

DIGITISATION IN THE PETROCHEMICAL SUPPLY CHAIN

REPORT



THE EUROPEAN PETROCHEMICAL ASSOCIATION



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FOREWORD

We are delighted to share the results of the latest EPCA Supply Chain & Logistics research study, *Digitisation in the Petrochemical Supply Chain*, in this report. This study was conducted over the course of 2017 on EPCA's behalf by Professor Ann Vereecke, Partner and Faculty Dean of Vlerick Business School along with her team, and with the invaluable contribution of hundreds of managers and experts **representing a broad spectrum of the Petrochemical industry supply chain**, from EPCA member companies. Building on the conclusions of the Logistics & Supply Chain session of the EPCA 50th Anniversary Annual Meeting which identified digitisation as a key issue for the industry moving forward, the research study was designed with a threefold objective: **investigate the digital maturity and harvest innovation best practices** in companies active in the petrochemical sector, **analyse the challenges and opportunities** coming from new technologies and **identify how digitisation can create added value in the petrochemical supply chain**. This comprehensive report provides us with informative and eye-opening data on the current status of digital transformation within the petrochemical supply chain.

Digital technology awareness and the appetite to transform is high within the EPCA membership even though overall, the **petrochemical industry is perceived as lagging behind** other sectors. It also offers a broader perspective into existing best practices and inspiring stories of producers and logistics service providers from within the EPCA community who have already embarked on the fascinating journey of digitisation.

We hope this research study and its findings will serve as a useful tool in widening your horizons and will be a source of inspiration, encouraging a culture where digitisation serves and supports an even more efficient management of the supply chain.

We would like to take this opportunity to thank all the contributors to this study, without whom we would not have been able to reach the point of having such an in-depth analysis and study to share with you. Firstly, we would like to express our gratitude to the **EPCA Supply Chain Program Committee (SCPC)** members and the Chairperson, Johan Devos, for their enthusiastic support throughout the process, and their invaluable contributions to the development and finalisation of this report. We would also like to thank the almost 240 managers and experts who

diligently filled out the survey on which the first part of this report is based and provided us with so much useful data. Finally, we would like to thank the entire **Vlerick Business School** team who brought a high level of professionalism, dedication and academic rigour to this study.

Lastly, as we have clearly seen that the appetite to continue the digital transformation journey is high amongst our membership, EPCA will be organising a **workshop on *Digitisation in the Petrochemical Supply Chain*** to be held in the academic environment of the Vlerick Business School campus in **Brussels** on **20th and 21st June 2018**. This **interactive workshop** will tackle the **tangible benefits of supply chain digitisation**, the possible **approaches** and the **existing paths** that our sector could follow to **accelerate its digital transformation** and **boost its supply chain**. Should you wish to have more information on this workshop, please visit the EPCA website **www.epca.eu**.

We look forward to continuing this journey with you!

Caroline Ciuciu
CEO
EPCA

EPCA SCPC MEMBERS (AS OF MARCH 2018)

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DIRK VERSTRAETEN - COVESTRO DEUTSCHLAND AG



The study was commissioned by EPCA, and carried out by Vlerick Business School in close collaboration with EPCA.

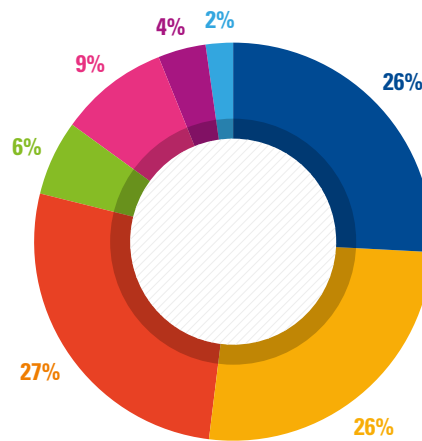
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www.vlerick.com

ABOUT THE RESEARCH

1

THE RESPONDENTS' FUNCTION



- CEO, managing director, general manager
- COO, operations & supply chain manager
- Sales Director, Sales manager, business development
- CIO/CTO/CDO
- CPO, procurement / purchasing manager
- Quality, safety & business improvement manager
- Other

In the contemporary fast-changing business and consumer environment, traditional businesses experience a wide range of challenges and opportunities, coming from new digital technologies. EPCA has therefore engaged in this research project with Vlerick Business School to identify how digitisation can create extra value in the supply chain of the petrochemical sector. Professor Ann Vereecke and researchers Joachim Van den Bergh and Olga Varganova conducted the research in two phases. Through a survey to a large number of respondents, they have investigated the digital technology awareness and digital innovation practices present in companies that are active in the petrochemical supply chain. Secondly, they identified some best practices of digitisation in the petrochemical supply chain and present them as eleven short cases, eye-openers showing the value that can be created through digitisation and how to get it done.

WHO RESPONDED TO THE SURVEY

Nearly 240 managers and experts in the petrochemical supply chain participated in the survey. As Figure 1 shows, about a quarter of the respondents have a general management function; an almost equal number are in operations and supply chain functions; another quarter are in sales and business development functions. Also represented, albeit in smaller numbers, are functions such as purchasing, information management, technology management, digitisation, quality and safety management, and business improvement management.

(see figure 1)

41% of the respondents (98 in total) are active in production companies in the petrochemical supply chain. The large majority (80 respondents) can be

classified as chemical producers; a small number (8) are upstream in the supply chain, active in refining, cracking and/or reforming; an almost equal number (10) are downstream producers that buy the chemical product to use it as raw material for their production process.

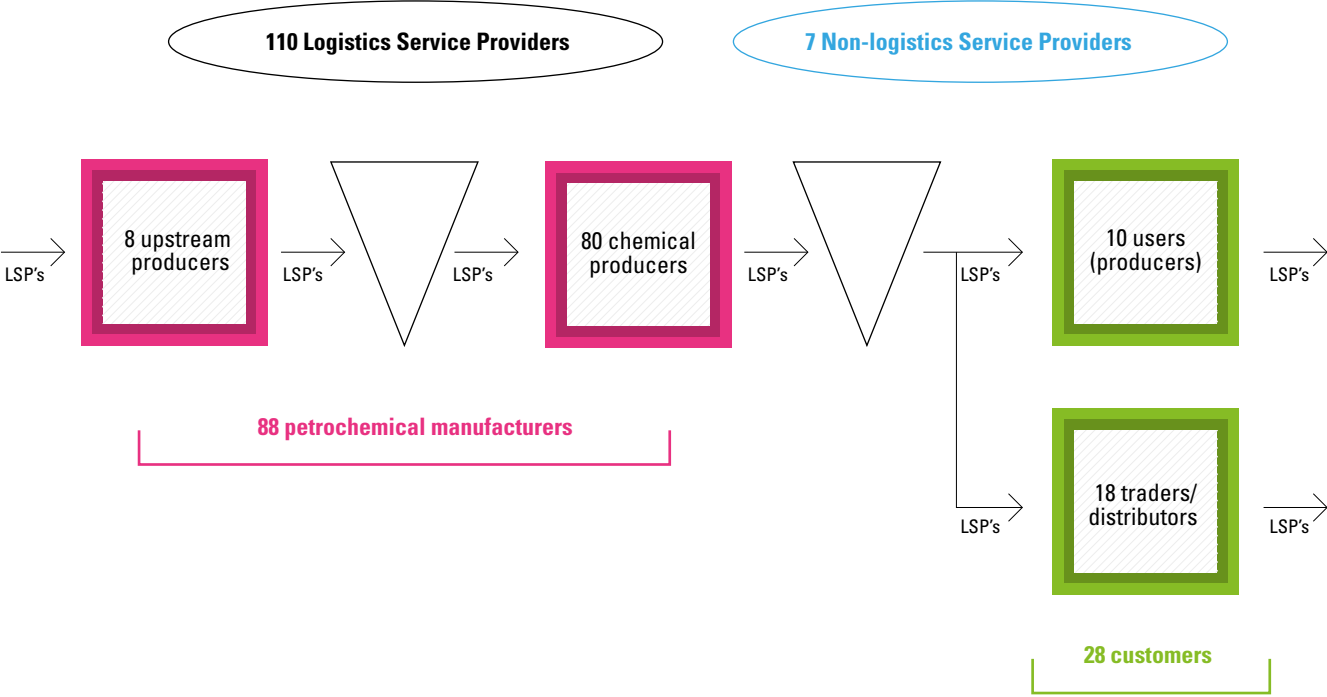
A second category of customers of the petrochemical companies, next to the users of the petrochemical products, are the traders and distributors. They are also represented with close to 10% (18) of the respondents.

49% of the respondents (117 in total) are service providers to the petrochemical companies. The majority of them (110) are logistics service providers, active in all sorts of logistics services, such as shipping, port's management, transportation (road hauliers, intermodal hauliers, barge operators, rail operators, airline operators, iso-tank operators, ...), 4PL services, freight forwarding, terminal operations, warehousing and storage, and cleaning.

(see figure 2)

2

THE RESPONDENTS' COMPANIES



Nearly 240 managers and experts in the petrochemical supply chain participated in the survey



EXECUTIVE SUMMARY

As in many other sectors, digitisation is taking place at a fast pace in the petrochemical sector. Proven and new technologies are introduced on the shop floor, in the warehouse, in transportation and in many other logistic activities. They change the way companies run their factories and their supply chain.

Our research shows that managers in the petrochemical supply chain are well aware of the impact of digitisation. They almost unanimously report that digitisation will have a significant impact on their internal processes and their supply chain. In particular, they expect that it will have an important

impact on the information flow (ordering, planning and control) and the financial flow (accounting, invoicing, payment), less so on the physical flow of products.

Half of the participants in our research report that it will even change the way they do business. New business models will arise, in manufacturing as well as logistics.

Not only is there awareness of the importance and impact of digitisation, there is also a sense of urgency. Three out of four participants in our research acknowledge that the petrochemical sector is lagging behind other sectors. Interestingly, customers are even more

stern; they almost unanimously report that the sector is lagging.

The customers are actually an important driver of digitisation. They are asking for transparency in the supply chain, for new solutions and for even better service; digital technologies and applications can bring the innovation the market expects. Interestingly, the closer to the customer, the higher the ambition for and the achievement of digitisation. The customer seems to “push” digitisation into the supply chain, all the way from the consumer to the refinery.

Pressure is also coming from newcomers in the sector: start-up companies launching new



Running the race of digitisation requires a set of capabilities

solutions, the so-called “GAFA” companies, or existing companies from other sectors entering the petrochemical sector.

The sector may be lagging... yet, there is a lot of ambition. About half of the participants aim to be an early adopter of digitisation or even an innovator. That being said, there is still a long way to go. About half of the participants admit to be still in the starting mode.

So, the overall picture we get is one of a sector that is well aware of the importance and potential impact of digitisation, that got off the starting blocks and is running. In this report, we provide some illustrations of innovative digital projects in the petrochemical supply chain, through eleven cases from manufacturers and logistics service providers. The cases show the implementation of a wide range of technologies and systems, offering more transparency, creating platforms for intensive collaboration, and improving supply chain performance.

Running the race requires a set of capabilities. Our research shows that there is a need for investment in developing these capabilities. The “number one priority” should go to attracting and developing digital talent. Although it is fair to say that effort is also needed on all other aspects – digital strategy, governance,

processes, culture and technology – of capabilities for digital transformation.

Investments are planned mainly in proven technologies. Big data and advanced analytics, cloud computing, digital identifiers and low-cost sensor technologies will find their way into the petrochemical supply chain soon, if not now already. There is a bit more hesitation on the technologies with medium to longer term impact: “Maybe” is the typical answer we get when asking about plans for investment in the next 3 years on Internet of Things, control tower solutions, robotics and automation, social media and self-learning systems. There is little enthusiasm for investments in augmented reality, blockchain and self-driving vehicles, which is in line with the low impact that is expected from these technologies. Finally, the overall interest in 3D-printing, unmanned aerial vehicles and bionic enhancement is low in the petrochemical supply chain. If and when we will see investments in these technologies, it will most likely be in niche applications in the supply chain.

Investments in technologies bring along some challenges that need to be managed. Firstly, the risk of “de-humanising” the supply chain needs attention. Secondly, the more we use information and communication technologies in the supply chain, the more we rely on these systems for our day-to-day operations, and the more

we have to manage the risk of hacking, system failures and temporary black-outs.

That said, digitisation does pay off. The majority of the participants in the study report an increase in efficiency and productivity, as well as an improvement of customer service. Especially for logistics service providers this also results in increased sales. Improved collaboration with suppliers is an often mentioned benefit. However, the increased visibility of assets and goods throughout the supply chain and the improved coordination and alignment across the chain has not (yet) led to lower inventory levels and improved asset utilisation for many of the participating companies. Could it be a matter of time before these longer-term benefits materialise?

Our study clearly shows a higher level of maturity among the logistics service providers than among the petrochemical manufacturers. Not only do the logistics service providers show a higher level of ambition for digitisation, they also have a higher level of digital capabilities, and they are further down the road to achieving their ambition. Since many of these logistics service providers are active in different sectors, they gain experience with more advanced practices that they can transfer to the petrochemical supply chain. As such, they act as the catalyst of digital innovations in the petrochemical supply chain.

INTRODUCTION

DIGITISATION, A HYPE OR REALITY?

“Data is the new oil.” Back in 2006, Clive Humby at Tesco, the architect of Tesco’s clubcard, said these almost prophetic words. Time proved him right. Now, 10 years later, the top 5 companies in the world in terms of market capitalisation are data intensive companies. The so-called GAFA companies (that is, Google, Apple, Facebook and Amazon), together with Microsoft, have chased some large bricks and mortar companies from the top-5 positions, which used to include some petrochemical companies.

We experience every day how data and digital applications change the way we communicate, the way we live, and the way we do business. It has changed entire sectors, such as telecommunications, retail, and media and entertainment; It gradually finds its way into other sectors, including the petrochemical sector.

Digital technologies have a huge impact on the structure of supply chains. Factories are becoming smart by introducing new process technologies, often referred to as Industry 4.0. E-commerce is changing distribution channels. Automation and augmented reality is changing the processes in warehouses and transportation. Logistics service providers are investing in end-to-end visibility across the chain. Startup companies are disrupting traditional logistics flows. The examples of digitisation in the supply chain are numerous. They may be considered as a threat for some, yet as an opportunity for other companies.

What does it mean for the petrochemical supply chain? How can digitisation create value in the supply chain of the petrochemical sector, from the upstream refineries, to the downstream traders,



distributors and customers of the chemical companies? In this report, we will answer this question in two ways: first by discussing the results of a survey sent out to a large number of companies in the petrochemical supply chain. And secondly by presenting a set of cases, best practices of digital innovations in companies – producers and logistics service providers – in the petrochemical supply chain.

The examples of digitisation in the supply chain may be considered as a threat for some, yet as an opportunity for other companies

RESULTS OF THE SURVEY

WORK TO BE DONE!

