Optimizing Net Content Control in Food & Beverage Packaging Operations

An Enact® Use Case

Introduction

In the food and beverage manufacturing sector, controlling net content is a mandatory operational requirement. There are many reasons why. Chief among them is the regulatory requirements. Most—if not all—developed nations, developing nations, and international trade blocs have some form of legislation that enforces acceptable levels of variation which may be encountered as part of the packaging process. And each of those legislations implements their own rules, regulations, and methods of measurement and reporting—such as the U.S. Department of Commerce Maximum Allowable Variation (MAV) and the European Union Tolerable Negative Error (TNE) and T1/T2 violations. Regardless of implementation, such legislation ensures that packages are not underfilled—protecting the consumer from underweight packages. Violating such regulations can result in significant fines or legal recourse.

There is also a significant reputational risk to underfilling food and beverage products. Today's consumers have instant access to global social media platforms (and other digital channels), and unhappy consumers "name and shame" brands when products fail to meet their expectations. Such incidents can quickly go viral, which can have a significant impact on a brand's reputation. Retailers—wary of getting caught up in these incidents—are increasingly moving to protect their own brands by taking a close interest in the net content control policies and processes of their major manufacturing suppliers, including the independent surveillance and audit of supplied goods. Sustained failures of such surveillance can cause manufacturers to lose lucrative sales contracts—imposing further commercial risks on the manufacturer.

In an attempt to mitigate these risks, many manufacturers resort to some degree of overfilling—so even when significant variation in net content occurs, the net content still falls within permissible levels. This is often the only option manufacturers have when they lack the internal capabilities needed to effectively monitor and control net content within the manufacturing packaging process. This approach is not only high-risk—it can be extremely costly. For packaged goods that are expensive to produce or are produced in high volumes, overfilling is an expensive activity that imposes a financial cost on the manufacturer—not only in the sale cost of that giveaway content, but also in the waste of resources consumed to produce that additional content (across man, material, and machine), potentially impacting the manufacturer's environment and social responsibilities.

Historically, that may have been the only economically viable option, but that is not the case today. The availability of cost-effective solutions in areas such as automation, digital sensors, process control, and quality monitoring means that manufacturers have at their disposal the capabilities needed to optimize net content control—while simultaneously avoiding the cost overheads associated with less efficient approaches.

This Use Case demonstrates how manufacturers around the world are using the Enact ® Quality Intelligence platform by InfinityQS® to optimize net content control operations.

Addressing the Challenges of Achieving Optimal Net Content Control in Food & Beverage Using Enact®

The Foundations: Net Content Control Data Collection

The foundation of any successful net content control strategy is data collection. Without accurate and timely data, manufacturers lack the visibility and insight needed to understand how processes are performing in real-time. As result, significant variations in net content may go unchecked, and the associated business risks increase. The importance of collecting timely and accurate data is paramount to successfully optimizing net content performance.

Operators need to understand how their packaging processes perform in order to identify trends and anomalies that enable them to keep processes as close to target as possible. Quality managers need to know that net content checks are being performed correctly and at the right intervals—and are within acceptable limits. Maintenance engineers need to be able to identify equipment that requires attention, such as a faulty filler nozzle or failing pump, before there is a significant impact on net content performance. Plant managers and manufacturing operations executives need to able to monitor overall packaging performance trends over time—and across multiple dimensions such as across products, processes, lines, shifts, or plants—so that continuous improvement initiatives and capital investment can be directed to where it will have the most positive impact.

None of the above can be achieved without data. Writing the result of a weight check on a piece of paper and performing a manual calculation of net weight from gross and tare weights, is a form of data collection. But it is an inefficient, and often unreliable one. These pieces of paper are rarely seen by anyone other than the person responsible for filling in the form—and if they are viewed it is typically at the end of a shift after the production period is completed. The tabular nature of the information also makes it difficult to identify underlying issues or trends. Any non-conformance in net content for products produced during that production period will

Efficient & Powerful Net Content Control Data Collection

Enact's powerful data collection capabilities enable manufacturers to put in place efficient and reliable data collection processes. Data can be collected from a range of different sources that have both a direct and indirect impact on net content control. Process-related data is collected from packaging and filling equipment (such as flow rates and line speeds), and product-specific data (such as from inline checkweighers or optical fill-level sensors) is also collected. Data from manual quality checks is entered directly into Enact via an intuitive data entry interface and by the completion of online checklists.

