Paint and Coatings Technologies to Watch for in 2021

By Cathia Challier, CoatingsTech Contributing Writer

The year 2020 has been challenging, to say the least. It will also be memorable not just due to the tragedy and hardship resulting from the COVID-19 pandemic, but also for the way people collaborated to develop innovative solutions despite the inability to travel and limited resources.

CoatingsTech was the beneficiary of many innovative collaborations. As well as contributors from industry and government research groups, the authors were asked to share their thoughts, which are presented below.

What are the most important paint and coating research areas that you and your colleagues are working in today?

Corrigan, ChemQuest Technology Institute: There are five leading areas being targeted by the paint and coating industry today.

- Increased use of biobased/biorenewable materials and materials derived from post-consumer, food waste.
- Increasing comfortablness with using nano-materials due to dispersion issues being solved.
- New technologies for haptics, scratch resistance, and self-healing.
- New technologies for antimicrobial performance (antibacterial, antivi-
- Quantum leaps in corrosion performance.

Provider, Polymers & Coatings Consultants: “Smart coatings” (coatings that have other functions in addition to protecting and decorating surfaces) are of particular interest today. Examples include rhein Williams’ “Paint Shield,” which is an antibacterial coating. Self-healing coatings is another area being worked on. I also expect artificial intelligence to be applied to formulation development and to paint manufacturing. More effective application of nanotechnology to coatings is another area of focus.

Pichler, The ChemQuest Group: In all major coatings segments—architectural, industrial, and special—there is a focus on maintaining or improving all the physical and performance properties of traditional waterborne and solventborne systems while continuing to decrease VOCs. This is the case whether the goal is to replace a solventborne automotive OEM color coat with a waterborne OEM color coat or to lower the VOC content in an interior latex house paint from 50 g/l to 10 g/l. There is also significant focus on the development of biosourced materials for raw materials and finished products.

Rosano, BASF: Environmentally friendly raw materials, labor savings, and performance are key areas in which we continually focus our innovation efforts.

Dettlaff, Eastman: We see demands driven by global consumer macro-trends, such as health and wellness, a growing middle class, and resources sustainability manifesting as regulatory and consumer need drivers in various coating segments. For example, in architectural coatings we see an enhanced need for low-VOC, low-odor coatings, which we are addressing by developing unique crosslinking aids and other additive molecules. In packaging, the need for BPA-free coatings, especially for food-contact applications, is driving our development of EDA, N1 polyester-based resin systems. We also see an opportunity to address material and energy conservation, which includes reducing coating system complexity, simplifying processes, and enhancing durability without sacrificing performance. We are addressing all of these efforts through our innovation platforms, especially in industrial and transportation coating systems, by designing new polyester-based resin systems that enable layer reduction, simplify the application process or enhance product durability.

Carson, Allerdinck Bolck: Our main focus has been the development of water-based products derived from renewable resources, products with excellent resistance to various stain/chemicals, and innovation in waterborne UV technology. We strive to produce binders that are environmentally friendly, including low-VOC-capable, multipurpose, and easy-to-formulate systems.

Xu, Cardiolite: Our primary goal is the further reduction of VOCs to ultimately reach zero VOCs while still achieving high performance of the resulting coating systems.

Meyer, Eonon: Currently, Eonon’s Coating Additives business line is focused on research areas related to addressing the performance gaps our customers are seeing as solvents are reduced or removed from coatings. This includes understanding the mechanisms involved in causing and preventing burnout, scratch, mar, staining, blocking and dirt pickup, as well as developing new technologies to address these challenges. We are also studying ways of achieving differentiated coatings through the development of new products that provide desired surface appearance and haptic properties.
The year 2020 has been challenging, to say the least. It will also be memorable not just due to the tragedy and hardship resulting from the COVID-19 pandemic, but also for the way people collaborated to develop innovative solutions despite the inability to travel and limited resources. CoatingsTech was the beneficiary of many innovative collaborations as well. Contributors from industry and government research groups discussed the fruits of internal and external partnerships that addressed a host of issues, from the principles of weathering and liquid color measurement to new resins and curing agents to biocide-free preservation solutions.

Bio-based resins and additives with unique properties and silicon-based materials were shown to improve the performance of many different types of coatings. The impact of harsh environments on coatings was discussed and potential solutions for minimizing damage were proposed.

In most instances, performance and sustainability were both at the heart of the work described in the contributed articles. By sharing these efforts with the readers of CoatingsTech, the goal was to spread valuable knowledge that will lead to enhanced paint and coating products. These contributed works were intended to inspire future work that will continue to build on the ever-growing base of science that serves as the fundamental building block upon which the industry has been constructed.

The authors of the articles published in CoatingsTech in 2020 were surveyed regarding their thoughts on the innovation landscape in the paint and coatings industry as we approach the new year. The authors were asked to share their thoughts, which are presented below.

What are the most important paint and coating research areas that you and your colleagues in polymer science are focusing on today?

Corrigan, ChemQuest Technology Institute: There are five leading areas being targeted by the paint and coatings industry today:

1. Increasing use of bio-based/bio-derived materials and materials derived from post-consumer and renewable resources.
2. Increasing comfortableness with using new technologies due to dispersion issues being solved.