How digital is the petrochemical supply chain? If we can take the online presence of the companies in the petrochemical supply chain as an indicator, we get the impression of a “bricks and mortar” rather than a digitised supply chain: 83% of the respondents generate less than a quarter of their revenue online. For manufacturing companies this number reaches even 87%, against 81% for logistics service providers. *(see figure 3)*

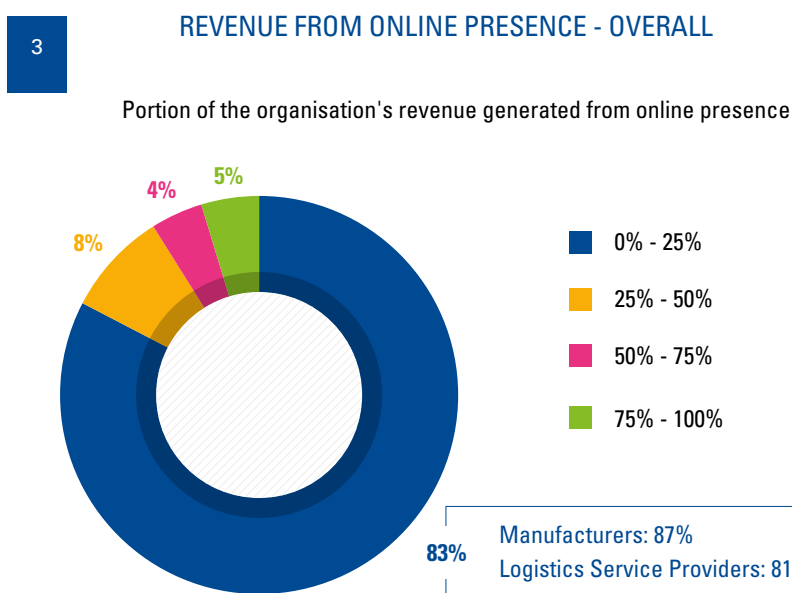
Given these numbers, it will not come as a surprise that 73% of the respondents consider the sector to be lagging behind other sectors. Only 23% consider it at par with other sectors, and 4% even see the sector as a pioneer in digitisation. *(see figure 4)*

Interestingly, the customers of the petrochemical supply chain – that is, the traders, the distributors and the producers using the petrochemical products - have an even more outspoken opinion: almost unanimously (95%), they categorise the sector as lagging behind other sectors. Work is to be done! *(see figure 4)*

PRESSURE COMING FROM OUTSIDE

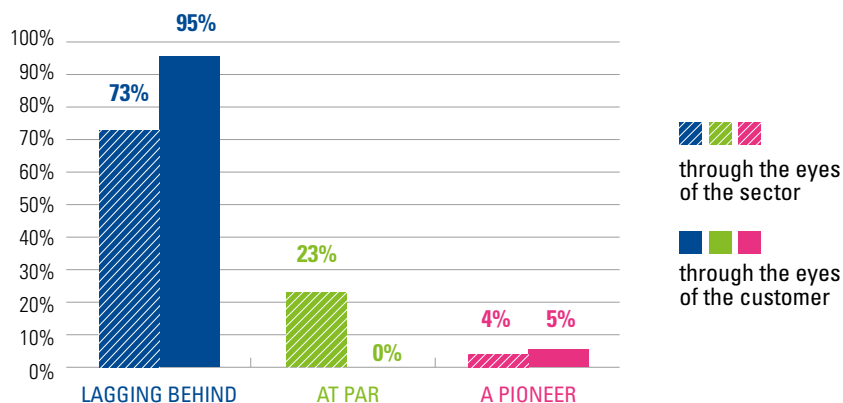
The pressure to digitise is mainly coming from the market and from outside the petrochemical industry.

The respondents were presented a set of potential sources of digitisation and they were asked to indicate to what extent they agreed that digitisation was indeed coming from these sources (1=not at all, 3=somewhat, 5=to a large extent). *(see figure 5 on following page)*



4 DIGITISATION OF THE SECTOR, THROUGH THE EYES OF THE SECTOR AND THE CUSTOMER

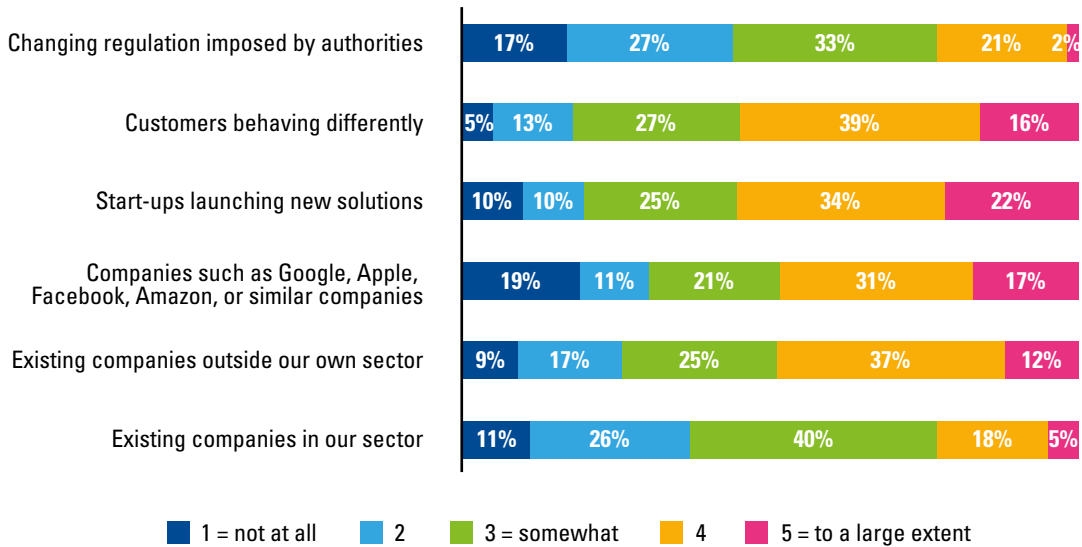
In terms of digital transformation, the petrochemical sector is ...



5

THE PRESSURE TO DIGITISE

Digitisation is coming from...



Over half of the respondents (55%) consider customers behaving differently as an important driver of digitisation (a score of 4 or 5). A remarkably low number of respondents (only 5%) see no push towards digitisation from the customer side.

There is also strong agreement that pressure is coming from newcomers, that is, from start-up companies launching new solutions (56% of the respondents), from the so-called “GAFA” (Google, Apple, Facebook and Amazon) and similar companies (48%), or in general, from existing companies from other sectors entering the petrochemical sector (49%).

This is in contrast with the pressure that is reported from within the sector: Only about a quarter of the respondents (23%) report that digitisation is coming from existing companies in the petrochemical sector to a significant or large extent.

Regulation is not the game-changer. Also close to a quarter (23%) of the respondents report changing regulations as an important driving factor for digitisation; alternatively, 44% of them see no or very little impact from changing regulations.

The drivers for digitisation are slightly different for logistics service providers than they are for the manufacturers. Logistics service providers experience somewhat more pressure from existing players outside their sector, which is not surprising given that many of the logistics providers have activities in multiple sectors. The manufacturers experience relatively more pressure from start-ups and from the “GAFA” and similar companies. Regulations also play a bigger role for manufacturers than for logistics providers.

Digitisation is expected to have a significant impact on how the company operates its processes, both internally and externally

DIGITISATION IS CHANGING THE PETROCHEMICAL SUPPLY CHAIN

Digitisation is expected to have a significant impact on how the company operates its processes, both internally and externally. The respondents were asked to rate the expected impact of digitisation, on a scale from 1 to 5 (1=no impact at all, 3=some impact, 5=a large impact).

(see figure 6)

The vast majority of respondents (83%) expect a significant to large impact on the company’s internal processes (a score of 4 or 5). An even larger number of respondents

(87%) expect a significant to large impact on the company’s supply chain.

Not only will it impact the process from order to delivery, it might even have an impact on how one does business. That, at least, is the opinion of one out of two respondents: 51 % of the respondents expect a significant to large impact on the company’s business model, whereas only 20% expect no or very little impact. This conclusion holds for manufacturers as well as logistics service providers: there is a common awareness that digitisation will go beyond improving the internal processes and the supply

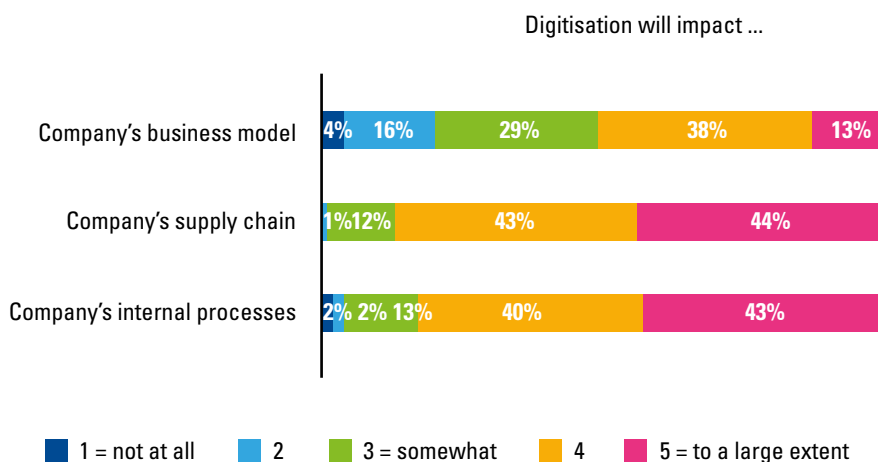
chain to change the company’s business model.

Digitisation is expected to change in particular the information flow (ordering, planning and control) and the financial flow (accounting, invoicing, payment): There is almost unanimous agreement (87%) that it will have a significant to large impact on the information flow (a score of 4 or 5), whilst two third (67%) of the respondents expect a significant to large impact on the financial flow.

(see figure 7)

6

THE IMPACT OF DIGITISATION



However, most companies expect the impact on the physical flow of products, from the raw material to the final customer, to be rather small or even non-existent. Only a quarter (27%) of the respondents expect a significant to large impact on the physical flow. About one fifth of the respondents (22%) expect that digitisation will have no impact at all on the physical flow.

AIMING HIGH

Although the petrochemical sector is perceived as lagging behind other sectors, the ambition to adopt digitisation is high. Almost 80% of the respondents have the ambition to be with the early majority (26%), or to be an early adopter (29%), or even an innovator (23%).

(see figure 8a)

The ambition to be an innovator is clearly higher among the logistics service providers than among the petrochemical manufacturers.

(see figure 8b)

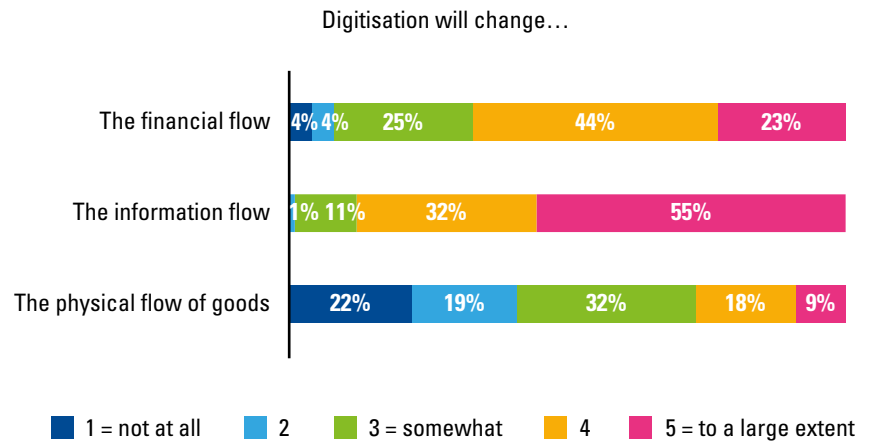
This being said, there is still a long way to go. When asked how close the company is to realising that ambition, half (50%) of them admitted that they are far off or have just started. About one in eight (13%) reported that they have almost or fully realised their digital ambition. Again, we see that the logistics service providers are a step ahead of the manufacturers.

(see figure 9a and b)

We also observe differences in ambition depending on the position in the supply chain. Figure 11a shows the “barometer of ambition,” indicating the percentage of respondents with the ambition to be early adopters or innovators; Figure 11b shows the “achievement rate,” indicating

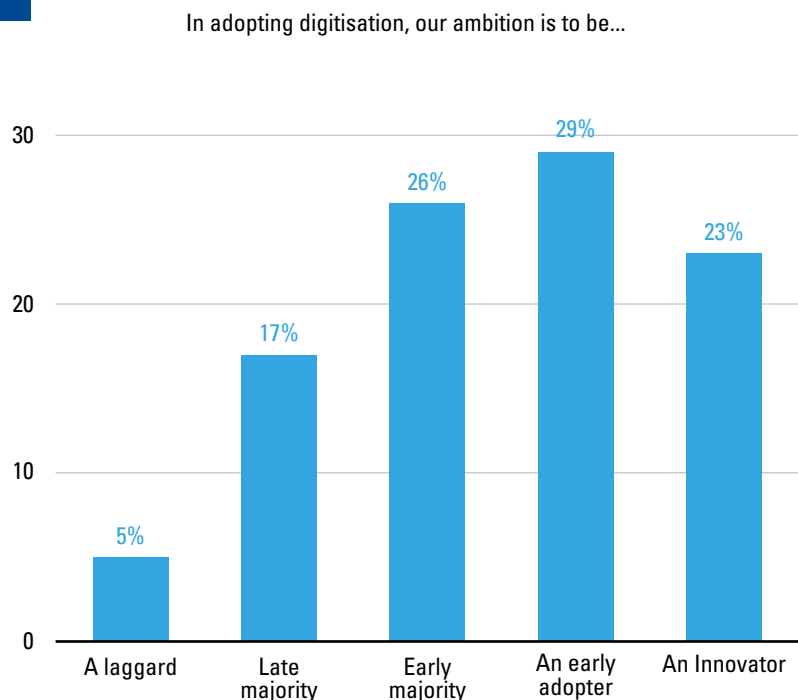
7

THE IMPACT OF DIGITISATION



8a

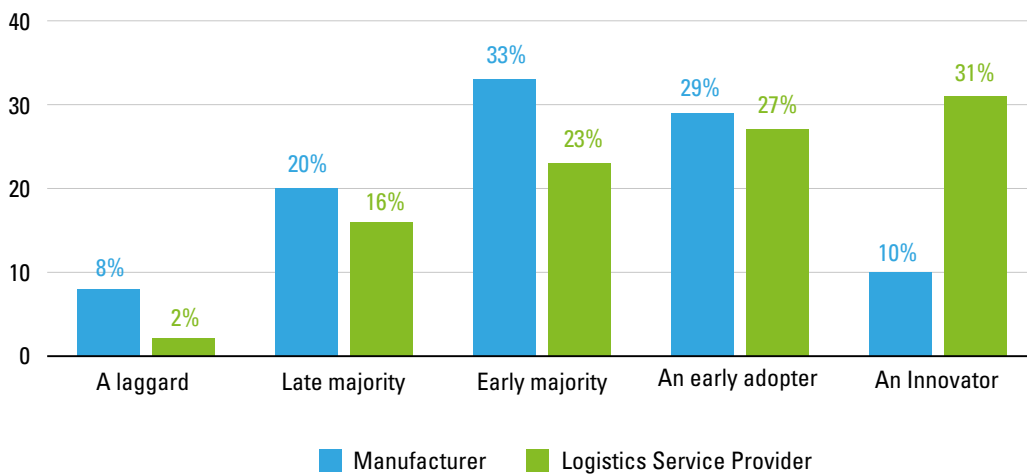
AMBITION - OVERALL



8b

AMBITION - OVERALL

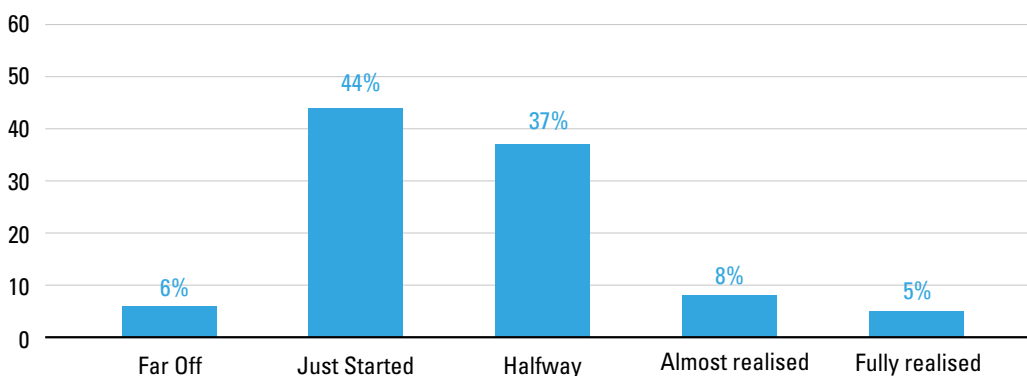
In adopting digitisation, our ambition is to be...



