WHITE PAPER

Improving the Product Innovation Process in the Chemicals Industry Through Data Access, Collaboration, and Visibility

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IN THIS WHITE PAPER

The chemicals industry is a vital element in our global economic ecosystem. Nearly all manufactured products, 96%, are touched in some way by chemistry (e.g., touchscreens for mobile phones or lightweight composite materials for airplanes). As such, the chemicals industry plays a pivotal role in driving innovation to improve existing products and in helping develop and bring new products to market. Indeed, the customers of chemical companies look to the chemicals industry as a source of innovation to support the development of new products and help improve existing products. For this reason, innovation in both product and process remains a top concern for chemical companies, and according to IDC Manufacturing Insights' 2015 *Product Life-Cycle Management (PLM) Survey,* over 59% of asset-oriented companies (including chemicals) cited product innovation as a top business priority over the next three to four years.

Product and process innovation is a critical component of the growth strategy in the chemicals industry, which is an evolving market. As product life cycles continue to shrink as new products and materials are brought to market, the challenge for chemicals companies is optimizing the innovation process to enable faster time to market and reduce risk while concurrently working to support sustainability.

The key levers of an effective innovation strategy are visibility, data access, and collaboration across the innovation ecosystem. This white paper explores the market forces driving the need for accelerated innovation cycles in the chemicals industry, defines a framework for streamlining the innovation process, and defines the value of data access, visibility, and collaboration within the innovation process.

IDC MANUFACTURING INSIGHTS OPINION

Companies competing in the chemicals industry must embrace innovation as a lever for growth and value creation. The fact that nearly all products are in some way impacted by the chemicals industry certainly speaks to the significant force that this industry has on the development of new and improved products. This is especially true for the specialty chemicals segment, which is the most robust, versatile, and profitable subsegment of the chemicals industry. Indeed, given the value of the specialty chemicals subsegment, it should come as no surprise that many large global chemicals companies continue to transition away from bulk chemicals and focus more on strategizing around the specialty chemicals subsegment.

This transition lends itself to the importance of innovation within the chemicals industry, especially in specialty chemicals. Chemical companies are focusing on driving revenue, growth, and profit through the highly profitable specialty chemicals subsegment and, as such, must look at innovation as a lever to support this transition. This need for innovation transcends the chemical companies and extends to the customers of the chemical companies that rely on chemical innovation to support their innovation efforts. As such, the need for effective and efficient innovation is driving the need for collaboration, visibility, and data access across the innovation ecosystem. Today, chemical companies require a robust collaboration platform by which to enable actionable insight across the innovation ecosystem in order to enhance innovation efforts while subsequently helping drive efficiency in the innovation process.

SITUATION OVERVIEW

Market Forces Driving Innovation in the Chemicals Industry

The chemicals industry is facing heavy pressure to innovate in terms of product and process in order to maintain competitiveness and drive profitable growth in an increasingly volatile economic ecosystem. Considering the significant role that chemicals play in supporting the manufacturing industry, it would be prudent to discuss some of the key factors that are currently shaping the global economic environment and how those factors are driving chemicals companies to innovate in order to respond to market conditions. Firms are being forced to adapt their business strategies to several factors that are having a profound impact across industries, especially chemicals, including:

- **Environmental and regulatory compliance, health, safety, and sustainability.** Chemical safety, health, and environmental and regulatory compliance continue to be top priorities for chemicals companies. Many chemicals companies are working on ways to improve transportation, security, safety, and track and trace relative to the manufacture, movement, and storage of product throughout the value chain. Environmental compliance and regulatory issues are expanding and evolving at the business, geographic, and industry levels, requiring chemicals companies to actively monitor, control, and report on how they are meeting compliance today and how they plan to evolve their procedures to exceed requirements in the future. Depletion of natural resources, pollution, and waste are all areas that chemicals companies must focus on to ensure responsible business practices. Many of these firms are actively working on ways to reduce fuel consumption in production and transportation, reduce emissions, and reduce water consumption. Chemicals companies are looking at alternative energy sources and evaluating how building new facilities and refitting existing facilities to utilize solar, wind, and water power and manufacturing-generated heat can help drive sustainability into their manufacturing processes. Further, the customers of the chemical companies rely on the chemicals industry to drive sustainability innovation downstream. For example, agrichemicals companies are looking to produce greater yields with less water and consumer packaged goods (CPG) companies are looking for more efficient cleaning chemicals that use less water and packaging innovation such as less plastic and material that is easier to recycle and break down. Each of these issues is driving the chemicals industry to innovate in order to achieve more sustainable, environmentally friendly, and compliant operations internally and for the customer.
- **Feedstock price volatility.** Sudden shifts in the price of feedstock have a tremendous impact on the cost and profitability within the chemicals industry. Most recently, oil prices experienced a sudden and drastic reduction of over 60%, and prices continue to fluctuate significantly on a daily basis. This drop in the price of oil is only the most recent example of volatility relative to feedstock. The price volatility of feedstock makes it quite difficult for chemical companies to

plan, forecast, and budget over any significant horizon, which is driving the effort to identify alternative sources of supply that can provide greater stability relative to price and availability. Beyond the issue of price volatility, chemical companies are continuing to look for more sustainable and environmentally friendly supply alternatives to reduce the reliance on fossil fuel as a feedstock.

