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AerNos™

2018 Global Gas Sensors Entrepreneurial Company of the Year Award

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2018 BEST PRACTICES AWARD

GLOBAL GAS SENSORS ENTREPRENEURIAL COMPANY OF THE YEAR AWARD

2018 BEST PRACTICES AWARDS

Contents

Background and Company Performance

Industry Challenges

Environmental research suggests that the quality of both indoor and outdoor air impacts human health. While air pollution can be responsible for causing seven million early deaths a year worldwide, research scientists opine that over 70 to 80% of the global urban population inhales air contaminated with toxic elements and harmful gases. This air pollution can have a detrimental short- and long-term impact on human health.

Such harmful air quality levels have already surpassed the limits mandated by key international health agencies, such as the World Health Organization (WHO). For instance, studies by the Environmental Protection Agency (EPA) and WHO suggest that the air circulating indoors has more contaminants than the air outdoors. In such a scenario, strong and effective measures as well as air quality sensing solutions to detect contaminants present in the air and determine air quality levels are needed to enhance the population's quality of life.

Furthermore, research surveys conducted by WHO, EPA, and non-profit organizations such as the Environment Research & Education Foundation (EREF) indicate that the human population is becoming increasingly interested in knowing about air quality, both indoors and outdoors as well as in enclosed spaces, such as vehicles, and how to make this air contaminant free for enhanced health and wellness.

To address these challenges, the industry needs effective nano gas sensors that can simultaneously detect multiple toxic elements and gases present in the air as well as generate insightful intelligence to reduce the exposure to such harmful environments and prevent detrimental health consequences.

Entrepreneurial Innovation and Customer Impact

Passionate Persistence

To minimize the negative effects of air pollution on human lives, San Diego-based AerNos, Inc. (AerNos) envisions a network of a trillion nano gas sensor within 10 years that will provide target industries, customers, and consumers with real-time actionable insights on pollution and air quality levels in various outdoor and indoor environments.

Recognizing the harmful impact that poor indoor and outdoor environmental air quality has on people's health, AerNos has been striving to offer customers and consumers sophisticated solutions that can reduce instances of air pollution-triggered diseases and create safe and sustainable environments. Aligned with this vision, AerNos has strategically partnered with Rogue Valley Microdevices, known for its full-service microelectrochemical system (MEMS) foundry, Fitz-Thors Engineering, Inc., known for its robotics and factory automation, along with multiple additional manufacturing partners, to mass manufacture its

game-changing nano gas sensor products, AerCity™ and AerHome™, and the game-changing AerBand™ Research wearable device announced at CES 2018, thus leveraging its proprietary fabrication techniques in numerous stages.

With air pollution/air quality sensing slowly gaining traction, AerNos is positioned to meet the mounting demand for such sensor products for over 50 billion connected devices by 2020, while helping advance health research related to air pollution. This positioning is remarkable because the company was only recently established in September 2016, thereby clearly highlighting its visionary leadership and entrepreneurial excellence.

Market Disruption

AerNos is set to disrupt several industry verticals with its cutting-edge nano gas sensors featuring sophisticated multi-gas sensing and air quality determination capabilities that stand unmatched in the market. Driven by rapid advancements in the nanotechnology space, AerNos has taken advantage of the popular technology Mega Trend Internet of Things (IoT) to design its two groundbreaking nano gas sensors, AerCity and AerHome, for smart city and smart home applications, respectively, as well as the AerBand Research wearable device for the environmental science and research community.

AerNos designed these products by leveraging its proprietary nanotechnology called AerCNT technology. Characterized by the capability to detect multiple gases accurately and simultaneously, AerNos' nano gas sensing technology is revolutionary because of its unmatched selectivity and sensitivity, which allows the technology to determine air quality levels and detect toxic gases present in the air in extremely low concentrations at the parts-per-billion (ppb) level.

These sensors can respond within seconds of exposure to air contaminated with toxic chemicals and pollutants. Scheduled for shipment in May 2018, these plug-and-play AerNos sensors will offer valuable information on air pollution as well as concentration levels of toxic gases present in the air in real time. These large sets of data are re-processed by leveraging deep machine-learning algorithms and predictive models to generate actionable insights. Such information can empower health officials, first responders, consumers, and city administrations with instant actionable insights to help reduce exposure to contaminated air.

With air pollution considered as the primary cause of untimely deaths worldwide, such effective and fast actions will reduce the possibility of diseases caused by air pollution that can severely affect the quality and longevity of human life.