9a

REALISING OUR AMBITION - OVERALL

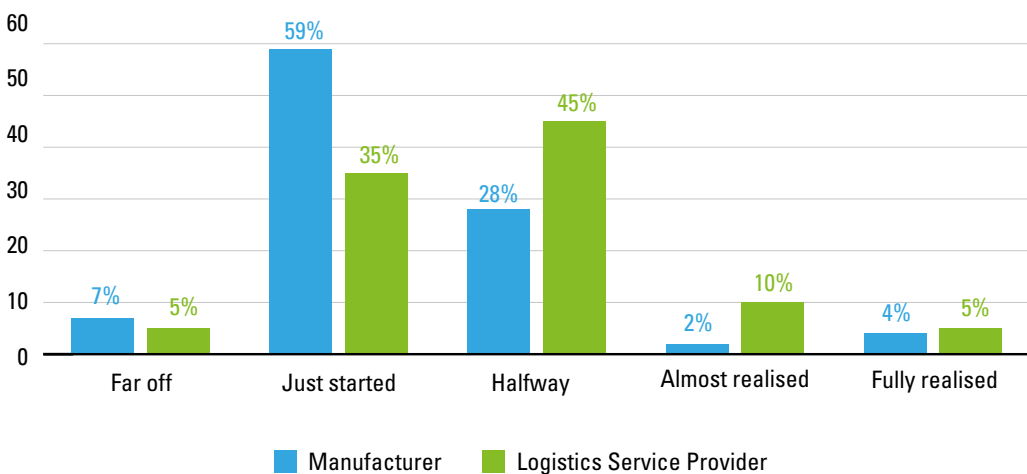
How close is your organisation to realising the ambition of adopting digitisation?



9b

REALISING OUR AMBITION - OVERALL

How close is your organisation to realising the ambition of adopting digitisation?



Digitisation also requires a culture that stimulates experimentation, that allows for “fast failures” and that has the agility to seize opportunities

the percentage of respondents that report their company is half way or even further on the path to realising its digital ambition. Clearly, both ambition and achievement rate are higher among the downstream producers than among the upstream producers, and they are higher among the logistics service providers and the traders and distributors than among the petrochemical manufacturers that supply them.

(see figure 10a and b)

DIGITAL SAVVINESS OF THE PETROCHEMICAL SUPPLY CHAIN

Reaching the ambition to be a digital innovator requires a set of capabilities. Are these capabilities available in the petrochemical supply chain? In order to answer this question, we have measured the maturity of the companies on six key capabilities: digital strategy, governance, processes, talent, culture, and technology.

(see figure 11a)

Truly digital companies set a digital strategy that is integrated into their overall strategy. They constantly respond to a changing, dynamic, competitive environment. They change their business model and their business processes to create new value propositions, and to offer innovative experiences to their customers, inspired by the capabilities provided by new technologies. They are open to collaboration with partners in an ecosystem. Meeting all these criteria would qualify a company for the highest score, that is a score of 5, on the digital strategy capability. With a score of 3,3 on the 1-to-5 scale, the petrochemical supply chain scores average.

Truly digital companies are also characterised by full commitment of top management for digitisation. They will adopt agile structures

and practices, set up separate business units or acquire companies to accelerate their digitisation. They will allocate budgets in a flexible way and share ideas and practices efficiently. This level of digital governance capability would get a score of 5. Also here, we conclude that the petrochemical supply chain scores rather average, with a score of 3,2.

The digital company excels in the use of digital technologies in its operational and support processes. It redesigns its processes to fit the changing behaviour of its customers. It leverages big data and advanced analytics to make its business processes smarter. And finally, it has a dynamic performance measurement system in place for real-time monitoring of the processes. Our data shows the same average score of 3,2 for the digital process capability in the petrochemical supply chain as we saw in the previous two capabilities.

The digitisation journey requires talent that may not be present in today's companies. The digital company will invest in the development of the necessary skills for its current employees and it will hire new digitally-skilled talents. It will flexibly allocate human resources for its digital transformation and it has a strong HR reward and retention programme for its digital talents. It exposes its employees to

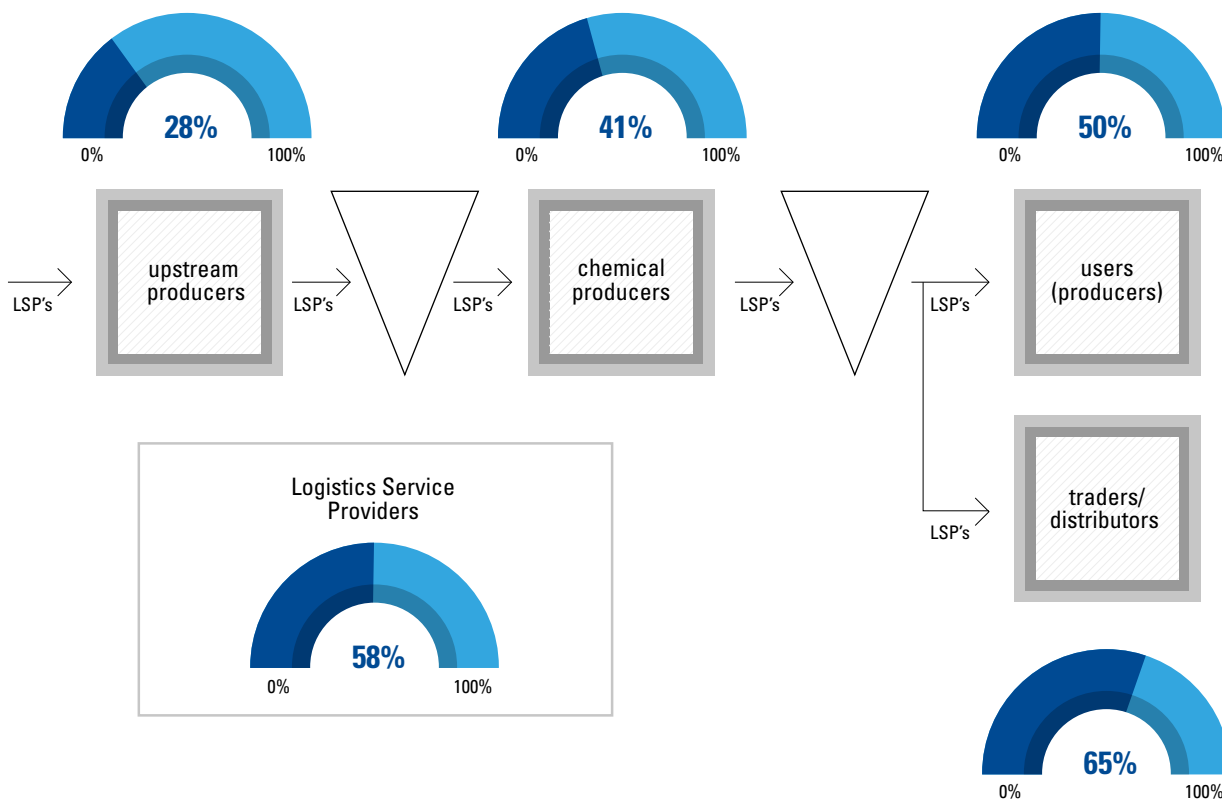
digital innovations through labs, incubators, accelerators or employee swaps. Digital technology specialists, such as data science experts, machine learning experts, blockchain technologists are sourced externally whenever necessary. With a score of 2,8 on the 1-to-5 scale, digital talent capability scores the lowest of all six digital capabilities. This highlights the need to invest in digital talent, by developing a strong talent pool from within, as well as by attracting expertise from outside.

Digitisation also requires a culture that stimulates experimentation, that allows for “fast failures” and that has the agility to seize opportunities. It makes customer-centricity the cornerstone of its digital transformation and it embraces data-driven decision-making. Cross-functional team work and external collaboration are stimulated. The digital culture capability score of 3,2 on the 1-to-5 scale reinforces the observation of an average level of capabilities in the sector.

10a

DIGITAL AMBITION

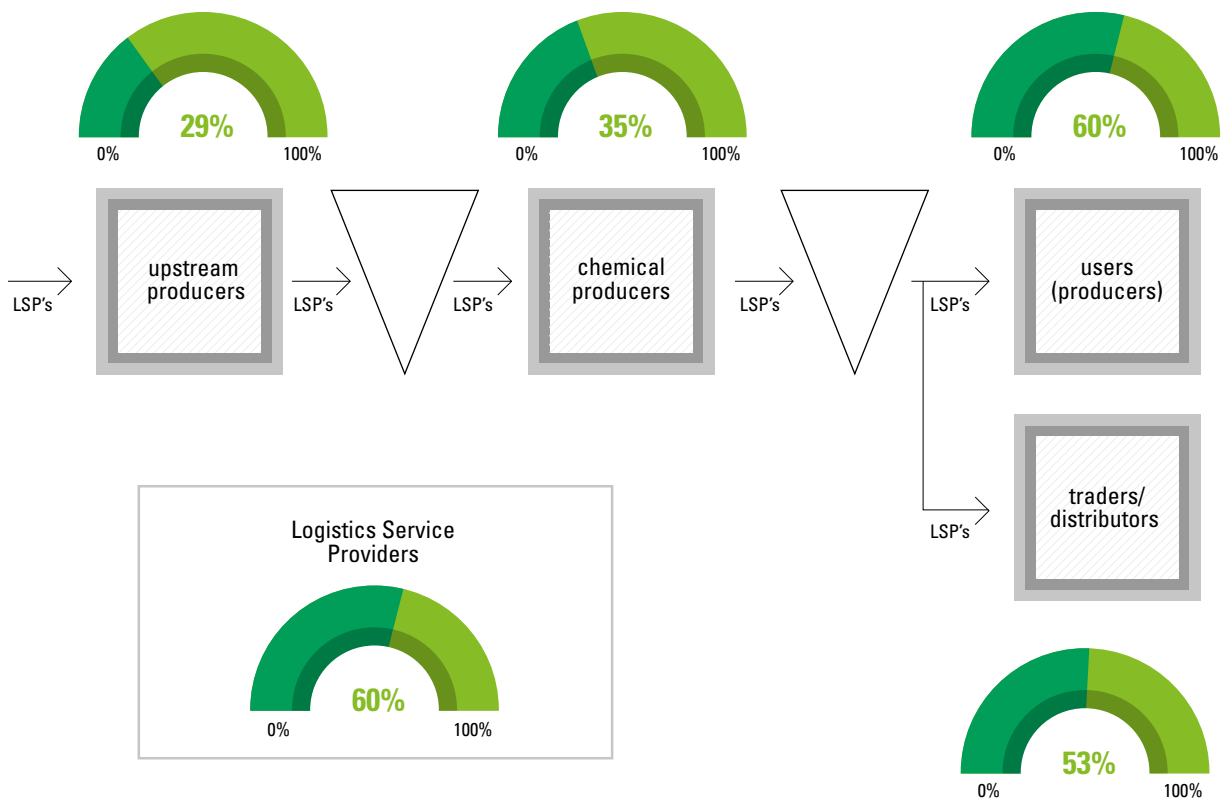
% of respondents with early adopter or innovator ambition



10b

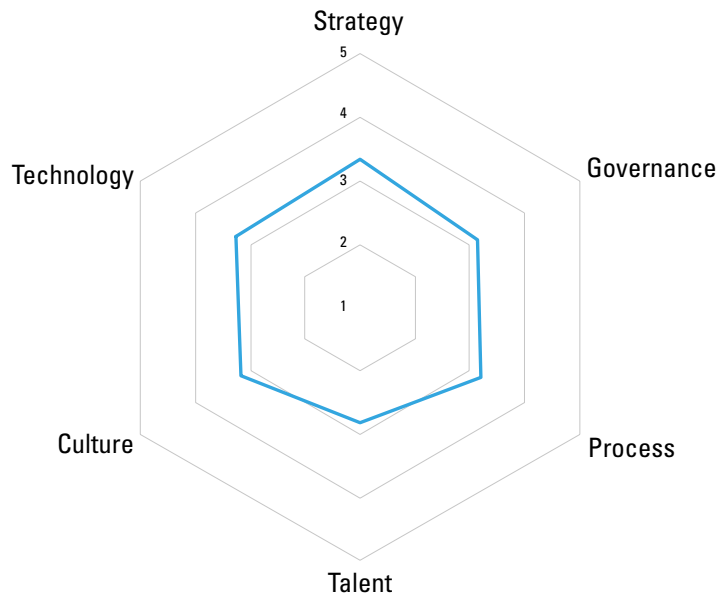
DIGITAL ACHIEVEMENT

% of respondents having realised ambition half way, almost or fully



11a

DIGITAL CAPABILITIES - OVERALL



Finally, digitisation is undeniably linked to the adoption of technologies, existing and new. It requires an IT core that is reliable, resilient and secure, yet agile to deliver fast results. It requires a technology platform that enables seamless integration of data and applications. The digital company flexibly allocates IT resources for its digital transformation and it treats data as an asset that generates value. Last but not least, the digital company stays current with new digital technology innovations, such as blockchain, cognitive computing or Internet of Things. This digital technology capability received a score of 3,3 on the 1-to-5 scale, in line with the scores on the other digital capabilities.

It is striking that the logistics service providers show a higher level of digital capabilities on all six aspects than the petrochemical manufacturers. Not only are the logistics service providers more ambitious and more advanced in the adoption of digitisation (as we discussed earlier), they also have more capabilities to reach their ambitious goals.