Enact's flexible data collection capabilities support three main methods of net content data collection:

Manual & Semi-Automated Data Collection: Using Enact, operators, quality, and lab personnel enter data directly into the data collection interface. This highly visual and intuitive interface guides the operator through the data collection process, ensuring that data are collected accurately and effortlessly. As data are added into Enact, the operator receives immediate feedback as to where the data value entered fits against the target value—and the upper and lower specifications defined for the product being produced. Reasonable allowable values can also be defined as part of the data collection requirements to prevent erroneous values (such as keying errors) from being captured.

Where manual data entry is performed, operators enter data using a computer or mobile device. With Enact's semi-automated data collection capability, digital gauges, such as scales or callipers, can provide data to Enact through the Enact Gauge Agent either directly via serial, USB or TCP/IP connections or wirelessly via wireless transmitters. This method increases operator efficiency still further by circumventing the need to manually key in data values, ensuring improved data collection accuracy by preventing keying and transposition errors.

As shown in Figure 1, an operator is prompted to enter product grossweight (including a multiple sample size as required) followed by tare weight—which can be selected from a lookup of stored tare weights relevant to the product or process. The Enact real-time calculation engine then automatically calculates net weight or net content volume at each data collection. Each of the three data points for tare, gross, and net weight for each sample are stored in Enact, and are then used for net content process monitoring, control, and analysis.

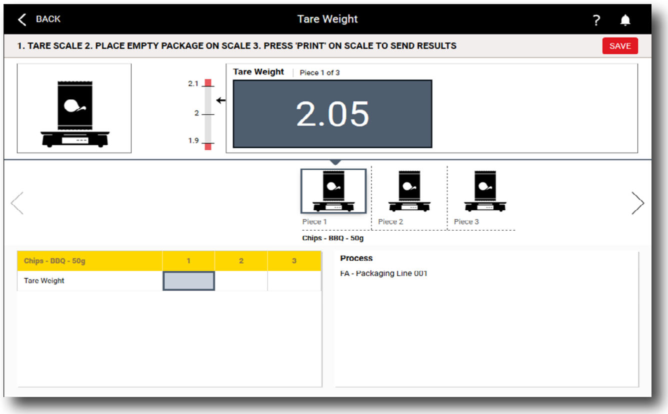


Figure 1: Enact's Data Collection Interface

When these quality checks and data collections should occur during the packaging process is an important aspect of any robust quality management operation. A manufacturer's quality team defines those requirements within their quality management procedures and policies. However, ensuring compliance to those procedures and policies on the

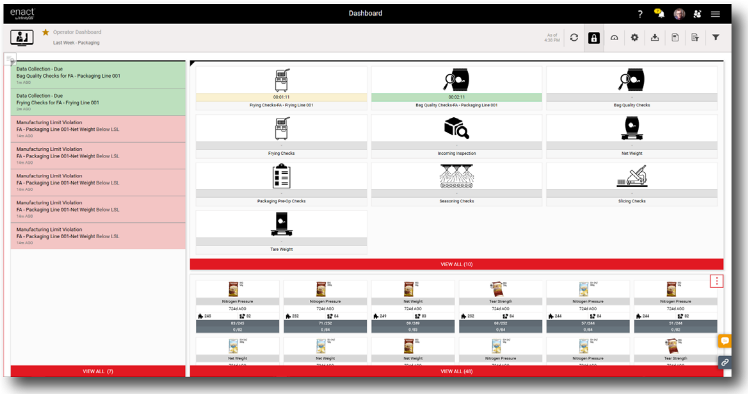
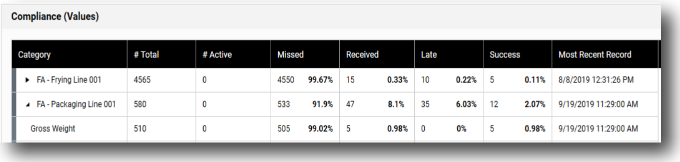


Figure 2: Enact's Timed Data Collection Tile

Operators have continuous visibility when quality checks and data collections are due via color-coded data collection tiles (as shown in Figure 2). When no checks are due, the tile is grey; when a check becomes due, the tile is green and displays a countdown timer indicating the time remaining to complete the required action. If the data collection is not performed by the due time, the tile color changes to yellow to indicate a late collection. After a pre-configurable period of time—if the data collection has not been completed—the tile changes to red to indicate a missed data collection.

