INTRASTAGE
ORGANIZING TEST DATA TO IMPROVE YOUR PRODUCT QUALITY

How to Use Test Data Dashboards to Manage your Key Quality Metrics

What is the number one issue that Organizational Leaders are facing today?

Managing time and energy in the face of growing complexity...the sense that the world is moving faster -Chris Zook (Bain & Company author of "Repeatability: Build Enduring Businesses for a World of Constant Change",2012)

In 1971 when the first Intel computer chip was shipped who could have foreseen the global revolution that this was to start. From this humble beginning, the internet, mobile phones, laptops and thousands of other electronic devices have sprung up changing the way people work, play and communicate. The most fundamental of these technologies has been the internet, allowing information to move around the planet at zero cost and instantaneously. As Chris Zook alluded to in his quote above "the sense that the world is moving faster" is a direct consequence of the internet's capability to move information from one corner of the planet to the other in real-time. People need to make decisions quicker and faster because if they don't their competitor will; based on the same information.

In this article, we will discuss how the impact of the internet and other forces are shaping a new paradigm in the way the Electronics Product quality is managed. Armed with this background, we will discuss some ways that leading world-class manufacturers are solving these problems with the use of data visualization and dashboard software techniques on Test Data.

Why managing Product Quality is getting more Complex

There are 3 distinct forces changing the way quality is being managed:

1. Instant communication through the internet
2. Storage cost is getting cheaper and cheaper
3. Electronics testing is getting more complex

In traditional Electronics manufacturing organizations, Product Quality was often a nebulous term to define. In fact, in most organizations people that were called "Quality Engineers" or "Quality Managers" focused on conformance to processes and ensured they were repeatable in nature. This was the most visible and tractable way to ensure that a product would be shipped with quality. But there are other forces that affect quality such as incoming supplier parts, performance variation due to changes in manufacturing and the design of the product itself which has a high impact on performance, reliability and durability. It has never been only the "Quality" people that need to be concerned with product quality, there are multiple functional people such as Manufacturing,

Engineering and even Management that can impact product quality. The power of the internet and instant communication will now enable this collaboration between these functional teams to occur at near zero cost and will significantly affect how quality is managed.

A second variable impacting product quality is related to Moore's law which Gordon Moore prophetically predicted in 1965 about the performance of semiconductor performance over time. He stated that computer performances will double every 18 months but the price will remain the same. This means the Play Station 3 which costs $300 has the equivalent processing power of 22 Million of the first UNIVAC computers introduced in 1952 which cost $750,000. Data storage has also increased exponentially. A refrigerator size 1.2 Gigabyte IBM disk in 1980 sold for $200,000 and today you can buy 4GB for $5.00.

Before this technology inflection, Test Data that was generated by Test machines in manufacturing or R&D environments was too expensive or difficult to maintain. Test Data gives the most accurate description of product quality because it describes precisely the performance and reliability of the product before it gets to the customer. Now storage is so cheap that everything is captured and stored. Some manufacturing companies can generate 400GB of data just from manufacturing test machines. This has allowed an unprecedented capability for companies to really understand their product quality through better analysis and management of their Test Data.

Electronics are also becoming pervasive in almost every possible device. No longer restricted to desktop computers or laptops, computers are now showing up in cars, TVs and even toasters. Today (according to Intel in 2012) there are 40 billion connected devices, by 2015 there will be 15 Billion and by 2020 there will be 50 Billion. The consequence of this is that product testing will become increasingly more complex as more and more electronics are added to any and all products. This complexity will challenge the way quality management is done in these products.

Using Dashboards and Data Visualization to better Manage Quality

To conquer some of these new challenges on managing product quality, modern manufacturing companies are turning to processes and technologies that allow them to get better and deeper visibility into the Test Data on their products so they can make better and faster decisions. Let's unpack this sentence a little more and talk about what can be done with Test Data and how decisions can be made faster and better.

Test Data by itself and isolated to specific serialized manufactured products can have uses as it relates to a Recall or when someone wants to look up performance quality of a specific manufactured part. But data analysis becomes really interesting when data can be aggregated across different products, manufacturing sites, measurements etc. This capability to aggregate data can help focus on the most important quality issues and spawn questions as shown in Figure 1.