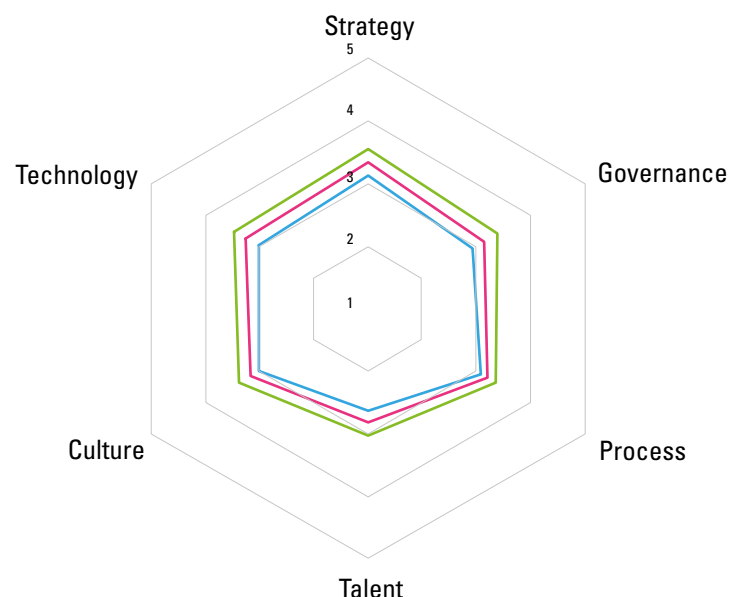
(see figure 11b)

With an overall score of 3,16 for digital capabilities, the petrochemical supply chain scores lower than the benchmark that resulted from the recent “Transformer 200” study¹ conducted by Vlerick Business School and Financieele Dagblad, with the 200 largest companies in the Netherlands (see Table 1). This positions the petrochemical supply chain in the “back peloton”, with the companies that have recently embarked on a digital journey.

In our study as well as in the “Transformer 200” study, the digital talent capability has the lowest score of the six capabilities, indicating the urgency to build a talent pool that has the skills and competencies needed in the digital century.

11b

DIGITAL CAPABILITIES MANUFACTURERS VS LSP'S



- Manufacturer
- Logistics Service Provider
- Petrochemical Supply Chain



The digital company stays current with new digital technology innovations, such as blockchain, cognitive computing or Internet of Things

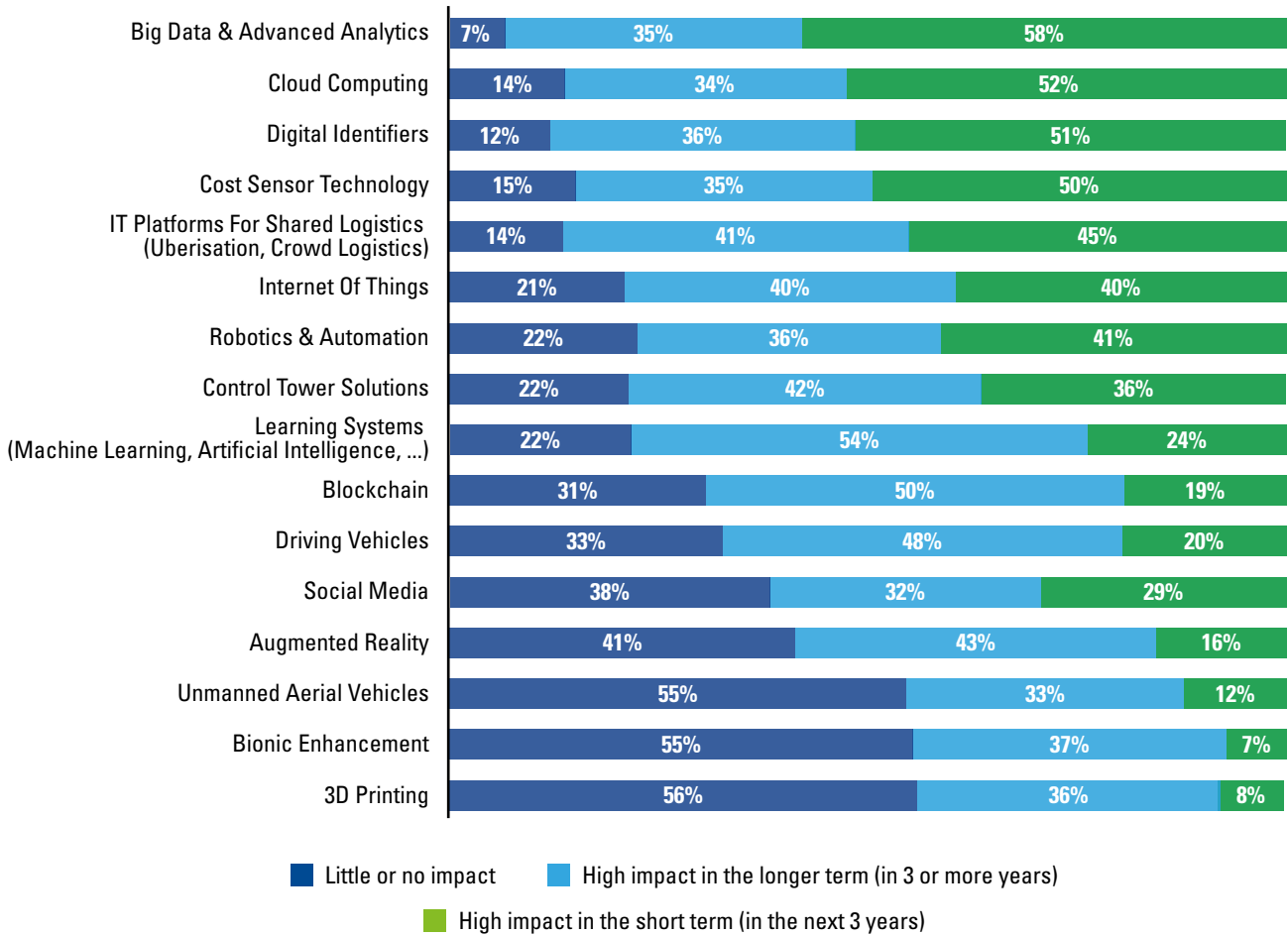
Table 1 – Digital capabilities

	Petrochemical supply chain	Transformer 200 ¹
Digital strategy capability	3,33	3,87
Digital governance capability	3,15	3,55
Digital process capability	3,20	3,56
Digital talent capability	2,83	3,28
Digital culture capability	3,17	3,66
Digital technology capability	3,25	3,59
Overall digital capability	3,16	3,59

¹ Reference: Steve Muylle, Willem Standaert, Joachim Van den Bergh and Stijn Viaene, <http://www.vlerick.com/en/research-and-faculty/knowledge-items/knowledge/who-are-the-digital-leaders-in-the-netherlands>. The scale of the capabilities has been adjusted to a 1-to-5 scale.

DIGITAL TECHNOLOGIES

Expected impact of technologies



DIGITAL TECHNOLOGIES IN THE PETROCHEMICAL SUPPLY CHAIN

There is no doubt that the petrochemical supply chain will be strongly impacted by technologies and that investments will be needed in these technologies. Some technologies already have a strong impact today, or will have soon (that is, within the next 3 years); others are expected to impact the chain in the longer term.

High on the list of short-term impact technologies are big data and advanced analytics, cloud computing, digital identifiers and low-cost sensor technologies. In the longer term, a high impact is expected

from IT platforms for shared logistics, the Internet of Things, robotics and automation, control tower solutions and self-learning systems.

The opinions on blockchain, social media and augmented reality are more mixed. Some believe the impact will be high (sooner or later), others expect little to no impact.

At the bottom of the list, we find the unmanned aerial vehicles, bionic enhancement and 3D-printing. Over half of the respondents expect little to no impact of these technologies.

(see figure 12)

We have created an “impact index,” which shows the expected impact of the technology, ranging from “no impact” over “high long-term impact” to “high short-term impact,” weighted by the percentage of respondents per category; and we have created an “investment index,” ranging from “no” over “maybe” to “yes” on the question whether investments are planned in the short term (that is, the next three years) in the technology, again weighted by the percentage of respondents per category. Figure 13 plots the investment index against the impact index.

Interestingly, the plans for investment in the next 3 years are very much linked to the expectations of the impact the technology will have, as is shown in Figure 13. Short-term investments are planned for technologies with short-term impact. Clearly, we can expect big data and advanced analytics, cloud computing, digital identifiers and low-cost sensor technologies to be widely adopted in the petrochemical supply chain soon, if not now already.

There is a bit more hesitation on the technologies with medium to longer term impact: “Maybe” is the typical answer we get when asking about plans for investment in the next 3 years on Internet of Things, control tower solutions, robotics and automation, social media and self-learning systems.

The list of top technologies is the same for logistics service providers and manufacturers, with two exceptions: For logistics service providers, investments in Internet-of-Things joins the “invest now” group of technologies; for manufacturers we find investments in robotics and automation in the “invest now” group.

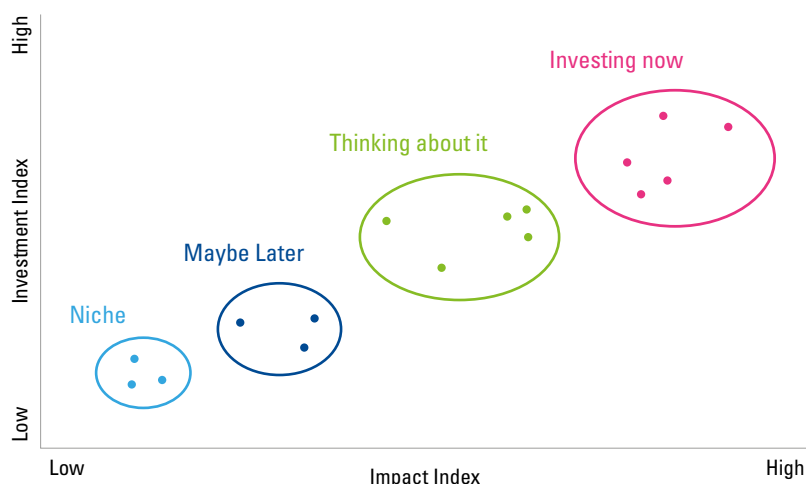
There is little enthusiasm for investments in augmented reality, blockchain and self-driving vehicles, which is in line with the low impact that is expected from these technologies.

Finally, the overall interest in 3D-printing, unmanned aerial vehicles and bionic enhancement is low in the petrochemical supply chain. If and when we will see investments in these technologies, it will most likely be in niche applications in the supply chain.

(see figure 13a and b)

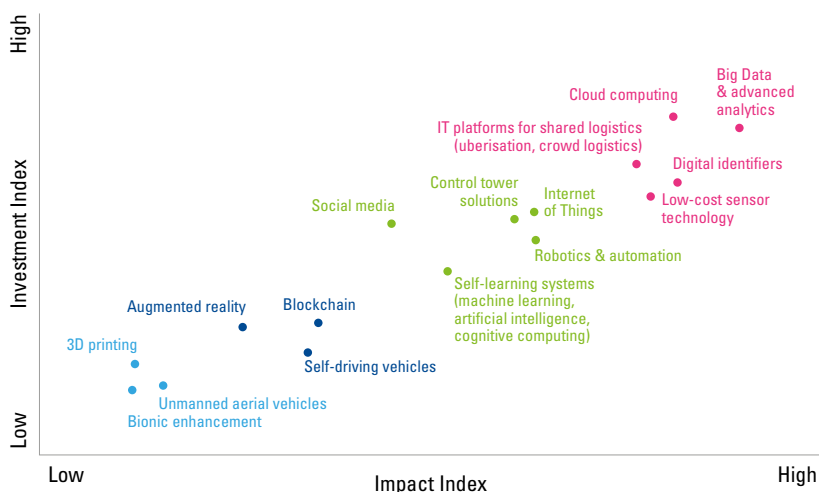
13a

THE RISE OF DIGITAL TECHNOLOGIES



13b

THE RISE OF DIGITAL TECHNOLOGIES



Digitisation clearly has a positive impact on the efficiency of the internal processes

DIGITISATION DOES ADD VALUE!

In every area of performance, the reported impact – if any – is mostly positive. Digitisation clearly has a positive impact on the efficiency of the internal processes. 80% of the respondents report that, thanks to digitisation, efficiency has improved somewhat or a lot. An impressive 60% of the respondents report improvements in staff productivity, although it is fair to mention that a few companies have seen a deterioration in staff productivity. Time will tell whether this is a permanent effect, or a temporary one in the transition to becoming a digital company.

Value is created towards the customer: 60% of the respondents report an

increase in customer service; for 37% of the respondents digitisation has already translated into an increase in sales. This is in particular the case for the logistics service providers: 50% of the respondents have seen an increase in sales, against only 20% of the manufacturers.

Finally, towards the supplier, digitisation has improved collaboration according to 56% of the respondents. 40% of the respondents report a reduction in procurement cost.

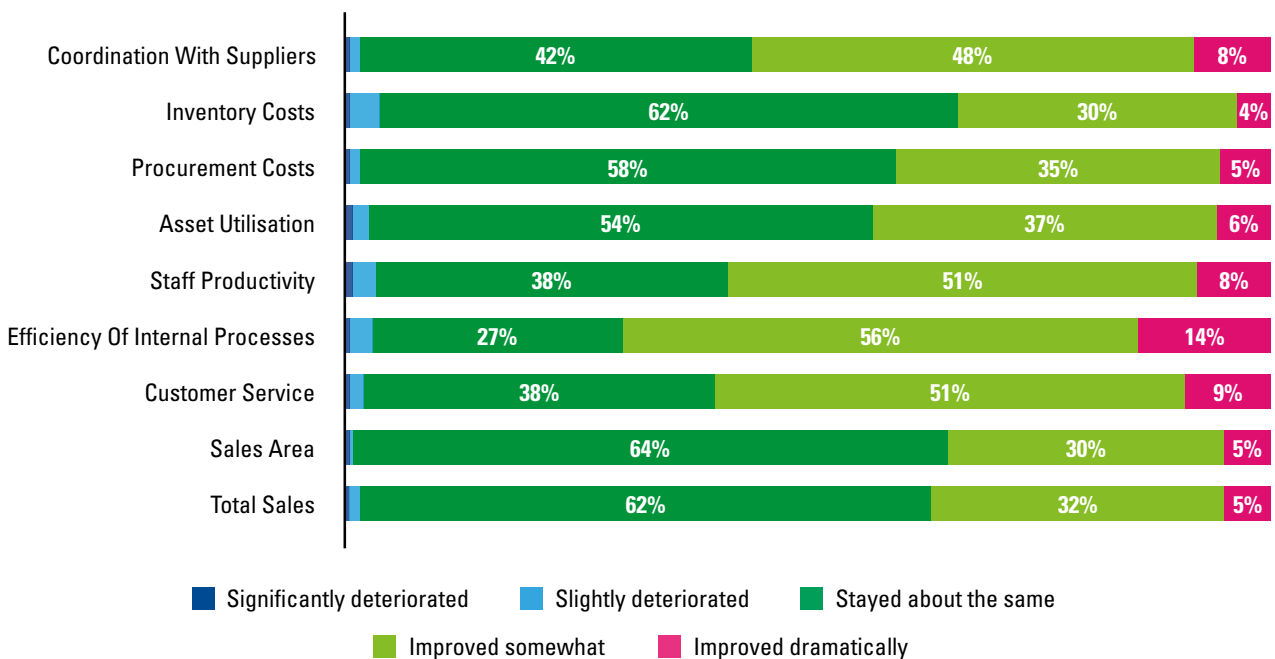
On the other hand, it is striking that 62% of the respondents report that inventory cost has not been reduced and 54% report that asset utilisation has not improved. This comes as a surprise since the increased

visibility throughout the supply chain should ultimately lead to better planning and control of the flow of goods, and hence lead to lower inventory levels. Along the same lines, we can expect that the use of low-cost sensors and information and communication systems make it possible to trace assets across the globe, which should improve asset utilisation. It seems that for many companies, this benefit from digitisation still has to materialise. *(see figure 14)*

14

IMPACT ON PERFORMANCE

Impact of the company's digitisation on the performance indicators in the past 3 years



RISKS AND CHALLENGES THAT NEED ATTENTION

Change unavoidably brings with it some risks and challenges that need to be managed and this is no different for the digitisation journey of the petrochemical supply chain. The top 3 risks mentioned by our respondents are the reduction of human contact in daily operations, the danger of hacking of the computer

systems, and the risk of system failures and temporary black-outs of the IT-system.

