



# An Advanced Product Analytics Platform for Industry 4.0 and IIoT

White paper



## MASS PERSONALIZATION

Industry 4.0, Industrie 4.0 or the fourth industrial revolution, is the current trend of automation and data exchange in manufacturing technologies. IIoT is a critical component of Industry 4.0 combining sensing, intelligent analytics and Internet/cloud connectivity. One of the main tasks of Industry 4.0 is mass personalization (meeting the customer's needs more effectively and efficiently) and it is often associated with mass customization (combining the flexibility and personalization of "custom-made" with the low unit costs associated with mass production.) In addition to mass customization, recent advances in IIoT, in particular the ability to complement process analytics with product analytics, have enabled another important task of mass personalization - mass optimization. Mass optimization is a task of improving the manufactured product and it is achieved when the manufacturing process for each part (a given instance of a product) is optimized based on product information collected during previous manufacturing and testing steps for the part and its components.

Lot Size One, also known as Lot Size of One or Lot Size 1, is an integral component of Industry 4.0, specifically addressing the tasks of mass customization and mass optimization. Lot Size One is a manufacturing technique, facilitated through coupling of manufacturing and logistics, where each part goes through the process separately. For instance, in the case of the injection molding supplier for Porsche, it means painting each car separately instead of in batches of twenty parts.

## DISCONNECTED AND SILOED SUPPLY CHAINS DO NOT BELONG TO THE FUTURE

For manufacturers, Lot Size One means a shift from mass production into mass personalization which brings many challenges in the way they operate their business. Manufacturers must have very flexible manufacturing processes in order to be able to achieve lot size of one with the mission to manufacture any product, any quantity, any variant, any sequence, in any assembly line at any time.

On the shop floor it means that the parts to produce may be totally different from one another and an IIoT featuring automatic machine set-up, products talking to machines, and machines talking to business systems is required. Finally, Lot Size One on the shop floor is about making manufacturing plants smart so machines and operators know exactly what is required for each of the parts they are assembling regardless of the sequence, type of product or variants. Knowing what is required for each part demands a flow of actionable information (an information highway) along the value chain, i.e. within the supply chains and between the supply chains. Because of that, disconnected and siloed supply chains have no place in Industry 4.0.

A strong focus on horizontal and vertical fab integration is definitely not new; all advanced semiconductor IDMs and foundries have done horizontal and vertical fab integration for years.



However, this integration strategy is rather new for classical discrete manufacturing environments where multiple players are involved. For instance, in electronics, the flow of information within a value chain is comprised of distributed and fragmented supply chains is either non-existent or severely restricted. Historically many issues such as lack of trust between the players, conflicting business interests, incompatibility of information systems, data security concerns, lack of understanding of each other technology, data availability concerns, etc. have prevented value chain players such as OEMs, OCMs, SIs, CMs, ODMs from sharing manufacturing data with each other. Absence of data sharing in turn has contributed to lack of accumulated artificial intelligence for converting manufacturing data into actionable information.

But this is about to change.

## PRODUCT ANALYTICS AND MANUFACTURING INTELLIGENCE BY OPTIMAL+

Optimal+ has been in the business of manufacturing intelligence and product analytics since 2006. Optimal+ is a leading provider of solutions that help semiconductor and electronic OEMs/brand owners improve their business on multiple vectors by providing transparency into their supply chain by smartly and efficiently leveraging product data collected during the test process and providing timely responses to problems that inevitably occur (i.e. providing actionable information).

While process analytics “the voice of the machine” is aimed at improving the manufacturing process – perform machine preventive maintenance exactly when needed, optimize asset (i.e. machine) utilization on the factory floor, etc., product analytics “the voice of the product” is aimed at improving the manufactured product – increasing its performance, quality, reliability, and brand protection, as well as its yield. Product Analytics by Optimal+ has been providing value to semiconductor and electronics OEM/brand owners in the form of both higher revenue (due to higher performance, higher quality, higher reliability, and brand protection) and higher profitability (higher yield = lower cost).

