Digitalization is occurring across all manufacturing industries, and the coatings sector is no exception. The quantity of data that can be leveraged to improve all business activities—from new product development, to production to customer service—is increasing dramatically. The challenge is to determine where and how to apply technologies such as artificial intelligence (AI), machine learning (ML), and natural language processing (NLP) and how to make the data on hand relevant to the problem or question of interest. These questions and others were considered by members of the coatings value chain and their insights are presented at follow.

Sapunj, Cal Poly
We need to be asking three questions when it comes to data needs in our industry. What data do we have? What data do we need? And what questions are we trying to answer? A lot of valuable data already exists, but it is tied up in reports, published literature, or subject matter expert knowledge. The data is there, but not collected in a way that allows helpful artificial intelligence and machine learning projects to be performed. Understanding what type of data is needed for a particular project is the first step in identifying where that data might already exist. If it doesn’t exist, that’s where experimentation can help by filling in the gaps in the available data.

Every imaginable type of data is amenable to artificial intelligence and machine learning implementations. In the coatings industry, the most helpful data is likely going to include small molecule structure-property data, polymer synthesis procedures and outcomes, formulation recipes, formulation design space data, “time zero” performance data that is measured after formulation, production or product application, and—especially—service life data, so that predictions can be made about the useful longevity of the product. All of this is largely quantitative and structured and can be found in tables, spreadsheets, unstructured data in the form of textual internet information, literature, technical data sheets, and even online data serve as a vast additional source of possibly useful data. Here, the challenge lies in creating natural language processing tools so that algorithms can “read” those technical documents and extract useful information like a human.

Ramadan, AkzoNobel
Holistic digital transformation of any well-established industry requires progress in three areas:

1. Customer Experience: creating a customer experience that keeps customers coming back. Creating new ways to engage customers, delivering desirable products before customers know they want it.
3. Disruption: Often overlooked in digital transformation, creating new transformative business models from Big Data. Migrating business models to service-led, rather than transactional, but also creating new markets entirely.

A good example of a disruption project is our Marine Fouling Chalener database. Created to support port coatings—specification tools (like InterVar and InterVar Vision), it has value by providing Global Fouling Challenge maps to new customers, for example, in carrying out risk analysis assessments or providing up-to-date status reporting.

Sensors are likely to facilitate a lot of digital transformation, especially in the manufacturing sphere. Internet of Things (IoT) sensors create the possibility of digital twins of manufacturing sites, which allow decisions to be made in real-time to further embed Lean manufacturing.

Jen Le, Dow Coating Materials: At Dow Coating Materials, examining large Intellectual Property (IP) data sets along with advanced analytics and Market Research-related data is used to uncover many different types of information. Specifically, hidden patterns, unknown correlations, market trends, and customer preferences can help the business make informed decisions regarding where it can participate and whether it should participate within a given segment. Coating-related IP data is well suited for the deep insights that Big Data techniques can provide because it is global, high varied, and continually changing. Applying the results of the Big Data analysis is also used to derive the best business strategy for a given market segment.

Michael, Covestro
Covestro is leveraging data related to decades of information—laboratory results, testing, customer trends, orders, and projects—we’ve completed for customers. All this information is in a data pool that is available to us. There is a very high volume of information, and we are determining how best to utilize the wealth of data to help inform our growth strategy, our sustainability efforts, and so much more.

Hahn, Evonik Industries: In the end, it is all about information that acknowledges customer needs. What is new is the inclusion of unstructured data and the smart combination with existing application-related structured data including those from high-throughput experimentation. This new approach will, for example, allow for a better derivation of formulation suggestions based on machine learning rather than solely from experiment. No, leveraging data will ultimately help us shorten development times.

What are other applications for Big Data in the coatings industry besides new product development?