- **Globalization, population, urbanization, and emerging markets.** From a business perspective, the Earth is flat. It is in the interest of firms to have a strategy in place to conduct all elements of business across a global landscape, including product development specific to geographies. This means that firms must have the ability to fully understand regional trade requirements, risk, and market nuances in order to build a competitive business in a global environment. Accelerating growth in emerging markets is impacting demand patterns as well as the competitive environment relative to chemicals. Chemicals industry growth in emerging markets is expected to significantly outpace growth in developed markets over the next several years (growth to the tune of 6–10% for emerging markets versus 2–3% for developed markets). This growth is not only fueling global chemical companies to focus on emerging markets but also driving the emergence of local competitors, which are often able to provide similar products at lower price for the local geography. As such, it becomes imperative that global chemical companies innovate to produce better products at a more competitive price point in order to better compete in the emerging markets and capitalize on the growth opportunities these regions present.
- **Customer focus.** Across all product categories, the balance of power has shifted from the manufacturing firm to customers. This shift in power is largely driven by the connected nature of today's customers who have the information required to make an informed purchasing decision in the palm of their hands at all times. This fact has enabled customers to demand a greater variety of product with nearly immediate fulfillment at a reasonable price point. While this factor is forcing firms to evaluate and innovate the supply chain to better manage a more robust portfolio and fulfillment network, it has also forced organizations to drastically reduce product life cycles, requiring them to rapidly innovate in order to bring new products and product improvements to the market, or they risk letting the competition step in and better meet the needs of the customer. It is the rapid acceleration of product life cycles and the need for more frequent innovation that really support the notion that chemical companies are impacted by the customer-focus market force. As pressure from the customer forces manufacturing firms to bring new and improved products to the market, chemical companies are leaned on as a source of innovation and must work with their manufacturing clients to drive product improvements and new releases.

Each of these factors is driving chemicals companies to innovate in order to become more competitive, drive revenue, increase profitability, and reduce costs. More fundamental, however, are the questions of where to focus resources on innovation and how to improve the probability of successful innovation initiatives, especially considering that the chemicals industry is a foundational input to nearly all other manufactured products. The relationship between chemicals and the rest of the manufacturing industry is a driving force behind the need for collaborative efforts between chemicals companies and downstream customers to innovate on product and process in order to deliver positive outcomes for the chemical companies, the manufacturers and, ultimately, the customer. The remainder of this white paper outlines an approach to identify where to focus resources for innovation and how visibility and collaboration can support the effort to reduce risk and waste in the innovation process.

According to a PWC study, growth for the most innovative companies (the top 20% of respondents, based on several qualifying questions related to innovation) was 16% higher than that of the least innovative companies (the bottom 20% of respondents) over the past three years. Within the same

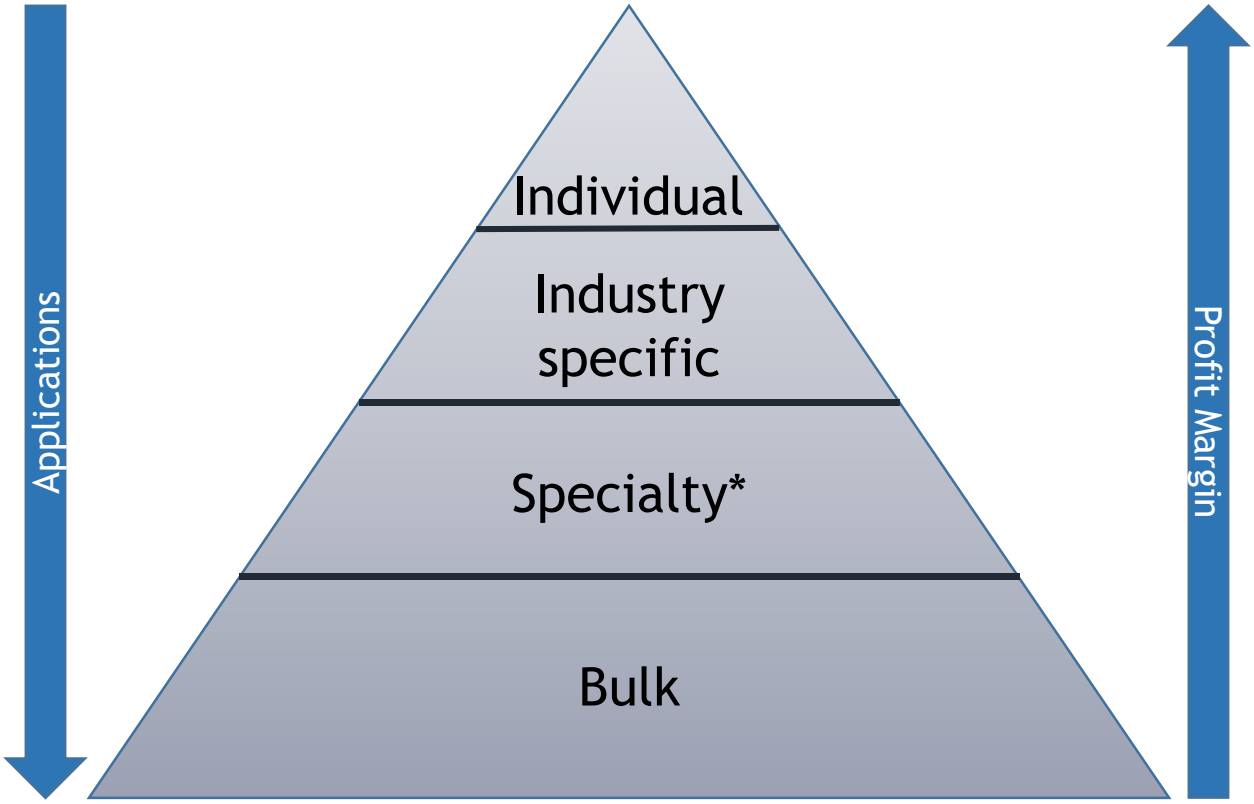
study, the most innovative companies forecast their growth rate to be over three times higher than the forecast growth rate of the least innovative companies over the next five years. Clearly, in the current market environment characterized by accelerated product life cycles, intense competition, globalization, and digital transformation, firms that emphasize innovation as a strategy for growth are able to create a competitive advantage and deliver on the promise of higher revenue, increased margins, and greater market share.

