Executive Summary

The Refining and Petrochemical industry is projected to continue growing in the next two decades, and companies that are investing in new technology today will be ahead of competition in about two years. Digitalization of the value chain, also known as value chain optimization, is therefore an essential part of staying competitive. However, it is also an undeniably complex task, whether we are talking about a single refinery/petrochemical or a major company with multiple plants, or even an integrated refining and petrochemical operation. Part of the complexity comes from the number of plants and interconnected units, but the other part of the complexity comes from the industry itself, and the diversity of challenges that occurs in different areas of the value chain within each operation. Optimizing the value chain, and deploying a real digital transformation to the business, requires acknowledging this complexity and creating a thoughtful plan with actionable and measurable goals. It is crucial that all departments and different teams across the enterprise are taken into consideration, so their challenges are addressed in the digital transformation strategy, and they are motivated to onboard on a journey that will significant impact the overall business.

In this white paper, we discuss the key components of the refining and petrochemical value chain, the common roadblocks faced by companies when attempting to digitalize their processes, and we outline some practical guidelines to create an effective path of value chain optimization, including highlights of real companies’ results on their journey towards successful digital transformation.
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The oil and gas downstream industry, which includes refineries and petrochemical plants, has been growing over the past few years, with projection to keep growing in the next two decades, as indicated in the charts below. This growth will be affected by market dynamics such as price volatility, social-political pressures, environmental regulations, and tightened margins. But one thing is for certain: in order to stay competitive, companies will have to embrace digitalization and fast-growing disruptive technologies.

It’s important for businesses to keep pace with the digital wave. Refining and petrochemical companies that are investing in new technology today will be ahead of competition in about two years. The following diagram illustrates the main investment areas for today and for the next 3 to 5 years.
The value chain workflow of a refinery or petrochemical business is complex and requires multiple specialized teams to work in collaboration to maximize overall economic value. The diagram below represents the key elements of this value chain:

The above business workflow may appear as an organized sequence of activities, but in reality, decisions are made simultaneously across the value chain. Each activity, or set of activities, is performed by a different team inside the organization that usually have their own systems, methodology and processes, driven by distinct goals and objectives. It is quite common that organizations operate in silos, with limited visibility and communication problems across different teams, resulting in reduced efficiency and value leaks for the enterprise. This is true even for smaller companies with a single site. It is in this regard that digitalizing business processes can lead to better collaboration, more agility and an optimized value chain.
Challenges of Achieving Value Chain Optimization

Every organization seeks streamlined processes that can optimize their value chain and increase profit. Technology is driving a series of innovations, bringing concepts such as big data, cloud, analytics and digital twins that promise a transformation to the way companies run their business. Several oil and gas companies are leading this fourth industrial revolution, and many are acknowledging its importance by setting up teams to define a digital transformation strategy. But why are there still many companies that fail to obtain economic return from their investment in digitalization?

There are three main aspects that are often underestimated when oil and gas companies decide to adopt new technologies for refinery or petrochemical value chain optimization, which result in low adoption rate and minimal return of investment. When this happens, skeptical resistance is created across different levels of the organization for any future digital initiative.

1. Diversity of goals and objectives across the value chain

Teams in an organization work towards specific objectives that can be different or even conflicting from other areas. From one perspective, this can motivate the achievement of local results that don’t maximize the overall business value. On the other hand, if individual objectives are not considered, there is a risk that important constraints or requirements are missed out, which could cause loss of production, logistic problems, or unsafe operations, to name a few.

The diagram below represents the key groups within refineries and petrochemicals value chain and highlights the challenges faced by each of them:

With such a diversity of goals, an important challenge is to strike the right balance between achieving these individual team goals, while maintaining the overall vision and goals of the business.
2. Disconnection of processes create silos of information

Companies create departments to address different objectives and functions of the organization, but a common side effect is the disconnection between teams, resulting in silos that operate with limited visibility of the rest of the organization. This often causes misalignment of information and delay in decision-making that requires multiple departmental inputs, leading to loss of value that could be used to increase the company profitability.

