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From disruption to maturity:

The evolution of digital R&D in chemicals

Digitalization has had a substantial impact on many aspects of the chemical industry, helping companies collaborate across their value chains, increase productivity and create new channels to markets. Research and development (R&D) is no exception, as companies have turned to digital technology to help accelerate the creation of new higher value and higher margin products.

Some chemical companies are using technology to increase throughput in the development of molecules with advanced functionalities. Others are performing predictive simulations to optimize formulations for cost and performance. And yet others are mining data from past experiments to determine how to better allocate resources to maximize the efficiency of R&D teams.

Such practices have been used in the pharmaceutical industry for some time, but they were economically impractical for chemical companies due to smaller sample sizes and less repetition in lab work. However, advances in technology have been making large-scale computing relatively inexpensive, leading chemical companies to adopt digital R&D at a faster pace.

While those efforts have brought results, the challenge now is to move beyond the fragmented and one-off use of technology to the cross-functional and cross-value chain integration needed to bring the full potential of digital to life.

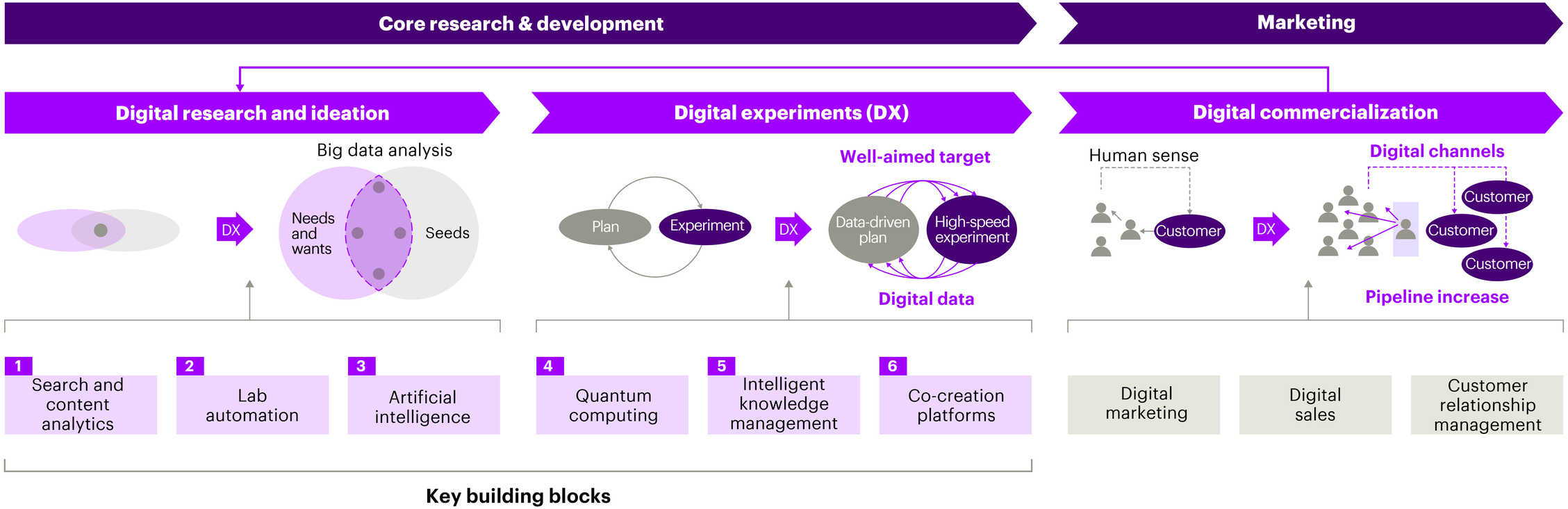
Six building blocks of digital R&D

Evolving technology means that chemical companies have a growing range of options to consider when applying digital tools in R&D. In our view, there are six technology “building blocks” that will likely be key to tomorrow’s R&D function.

1. Search and content analytics for deeper insights
2. Lab automation to increase productivity and data consistency
3. Artificial intelligence (AI) to accelerate product innovation and market expansion
4. Quantum computing to enable new forms of rapid, cost-effective analysis
5. Intelligent knowledge management for the efficient use of innovation-related information
6. Co-creation platforms to foster collaboration and integration

These six building blocks can be applied to the core R&D process that moves innovations from concepts to products ready for commercialization and marketing (see Figure 1). Together, they have the potential to help R&D—and the chemical company as a whole—reduce costs, increase margins, improve service and customer satisfaction and, ultimately, accelerate innovation. On the pages that follow, the six building blocks are discussed in greater detail.

