be required to address a specific issue. For larger organisations that can benefit from economies of scale and have sufficient resources to design and implement, such a solution may cost no more to implement in the long term. However, even in these cases, a kit-based solution can be considered as a pragmatic, quick-to-deploy option that generates benefits in the short-term while a long-term solution is considered.

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