The Chemicals Industry Value Pyramid

Not all products in the chemicals industry are created equal. Chemicals can be broken down into four buckets (see Figure 1), where the broader base of applications has an inverse relationship to profitability.

FIGURE 1

The Chemicals Industry Value Pyramid



* Adhesives, agrichemicals, cleaning materials, cosmetic additives, construction chemicals, elastomers, flavors, food additives, fragrances, industrial gases, lubricants, polymers, surfactants, and textile auxiliaries

Source: IDC Manufacturing Insights, 2016

Innovation in the chemicals industry must and will occur across each of the four categories of chemicals; however, we see the greatest opportunity to create value through innovation within the specialty chemicals group. Margins in the specialty chemicals subsegment are significantly higher than

those typical of bulk chemicals, and due to the cross-industry applications, these chemicals offer a more versatile market than industry-specific and individual chemicals. For example, PolyOne, a global provider of polymer materials, transformed its approach from a focus on bulk chemicals to a focus on specialty chemicals, which resulted in a margin increase of over 200% while concurrently reducing volume output by 34%. PolyOne increased the percentage of operating income from specialty chemicals from just 2% in 2005 to 65% in 2014, which has helped the company drive revenue and margin growth. Such results speak to the value of competing in the high-margin specialty chemicals business compared with low-margin bulk chemicals.

Because of the versatility of specialty chemicals and robust market applications across industries such as agriculture, health/nutrition, bioscience, and high tech, innovation focused in the specialty chemical space tends to yield greater opportunities. Specialty chemicals are sold based on performance or function, as opposed to chemical composition (as you would find with bulk chemicals). This fact supports the notion that innovation in the specialty chemicals space provides the opportunity for cross-industry applications, resulting in revenue growth, market share opportunity, and profitability.

With regard to the drivers of innovation in the chemical space (environment and sustainability, feedstock variability, globalization, and customer centricity), we find that innovation in the specialty chemicals category is especially appealing because of the ability to identify products with enhanced functionality and the ability to drive the level of product improvement and innovation required to meet the needs of an evolving market. Forecasts for the specialty chemicals industry expect the market to reach as high as $470 billion by 2020, representing annual growth of 4–6%. Some of this growth will be part of organic higher demand for products because of population growth; however, we expect innovation and new product development to be the catalysts that accelerate this growth.

Keeping up with demand for new and better products will continue to be a driving force in the chemicals industry. Chemical companies today spend on average 6.8% of revenue on research and development (R&D), representing roughly $24.5 billion in 2015 and forecast to reach nearly $32 billion in 2020. While this percentage is robust relative to the percentages in other industries, the rate is not increasing in any substantial way. The combination of this level rate of R&D spending, shifting emphasis toward specialty chemicals, and the pressure to get to market quicker yields a "do more with less, faster" challenge that dictates that chemical companies transform their approach to innovation while maintaining a focus on sustainability.

