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BEST PRACTICES

AWARDS

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2020 BEST PRACTICES AWARD

 devan
Bringing textiles to life 

**2020 EUROPEAN
ANTIMICROBIAL TECHNOLOGY FOR TEXTILE
TECHNOLOGY INNOVATION LEADERSHIP AWARD**

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Background and Company Performance

Industry Challenges

Beyond causing a dearth of personal protective equipment (PPE) supply, the global COVID-19 pandemic has increased concerns regarding medical-grade materials' susceptibility to microbial and bacterial growth, which may result in health risk and inadvertently the spread of respiratory viruses. Additionally, microbial growth on textile surfaces causes foul odor, reduction in mechanical strength, and discoloration. Although some solutions that help address these issues exist, the need to develop medical-grade textiles with better-performing antimicrobial properties that are highly reusable is more pressing than ever before.

To integrate antimicrobial abilities into textiles, different approaches have been explored. Manufacturers have delivered antimicrobial technology with biocides that contain organic and inorganic compounds, such as heavy metals, bis chlorinated phenols (e.g., triclosan), organo-tins (e.g., TBT), silver and copper zeolites, chitin, and biguanide. Triclosan-based antimicrobial agents release phenols and chlorine for cellular absorption to cause lethal mutation in cell DNA. Silver-based technology, on the other hand, releases ionic-free radicals for poisoning the cell DNA from inside and interferes with the microbes' metabolism, causing alternation in DNA, and in turn, mutation. However effective, mutation causes the formation of adaptive microorganisms (i.e., resistant superbugs on the surface) that show decreased bacterial resistance to both silver and triclosan-based antimicrobial agents. Additionally, both silver and triclosan are not chemically bounded, thus migrate and diffuse from the surface, causing decomposition issues in down streaming.

Considering these challenges and rising public health awareness about risks associated with both inorganic and organic agents, demand is quickly picking up momentum for a new antimicrobial technology that meets health and hygiene requirements without compromising the safety of both human health and the environment. Typically, stakeholders active in developing antimicrobial technologies for the textile industry are more focused on developing sustainable as well as non-migrating solutions that are physically bonded to the substrate and can minimize the bacterial cell mutation to provide long-term bacterial resistance for consumer products.

Technology Attributes and Future Business Value

Industry Impact

Founded in 1977 and headquartered in Belgium, Devan Chemicals NV (Devan) is a pioneer in developing textile antimicrobial finishes or biocides with unique quaternized silane chemistry. By providing non-migrating antimicrobial technology for the textile industry, the company efficiently addresses the safety and performance issues related to current inorganic and organic antimicrobial agents.

Devan's antimicrobial technology in contrast to silver- or triclosan-based technology comprises non-migrating monomers and prepolymers, such as organo-functional silane. The monomer used is 3-(Trihydroxysilyl) propyl dimethyloctadecyl ammonium chloride

wherein its octadecyl-ammonium portion with chlorine as a counter ion is cross-linked with siloxane to provide siloxane polymers. The organo-silane polymers are covalently bonded and polymerized to the textile surface as a coating via padding, exhaust, and spraying techniques. The coating forms a non-leaching reactive surface and destroys the microbes on contact without releasing harmful components into the environment. The antimicrobial technology with quaternary silane chemistry remains affixed to the substrate at the molecular level and is not metabolized by cells. Impressively, the technology prevents the growth and proliferation of microbes by physically puncturing the cell membrane.

Much of the antimicrobial solutions comprised of unbounded antimicrobial agents (e.g., triclosan, silver, and chitosan) are not durable due to their migrating behavior. These agents leach, so when they come into contact with skin they cross the skin barrier and cause rashes and other irritations. Devan's antimicrobial technology, in contrast, remains on the substrate and does not migrate to develop drug-resistant superbugs. The antimicrobial effects provided by the technology do not diminish with time (e.g., after multiple wash cycles) and pose zero risk to human health and the environment.

