

The State of Automation in the Bulk Chemical Industry

SPONSORED BY **ABB**

A survey of readers of
Chemical Engineering
magazine conducted by
the *Chemical Engineering*
Marketing Department

The State of Automation in the Bulk Chemical Industry

Executive Summary

Bulk chemical manufacturing is a challenging industry. With little differentiation between products and intense global competition, margins are tight and cost control is mandatory. In this environment, automation serves a dual purpose: it enables innovation in areas that matter to customers, (e.g., delivery time, product consistency, etc.), and it improves cost efficiency throughout the manufacturing process.

In November 2016, *Chemical Engineering* magazine invited subscribers to participate in a web-based survey to help us better understand the challenges they face and how they are prioritizing their investments in automation as well as other areas.

Highlights

We've broken the survey results down into 4 areas: Outlook & Challenges, Automation, Power Reliability & Quality, and Security. Here are a few of the highlights:

- » Overall, respondents were optimistic saying they expected their business to perform better in the next three years as compared to the last three.
- » A slight plurality expected CapEx (43%) and OpEx (47%) spending to remain flat, whereas almost as many anticipated budgets to rise (40%, 36%, respectively).
- » Cost control, especially for raw materials and energy, is a primary concern as is global competition.
- » The majority (79%) agreed that automation can have a definite positive impact on performance, but many still struggle with issues such as integrating legacy systems into new technologies and a lack of standardization.
- » 62% of respondents believe it is important for plant control systems to manage electric power as well as process automation.

About the Survey

Demographics

We received 426 responses from people representing a wide variety of roles, product types, and facility sizes within the bulk chemicals industry. As we call out in the report, aspects of these demographics sometimes influenced how the respondent views the industry outlook as well as had a bearing on their unique challenges and concepts for addressing them.

JOB FUNCTION

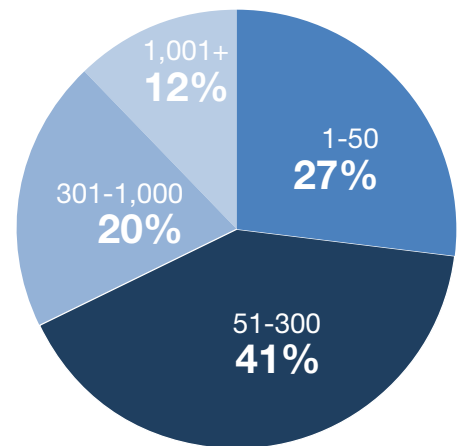
Figure 1 n=307

RESPONSE	PERCENTAGE
Engineer	32.6%
Mgr/Supervisor Engineering	14.7%
Executive Management (C-level, Pres, GM)	9.4%
Project Manager	8.1%
Plant Manager	7.8%
VP/Director Engineering	6.2%
Environmental Health & Safety Manager	6.2%
Mgr/Supervisor Operations	5.2%
Other (please specify)	5.2%
VP/Director Operations	2.9%
Maintenance Technician	1.0%
Maintenance Manager	0.7%

FACILITY SIZE

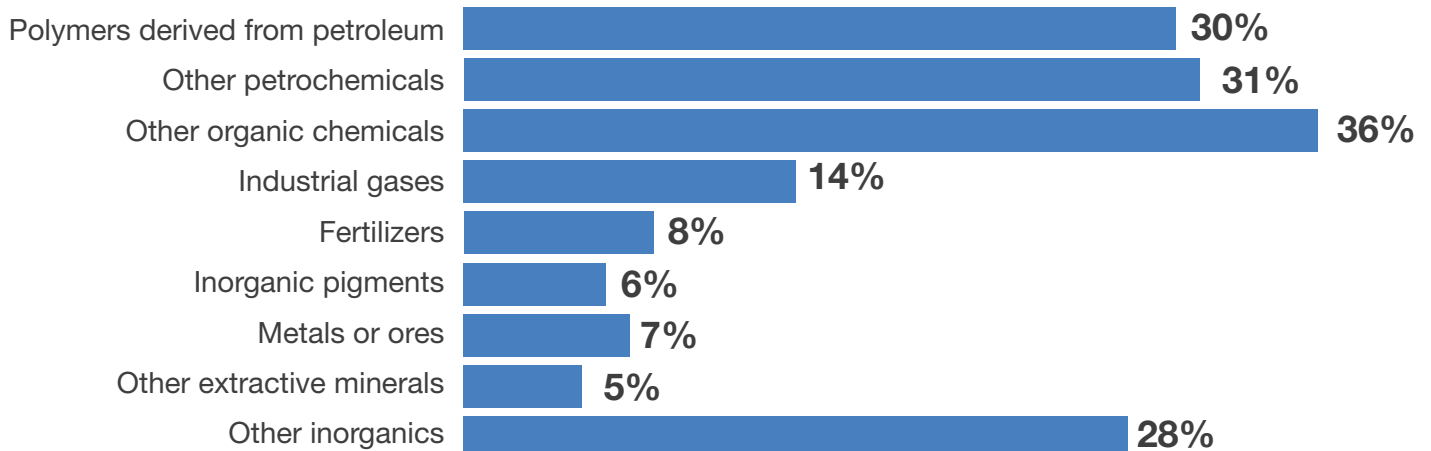
Figure 2 n=307

(# Employees at Plant)



TYPES OF PRODUCTS MANUFACTURED

Figure 3 n=426



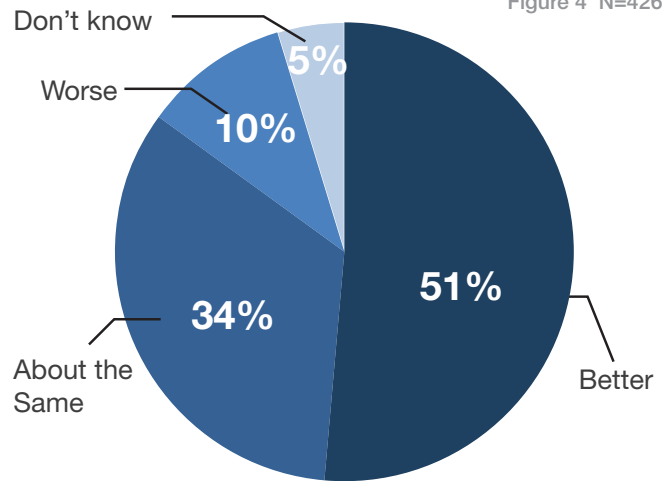
Optimism Prevails

Our survey found U.S. bulk chemicals producers to be broadly optimistic, with more than half (51%) of all respondents expecting their business to perform better in the next three years as compared to the last three. (See Figure 4)

This optimism is in line with the overall economic outlook for the industry. For example, in December of 2016, the American Chemistry Council published their Year End 2016 Chemical Industry Situation and Outlook, stating that despite a contraction in 2016, U.S. chemical production (excluding pharmaceuticals) is expected to realize overall growth of 1.6% in 2016, followed by a 3.6% growth in 2017 and 4.8% in 2018.¹

How do you think your business will perform in the next three years, compared to the last three?