The Innovation Imperative

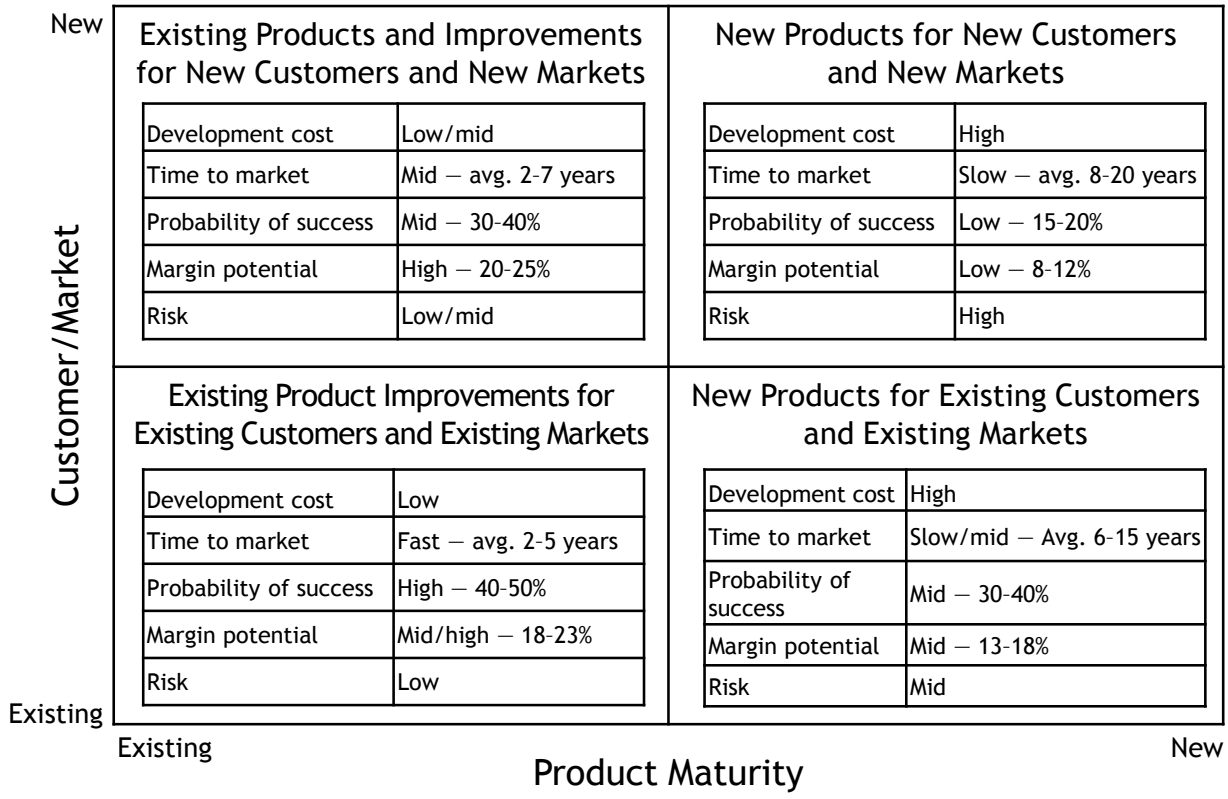
The velocity with which new products/materials must be introduced has taken on a greater importance relative to innovation in the current market. Many of the products sold today were not available on the market several years ago, and product life cycles have accelerated to the point where in certain markets, multiple product innovations may occur in the same year, rendering previous versions obsolete. Take 3M, for example, where more than 34% of revenue comes from products that did not exist five years ago, or Apple, where in 2010, 60% of sales came from new products.

To this point, the vitality imperative for the chemicals industry requires that 40% of revenue come from products developed in the past three years by 2020. On the surface, this may seem like an aggressive objective; however, we have found that for leaders in the chemicals industry, as much as 36% of revenue over the past several years has come from new products/materials, and therefore, firms are innovating at a rapid pace and driving toward this objective.

Innovation remains at the top of the list of priorities for the chemicals industry. The speed of change in the market today coupled with intense regulatory pressure and sustainability initiatives is forcing chemicals companies to continue to come up with new products to meet the demands of an evolving market, or risk the competition doing so. However, chemical companies must take a measured approach to investing in innovation initiatives and understand the risk and reward potential of investing in R&D spend, which is forecast to reach $31.96 billion by 2020. Figure 2 presents the innovation matrix, a framework for aligning innovation initiatives across the dimensions of product maturity and customer/market.

FIGURE 2

Innovation Matrix



Note: For more information, see *Chemical innovation: an investment for the ages.*

Source: IDC Manufacturing Insights and McKinsey, 2016

The innovation matrix enables chemical companies to evaluate and plan for innovation initiatives based on a set of expectations. Discussing the potential for innovation across the four dimensions detailed in Figure 2 provides a foundation to help chemical companies understand the value, risk, and potential associated with innovation efforts aligned against market familiarity and product maturity. The innovation matrix provides guidance for determining where to innovate, but there must be a well-rounded approach to innovation by which each quadrant is appropriately addressed to generate maximum value.

