2016 Global Big Data Analytics
For Semiconductor and Electronics
Visionary Innovation Leadership Award
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Background and Company Performance

Industry Challenges

Business Optimization through Big Data Products Analytics

Electronics original equipment manufacturers (OEM) are in a bind, struggling to improve their operations to increase their production yield, operational efficiency, and product quality by reaching objectives such as zero defective parts per million (DPPM). In addition to the enormous amount and variety of data that these companies deal with, a lack of control over manufacturing data and standardization makes it extremely difficult for these organizations to extract value from the data that they collect. Engineers end up spending an inordinate amount of time locating the data they need for analysis and then contextualizing it in order to perform analytics to be able to act on insights from the data.

The complex supply chain of most electronics OEMs, which typically includes multiple contract manufacturers and IC suppliers, compounds the above-mentioned challenge, making it difficult for these companies to have complete visibility throughout their supply chain. Electronics OEMs require insights throughout their distributed operations, including into factories that they do not own. They also need to be able to easily make changes to their supply chain. With distributed
operations, security also remains a top concern for many electronics manufacturers looking to capture the benefits of Big Data analytics solutions. Hence, these organizations require well thought-out solutions with encryption and authentication capabilities. Meanwhile, the increasing complexity of smart products, more demanding users, and stiff competition are driving the onus of product quality and productivity.

**Focus on the Future and Best Practices Implementation**

**Visionary Scenarios through Mega Trends**

Requirement: Incorporate long-range, macro-level scenarios into the innovation strategy, thereby enabling “first-to-market” growth opportunities and solutions.

With its electronics solutions, Optimal+ endeavors to provide the missing link between the electronics and semiconductor industries. Its leading position in the integrated circuit (IC) and multi-chip packages space (MCP), coupled with its coverage of populated printed circuit boards (PCBs), PCB rework, and complete electronic systems, provide it with a platform to reach that goal. Optimal+’s big data infrastructure provides a common platform to connect the electronics supply chain to that of the semiconductor industry. As such, all the test and process data collected from semiconductors is in the same database as the test data from PCBs, rework PCB data, genealogy, systems’ performance data, and semiconductor reliability data.

Eventually, Optimal+ will include in-use data and reliability data for electronics, providing the ultimate Big Data product analytic solutions for both semiconductor and electronics manufacturing, which the company refers to as the Suppliers Quality Network (SQN), addressing the need for a bi-directional data linkage between semiconductors and electronic systems. Currently in a proof-of-concept program with a major electronics networking company, SQN takes advantage of Optimal+’s common database to share mutually agreed upon data between the semiconductor and electronics supply chains with the ultimate objective of addressing quality, reliability, and warranty issues for the entire semiconductor-electronics ecosystem.
Another capability provided by Optimal+ in both the semiconductor and electronics environments is a feature called Data Feed Forward (DFF), which enables customers to leverage prior test results within a current test to screen out suspect devices from a good population. With DFF, analytics are performed by using the board or device ID to selectively retrieve previous test measurements from the Optimal+ database while that board or device is sitting on a functional tester undergoing tests. The ability to compare test results between current and prior test operations in real time enables customers to identify issues such as excessive parametric drift between certain test results which can be used to identify a good device that has passed all the required tests but will probably fail prematurely. Scenarios like these are why electronics manufacturers need solutions that can go further than a simple good or bad designation. Optimal+ has solved this challenge by providing customers with the ability to quickly and automatically retrieve historical test data that can be used in real-time in order to screen out bad devices from good populations, enabling customers to meet aggressive quality goals while maintaining high yields.

Although SQN is Optimal+’s long-term vision for the industry, its solutions for semiconductors and electronics are standalone and fully self-contained; the semiconductor solution has always been standalone, used by leading companies in the semiconductor industry for the past 10 years. While there are benefits for an electronics OEM to use the semiconductor and electronics solutions together (the aforementioned SQN), the electronics solution is also fully standalone and can be used without any access to the semiconductor solution or its accompanying data.
The key semiconductor solutions include Global Ops for Semiconductors and Characterization, which address IC and multi-chip package applications including productivity and yield (reclamation and ramp). Optimal+ also provides semiconductor solutions that address quality such as Escape Prevention and Outlier Detection. In parallel, the company offers Global Ops for Electronics, which is at the core of its Electronics Operations Platform, and will be introducing its New Product Introduction (NPI) and ramp solution for electronics later this year.