It is essential for biocidal product manufacturing company in Europe to comply with Biocidal Product Regulation (BPR). Whereas competing products in the antimicrobial technology market limiting their applicability due to toxic solvents concerns and lack of regulatory measures. Devan's antimicrobial technology with quaternary silane chemistry, in contrast, does not contain any harmful solvents such as formaldehyde and polychlorinated phenols and is more safe and effective as it fulfills the regulatory obligations of the EU BPR.

Frost & Sullivan's industry benchmarking research confirms that Devan's antimicrobial non-migrating technology is longer lasting and more sustainable as compared to products from competing companies. The non-leaching attributes of the technology coupled with its ability to reduce microbial mutation make it a potential candidate for textiles where durability and safe human contact are of high value.

Product Impact

Devan, with more than 20 years of experience in antimicrobial technology, provides antimicrobial products under the trade name Bi-OME. The company combines antimicrobial technology with advanced functionalities to produce three innovative variants: Bi-OME Antiviral, Bi-OME Quick-dry, and Bi-OME Stretch.

Most medical textiles or homemade masks have poor material pore sizes, leaving them conducive to disease transmission and cross-infection caused by insidious hepatitis virus, microbial growth, Ebola, and blood borne or sexually transmitted pathogens. To combat the spread of COVID-19, researchers have come up with multilayer polymer coatings, such as textile finishes; these coatings have achieved a reduction in drug-resistant bacteria/viruses up to 98.7% for unwashed samples. Moreover, other commercial disinfectants such as ethanol, benzalkonium chloride, and ortho-phthalaldehyde reduce 90 to 95% coronavirus infectivity, with used in high concentration ranging between 62 and 71%. In contrast, Devan's Bi-OME Antiviral products when applied on polyester or cotton

fabric in a small concentration of 3% have demonstrated a reduction of infectivity in the corona viridae family by 99.59% on unwashed samples and 97.25% after multiple washes.

Other products, such as the Bi-OME Stretch, combine the antimicrobial solution with elastic stretch properties so that after multiple washes the fabric can return to the original state for best fit whereas Bi-OME Quick-dry combines the antimicrobial solution with advanced moisture management properties, which allows odor control with faster evaporation to promote quick cooling and comfort in sportswear.

Frost & Sullivan notes that Devan's technology offers great flexibility to combine its antimicrobial properties with other functionalities, such as antiviral and anti-odor. Unlike disinfectants and alcohol-based gels, these solution attributes when applied on textiles have significant potential to reduce secondary bacterial or viral infections and provide better hygiene, durability, and scent.

Application Diversity

Devan's antimicrobial technology offers wide applicability across the textile industry. Its effectiveness enables use for both woven and non-woven applications, including sportswear, socks and underwear, towels, mattresses and pillows, aviation textiles, and even carpets and curtains. Importantly, the technology can be utilized in surgical drapes, sponges, linen, and hospital garments. Competing antimicrobial technologies comprising silver or triclosan offer strong antimicrobial activity for up to 50 laundry cycles, but after that, the concentration of these agents rapidly declines, indicating poor antimicrobial activity. In contrast, Devan's technology even after 50-100 laundry cycles maintain its antimicrobial performance and provide long-term protection from bacteria whereas in case of viruses, the company is likely to achieve laundry cycles in range of 50-100 with third-party evaluation in near future.

The antimicrobials available in the market that work by leaching, such as silver, when used on textiles exposed to microbes demonstrated microbial activity ranging between 1.4 to 2.0 log reduction, indicating 90 to 98% efficiency. Triclosan, on the other hand, when used on textiles showed less log reduction of 0.56 to 0.58 against Gram-negative bacteria and 1.4 to 1.8 log reduction against Gram-positive bacteria, indicating efficiency of less than 90%. Therefore, it is quite likely that thousands or hundreds of bacteria remain that are resistant to leaching antimicrobial agents. Devan's antimicrobial technology in a wet state, compared its counterparts, is effective in reducing bacterial as well as enveloped viruses with log reduction in the range of 4.9 to 7.1, indicating efficiency between 99.99 and 99.999999%.