The innovation strategy must also consider the product portfolio and strategic vision of the chemicals firm. Part of an effective innovation strategy is efficient utilization of resources aligned with the most profitable and strategically significant projects. Chemical companies must evaluate how their current product portfolio aligns with the innovation matrix and how innovation efforts can support the corporate strategy while driving revenue, profit, and market capture. The longtime lines associated with new product/material development in the chemicals industry make it imperative that chemical companies align long-term strategy with the innovation strategy. Such alignment helps ensure that R&D is focused on the areas that provide the most strategic value for the firm over the planning horizon.

When talking about innovation, we must also look to process innovation as an area where tremendous value can be gained for the chemicals industry. With regard to the vitality imperative, process innovation refers to the ability to drive product innovation while leveraging existing suppliers, materials, and equipment. In the effort to reduce the time it takes to bring innovation to market, the ability to leverage existing resources creates tremendous value by helping keep down material and production costs. Further, internal knowledge of material, suppliers, and equipment helps manage the learning curve and capital expense when bringing innovation to market. Knowledge capture is currently an area within the chemicals industry where the technology available today can support the innovation process by providing visibility and enabling collaboration. It is in this knowledge capture that wasted cost, spent on non-value-adding experiments and procedures, can be reduced to drive cost savings and improve productivity through the elimination of redundant efforts. Therefore, robust visibility and collaboration across the chemical company into process, suppliers, and capacity play a significant role in driving process innovation.

In addition, process innovation concurrently refers to the ability to identify process improvements to drive efficiencies in bringing existing product to market. The effort to "do more with less, faster" requires that firms actively seek out opportunity to maximize resource utility, reduce time spent, and reduce capacity required to produce products/materials. When thinking about process innovation, we must also consider that effort must be taken to identify risk and potential problems earlier in the process in order to take corrective action before suffering setbacks. Such process innovation enables the chemical company to reallocate resources and capacity to meet increasing demand without the high cost of investing in additional resources and capacity while minimizing downtime and batch failure during development and production scale-up. As chemical companies continue to derive greater volumes of revenue from new products, the ability to produce with less capital outlay and more efficient risk management helps improve margins and can drive a faster time to market, thus "doing more with less, faster."

RDQM Innovation Framework

Innovation in the chemicals industry can be broken down to four key elements:

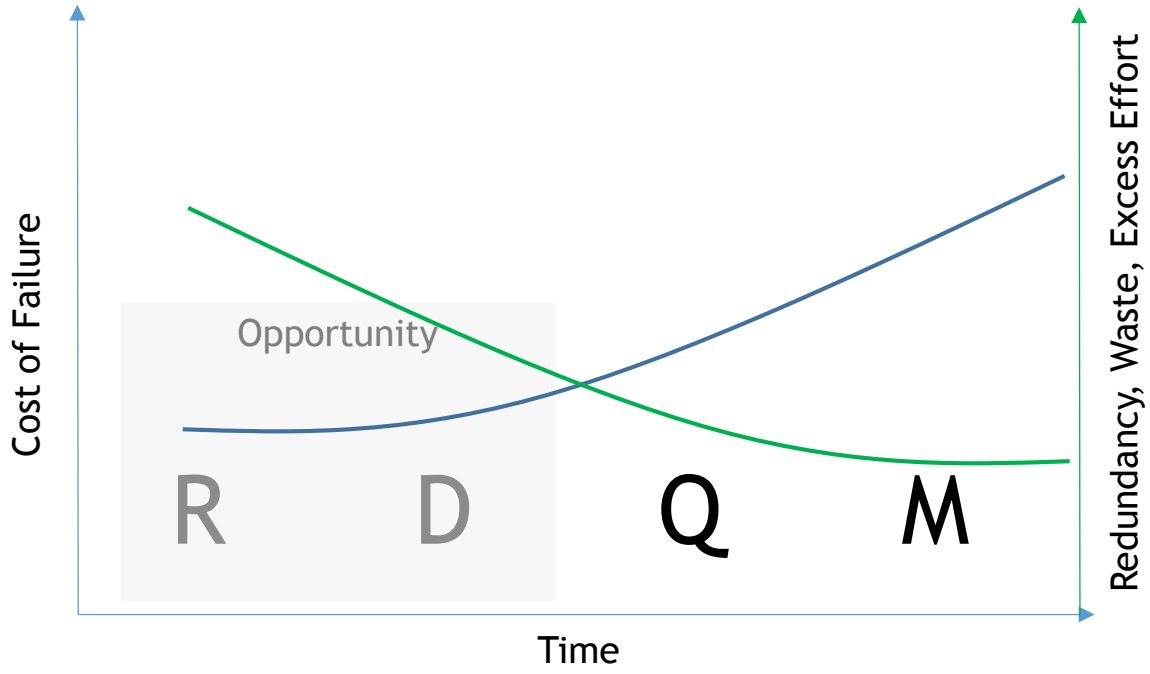
- Research
- Development
- Quality
- Manufacturing

By taking the research, development, quality, and manufacturing (RDQM) approach to innovation, chemical companies can better align resource requirements, risk, cost, and opportunity across a spectrum relative to time and cost of failure (see Figure 3). Such a framework provides some guidance

to innovators relative to the value of improving the innovation process earlier on in the cycle, thus reducing the risk and cost of failure later on in the process.