Blue Ocean Strategy

Requirement: Focus on creating a leadership position in a potentially “uncontested” market space, manifested by stiff barriers to entry for competitors.

Optimal+ is targeting quality-sensitive electronic industries including automotive, networking/data servers, and smart electronics such as smartphones. The company’s first step into the Big Data product analytics solutions market for electronics manufacturing was in release 6.5 of its software. Developed in close partnership with NVIDIA, Optimal+’s solution for electronics is thorough, spanning the needs of customers across the product lifecycle from ICs and Multi-Chip Packages (MCPs), PCBs and the rework that is performed on those boards, to the systems in which the boards are incorporated. Optimal+ developed another strategic partnership to tackle the heterogeneous test environment of the electronics manufacturing industry with National Instruments (NI), taking advantage of the common use of NI TestStand and LabVIEW in electronics manufacturing.
While the development of these partnerships took time and effort, Optimal+ is in a league of its own in the Big Data product analytics market for semiconductors and electronics. One of the key aspects of Optimal+’s solutions is its holistic approach, wherein the company collects, manages, and governs the data to perform analytics and to drive immediate and automatic action throughout the supply chain. The company also puts significant emphasis on using quality data while other solutions might use data already collected by the customer. Similar to what it does in semiconductors, the company obtains the data directly from the testers that reside on its customers’ manufacturing lines and gathers the information in servers installed at all factories that supply parts to customers. Because Optimal+ collects data directly from the source, it is always good, clean data. In addition, it augments this data with data from other sources including manufacturing execution system (MES) data and genealogy data. The use of complete and reliable data is critical for data analysis. Optimal+ spends significant efforts on ensuring its customers have the most complete, high integrity data to perform product analytics, which is a key reason for the strong return on investment (ROI) that customers have experienced with Optimal+’s solutions.

Optimal+’s technology also brings unique and differentiated value to the popular area of Industrial Internet of Things (IIoT). Most of today’s focus in IIoT is on improving manufacturing processes through big data analytics. To this important element Optimal+ adds improvement of the manufactured product itself through product-based big data analytics.

**Technological Sophistication**

Requirements: Systems enable companywide transparency, communication, and efficiency.

Optimal+’s Electronics Operations Platform includes Global Ops for Electronics and its upcoming NPI and ramp solution for electronics. These solutions as well as its semiconductor solutions are both developed on the same software, release 6.5, to enable SQN. Similar to Global Ops for Semiconductors, Global Ops for Electronics is an end-to-end solution that encompasses data collection and analysis, and drives immediate action to be taken throughout the supply chain based on manufacturing data and eventually in-use and Return Merchandise Authorization (RMA) data. Using rules, the solution monitors operations automatically and continuously, and takes action in real time when needed. While most test methods use 0/1 binning, namely a chip or a product is deemed "good" or
"bad" based on test results, the analytics Optimal+ provides help eliminating "false positives", thus improving quality, and "false negatives", thus improving cost and revenue. In addition, these product analytic capabilities also help support other requirements such as adaptive testing and smart pairing.

Optimal+ employs a number of data scientists that have developed a multitude of algorithms and rules for its solutions providing it with a significant edge over competing solutions, both homegrown and commercial. With personnel at customer sites, Optimal+’s solutions have been developed with a deep knowledge of the specific challenges and requirements faced by semiconductor and electronics manufacturing customers, reducing the need and time for its customers to tailor the solutions to their needs, while producing actionable insights and tangible results.

**Focus on Unmet Needs**

Requirement: Implement a robust process to continuously unearth customers’ unmet or under-served needs, and create the products or solutions to address them effectively.