	PAST	PRESENT	FUTURE
INFORMATION	What happened? (Reporting)	What is happening now? (Alerts)	What will happen? (Extrapolation)
INSIGHT	How and why did it happen? (Modeling, experimental design)	What's the next best action? (Recommendation)	What's the best/worst that can happen? (Prediction, optimization, simulation)

Figure 1: Key questions to ask when doing data analysis

On the vertical axis of this table, data analysis can yield either information (where events are presented to the person and the person makes the ultimate decisions) or insights (where recommendations are made by software which simplifies the decision process of the person). The horizontal axis indicates whether we are concerned about answering questions about the past, present or future.

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Figure 2: Focusing on reporting and what has happened

Data visualization and reporting fit nicely into category One where the data analysis is answering questions about on "What Happened".

Data visualization allows people to understand the data faster by visually at looking at patterns of data and comparing one set of data against another such as using Line graphs, bar graphs, scatter plots etc. See Figure 3 for some examples. By just looking at the raw numbers, this would take a lot of human computation to discern any patterns of interest and data visualization greatly reduces this burden.

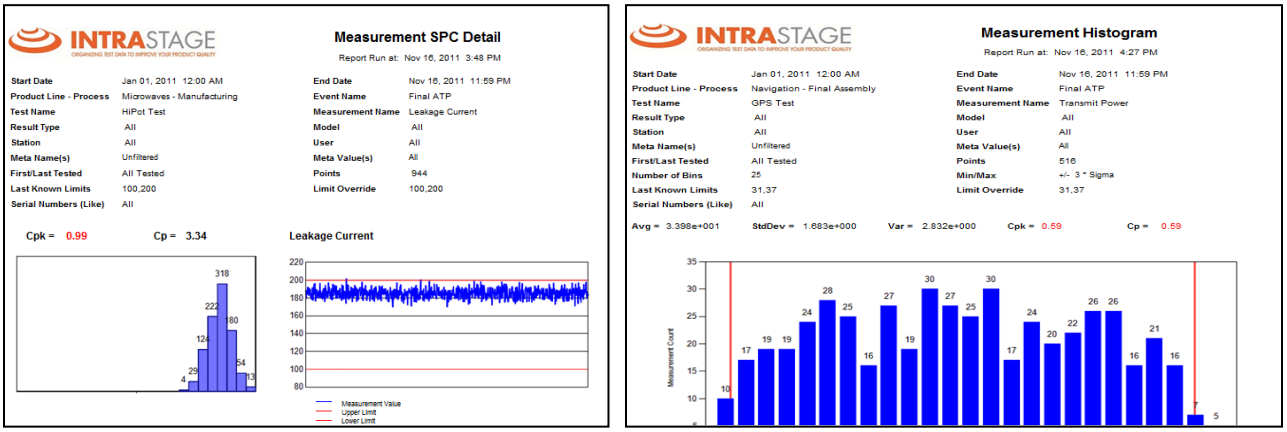

Figure 3: An example of IntraStage Data Visualizations

The next category of analysis answers the question "What is happening now?" and focuses on giving alerts to people so they do not have to actually analyze the data. This allows software

algorithms or threshold points set by users to alert when certain conditions are met or exceeded.

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Figure 4: Focusing on making decisions now

Dashboards also provide an excellent way to allow users to rapidly scan various visualizations and tabular forms of data to make quick decisions similar to what an "Alert" would accomplish. An example of a dashboard is given in Figure 5. Because every person has key metrics that they would like to track such as yield, SPC, Trends etc…the dashboard must be flexible enough to be configured and personalized to that person's goals.