Hahn, Evonik Industries: First of all, data thinking in the coatings industry should not be limited to Big Data. The intelligent use of data is more important than the absolute amount of data. Potential use cases can focus on

- Customer insights: Understanding customer behaviors, preferences, and needs to improve customer experience and loyalty.
- Supply chain management: Optimizing supply chain efficiency, reducing costs, and increasing sustainability by leveraging real-time data on inventory, transport, and logistics.
- Product development: Accelerating the product development process by analyzing market trends, consumer feedback, and competitor activities.
- Environmental sustainability: Monitoring and mitigating environmental impact through data-driven insights on resource consumption, waste management, and carbon footprint.

In summary, Big Data offers transformative opportunities in various aspects of the coatings industry, enabling informed decision-making, improved operational efficiencies, and innovative product offerings to meet the evolving needs of customers.
Leveraging Big Data, Artificial Intelligence, and Machine Learning in the Coatings Industry

By Cynthia Chandler, Contributing Writer

Digitalization is occurring across all manufacturing industries, and the coatings sector is no exception. The quantity of data that can be leveraged to improve business activities—from new product development to production to customer service—is increasing dramatically. The challenge is to determine when and how to apply technologies such as artificial intelligence (AI), machine learning (ML), and natural language processing (NLP) and how to make the data on hand relevant to the problem or question of interest. These questions and others were considered by members of the coatings value chain and their insights are presented as follows.

Supper, Carl Poley: We need to be asking three questions when it comes to data needs in our industry. What data do we have? What data do we need? And what questions are we trying to answer? A lot of valuable data already exists, but it is tied up in reports, published literature, or subject matter expertise. The data is there, but not collected in a way that allows helpful artificial intelligence and machine learning projects to be performed. Understanding what type of data is needed for a particular project is the first step in identifying where that data might already exist. If it doesn’t exist, that’s when experimentation can help by filling in the gaps in the available data.

Every imaginable data type is amenable to artificial intelligence and machine learning applications. In the coatings industry, the most helpful data is likely going to include small molecule structure-property data, polymer synthesis procedures and outcomes, formulation recipes, formulation design space data, “time-zero” performance data that is measured after synthesis, formulation, or product application—and—especially—service life data, so that predictions can be made about the useful longevity of the product. All of this is largely quantitative and structured data found in tables and spreadsheets. Unstructured data in the form of textual internal and external literature, technical data sheets, and even online data serve as a vast additional source of possibly useful data. Here, the challenge lies in creating natural language processing tools so that algorithms can “read” those technical documents and extract useful information like a human.

Ramadan, AksoyNobel: Holistic digital transformation of any well-established industry requires progress in three areas:

- **Customer Experience:** Creating a customer experience that keeps customers coming back. Creating new ways to engage customers, delivering desirable products before customers know they want it.
- **Manufacturing Excellence:** Using data to further embed the principles of Lean manufacturing. Predictive maintenance reduces downtime—and optimizes manufacturing schedules.
- **Disruption:** Often overlooked in digital transformation, creating new transformative business models from Big Data. Migrating business models to service-leads, rather than transactional, but also creating new markets entirely.

A good example of a Disruption project is our Marine Foiling Challenge database. Created to support our coatings specification tools (like Interstrat and Interstrat Vision), it has value by providing Global Foiling Challenge maps to new customers, for example, in carrying out risk analysis assessments or providing up-to-date status reporting.

Sensors are likely to facilitate a lot of digital transformation, especially in the manufacturing environment. Internet of Things (IoT) sensors create the possibility of digital twins of manufacturing sites, which allow decisions to be made in real-time to further embed Lean manufacturing.

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**What are other applications for Big Data in the coatings industry besides new product development?**

**Hahn, Evonik Industries:** First of all, data thinking in the coatings industry should not be limited to Big Data. The intelligent use of data is more than a matter of Smart Data. Potential use cases can be found in almost every part of a coatings company—such as customer development, R&D project management, production, sales, and logistics.
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be found for any business process—from the utilization of the information flow within the supply chain network to improving the accuracy of sales forecasts to enabling effective production planning.

Ramdev, Atul/Nobels. Potential applications for AI are wide-ranging in our industry—from in-field performance predictions to coatings that tell us what owners when they need attention.