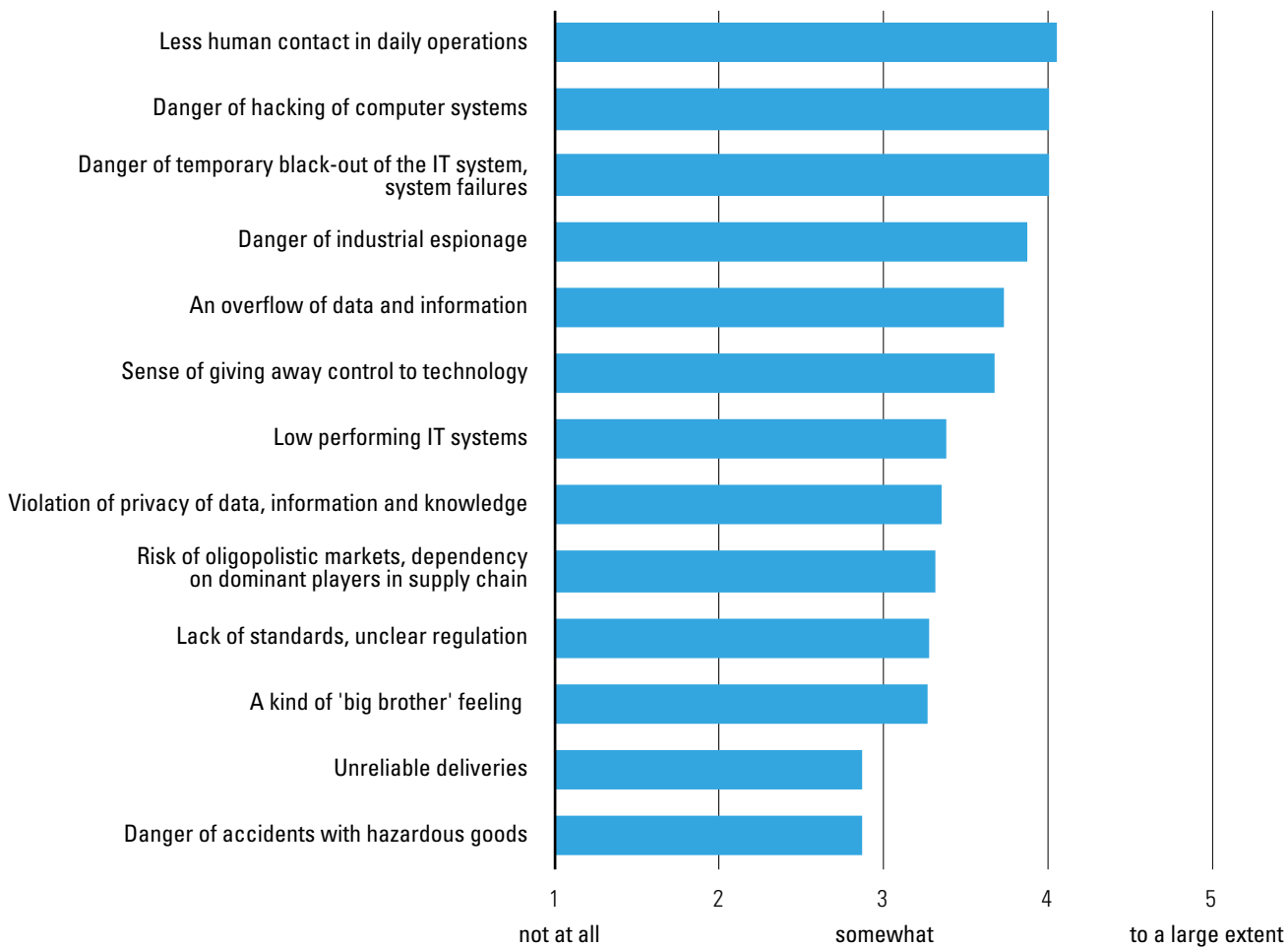
Rated lowest are the risk of accidents with hazardous goods and the risk of unreliable deliveries. Rather, for many companies, digitisation is even a way to improve safety and customer service, two critical aspects of the petrochemical supply chain. Several of the cases presented in

Section 4 illustrate how technology can be used to trace product and assets, to create transparency across the supply chain, to align processes, to coordinate with customers and suppliers, to control access, etc. Bottom-line, this renders the supply chain safer and more reliable.

(see figure 15)

15

RISKS AND CHALLENGES OF DIGITISATION



SHORT CASES

For the digital innovations to succeed, a clear vision and alignment of all partners involved in the project are needed

Our survey has shown that the petrochemical supply chain has left the starting blocks and is running the race of digitisation. In this section, we illustrate what digitisation means to the petrochemical supply chain by describing eleven cases. Each case tells us the story of a producer or logistics service provider, early movers that have embarked on the journey of digitisation. The cases illustrate the implementation of a wide range of technologies and systems: mobile and satellite communication systems, sensors and the Internet of Things, drones and sailing robots, self-driving trucks, platforms and portals, cloud computing and data analytics, blockchain, ERP-systems and business apps, tablets, smartphones and augmented reality.

Several cases offer examples of tracking, tracing and sensing of equipment: rail tank cars at SABIC and at Dow, containers at HOYER, thousands of valves and pumps at Vopak, Isotanks at Maersk/Damco, and shipments on all sorts of transportation modes at BASF. They show the value these systems bring to the users: better utilisation of assets, increased efficiency of employees, less administrative burden and more lean processes, which leads to lower costs. But also more reliable deliveries, better control over the quality of shipments and a safer and sustainable supply chain.

The use of autonomous vehicles in some of the cases speaks to the imagination: Katoen Natie's self-driving trucks on Jurong Island in Singapore, H.Esser's drone Yacob taking over surveillance tasks on logistic sites, and drone Elios and the Aquadrone sailing robot at Vopak are intriguing examples of technology that supports the human in the execution of tasks. The case of

the truck driver app at Bertschi is in turn an interesting example of a system that not only brings transparency to the chain, but also improves the communication between the person (in this case the truck driver) and the "machine" (in this case the planning system), leading to more involvement and better decision-making.

Through the use of portals and data platforms, players in the supply chain get access to data that used to be scattered and difficult to find. It opens opportunities for better scheduling and optimisation of flows. The "OneTouch" portal at Maersk/Damco and the "Avanti-Pronto" and "Navigate" platforms at the Port of Rotterdam are interesting recent developments. This leads to predictive and, in the future, prescriptive supply chains, as is illustrated in the case of BASF.

The application of blockchain technology is still in its infancy, but the first pilots are promising, as one can read in the Maersk/Damco and the Dow cases.

Interesting to note that several of the cases involve many partners; digital transformation is typically not the initiative of one player in the supply chain. Rather, it is often the result of an eco-system of partners bringing different competencies and capabilities to the project. The paperless European Cleaning Document, the e-ECD, for example, is being developed for a true community of chemical producers, tank cleaning operators, tank storage operators

and transportation companies, brought together by a unique consortium of ECTA, essencia, CEFIC and EFTCO.

Change and innovation don't come naturally. For the digital innovations to succeed, a clear vision and alignment of all partners involved in the project are needed. As is often the case in supply chain improvement projects, it requires total supply chain thinking above individual silo thinking; it takes a common goal, a common understanding of the investments that are needed, openness to share information, and an agreement on how to share the gains of the innovation. This takes trust and an open mind.

The cases of Vopak and the Port of Rotterdam focus in particular on how to create a culture of digital innovation. As speed of innovation is critical, employees should feel comfortable to experiment and there should be room for "fast failure." How to make this happen without putting the current operations at risk, is an important question for executives.

Digital innovation requires human resources policies geared towards attracting, developing and retaining digital savvy employees. Interestingly, innovativeness spills over into employer branding, since people are eager to work for a company that is part of the future economy, as witnessed in the case of Katoen Natie.



SABIC/OVINTO

NEVER LOSE SIGHT OF A RAIL TANK CAR

Back in June 2013, Judith Kleinen, Category Manager of Rail and Storage for Liquids in Supply Chain Management at SABIC, returned to her office after a very engaging meeting with Frederick Ronse, CEO and founder of Ovinto, a small start-up company specialised in satellite-based remote monitoring of rail tank cars and intermodal tank containers. She realises now that this meeting was the start of a digital journey that would truly innovate the company's supply chain management of transporting their products to customers and receiving products from their suppliers. Four years later, all 500

(approximately) rail tank cars of SABIC's fleet are equipped with a GPS device. SABIC has co-operated with Ovinto to develop and implement the reporting tool that provides full visibility of the location and conditions of each rail tank car and they are today further co-operating to improve the system.

The initial meeting of two companies took place not long after the tragic accident with a derailed freight train that was carrying chemical products, in Wetteren (Belgium) in May 2013. This unfortunate incident was a wake-up call for the sector as it highlighted

the importance of timely, accurate and easily accessible information about the load carried by trains on their journeys throughout Europe. 'When it comes to transporting potentially hazardous goods, like liquids and gases,' says Judith Kleinen, 'you want to make sure you know where and in which condition the rail tank cars are at any moment of the day'. The Internet of Things (IoT) seemed to be the answer to this challenge.

A small project team consisting of Judith Kleinen, Henk Bril, Senior Expert of Distribution and Safety and Pauline Lummen, Senior Operations Officer at SABIC, conducted

The advantage of using satellite communication over mobile technology is the availability and reliability of the network, and the low power consumption

a pilot project with 11 rail tank cars equipped with the Ovinto's GPS unit. The first results were promising. "We received vast amount of information from tracking our rail cars through a relatively simple satellite system," says Judith Kleinen. It motivated us to build a business case to assess the operational and financial viability of the technology. By the first quarter of 2015, the decision was taken by SABIC to adopt the system that is developed by Ovinto and to equip all rail tank cars with a GPS unit. These units collect a variety of data, such as exact location, direction, speed and temperature of the cars and other important parameters. Then it transmits these data to the Ovinto Sat Monitoring System via the Low Earth Orbit (LEO) Globalstar satellite network with around 50 satellites, covering the world. As a next step, the received data is transferred to secured servers, where it is further transmitted to the customer.

The advantage of using satellite communication over mobile technology is the availability and reliability of the network, and the low power consumption. The system comes with a lithium-metal battery that has autonomy up to 6 years. Moreover, the system is certified at the highest ATEX² explosion safety level, allowing it to be used in any chemical plant and with any chemical product.

Does this come at a cost? The answer is obviously "yes." First of all, there is a rental cost of the GPS devices. Over the life-time of the GPS device, there is the maintenance cost including replacing the batteries, although this cost can be avoided by opting for a solution with low energy consumption.

"For SABIC, environment, health, safety, and security is more than just a priority; it is a core value – a deeply held belief which

is a fundamental force driving actions, and one never to be compromised in pursuit of short-term commercial goals. In line with this, our project represents our commitment to making sure of the safety and security of our assets through knowing the exact location of the rail tank cars at any given time and it helps our company to support the protection of environment, and human health," says Judith Kleinen.

In the beginning, what made the assessment of the business case difficult was that the benefits – although substantial – were less easily quantified than the costs. However, SABIC collected and analysed the data coming from the system about the usage of the rail tank cars, the arrival times at loading and unloading stations, the waiting time for loading and unloading and the time spent in maintenance. As a result, SABIC was able to manage and improve the flow of the rail tank cars, thus to reduce demurrage costs and optimise the utilisation of the rail tank cars by monitoring the location and the movements of the rail tank cars.

"Analysis of our data showed us some important findings, such as that we are able to deliver larger volume of product by using the same size rail tank car fleet," says Judith Kleinen, "This helped us to optimise the supply chain cost". Additionally, the system automates the information flow, which reduces the paperwork and improves the efficiency in administration. She adds that the project has further improved customer service, since it gives SABIC the ability to inform its customers even more accurately about the estimated delivery time of the product. Last, but not least, in case of a disruption in the supply chain, all parties involved (suppliers, customers, municipalities, emergency services) will know within minutes, which

products and rail tank cars are involved. SABIC is not the only company to adopt this system. The innovation is the result of a co-operation between different petrochemical companies. Together with Ovinto, three chemical producers are now taking the project to the next level, by developing a data platform that will allow optimisation of the rail tank car fleet. Judith Kleinen concludes that the benefits of this digitisation project clearly outweigh the costs for the company. "This is how we create 'Chemistry that Matters™' for our company and for our customers and industries."



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² European directives for controlling explosive atmospheres

HOYER

SMART TANKS, SMART TRUCKS, SMART LOGISTICS

Hamburg, 19 July 2017 – Logistics service provider HOYER, worldwide market leader in moving liquids by road, rail and sea, was honoured as one of the top 3 companies in Germany's Digital Leader Award 2017, in the "Create Impact" category. A nice recognition for the Smart Logistics strategy that has been implemented at HOYER.

"Telematics" is at the core of HOYER's Smart Logistics concept; it allows HOYER to control, monitor, analyse and optimise its logistic processes. Telematics has been applied for tank containers, as well as trucks.

By now, 7.000 tank containers have been equipped with sensors that constantly monitor the location, filling level, density, pressure and temperature of the tank container. The other 30.000 tank containers will follow over the next couple of years. The hardware and software are provided by the Dutch company Intermodal Telematics BV (IMT).

The sensing device sends this data with regular intervals to the central database, via mobile communication technology. The dispatcher and the customer can have information about the container's location and conditions at any time, via the user-friendly Smart Logistics web portal. This tracking, tracing and sensing tool allows the customer to detect anomalies and disruptions in the supply chain early, and provides the required evidence of the quality consistency of the product throughout its journey to its final destination. It increases the efficiency in monitoring the flow of goods in transit for HOYER's customers, and it allows them to optimise the turnaround time and utilisation rate of the containers. Full ATEX certification allows the use of the system under sensitive conditions.



The majority of HOYER's trucks are equipped with a board computer that records the position and critical operational parameters of the truck and that links the truck to the central transport management system. The trucks are constantly online; the system updates them on their schedule, and they report back to the system if their route has changed because of, for example, congestions on the road. This way, the customer gets early warnings in case of delays. Optional, when the truck arrives at the (virtual) "fence" of the loading or unloading station, the geofencing system will give notification that the truck is getting near. When the truck leaves the fence, the system is again notified. The EDI-system ties all of this together. All data, end-to-end, from order to delivery, is exchanged via EDI between the customers' ERP-systems and HOYER's Oracle-based platform. This combination of tracking,

tracing, geofencing, EDI and ERP creates an integrated network that provides real-time visibility of the truck fleet. It allows for optimal use of the trucks and efficient processes for all partners involved.

HOYER
WHEN IT MATTERS. ■

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KATOEN NATIE

ON THE ROAD, WITHOUT A DRIVER

A milestone in the history of petrochemical transportation in Singapore? On September 15 2017, the first autonomous truck was driving on Jurong Island. The pioneering company taking the lead in this Singapore Autonomous Truck project is Katoen Natie, one of the global chemical logistics companies. To make this happen, Katoen Natie partnered with ExxonMobil - one of its main customers - that allowed the logistics service provider to start operating driverless trucks within its petrochemical plant in Singapore.