Provider, Polymers & Coatings Consultants: “Smart coatings” (coatings that have other functions in addition to protecting and decorating surfaces) are of particular interest today. Examples include Thruvin Williams’ “Print Shield,” which is an antibacterial coating. Self-healing coatings are another area being worked on. I also expect artificial intelligence to be applied to formulation development and to paint manufacturing. More effective application of nanotechnology to coatings is another area of focus.

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Detwiler, Eastman: We see demands driven by global consumer macro-trends, such as health and wellness, a growing middle class, and resource sustainability manifesting as regulatory and consumer need drivers in various coating segments. For example, in architectural coatings we see an enhanced need for low-VOC, low-odor coatings, which we are addressing by developing unique cross-linking aids and other additive molecules. In packaging, the need for BPA-free coatings, especially for food-contact applications, is driving our development of EA-101 polyester-based resin systems. We also see an opportunity to address metal and material energy conservation, which includes reducing coating system complexity, simplifying processes, and enhancing durability without sacrificing performance. We are addressing all these efforts through our innovation platforms, especially in industrial and transportation coating systems, by designing new polyester-based resin systems that enable layer reduction, simplify the application process or enhance product durability.

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Brown, Chemours: As a pigment producer, most of our research involves how we engineer our products and processes to better fit the current and future demands of our customers in a sustainable and responsible manner. This involves evaluating new and innovative options that will help us in meeting our corporate sustainability goals, looking at how we can simplify and innovate to help our customers win, and strategizing how we can attract scientific interest to advance fundamentals across the broader scientific community.

Within Chemours, we are working in three general longer-term areas that are anticipated to impact the broader coatings community:

1. Smart and sustainable pigment systems are anticipated to be the next improvement in modern pigments. These materials embrace safer-by-design principles and are engineered to not only perform as traditional pigments—using raw materials and responsible product design chices—but also add functionality for the formulator, enabling further simplification of formulation processes while enabling end-use property gains. Doing this while we're innovating manufacturing processes to reduce emissions and waste is an important goal for our company.

2. What is driving interest in these specific issues? Are they addressing specific gaps in manufacturing, application or performance of paints and coatings? Emerging trends?

Corrigan, Chemours: One technology initiative is increasing use of biobased/biobased materials and technologies derived from post-consumer content versus traditional petroleum-based materials. This offers a number of benefits in terms of price stability. Performance is approaching or exceeding other oil-derived materials, the economics are more reason- able, there are increased environmental concerns and regulatory pressures, and customers have become savvier.

Nanostructures are of interest because they offer increased performance, but price, environmental impact, and poor incorporation into the base material have suggested that they have not been widely used. However, the core benefits of nanomaterials and self-assembly, as well as their ability to leverage the performance of high-performance automotive OMEs, are relevant. They can be used to reduce CO2 emissions, which is a key concern for many automotive OEMs. In automotive manufacturing processes, these materials are introduced in specific applications, especially on high-performance coatings and paint formulas.

The strong desire for antimicrobial per- formance is attributed to the emergence of the COVID-19 pandemic and the increasing prevalence of drug-resistant microbes, while rising demand for hygiene and health protection, scratch resistance, and self-healing is due to rising expectations for aesthetics by end-users, particularly in the automotive sector. The desire for real advances in corrosion protection is driven by the ever- increasing costs associated with failure of large capital assets.

Dettmer, Eastman: The key drivers are regulations and regulatory authorities who are seeking better health and wellness solutions that will also deliver lower total cost of ownership, lower odor, and lower volatile organic emissions. The market is looking for opportunities to better our customer's ability to enhance product service life as well as those that offer lower material and energy demand during the manufacturing process. Driven by upcoming regulatory changes, we are also seeing early emerging needs in some geographical regions looking for options that have better end-of-life sustainable solutions.

Meier, Evonik: The reduction or elimi- nation of VOCs in architectural and do-it-yourself wood coatings has driven the industry to use waterborne coatings and new polymer binders capable of film forming with minimal or no coalescing solvents. These polymers generally have lower glass transition temperatures and can result in softer coverings that are susceptible to damage unless the coating can be formulated to counter this tendency. However, environmental, health, and safety drivers are not the only factors that prompt our customers to seek new solutions. Fashion trends and prevailing consumer preferences play a heavy role in the surface appearance and haptics sought in wood coatings, flooring, and architectural coatings. For example, consumers’ renewed focus on comfort within their own homes is driving choices in paint colors, sheens, and textures—all of which can be enhanced or improved through the use of special-ity additives.

Carson, Alberdingk Thöning: Alberdingk’s mission is to deliver technology and innovation of value to our customers. This is resulting in effective product solutions that meet global environmental regulations. Listening to the voice of the customer is the top priority. We also closely follow market trends, looking for new applications and technologies where our technologies can be leveraged.

Brown, Chemours: The Chemours company is committed to the sustainable development and responsible development of products. This drives the way we consider new product opportunities and provides the path as to how we develop them. Making responsible choices throughout the product development process is a current trend and is anticipated to become the norm in the future. But while it is necessary, now and safe and more sustainable product development is essential for the future. But while it is necessary, now and safe and more sustainable product development is essential for the future, it also need to anticipate and address our customers’ needs in the coatings indus- try. This involves exploring new funda- mental options through engineered pigments that benefit downstream users in new ways, as well as paying close attention to regulatory and societal signals. To do this effectively requires bridging several gaps in the fundamental science involving complex matri- ces, which is in turn involves nurturing, recruiting, and collaborating with world class experts across disciplines.