Frost & Sullivan appreciates that Devan's antimicrobial technology demonstrates higher bacterial as well as virus reducing efficiency, even after multiple washes, than what is possible from its counterparts and can be used by both the general population and frontline professionals to protect against SARS, COVID-19, and H1N1.

Scalability and Customer Acquisition

Devan has a presence in major textile hubs, with production units in Europe and the United States, and it works with major retailers to distribute its products across the globe. Also, customers are guaranteed the company upholds high-level market as well as quality control support, which has helped it maintain lasting customer relationships. Currently, the company produces Bi-OME in three formulations: 5% solution, 10% solution, and in pure concentration solution, but it can customize formulations based on customer requirements, typically for a hospital environment. The ability to provide customized antimicrobial product lines with unique functionalities coupled with strong global distribution networks and cross-border support, including quality assurance testing of finished goods, create differential competitive advantage in terms of high productivity and a wide customer base.

Devan is continuously trying to improve its product range in the field of textile antimicrobial solutions by collaborating with laboratories and research institutes. For instance, its Bi-OME Antiviral product line was developed in collaboration with The Pasteur Institute of Lille, based in France, to combat enveloped viruses such as H1N1, corona family viruses, and naked viruses such as Rotavirus. Devan's ability to form productive partnerships with universities has helped it in several ways, from innovative product development to profitability improvement. The partnerships have also helped it boost its competitive advantage by offering products with multi-functionality that cater to various customer demands.

Brand Equity

Devan is working towards sustainability and green chemistry. For instance, it has eliminated the use of heavy metals such as silver and created products with a lower environmental impact. The company's antimicrobial BI-OME product lines are registered under EU BPR (PT2 and PT9), Turkish BPR, and US EPA. Also, they are classified as safe under sustainable textile consumer label Oekotex Class 1. Devan's efforts to provide highly differentiated products with focus on sustainability have helped it attain an attractive market position and foster customer loyalty. To maintain its brand recognition among customers, the company adopted the strategy of replacing toxic chemicals with plant-based ingredients; and in 2020, under its sustainable product portfolio, Devan commercialized a new line of antimicrobial products named Bi-OME Natural made with active ingredients based on dried seeds of linseed oil derived from the flax plant.

Because textile finishes made with leaching antimicrobials are not effective against controlling odor and fighting germs after multiple washes, many of these fabrics gain a permanent odor and microbial stains so are discarded. When added to residual waste, they can impede the textile recycling process. In contrast, Devan's Bi-OME Natural product help to eliminate the malodor and staining created by bacteria, yeast, and fungus and provides long-term protection and freshness even after multiple washes. The technology's use of plant-based raw materials makes the products organic, biodegradable,

GMO-free, and recyclable. Additionally, this product line has attained Halal and Kosher certification.

Devan's commitment to promote sustainability in textile finishes with a strong focus on GMO-free, Kosher and Halal certification, and recyclability has given the company an innovative edge in launching new products at an accelerated pace that match today's customers' most pressing concerns and demands.

Conclusion

The global COVID-19 pandemic and increasing risk of infectious diseases, including SARS and Ebola, are pushing national governments to invest trillions of dollars to improve population health management and safeguard more lives. Devan's antimicrobial technology has addressed the medical issues of greatest importance concerning the contamination of PPE and textiles, including the spread of drug-resistant bacteria, viral transmission, and hospital acquired infections (HAIs).

Devan's quat-silane technology, due to its non-migrating behavior, physically punctures the microorganism cell to destroy it yet does not interfere with cell DNA. Notably, the technology eliminates the ill effects associated with competitors' leaching antimicrobials (e.g., formation of adaptive organisms resistant to antimicrobial agents, human and environmental harm, diminishing durability) while providing high efficiency in the range of 99.99 to 99.999%, even after multiple washes. The technology does not contain any heavy metals, such as formaldehyde, silver, lead, or mercury, and thus does not cause any harm to the environment or human health. Also, the technology complies with the statutory requirements imposed by regulating bodies of different countries, including the United States and various European nations, which has helped the company widen its customer base across the globe.

For its strong overall performance, Devan Chemicals NV has earned Frost & Sullivan's 2020 Technology Innovation Leadership Award.