Bridging Market Gaps with Revolutionary Nano Gas Sensors

Conventional gas sensors are large and heavy, which make them fit for use only in industrial and commercial applications. These sensors can detect only one or two gases

simultaneously, and their form factor makes them unfit for use in space-constrained applications or embedded in small-sized MEMS boards. Therefore, these conventual sensors cannot be integrated into electronic devices with a compact form factor, which is an essential requisite for detecting air contamination levels. Additionally, conventional sensors can be costly, thus making them unfit for both mass production and large-scale deployment as well as reducing the value proposition in the process.

Boasting a small form factor of 3 millimeters (mm) x 3 mm, AerNos' innovative nano gas sensor array (with temperature and humidity sensing modalities) can be seamlessly embedded in consumers' IoT-enabled electronic devices to monitor and determine air quality levels. These sensor devices range from smart city applications and smart home appliances to wearables as well as devices used for detecting food spoilage and ensuring homeland security and for research purposes.

Additionally, these nano gas sensors can simultaneously detect volatile organic compounds (VOCs), apart from hydrogen sulphide, sulphur dioxide, nitrogen oxide (up to a 10-ppb level), methane, ozone, formaldehyde, and carbon monoxide. Until now, the ability to determine the level of airborne contaminants present in both indoor and outdoor environments has only been imagined. Consuming power of less than 20 mA while in operation, AerNos' sophisticated sensors can run constantly, thereby providing the ability to monitor air pollution and detect multiple harmful gases in the air in real time.

With the launch of its AerCity nano gas sensors, AerNos is enabling smart cities to monitor air pollution levels round-the-clock and determine the concentration of hazardous climate gases and areas of infrastructure leaks, all marked by the utmost granularity and, hence, a breakthrough level of accuracy. AerCity sensors are low cost and small in form, thus making them fit for large-scale integration with IoT-enabled smart city application devices, such as smart street lights and parking meters.

Moreover, these sensors are self-calibrating, which eliminates the hassle otherwise associated with ongoing calibration of conventional gas sensors, thus making large-scale integration possible. Additionally, because these sensors are compatible with standard communication protocols, data transfer and access are simplified.

AerNos' AerHome nano gas sensors can determine indoor air quality by detecting the presence of air contaminants and harmful toxic gases. AerHome sensors are fit for integration in smart home devices, including air filtration systems, smoke detectors, personal digital assistants, smart lights, and several other IoT-based electronic devices, thus providing IoT device integration partners the capability to automatically mitigate air pollution while providing residents with accurate and real-time information on air quality, including effective suggestions they can implement to reduce exposure to such contaminants.

With air pollution as the primary cause of diseases and untimely deaths worldwide, environmental research scientists are deeply engaged in studying how hazardous air contaminants are affecting human health and how reducing the exposure to these toxic elements can increase the human wellness quotient.

AerNos' launch of the AerBand Research wearable device will play a game-changing role in advancing the research of environmental scientists and research institutions in the United States and around the world on the impact of air pollution on human health. The absence of such a device has been a significant limitation to health research, especially related to air pollution exposure and air quality determination.

Using AerNos' revolutionary wearable device, scientists can monitor the personal air circulating around research participants, both indoors and outdoors, on a round-the-clock basis. This ability will offer better insights into health research and advance the development of effective solutions that can reduce the rate of diseases and deaths caused by air pollution. Such solutions will empower regulatory bodies and smart cities to manage air pollution better and enhance quality of life. Moreover, these insights will benefit different companies focused on building systems that will effectively address air pollution-triggered health and safety issues.

Research participants need to wear either the device or attach it as a clip, and research scientists only need to pair these devices with an end-user application to view real-time air pollution data as well as actionable insights. In addition, AerNos' AerBand Data Cloud application programming interface (API) allows research institutions to access participants' information, including geolocation.

Customer Acquisition

Highly impressed by the revolutionary capabilities of AerNos' nano gas sensors, MPS Inc decided to collaborate with AerNos in January 2018 to integrate these state-of-the-art products into its IoT-enabled smart city parking meters. This integration will equip MPS's smart parking meters with the reliable and round-the-clock ability to detect contaminant levels in the air, both on and off the streets of smart cities in Canada and the United States.