Figure 1: R&D stage-gate process enabled by digital technology and integrated with digital marketing



Source: Accenture

1 Search and content analytics for deeper insights

Patent analysis is a vital step in qualifying possible innovations and building a healthy innovation funnel. By monitoring the patents coming from key academic groups and start-up companies, R&D departments can identify opportunities to collaborate on innovation. However, this monitoring process is often labor-intensive, involving a manual scanning process that typically requires highly qualified specialists, such as patent attorneys or researchers—making it an attractive area for automation.

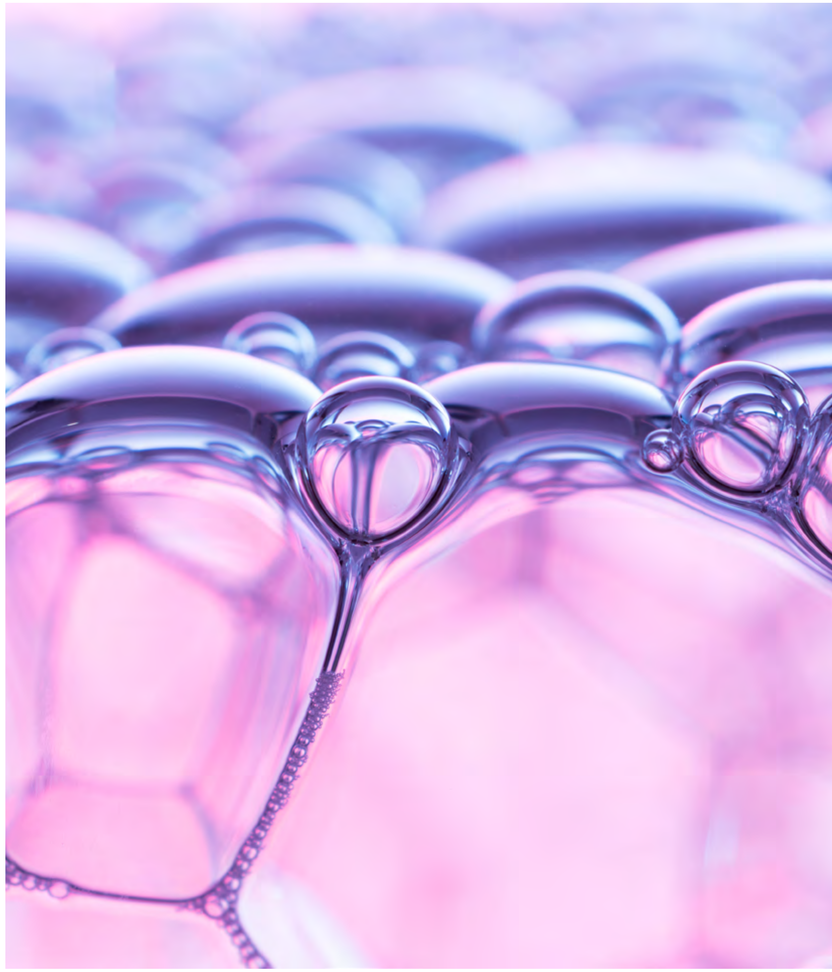
The automation of patent analysis can help increase efficiency and speed in uncovering innovations. For example, today's technologies enable automated processing based on intelligent semantic search algorithms—which considers context and intent in language—applied to internal and external sources of information. This type of automation can free up specialists to focus on higher-value tasks that require creativity and judgment.

Search and content analytics can be used to automate several aspects of the innovation process:

Portfolio analysis – assessing active patent portfolios to determine the strength of patents and the growth rate of filings

Technology analysis – evaluating concentrations, inventor demographics and quality of innovations

Trend analysis – identifying leading institutions, innovation trends and interconnected themes



2 Lab automation to increase productivity and data consistency

Lab automation has been widely used in the chemical industry for a number of years, particularly in synthesis, sampling and testing. Robotic aids, such as cobots designed to work alongside humans, can be set up and programmed with relative ease and flexibility, making them a low-cost and precise alternative for manual and repetitive tasks.

While chemical companies have made use of lab automation technology, it has usually been deployed in isolated, standalone situations, creating islands of automation within labs. This is useful, but it leaves significant value on the table. The real opportunity lies in linking systems to create end-to-end automated lab workflows, tied into the company's enterprise resource planning (ERP) system.