If an operator fails to perform a collection at the required time, or performs a collection later than is specified, notifications can be sent to relevant team members to escalate corrective action—and an auditable record of non-conformance events are stored in Enact. Shift supervisors and quality managers can review up-to-date KPIs on quality control compliance metrics at many levels—from an individual operator or across the entire organization (as shown in Figure 3).


Compliance (Values)

Category	# Total	# Active	Missed		Received		Late		Success		Most Recent Record
FA - Frying Line 001	4565	0	4550	99.67%	15	0.33%	10	0.22%	5	0.11%	8/8/2019 12:31:26 PM
FA - Packaging Line 001	580	0	533	91.9%	47	8.1%	35	6.03%	12	2.07%	9/19/2019 11:29:00 AM
Gross Weight	510	0	505	99.02%	5	0.98%	0	0%	5	0.98%	9/19/2019 11:29:00 AM

Figure 3: Data Collection Compliance

Enact's ability to monitor process states from the manufacturing environment (either by manual selection or automatic state detection) applies intelligence to the data collection process. This prevents operators from being prompted to perform data collections when the process is not currently running, or to request specific data collections or completion of particular checklists—only when particular process state changes are detected—such as line start-up checks, shift change-overchecks, or product change checks (as shown in Figure 4).

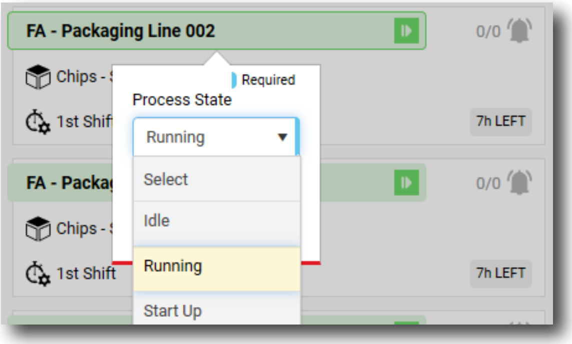


Figure 4: Process States

Automated Data Collection: In many scenarios, manufacturers may need to capture data automatically—without requiring any physical operator action or intervention. Enact's Automated Data Collection (ADC) seamlessly integrates data from sources such as Programmable Logic Controllers (PLCs) and Supervisory Control and Data Acquisition (SCADA) systems, as well as from inline process equipment such as checkweighers or optical fill level sensors.

Whatever method is used to collect data, the real-time data processing engine in Enact automatically performs data calculations. For example, gross weight data from a checkweigher can have tare weight automatically subtracted to calculate net weight, or can have net weight transformed into net content volume. Those calculated values are then stored in Enact for monitoring and analysis. Enact's event processing engine automatically triggers alarms and notifications if data values breach upper or lower specification or control limits (as shown in Figure 5).

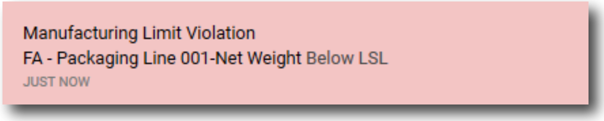


Figure 5: Event Notifications

From Data to Real-time Operator Insight

Having manufacturing data collection in place is an important foundation in any successful net content control strategy. How, when, and where the insight gleaned from operational and quality data is utilized, is where its value is leveraged. The shop floor—where packaging operations are being performed—provides the prime opportunity.

Operators and quality personnel must be able to monitor net content performance continuously, in real time, to instantly identify problems and issues within the packaging processes and take immediate corrective action before a material impact on net content performance occurs. It is even more effective to prevent net content issues from occurring in the first place, which can greatly reduce rework, waste, or yield loss. Enact can help solve these challenges.

Advanced Process & Quality Monitoring Capabilities

The advanced process and quality monitoring features in Enact are delivered through an intuitive and modern dashboard user interface. Production personnel have instant access to the information they need to understand about how their packaging operations are performing. When non-standard events occur anywhere in the manufacturing process, production personnel receive live notifications—ensuring they never miss an opportunity to improve net content performance.