With the growing popularity of the smart city concept that promises to guarantee citizens an enhanced quality of life, such collaborative initiatives are slated to improve citizens' quality of life by creating a sustainable environment through informed decision making and strong measures to reduce harmful levels of air pollution and contaminants that impact human health.

AerNos also has orders from multiple research institutions, including children's hospitals and major research universities, to provide AerBand Research in units for use in air pollution health studies.

Strategic Geographical Expansion

Asia-Pacific is the fastest growing market for gas sensors, especially for smart city and eHealth applications; therefore, AerNos has made the strategic decision to establish its geographical footprint in this region by setting up a fully-owned subsidiary called AerNos Japan GK.

AerNos' entrepreneurial excellence is further exemplified by its decision to appoint Mr. Seiji Miwa-san, who possesses 40 years of rich executive and leadership experience in the electronics and semiconductor domain, as the president of this subsidiary. AerNos is looking to leverage Mr. Miwa-san's strong rapport with leaders of several top Japanese semiconductor companies to strengthen and accelerate the penetration rate of AerNos' gas sensor products in Japan as well as in the rest of Asia.

Endless Application Potential in Future

The growth of the gas sensors market is expected to open up endless application possibilities for AerNos' gas sensors in the coming years. These applications could include detecting food spoilage and safety through odor sensing, determining the air quality inside vehicles and in work environments, and measuring the amount of contaminants and toxic chemicals in the air circulating throughout industrial environments.

For instance, when a driver is stuck in traffic, the air circulating inside the vehicle is 10 times more polluted than the outside environment. People inside the vehicle inhale this poor-quality air, which could consequently affect their health in either the short- or long term. In such a context, integrating AerNos' nano gas sensor into the vehicle's air filtration system can purify the air after detecting the presence of harmful contaminants by leveraging photoionization methods.

Furthermore, AerNos' sensors can be used in medical research and preventive health applications to detect different types of diseases, such as respiratory disease, at an early stage by assessing the patient's exhaled breath.

As an entrepreneurial company focused on building application-specific nano gas sensors that can be seamlessly embedded into connected devices, AerNos is already being approached by major companies hailing from various sectors, such as automotive, oil and gas, chemicals and petrochemicals, manufacturing, transportation, and electronic appliances, as well as by original equipment manufacturers (OEMs) for collaborative partnerships and innovations targeted toward their respective application domains.

Companies are already looking to integrate hundreds of thousands of sensor units in the first year, a million units in the second year, and so on, thus aligning well with AerNos' vision of providing a trillion nano gas sensor networks within 10 years. In addition, AerNos is looking to penetrate the smartphone market in the next 2 to 3 years, and AerNos is

already in talks with industry leaders, which will help AerNos launch new application-specific solutions in the future.

Based on such knowledge-sharing conversations, AerNos is building its advisory board around these futuristic trends and application possibilities so it can continue revolutionizing the customer experience.

Conclusion

Aligned with its vision of establishing a trillion nano gas sensor networks within 10 years, AerNos has taken the strategic initiative to prepare a strong foundation that will enable it to meet the rapidly growing global demand for multi-gas detection sensors in the coming years.

AerNos' visionary leadership and entrepreneurial excellence are exemplified by the company's strategic partnerships, including Rogue Valley Microdevices, to support the mass manufacturing of its revolutionary AerHome for smart home applications, AerCity for smart city applications, and the groundbreaking AerBand Research for the research community; the decision to establish a fully-owned subsidiary in Japan to reach out to customers based across Asia; and the appointment of Mr. Miwa-san as the president of this subsidiary.

Furthermore, the superior capabilities of AerNos' sensors, including detecting multiple harmful gases simultaneously, determining ppb levels, consuming low power, and featuring a small form factor, are already providing AerNos with an edge over other market participants. AerNos has received excellent responses from major enterprises hailing from most industry verticals, and the company is in talks with big enterprises that are keen to design solutions collaboratively that target specific application areas.

With its strong overall performance, AerNos Inc has earned Frost & Sullivan's 2018 Entrepreneurial Company of the Year Award.

Significance of Entrepreneurial Leadership

Ultimately, growth in any organization depends upon customers purchasing from a company and then making the decision to return time and again. In a sense, then, everything is truly about the customer—and making those customers happy is the cornerstone of any long-term successful innovation or growth strategy. To achieve these dual goals (customer engagement and growth), an organization must be best-in-class in three key areas: understanding demand, nurturing the brand, and differentiating from the competition.

