FROST & SULLIVAN

# BEST PRACTICES AWARDS


BERKSHIRE GREY

## 2020 NORTH AMERICAN AI-BASED ROBOTIC FULFILLMENT SYSTEMS ENABLING TECHNOLOGY LEADERSHIP AWARD

# Contents

# Background and Company Performance

## *Industry Challenges*

From eCommerce to retail and consumer packaged goods (CPG), companies want to solve operational challenges in their warehouses that are impacting supply chains so they can capitalize on new logistics opportunities. Some of the major operational challenges are labor scarcity or availability, and the pressure to improve capacity and maximize utilization of existing facilities and assets. In addition, the COVID-19 pandemic has made labor availability as well as labor management (e.g., maintaining social distancing between workers within facilities) all the more difficult, thereby intensifying operational challenges. Yet despite COVID-19 and with fewer workers available, Frost & Sullivan points out that companies remain under pressure to deliver customer orders faster and safer.

Operational challenges in today's labor market cannot be addressed by simply increasing worker numbers, which will certainly not help companies stay competitive and cost-effective. Market forces such as the current pandemic, other operational challenges impacting supply chains, evolving consumer preferences, advances in technology, and intensifying competition are all forcing companies to change the way they do business to improve efficiency, raise quality, and get their goods to more places more rapidly than ever before. Businesses that do not innovate and adapt won't thrive.

Consequently, many companies are moving rapidly to adopt innovative robotic automation. Some automation systems, however, lack wide-ranging functionalities, such as the ability to pick, pack, and sort a variety of items of different sizes; systems integration; and intelligence, to name a few. In addition, the software is neither scalable nor flexible. As such, Frost & Sullivan notes that companies need automation systems that will enable them to move forward and adapt to changing times. They cannot afford to stick with traditional and cumbersome systems that are slowing them down.

Under such circumstances, Frost & Sullivan analysts conclude that the vendors that offer advanced robotic systems and solutions to help companies automate their entire operations, change the way they do business, and remain cost-competitive while meeting evolving consumer preferences in a futuristic and adaptable way will secure leadership positions in the market.

## *Technology Leverage and Customer Impact*

**Commitment to Innovation & Creativity**

Staying true to its commitment to automating fulfillment processes in retail, eCommerce, and logistics, Berkshire Grey (BG) leverages its solid foundation and proven track record to offer advanced AI and robotics solutions. Founded in 2013, the company has received extensive backing from Khosla Ventures, NEA, SoftBank, and Canaan Partners. One of the factors that has contributed to the company's success is its in-house team of highly efficient and talented employees who have deep academic and industry experience in robotics and AI. More than 70% of the company's technical team comes from advanced robotics, AI, and engineering backgrounds at institutions ranging from MIT, CMU, Cornell,

UPenn, WPI, and Stanford. In addition, the company's team has extensive operational experience in working with industry heavyweights such as Google, Oracle, iRobot, Tesla, Microsoft, and Kiva/Amazon Robotics, where they developed commercially viable products generating billions in revenue in consumer, medical, military, and other markets.

Frost & Sullivan finds that BG clearly demonstrates its technology leadership based on several distinguishing fronts. For instance, the company discovered that creating successful robotics automation systems and solutions requires more than building software and hardware; it requires expertise across various domains, something that many of its competitors simply lack. Keeping this in mind, BG has taken a holistic approach to developing all components, including cloud-based, modular, and scalable AI software technologies for perception (i.e., computer vision), learning (i.e. machine learning), motion planning, grasping, and sensing; AI-enabled robotics; electro mechanicals; flexible systems integration; and mobility. This means that BG does not sell the robot, the computer vision, or the software separately, but nicely packages them together to create novel and configurable solutions that the market needs – all so that its customers can gain maximum value from them. As opposed to other competing manual (essentially, figure-it-out-on-your-own) systems, a lot of advanced engineering underpins how BG designed and integrated these technologies, instead of leaving it up to someone else to assemble. In addition, BG's API facilitates seamless and secure coordination, connectivity, and integration between its systems and other enterprise IT systems (e.g., WMS, WES, CMMS, and EAS) that its customers have been running on their business processes.