A significant contribution to this disconnection is the segregation of systems and technology used by each department. Even though the flow of information between departments is heavy, often it relies on people that manually take data from one system and send to the next department. This is very timing consuming, has a high risk of error, and creates a tendency of working with outdated information. A typical plant can have more than 15 systems and applications to update and maintain.

Even when companies are investing in new digital technologies, each department in the organization is focused on their own digital transformation and the best technology for their own use. While this is an important aspect of improvement, integration between systems and improvement of work processes through the complete value chain is all too easily left as a low priority item.

This results in many custom codes and complex data file transfers that increase maintenance cost and dependency on tool expertise held only by a small group of people.

To illustrate these challenges, we can analyze the information flow to execute the plant scheduling, as show in the figure below.

There are clear benefits of cross-team collaboration, including additional business value and performance speed. Questions such as:

- Where is the most up-to-date information that my team need?
- Can they easily access it, or do they need to contact a different team?
- Is the available information easy to understand?

- How easily can teams send feedback and collaborate?
- If someone has more up-to-date information, how this person makes everyone else aware of?

are integral to understanding the way people work and the existing limitations across teams – both of which are key to begin a structured digital journey that optimizes the value chain.
3. Business changes are tough, costly and disruptive, with a high chance of failure

Digital transformation is a big trend and it brings limitless possibilities for process improvements through exciting leading technologies. It is easy to be amazed by software capabilities and how they have the power to transform the value chain. Some companies’ executives decide to invest millions of dollars to deploy systems in the belief that it will be enough to achieve a new operation model of increased production, better business agility and optimized profitability.

But the fact is: **technology is only one piece of the puzzle. You may have the right technology, but if your people and teams are not willing to change the way they work, you will not be able to realize the expected benefits.**

It is generally quite difficult to make people do things differently – humans beings tend to prefer to do things the way they already know and feel comfortable with.

Ensuring a Winning Strategy – Practical Guidelines to Achieving Value Chain Optimization

With so many challenges, how can businesses ensure they have a strategic digital transformation program that will successfully result in value chain optimization? Here are some thoughtful tips to start right:

**Address each and every team across the value chain**

As shown above, there is a diversity of goals and challenges faced by different groups across the value chain. Ignoring the needs of specific areas to focus on a unique enterprise goal will translate to a shallow evaluation of the business, with a high risk of missing important criteria and constraints that would be caught with more focused analysis.

A successful value chain optimization is not achieved by adapting the entire organization towards work that is focused on maximum overall business profit. Instead, **digital technologies must be used to empower each group to better achieve their individual goals. The improved information sharing and visibility will then drive more agile processes and streamlined collaboration across the enterprise, which will help maximize overall business profit margins.**

In a business perspective, there is the additional fact that changes may be perceived as threats. A new system that brings traceability and enhanced visibility for management can be seen by users as an invasive supervision of their work. Systems that automate workflows and reduce time to execute an activity can concern professionals on whether they will no longer be needed. Such aspects can cause resistance to adopt new technologies and can amplify disruption during its deployment.

**Technology gives you power, but it is the human aspect that will drive the results.**

It is important to see the digitalization process of the value chain as a business transformation, taking into consideration the existing culture, business workflows and perceptions of the individuals inside an organization. There is no shortcut – any change will be challenging and will demand a lot of employee engagement. Organizations must properly set the journey steps, so the chances of failure are reduced.

**Start small, think big**

Companies invest in distinct systems to address the specific needs of different teams across the organization. Yield accounting software helps operations measure the performance of the plant; an assay management system supports assay specialists to characterize the feedstock and keep track of the cargos; a real-time optimization solution guides operators on the most profitable operating point of the plant, and so on.

**Shell – Long-term Optimization Program**

Shell has been an early adopter of process optimization for over two decades through use of rigorous performance and real-time optimization, having a solid program that expended across all their refining plants.