FIGURE 3

RDQM Failure Cost Curve



Source: IDC Manufacturing Insights, 2016

The RDQM framework identifies the greatest opportunity earliest in the innovation process relative to risk management. Essentially, by identifying the potential for innovation success or failure during the R&D phases, chemical companies are better equipped to make the go/no-go decision before incurring the high cost associated with failure later on during the Q&M phases and limit the financial expenditure on efforts that do not have potential for success. However, identifying the potential for success versus failure early on in the innovation process is not a simple effort, especially for the chemicals industry where potential outcomes cannot be identified until a series of experiments are conducted with various chemicals, formulations, and molecules under various conditions. Therefore, the ability to share insight relative to past and current innovation efforts plays a significant role in innovation risk management.

Clearly, earlier on in the RDQM framework, we would expect to see higher levels of redundancy, waste, and excess effort as ideas and experiments materialize. We also expect to see these inefficiencies reduced as innovation progresses through each phase and waste is identified and eliminated. The challenge for chemical companies working to innovate is to become more efficient at identifying this waste earlier in the process; reducing the cost, time, and effort spent on redundant work; and leveraging existing resources rather than spend time with redundant efforts.

Keep in mind that the RDQM framework is not exclusively for a net-new product. The framework is designed to support the identification of risk, waste, and cost, regardless of whether a new product is being designed or innovation is targeting an improvement to an existing product or process. The fundamentals remain the same: Cost, risk, and waste remain highest earliest on in the innovation process and are eliminated as the innovation process progresses.

For chemical companies to truly optimize the opportunity and reduce innovation risk, they must be committed to collaboration and enabling access to research data and visibility across the innovation ecosystem and across each element in the RDQM framework. Through collaboration, visibility, and data access, knowledge and actionable insight are transferred across stakeholders to enable the efficient movement of the risk curves within the RDQM framework to support more cost-effective, successful, and rapid innovation.

Data Access, Collaboration, and Visibility Enable Efficient Innovation

The tools and processes embedded in the innovation strategy to enable access to data, collaboration, and visibility are just as important as the innovation strategy and road map. Each of these elements is a critical lever in driving not just an effective innovation strategy but also an efficient innovation strategy, especially in the chemicals industry.

Innovation in the chemicals industry is not something that can be conducted within a vacuum. Companies in the chemicals industry understand that effective innovation requires tight collaboration among internal scientists and engineers, customers, government, non-governmental organizations (NGOs), the education community, and other strategic partners. Such collaboration enables those with a stake in the research and development of chemicals to actively participate in the wide range of innovation opportunities that exist. However, such broad collaboration and the idea of open innovation require an efficient system and process for capturing and sharing information related to experimentation, outcomes, formulations, and so forth to help reduce redundancy in the process and more rapidly identify existing information that may support a broad range of efforts.

The volume of molecules, formulations, and materials that exist combined with the volume of experiments in the space leads to a massive amount of data relative to materials, processes, and reactions. Such high volumes of information create certain challenges relative to innovation initiatives because of the inherent risk of missing some key piece of existing information. Case in point: Companies in the chemicals industry spend 50% of R&D budget on testing, yet 30% of the tests are duplicates. Some of these duplicate tests are required, but some are not, and this speaks to the volume of waste associated with lack of visibility and collaboration. In addition to the value of identifying key information, innovation in the chemicals industry can be greatly enhanced by the ability to conduct research and analysis on existing information. As such, the chemicals industry is moving toward greater adoption of open innovation, greater levels of collaboration, and digital transformation as levers to drive effective and efficient innovation.

We continue to see the chemicals industry focused on getting greater productivity and efficiency out of business processes and capital equipment. These elements continue to show up in our annual surveys at the top of respondent priorities, and many chemical companies are looking toward digital transformation to help achieve these objectives. Over the years, chemical companies have invested heavily in IT systems and automation to drive operational efficiency and improve productivity. Now, as organizational infrastructure becomes increasingly connected, opportunities to leverage rapidly increasing amounts of data to generate business impacts are at the forefront of business strategy. The explosion of data, a result of increased use of sensors and the emergence of the Internet of Things (IoT),

is enabling chemical companies to look at old problems in new ways and identify innovative solutions to further improve productivity and reduce costs.

Digitization goes beyond the internal operations and helps connect chemical manufacturing firms with their customers, suppliers, distributors, and research partners. Such value chain alignment drives the need for applications designed for collaboration and visibility throughout the supply chain to enhance collaboration. Digital transformation is enabling the chemicals industry to both identify and implement internal improvements and connect with the extended value chain and innovation ecosystem to innovate and improve products, processes, and strategies.

Applications designed specifically for innovation and collaboration in the chemicals industry play a critical role in driving efficiency in the innovation process. These tools must be designed to enable a broad range of innovation stakeholders within the collaboration process, access to historical experimentation data in a digital format, and insight into current-state efforts that may align across multiple efforts.