As warehouse robotics are largely about identifying, perceiving, and grasping, they also require great reach, speed, and conveyance to automate accurate picking at high speed and with great efficiency. Frost & Sullivan finds that BG excels in all aspects. BG has written advanced video processing algorithms to isolate and identify goods and their grasp points, even in unstructured or cluttered environments. Therefore, when looking in a tote, for example, BG's system is able to figure out what it contains, how to pick it up, and how to adjust in realtime to whatever changes happen in a dynamic, physical environment. To do so, the sensor built into the system not only sees and picks goods in realtime, but also handles them effectively (without crushing or smashing anything). Such nuances help BG handle unpackaged apparel, such as a hat. BG manages millions of stock keeping units (SKUs) in a variety of form factors, whereas its competitors cannot handle the breadth of products that BG covers.

In addition, BG's systems handle goods or items that they have never processed or dealt with before. For example, if the system has never seen a sauce bottle, but has seen a shampoo bottle, then it will pick up the sauce bottle the way it picks up a shampoo bottle. And if it loses grip, then the system will sense the pressure differential in realtime and adjust. Overall, BG's system keeps running and does not stop just because it has come across a newer item. And with ML built into the core software, BG's system automatically self-learns and performs its operations even more efficiently the next time. Frost & Sullivan is impressed that BG's systems get better over time with every pick completed at a customer's facility.

After identifying, perceiving, and grasping items, the robotics system moves them quickly without failure. BG's motion planning rapidly transports goods to a wide range of locations without dropping anything or colliding with obstacles. Chief among BG's identification capability is its patented HyperScanner for scanning items at speed. The picked items pass through the HyperScanner vertically enabling fast reading on a variety of goods including irregular shaped packages - as opposed to people or robot arms picking up an item and then trying to wave it by a bar code scanner, a process that consumes much time to identify an object.

Frost & Sullivan applauds BG's holistic approach of combining scalable and reliable AI software, robotics, and electro mechanicals that has resulted in increased adaptability, precision, speed, and continuous performance improvements, all while automating tasks that were previously not possible by conventional machines and systems.

**Application Diversity**

For customers to gain maximum value, robotic systems should complete the entire business process for them, support their growth, and leave them the flexibility to scale. Yet cumbersome and rigid automation systems that force customers to conform to the available software and system too often slow them down. Frost & Sullivan analysts believe that BG truly disrupts this outdated model. The company is all about applying its technological expertise in AI and robotics to deliver next-generation products and solutions that customers can use to innovate, adapt quickly to future changes, and essentially change the way they do business. What is impressive about BG is its use of advanced technologies to offer a portfolio of complete and comprehensive, engineered solutions. To this end, the company effectively matches its capabilities to meet industry applications through a unique combination of 5 AI-enabled robotic solutions: Robotic Pick Cells (RPCs), Robotic Induction Stations (RISs), Robotic Store Replenishment System (RSRS), Robotic Parcel Sortation (RPS), and Mobile Robotic Fulfillment Systems.

*Robotic Pick Cells (RPC):* In a goods-to-person station, the human worker stands at a station, picks items out of bins, and puts items into bins — a very "robotic-type" of activity. While cobots, or collaborative robots, exist to help warehouse personnel, they do not provide the breadth, reach, and performance required to service these workstations in a scalable manner. BG's independent RPCs convert the traditional goods-to-person workstations into goods-to-robot stations to fully automate picking from automated storage and retrieval systems (ASRS) and micro-fulfillment centers, therefore increasing the efficiency and accuracy of picking.

Creating a functional goods-to-robot station requires that the robot and surrounding instruments fit properly. Knowing quite well that a one-size-fits-all approach simply would not work, BG has designed a set of RPCs that are compatible with existing stations. Now, BG easily converts a goods-to-person station into a goods-to-robot station. For instance, the modular design of an RPC allows direct and flexible integration with a wide range of existing equipment and systems. BG supports scalability by integrating with multiple stations as and when its customers' needs grow.

*Robotic Induction Stations (RIS):* Sorters cost millions of dollars and are therefore a huge capital investment. Inducting items to traditional sorters often involves numerous people who complete manual, labor-intensive, repetitive activities (e.g., manual scan, manual place) that are ripe for automation. In manual induction setups, workers are clustered. The BG RIS system with auto identification and speed injection automates product and package induction for traditional sorters and improve capacity and utilization without requiring manual labor. Since multiple RIS systems can work in parallel, total throughput is increased. Similar to an RPC, RIS's independent design allows the solution to scale to meet a customer's throughput needs; and the modular design allows direct and flexible integration with a wide range of existing equipment and systems.