The potential benefits include:

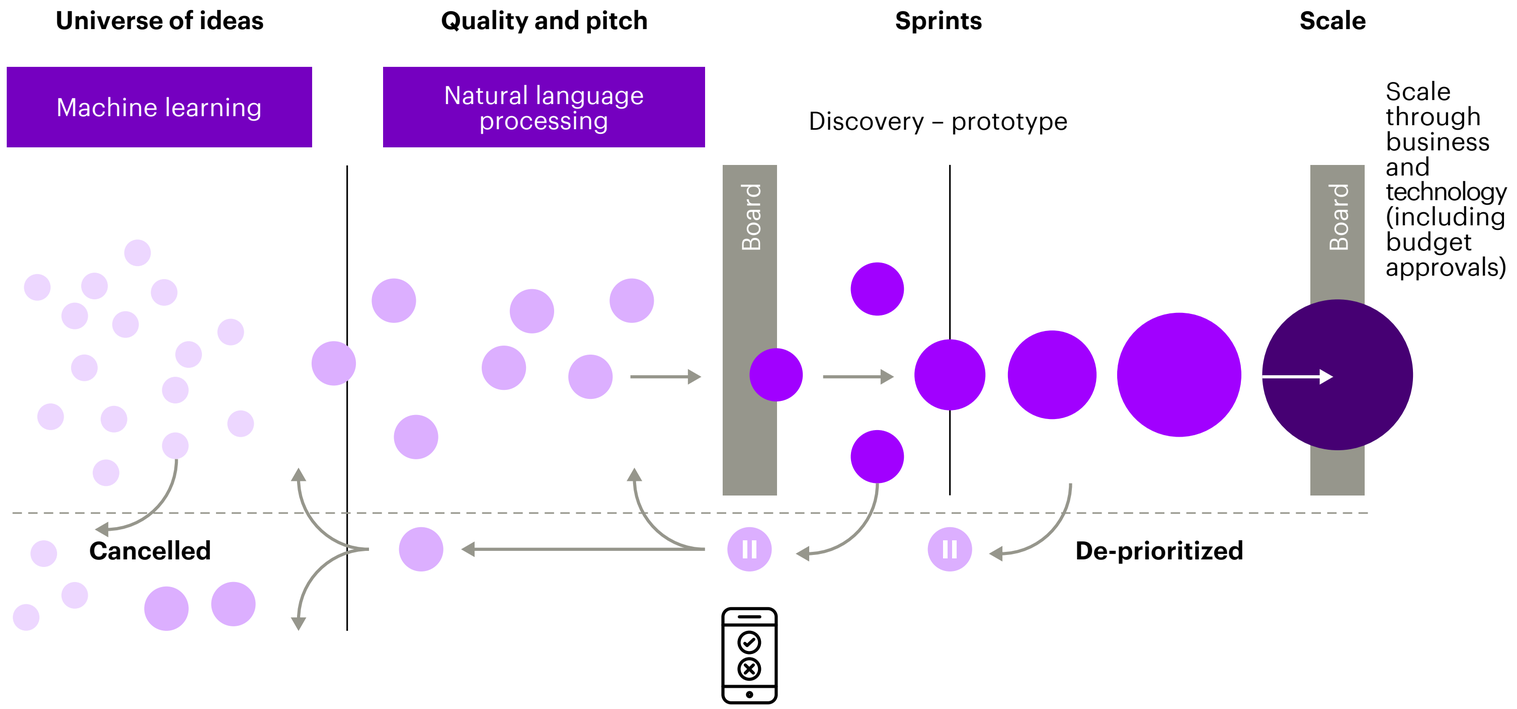
- Elimination of idle lab time through automated 24/7 testing
- Repeatable, consistent measurement procedures
- Immediate, accurate data logging, transfer and ingestion into the ERP system
- Seamless research design in Electronic Lab Notebooks and streamlined sharing of analyses and results among multidisciplinary teams
- Paperless tracking and tracing of samples
- More robust statistical insights because of the ability to test a higher number of samples
- Additional insights due to the ability to fully correlate all test data sets

These benefits can help reduce time-to-market and increase quality and reliability in the lab—and cut costs. Based on Accenture's experience, lab automation can lead to cost reductions of 10 to 25 percent, based on the automation of up to 50 percent of sample preparation and up to 80 percent of sample taking.

3 AI to accelerate product innovation and market expansion

AI can enhance the ideation funnel in a number of ways (see Figure 2). Machine learning, for example, can be used to quickly sort through large amounts of structured and unstructured information, significantly enlarging the universe of ideas that can be considered for further development. And natural language processing can be used to assess the quality of possible new materials and identify the most promising candidates for further development. These capabilities can significantly accelerate R&D and the delivery of new products to market.