Ultimately, innovation applications for the chemicals industry must be designed with the objective of accelerating the innovation process while increasing the probability of successful outcomes. A successful outcome can be characterized as the identification of new or enhanced materials, formulations, or processes that meet a market need and can be scaled up to provide a profitable introduction into the market for new products/materials or drive additional revenue, profit, and market share and push down the cost of an existing product.

When discussing the value of data access, collaboration, and visibility in the context of innovation, one must consider the role of the innovation platform and the purpose for which chemical companies are using such tools within the RDQM framework. Through data access, collaboration, and visibility, chemical companies are better equipped to identify innovation risk and accelerate the go/no-go decision-making process when working toward innovative product and process.

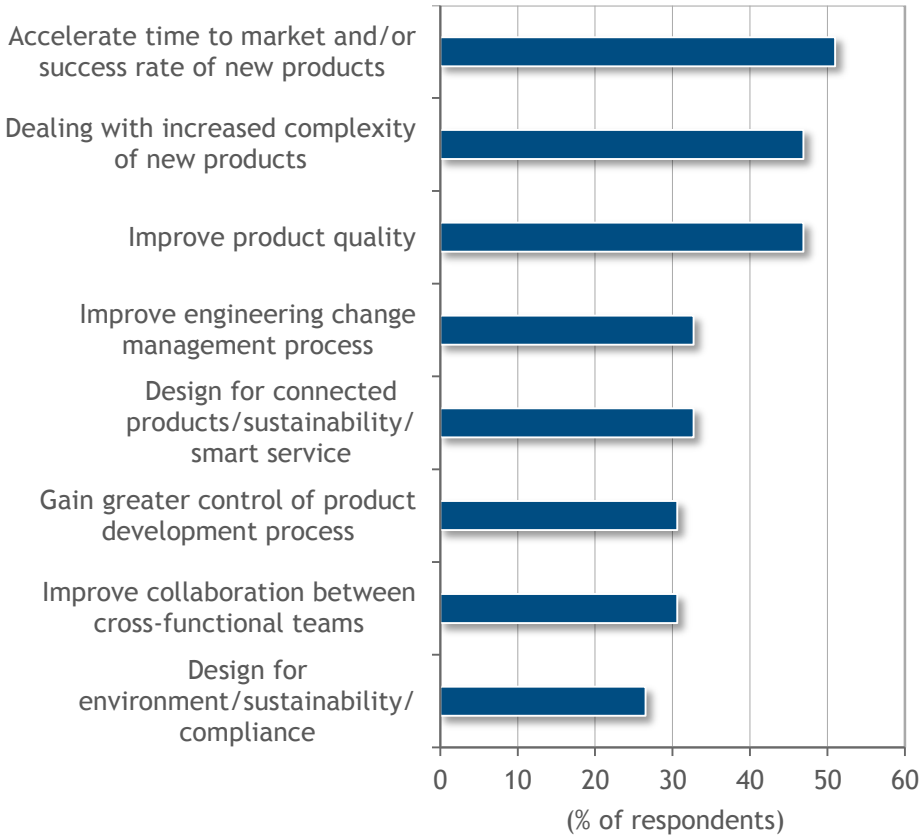
According to IDC Manufacturing Insights' 2015 *PLM Survey,* respondents in the asset-oriented industries, including chemicals, identified with the following as the top drivers of PLM efforts (see Figure 4):

- Over 50% of respondents cited accelerating time to market and/or success rate of new products as a top driver of PLM efforts.
- Dealing with increased complexity of new products and improving product quality were identified by 47% of respondents as a top driver of PLM efforts.
- Improving cross-functional collaboration and gaining control of the product development process were identified by just over 30% of respondents as drivers.
- 26% of respondents identified design for environment, sustainability, and compliance as a driver of PLM efforts.

FIGURE 4

Drivers of PLM Efforts in the Chemicals Industry

Q. What are the top 3 drivers of your organization's PLM efforts?



n = 49

Source: IDC Manufacturing Insights' *Product Life-Cycle Management Survey,* 2015

Unfortunately, achieving the requisite levels of data access, visibility, and collaboration to efficiently innovate has been somewhat hindered by a traditionally fragmented solution set. Over time, various applications, from a wide variety of vendors, have been developed targeting specific trouble areas and often implemented in an ad hoc manner. Typically, while these solutions may interface with one another, they tend to lack the level of integration required to truly provide complete visibility. With the accelerating pace of change and the need to constantly innovate, it is more important than ever that chemicals companies take a more holistic approach to innovation and leverage applications designed for the end-to-end innovation process.

We can use the drivers identified in Figure 4 to draw a line between the need for applications to provide visibility, collaboration, and access to relevant data when conducting R&D. Figure 2 shows that bringing innovation to market varies in terms of time, success rate, and cost, depending on which category innovation is targeting. The timeline is drastically shorter when working with existing products and materials than when working with new products and materials.