Würhiede, Oronite: I think, besides the overall trend of sustainability, it is most important to transfer an experience-driven formulation process to a scientific-drives process. It is very important to systematically work on a better understanding of the paint systems in formulation and applica- tion. Digitalization creates the basis; artificial intelligence can help gain more knowledge.

Kelly, DST: DST conducts research in areas where no or limited indigenous capability exists either in academia or industry and where the classified nature of the research is such that it cannot be done outside of DST. The research into specific coating and manufacturing technologies, such as low-emissions coatings, is driven by the need for reducing the detectability of platforms and increasing their survivability against a range of threats. Defense desires to reduce or eliminate chromate primers and conversion coatings used to prevent corrosion on Australian Defense Force (ADF) aircraft, since they create waste health and safety issues during application, maintenance, and removal. The adoption of waterborne coatings is being driven by the Australian Government’s regulations to reduce VOC limits, pollution, and haz- ards during use and storage. Australia’s harsh conditions also make DST a reason for assessing external research on exterior durable coatings.
Brown, Chemours: As a pigment producer, most of our research involves how we engineer our products and processes to better fit the current and future demands of our customers in a sustainable and responsible manner. This involves evaluating new and innovative options that we add to meeting our corporate sustainability goals, looking at how we can simplify and innovate to help our customers win, and strategizing how we can attract scientific interest to advance fundamentals across the broader scientific community.

Within Chemours, we are working in three general longer-term research areas that are anticipated to impact the broader coatings community:

1. Smart and sustainable pigment systems are anticipated to be the next improvement in modern pigments. These materials embrace safer-by-design principles and are engineered to not only perform as traditional pigments—using pigments and responsible product design choices—but also add functionality for the formulator, enabling further simplification of formulation processes while enabling end-use property gains. Doing this while evolving our manufacturing processes to reduce emissions and waste is an important goal for our company.

2. Würthle, Orontec: We see digitalization and process acceleration as the most important drivers. In the field of digitalization, it becomes necessary to understand and better differentiate materials interact and come closer to the target of a digital twin of formulations. To the coatings industry, it is important to become more efficient in production and faster in the process of bringing new products to the market. The same is true for modifications of existing formulations with different raw materials. We see that there is a lack of digital methods for understanding and simulating the processes of production and the application process. All three components—formulation, scale-up and application—are crucial for successful digitalization in the paint and coatings industry. Orontec is working on all these three fields in customer projects already.

3. Siebert, Ford: Much of the research in automotive paint and coatings is focused on a few diverse areas of interest. First, functional coatings, especially those that can be used on autonomous vehicle sensors to keep them clean and clear of fouling, are of great interest. The development and implementation of autonomous vehicles depend on the success of these coatings and their ability to allow sensor systems such as cameras or LiDAR to collect high-fidelity data without interference. Next, there is always a focus on exterior coatings, specifically on exterior cure coatings and/or radiation-cure coatings with the performance of their high heat and high-temperature counterparts. As more interest in cars, actuators and PEFC to collect high-fidelity data without interference. Next, there is always a focus on exterior coatings, specifically on exterior cure coatings and/or radiation-cure coatings with the performance of their high heat and high-temperature counterparts, as more interest in cars, actuators and PEFC to collect high-fidelity data without interference.

Corrigan, Chemours: A technology institute (CIT) is increasing the use of biobased, biofunctionalized materials and post-consumer content. This technology institute offers cost savings. Performance is approaching or exceeding other oil-derived materials, and the sustainability and biobased advantage is significant. Using biobased materials in automotive and industrial applications, with less environmental impact, is a significant area of interest. Materials have been developed that can be used in a variety of applications, such as in automotive, industrial, and building applications. These materials are designed to be cost-effective and environmentally friendly, while providing superior performance for a wide range of applications. In addition, the use of biobased materials helps reduce the environmental impact of automotive and industrial applications, making them a more sustainable option.

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Brown, Chemours: The Chemours company is committed to the sustainable and responsible development of products. This drive is the way we consider new product opportunities and provides the path as to how we develop them. Making responsible choices throughout the product development process is a current trend and is anticipated to become the norm in the future. That said, it is critical for companies to continue to invest in research and development to ensure that they can continue to provide cost-effective solutions that meet the needs of their customers around the world.
Machine learning offers improved time management by accelerating the selection and discovery of new materials for tailored coatings. There is also a stronger driver for the development of polycrylate-free coatings. While it has been possible to move away from solvent-based two-pack polyurethane to polylactone topcoats on Australian Navy platforms, elimination of polycrylate has not been possible yet on Army or Air Force equipment due to certain performance limitations.

What technological hurdles must be overcome to be successful in realizing the adoption of targeted solutions within the industry?

Xu, Caroline: New technologies can bring about so much higher performance to coating systems. However, it is common that new technologies have some features that do not fit well with current application techniques or formulation schemes. The mismatch between new technologies and application/formulations is a challenge that must be overcome.