Figure 2: AI in the innovation funnel



Source: Accenture

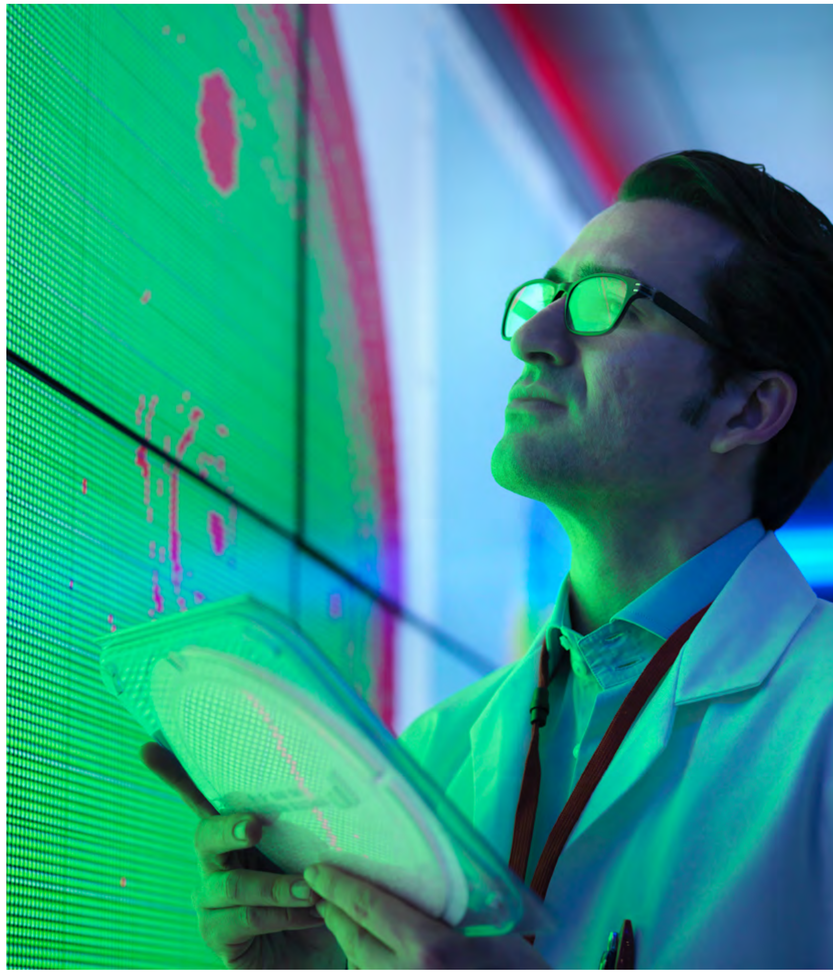
4 Quantum computing to enable new forms of rapid, cost-effective analysis

Quantum computing has the potential to completely revolutionize molecular comparison by enabling new methods of analyzing large molecules. Companies are currently able to compare millions of molecules on regular computers, but there are limitations on the molecule size that can be accurately compared on such devices. Quantum computers, on the other hand, work much differently than traditional computers and are able to quickly handle large, multifaceted computations. As a result, they can compare much larger and more complex molecules—a capability that promises to deliver competitive advantage in speed and cost.

While traditional methods only look at molecular trait matches, the quantum-enabled approach provides deeper contextual details of common traits between the compared molecules.

As a result, it is possible to see where, why and how molecule bonds matched, providing more detailed insights as well as the potential to expedite the discovery of new drugs.

Quantum computing is not yet in wide use, but it is advancing quickly. Accenture Labs has collaborated with a quantum software company to conduct quantum business experiments through newly available quantum hardware platforms and software application programming interfaces (APIs). With one pharmaceutical company, for example, this technology was used to improve the molecular comparison model, and comparatively weigh different molecular variables, providing a clear advantage over the traditional “black box” comparison model.



5 Intelligent knowledge management for the efficient use of innovation-related information

Knowledge management is essential to an effective workforce, including employees in R&D. Companies today often combine data repositories to break down information silos within an organization and support the sharing of information.

Chemical companies could enhance those approaches with AI-powered knowledge management solutions. These types of solutions can help address some of the key challenges of conventional knowledge management approaches, such as struggling to keep up with ever-expanding amounts of information, the significant amount of time needed to access and retrieve knowledge, and the difficulty involved in finding the specific knowledge that can help solve a given problem.