*Robotic Store Replenishment (RSR) systems:* BG's RPCs automate what one person can do, whereas its RISs, slightly more complex, automate what a group of people do. However, BG's overall approach is to offer holistic solutions, so it created RSRs. RSRs are a complete solution that can pick millions of items continuously for many orders simultaneously to gain efficiencies both upstream and downstream of the picking process. The primary use case for this solution is to autonomously pick, pack, and ship less-than-case orders for retail store replenishment. Item presentation, singulation, sortation, completion, and order circulation are the robotic store replenishment processes handled by BG's RSRs. This solution may be integrated with manual storage approaches or ASRS systems from multiple suppliers.

*Robotic Parcel Sortation (RPS):* eCommerce has introduced a tremendous amount of small parcels (e.g., padded mailers, poly bags), and retailers get charged for every parcel they send to UPS or FedEx. Not only does UPS charge for every parcel, it is cumbersome for it to physically handle every single parcel. In an effort to address this issue, BG's robotic parcel sortation solution autonomously sorts small parcels by zones, zip code, or other user defined location strategies into bags, boxes or reusable containers. BG sells its robotic parcel sortation solution to both retailers and parcel companies. This solution picks all small parcels going to the same location and puts them into one big bag, box or container that the parcel carrier can move through its network. This approach makes it less expensive for retailers and parcel companies to ship and sort small packages, and less painful for the carriers to handle at each point in their networks.

*Mobile Robotic Systems:* BG's proprietary mobile robots work as an orchestrated 'swarm' to provide a fast, flexible, and accurate system for picking and transporting orders based on customer sequencing requirements. The systems are highly configurable, deliver items where needed, and enable granular scheduling capabilities that traditional conveyor-based systems are unable to. This allows distribution operators to load trucks and rolling cages in specific orders such that the unload and put-away processes will be optimized for efficiency at the downstream customers (stores or other enterprises).

Overall, Frost & Sullivan recognizes BG for combining its proprietary and advanced technologies into 5 engineered solutions that solve end-to-end problems for its customers.

**Customer Ownership, Purchase, and Service Experience**

Primarily, BG serves the retail supply chain, which includes CPG manufacturers and retailers. Customers clearly find BG appealing, as its innovative robotic automation solutions enable them to meet evolving consumer preferences, stay competitive amid intensifying competition, improve capacity and utilization of existing facilities and assets, and remain cost-effective by averting the need to staff up.

Labor scarcity, which was already a looming issue, has intensified; a large percentage of the warehouse labor force is out of work due to the COVID-19 pandemic. Frost & Sullivan believes that labor scarcity will remain an issue well into the future. The need to maintain social distancing within facilities has made labor management all the more difficult. Yet some customers in the retail sector whose business is booming almost every day have to meet consumer demands despite pandemic-caused constraints and labor scarcity. Frost & Sullivan finds that the aspect of BG's robotic automation solutions that deliver some of the greatest customer value during this health crisis is in completing orders faster and safely, but with fewer or no people. For instance, BG's automation solutions facilitate social distancing within facilities, because workers are not clustered. Frost & Sullivan appreciates BG for enabling its customers to operate at full efficiency, meet consumer demands, maintain social distancing and safety, and remain productive with minimal personnel amid COVID-19 conditions.

BG's customers have gained competitive advantage as well as immediate and significant return on investment (ROI). For instance, a single distribution center of a national retailer in the United States that replenishes more than 2.5 million units per month using traditional operations was spending more than 10,000 labor hours per year on store replenishment. BG helped this national retailer achieve increased productivity and capacity with less dependency on manual labor. Upon using BG's RSR system, the retailer was able to reduce direct labor by more than 70% and saves millions of dollars in labor costs every year.

## *Conclusion*

Companies dependent on dynamic warehouse and supply chain processes need intelligent, advanced, and flexible robotic automation systems to solve their operational challenges, change the way they do business, and quickly adapt to any industry disruption. Frost & Sullivan analysts conclude that BG's solutions built on AI-enabled software, robotics, and electro-mechanicals that automate fulfillment activities in retail, eCommerce, and logistics successfully address this need.

BG's products and technologies redefine and transform pick, pack, and sort operations. The company's use of advanced technologies to identify, perceive, and grasp millions of items of various sizes as well as its systems' reach, speed, and conveyance to automate the warehouse environment with high-speed, accuracy, and efficiency is impressive. The use of ML and AI enables BG's systems and solutions to constantly learn and continuously improve - so that customers' operations are ultimately not interrupted.