Significance of Technology Innovation Leadership

Ultimately, growth in any organization depends on finding new ways to excite the market and maintaining a long-term commitment to innovation. At its core, technology innovation, or any other type of innovation, can only be sustained with leadership in 3 key areas: understanding demand, nurturing the brand, and differentiating from the competition.



Understanding Technology Innovation Leadership

Technology innovation begins with a spark of creativity that is systematically pursued, developed, and commercialized. That spark can result from a successful partnership, a productive in-house innovation group, or a bright-minded individual. Regardless of the source, the success of any new technology is ultimately determined by its innovativeness and its impact on the business as a whole.

Key Benchmarking Criteria

For the Technology Innovation Award, Frost & Sullivan analysts independently evaluated 2 key factors—Technology Attributes and Future Business Value—according to the criteria identified below.

Technology Attributes

- Criterion 1: Industry Impact
- Criterion 2: Product Impact
- Criterion 3: Scalability
- Criterion 4: Visionary Innovation
- Criterion 5: Application Diversity

Future Business Value

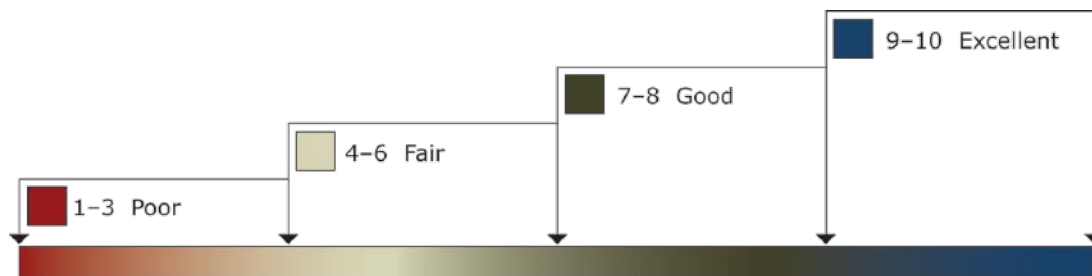
- Criterion 1: Financial Performance
- Criterion 2: Customer Acquisition
- Criterion 3: Technology Licensing
- Criterion 4: Brand Loyalty
- Criterion 5: Human Capital

Best Practices Award Analysis for Devan Chemicals

Decision Support Scorecard

To support its evaluation of best practices across multiple business performance categories, Frost & Sullivan employs a customized Decision Support Scorecard. This tool allows research and consulting teams to objectively analyze performance according to the key benchmarking criteria listed in the previous section, and to assign ratings on that basis. The tool follows a 10-point scale that allows for nuances in performance evaluation. Ratings guidelines are illustrated below.

RATINGS GUIDELINES



The Decision Support Scorecard considers Technology Attributes and Future Business Value (i.e., the overarching categories for all 10 benchmarking criteria; the definitions for each criterion are provided beneath the scorecard). The research team confirms the veracity of this weighted scorecard through sensitivity analysis, which confirms that small changes to the ratings for a specific criterion do not lead to a significant change in the overall relative rankings of the companies.

The results of this analysis are shown below. To remain unbiased and to protect the interests of all organizations reviewed, Frost & Sullivan has chosen to refer to the other key participants as Competitor 1 and Competitor 2.

<i>Measurement of 1-10 (1 = poor; 10 = excellent)</i>			
Technology Innovation	Technology Attributes	Future Business Value	Average Rating
Devan Chemicals	9.1	9.3	9.2
Competitor 1	8.5	8.3	8.4
Competitor 2	8.3	8.0	8.2

Technology Attributes

Criterion 1: Industry Impact

Requirement: Technology enables the pursuit of groundbreaking ideas, contributing to the betterment of the entire industry.

Criterion 2: Product Impact

Requirement: Specific technology helps enhance features and functionalities of the entire product line for the company.

Criterion 3: Scalability

Requirement: Technology is scalable, enabling new generations of products over time, with increasing levels of quality and functionality.