“Shell spends about $25 in support costs to achieve $1,000 in benefits from optimisation.”

- Bert Onstott, Shell Global Solutions
Frequently, the digital transformation of the value chain begins with a challenge of a group and the investment and evaluation of the corresponding digital technology is led within this group. The problem is that if only focused stakeholders participate in this process, there is a high chance that the selected solution will not address business requirements for a wider value chain optimization strategy and instead, it will represent a siloed process to be overcome by the enterprise.

AVEVA recommends starting small. Looking at the entire value chain, verifying the biggest pain points – that is, the area in the value chain where the biggest step-change could be achieved by digitalization – and to start optimizing from there. But it is crucial that each smaller initiative goes hand-in-hand with a well-grounded digital transformation strategy, ensuring that what will be deployed now is scalable, aligned with IT strategy and easily adaptable for a broader scope.

**Adopt leading technology**

Technology changes rapidly. Think about cell phones just ten years ago; look how quickly artificial intelligence is being tested and applied in industry. Advancements are constant, and when talking about digital technology, it is only matter of a couple of years before software becomes outdated unless continuous R&D investments are made. So when choosing any digital software, it is critical to select a leading technology that is focused on user experience, that leverages the latest technological advances and most importantly, has a solid strategy of continued focus on research and development to drive further innovation.

While some companies opt to build their own systems, it is generally a matter of time before it becomes a white elephant to the business. One of the main reasons is that oil and gas companies’ focus isn’t software development (and it shouldn’t be), so best-practices of software architecture and development may be missed. Update and maintenance is also generally slower and more expensive in those cases. Lastly, in-house software can easily become a barrier for future changes, due the conflict of interest that may disturb an impartial evaluation of best option for the company.

There are cases when oil and gas companies have proprietary models or algorithms that are extremely valuable and part of their industry intelligence. In those cases, it is recommended to partner with a trusted software provider to integrate the company’s information into a commercial software. Oil and gas companies can then spend time and energy on the strategic portions that are aligned with the oil and gas business, and can leave the software maintenance and improvement to a specialized third-party.

**Get rid of manual and customized**

So far, we have talked about selecting the best technology to address each challenge inside your value chain in alignment with a broader digital transformation strategy, but we still haven’t addressed the important aspect of collaboration. The inflection point for a successful value chain optimization is when the barrier between departments are removed, information flows more easily through the enterprise, and better-informed teams make better decisions for the business. So it is key that systems are connected and data is properly managed within the business.

There are several ways to connect systems and share information between teams and what we have seen is a high rate of failure when data sharing and workflows are heavily dependent on people’s action. This is because resources are always pushed to do more in less time. Everyone always has a bigger list of activities than the bandwidth to execute them, leading to the need of prioritization and focusing on the higher value tasks. Filling in reports, forms and following time-consuming procedures will certainly be left behind. Therefore, make sure that process workflows are embedded in the selected technology and information flow is automated as much as possible.

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**BP – Revolution in the Cloud**

BP has invested in leading technologies in the cloud to simplify and standardize its value chain processes, with impressive results reported:

“Believe it or not, for the same data set, the same crude and feed stocks, the same units, what used to take us seven hours to run now takes just over three minutes. I have to admit I didn’t really think that we’d get that out of cloud, so it has been quite revolutionary for us”

- Claire Dickson, CIO of Downstream
The systems should be straightforward and promote a new way of working in your organization through a rational, streamlined and effective manner. **Technology must save people time, not the other way around.**

Finally, don’t fall on the temptation of customizing interfaces and building connections that don’t use industry-standard communication protocols. It may work initially, but the energy and cost involved in the maintenance when any system is updated to a new version brings a high chance of it not getting maintained at all.