Increasing yield and quality remains the top priorities for electronics manufacturers as they strive to bring higher quality and more reliable products to the market while lowering costs, especially in segments like automotive and data servers. One of the key obstacles to reaching these objectives is the separate supply chains of electronics manufacturers and semiconductor companies, which prevent overall supply chain management. This is compounded by silos within each supply chain, where data is not shared between the different phases of the manufacturing process, even those taking place at the same location. This challenge has remained unaddressed, but its importance is greater than ever before due to the proliferation of smart products. Optimal+’s solutions address this challenge by bridging the data silos within and between these two industries. By enabling capabilities such as DFF and Data Feed Backwards (DFB), Optimal+’s solutions can significantly increase quality, efficiency, and yield for both electronics OEMs and semiconductor companies.
Growth Performance

Requirement: Growth success is tangibly linked to new growth opportunities identified through visionary innovation.

Optimal+ is a growing company. With its roots in semiconductor manufacturing, the company has experienced continued success in this space. It increased the number of chips it analyzed by approximately 80% in 2015, from 20 billion to 35 billion, and is expected to reach 50 billion in 2016. This is the result of expanded use by existing customers as well as the addition of new clients such as Renesas and NXP. Increased volumes translate into revenue growth for the company as its business model is closely based on the number of devices tested by its customers as opposed to software seats. In the Optimal+ business model, there is no limit to the number of users that can access the manufacturing data or the analytic results.

While the electronics industry is a new market for Optimal+, the newly released solution has already been deployed in a production environment with NVIDIA, who uses it for 4 different types of boards and systems including super computing, graphic cards, automotive infotainment, advanced driver assistance systems (ADAS) systems, and game consoles. Optimal+ expects to analyze over 30 million boards in 2016. NVIDIA especially likes the visibility the solution provides its engineers into their manufacturing processes and its ability to spot and address issues no matter where they are in the supply chain. Optimal+ is also working closely with many leading electronic systems companies in the US, Europe and Asia.

Company Culture

Requirement: The executive team sets the standard for commitment to customers, quality, and staff, which translates directly into front-line performance excellence.

Optimal+ is no stranger to visionary innovation. It revolutionized the Big Data product analytics industry for semiconductor manufacturing, for which it received the 2015 Visionary Innovation Leadership Award in the Semiconductor Test Industry. With its range of offerings that include Global Ops, Test Floor Ops, EXACT, Test Time Reduction (TTR), Escape Prevention, and Outlier Detection. The Optimal+ Semiconductor Operations Platform has delivered impressive results to a wide range of semiconductor companies. Customers such as AMD, Broadcom, Qualcomm, and ST Micorelectronics have experienced production yield increases of up to 2%, TTRs of up to
30% over traditional methods, improvements in operational efficiency of up to 20%, and up to 50% reductions in test escapes.

With its new electronics solutions, Optimal+ aims to bring the same type of disruptive change to electronics OEMs. To that end, the company has set up a separate chain of command to focus on electronics customers, the Electronics Business Unit. It is also applying the same business model as for its semiconductor customers, placing staff permanently at customer sites to address the business metrics that customers want to improve on and ensure a high ROI on its solutions. While an expensive proposition for the company, research shows that usable insights require an iterative process between machines and data scientists with domain expertise.

**Conclusion**

Optimal+ focuses on helping companies in the semiconductor and electronics industries improve their business operations and product quality. Its holistic approach, use of comprehensive and high-quality data, and prompting immediate action to be taken to remediate problematic situations have enabled the company to provide measurable results to a variety of semiconductor companies and early adopters in the electronics manufacturing industry. With its Electronics Operations Platform, Optimal+ is pioneering the use of Big Data product analytics solutions in the semiconductor-electronics manufacturing ecosystem and has demonstrated promising early results.

With its strong overall performance, Optimal+ has earned Frost & Sullivan’s 2016 Visionary Innovation Leadership Award.
Significance of Visionary Innovation Leadership

A visionary innovation leadership position enables a market participant to deliver highly competitive products and solutions that transform the way individuals and businesses perform their daily activities. Such products and solutions set new, long-lasting trends in how technologies are deployed and consumed by businesses and end users. Most important, they deliver unique and differentiated benefits that can greatly improve business performance as well as individuals’ work and personal lives. These improvements are measured by customer demand, brand strength, and competitive positioning.