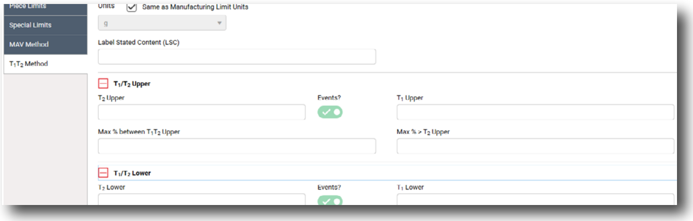


Figure 6: Quality Parameters Configuration

Enact's comprehensive configuration capabilities enable manufacturers to accurately define all of their process and quality parameters (as shown in Figure 6). For each individual part (or product) being manufactured, limits are configured across the required part features—such as net weight, gross weight, and fill level. Those manufacturing limits may include parameters such as upper and lower specification, upper and lower T1 and T2 variances, or upper and lower MAV (Maximum Allowable Variance). Industry standard statistical rules (as well as custom rule creation) can also be configured to trigger events and notifications when particular statistical trends occur such as "Consecutive points rising or falling," "Oscillating up or down," or "Run with in Zone C."

When data from packaging operations is added into Enact—either manually or via automatic data collection—that data is automatically evaluated against limits and rules in real-time. Enact's Stream Summary tile (as shown in Figure 7) provide production personnel with a statistical overview of the performance of each of the packaging processes under their responsibility.

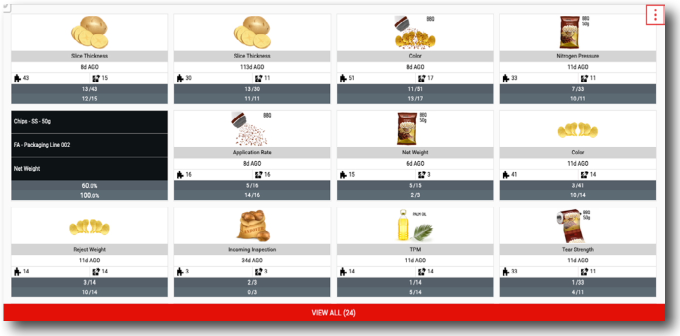


Figure 7: Enact's Stream Summary Tile

Each Stream Summary sub tile displays real-time key performance metrics, such as the number of data collections, out of specification (OOS), and out of control (OOC). Enact intelligently displays these tiles in priority order, with the data stream (a combination of part, process, and feature) that has the most issues displayed first. This enables operators to easily monitor areas having the most impact on performance, or which are presenting the most operational risk of net content compliance.

When Stream Summary sub tiles indicate that problems are occurring, quality personnel have immediate access to further information at the click of a mouse—without having to manually query data. Simply clicking a Stream Summary sub tile provides immediate access to data visualization displays, such as histogram, pareto, and control charts (as shown in Figure 8). Operators can easily zoom chart dimensions in and out to include more or less data over longer or shorter timeframes. These data visualizations are augmented with a comprehensive set of statistical metrics which provide a wealth of insight—and enable problems to be quickly identified and remedial action to be taken (as shown on the following page, in Figure 9).

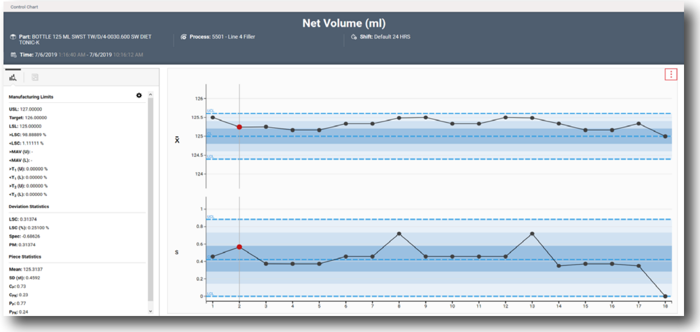
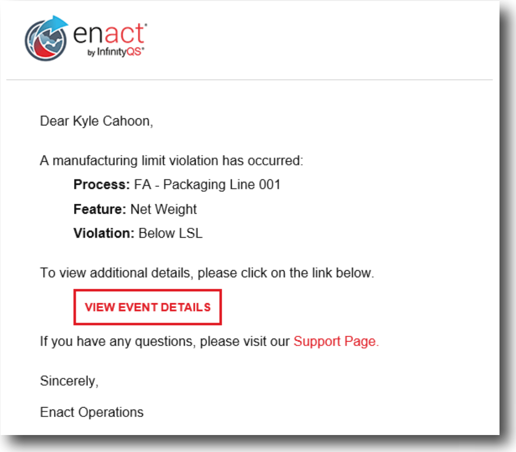