In addition, BG's 5 AI-enabled comprehensive, engineered solutions further enhance the

customer value proposition. Customers that have adopted BG solutions handle more items and automate all operations, which some competing as well as traditional systems are unable to achieve. What largely differentiates BG is that it enables its customers to innovate, adapt quickly to changing market conditions, thrive in uncertain times like the COVID-19 pandemic, and meet evolving consumer preferences amid intensifying competition.

For its strong overall performance, Berkshire Grey has earned the 2020 Frost & Sullivan Enabling Technology Leadership Award.

## Significance of Enabling Technology Leadership

Ultimately, growth in any organization depends on 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. Making customers happy is the cornerstone of any successful, long-term growth strategy. To achieve these goals through enabling technology leadership, an organization must be best in class in three key areas: understanding demand, nurturing the brand, and differentiating from the competition.


## Understanding Enabling Technology Leadership

Product quality (driven by innovative technology) is the foundation of delivering customer value. When complemented by an equally rigorous focus on the customer, companies can begin to differentiate themselves from the competition. From awareness, to consideration, to purchase, to follow-up support, organizations that demonstrate best practices deliver a unique and enjoyable experience that gives customers confidence in the company, its products, and its integrity.

### *Key Benchmarking Criteria*

For the Enabling Technology Leadership Award, Frost & Sullivan analysts independently evaluated Technology Leverage and Customer Impact according to the criteria identified below.

**Technology Leverage**

Criterion 1: Commitment to Innovation
Criterion 2: Commitment to Creativity
Criterion 3: Stage Gate Efficiency
Criterion 4: Commercialization Success
Criterion 5: Application Diversity

**Customer Impact**

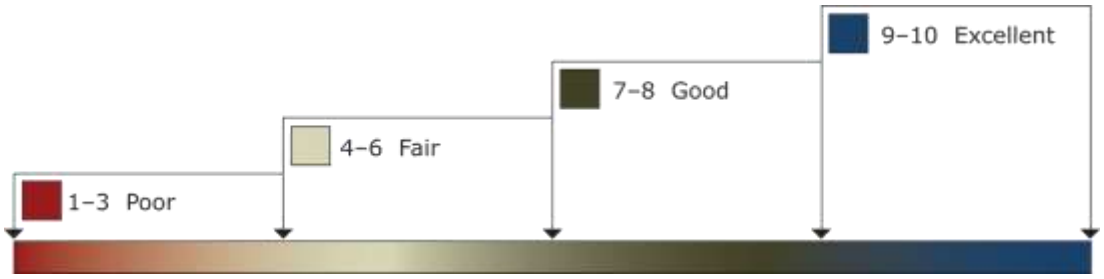
Criterion 1: Price/Performance Value
Criterion 2: Customer Purchase Experience
Criterion 3: Customer Ownership Experience
Criterion 4: Customer Service Experience
Criterion 5: Brand Equity

## Best Practices Award Analysis for Berkshire Grey

### *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 Leverage and Customer Impact (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 2 and Competitor 3.

| *Measurement of 1–10 (1 = poor; 10 = excellent)* | | | |
|---|---|---|---|
| **Enabling Technology Leadership** | Technology Leverage | Customer Impact | **Average Rating** |
| | | | |
| **Berkshire Grey** | **9.0** | **9.0** | **9.0** |
| Competitor 2 | 8.5 | 7.5 | 8.0 |
| Competitor 3 | 7.0 | 7.0 | 7.0 |

## *Technology Leverage*

### Criterion 1: Commitment to Innovation

Requirement: Conscious, ongoing adoption of emerging technologies that enable new product development and enhance product performance.

### Criterion 2: Commitment to Creativity

Requirement: Technology leveraged to push the limits of form and function in the pursuit of white space innovation.

### Criterion 3: Stage Gate Efficiency

Requirement: Adoption of technology to enhance the stage gate process for launching new products and solutions.

### Criterion 4: Commercialization Success

Requirement: A proven track record of taking new technologies to market with a high rate of success.

### Criterion 5: Application Diversity

Requirement: The development and/or integration of technologies that serve multiple applications and can be embraced in multiple environments.