Katoen Natie has selected the Dutch group VDL as its technology partner for the autonomous system in the trucks.

This company's experience in automated guided vehicles in ports and airports proved to be very valuable in combination with Katoen Natie's experience in petrochemical logistics.

Singapore Management University was Katoen Natie's partner for the market study of the autonomous technology. The Singaporean government was another important partner in the project. It is actually no surprise that this new project is being implemented in Singapore, a nation that focuses on the adoption of smart solutions to boost economic growth, increase productivity and address labour shortage due to an aging workforce. According to Koen Cardon, Katoen Natie's CEO for Asia, truck drivers are hard to find in Singapore; most of them are over 50 years old, and the job is not appealing to young people.

In a first phase, Katoen Natie introduces 12 driverless trucks to move products within the large petrochemical plant. Each truck will move around 250,000 tons of finished product per year as it follows a fixed, designated route on the island, from the production plant to a storage area next to the plant, on a 24/7 basis. The trucks communicate with transponders in the road, just like a train communicates with the railway signalling system. In this first phase, Katoen Natie is also implementing a pilot project for fully automated container loading and handling.

In a second phase, the trucks will be guided by a GPRS (General Packet Radio System) and will leave the boundaries of the petrochemical plant to drive on Jurong Island.

Looking ahead, Katoen Natie is exploring the option of driverless transport between the plant and the port with the chemical

manufacturer and different government bodies. This third and final phase is the most exciting yet also most challenging one, since the trucks will be driving on public roads outside the industrial area. The challenge in this phase is not so much to manage the technology, but rather the legal framework and liabilities aspects of the innovation.

Important benefits expected from the introduction of autonomous trucks are the productivity improvement and the cost savings. Koen Cardon argues that "to operate 12 trucks 24 hours a day and 7 days a week, you need 4 teams of 12 drivers." Will these drivers then be redundant? Koen Cardon doesn't think so: "They will be assigned to other jobs in Katoen Natie. In the Singapore job market, given the scarcity of truck drivers, autonomous transportation is the way to go." In addition to the impact on productivity and cost, there is also an important impact on safety. By increasing automation and reducing workforce in the plant and on the road, Katoen Natie expects to see a reduction in hazards and an improvement in safety performance. These benefits have drawn the attention at C-level within the petrochemical company, where the project is considered as strategic because of its potential to improve both productivity and safety.

A key success factor of the project, according to Koen Cardon, has been the enthusiasm of the customer to partner in this innovation. When reflecting on the other business units in Katoen Natie – such as logistics for e-Commerce and consumer goods - he observes that the petrochemical sector has been conservative and slow in adapting new technologies for their product handling and logistics. However, some major petrochemical companies

now clearly see the value of innovation in the supply chain and they partner with service providers who can bring innovative solutions using new technologies, such as wireless networks for IoT solutions and autonomous vehicles. Koen Cardon concludes that these projects bring the partnership with the customer to a new and higher level, provided that all stakeholders are aligned. This includes the producers, service providers and technology partners, but also the government authorities.

Last, but not least, Koen Cardon mentions an interesting spillover of these digital innovations on the human resources, since people are eager to work for a company that is part of the future economy. By piloting supply chain innovation projects that have impact, service providers and chemical companies become more attractive employers on the job market, in particular for young employees. This is a major advantage in today's war for talent!



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VOPAK

THE POWER OF DIGITAL INNOVATION

“Data is the new oil; it’s valuable, but if unrefined it cannot really be used. This statement, made in 2006 by Clive Humby - a UK mathematician who was the architect of Tesco’s Clubcard scheme – is what drives us at Vopak.” We’re listening to Leo Brand, CIO of Vopak. “We took the board of our company to Silicon Valley,” Leo Brand continues, “This study trip convinced us that the winners will be those companies that invest in data and software.”

It triggered the digital transformation at Vopak, with a strong focus on improving digitised products and services to the customers and on improving efficiency and effectiveness of the internal processes. Vopak’s CEO, Eelco Hoekstra, recently underlined the importance of digital innovation by stating that “digital solutions are as important to us as our storage tanks” (Financieel Dagblad). The digital strategy is supported by a state-of-the-art IT system and an organisation that stimulates experimentation and that fosters innovation.

Creating a mindset of innovation in a traditional organisation takes time and effort. Rather than imposing it on the organisation – which would be planning for failure - Vopak opted for creating an innovative employee mindset that spreads itself into the DNA of the company. It all started early 2016, when Vopak established a small innovation team, with the objective to make work at Vopak and at the Vopak terminals safer, more efficient, and more pleasant for partners and customers. The initial team consisted of two people from inside the company, and two recruited from outside. A lot of effort was put in the composition of the team to ensure it contained a diverse mix of backgrounds and experience: from Vopak high management experience to experience in running a start-up company,



and from implementing big IT projects to coaching in change programs.

The first initiative of the team was to visit a large number of terminals in order to identify the challenges they are facing and the issues they’re struggling with; the next step was to match these issues with new technological solutions. This then led to a set of Proofs of Concept (PoC’s). Speed of innovation is critical; the goal is to validate the technology and its business value within 8-10 weeks. The outcome should be a viable product and a

business case for a pilot implementation. If the pilot is successful, the solution is scaled up globally. The ownership shifts throughout the innovation process. In the PoC phase, the innovation team takes the lead; when moving towards the implementation phase, the business owner takes the lead and the innovation team has a rather supportive role.

We wonder why a terminal would collaborate in such a PoC. Would it not be easier to let colleagues in other terminals experiment and adopt the innovation when it has

proven to be successful? Leo Brand reacts: "Indeed, one should create incentives for being involved in the PoC's." The deal at Vopak is that the innovation team carries the cost of the PoC. When the PoC is successful, the terminal gets a reduction of 40% of the cost of the implementation. This has created a lot of enthusiasm for the PoC's and has created an atmosphere of collaboration and exchanging ideas.

The new approach to innovation has proven to be very powerful. Less than two years after the introduction of the innovation process, Vopak already has 80 PoC's running in parallel. People now feel comfortable to experiment, which is not obvious in an environment in which safety is and will always be priority number 1. What's more, several of these PoC's have already resulted in successful implementations around the world.

Have you heard of Elios? Elios is a drone that can bounce off walls and fly where no other drone can. He is used for inspecting storage tanks, a dangerous task, that takes days for humans, hours for Elios. Not only does Elios reduce the time needed for inspection, the drone also improves safety for the maintenance operators and it brings an important cost reduction. Next to the flying robots, Vopak is also experimenting with sailing robots. The Aquadrone, for example, is used to inspect jetties. This sailing drone navigates underneath the jetty – a place hard to reach for maintenance operators – and reports back the results of a visual inspection. It again saves time, which means the jetty is available sooner for customers to moor their ship.

The IoT (Internet of Things) also found its applications in Vopak. LoRa, long range low power wireless sensors are mounted

on assets worldwide, which allows the company to monitor the use and condition of these assets in real-time. In the future, the operation of 250.000 valves and 10.000 pumps will be monitored from a distance, signalling technical problems before they occur, which will allow for advanced predictive maintenance.

Augmented Reality looks very promising. Vopak sees a lot of potential applications, for example smart helmets and smart bracelets to assist field workers, replacing the fixed screens that they have to consult or the devices that they carry with them and hold in their hands.

Vopak is not only experimenting with new applications; innovation is also present in the underlying communication technology. A promising area for the longer-term future that is now being investigated is the use of fibre optics as a sensor technology. Still in experimentation phase, but also promising, is Blockchain, which will make transactions more reliable, more secure, more efficient and faster.

There is one common thread throughout these digital innovations, that is, the value of data. In combination with solid data platforms and advanced analytic tools, Vopak strongly believes that data can and will become a source of competitive advantage.

IT undeniably plays an important role in the innovation process. Vopak has adopted an IT architecture that cleverly combines standardisation and flexibility. The HR and finance processes run on a global, standardised system, for which Vopak has selected SaaS (Software as a Service) solutions from Oracle Cloud and Workday. For those processes that Vopak wants to tailor to the needs of its customers, such

as the order-to-cash process, Vopak has selected a PaaS (Platform as a Service) solution from Outsystems, also called Rapid Application Development Platform. The platform gives Vopak the agility needed to differentiate the core processes towards its customers. As such, IT has become an enabler of innovation, rather than the barrier that some people thought it was some years ago.

The new innovation process not only established a drive for experimentation and collaboration within the company, it also opened up the company for collaboration with partners in a true spirit of open innovation. Large companies such as GE, as well as small start-up companies such as Widget Brain and Semiotic Labs have become valuable partners bringing new ideas and solutions from a fresh perspective.

Leo Brand concludes: "By opening up our problems to the world - a practice that is very new to our company and our sector - we accelerate our journey towards becoming a true digital player"



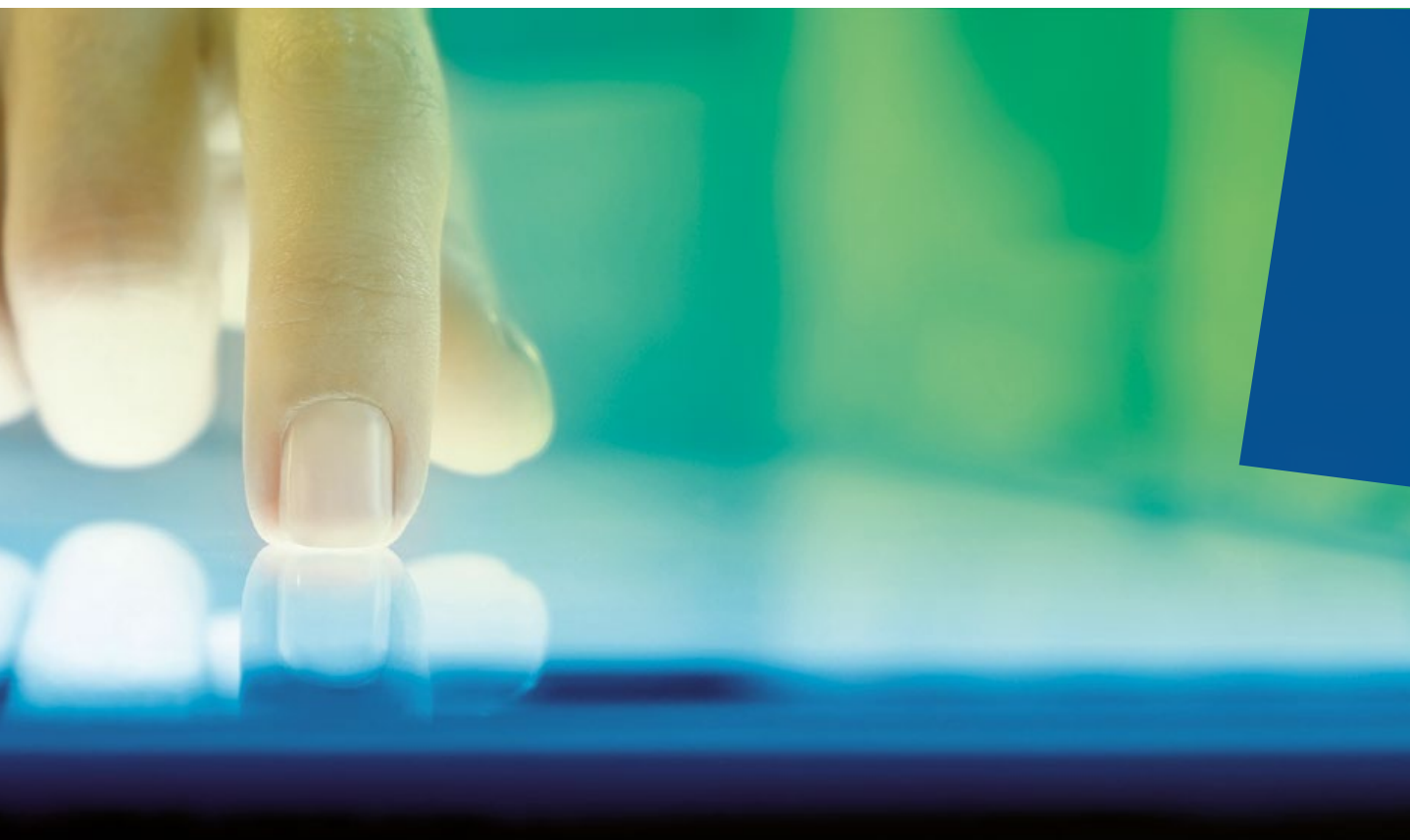
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MAERSK/DAMCO

GETTING READY FOR THE NEXT 100 YEARS



It has been said that the past is the best predictor of future behaviour. Nowhere is that perhaps more evident than at Damco where for the past few years, the company has been proactively involved in shaping the new digital supply-chain landscape. As Anthony Elwine, Global Head of Industrial & Chemical at Damco notes, “Our company has been in business for more than 100 years, and we intend to grow and thrive for centuries to come. That means just as we have in the past, we have to adapt and innovate continuously on the one hand, while on a practical level, remain committed to shaping the industry and to the organisations that rely on us to help them stay ahead.”

This combination of adaptation, innovation and industry-shaping could prove vital to easing the path to full digitisation. Anthony continues, “That’s why digitisation is a cornerstone of our strategy and a crucial element in preparing the company for growth.”

In this brief case study, we look at some examples of how Damco is adapting and contributing to developments in the new digital landscape. Damco is one of the 5 companies (the others being Maersk Line, APM Terminals, Svitser and Maersk Container Industry) comprising Maersk Group’s Transport & Logistics business. It has been actively involved in several of the company’s new digital innovations.

This has led to the adoption of various technologies as well as involvement in both the co-creation of and strategic partnering on key projects.

Collaboration, cooperation and bridging the digital gap

Although not related to petrochemicals, one such example is the collaboration between Damco and Alibaba, which has enabled Chinese shippers to reserve shipping space on Maersk’s vessels through Alibaba’s “OneTouch” portal. Although limited in scale, this online cargo booking platform has been an eye-opener for many across the industry.

Another example is in bridging the gap between online (platform) presence and digital impact. Although MyDamco, the company's one-stop-shop logistics portal, gives customers direct and constant access to the data they need to securely book shipments, generate documentation, reports and more, it also houses many of Damco's digital apps; apps which can also be accessed independently of the portal.

Strategic partnerships to transform the digitalised supply chain

Damco has also played a key role in the recent introduction of one of the most innovative solutions – blockchain. With blockchain set to digitise global trade, Maersk has been working in collaboration with IBM on a global trade digitisation (GTD) project. Based on the Hyperledger Fabric, the project will help to track and manage the paper flow of the tens of millions of containers shipped across the world annually. By digitising the end-to-end supply chain, improvements in transparency and the facilitation of information-sharing among trading partners can be achieved in a highly secured IT environment. In other words, all parties involved in a container shipment can access and exchange, for example, its locations, status of customs documents and bills of lading. Even though these documents are exchanged in real-time, no modifications can be made to them without the consensus of others in the supply chain.

The result is an agile, lean supply chain solution which has the potential to save the company and its customers billions of dollars. Maersk intends to work with a network of shippers, freight forwarders, ocean carriers, ports and customs authorities to build this innovative global trade digitisation solution. One successful pilot project conducted with a range of

industrial companies has already shown the potential benefits of the blockchain solution.