Big Data allows us to answer many questions that, up to this point, have been impossible to address. Data frequency, as well as the range of data sources, allows us to track, and affect many more elements in our manufacturing, customer experience, and new markets than ever before.

The crucial applications for Big Data will be in creating new knowledge and insights, including innovation, using data as a tool. Data, in itself, has no value, but the value lies in how it is used to gain insight, or to drive a change for the better, is where Big Data, AI, and ML will have the largest impact.

There are already tools built on Big Data and AI in our industry—for example, FCA's and Ansys' data-driven design tool, which provides a full overview of the impact of marine vessel deciding to ensure that every customer can make fully informed decisions.

It is crucial that the problems we tackle with data are real, and that data is viewed as a tool to help us design solutions to renewable energy.

Richards, Covestro Digitalization makes it easier and faster to collaborate within our company, allowing us to develop new solutions and increase efficiencies.

Schwabacher, Battelle. By integrating the machines, we can optimize the flow of data and increase productivity.

Seppen, Cal Poly. Artificial Intelligence and machine learning implementations are providing an effective tool for complex problems.

Schwabacher, Battelle. By training models on large amounts of data, we can make better predictions and improve our decisions.

Richards, Covestro. There are nearly countless ways the coatings value chains can benefit from AI and ML, but here is one example—the end-to-end supply chain, from the purchase of raw materials to the final product.

Seppen, Cal Poly. Service life prediction methods can be improved with the development of large data sets of coating performance over time, especially if driven by sensors and IoT collection methods.

Studwell, Dow Coating Materials. Dow has developed collection, validation, analysis, and visualization methodologies that unlock insights from business-relevant internal and external data sources. While Dow does not sell direct to customers, we have found it valuable to mine social media to gauge consumer sentiment on our customers' products. Armed with those insights, Dow has been able to target alternative coating techniques and improvements to our customers that benefit the end consumer.

Studwell, Dow Coating Materials. Leveraging Big Data in combination with machine learning has the potential to find hidden relationship patterns within big data that normally would not have been found and haven't really been studied before. This type of information can be used to improve many different business activities, including innovation efforts. For instance, it may be used to estimate potential product failures—tease out relationships or effects that aren't yet understood. In the process environment, we are using these tools to gain insight and optimize processes, including production testing.

Studwell, Dow Coating Materials. This technology helps us understand the quality of our products and how they perform in real-world applications. By combining this information with real-time monitoring, we can track the health of our products and make adjustments as needed.

Hahn, EnviroInk Industries. We have always worked closely with our customers to develop products that meet their needs and exceed their expectations. In the case of digital inks, we work with Inkjet Design to provide solutions that meet the needs of our customers.

Millhorn, Dow Coating Materials. The emulsion network generates data at a higher rate than ever before, which can be overwhelming. We need to find ways to make sense of this data and turn it into actionable insights to improve our products and processes.

Risseeuw, Battelle. Data quality and quantity are probably going to be big challenges. Many companies may have data sets with one or two hundred data points for trial formulations, but that doesn't qualify as Big Data and is usually insufficient for effective use of AI and ML. What we need are systematic solutions that enable leveraging of limited data.

A separate issue is the misapplication of these advanced tools in the hands of students that lack proper training. It is still an issue today with those early adopters of AI-like technology. For example, ChatBots are already used in a variety of industries to provide information and guidance in an easy and simple manner to customers. Again, this type of solution does not replace human need; it reduces human effort on the simple tasks, and raises questions and failures that need answering.
be found for any business process—from the utilization of the information flow within the supply chain network to improving the accuracy of sales forecasts enabling effective production planning.

Ramadesi, Akinbode: Potential applications for Big Data are widespread—ranging from our industry—from in-field performance predictions to coatings that tell the asset owners when they need to attend.

Big Data allows us to answer many questions that, up to this point, have been impossible to address. Data frequency, as well as the range of data sources, allows us to track and affect many more elements in our manufacturing, customer experience, and new markets than ever before.