Understanding Entrepreneurial Leadership

Demand forecasting, branding, and differentiation underpin an entrepreneurial company's journey toward forming deep relationships with customers and permanently altering the market with their actions. These two concepts—Entrepreneurial Innovation and Customer Impact—are the cornerstones of this Award, as discussed further in the next section.

Key Benchmarking Criteria

For the Entrepreneurial Company of the Year Award, Frost & Sullivan analysts independently evaluated two key factors—Entrepreneurial Innovation and Customer Impact—according to the criteria identified below.

Entrepreneurial Innovation

Criterion 1: Market Disruption
Criterion 2: Competitive Differentiation
Criterion 3: Market Gaps
Criterion 4: Blue Ocean Strategy
Criterion 5: Passionate Persistence

Customer Impact

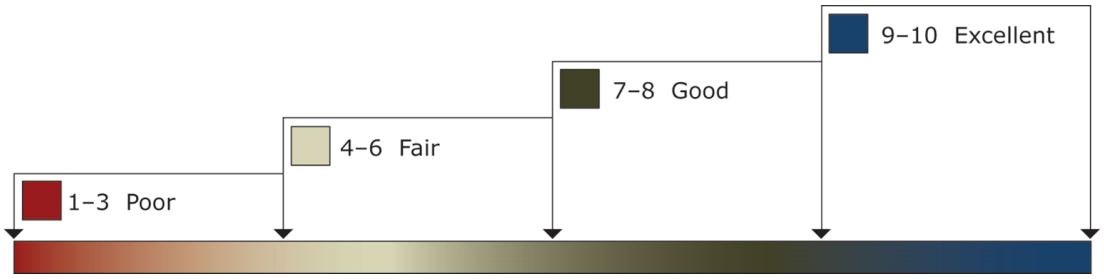
Criterion 1: Price/Performance Value
Criterion 2: Customer Purchase Experience
Criterion 3: Customer Ownership Experience
Criterion 4: Customer Service Experience
Criterion 5: Brand Equity

Best Practices Award Analysis for AerNos

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 our 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 is organized by Entrepreneurial Innovation and Customer Impact (i.e., these are 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, we have chosen to refer to the other key participants as Competitor 2 and Competitor 3.

Measurement of 1–10 (1 = poor; 10 = excellent)			
Entrepreneurial Company of the Year	Entrepreneurial Innovation	Customer Impact	**Average Rating**
AerNos	**9.8**	**9.6**	**9.7**
Competitor 2	8.5	8.7	8.6
Competitor 3	8.2	8.0	8.1

Entrepreneurial Innovation

Criterion 1: Market Disruption

Requirement: Innovative solutions that have genuine potential to disrupt the market, obsoleting current solutions and shaking up competition

Criterion 2: Competitive Differentiation

Requirement: Deep understanding of both current and emerging competition to create and communicate strong competitive differentiators in the market

Criterion 3: Market Gaps

Requirement: A clear understanding of customers' desired outcomes, the products that currently help them achieve those outcomes, and where key gaps may exist

Criterion 4: Blue Ocean Strategy

Requirement: Strategic focus on creating a leadership position in a potentially "uncontested" market space, manifested by stiff barriers to entry for competitors

Criterion 5: Passionate Persistence

Requirement: A deep belief in the "rightness" of an idea and a commitment to pursuing it despite seemingly insurmountable obstacles

Customer Impact

Criterion 1: Price/Performance Value

Requirement: Products or services offer the best value for the price, compared to similar offerings in the market.

Criterion 2: Customer Purchase Experience

Requirement: Customers feel they are buying the most optimal solution that addresses both their unique needs and their unique constraints.

Criterion 3: Customer Ownership Experience

Requirement: Customers are proud to own the company's product or service and have a positive experience throughout the life of the product or service.