Figure 4 N=426



Cost Control a Concern

Manufacturers of bulk chemicals work hard to stay profitable in the face of fierce global competition. Their products – commodity polymers, raw materials for downstream chemical producers, fertilizers, industrial gases, pigments – are largely undifferentiated. As a result, manufacturers gain scant advantage from branding. Even product quality is generally important only in terms of the need to meet certain minimum standards.

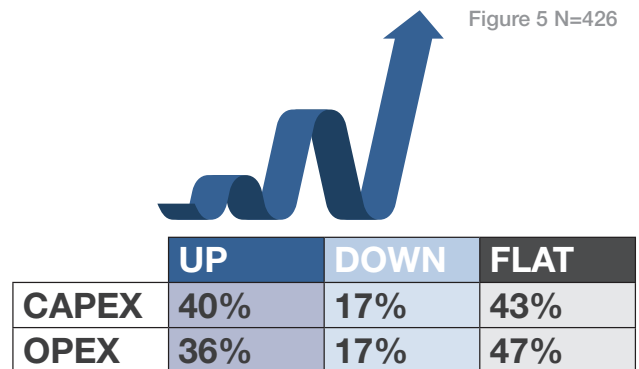
While not a majority, the greater percentage of respondents to our study expected both CapEx (43%) and OpEx (47%) spending to remain flat (See Figure 5), potentially reflecting a greater organizational goal of reigning in spending. Even so, of those respondents who anticipated a change in spending, far more anticipated an increase than a decrease. We will get deeper into how chemical manufacturers are spending budget dollars when we look at specific investments later in this report.

Interestingly, the smallest facilities (1 to 50 employees) were the most likely to expect CapEx and OpEx to increase: 48% in both expense categories as compared to an average of 40% for CapEx and 36% for OpEx.

This group was also the most optimistic about the future of their business, with 64% expecting it to be better over the next three years as compared to 51% overall.

Next year, how will your capital and operating budgets compare to 2016?

Figure 5 N=426



The Hurdles Are High

To better understand the issues facing the industry, we asked respondents to choose the three most pressing challenges for their business going into 2017, giving them several predetermined choices as well as the option to write in their own. When adding up the responses, the three categories that received the highest rankings were global competition, raw material costs, and energy costs. (See Figure 6)

Bulk chemical manufacturing is a highly competitive market and one where businesses often compete on a global level. Most of our

readers would probably expect global competition to score high on a list of concerns, but that it ranked ahead of more immediate costs concerns could be seen as something of a surprise.

The second- and third-ranked concerns were both cost related: raw materials costs and energy costs. This adds an interesting flavor to the previous answers on 2017 budgets levels.

Those respondents who expected OpEx spending to rise (36%) may not have been anticipating increased spending on added capacity so much as accounting for the overall rise in the cost of raw materials and other variable costs.

Top 2017 Business Concerns:

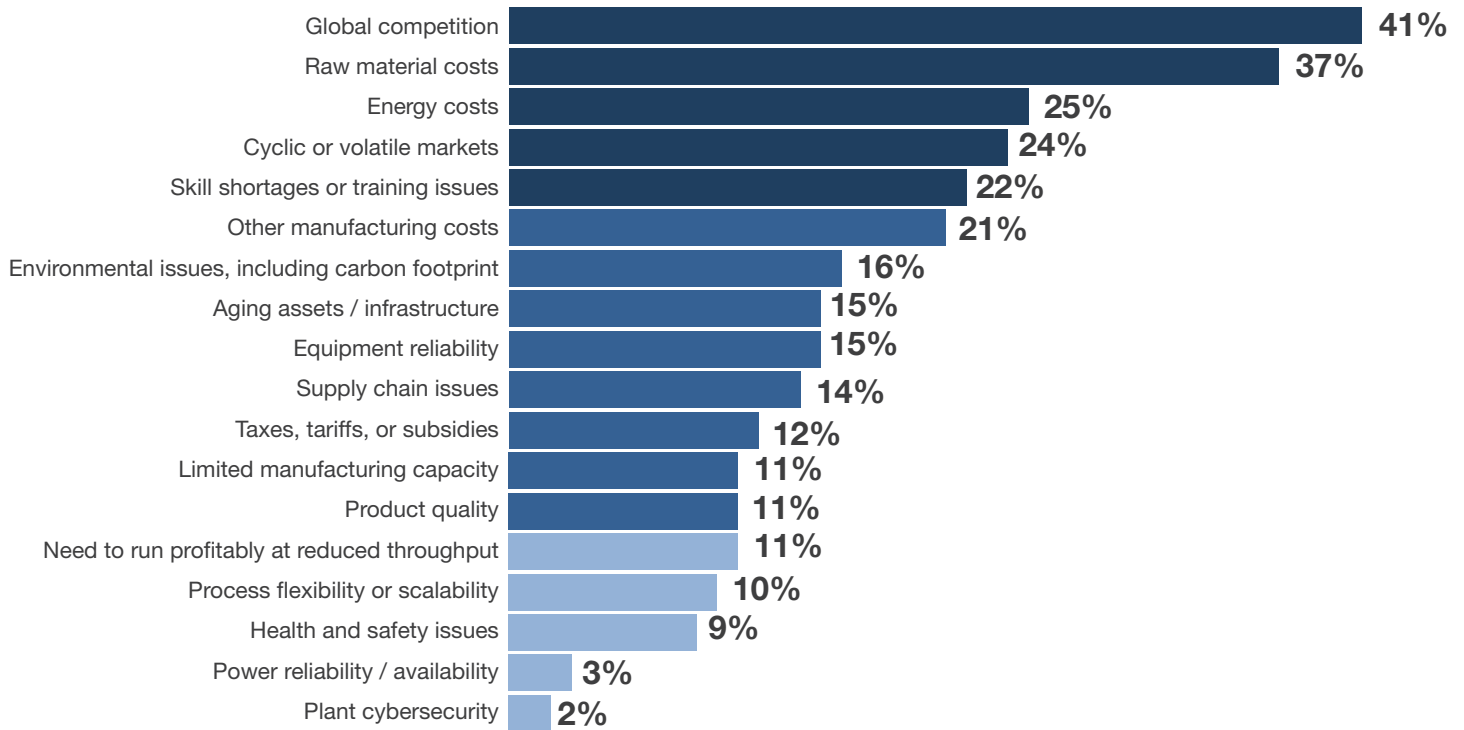
1. Global competition
2. Material costs
3. Energy costs