Semiconductor and electronic component manufacturing and test generate a goldmine of product data which can be leveraged to achieve significant benefits. In order to realize its full potential, the data must be collected, summarized, analyzed and mined. Optimal+ has developed and deployed an infrastructure which can provide the performance and functionality required to load thousands of data log files a day and to find the valuable nuggets which translate to high ROI:

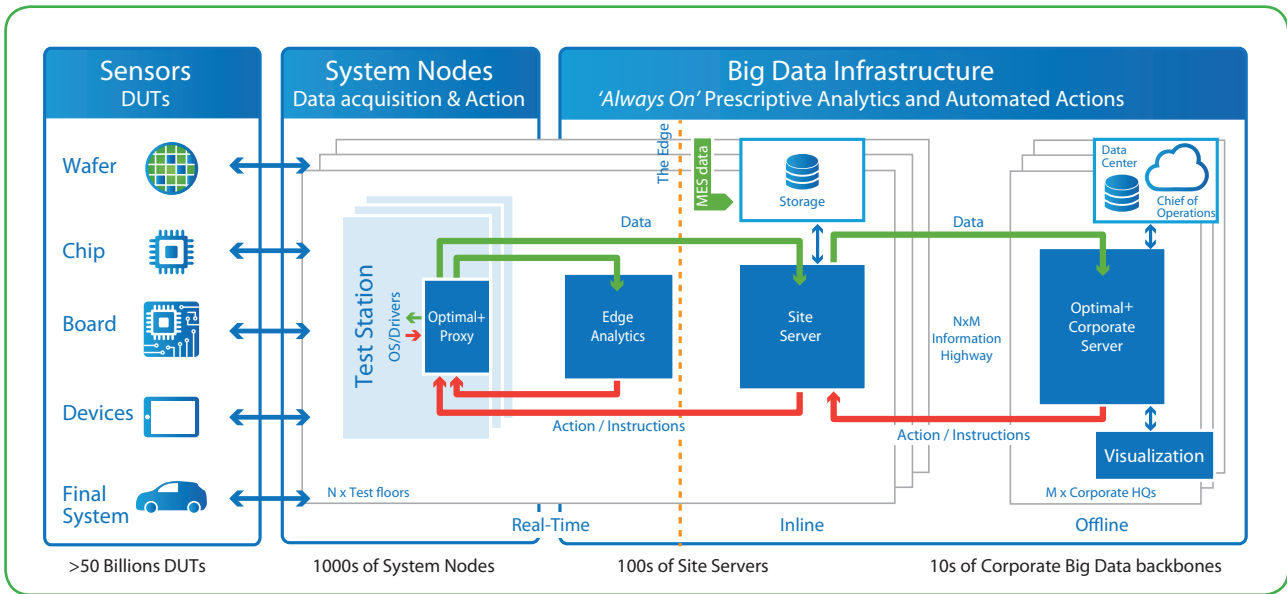


Figure 1 - Typical IIOT architecture deployment

### Optimal+ Information Highway

The Information Highway captures and stores massive amounts of product (e.g. IC, boards, etc.) test data while guaranteeing data integrity, completeness and timeliness and enabling real-time decisions based on current and historical test data. Wide deployment makes it easy for new customers to join the highway and immediately benefit from the supply chain transparency and control that the solution provides.

- ❖ A fleet of servers installed at over 90% of the world’s semiconductor OSATs and Foundries.
- ❖ Proxy+ software installed on the testers at the suppliers providing real-time data acquisition and ability to interact with the tester. There are built-in tools to trace datalogs and troubleshoot data delivery issues
- ❖ The servers are integrated with the Manufacturing Execution Systems (MES) on the shop floor and can perform actions on problematic material as soon as necessary data is obtained, i.e. on the edge in real-time
- ❖ Data feed forward system for providing upstream test programs with contextual historical data and for supporting off-line analytics.