Wildeheide, Orontes: We need a complete redesign of test methods. Many archaic methods are used, primarily because the technological understanding of customers is very low and methods are considered proven.

Brown, Chemours: Adapting proven processes to produce more complex materials can be a challenge and requires innovation on the product side and the analytical and process side. There is a diversity of methods, and each has its own value. However, sometimes they lead to confusion over what they are conceived and not for purposes. Breaking down testing barriers to help separate art from science is a challenge. There are several instances where a re-examination at fundamentals and driving mechanisms to identify the appropriate suite of test methods could help with the adoption of the best solutions.

Rosato, BASF: Discovering environmentally friendly, cost-effective solutions that deliver the desired end-use performance is a key challenge.

Carson, Alberdingk Royle: Finding sustainable raw materials that are readily available to produce water-based products is a challenge. New building blocks must meet environmental regulations and produce materials that have excellent performance without a significant increase in cost. These raw materials also need to be listed in various chemical inventories, which is one of the biggest challenges for us.

Procter, Polyureas & Coatings: Consultans: Developing multifunctional coatings (smart coatings) for specific end uses with a cost/performance at least equal to that of conventional coatings is a serious challenge. Kelly, DST: Chromate replacement has proved to be one of the most difficult challenges as there are chromate-free primers to date that perform the same as, or better than, chromated primers. The coatings industry, academia, and DST researchers have directed considerable effort in formulating and testing various chromate-free pre-treatments and primers for the aerospace industry and are keen to have effective replacements. It is extremely important for DST to ensure corrosion on Defence assets is minimized, particularly in the maritime and aerospace domains where anticorrosion performance is critical for both sea and air-worthiness.

Seaburd, Ford: For many new paint and coating technologies, the biggest hurdle is outdoor durability and performance. Automotive durability requirements are some of the toughest requirements in any industry, and typically require 10 years of performance without major failures such as fading, cracking, delamination, or gloss loss. Any new paint or coatings materials, whether it is low-temperature cure, radiation cure, hydrophobic coatings, or toner paint systems, need to meet these requirements before they are considered for implementation.

Pilcher, The ChemQuest Group: The greatest technological hurdles vary with regard to individual technology areas and end-use requirements. In general, however, the greatest hurdle is to develop technology that performs equal to, or better than, currently available technology, while maintaining or improving the cost-in-use to the customer.
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Carrigan, ChemQuest Technology: New technology is needed to adopt new technologies is the risk of exposure due to the unknowns present by a new material or process. In the overall system, the current baseline, not incremental improvement.

Are there any other barriers to adoption and how can they be broken?

Pilcher, The ChemQuest Group: Varying needs result in different barriers that require specialized solutions. There is no "one size fits all" with regard to almost all areas of materials science, whether paints and coatings, sealants and adhesives, composites, plastics, etc.

Kelly, DST: Raw material costs are an important input factor to achieve commercially competitive products. For example, the Australian dollar has not always demonstrated strong performance, limiting the type of materials imported from overseas and therefore limiting coatings development. A frustrating conundrum lies in the cost-competitive nature of the coatings industry at times working against end-user interests. The efforts to shave off a few cents per liter on the cost of a coating can, at times, actually affect long-term performance of that coating applied on a Defence platform.

Carrigan, Alberdingk Boyle: Changing the mindset of customers using traditional materials such as solventsborne can be challenging, especially when lines are running well and cost is acceptable. New technology will only be adopted when there is a clear performance difference that can be understood in the market. Environmental legislation is passed that bans the use of certain products, or efficiencies are gained that help the bottom line. Using a combined approach to solve a problem along with using the expertise of two or more raw material suppliers is a viable route forward as this may be the better tool to get bigger improvements in product performance compared to a standalone approach.

Brown, Chemours: The challenge for achieving broad adoption of a technology that may alter how one formulates is a bit more complex and reaps on issues related to tradition and perception. This means what we offer must be either transformative or help make a new coating application successful. Collaborations in the coatings technology space between raw material suppliers and coating manufacturers will be necessary to bring forward the next generation of coatings technologies. We need to show our potential (customers) that we are knowledgeable in our field and can respond to their needs with viable solutions, not only on the pigment side but though a wide range of resins.

Dentwiler, Eastman: The key barrier we see for development and adoption of new technology is a lack of understanding of critical needs, processes and matrices used by key stakeholders at each node in the value chain. This often causes the industry to be sub-optimal in its innovation efficacy. We see cross-value-chain collaborations to develop technologies that ultimately bring solutions to the strongest needs of the end customers. This collaboration creates value for each node in the value chain and is the key to success. Developing such win-win, trusting, innovative relationships across the value chain breaks down barriers and allows each partner to bring unique, complementary skills-sets and comprehensive solutions to development to the adoption process.

Seaburt, Ford: Cost is still a major driver in any industry, and the automotive industry is no different. However, OEMs typically look at the cost-value proposition of the technology, meaning even if a new material costs more than what is currently used, that cost increase can be offset by material or process. To reduce this risk, extensive long-term testing is needed that simulates real-world conditions and enduring stresses. Substantial beta-testing programs are also needed before transitioning to full commercial deployment. Another major barrier is the testing standards required for any given industry, especially automotive aerospace.