The crucial applications for Big Data will come from application of existing knowledge and thinking, including innovation, using data as a tool. Data itself has no value unless data and insights can be generated from that data to gain insight, or to drive a change for the better, is where Big Data, AI, and ML will have the largest impact.

There are already tools built on Big Data and AI in our industry—such as the Internet of Things (IoT) and Artificial Intelligence (AI). These tools provide a full overview of the impact of marine vessel decision making to ensure that coating customers can make fully informed decisions.

It is crucial that the problems we tackle with data are real, and that data is viewed as a tool to help us design solutions to satisfy them.

Richards, Covestro: Digitalization makes it easier and faster to collaborate within our company, all along the value chain. New top objectives related to digitalization are enhancing the customer experience. This summer we launched our data center in Charlotte, North Carolina, which is a central place our customers can visit to look for case studies, hands-on experience with our data, and other information.

The amount of information is exhaustive. While much of it was available before, we focused on packaging it so that it can be used more effectively. Data overload is something we can relate to, in our personal and professional lives; the trick is finding the data that is most meaningful for you. As Covestro, we’ve also developed a digital tool to help our customers streamline product selection. Using this tool, customers can select the properties they are looking for. Based on these inputs, we can efficiently determine the optimal formulation for achieving the desired coating performance.

Saggy, CalPoly: There are nearly countless ways the coatings value chain can benefit from AI and ML. But here we highlight one example—end-to-end supply chain, from the purchase of raw materials to the final coating on your doorstep. Today, there is an opportunity to leverage technology to provide greater insight and make the process more efficient and automatic. In the consumer world, when you order an item on your phone, you can track it until it arrives at your doorstep. Of course, there are challenges unique to the purchase of chemicals and coatings, and it must be done safely and compliently, but there is an opportunity to unlock insights that weren’t being done so. We’ll open the door to utilizing that information to plan ahead and communicate with the supply chain about the resources that are needed each step of the way, so that the entire process is as safe and efficient as possible.

Kettleshon, Dow Coating Materials: This year we are showcasing approximately 7,000 shipments per day globally and has the largest privately owned railcar fleet in North America. This year, Dow implemented real-time tracking and delivery predictions for customers—helping to provide real-time feedback to our customers about their orders through Yardscout. The technology uses real-time data from the largest GPS, ETL, and telematics network and combines that with predictive analytics to provide customers with the status of their order. Today’s world, customers expect real-time information and the ability to track their shipments. This solution leverages data and focuses on exceptions rather than monitor every load, set up customized alerts, or respond quickly to inquiries.

Hahn, Evonik: Digitalization is changing the way we work, and we’re working together on the development of digital offers, services, and solutions at an early stage. In other words, the digitalization of data and services is an evolution of how we interact and communicate. The new solutions will work alongside us to help us make decisions with more insight, not remove decisions from us.

Millano, Dow Coating Materials: The emulsion network generates large amounts of discrete and continuous data during batch operations. The Data Cube project in our plants gathers process inputs into a central database to compare current production with historic trends, which enables our engineers to perform troubleshooting faster and more effectively.

Rassey, Battelle: Data quality and quantity are probably going to be big challenges. Many companies may have data sets with one to two hundred data points for trial formulations. That doesn’t qualify as Big Data and is really insufficient for effective use of AI and ML, which typically rely thousands or millions of data points. There is a need to develop intermediate solutions that enable leveraging of limited data. A separate issue is the misapplication of some of the advanced tools in the hands of novices that lack proper training. It is still an issue today with those
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Over a fully automated paint (Toronto) testing system, the time to test an optimum formulation is reduced. Over 100 formulations can be tested within 24 hours at this Toronto facility.

technologies that many people do not yet really understand how to use them properly. Misapplication generally leads to poor results, which then raises questions about the efficacy of these types of projects.