### Optimal+ Big Data Analytics

Optimal+ Big Data Analytics enable engineers to get answers to complex questions on huge data sets in seconds. The data is already available in the database and can be processed at lightning speeds. The analytics algorithms are infinitely customizable through use of R. The system is capable of providing insight into possible issues which are only visible when the full “DNA” of the part is known. Customers can choose between accessing the system on the Cloud (Software as a Service – SaaS) or deploying it on premise.

- ❖ A multi-layer database, consisting of a combination of database engines – Microsoft SQL Server for transactional processing, HP Vertica for Big Data Analytics and soon, Hadoop
- ❖ Portal+ client with comprehensive user interface and structured scripting language for performing advanced analytics



- ❖ Full integration of R language and environment for statistical computing
- ❖ Software for tracking the complete genealogy and IC “DNA” of the parts

### Optimal+ Rule Engine

The Rule Engine provides capability for automating routine analytical tasks in order to free customers from monitoring vast “normal” operations and product information. The rules can raise alarms indicating potentially “abnormal” events, interact with the testers to enable adaptive TTR, prevent bad parts from being wrongly labeled “good”, monitor pairing of the components, etc. Rules behavior can be evaluated prior to their release to production.

- ❖ A Rule Engine for creating and deploying rules automating a wide range of analytical tasks and capabilities
- ❖ Self-adjusting rules which constantly recalculate their baseline settings based on recently tested parts
- ❖ Rule simulation by leveraging historical data

### Optimal+ Expertise

The application expertise is ensuring that every ROI opportunity is exploited while the operational expertise is ensuring that data is flowing and that system is functioning as expected.

- ❖ An operations team and teams of application engineers, many of whom are located at customer sites and are working hand in hand with the customers and their suppliers

More information about Optimal+ infrastructure and its capabilities can be found on our website: [www.optimalplus.com](http://www.optimalplus.com).