Carrigan, ChemQuest Technology: A major barrier to adoption of new technologies is the risk of exposure due to the unknowns presented by a new material or process. In the overall system, the current baseline, not incremental improvement.

What developments will you and your colleagues be monitoring that will enable ideal or improving conditions to help enhance success in your field of research?

Seaburt, Ford: Success depends on continued funding for such activities, as well as teams of OEMs, suppliers, and technology developers working openly and together to address challenges as they arise during the development process.

Wright, Ormonte: Initiatives from paint suppliers and their customers to improve the interaction between paint and application on a scientific and practical basis is of continued interest to us.
Rosatos, R.A.S.P.: Developments occurring in the coating industry in general and, for example, environmentally friendly coatings, new raw material and production processes, and new markets are always of importance to our work.

Xu, Carolides: We always track new technological developments and the emergence of specific coatings adhesives/irradiants/anchors (CASIo) fields.

Rowen, Chemours: On the technology side, we actively monitor developments in the scientific literature around emerging particle technology and any as well as emerging technologies in photopolymerization. These can identify opportunities that are relevant to our work. By focusing on emerging coating systems and adapting these for different application areas, we can see opportunities to facilitate innovation and provide faster development.

Rosatos, R.A.S.P.: Surface modifications of coatings and other materials to produce functional/multifunctional surfaces that resist ice build-up, prevent environmental staining and easy removal reasons of graffiti, and provide environmentally acceptable anti-fouling properties, are just a few examples.

Raysor, R.A.S.P.: We expect to see our new technologies applied in a variety of market sectors such as surface coatings, packaging, adhesives, and construction materials. These opportunities are enabled by a wave of innovations and new materials that will improve performance and aesthetics for those applications. Our focus is also on developing sustainable flexible packaging coatings and durable wood coatings.

Xu, Carolides: Our technologies are mainly targeting applications that demand high performance because they can provide unique performance in the form of sustainable materials.

Brown, Chemours: We are not targeting a single application but rather a range of applications, from traditional structures such as consumer and architectural coatings to loss-established safety systems. We are focusing on developing an extended range of applications, from consumer to industrial and personal care products.

Kelly, D.S.T.: High-performing cation-free pre-treatments and primers will see us develop a range of applications, from traditional systems to new and emerging markets.

Brooks, OSU: The use of engineered silica in high-performance coatings is an area of significant interest. This technology has the potential to provide unique performance in a variety of applications, including automotive and industrial coatings.

Networking: Strategic partnerships such as those with Corning, Johnson Controls, and 3M provide unique opportunities for success.

Powder, Polymer & Coatings Consultants: The best way to stay ahead of competition is to offer your own products/technologies before your competitors do so. The most successful companies will develop technologies intended to achieve this goal.

Cayton, Airdherry Daley: Our work is focused on industrial, commercial, decorative, and architectural applications. The packaging coatings market for paper and plastic-based materials is another major area of our activities.

Rosatos, R.A.S.P.: With less competition with traditional or where there is a trend toward sustainability, health and safety, and cost reduction.

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Sebrett, Ford: Of the technologies I described, advancements in turbine application and reduced-energy curing are the technologies that meet the near-term potential. Coatings for autonomous vehicles are several years away, but are also necessary for autonomous vehicles to operate and come to market.

Rosatos, R.A.S.P.: The most successful companies will develop technologies intended to achieve this goal.
Paint and Coatings Technologies to Watch for in 2021

Rosato, R.P.S.P.: Developments occurring in the coatings industry are driven in large part by the need for better coatings, in terms of both quality and performance, in order to meet increasingly stringent regulations and standards. These developments are driven by advances in technology and innovation, as well as by the growing importance of sustainability and environmental concerns.

Detwiler, Eastman: We will continue to see advancements in the field of additive manufacturing and the use of 3D printing technologies for the production of custom coatings.

Brown, Chemours: The technology landscape is rapidly changing, with new and innovative coating solutions being developed to meet the demands of various industries. This includes advancements in the areas of sustainability, durability, and performance.

For what applications do you see the new technologies/technologies emerging? What are the potential opportunities? Success stories.

Procter, Polymer & Coatings Consultant: The trend towards more sustainable and environmentally friendly coatings is expected to continue, with a focus on the use of renewable resources and the development of coatings that can be easily recycled or decomposed.

Kelly, DST: The use of advanced materials and technologies, such as nanotechnology and advanced coatings, will continue to play a major role in the development of new coatings technologies.

Vehicle to commodity: What do you think the future of the coatings industry looks like in 2021 and beyond?

Shy, Contaminant: The use of sustainable and eco-friendly coatings is expected to increase in the coming years, driven by growing concerns about the environmental impact of traditional coating systems.

The role of additives and technologies: How do you think these will evolve in the future?

The role of regulations and standards: How do you think these will impact the coatings industry in 2021 and beyond?

The role of innovation and technology: How do you think innovation and technology will shape the future of the coatings industry?
Paint and Coatings Technologies to Watch for in 2021

standard coating technology used on AEp especially aircraft and armament equipment for camoflage purposes such as low-emittance coatings. Moderate performance will assist in selection of the best existing materials and source of more advanced technology to formulate more efficient and functional coatings. It may also lead to better understanding of coatings phenomenon such as degradative pathways.