Improving visibility and predictive planning

Through its strategic partnership with Microsoft, Damco has also recently launched a number of supply chain solutions built on Microsoft Azure. Combined with an agile approach, these solutions have led to shorter development cycles when responding to and developing customer specific applications. The company's Isotank management solution for example is designed to improve the visibility and optimise the utilisation of the fleet of isotanks. Another interesting development is the Disruption Indicators application that not only predicts disruptions in the supply chain, but also highlights their potential impact and provides information to help users decide on mitigation actions. Maersk has selected Microsoft to be its preferred partner for its digital transformation journey with Microsoft Azure similarly set to become the platform on which the company will build its digital applications.

These examples illustrate how Damco has addressed and will continue to shape the digital supply chain space through its products, solutions, innovations and collaborations. Anthony Elwine concludes, "It is important to note nonetheless that digitisation and the potential value it can create for business, is also dependent on preparing the organisation to do business differently, especially if we want to maintain relevance to our customers and their business. In practical terms, that will mean: cultivating customer-centric practices, reducing (the negative effects of) silos within and outside the organisation, improving cyber-security, being prepared to re-shape existing business models as

we are seeing with the blockchain, and perhaps most importantly, recruiting with rapidly shifting future developments top of mind."



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H.ESSERS

SECURITY'S EYE IN THE SKY

A dark and rainy night, the last truck of the day has left the site, the employees have gone home after a busy day, to be back early in the morning. All gates are locked. All of a sudden, the alarm is triggered; someone must have entered the site without authorisation. In a split second, drone Yacob leaves his docking station to fly to the location of the incident and to investigate what has happened. It spots two men who have entered the site. Yacob takes a couple of pictures, sends them to the security system and seconds later one of the intruders has been identified....

It sounds like the scenario of a Hollywood movie. For sure this is not reality yet, but it may soon be.

What we describe in our "movie scenario," is the ultimate goal of Mirador, a project launched by DroneMatrix, in collaboration with logistics provider H.Essers.

DroneMatrix is a small, entrepreneurial high-tech company that offers drone systems and drone solutions. The company is the first one in the world to have developed a truly autonomous drone. The autonomous drone leaves its docking station, carries out a pre-programmed mission, collects and transmits data and returns to its station without the intervention of a pilot. This is what distinguishes an "autonomous" flight from an "automated" flight. Automated flights require a pilot who decides on the departure of the drone, who controls the flight and who can intervene when needed. Autonomous flights, without involvement of a pilot, are most likely the next step. Technically this is already possible, but it still needs a change in regulation before it can be implemented beyond the testsite of DroneMatrix, in a logistic park.



For H.Essers, a logistics service provider with headquarters in Belgium, innovation is high on the strategic agenda. "Supply chains have become more and more complex," says Erik Lamoral, CIO of H.Essers. "We know that technology plays a crucial role in tomorrow's success."

Yacob is not the first drone experiment at H.Essers. A first pilot project was the in-door use of drones in the warehouse,

for stock counting. The experiment didn't lead to full-scale application, but it turned out to be a great learning opportunity. The operating range of the drone was insufficient, forcing it to return too often to its loading station. Also, it turned out that the drone wasn't sufficiently stable to recognise labels on boxes when hovering. The drone was replaced by a mini-zeppelin, but this also wasn't too successful for stock counting. New tests are now carried out

It's just a matter of time before the drone will strengthen our security team and help us protect our sites 24/7, with great precision and continuous dedication



In the current phase of the project, the drone is tested under the supervision of an experienced drone pilot, following the highest safety norms. When leaving its docking station, it follows a pre-defined route along way-points identified by their geo coordinates. On its route, it recognises obstacles such as wind mills and poles. In a later stage, the drone will be self-learning. It will detect changes in its surroundings, report unusual situations, and will “learn” how to react ad hoc, for example when to take a picture of an object or a person.

With this new technology, security can evolve from physical to remote control. The nightly surveillance round of a security guard and his dog can be replaced by remote monitoring and interventions of Yacob, who can “see” in the dark with high precision.

“Obviously, there are still several technical and legal hurdles,” says Bob Van Steenweghen, “but it’s just a matter of time before the drone will strengthen our security team and help us protect our sites 24/7, with great precision and continuous dedication.”

with a camera on a pole, mounted on an AGV. Bob Van Steenweghen, Marketing & Corporate Affairs Manager at H.Essers, highlights the importance of a culture that is open to experimentation and innovation. “When DroneMatrix contacted us and invited us to collaborate in the development of a drone for security of logistic sites, we didn’t hesitate. It’s fascinating to be involved in such a promising project. This is the drone technology of the future!”



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BASF

FROM PREDICTIVE TO PRESCRIPTIVE SUPPLY CHAIN SYSTEMS

No less than three awards for BASF's supply chain in 2016! For the first time ever, BASF entered the top 25 of Gartner's supply chain ranking; BASF received the "Supply Chains to Admire" award of the American organisation "Supply Chain Insights"; and it obtained the "Salzburg Medallion" by Syracuse University for its sustainable supply chain. A nice recognition for the company's efforts to build a supply chain that drives competitive advantage.

BASF's ambition is to let the supply chain operate at the pace of the consumer. "We believe that we no longer live in a B2B environment, our reality is B2B2C. Digitisation offers tremendous opportunities, not only to increase the efficiency and effectiveness of our processes, but also to create additional value for our customers," says Frithjof Netzer, Chief Digital Officer at BASF. The vision of BASF's digitisation journey is on providing digitally enabled solutions to customers. Digitisation will also drive connectivity, externally with suppliers, customers and other partners in the supply chain, as well as internally, down to the shop floor. A third goal is to offer digital enablement to the entire workforce in BASF.

"Our ultimate goal," says Frithjof Netzer, "is to have a prescriptive supply chain, in which all actors involved get prescriptive recommendations of which product to take in which quantities, from where, to where and when".



This requires in the first place visibility of the physical flow of goods throughout the supply chain. Sensors, tracking devices, checking procedures, mobile transportation apps,... should allow door-to-door transparency of all shipments, no matter the mode of transportation. To make this possible, BASF has implemented an IT application with a third-party service provider that functions as a flexible, central node providing supply chain visibility. For example, a "source app" which is currently work-in-progress at BASF combines tracking data with data from news sites, weather forecasts and

social media, alerting the user in case of disruptions or delays in the supply chain.

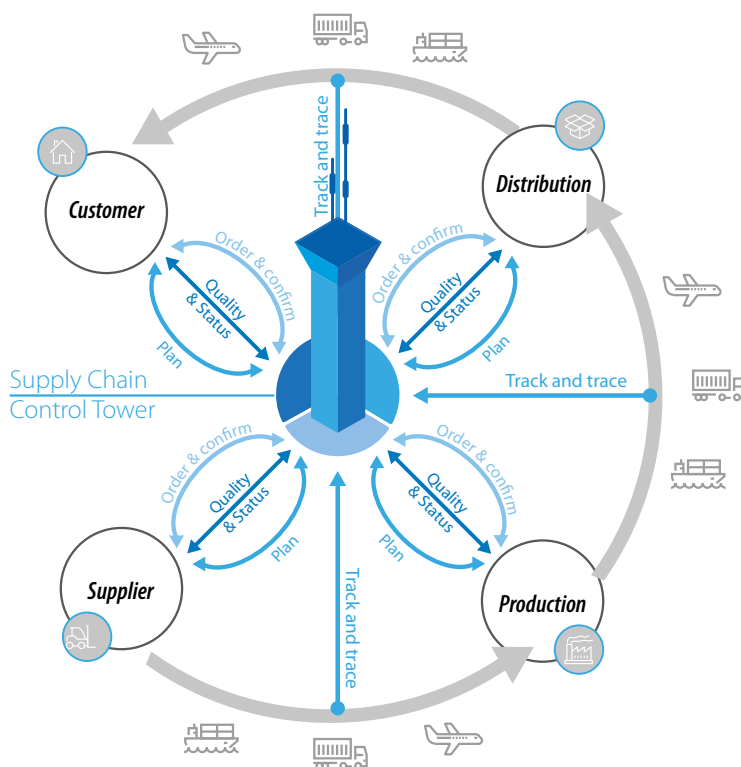
The second pillar is horizontal integration, linking the planning systems of the different partners in the supply chain. The planning modules of their ERP systems – as agreed and defined by all involved parties - are loaded into the cloud to give all participants access to the relevant data, such as production volumes, inventory levels and demand data. A supply chain "control tower" controls and manages the flows of information, enabling a truly

integrated supply chain ecosystem. A specific software application offers the planning and analytics capabilities necessary to link production, supplier, distribution and customer data and to optimise the end-to-end planning. BASF is currently piloting the system with a few strategic key account customers. The plan is to include 80% of BASF's chemical value chains with a select set of strategic key accounts by 2021.

Digital technologies have also entered the production plants. A hands-on innovation is the use of augmented reality in production. After a pilot run in 2015, a platform solution coupled with handheld devices is now in implementation at 15 BASF plants in Europe and the USA. By the end of 2017, a second wave will include more than 100 plants in all major geographic regions. The solution offers a set of pre-installed user-friendly applications like maintenance & repair or operator rounds. Technical information sheets of equipment parts and piping can be accessed decentrally through handheld devices. Work results are logged into the tablets in real-time, by the shop floor workers. An upload into a central platform ensures closed-loop documentation, to multiple interfaces with engineering and production, spanning a variety of legacy systems. It also offers the possibility of a dialog between the control room and the worker who is active in a different part of the plant. This cuts out unnecessary transaction time.

BASF is implementing its digitisation strategy step by step. A high-performance IT backbone is a key prerequisite in this undertaking. Close collaboration between the IT/IS and supply chain legacy organisation with the project-driven digitisation team is paramount to success. The systems that are introduced

today will become "smart systems" in the future. As data constantly comes in, the systems will learn and generate knowledge that will enrich human-decision making. "Just imagine that shipping traffic on the Mississippi River is blocked because of ice on the river" says Frithjof Netzer. "Not only will the system tell us that there is a problem. It will also inform us on when the same problem occurred in the past, how long it lasted, which actions we took to solve the issue, and what our options are to solve it this time. This information is typically scattered: the transportation company remembers some of it, and so does the supplier. The cool thing about the self-learning digital solution is that it brings data from so many different sources together, and it turns it into valuable knowledge when you need it. We're not there yet, but the ambition to create such a prescriptive supply chain is what keeps us going!"



BASF
We create chemistry

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PORT OF ROTTERDAM

NAVIGATING ON DIGITAL WAVES

Number 1 in Europe, number 9 in the world... The Port of Rotterdam is undeniably a global hub for numerous flows of goods, including oil and petrochemical products. But size is not the main driver of the port's strategy; more important than being large, is being "best" and being "smart." Innovation and digitisation are at the core of this ambition to be the smartest port in the world. As an active player in a true innovation ecosystem, the port is constantly searching for new solutions to manage the flows faster, more efficiently and more sustainably.

"We have realised that data is of tremendous value, if used wisely," says Matthijs van Doorn, Manager Logistics of the Port of Rotterdam. "How can we create value from data, was the key question we asked ourselves back in 2015. This has triggered our digitisation journey. We decided to play an active role in the development of solutions for our customers."

The focus of the digitisation strategy is on two key areas of improvement: efficiency and transparency. To make it happen, the port set up an Innovation Lab, called the Rotterdam Logistics Lab, with the mandate "to innovate, to accelerate, and to make it happen." As a corporate start-up initiative, the Lab's main task was to generate ideas, to experiment in collaboration with customers and to develop a set of Proofs of Concept (PoCs). And to do this as fast as possible. "This may sound easy, but it isn't," says Matthijs van Doorn. "It requires a true shift in mindset. Experimentation implies that we launch a beta version of a new system with our partners. That's a new way of working for us. We're used to launching a new solution when it has been finalised. Just imagine that we would deliver a quay wall before it is 100% ready for use... We have to get used to the fact

that the speed of innovation in the digital world is a lot higher than in the bricks and mortar world."

Two years after it was launched, the Innovation Lab has delivered several interesting PoCs already, and some made it into pilot projects that may soon go into full-scale implementation.

An interesting example is the development of "Avanti-Pronto," a new system for port call optimisation. The objective of the project is to reduce the time to berth and to minimise time at berth for the vessels. Entering and leaving a port is a complex process that requires coordination of many players. Paperwork, phone calls, waiting for a reply, ... a lot of time and resources are wasted in this process. The new digital solution will allow to decrease the time to berth with several hours, reduce unnecessary waiting time at berth and increase the overall efficiency and communication of the process. "Pronto" collects and shares dynamic data (real time events, such as estimated time of arrival) of port calls to optimise the scheduling of the vessels and the corresponding services in the port. "Avanti" collects and shares static data, such as the tides, the reliable depth of the waterways and restrictions in the port. A dashboard allows the different actors, such as the marine operations planner (who is responsible for the vessel's journey), the pilot, the tug master or the terminal to schedule and coordinate the berthing process.

"If we can eliminate waste in the process of vessels entering and leaving the port, we can accomplish this with other processes as well," says Matthijs van Doorn. "We now have a similar project running to streamline the process of rail transport in and out of the port."



"Navigate" is another tangible result of the Port's digital strategy, improving supply chain visibility. Navigate is a beta-website that gives a complete overview of the most efficient routes via Rotterdam, by deep-sea, shortsea, rail or barge, with information on the expected transit time and a list of the logistics companies that offer services on these routes. It includes shortsea and deep-sea schedules from 550 ports worldwide as well as all rail and barge connections between Rotterdam and more than 150 European inland terminals. This makes Navigate the most complete route planner of its kind. Navigate has been designed for companies that want to use container transportation in smarter ways for their supply chain. Next

Transparency of data is a key benefit of the digital projects, yet at the same time it is also something that needs to be carefully managed



to that, the Port of Rotterdam is piloting a supply chain visibility dashboard that will give shippers transparency on the status of their container.

Obviously, there are some road blocks in this digitisation journey. Standardisation of data is a critical factor, since different ports and service providers use different standards. In 2014, the international taskforce "Port Call Optimization" was created by the industry, to standardise the communication on critical nautical port information that is required to realise port call optimisation. Amongst its members are Shell, Maersk Line, MSC, CMA CGM and the Ports of Goteborg, Algeciras, Busan, Singapore,

Houston and Ningbo Zhoushan. Standard partners are GS1 and the UK Hydrographic Office.

Transparency of data is a key benefit of the digital projects, yet at the same time it is also something that needs to be carefully managed. Which data to share with whom is a decision that should not be taken lightly. Some data is proprietary and competitive and should remain confidential. It takes a good understanding of the business and an open mind to find the right balance of what should and what shouldn't be shared. What advice can Matthijs van Doorn give us, having navigated on the digital waves for two years now? "Just do it! Get started!

Dare to experiment, in collaboration with the users, to shape the ideas and to make them tangible. Don't hesitate to start a couple of pilot projects; they will show the impact of the innovation. It takes investment and guts and it gets you out of your comfort zone, but it's fun and you will see that it leads to new, surprising opportunities."



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e-ECD

THE PAPERLESS CLEANING DOCUMENT



Digitisation is looming around the corner for the European Cleaning Document (ECD). Twelve years after its introduction, the ECD is ready for the next phase. When the initiative was launched in 2005 by EFTCO, ECTA and CEFIC, it was a game changer in the industry. As a support document for every single tank cleaning in the supply chain of chemicals, food and other products, the ECD indicates which cleaning steps have been performed and thus gives the necessary information allowing the next loading point to judge if the cleaned tank meets its quality requirements. The introduction of the ECD has been an important aspect in the commitment towards Responsible Care for chemical producers, transportation companies as well as tank cleaning operators.