Outlook & Challenges

Solutions as Varied as the Issues

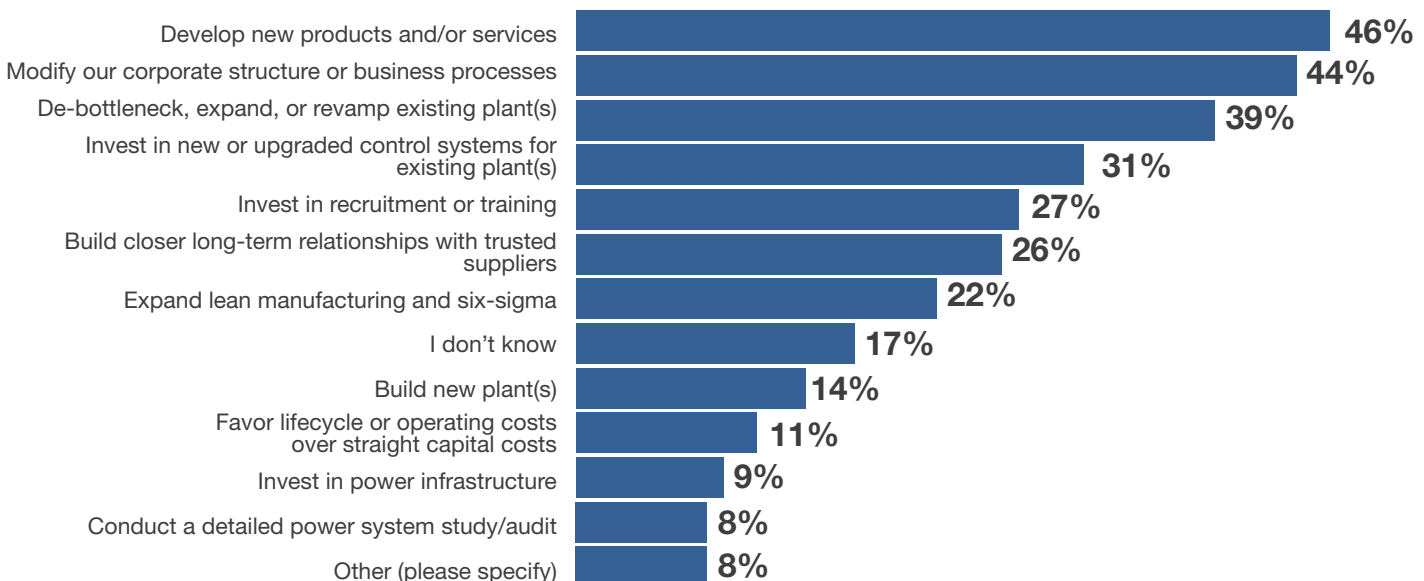
What are **THREE** most pressing factors affecting your facility or business going into 2017?

Figure 6 n=352



How do you plan to address the issues you identified in the previous question? (Select three)

Figure 7 n=352



A Decisive Impact on Profitability

Next, we asked respondents to tell us how they planned to address their challenges in 2017, giving them several options to choose from as well as the ability to write in their own responses. While the focus of our study was automation, we purposefully did not limit responses to automation strategies. (See Figure 7)

Almost half (46%) said they planned to develop new products and/or services, reflecting a commitment to innovation.

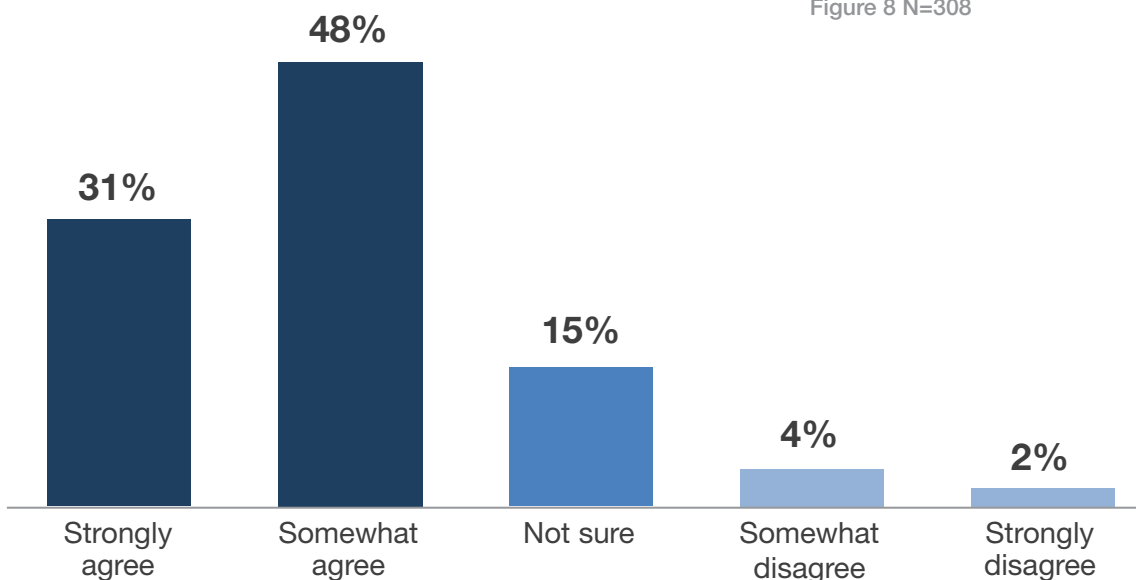
Process re-engineering followed in second and third place with business processes being the focus of 44% of respondents and manufacturing processes/capacity cited by 39% of respondents.

Automation, came in 4th with 31% of respondents saying they plan to invest in new or upgraded control systems for their existing plants. At first glance, this may seem like an unusually small percentage for a strategy that can have a dramatic impact on productivity and capacity. In a related question, 79% either agreed or strongly agreed that automation can decisively impact profitability. (See Figure 8)

74% of chemical manufacturers agree that automation has a decisive impact on profitability.

"Plant automation has a decisive influence on our profitability."

Figure 8 N=308



Uncertainty High Amid the Opportunity

Our work with chemical manufacturers tells us they recognize the performance gains to be found but often include automation strategies as a component of broader plans such as revamping existing facilities.