Wörheide, Orontes: Our technologies contribute to a more efficient and sustainable paint supply process, particularly in the use of raw materials and how it performs in an application process such as connection with the pigments and components being used.

"As a thought leader in the development of the paint and coatings industry how do you see the advance and adoption of those technologies?"

Seubert, Ford: Paint and coating suppliers in the automotive industry do a great job in listening to their customers and understanding what advancements are needed by the OEMs. The will also identify technologies developed by startups and academic institutions and work to bring them to market if warranted.

Dewitt, Frostman: Since coatings tend to add disproportionate value to the applications where they are used, the paint and coatings industry fosters innovation and the adoption of new technologies when there is strong collaboration along the value chain. Given the paint and coating industry’s exposure to a wide range of applications, we are often able to make connections that our downstream partners may not see. This partnership model is something that creates synergy between different nodes of the value chain.

Carson, Allowdoh Royce: The paint and coating industry in very effective in providing several forums where personal working in the industry can stay in contact with the latest technology updates, including trade journals, conferences, and technology-focused webinars. All these platforms relay information ranging from more fundamental research results to data about fully commercialized products and technologies, all of which inspires further innovation and development. Awards given to recognize innovative contributions to the coatings industry are also of note.

Brown, Cherrony: The coatings community is full of opportunities for collaboration. There are multiple forums through ACA, trade journals and other organizations where companies and scientists can interact and share ideas and learnings, from the very technical to regulatory and product stewardship related. Coatings technologies are so broad that there are always a variety of perspectives shared that inevitably leads to a pipeline of innovative technologies and continual advancement. For adoption, the facilitation of information exchange is again a major attribute. Sharing the insights of others and providing forums for open practical and technical discussions is an important part of this process.

Rosano, BASF: The industry does an excellent job of promoting and requiring continual improvement.

Xu, Cardinali: The paint and coatings industry is always eager to adopt new technologies through two main pathways. First, formulators are always on the lookout for new technologies and want to learn about new materials step-by-step in existing formulations/systems to improve performance without changing manufacturing and application properties significantly. Second, for those technologies that require big revolutions in formulations/manufacturing/applications, there are several years of transitional time for new technologies to be adopted/ matured. During this time formulators/manufacturers companies prepare themselves in advance for new technologies before market needs emerge.

Provider, Polymer & Coatings Consultants: The industry is very good at innovating in response to external threats that threaten its very survival. A good example is the development of low- and no-VOC paints.

Kelly, DST: From the perspective of the DST, innovation in the coatings industry allows for enhanced mutual vulnerability and leveraging from Defence partners such as calibration, industry foundation is a high priority. DST’s motto is “From the Laboratory to the Battlefield,” so it is important to provide advanced coatings technology to Australia’s war fighters to enable a tactical advantage, greater survivability and a reduced cost of ownership. This is done through a number of Defence Innovation Partnerships, the Defence Innovation Hub and the Next Generation Technology Fund, allowing new ideas to be proposed and funded. Key Defence initiatives enable information exchange and program development with allied organizations, such as NATO, through bilateral and multilateral agreements and programs with other countries, as well as under frameworks such as The Technical Co-operation Panel (TCP) involving the Five-Eyes nations.

Pichler, The ChemQuest Group: We don’t believe that the paint and coatings industry has a long history of innovation and advancement of new technologies, with certain widely spaced exceptions. With a desire to adopt new technologies through two main pathways. First, formulators are always eager to adopt new technologies through two main pathways. First, formulators are always on the lookout for new technologies and want to learn about new materials step-by-step in existing formulations/systems to improve performance without changing manufacturing and application properties significantly. Second, for those technologies that require big revolutions in formulations/manufacturing/applications, there are several years of transitional time for new technologies to be adopted/matured. During this time formulators/manufacturers companies prepare themselves in advance for new technologies before market needs emerge.

Carrettin, ChemQuest Technology Institute: Organizations should increasingly rely on information and innovation generated outside of the Four Walls. Also, greater use of industry-funded research consortia could lower the financial burden on any one industry, while allowing the acceleration of multi-disciplinary research that benefits all members.

Wörheide, Orontes: The industry is still perceived as old-fashioned and needs a new image. It needs to implement an initiative that will motivate young people to join this sector and then use more scientific methods. Digitalization and better test methods also need to be adopted, and open innovation should be encouraged.

Dewitt, Frostman: One of the challenges in the coatings industry is the long qualification cycle to bring new technologies to the market. One initiative that needs to be implemented is an initiative that will motivate young people to join this sector and then use more scientific methods. Digitalization and better test methods also need to be adopted, and open innovation should be encouraged.

Carrettin, ChemQuest Technology Institute: Increased use of strategic research and development planning, rather than more tactical and ad hoc approaches. It may put firing out fires that lead paint and coatings producers to yield water, rather than swim to new shores, is needed. From a research and development point of view, a culture in which certain raw materials are permitted for use, and are formulated using established guidelines, offer a more consistent product available according to established processing protocols tends to produce "more of the same" - or at least a slightly improved version of the same. It requires an injection of outside thinking and an investment in a combination of basic research, applied research, and development work to produce truly innovative products. This only happens when a strategic approach is employed in the development process, and not by implemented in many different ways, although this approach does not ignore independent contract research organizations, universities-industry cooperation projects, government programs, and strategic management consultants, along with the paint community research and development organization.