**Enhance your visibility**

You can only correct and improve what you can see. Investing in visualization tools brings alignment among stakeholders and creates clarity on economic opportunities that were missing in the communication gaps inside an organization. Once you can visualize information, there is still the challenge of the amount of available data and the complexity of the refining and petrochemical value chain, which may hide non-trivial better decisions. **This is where you should take advantage of analytics and advanced decision-supporting tools that enables better understanding of possibilities and, in some cases, can even suggest a recommended path forward.**

Although you might realize that your business needs a specialized visualization software, keep in mind that the visualization and analytics capabilities within the systems of each functional area are just as important, because it brings the benefits we just talked about into each layer of the value chain.

**Culture and change management needs to be at the core**

If technology is the foundation of value chain optimization, people are the core! Every strategic change must be embraced by your people and supported by the culture that has been created in your organization. Underestimating this aspect can result in a big disruption during the digital transformation journey or can lead to achievement of minimal results. People must be on board and willing to adapt and change. In this aspect, each organization is different and unique.

When building a strategy for digitalization of the value chain or during the evaluation process of a digital technology, bring in representatives of the different departments of the organization. This will help people feel ownership of the project, willing for it to succeed. But mostly importantly, it will help you understand how your strategy is perceived by different stakeholders and how changes will affect the way they work and the way they feel about the work. It will bring you different thoughts and ideas and anticipate potential threats, giving you time to prepare and adapt your plan.

Depending on the size of the organization, it may be a good idea to start with a proof of concept, implementing the new technology in a reduced and more controlled environment. This enables improved risk management and gives the possibility to adapt the strategy as required before rolling it out across the complete enterprise. However you decide to structure your value chain optimization strategy, the change management process must be carefully addressed taking into consideration the people and culture of the organization. Partnering with suppliers that have field proven experience in the deployment of digital technologies can be very helpful in your journey.

**ADNOC’s Panorama Digital Command Center:**

The Abu Dhabi National Oil Company, one of the world’s leading energy producers, developed a strategy project to create a single source of accurate information across ADNOC’s value chain, enabling savings between $100M to $200M through optimized operation.

“Oil and gas 4.0 is putting the Industrial Revolution 4.0 within an oil and gas context. A leader in adapting new technology, a leader integrating technology that comes from outside our domain, and see if this technology can add value to our production for the economy and the world in general.”

- Abdul Nasser Al Mughairbi
The Functional Areas and Potential Benefits of Value Chain Optimization

A digital transformation strategy of the end-to-end value chain tackles different functional areas and incremental benefits can be realized on each of them, which in total can boost profitability by $50 to 300 million per year for a typical oil refinery.

- **Supply Chain:**
  - Crude Purchases: Reduce cost of purchases, reduce maintenance
  - Planning, Scheduling and Logistics: Increase throughput, increase yield
- **Process Performance:** Longer equipment life, increase availability, quality, and yields
- **Blending and Oil Movements:** Reduce giveaway, no rework, minimum inventory, minimum downgrades, higher fuels agility
- **Energy Management:** Reduce energy conversion cost, reduce energy consumption cost, reduce cost of crude for energy
- **Production Management:** Reduce accounting losses, reduce inventory, reduce hydrogen and steam consumption, increase throughput
- **Operations Management:** Reduce unplanned shutdowns, increase yield, reduce hydrogen and steam consumption, increase throughput

To learn more about Value Chain Optimization and how AVEVA can support you to boost your profitability, visit our website: [sw.aveva.com/value-chain-optimization](http://sw.aveva.com/value-chain-optimization)
About AVEVA

AVEVA is a global leader in engineering and industrial software driving digital transformation across the entire asset and operations life cycle of capital-intensive industries. The company’s engineering, planning and operations, asset performance, and monitoring and control solutions deliver proven results to over 16,000 customers across the globe.

Its customers are supported by the largest industrial software ecosystem, including 4,200 partners and 5,700 certified developers. AVEVA is headquartered in Cambridge, UK, with over 4,400 employees at 80 locations in over 40 countries. Learn more about AVEVA at www.aveva.com.

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