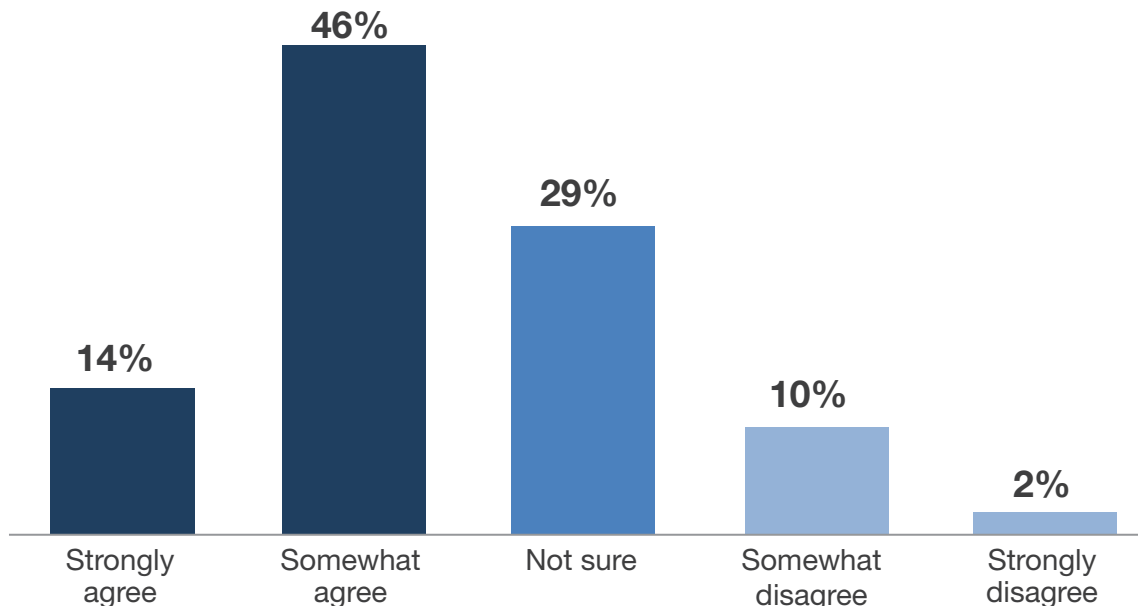
We asked respondents to rate their degree of agreement with several statements having to do with automation. Only 14% strongly agreed that they were confident they understood how automation fit into their future, while another 46% were only somewhat confident and 29% were unsure. (See Figure 9)

This middle ground of uncertainty is important in a world where digitization of manufacturing is already having a huge impact on performance.

For example, the American Society for Quality (ASQ) found that among manufacturers that had digitally transformed their processes, 82% increased efficiency, and 49% saw fewer product defects.

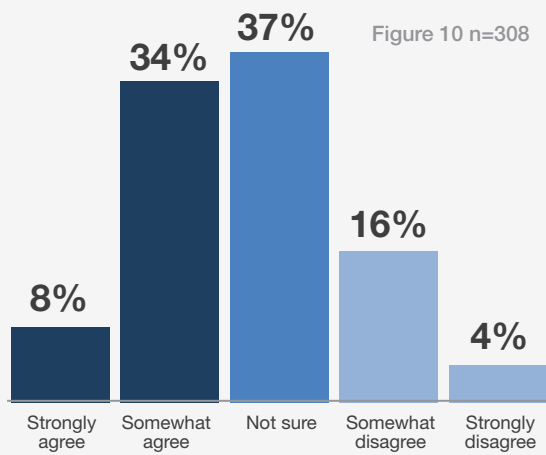
“We are confident and knowledgeable about our place in the changing world of automation.”

Figure 9 n=308

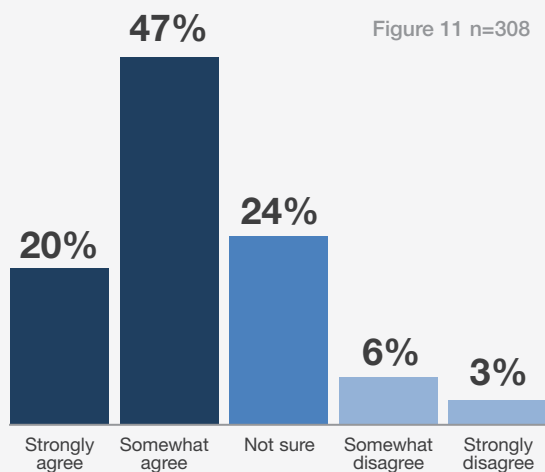


Automation

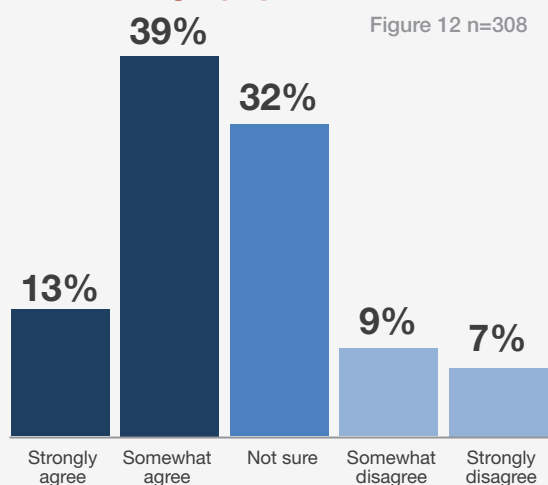
“Our existing automation systems don’t deliver all that their vendors promised.”



“We would like to be more standardized in terms of automation technology.”



“We have issues integrating multiple legacy systems.”



Living Up to the Promise

Solution performance also appears to be a challenge, with 43% saying their systems aren’t living up to vendor promises. Perhaps as troubling, 37% aren’t sure. (See Figure 10)

However, those who considered their organizations to be “automation leaders” rated the results of their implemented solutions more favorably. It’s vital for chemical manufacturers to choose vendors with a proven track record in automation and a commitment to follow through on projects. That said, it’s just as important for executive sponsors of the project to be clear about expectations, both internally as well with the vendors implementing the solutions. Being better at understanding what automation can do and communicating expectations may be one of the reasons the leaders rate solution performance higher.

As technology advances, it’s not surprising to find multiple systems in use. More than half of respondents (52%) said they were having problems integrating legacy systems, and 67% of respondents said they would like to be more standardized. (See Figures 11 and 12)

These two responses may be another reason why some respondents were unhappy with solution outcomes. Purchasing different components of an overall systems from multiple vendors can make communication more challenging. Individual vendors may see the project through the lens of their solutions, not in terms of the big picture, unless they are given a more holistic view of the goals by the project leads. Moreover, integrating newer systems with older technologies requires specialized expertise that not all vendors have.

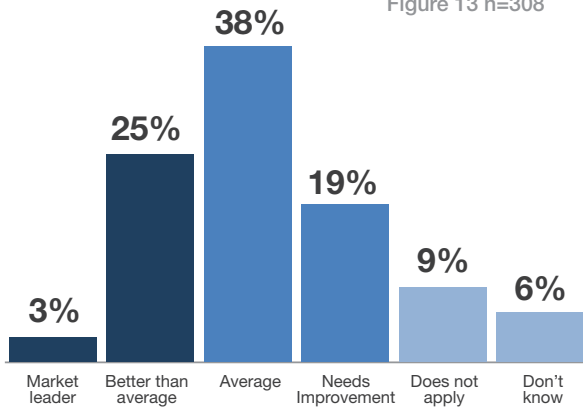
The twin issues of standardization and integration are not minor when it comes to realizing value from digitization and automation. McKinsey estimates that interoperability is a prerequisite for 40 – 60% of the value of the Internet of Things (IoT).²

Self-Rated Control Technologies Expertise

How would you rate your facility's or company's use of these automation technologies?