This makes sense because there will be information related to existing product and processes that is not available for new products and materials, and therefore the potential to reduce time to market will be limited when working to develop innovative new products and materials. However, time to market is significant when chemicals companies are working to innovate and develop new products and materials, and therefore, the potential to leverage insight to accelerate the R&D process can certainly help achieve a more rapid time to market. To this point, applications that provide access to a wide range of historical and current data and visibility into the innovation process across the innovation ecosystem and enable effective collaboration can target various processes that contribute to the length of time it takes to innovate.

Leading solutions have delivered the following results for users:

- 30% reduction in errors and rework
- 35% reduction in review times
- 40% reduction in audit and report times
- 90% reduction in regulatory reporting cycle times
- 50% reduction in cycle times

Each of these measures plays a role in the speed at which innovation is brought to market, and therefore, such improvements support the effort to accelerate time to market. Given the highly competitive nature of the chemicals industry, bringing innovation to market faster can help create competitive advantage and drive revenue, market share capture, and cost reduction.

FUTURE OUTLOOK

Innovation remains a critical element in driving value in the chemicals industry. The understanding that by 2020, 40% of revenue must come from products developed in the past three years is driving chemical companies to develop an efficient and effective innovation strategy in order to meet the needs of an evolving market. To meet these needs, chemical companies must embrace the idea of a highly collaborative product innovation platform by which to leverage a broad range of knowledge and insight in the innovation process.

In the chemicals industry, the product innovation platform is becoming increasingly reliant on the ability to create a collaborative innovation process inclusive of inputs, outputs, process, and stakeholders. As chemical companies strive to "do more with less, faster," an interconnected innovation platform provides the necessary tools to accelerate the process of turning money into ideas (research) and turning ideas into money (development). Customer and market needs are critical components in this process because the objective of innovation is to improve products/materials for the customer or create new products/materials that meet market needs (see Table 1).

TABLE 1

Innovation Objective

Analysis Type	Objective	Business Benefit
Portfolio	Allocate resources	Less waste in R&D processes
Scenario	Mitigate risk	Early failure detection (RDQM curve)
Value	Optimize outcomes	More versatile formulations/higher revenue
Situational	Next best action	More high-margin, individualized customer sales

Source: IDC Manufacturing Insights, 2016

Collaborative innovation will be at the forefront of the next generation of innovative breakthroughs. As greater emphasis is placed on collaboration and visibility in the innovation process, chemical companies must focus on driving access to data across the innovation ecosystem. This effort will require that analytic tools reside within a common data repository, external resources are connected through a dedicated collaboration platform (perhaps a "science cloud"), and market demand signals are captured, communicated, and aligned with the innovation process.

Within this framework, the innovation platform provides internal stakeholders access to the vast amounts of historical and current data in order to leverage internal knowledge, conduct analytics, avoid the mistakes of the past, and align effort around organizational strategic objectives. The "science cloud" enables collaboration with the external science community to share insight and provide beneficial innovation opportunity across the innovation ecosystem. As a result of such an inclusive innovation process, the market will be rewarded with better products/materials, while the chemical companies will be rewarded with faster time to market, reduced costs, improved margins, and increased revenue.

ESSENTIAL GUIDANCE

The rapid pace of change in today's market is driving the need for innovation across all aspects of business in the chemicals industry. Downstream customers of the chemicals industry rely on chemical companies to deliver innovative materials that drive product performance and capabilities to meet the needs of an increasingly demanding and evolving market. In addition to delivering on the promise of innovative materials, chemical companies must look at innovating in terms of process while maintaining a focus on sustainability.

As chemical companies drive toward achieving the vitality imperative, 40% of revenue from products developed in the past three years, the importance of accelerating the innovation process and reducing risk in the innovation process becomes a key component of success. Effective and efficient innovation requires chemical companies to leverage a defined framework (such as RDQM) for identifying where to innovate, with decisions influenced by the potential for revenue growth, market share capture, and

profitability relative to innovation. To achieve the requisite level of insight to support these innovation objectives, chemical companies must maximize their ability to gain insight into information across the innovation ecosystem. To effectively maximize this ability, chemical companies must build out an innovation platform that can provide data access and visibility and enable collaboration across the innovation ecosystem.

Actions to Consider for Chemical Innovation

- Define an innovation strategy inclusive of an innovation road map aligned to deliver innovative product and process across the dimensions of time, product maturity, and customer segment.
- Create a culture of collaboration that cuts across functional silos to drive knowledge transfer across the organization.
- Extend collaboration to external partners including key customers, government, NGOs, and the educational research community.
- Invest in technology as a lever to deliver data access and visibility while enabling enhanced collaboration across the innovation ecosystem.
- Implement a strategy around an innovation platform to help accelerate innovation and manage risk in the innovation process.
- Leverage a collaboration application, designed for science innovation, to accelerate the innovation process while reducing risk and waste within the innovation process.

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