Intelligent knowledge management can improve the ability of those in R&D to efficiently capture, retain and leverage information, giving decision makers real-time access to critical knowledge needed to pursue innovations and deliver more business value.

6 Co-creation platforms to foster collaboration and integration

Customer-driven innovation has become a core business practice for many chemical companies, and the ability to collaborate with customers, and also with suppliers, is now vital to growth for many companies.

Innovation management platforms can enhance this process by integrating R&D and IT and connecting them with partners. These platforms can help companies tap into the knowledge and expertise of suppliers, startups and others, and provide access to a wide range of skills, technologies and data. This can support an agile innovation-incubation process and the completion of innovation projects more quickly, from the identification of new ideas to proofs of concept and deployment.

The digital R&D business case

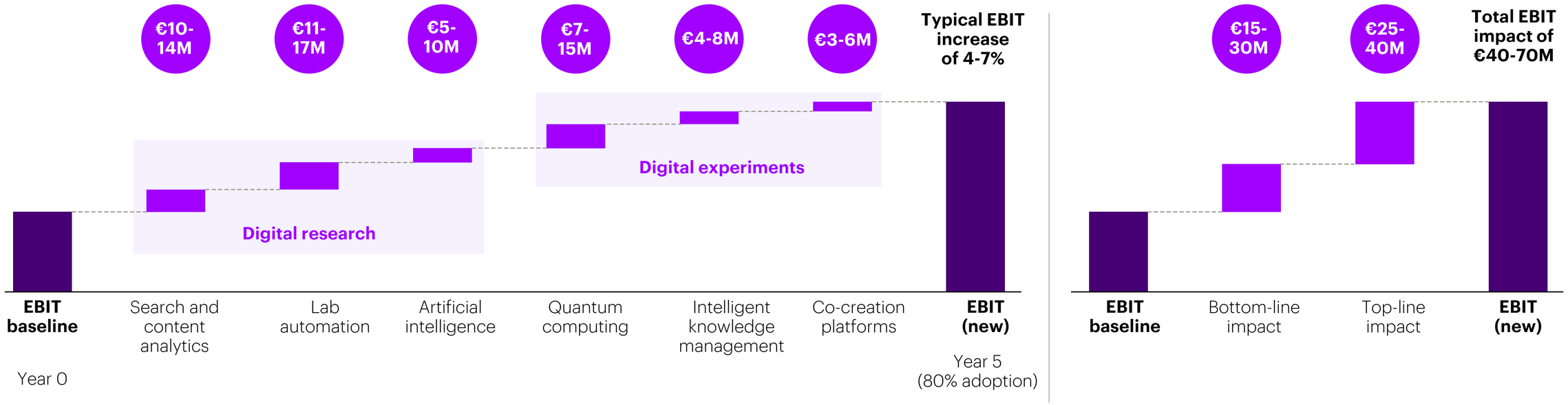
The increased use of digital technology in R&D can drive substantial economic value in several ways.

For example, an enhanced ability to access and analyze data makes it easier to assess the economic feasibility of a potential development and optimize the allocation of resources for projects, leading to increased success rates. Automating the preparation and execution of physical lab experiments can substantially speed up the idea-to-product process. And virtual “in silico” experimentation can make it possible to rapidly explore and test a wider range of innovations.

Using readily available digital approaches to R&D, Accenture found a typical €10 billion revenue company could potentially see an EBIT (earnings before interest and taxes) increase of €40 to €70 million through a combination of top-line and cost improvements (see Figure 3).

The effective digitalization of R&D does not come without challenges, however. Many companies have learned the hard way that the lack of a systematic approach can drive up costs and make it difficult to achieve the expected benefits. A successful digital transformation in R&D depends largely on planning and executing a multidimensional, well-structured effort.