Seubert, Ford: Paint suppliers and the coatings industry in general needs to put more efforts into technologies or processes that result in a revolutionary change within the industry. Much of the research and development that has focused on evolutionary changes within the standard automotive paint system.

Brown, ChemQuest: A great instrument to view advancement and innovation in key areas is the proportion of technology challenges. What would you consider as a grand challenge to the coatings industry? What does the industry technology roadmap look like from a technical, regulatory, and sustainability perspective? Generating outlooks and industry technology targets could result in healthy competition spurring innovation and continual improvement, but also how is the industry’s R&D performance measured? What are your priorities needs to those outside of the coatings world, expanding our innovation sharing?

There is also a need to revitalize test methods and ensure they are funda-

damentally validated and fit-for-purpose so our path to future coatings technology doesn’t hit artificial speed bumps. Discriminating art from science is always a barrier to innovation and the testing analytics at hand. How do we harmonize testing and shelf methods that don’t run to modern science? How can we expedite the adoption of improved measurement systems?

Carrettin, ChemQuest Technology Institute: Compared to the quick development of novel materials and formulations, innovations in coating application/equipment technology come at a much slower speed. Improving coating applications more effective, easier to handle (good for DIY), and lower cost are needed.
standard coating technology used on AIP and USM, especially aircraft and armament equipment and for camouflage purposes such as low-visibility coatings. Marketing and sales will assist in selection of the best existing materials and processes to form the basis of new coatings technology. This may also lead to better understanding of coating performance such as degradative pathways.

*Wichride, Onteco* Our technologies contribute to a more effective and sustainable paint supply process, particularly in the use of raw materials and how they perform in an application process in connection with the pigments and components being used.

**Seubert, Ford** Paint and coating suppliers in the automotive industry do need to foster innovation and the development of advanced technologies.

**DeWitte, Flatman** Since coatings tend to add disproportionate value to the applications where they are used, the paint and coatings industry fosters innovation and the adoption of new technologies. Long-term, there is a strong collaboration among the value chain. The paint and coatings industry is eager to adopt new technologies through two main pathways. In the first pathway, formulators are always open to new technologies and want to use new materials step by step in existing formulations and systems, to improve performance and efficiency of coatings. In the second pathway, there is a wide range of applications that are often extremely complex and need new technologies to solve specific problems. This partnership model is something that creates synergy between different industries.

**Carmer, Allrotheringley** The paint and coatings industry is very effective in providing innovative solutions to the latest technology updates, including trade journals, conferences, and technology-focused webinars. All these platforms rely on information ranging from more fundamental research results to data about fully commercialized production technologies, all of which is interesting for the coatings industry. Awards given to recognize innovative contributions to the coatings industry are also of merit.

**Brown, Chernova** The coatings community is full of opportunities for collaboration. There are multiple forums through ACA, trade journals, and other organizations where companies and scientists can interact and share ideas and learnings, from the very technical to regulatory and product stewardship related. Coatings technologies are so broad that there are always a variety of perspectives shared that inevitably leads to a pipeline of innovative technologies and continual advancement. For adaption, the facilitation of information exchange is again a major attribute. Sharing the insights of others and providing forums for open technical and practical conversations is an important part of this process.

**Rosano, BASF** The industry does an excellent job of meeting and requiring continual improvement.

**Xu, Cardinal** The paint and coatings industry is always eager to adopt new technologies through two main pathways. First, formulators are always open to new technologies and want to use new materials step by step in existing formulations and systems. This can be a slow process as technology development and application properties can take years to fully mature. Second, for those technologies that require big revolutions in formulations/making/production/applications, there will be several years of transitional time for new technologies to be adopted/mature. During this time formulators/companies prepare and develop new solutions to advance for new technologies before market needs emerge.

**Provider, Polymer & Coatings** The importance of this technology is very important in innovation with respect to external threats that threaten its very survival. A good example is the development of low- and no-VOC paints.

**Kelly, D'Souz** From the perspective of the DST, innovation is essential to allow for enhanced military traction and leveraging of Defence partners such as industry. Innovation is a high priority. DST’s motto is “From the Laboratory to the Battlefield,” so it is important to provide advanced coatings technology to Australia’s war fighters to enable a tactical advantage, greater survivability and a reduced cost of ownership. This is done through multiple and organisations such as Australian State Innovation Partnerships, the Defence Innovation Hub and the Next Generation Technology Fund, allowing new ideas to be proposed and funded. Key Defence initiatives enable information exchange and program development with allies organisations, such as NATO, through bilateral and multilateral agreements and programs with other countries, as well as under frameworks such as The Technical Co-operation Panel (TCP) involving the Five-Eyes nation.

**Pilcher, The ChemQuest Group** Don’t believe the paint and coatings DuPont story of long-term history of innovation and advancement of new technologies, with certain widely spaced exceptions. Why? To be eager to adopt new technologies through two main pathways. First, formulators are always open to new technologies and want to use new materials step by step in existing formulations and systems. This can be a slow process as technology development and application properties can take years to fully mature. Second, for those technologies that require big revolutions in formulations/making/production/applications, there will be several years of transitional time for new technologies to be adopted/mature. During this time formulators/companies prepare and develop new solutions to advance for new technologies before market needs emerge.