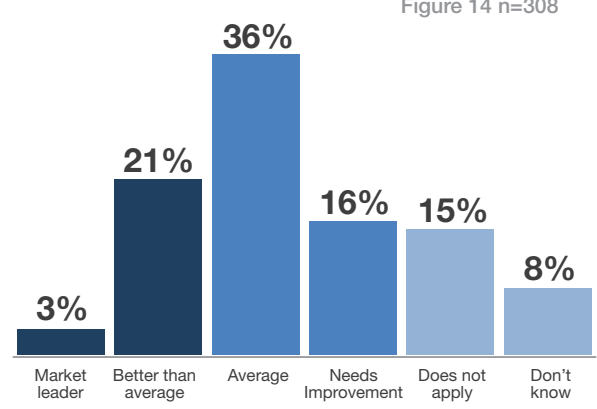
DISTRIBUTED CONTROL SYSTEM (DCS)

Figure 13 n=308



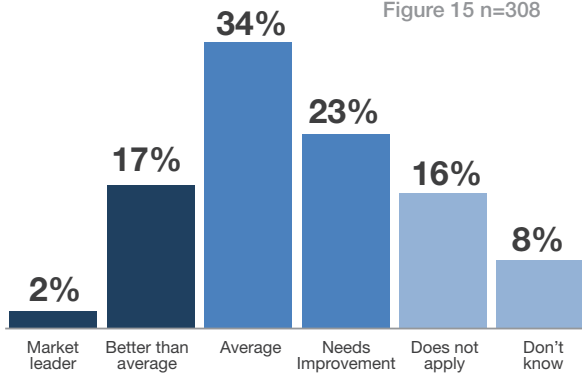
PROGRAMMABLE LOGIC CONTROLLERS (PLC)

Figure 14 n=308



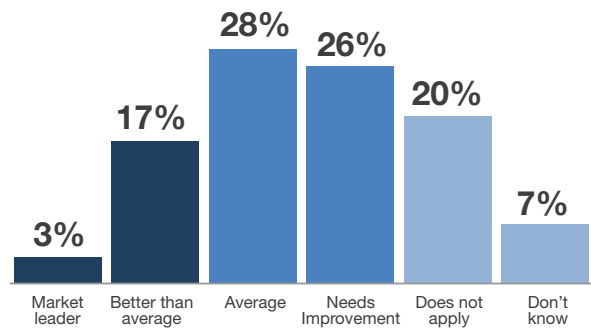
SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEMS (SCADA)

Figure 15 n=308



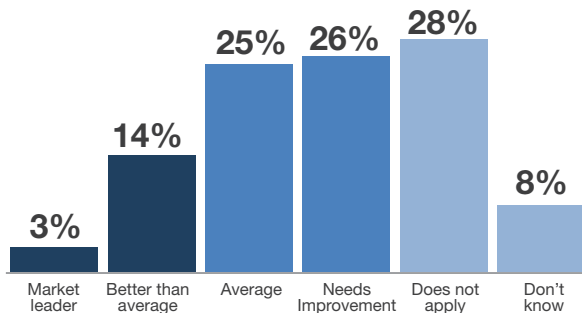
ADVANCED CONTROLS

Figure 16 n=308



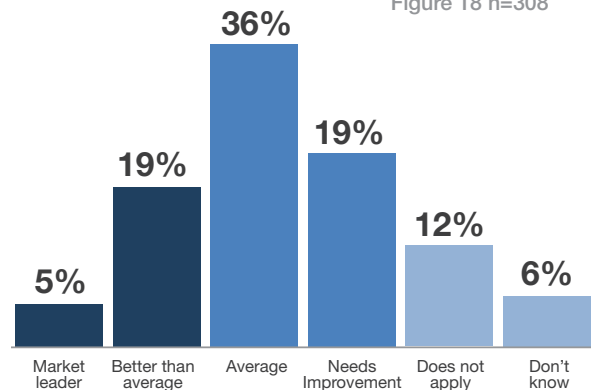
DYNAMIC SIMULATION

Figure 17 n=308



ONLINE SIMULATION

Figure 18 n=308



Digital Transformation Underway

Earlier, we mentioned that while the majority of respondents to our survey said they planned to keep both CapEx (43%) and OpEx (47%) spending flat in 2017, some foresaw increases in both categories (40% and 36%, respectively). (See Figure 5) The majority (72%) said they plan to invest in equipment and technology in the next eighteen months. Let's take a closer look at those investment plans.

The top responses: Distributed control systems (43%), Programmable logic controllers (44%), Online instrumentation (39%), and Wireless technologies for the plant (39%), seem to suggest a digital transformation is underway in many chemical manufacturing facilities. (See Figure 19)

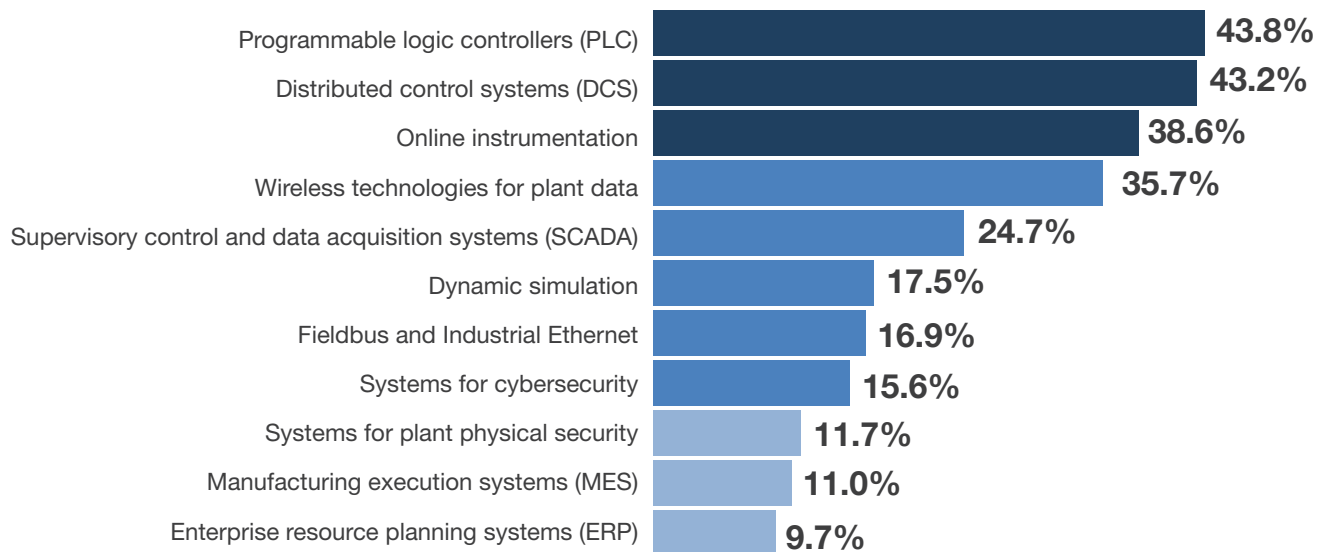
IDC predicts the IoT (Internet of Things) revenue opportunity for process manufacturing industries (including chemicals) will be as much as \$167B by 2018.³ The bottom line benefits cited by research organizations like IDC and others may be fueling these investments.