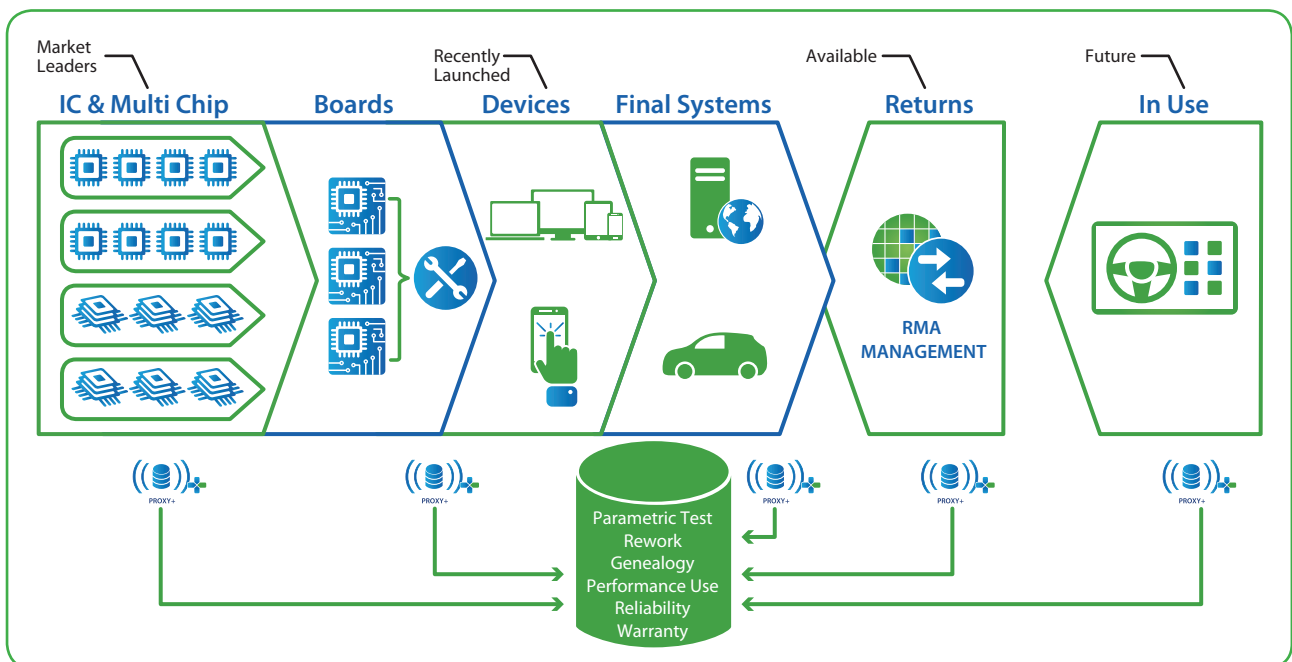


Figure 2 - Optimal+ solutions for the electronic value chain



## PRODUCT ANALYTICS AND MANUFACTURING INTELLIGENCE BY OPTIMAL+ FOR INDUSTRY 4.0

The unique capabilities and solutions that Optimal+ successfully brought to the semiconductor industry promise even higher strategic value to the electronics OEMs/brand owners. Optimal+ is the only company that can combine real-time data on both IC components and populated boards to provide full “DNA” data for mass optimization of mobile devices, medical devices, communications and networking equipment, automotive electronics, and other products with high electronics content. Thus creating an IIoT system for Lot Size One where different aspects of the adaptive manufacturing of each part such as adaptive testing, adaptive smart pairing of components, adaptive provisioning, adaptive repair and adaptive firmware can now take advantage of the full “DNA” data for the part.

Optimal+ product analytics applies to every step in the value chain, from chips to boards, to systems, and to end system in-use. One of the main values of such holistic product analytics is that it allows an OEM/brand owner to get full visibility throughout his value chain and correlate end system in-use data with chips and boards used in that system. This is why product analytics provides the full voice of the product.

The Optimal+ infrastructure also makes it possible to address the unique issues currently preventing data sharing among electronics value chain players:

### **Mistrust between players**

Once on the Information Highway, the test data can be stripped from meta data or normalized in order to decouple sensitive manufacturing information.

### **Data security concerns**

Optimal+ has a proven record of securely collecting, storing and distributing test data. The data on the Information Highway can be compartmentalized based on target audiences and access to each compartment can be limited to only the players with the “right to know”.

### **Incompatibility of information systems**

Once the data is on the Information Highway, it is inherently compatible with any system that is compatible with the Highway. Therefore, the data and the actionable intelligence can be used by any IIoT manufacturing system as long as it is connected to the Highway.

### **Lack of understanding of each other technology**

Analyzing component’s test data in conjunction with integrated system’s test data may yield a quality index – a methodology that reduces test data to a parameter which models an expected performance of the component within the integrated system. Use of quality index or indexes removes the need to understand each other testing and manufacturing processes and enables adapting the manufacturing process of a given part based on quality indexes of its components.



### **Data availability**

Data availability has historically been a strong selling point of Optimal+ systems. Data feed forward will ensure that historical contextual data is delivered in-time when it is needed to make manufacturing decisions for optimizing manufacturing of each part.

### **Conflicting business interests**

The apparent benefits of enabling Industry 4.0 and in a particular Lot Size One will likely outweigh initial reluctance to share the data between component suppliers and integrated systems manufacturers. In addition to enabling mass customization, the tangible benefits of sharing may include improved yields, shorter product qualification and time to market, reduced testing, better system and component designs, etc.

### **Lack of accumulated artificial intelligence**

Optimal+ Big Data and Product Analytics ability to get answers to complex questions on huge data sets can be used to efficiently develop new actionable intelligence. Optimal+ Rules Engine can turn the intelligence into actions optimizing the manufacturing processes for each part.

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## **CONCLUSION**

The Industry 4.0 provides an exciting opportunity for Optimal+ to leverage its substantial existing capabilities in enabling Lot Size One and to provide a compelling mass optimization solution for a new industry. Optimal+ takes IIoT a big step forward by adding product analytics to process analytics thus unlocking the full value of IIoT for the designers and manufacturers of electronics.

[www.optimalplus.com](http://www.optimalplus.com)

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