Figure 8: Control Charts

When packaging processes are running to plan and without issue, operators should not be required to continually monitor data, waiting for a problem to occur. The Enact notification engine takes on that responsibility by continuously monitoring and evaluating the data streams that are entered. When a violation occurs—such as aviolation of manufacturing limits or when a statistical rule is triggered—Enact immediately issues a notification to a configurable set of recipients. This ensures that notifications are issued only to the appropriate recipients and prevents production personnel from being inundated with notifications that are not relevant to their area of responsibility. Configuration of notifications by the type of event that has occurred also enables notifications of differing severity to be correctly routed. For example, a statistical rule may alert a production operator, whereas a T1/T2 or MAV violation may route to a quality manager. Event notifications are displayed within the Enact interface and are emailed to required personnel (as shown in Figure 10).


Dear Kyle Cahoon,

A manufacturing limit violation has occurred:

Process: FA - Packaging Line 001

Feature: Net Weight

Violation: Below LSL

To view additional details, please click on the link below.

VIEW EVENT DETAILS

If you have any questions, please visit our Support Page.

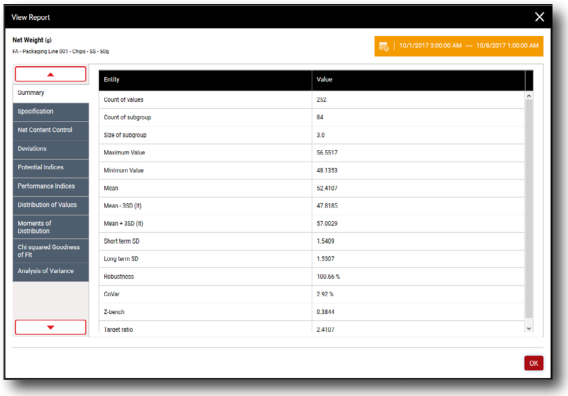
Sincerely,

Enact Operations

Figure 9: Statistical Summary Report

When issues do occur within packaging operations, not only is the timely discovery and remedial action of those issues important to net content performance, identifying root causes and learning from those problems are equally important in continuous improvement. In this case, additional information may be required from production personnel that can be used to further identify sources of issues—and what corrective action has been taken.

Enact notifications can be configured to request this additional information and can be configured specifically depending on the type of event that has occurred. This may be as simple as requiring an operator to select from a list, such as "Blocked Filler Nozzle" or "Poor Seal."


View Report

Net Weight (g)

FA - Packaging Line 001 - Chips - SS - 50g

10/1/2017 3:00:00 AM — 10/8/2017 1:00:00 AM

Summary | Specification | Net Content Control | Deviations | Potential Indices | Performance Indices | Distribution of Values | Moments of Distribution | Chi squared Goodness of Fit | Analysis of Variance

Entity	Value
Count of values	252
Count of subgroup	84
Size of subgroup	3.0
Maximum Value	56.5517
Minimum Value	48.1353
Mean	52.4107
Mean - 3SD (lt)	47.8185
Mean + 3SD (lt)	57.0029
Short term SD	1.5409
Long term SD	1.5307
Robustness	100.66 %
CoVar	2.92 %
Z-bench	0.3844
Target ratio	2.4107

OK

Figure 10: Event Email Notifications

Notifications can be extended to include Enact workflows, which can be configured to request additional information depending on the cause selected for a particular event. For example, an operator may report a “Failed Vacuum Pump” as the cause, triggering a request to the maintenance team who is then required to enter additional information (either mandatory or optional), such as the action taken to resolve the issue and the identification of the root cause—as well as free-form comments (as shown in Figure 11). This information can then be easily analyzed to support manufacturing excellence and continuous improvement initiatives to increase future operational performance and mitigate future compliance risks.

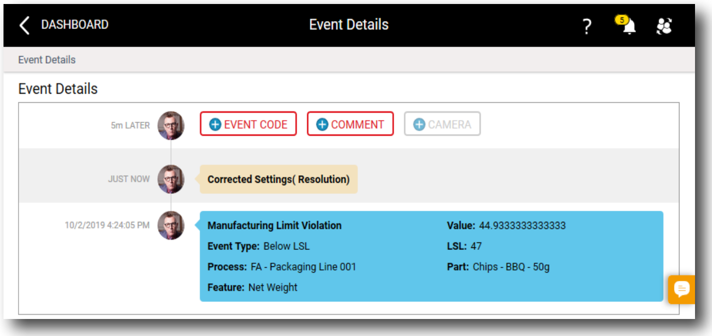


Figure 11: Enact Workflows

From the Shop Floor to the Top Floor

For manufacturers with a larger number of packing or filling lines, the ability to compare and monitor net content performance across multiple dimensions enables them to effectively prioritize continuous improvement initiatives—and to direct capital investment decisions to where it will have the most return in performance and risk. Which filling lines are performing worse than others? Are there operators, shifts, or crews that are not as effective as others at controlling processes, and do they require additional training? Which products or product groups have greater unpredictability and variability in net content? Is a particular piece of machinery, type of equipment, or equipment from a particular supplier failing more than others? Is a specific part of the overall packaging process underperforming other process areas?