Figure 3: Value potential from digital R&D



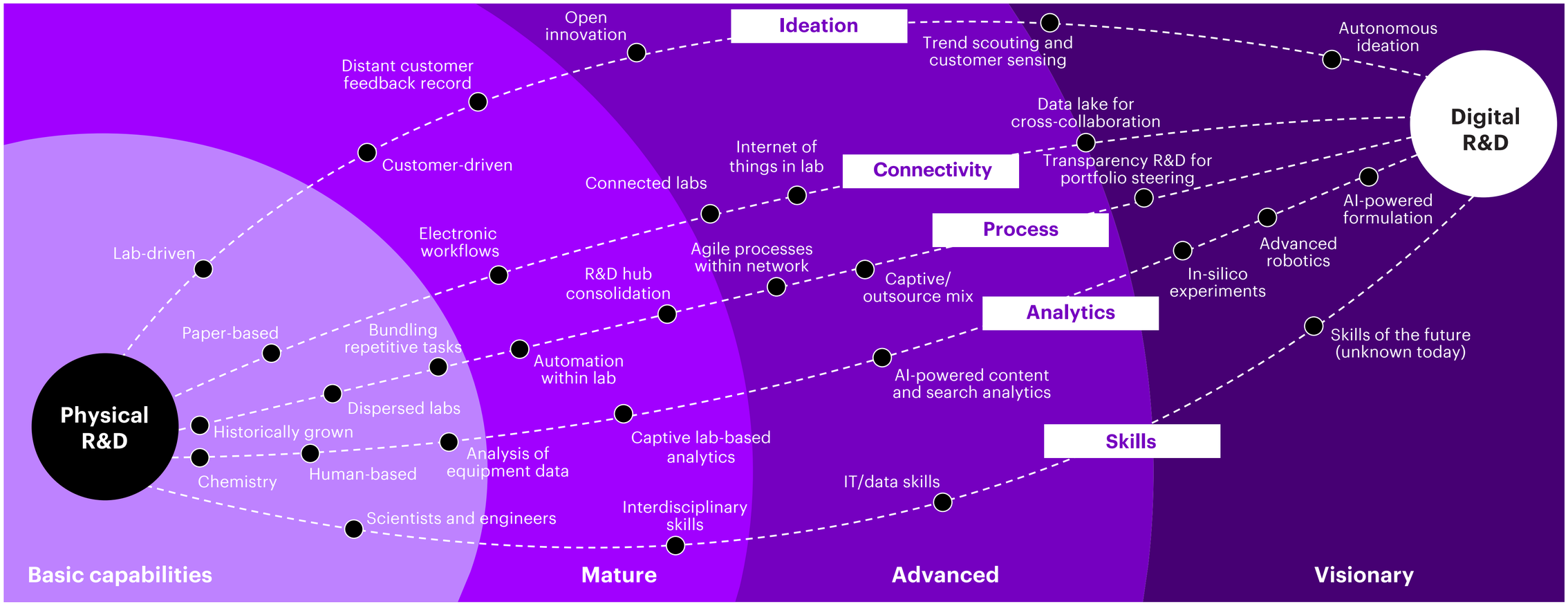
Note: Numbers do not add up due to rounding. Exemplary €10 B revenue chemical company with a 10% EBIT margin (€1,000 M EBIT baseline). 3% R&D costs as % of revenue.

Source: Accenture

Moving from physical to digital R&D

Taking R&D from its largely physical practices to full digitization requires a broad-based evolution that moves forward along several paths, including ideation, connectivity, process, analytics and skills (see Figure 4).

Figure 4: From physical to digital R&D



Source: Accenture

This evolution will not happen all at once, and it will involve multiple efforts. To get started, chemical companies should consider taking three important steps.

1

Create a vision and roadmap. This will help identify the main issues affecting R&D's performance and prioritize the digital technology use cases that can best address those issues. This effort should encompass the R&D function as a whole as the full potential of digital R&D will not be reached by addressing only one or two use cases.

2

Conceptualize and begin building a state-of-the-art data and technology platform. A fast-paced, high-impact rollout of digital technology in R&D requires several technology enablers, such as cloud infrastructure or data science. Companies may need to work with a broader range of external partners, such as software vendors, that can help them get a head start on these requirements.

3

Execute with agility. An integrated execution of the digital R&D strategy together with a company's IT functions requires value-oriented governance, embedded in an overarching digital strategy. From an organizational perspective, it will be important to identify required new capabilities in areas such as advanced analytics, software development and user-experience design.

Many chemical companies have brought some degree of digital technology to their R&D functions—but now, they have an opportunity to do more. The key will be understanding and taking advantage of the building blocks of digital R&D. At the same time, companies will need to move beyond the usual isolated, one-off approaches to digital technology in R&D. Instead, they will need to develop comprehensive plans for digital transformation that target an R&D function that is integrated, highly automated and AI-enabled—and able to move with greater speed and efficiency.

Companies will need to work on many fronts to make digital R&D a reality. But those that move forward will be rewarded with an entirely new level of R&D effectiveness, with the ability to pursue a vastly larger universe of ideas, significantly shorten time to market, reduce costs and remain competitive in an innovation-driven industry.

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