## *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 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

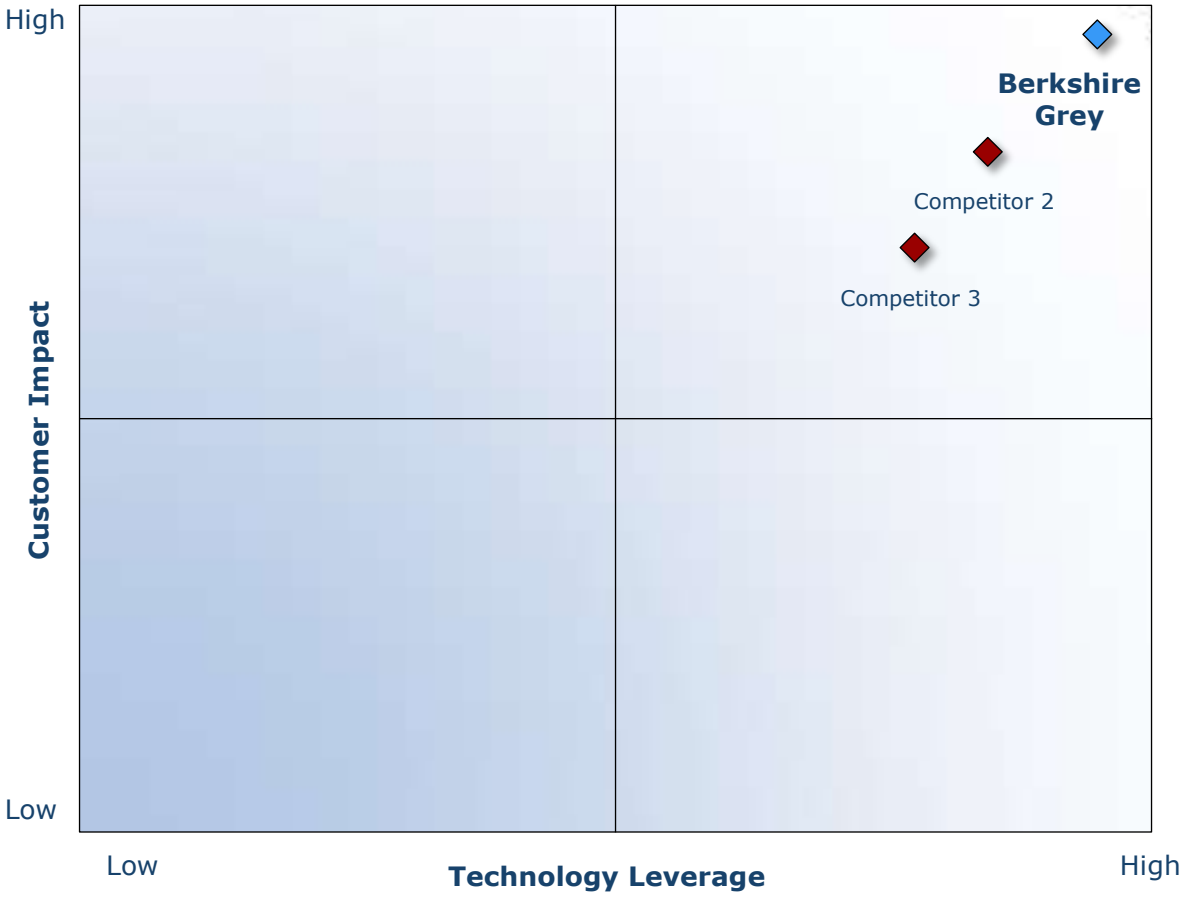
Requirement: Customer service is accessible, fast, stress-free, and of high quality.

**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 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 | • Conduct in-depth industry research<br>• Identify emerging industries<br>• 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 | • Interview thought leaders and industry practitioners<br>• Assess candidates' fit with best practices criteria<br>• 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 practices criteria<br>• Examine eligibility of all candidates<br>• 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<br>• Invite multiple perspectives on candidates' performance<br>• 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 | • Share findings<br>• Strengthen cases for candidate eligibility<br>• 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<br>• Pressure-test fit with criteria<br>• 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<br>• Write nominations<br>• 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 | • Review analysis with panel<br>• Build consensus<br>• Select recipient | Decision on which company performs best against all best practices criteria |
| 9 | **Communicate recognition** | Inform Award recipient of recognition | • Announce Award to the CEO<br>• Inspire the organization for continued success<br>• 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<br>• Design a marketing plan<br>• 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.

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS


## 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.