The revenue opportunity for process manufacturing industries will be as much as \$167 Billion by 2018.

-IDC

If you plan to invest in automation in the next 18 months, which technologies are most important? (Select all that apply).

Figure 19 n=308



Industrial Internet of Things (IIOT)

The positive outlook and increased anticipation of spending we discovered combined with a relative uncertainty over automation leads us to believe that many bulk chemical manufacturers may be willing to invest but are uncertain which investments will deliver the best returns.

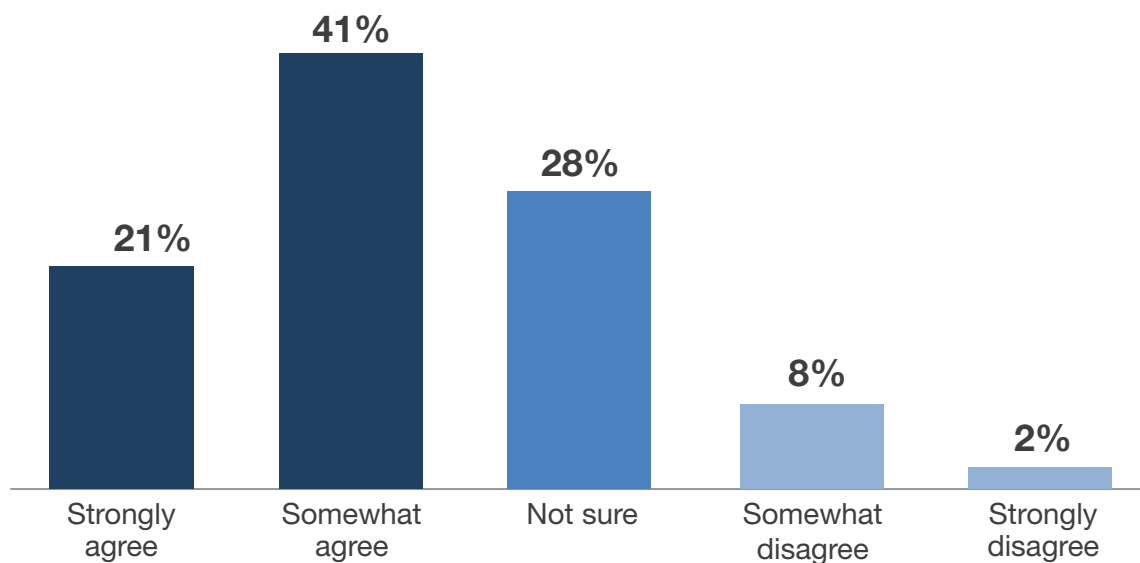
Furthermore, Gartner predicts almost 21 billion things will be connected to the Internet of Things by 2020.⁴ Other analysts aren't nearly as conservative in their estimates.

Whether 21 billion or 50 billion, the explosion of devices and sensors as well as the applications needed to analyze the data will create a tremendous opportunity for improving processes, streamlining operations, and competing on a global scale. In fact, McKinsey & Co predicts the total economic impact of the Internet of Things could be more than \$11 trillion a year by 2025.⁵

The IIoT may also have had an impact on the scope of manufacturing automation systems. For example, 62% of respondents to our survey expected automation systems to be able to control power as well as processes. (See Figure 20) In an increasingly digital world, power reliability and quality are more important than ever, and our study examined those concerns as well.

Is it important for plant control systems to manage electric power as well as process automation?

Figure 20 n=308



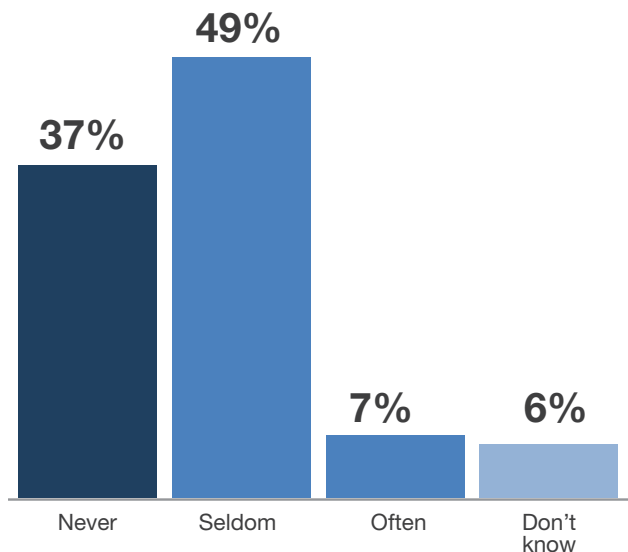
Downtime Proves Costly

The costs of unplanned downtime for manufacturing is often cited at \$7000 to \$8000 an hour. For many chemical manufacturers, those costs can skyrocket if sensitive processes are interrupted mid-cycle. Reliability of power is vital as is quality of power, and the responses to our survey suggest that most of our audience has a high degree of confidence in both.

Facility size did make a measurable difference in responses for both the largest and smallest facilities. While, overall, 12% of respondents said they often had problems with power reliability (See Figure 22), that percentage jumped to 17% for facilities with 1 – 50 employees and fell to 6% for facilities with more than 1000. However, only 5% of the respondents from the smallest facilities said they often experienced significant power cuts leading to lost production as compared to an average of 9% overall. For facilities with between 51 and 300 employees the percentage was 10% and 13% for facilities with between 301 and 1000 employees. For facilities with over 1000 employees, the percentage fell back to 8%.