Criterion 4: Visionary Innovation

Requirement: Specific new technology represents true innovation based on a deep understanding of future needs and applications.

Criterion 5: Application Diversity

Requirement: New technology serves multiple products, multiple applications, and multiple user environments.

Future Business Value

Criterion 1: Financial Performance

Requirement: Potential is high for strong financial performance in terms of revenue, operating margins, and other relevant financial metrics.

Criterion 2: Customer Acquisition

Requirement: Specific technology enables acquisition of new customers, even as it enhances value to current customers.

Criterion 3: Technology Licensing

Requirement: New technology displays great potential to be licensed across many verticals and applications, thereby driving incremental revenue streams.

Criterion 4: Brand Loyalty

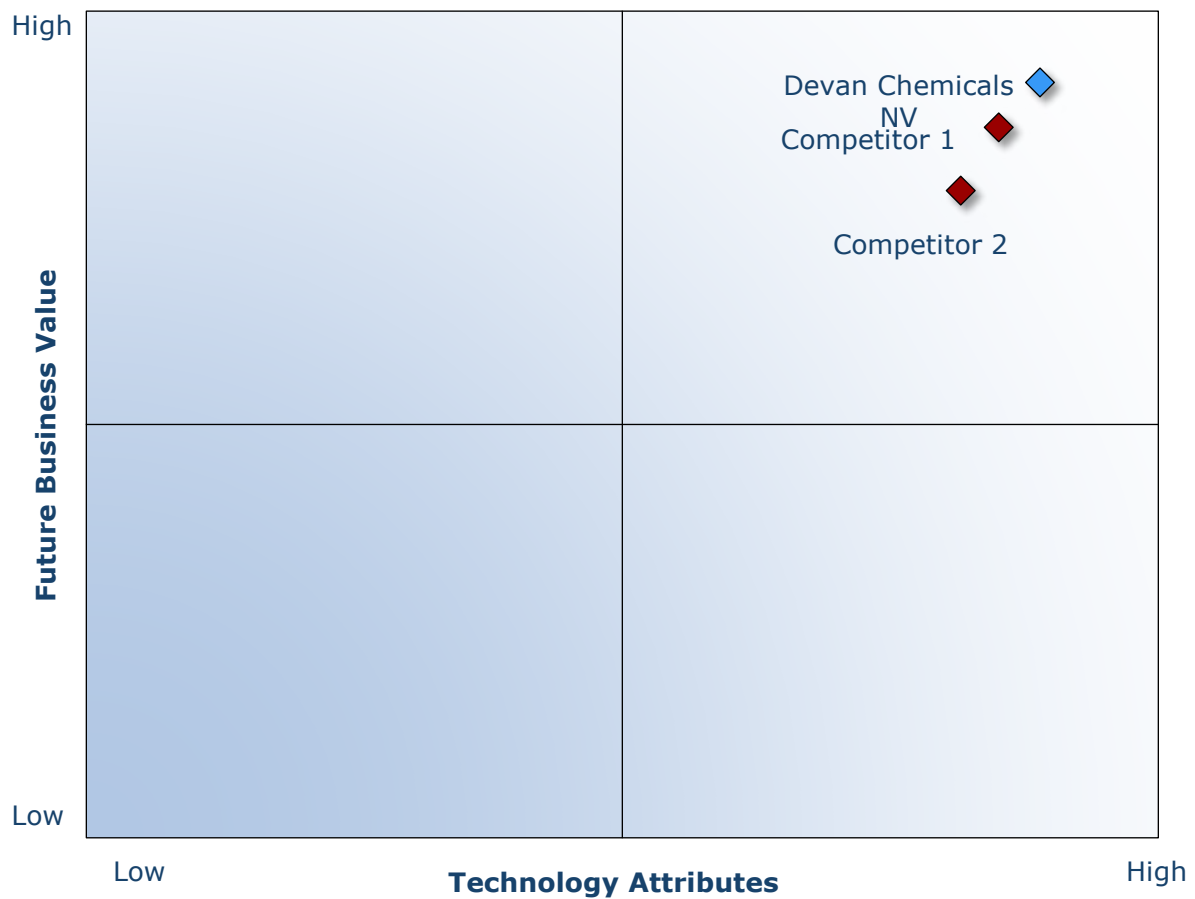
Requirement: New technology enhances the company’s brand, creating and/or nurturing brand loyalty.