Schuster, Jetteppe: Getting these millions of points of data in coatings and the broader materials industry is difficult to do, largely because companies need to adopt new manufacturing processes and are, therefore, unwilling in general to share this type of information. These classes can generally be avoided if, for example, there is an instrument producing a stream of data regarding a specific aspect of a material’s structure, perhaps a sensor providing a continuous stream of data on the manufacturing or formulation. But trying to solve problems using independent, orthogonal data points will generally not yield information from data in many different sources cannot be aggregated.

On the flip side, there is also the potential of having lots of data, but not the right types of data for a given problem. For many AI/ML models, data sources are being used that have never been relied upon before. These inputs must be selected very carefully, because if the data is not relevant to the problem, then it won’t enable the development of effective models. In addition, models are often as good as the data and assumptions used to define the framework of the quality or scale of data used to train a model, if the assumptions built into the models are not valid, then the model will provide misleading results and have potentially unfavorable behavior.

Romden, AkzoNobel: We see three major challenges in the coatings industry to implement AI/ML solutions: Leveraging Big Data: • Upskilling the existing workforce • Creating and attracting new talent • Centrality of data • The availability of easy-to-use tools to exploit data • Upskilling our workforce is where large and rapid gains in data utilization can take place. Our industry has a wealth of knowledge, experience, and skill—all in a technical sense and a business in general. Upskilling our existing workforce and educating these data techniques and tools in a way that aligns with our business unit, forming such teams is just one aspect of what we’re taking to get people through the organization up to speed on the latest technologies.

Another challenge is avoiding data overload... efficiently passing through the sheer volume of information we have in order to find the data that is critical to the task at hand. It’s important to have one point of chal- lenge and if not addressed, can be counterproductive, limiting our ability to be more nimble and better informed.

Kratz, Pew Coating Materials: Successfully implementing and adopting artificial intelligence, machine learning, and Big Data requires new organizational capabilities and a significant culture change—it is a true transformation. Fortunately, initial consensus over job losses seems to be waning, and there is a new perspective that AI, ML, and Big Data will make everyone’s job more interesting.

Bahn, Swissvertex: It always is not about a single grand challenge, but moves the sum of small challenges, complexity, viability, consistency, timeliness, and accuracy of data, among others. The key is that this can be overcome by adequate training and by putting in dedicated service providers. In this context, IP concerns have to be taken into account. A clear distinction of the knowledge (coatings versus algorithms) could help to address those. Just but a bit, leveraging AI, ML, and Big Data is a matter of change management, too.

Sapra, CalPoly: Often times, early AI and ML projects must be bootstrapped along with some experimental and product development workflows. This means that the problem being solved is part of the project, but also tends to make the project highly visible within an organization. The high level of visibility may not be appropriate given the amount of risk and learning involved and also stressful and time consuming across both the experimental and analytical sides of a project.

In conclusion, there is often a challenge organizationally in creating machine learning or data-driven workflows, which largely involves changing the culture around keeping experimental data. Chemists must properly document and record all experimental data, even for poorly performing materials, so that models can learn and evolve alongside traditional empirical experimentation cycles.

Regarding implementation, there is a real need at such organizations for experi- mented early wins in applying these tools, so that management and product development teams buy into the methods and beyond that. The popular science story cycle might suggest. Across our industry as a whole, there is a real need to identify progressive research opportunities for industry to work on together, such as the development and publication of standard coating formulations and associated data sets. Standardized coatings and standard service life data. Each data set must include fully characterized material information in order to be truly used. Tradenames and qualitative descriptors like "SE epoxy" or "PMDS" will work for many models that can use categorical inputs, but highly granular structural chemical data is needed to extract any widespread change in model development and adoption across the industry.

Large, these challenges are being overcome thanks to the intrinsic motivation of research chemists and directors who have felt inefficiencies in their own material discovery processes. Despite the hype around the tools, successful implementation seems to be a work in progress. They are establishing working groups and putting in place the necessary network to connect data and best practices.