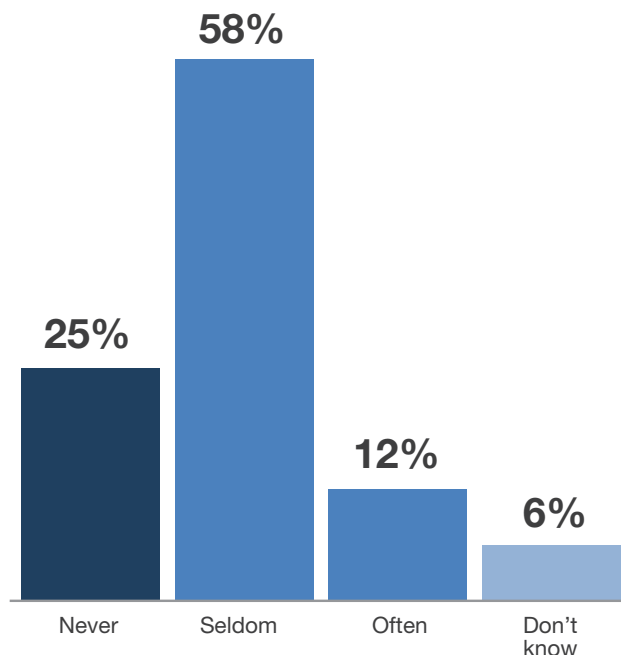
Do you have problems with inadequate power availability to support peak loads or large motors?

Figure 21 n=318



Do you have problems with power reliability?

Figure 22 n=318



Power Reliability and Quality

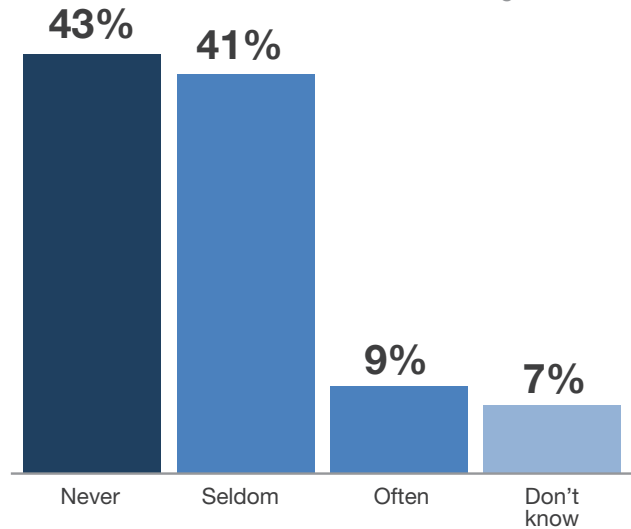
Power Strategies

Given the sensitive nature of many bulk chemical manufacturing processes and the high cost of downtime, it's worth noting that half of all respondents said that they have had a significant power cut leading to lost production. (See Figure 23)

Surprisingly, 40% said they either don't have backup to critical power or don't know if they do. Very few (16%) generate their own power on site. (See Figure 24) Moreover, as you can see from the chart, even smaller percentages of respondents have plans to address these issues in the next 18 months.

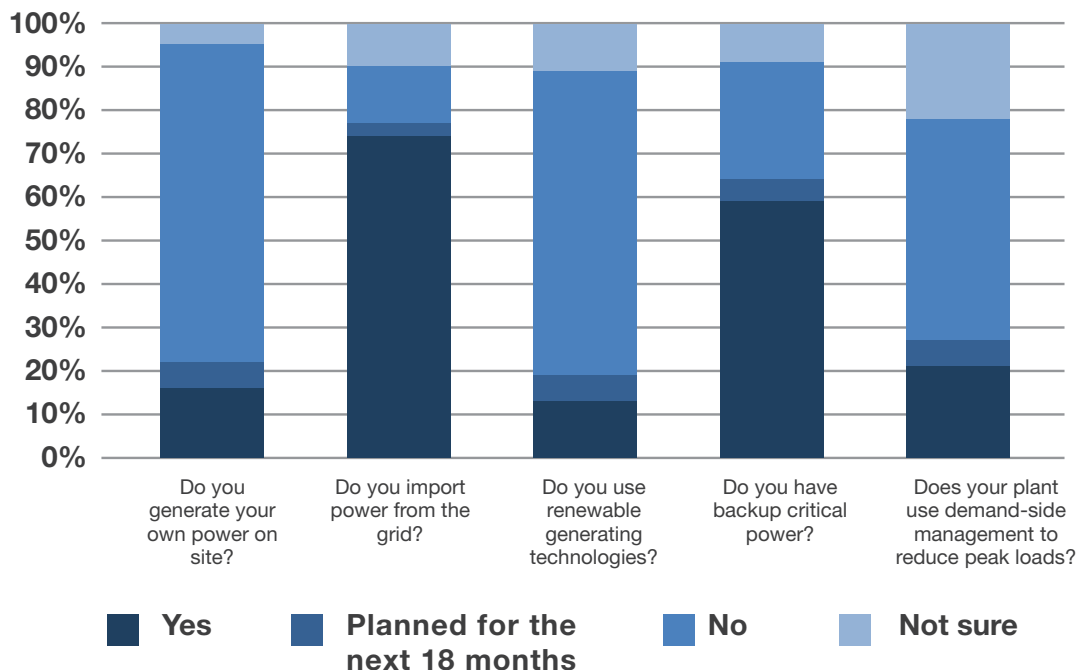
In the last year, has your plant suffered a significant power cut leading to lost production?

Figure 23 n=318



Tell us about electric power availability and power quality at your plant.

Figure 24 n=318



Quality as Important as Quantity

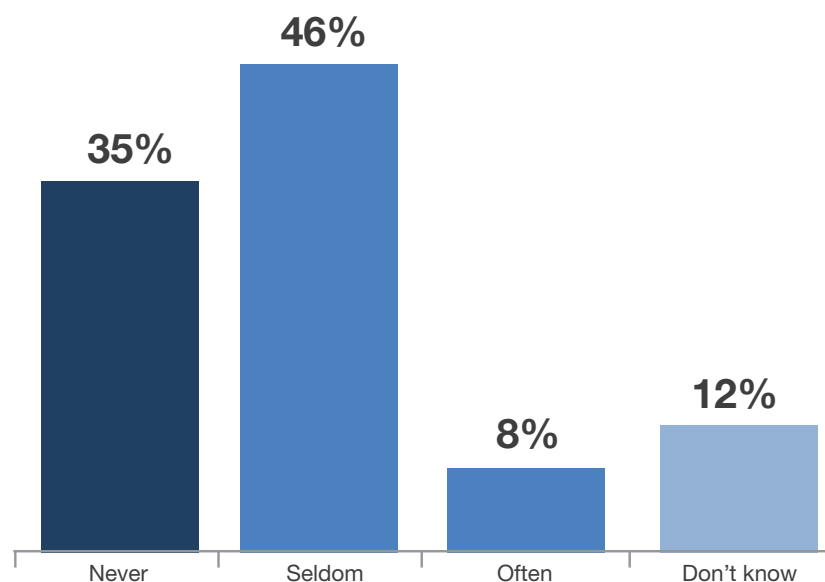
Power quality is an important variable in the power reliability equation. Only 8% of respondents said they often have issues with power quality (See Figure 21), but problems with power factor, harmonics, and voltage fluctuations can go unnoticed if they aren't severe enough to disrupt processes. Even if undetected, these problems can increase costs.