**Corrigan, ChemQuest Technology Institute** Organisations should increasingly rely on information and innovation generated outside their usual four walls. Also, greater use of industry-funded research consortia could lower the financial burden on any one industry, while allowing the acceleration of multi-disciplinary research that benefits all members.

**Wichride, Onteco** The coatings industry is still perceived as old-fashioned and needs a new image. It needs to implement an initiative that will motivate young people to join this sector and use more scientific methods. Digitalisation and better test methods also need to be adopted, and open innovation should be encouraged.

**DeWitte, Flatman** One of the challenges in the coatings industry is the long qualification cycle to bring new technologies to market. It needs to implement an initiative that will motivate young people to join this sector and use more scientific methods. Digitalisation and better test methods also need to be adopted, and open innovation should be encouraged.

**Carmer, Allrotheringley** Increased use of strategic research and development planning, rather than more tactical and ad hoc, will put our industries on the map in attracting new talent and innovators. The challenge is to identify key objectives and break down the barriers to innovation that we face. How can we improve the adoption of improved measurement systems?

**Xu, Cardinal** Compared to the quick development of new materials and formulations, innovations in coating application/equipment technology commonly occur more slowly. New coating applications are effective, easier to handle (good for DIY), and lower cost are needed.
Paint and Coatings Technologies to Watch for in 2021

Caruso, Alexander Boley: More collaborative work/interaction among coatings suppliers to address the needs of the industry, as well as a better understanding between suppliers and coating producers, would make new developments faster and more successful.

Outside of the paint and coatings industry, what do you identify as the top technologies to watch in 2021 for potential long-range impacts in this industry?

Brown, Chemours: There are several technologies advancing outside of the paint and coatings industry that could contribute to further advances within the industry, including developments in data science, functional materials, biomimetics, recycling, regulatory science, and materials science.

There are significant opportunities for artificial intelligence and other data analytics tools to enlighten the future of the coatings industry, while the combination of structure and chemistry to engineer new functionality and new properties is leading to advances in growing technology areas such as epoxies, energy storage, and biotechnology. Much of this science and knowledge are transferable to coating systems, although the practical application is a bit more complex. Biomimetics is not a new area, but there remains much that we can learn from nature and apply in the coatings industry. While recycling efforts are largely focused on plastics, some of the learnings there may also be translatable, particularly considering that the voice of the coatings industry and its needs are included in national and international investments in this research is important.

From nanoplastics, microparticles, nanomaterials, substance reclassification, to advance materials and beyond, activities in the regulatory space and the associated science will continue to impact the coatings industry. Finally, a wide range of new and interesting analytical tools are becoming more broadly available in the areas of molecular, particle, and surface science. Harnessing these tools strategically to develop the next generation of coatings technologies may provide unique opportunities and critical advancements in the fundamental science.

Rosano, BASF: Smart and environmentally adaptive materials will be of increasing importance for the development of coating ingredients that enable novel coating solutions.

Wirthlede, Drontec: The top technologies that could directly impact the coatings industry include energy efficiency, bio-technologies, robotics, and artificial intelligence.

Kelly, BST: The immediate technology drivers outside the coatings industry that may impact this industry will be the use of robotics, specifically drones. Connected to neural networks, they will conduct coating application, inspection, and repairs on large vessels and industrial structures with little human interaction. Further improvements to machine learning, enabled by faster processor technology or quantum computing yielding quantum machine learning, will produce better algorithms resulting in long-term research benefits. Advances in engineered surfaces, via 3D printing or other technologies, that provide multifunctional properties using meta materials, delivered as appliques, will also impact the coatings industry.

Xu, Cordellite: Nanotechnology will continue to have an impact, as well as technology innovation in clean energy. The continuous adoption of high-throughput screening technologies will also occur in coating industry and facilitate more rapid product development.

Detwiler, Eastman: Outside the coatings industry, we need to keenly observe the development of sustainable and recyclable technologies, both from a regulatory and consumer perspective across all industries since paints and coatings are ubiquitous. We need our products to enable practical end-of-life solutions for the applications where they are used because sustainability is integral to the long-term growth of our industry and the wellbeing of our communities.

Sewert, Ford: Electricity and the manufacture of long-range electric vehicles will continue to grow during the next decade. These vehicles have their own unique set of challenges and new coating technologies can address some of these challenges. Many of these coatings are needed inside the battery packs to improve the battery pack performance and reduce their cost.

Pichler, The ChemQuest Group: I see anti-Virbal research booming in multiple industries, as well as extensive cross-industry work being done as a result of the trend toward the production of electric vehicles. Green energy will continue to be a significant source of interest to both the automotive and commercial sectors. For example, the blades of windmills wear out and must be periodically replaced, preferably with more durable composites and coatings.

Caruso, Alexander Boley: The effect of groups such as "Fridays for Future" on consumers and industry should be considered. The global trend to reduce plastics in packaging leads to a rapid development of more sustainable solutions that can be achieved by water-based barrier coatings.