Understanding Visionary Innovation Leadership

Visionary Innovation is the ability to innovate today in the light of perceived changes and opportunities that will arise from Mega Trends in the future. It is the ability to scout and detect unmet (and as yet undefined) needs and proactively address them with disruptive solutions that cater to new and unique customers, lifestyles, technologies, and markets. At the heart of visionary innovation is a deep understanding of the implications and global
ramifications of Mega Trends, leading to correct identification and ultimate capture of niche and white-space market opportunities in the future.

**Key Benchmarking Criteria**

For the Visionary Innovation Leadership Award, Frost & Sullivan analysts independently evaluated two key factors—Focus on the Future and Best Practices Implementation—according to the criteria identified below.

**Focus on the Future**
- Criterion 1: Focus on Unmet Needs
- Criterion 2: Visionary Scenarios through Mega Trends
- Criterion 3: Growth Pipeline
- Criterion 4: Blue Ocean Strategy
- Criterion 5: Growth Performance

**Best Practices Implementation**
- Criterion 1: Vision Alignment
- Criterion 2: Process Design
- Criterion 3: Operational Efficiency
- Criterion 4: Technological Sophistication
- Criterion 5: Company Culture

**Best Practice Award Analysis for Optimal+ 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 Focus on the Future and Best Practices Implementation (i.e., the overarching categories for all 10 benchmarking criteria; the definitions for each criteria 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 players as Competitor 2 and Competitor 3.

**DECISION SUPPORT SCORECARD FOR VISIONARY INNOVATION LEADERSHIP AWARD**

<table>
<thead>
<tr>
<th>Visionary Innovation Leadership</th>
<th>Focus on the Future</th>
<th>Best Practices Implementation</th>
<th>Average Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optimal+</strong></td>
<td>9.4</td>
<td>9.4</td>
<td>9.4</td>
</tr>
<tr>
<td>Competitor 2</td>
<td>6.0</td>
<td>7.0</td>
<td>6.5</td>
</tr>
<tr>
<td>Competitor 3</td>
<td>8.2</td>
<td>8.6</td>
<td>8.4</td>
</tr>
</tbody>
</table>

**Focus on the Future**

**Criterion 1: Focus on Unmet Needs**
Requirement: Implementing a robust process to continuously unearth customers’ unmet or under-served needs, and creating the products or solutions to address them effectively

**Criterion 2: Visionary Scenarios through Mega Trends**
Requirement: Incorporating long-range, macro-level scenarios into the innovation strategy, thereby enabling “first to market” growth opportunities solutions

**Criterion 4: Growth Pipeline**
Requirement: Best-in-class process to continuously identify and prioritize future growth opportunities leveraging both internal and external sources

**Criterion 3: Blue Ocean Strategy**
Requirement: Strategic focus in creating a leadership position in a potentially “uncontested” market space, manifested by stiff barriers to entry for competitors

**Criterion 5: Growth Performance**
Requirement: Growth success linked tangibly to new growth opportunities identified though visionary innovation

**Best Practices Implementation**

**Criterion 1: Vision Alignment**
Requirement: The executive team is aligned on the organization’s mission, vision, strategy and execution

**Criterion 2: Process Design**
Requirement: Processes support the efficient and consistent implementation of tactics designed to implement the strategy
Criterion 3: Operational Efficiency
Requirement: Staff performs assigned tactics seamlessly, quickly, and to a high quality standard

Criterion 4: Technological Sophistication
Requirements: Systems enable companywide transparency, communication, and efficiency

Criterion 5: Company Culture
Requirement: The executive team sets the standard for commitment to customers, quality, and staff, which translates directly into front-line performance excellence

Decision Support Matrix
Once all companies have been evaluated according to the Decision Support Scorecard, analysts can 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.

DECISION SUPPORT MATRIX FOR VISIONARY INNOVATION LEADERSHIP AWARD
Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan awards 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.

<table>
<thead>
<tr>
<th>STEP</th>
<th>OBJECTIVE</th>
<th>KEY ACTIVITIES</th>
<th>OUTPUT</th>
</tr>
</thead>
</table>
| 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 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 winner | 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 may 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 |
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 almost 50 years of experience in partnering with Global 1000 companies, emerging businesses and the investment community from 31 offices on six continents. To join our Growth Partnership, please visit http://www.frost.com.