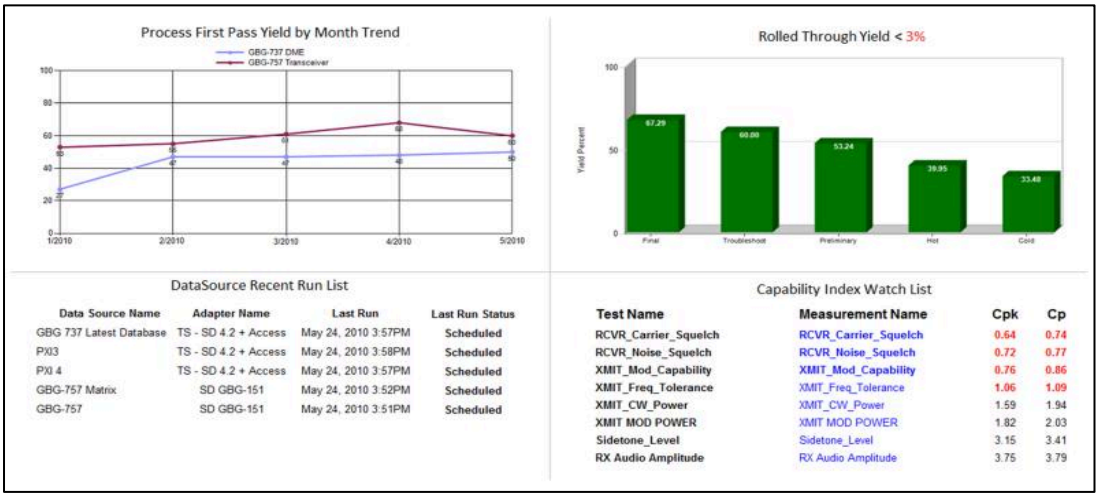

Figure 5: An example IntraStage dashboard

General Dashboard Design Principles

Dashboards are a common concept in the world of cars. The usual car dashboard contains instruments such as speedometer, fuel gauge, RPM, odometer etc. These are meant to give the driver information about the condition of the car so that it can be properly driven and maintained. But the design of dashboards can vary immensely depending upon the use. A car has a very different dashboard

design than a boat for example and not all of the differences are merely just aesthetics. Careful design of the dashboard leads to the best and most efficient way to use the information presented. If the goal is to quickly be able to make decisions off the dashboard of manufacturing, reliability or R&D Test Data, then there are general principles that can be followed and it all starts with the goal of the User.

A Test Data dashboard would be typically designed based on 3 categories of User goals:

- Strategic: These are dashboards that are looked at once a week or month to understand the overall health of long term metrics. Typically these dashboards do not have analysis capability. An example would be: Total number of Failures on a product line.
- Analytical: These are dashboards that allow the user to analyze and mine the data. The analysis could entail filtering key parameters to see different views on the data. An example would: Yield lines, Yield paretos
- Operational: These are dashboards that give updates on important metrics that are happening in real time and which are important to react to in real time. An example would be: Machine is not working.

The split of these dashboards into strategic, analytic and operational defines the type of controls (how much the user can manipulate the data on the one screen) and the types of data visualization that can happen. This paper will not go into details on how dashboards should be designed as that is best served by the many industry and educational books that are available(Stephen Fews "Information Dashboard Design"), but it is important to realize that a good dashboard must be architected well for best usage. It also must be customizable for the User as this allows relevant metrics to be presented.

The Way Forward

As the forces of cheap memory storage, the internet and electronic pervasiveness push the management of Product Quality into new directions, the best-in-class companies will continually look at new ways to stay ahead. With a proper Test Data strategy in place, industry leading companies are now fully exploiting a latent asset which has just been sitting there before. By adding dashboard capability to that analysis of data, they are now enabling more teams to contribute to the improvement of overall Product Quality in a quicker and more efficient way.

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About IntraStage

IntraStage is a Quality Management Software provider for companies who design and manufacture electronic products. We provide SPC, Yield, CP, CPK, and test data analytical tools by automating the retrieval, storage, mining and reporting of R&D, Manufacturing, Supplier and Field test data. Our clients choose us because we seamlessly integrate test data from different sources, lower their product design, manufacture and return costs by finding quality trends more quickly and accurately. Fortune 1000 companies rely on our business intelligence to keep them competitive when product quality and customer satisfaction are key differentiators.

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