Criterion 4: Customer Service Experience

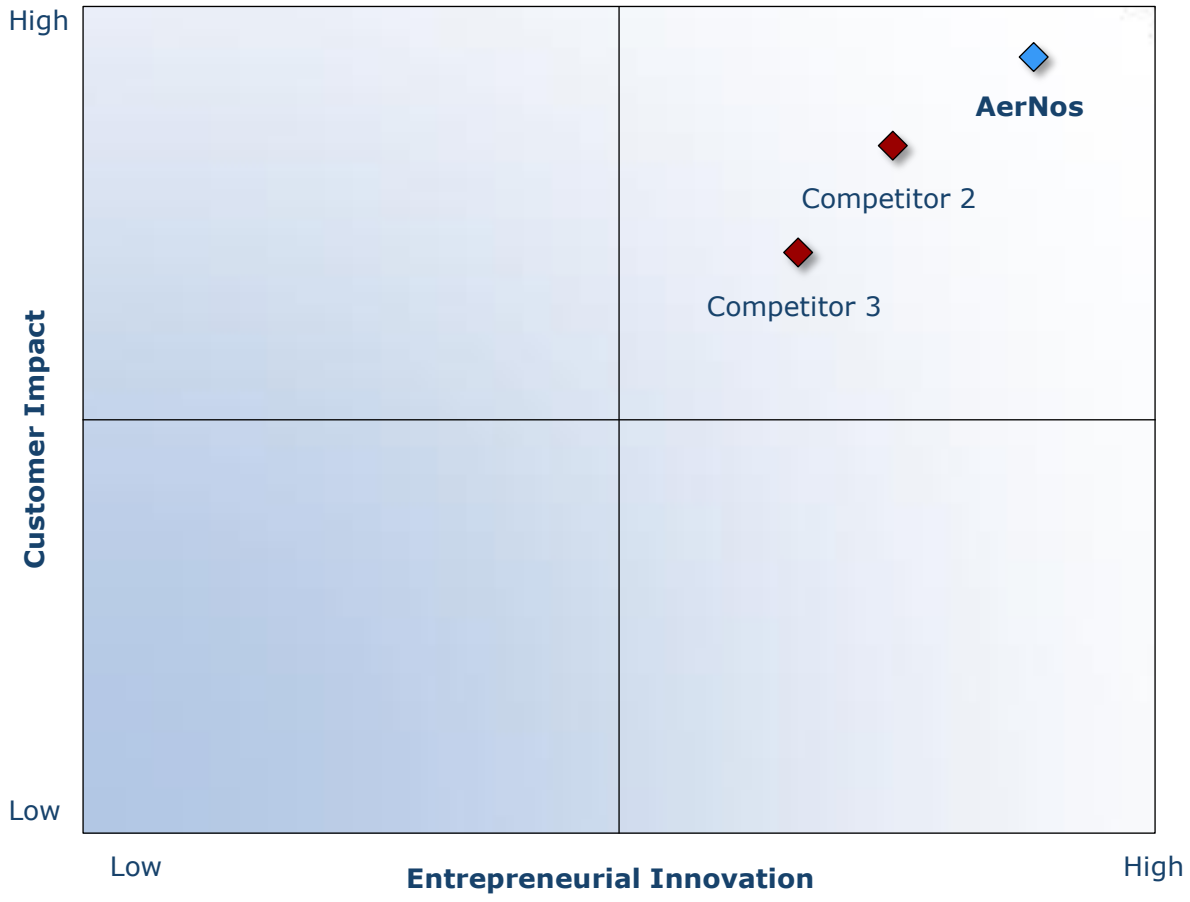
Requirement: Customer service is accessible, fast, stress-free, and of high quality.

Criterion 5: Brand Equity

Requirement: Customers have a positive view of the brand and exhibit high brand loyalty.

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 practice 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 globe	• Conduct in-depth industry research • Identify emerging sectors • Scan multiple geographies	Pipeline of candidates who potentially meet all best-practice criteria
2	**Perform 360-degree research**	Perform comprehensive, 360-degree research on all candidates in the pipeline	• Interview thought leaders and industry practitioners • Assess candidates' fit with best-practice 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	• Confirm best-practice 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	• Brainstorm ranking options • Invite multiple perspectives on candidates' performance • Update candidate profiles	Final prioritization of all eligible candidates and companion best-practice positioning paper
5	**Assemble panel of industry experts**	Present findings to an expert panel of industry thought leaders	• 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	• 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	• 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-practice Award recipient	• Review analysis with panel • Build consensus • Select recipient	Decision on which company performs best against all best-practice criteria
9	**Communicate recognition**	Inform Award recipient of Award recognition	• Present 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	• Coordinate media outreach • Design a marketing plan • Assess Award's role in future 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 our 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, leading to 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.

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS

About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, enables clients to 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 practice models to drive the generation, evaluation and implementation of powerful growth strategies. Frost & Sullivan leverages more than 50 years of experience in partnering with Global 1000 companies, emerging businesses, and the investment community from 45 offices on six continents. To join our Growth Partnership, please visit http://www.frost.com.