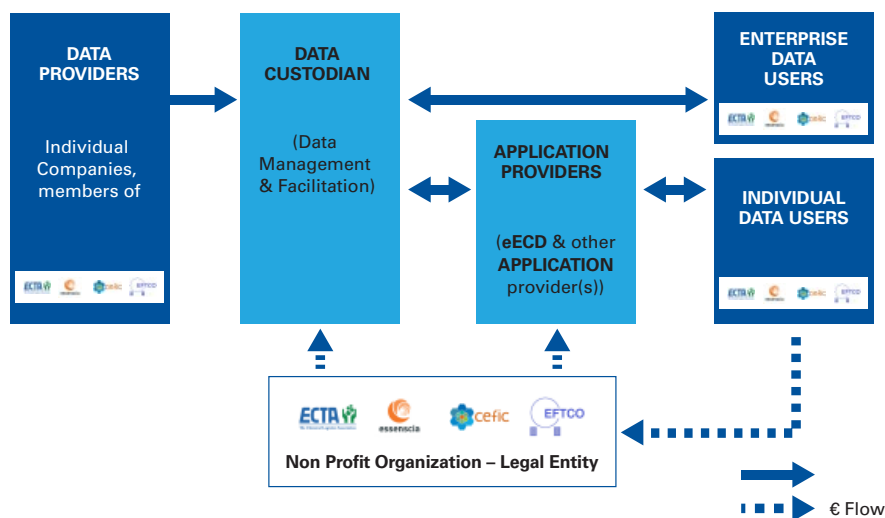
Whilst the benefits of the ECD paper document were substantial and important, it created a considerable administrative burden. It soon became obvious that the process would be more efficient and reliable if it could be automated. The first idea of the electronic ECD emerged in Germany through DVTI, the German National Cleaning Association, already in 2011. It turned out however that time wasn't right to digitise the process and the initiative was abandoned for lack of support from the industry.

In 2015, inspired by the many digitisation initiatives, *essenscia* – the Belgian federation for chemistry and life sciences industries - relaunched the idea and forces were joined between *essenscia*, EFTCO (the European Federation of Tank Cleaning Organisations)

and ECTA (the European Chemical Transport Association) to formalise the project in 2016. During the project kick-off, CEFIC (the European Chemical Industry Council) decided to join, so the project obtained a truly European scope. As a consortium, these organisations represent over 600 companies that are major stakeholders in the European petrochemical supply chain. What emerged was a true community of chemical producers, tank cleaning operators, tank storage operators and transportation companies.

The digitisation project consists of three main phases. In a first phase, the team has worked on the selection of the data platform, the choice of the technology, the selection of the technology provider, and a project business plan to obtain funding for the next, pilot project phase. The architecture of the collaborative data sharing platform is shown in Figure 1. A critical role on the platform is the "Data Custodian" *NxtPort*, that takes care of storing the data in a secure and safe way. Each company providing e-ECD data to the platform can define which data fields are to be considered as private, community or public data and can monitor the usage of its own data throughout the e-ECD process. There is no risk that the data hub is used to store historical, sensitive business data, and the platform is used for transactional data exchange only, not for business intelligence purposes. The Data Custodian feeds the web applications of the companies in the community that provide transportation and cleaning services. This cloud-based architecture has been chosen to allow trustful and safe data sharing and collaboration across the chemical supply chain.

The platform is managed and will be operated through a new not-for-profit organisation established by the founding



project associations of the 3 industry sectors. It will offer its service on a licence and fee basis, with a transparent and market-conform tariff structure.

While 2017 was the year to shape the e-ECD digitisation project path, 2018 marks the start of the pilot project, which targets to involve approximately 20 companies in Belgium, the Netherlands and Germany. This phase will allow to demonstrate the benefits of the digital ECD in a realistic scope, with a manageable number of partners, and in four languages.

The roll-out of the project towards all European stakeholders in the chemical supply chain, involving about 600 companies and 20 languages, is planned as of the second half of 2018 up to 2022. In the final phase of the project, the supply chain of products for the food and pharma industry may be added to the scope.

The benefits of the e-ECD for the community of users are three-fold:

- The digitised process improves quality and compliance, since it ensures that accurate and timely information is exchanged between the chemical, tank storage, transport and tank cleaning companies. It makes the communication process less error prone, more transparent and real-time which helps to deliver a high-quality

product and service to the end customer.

- It brings the process to the next level of safety and Responsible Care. Misinformation due to non-transparency of product data, inconsistent safety data and data delays are problems of the past, which reduces the risk of dangerous situations for all partners in the supply chain.

- It makes the process leaner, since it implies less manual work, faster site entrance and loadings, less rework and checks, and reduced waiting times for truck drivers. It allows a better utilisation of the tanks and trucks, which reduces costs and increases efficiency.

The expectation is that the paperless e-ECD will be again a game changer in the industry, as was its paper-version in 2005. The technology is available, the architecture has been designed, the systems are being prepared for a first roll-out. That doesn't mean there are no more hurdles to be taken. The main one is the change in mindset that is needed to move from a traditional one-on-one supply chain, with handovers of documents between two partners, to a transparent, shared platform accessed by a community of players. It requires alignment and a common goal between the partners in the chain, openness and willingness to share data, and an understanding of the opportunity digitisation brings to optimise the supply chain. Above all, it requires

trust, which takes time to develop. Peter Devos, Managing Director of ECTA and member of the steering committee reflects on the project: "There are believers and non-believers, as is often the case in innovation projects. The pilot project will show the potential impact and benefits of the paperless e-ECD. As soon as we have reached some critical mass, this innovation will find its way in the community, and will bring our industry to the next level of Responsible Care."



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<http://www.eftco.org/>

For an example of the ECD, see <http://www.eftco.org/european-cleaning-document/example-ecd>

BERTSCHI

EVERY MINUTE COUNTS

When a container filled with products leaves a chemical plant, it typically embarks on a long journey that involves hand-overs from one mode of transportation to another, until it finally arrives at the end customer. A journey with long queues at terminals, uncertain arrival times and a lot of handling. Having visibility on the status of the container on its journey could improve the process, making it more reliable and more efficient for all partners involved. This is where digitisation can help.

Bertschi developed a truck-driver app for this purpose. The majority of Bertschi's transportation is intermodal, on barges and trains, yet almost every intermodal trip involves some distance travelled by truck. For example, a truck takes the product from the chemical plant to the railway terminal; another truck picks up the container after its train journey, to take it to the end customer. The trip on the train is tracked through electronic data interchange between the intermodal logistic partners and Bertschi, yet in terms of visibility this is not the most valuable part of the journey. The highest value of transparency is in the "first mile" from the plant to the terminal, and in the "last mile," from the terminal to the customer. "Given that this is the part of the supply chain in which we are in contact with our customers and logistics partners, this first and last mile is the most important part of the journey and - in regard to optimisation of processes - the most valuable part," says Cedric Walti, Head of Process Redesign & Digitalization at Bertschi. The truck-driver app provides the visibility that is needed to optimise this critical part of the supply chain.

The goal is to connect every driver – whether they are Bertschi-drivers or



The app provides real-time information on the status of the shipment on the truck

drivers working for subcontractors – to the Bertschi system through a business application on his/her smartphone. “We knew right from the start that, for this innovation to be successful, the app should be easy to use for the drivers and fully integrated with our own internal system, and flexible to connect to all customers and logistics partners,” says Cedric Walti.

The project was launched in 2016, with a prototype smartphone app that was tested with a few drivers. In a second phase, it has been linked into the existing Bertschi system, integrating also the subcontractors. “This,” according to Cedric Walti, “is where the application really starts to add value.” By the end of 2017, already a significant part of drivers is connected through the app; the goal is to onboard everyone driving a truck for Bertschi soon.

The app provides real-time information on the status of the shipment on the truck; for example, it’s loading weight, its location, and most importantly, its estimated time of arrival. It uses many features available on a smartphone: the gps for recording the geo-position, the camera for scanning documents, or the clock for recording timings. It creates the opportunity for a “person-machine” dialog between the driver and the planning system: the plan generates an estimated time of arrival at the terminal or gate, based on the planned route; the driver adds his judgement of traffic density or an unplanned stop to have a more accurate time of arrival. This information is for example of very high value for the operator of the terminal. Cedric Walti illustrates the value of the visibility offered by the app: “If the terminal operator knows that a truck will arrive in 10 minutes, he can decide not to unload a container from the train to the ground,



but to wait until the truck has arrived and load the container directly from the train to the truck. This avoids extra handling, which would be waste in the process. Every minute counts in a terminal!” The information is also very valuable for the customer, who can optimise his logistics activities based on the real-time arrival time of his incoming shipments.

This also improves the efficiency for the driver. Better scheduling of the terminal operations reduces the queues at the terminal, thus eliminating waiting time for the driver and improving the utilisation of the truck. The benefit goes beyond efficiency improvements and cost reductions. The app changes the communication between the driver and the planners, by giving the driver access to information that matters for him or her, such as the product on the truck or the handling procedures

for the shipment. And it speeds up the processing of documents: the driver scans documents at the terminal, sending them immediately to the back-office, which can process them a lot faster. The result is shorter administrative cycles and improved efficiency in the back-office.

Was there any reluctance to adopt the system? “Of course there was, as is the case with any innovation,” says Cedric Walti. “Not everyone sees the benefits of visibility in the chain and every change project encounters some reluctance. This is also just one step in a longer-term plan for digitising the supply chain. On the other hand, we have been surprised by how well the new app was accepted by the truck drivers. They are very open to this innovation, and we have received a lot of feedback from them, asking for features in the app that we hadn’t even thought of. We were impressed by the dynamics of the interaction that it created between the drivers, the developers and the planners!”



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DOW

MAKING THE INVISIBLE VISIBLE

Talking about massive change! Dow is working on the integration of three companies – Dow, Dow Corning and DuPont. It does so with the intention to spin off three new publicly traded companies: a material science company, an agriculture company and a specialty products company. As if this isn't sufficiently challenging, Dow has launched its digital revolution. For a company that has been around for more than 120 years, it means not only rethinking solutions but also processes and capabilities. It requires a new IT strategy, branded internally as a "New IT for a New Dow." It challenges existing organisational models and requires a true cultural change.

Dow's digital transformation focuses on two fundamentals: transforming the customer experience as well as the employee experience. Offering innovative and smart services to the customer, with excellent delivery performance, is a key objective. Offering innovative and intuitive solutions to transform the way employees work is another one. In a nutshell, digitisation should help employees to make faster decisions to serve the customers' needs better, while of course ensuring safe, secure and sustainable operations.

The digital transformation has triggered a large number of initiatives in manufacturing and in supply chain, some involving maturing technologies, others exploring new, emerging technologies. "Whichever technology we adopt, the driver for digitisation should come from the fundamental objectives we are working to deliver," says Tracy Johnson, Associate Director of Visibility, Transportation Management, and Road & Warehouse Mode Technology at Dow. "Today's consumers are used to ordering online from companies such as Amazon and tracking their parcel

until it is delivered. It's unavoidable that some of these expectations of the B2C world are moving into the B2B world. To be competitive, we will need to adapt to this trend. The speed of change is high and our response is to launch PoC's (Proofs of Concept), some of which lead to pilot projects and ultimately to full-scale implementations."

At the heart of digital supply chain transformation in Dow is Supply Chain Visibility with the purpose of translating data into value, for customers and employees. For customers, visibility means access to the status of their orders at any time, proactive notifications in case of shipment delays and, most importantly, improved delivery reliability thanks to improved planning and optimised logistics. For employees, visibility means access to shipment status information and receiving alerts in case of potential delays, allowing them to proactively take actions and be better informed when making decisions. Supply chain visibility also improves cost and working capital. For example, demurrage and detention costs can be decreased thanks to visibility of dwell times at loading/unloading facilities and in ports; production interruptions can be avoided and resource scheduling can be improved thanks to up-to-date information on shipment ETAs; safety stocks can be reduced thanks to more accurate information on stock levels throughout the supply chain and reduced transit times through improved carrier performance management. "We are actively working on projects for increasing visibility for all our modes of transportation - rail, air, road and marine

We are actively working on projects for increasing visibility for all our modes of transportation - rail, air, road and marine - globally

- globally," says Tracy Johnson. "Let me share two examples, one in which we are quite advanced, the tracking of our railcars, and one in which we are taking our first steps, the marine packed cargo blockchain pilot project."

Rail visibility has been implemented for a number of years already in North America. All of Dow's 20,000 North American railcars are equipped with RFID tags that are identified by Automatic Equipment Identification readers (AEI) installed along the railways throughout North America. The Car Location Messages generated allow the company to track and trace the railcars at any point in time. Under normal operating conditions, information such as estimated arrival times and railcar dwell times at Dow and customer sites are available. Under exceptional circumstance, such as a severe weather condition, impacted railcars can be identified, allowing the company to work with the railroad to reroute cars as needed and proactively communicate with the customer about potential delays. In Europe, the AEI RFID technology does not exist so GPS units are being installed on all 1,500 Dow railcars to provide the same visibility in the region. Safety, efficiency and improved asset utilisation are obvious benefits of this digital innovation.

One of the challenges of visibility projects is whether or not to deploy different technologies in different regions. In the case of railcar visibility, the choice to use RFID tags in North America was driven by the Association of American Railroads. However, the infrastructure to support RFID technology is not available in other



regions, such as Europe, which may imply that different technologies should be used. In the case of truck visibility, there are no real time visibility technologies available today that have a strong global presence. The trade-off to be made, according to Tracy Johnson, is whether to use a technology provider that is strong in a region, e.g. North America, and then work with that local provider to build global presence, which takes time; or to work with different technology providers in each region and accept the implication that you end up working with different technologies across the globe. Tracy Johnson concludes that "To implement more quickly, it is important to establish global requirements and implement regional technologies that meet those requirements. It is then the integration into the company's systems that is important. We are moving in the direction of building one 'smart hub', a centralised platform that all visibility technologies can integrate into, providing

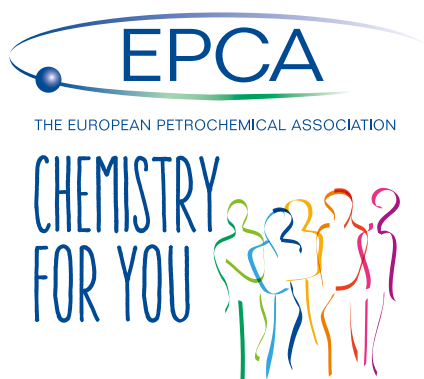
one location that Dow users can access to get visibility information".

A fascinating and promising digital project is the "Global Trade Digitization" (GDT) collaboration with IBM and Maersk. These two companies joined forces in June 2016 to introduce the capability of blockchain technology in supply chain. Dow was among the first companies to pilot the platform, with marine packed cargo shipments from the Port of Houston to the Port of Rotterdam. The technology is promising: end-to-end supply chain visibility and paperless, automated processing of the information flow are within reach. The project is still in its infancy and faces the challenge of regulatory support across the globe, adoption in the industry and clarifying the business model. "We are excited to be participating in emerging technology projects such as these that may help shape the future of Supply Chain," Tracy concludes.



Sources

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