Rumwerp, AkzoNobel: At AkzoNobel, we’ve been making paints and coatings long enough to have steeped pushing the boundaries of technology. Our passion for paint and innovation has been part of our story. That’s why we believe excellence in technology is critical to our company and our customers. We believe in taking innovation beyond expectation and imagination. To make a serious and lasting impact, we’re building a comprehensive, end-to-end approach across the organization. We’re focused on delivering solutions that our own companies have a wealth of, even if they are not necessarily prepared for a data analysis. Data extraction from historical data is a good place to begin if you have a problem in mind and need relevant data.

Companies need to take a brave and bold approach to incorporating AI and ML practices within their current R&D portfolios. Don’t hire data scientists or chemists (although they are key), but also encourage your scientists, chemists, formulators, and engineers to begin getting comfortable with data-driven workflows. It’s essentially a rewiring of culture, but one that reports data, all data, good and bad, throughout the year, as opposed to haphazard project reports delivered at the end of the calendar year.

Weerdm, Pew Coating Materials: We are evaluating our business as developing our enterprise capabilities and building the necessary infrastructure to focusing on customer insights and exploring external partners. AI, ML, and Big Data are widely used in our business strategy, and it is important that teams work together with the organization, the group, and the supply chain. In addition, we have been building the capabilities of our network to share learnings and best practices.
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In a field of constant innovation, the ability to harness and analyze data is crucial. The coatings industry, like many others, is increasingly relying on artificial intelligence (AI), machine learning, and big data to improve efficiency, accuracy, and sustainability. This integration allows for more data-driven decision-making and the ability to forecast trends and challenges before they become critical.

Technologies such as machine learning enable predictive maintenance, reducing downtime and improving overall productivity. AI can help in the early detection of coating defects, allowing for timely repairs and preventing costly stoppages. Big data analytics can provide insights into consumer preferences and market trends, guiding product development and marketing strategies.

A holistic approach to leveraging these technologies involves capturing data at every stage of the coating process—production, application, and monitoring. By integrating AI and machine learning, companies can automate and optimize processes, reducing waste and improving yield.

Moreover, the integration of these technologies can enhance sustainability. For example, AI can be used to optimize energy consumption in manufacturing processes, reducing the carbon footprint. Machine learning can also predict maintenance needs, minimizing the use of raw materials and reducing waste.

As the field continues to evolve, it is crucial for companies to consider the ethical implications of using AI and big data. Ensuring data privacy and security is paramount, and the industry must be transparent in how it uses data to respect customer confidentiality.

In conclusion, the future of the coatings industry lies in the intersection of art and science, where technological advancements meet consumer needs and environmental considerations. By embracing AI, machine learning, and big data, the coatings industry positions itself for innovation and sustainability in the decades to come.
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Hahn, Evonik Industries: Our strategy is also our mission: we want to break down data thinking and data-based acting to the level of all strategic business units and functional units and even more importantly, take all employees along with us in this journey. In doing so, it is clear that digital also means entering into new collaborations and partnerships, for example with technology companies such as IBM or Alibaha, and also with young digital companies and startups via our investment in the Digital Growth Fund I managed by the growth investor Digital Partners. We have also established a dedicated Cognitive Solutions team within Evonik Digital to tackle complex and challenging problems.

A recent example of connecting people, data, and processes is COATINO®—a voice-controlled, multi-channel platform enabling Evonik Additives customers fast and easy access to innovative and sustainable solutions. This digital laboratory assistant is designed to reduce labor-intensive searches in the coatings industry. Evonik has equipped COATINO in technical knowledge and specialized expertise, enabling it to process impressive, expert responses to even complicated questions in the areas of coatings. The prototype was developed in close collaboration with European partners, and we aim to make the digital lab assistant available to the industry as early as 2020.