For example, a facility's power factor is the ratio of real power (the power that does the actual work) to the apparent power that is supplied to the circuit. The difference between these two is called reactive power. You need a certain amount of reactive power to stabilize the circuit, but when you have too much reactive power, utilities must provide more real power to your facility, and they will often assess a reactive power fee, sometimes as much as 20% of the bill.

A poor power factor also creates energy losses in the form of heat on the wires and the transformers. Raising the power factor can add power capacity to the facility because it helps unload the transformer, allowing greater loads to be added without increasing the size of the transformer. Addressing power factor issues can sometimes help chemical manufacturers increase capacity while keeping capital expenses down.

Do you have problems with power quality, including frequency drop, voltage drop, harmonics, or radio-frequency interference?

Figure 25 n=318



Vital to the Nation

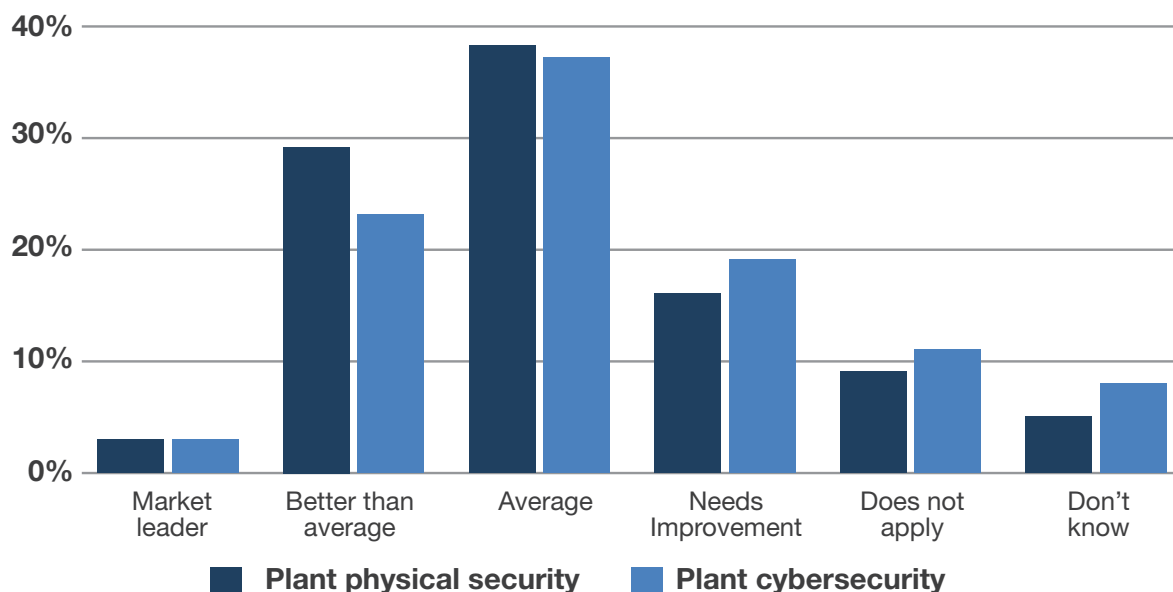
In February of 2013, Presidential Policy Directive 21 (PPD-21): Critical Infrastructure Security and Resilience named chemicals as one of 16 critical infrastructure sectors “whose assets, systems, and networks, whether physical or virtual, are considered so vital to the United States that their incapacitation or destruction would have a debilitating effect on security, national economic security, national public health or safety or any combination thereof.” Then, in August 2013, Executive Order 13650 Improving Chemical Facility Safety and Security increased industry oversight, putting the responsibility under the joint control of Homeland Security, the Environmental Protection Agency, and the Department of Labor.

While our study was not focused specifically on physical or cyber security, several of the questions had a security element to them. In addition, as plant automation increases, we would expect to see cyber security concerns rise accordingly. However, when we asked respondents what their three most pressing issues were, Cyber security and Physical security ranked the lowest at 1.99% and 0.28% respectively.

Naturally, this led us to wonder if chemical manufacturers aren’t prioritizing security concerns or if they feel they have this area adequately covered. When we asked them to rate their facility’s or company’s use of the automation and electrical technologies in these two areas, we got a standard bell curve response indicating that the majority felt they were at least keeping up with their peers: Physical security (70%); Cyber security (63%). However, that leaves 19% and 23% of organizations, respectively, that know they need to step up their game. (See Figure 26) As incidents of physical- and cyber-terrorism rise around the world, this is an area chemical manufacturers will need to proactively address to stay ahead of the threat.

How would you rate your facility’s or company’s use of the automation and electrical technologies for physical and cyber security?

Figure 26 n=318



Automation: The Next Frontier

The positive outlook both in the industry and within individual facilities indicates a bright future ahead for the bulk chemicals industries. Nevertheless, it will not be without its challenges. Global competition is only going to increase, putting additional pressure on chemical manufacturers to create a sustainable differentiation in a highly commoditized market. With margins already tight and the cost of energy and raw materials uncertain, a price-based competitive strategy can only go so far.

Automation has long been a factor in process manufacturing industries like bulk chemicals. However, we stand today on the cusp of what is sure to be a revolution in automation. It's not unlike the difference between landing on the Moon and sending a manned mission to Mars. An apt analogy since the smartphone in your pocket has far more computing capacity than the Apollo Guidance System.

Software and devices for chemical manufacturing have advanced beyond simply controlling process elements such as flow rate and temperature. Today's technologies collect more data from more parts of the process than ever before. Advanced analytics turns this data into actionable information. Mobile devices put it in the hands of employees, giving them the insight they need to make better decisions faster, optimizing operations and controlling costs.

We believe the future of chemical manufacturing is not going to belong to whichever company can cut its prices below the competition. It already belongs to the manufacturer that recognizes the power of automation and uses it to redefine decades-old processes and ways of doing business.

Global competition is only going to increase, putting additional pressure on chemical manufacturers to create a sustainable differentiation in a highly commoditized market.

FOOTNOTES

- ¹ *Outlook: U.S. Chemical Industry Continues to Outpace Industrial Output; Accounts for More Than One-Half of Construction Spending by Manufacturing Sector*, American Chemistry Council, December 2016.
- ² *Unlocking the potential of the Internet of Things*, McKinsey & Co., June 2015.
- ³ *Worldwide Internet of Things Spending by Vertical Market 2014–2018 Forecast*, IDC, June 2014.
- ⁴ *Gartner Says 6.4 Billion Connected “Things” Will Be in Use in 2016, Up 30 Percent From 2015*, Gartner Press Release, November 10, 2015.
- ⁵ *Unlocking the potential of the Internet of Things*, McKinsey & Co., June 2015.