Criterion 5: Human Capital

Requirement: Customer impact is enhanced through the leverage of specific technology, translating into positive impact on employee morale and retention.

Decision Support Matrix

Once all companies have been evaluated according to the Decision Support Scorecard, analysts then position the candidates on the matrix shown below, enabling them to visualize which companies are truly breakthrough and which ones are not yet operating at best-in-class levels.



Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan analysts follow a 10-step process to evaluate award candidates and assess their fit with select best practices criteria. The reputation and integrity of the awards are based on close adherence to this process.

STEP	OBJECTIVE	KEY ACTIVITIES	OUTPUT
1 Monitor, target, and screen	Identify award recipient candidates from around the world	<ul style="list-style-type: none"> • Conduct in-depth industry research • Identify emerging industries • Scan multiple regions 	Pipeline of candidates that potentially meet all best practices criteria
2 Perform 360-degree research	Perform comprehensive, 360-degree research on all candidates in the pipeline	<ul style="list-style-type: none"> • Interview thought leaders and industry practitioners • Assess candidates' fit with best practices criteria • Rank all candidates 	Matrix positioning of all candidates' performance relative to one another
3 Invite thought leadership in best practices	Perform in-depth examination of all candidates	<ul style="list-style-type: none"> • Confirm best practices criteria • Examine eligibility of all candidates • Identify any information gaps 	Detailed profiles of all ranked candidates
4 Initiate research director review	Conduct an unbiased evaluation of all candidate profiles	<ul style="list-style-type: none"> • Brainstorm ranking options • Invite multiple perspectives on candidates' performance • Update candidate profiles 	Final prioritization of all eligible candidates and companion best practices positioning paper
5 Assemble panel of industry experts	Present findings to an expert panel of industry thought leaders	<ul style="list-style-type: none"> • Share findings • Strengthen cases for candidate eligibility • Prioritize candidates 	Refined list of prioritized award candidates
6 Conduct global industry review	Build consensus on award candidates' eligibility	<ul style="list-style-type: none"> • Hold global team meeting to review all candidates • Pressure-test fit with criteria • Confirm inclusion of all eligible candidates 	Final list of eligible award candidates, representing success stories worldwide
7 Perform quality check	Develop official award consideration materials	<ul style="list-style-type: none"> • Perform final performance benchmarking activities • Write nominations • Perform quality review 	High-quality, accurate, and creative presentation of nominees' successes
8 Reconnect with panel of industry experts	Finalize the selection of the best practices award recipient	<ul style="list-style-type: none"> • Review analysis with panel • Build consensus • Select recipient 	Decision on which company performs best against all best practices criteria
9 Communicate recognition	Inform award recipient of recognition	<ul style="list-style-type: none"> • Announce award to the CEO • Inspire the organization for continued success • Celebrate the recipient's performance 	Announcement of award and plan for how recipient can use the award to enhance the brand
10 Take strategic action	Upon licensing, company is able to share award news with stakeholders and customers	<ul style="list-style-type: none"> • Coordinate media outreach • Design a marketing plan • Assess award's role in strategic planning 	Widespread awareness of recipient's award status among investors, media personnel, and employees

The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of the research process. It offers a 360-degree view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often companies make important growth decisions based on a narrow understanding of their environment, resulting in errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry participants and for identifying those performing at best-in-class levels.



About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, helps clients accelerate growth and achieve best-in-class positions in growth, innovation, and leadership. The company's Growth Partnership Service provides the CEO and the CEO's growth team with disciplined research and best-practices models to drive the generation, evaluation, and implementation of powerful growth strategies. Frost & Sullivan leverages nearly 60 years of experience in partnering with Global 1000 companies, emerging businesses, and the investment community from 45 offices on 6 continents. To join Frost & Sullivan's Growth Partnership, visit <http://www.frost.com>.