Richards, Consestra: Leveraging AI, ML, and Big Data is being discussed at the highest level of the organization, and we see it as a core part of the product—IT-related. It permeates all levels of our organization. In fact, I’d say it’s becoming a framework to everything we do, and the strategy and effort we’re putting behind digitalization is in the same level of traction as any other IT-related thing. It’s just that important. As such, we’re looking at our current organizations to ensure that we are able to leverage these technologies where it makes sense. As an example, we are working with a university professor who is focused on ML-related tools that can be used to develop new polymers.

Schroeter, Rottello: Because we are consulting for a variety of clients, we are focused on tailoring the application to each problem or in some cases, the application to familiar clients.

Sapper, Cal Poly: At Cal Poly, we are building natural language processing tools that can read and extract chemical information from textual documents, including patents, scientific journal articles, and technical data sheets available online. We are also developing computational algorithms that can automatically discover novel polymers and coatings formulations given a desired set of properties and constraints. We are making integration tools so that these new models may be appropriately coupled to new models of experimentation, especially in the areas of boundaryless design spaces, flow polymerization, and autonomous synthesis and formulation. These tools will ultimately enable quicker design and discovery of materials with high performance characteristics.

Richardson, Consestra: More and more, the coatings industry will come to the realization that the R&D budget needs to be focused on the crucial areas of the business. As we think about the core growth areas for the company, we need to be able to find solutions to new problems and create new business. It’s a journey that we’re on right now. We’re looking at a variety of areas, such as digitalization of the business, looking at new ways to do business, new ways to serve our customers, how we can leverage technology to advance our industry and better serve our customers.

Hahn, Evonik Industries: Currently, we have a large number of data-driven businesses—often with a clear focus on end consumer data. When it comes to products, general and the coatings industry in particular, I have the impression that fixing the basics, i.e., making data fit for its intended use, is more topical. So, we are working on the question of whether analytics, in particular, is a good tool to optimize the decision-making process, where the general, the analytics, and the knowledge are already being embedded in some industrial applications.

Overall, technology and data science will become more prevalent globally, and the industries that embrace AI, ML, and Big Data as tools to help manufacturing, satisfy customers, and create new business models, will flourish.

Eckersley, Dow Coating Materials: Heritage material companies will continue to address the challenge of transforming the way they do business.

In many cases, they have already built expert systems and now have to transition them to incorporate AI, ML, and Big Data. Companies will also be building new employee skill sets; today, everyone needs composite skills—factual, fundamental work combined with the ability to work with big data, AI, and ML. In other words, marketing is transitioning to Digital Marketing and R&D is transitioning to Digital R&D. That is because at their core, AI, ML, and Big Data are helping people do work better and more quickly, reducing non-value-added, repetitive tasks, and freeing up time for more value-added activities.

The advent of Big Data, AI, and ML represents the 4th Industrial Revolution. With these new capabilities, it becomes possible to find new solutions to unsolved problems and create a better world. It’s a journey that we’re on right now. As we’re doing this, we’re creating new careers, new innovation, and efforts and enjoyable customer experiences.

Sapper, Cal Poly: We are in early days of understanding the possibilities as far as machine learning and automation in our industry goes. We are just coming to terms with the notion of taking statisti
cal, designed experiment approaches to synthesis and formulation. Similarly, the ideas of combining our high-throughput experimentation, and roboticized materials science are just now becoming commonplace with certain organizations. As we get used to these methods, we will naturally begin to discover efficiencies in our culture, including design space constraints and the problem of material enumeration,
coupled with a large and fast influx of expert systems that is a new challenge to many researchers and engineers.

When this happens, data will become too large to easily handle using the traditional tools of paper notebooks, spreadsheets, and fitted trendline models. At the same time, material requirements will become more demanding, along with shorter expected development and turnaround times. Material interactions in complex formulation systems will be too complex to model using previous, regression-based approaches. At this point, researchers will understand that data-centric approaches to material generation, experimentation, and exploration are needed.

It will be slow going at first, as these methods must run in parallel with existing experimental approaches. Ultimately, though, within the next decade, I would say the data workflows and the ability to design or propose new materials and formulations with a high degree of fidelity in virtual settings will surpass our ability to quickly discover these formulations in the lab using pure empirical methods. At this point, lab experimentation will be highly automated, and much of the day-to-day synthesis of material will fall in the domain of experimental design and model building, by data scientists, and for data scientists.

Ultimately, the impact of artificial intelligence learning in the coatings industry will be our industry will be large and unavoidable. The job of a bench chemist will disappear since they won’t be able to find solutions to unsolved problems and create a better world. It’s a journey that we’re on right now. We’re looking at a variety of areas, such as digitalization of the business, looking at new ways to do business, new ways to serve our customers, how we can leverage technology to advance our industry and better serve our customers.
Leveraging Big Data, Artificial Intelligence, and Machine Learning in the Coatings Industry

Hahn, Evonik Industries: Our strategy is also our mission: we want to break down data and think and data-based acting on the level of all strategic business units and functional units and even more importantly, take all employees along with us on this journey. In the age of digitalization also means entering into new collaborations and partnerships, for example with technology companies such as IBM or Aliaba, and also with young digital companies and startups via our investment in the Digital Growth Fund I managed by the growth investor Digital+ Partners. We have also established a dedicated Cognitive Solutions team within Evonik Digital to tackle the challenges and projects driven by AI and ML.

A recent example is our project of connecting people, data, and processes in the COATING+® - a voice-controlled, multi-channel platform enabling Evonik Additives customers fast and easy access to innovative and sustainable solutions. This digital laboratory assistant is designed to reduce labor-intensive searches in the coatings industry. Evonik has equipped COATING+ with technical knowledge and specialized expertise, enabling it to provide impressive expert responses to even complex questions in the area of coatings. The prototype was developed in close collaboration with European partners, and we aim to make the digital lab assistant available to the industry as early as 2020.

Scheeber, Rattelle: At Battelle, we view the use of Big Data, AI, and ML as tools that are an important part of the toolset we have to help our customers solve their most pressing problems. For us, big data is not just a technological development but a fundamental shift in the way we think about and work with our clients.

Richards, Covestro: More and more, the coatings industry will come to the realization that the B2B digital experience is something that is important for our customers and our partners, the whole mindset has changed and it is being shaped by the R&D experience. Our clients will be more demanding and we need to be able to meet these expectations with the same level of precision and service. We see a shift toward a more proactive and customer-centered approach.

Kocher, Dew Coating Materials: Heritage material companies will continue to invest in the development of new and innovative solutions. These solutions will be designed to meet the needs of the market and to meet the expectations of our customers.

Hahn, Evonik Industries: Currently, we are working on developing new data-based business models – often with a clear focus on end consumer data. When it comes to end consumer data, the general and the coatings industry in particular, I have the impression that fixing the basics, i.e., making data fit for its intended use, is more the topic we are struggling with. The technologies that are beyond a certain maturity, though, we will resolve in the near future. The challenge will be to make the coatings industrydata available and usable for other industries.

Sapper, Cal Poly: At Cal Poly, we are building natural language processing tools that can read and extract chemical information from textual documents, including patents, scientific journal articles, and technical data sheets available online. We are also developing evolutionary algorithms that can automatically discover novel polymers and coatings formulations given a desired set of physical and chemical properties set by AI and ML.

Benaden, AkzoNobel: In the future, the coatings industry will further embrace Big Data and digital transformation. Data will form the cornerstone of how products are developed, manufactured, and sold. This development isn’t a threat to our industry; rather, it is an opportunity to use data to get even better at doing what we do. In the next five years, Big Data, ML, and AI will be assisting us to do our jobs more efficiently than ever before. Automation is key and the future is bright.

Robotization will continue to impact the manufacture, application, inspection of coatings, radically changing the amount of people exposed to dangerous environments, and increasingly able to change the core of the production process. Lean manufacturing efficiencies.

In the future, we think that the coatings industry will also begin to make inroads in our industry. New business models will be offered to the consumer in a way that is more seamless and efficient. We will be able to offer more personalized and customized products.

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