Yet identifying areas of weaknesses and problems is only one side of the same coin. Similar questions can be used to highlight areas performing particularly well and can be used to set benchmarks and targets for all areas to achieve. The number of questions is almost limited only by imagination.

Defining the question is often the easy part yet collecting and analyzing data to answer the question is often an altogether less easy task. To answer those questions efficiently—and to streamline continuous improvement programs—manufacturing leaders and continuous improvement professionals need access to real-time production data and insight that is in a standard structure and format that can easily be rolled-up and compared.

They also require analysis tools to quickly turn that operational insight into actionable intelligence. When information resides in disparate locations, in different forms—or worse, in manual form only—the overhead involved with collecting and analyzing data makes these initiatives economically unfeasible.

At a senior management or operational executive level, overall net content performance and compliance reports are often prepared manually on a weekly, monthly, or quarterly basis. Not only are those reports time consuming to produce, underperformance and compliance risk has likely occurred during that elapsed time. Executives need access to real-time performance data presented in a way that is both meaningful and intuitive—enabling them to make quick assessments of trouble spots, respond quickly, and easily see results.

In addition to operational performance monitoring, deciding when and where to invest in new equipment should also be a significant consideration. It may be that improvements in net content performance at a process level are limited by the physical capability of the equipment itself. The ability to identify process equipment with inherent limitations—and to evaluate the cost of overfill and the impact of compliance risks as a result—may improve cost analysis and help justify where to target capital investment initiatives to achieve the greatest improvement.

Enterprise Analytics & Grading

When manufacturers need to analyze and compare operational performance across multiple dimensions—such as products, process, lines, shifts, plants, or regions—two factors become critical. The first critical factor is standardization. Standardization involves how and when data collections are performed, the format of collected data, and consistency of meta-data (a set of data that describes and gives information about the collected data). Without standardization, it can be difficult to accurately and efficiently analyze comparative data.

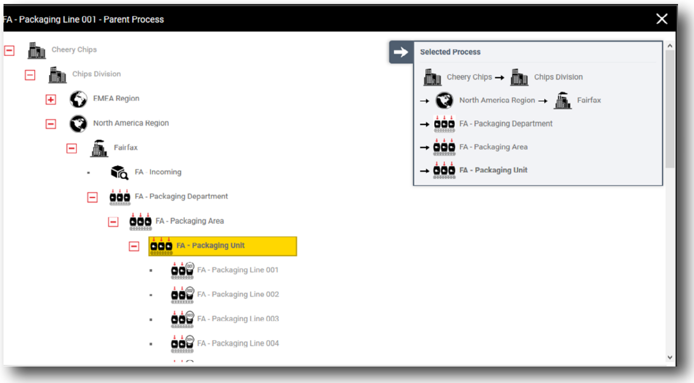


Figure 12: Process Hierarchy

The second critical factor is centralization. If the data needed to conduct enterprise analysis resides in disparate or localized systems—in different formats—a significant effort is required to integrate and transform those data into a central repository. This may require specialized IT knowledge and integration technologies. Manufacturers soon realize the cost and complexity of such initiatives become a barrier, and such efforts are rarely implemented successfully. The end result is that many manufacturers continue to lack enterprise analysis capabilities—and instead rely solely on individual line-based performance. Enact includes a unified cloud-based data repository that ensures all data entered into the system—manually or automatically, and regardless of the size, complexity, or plant location—is stored in a centralized repository, making it immediately available for enterprise analysis.

Standardization is a core element of the Enact architecture. When a manufacturer first deploys the product, they configure an enterprise hierarchy that mirrors the physical and logical hierarchy of their actual manufacturing operation. This hierarchy starts at the corporate level and reaches down to individual processes, machines, or sub-processes—ensuring that all Enact configurations and data collections are assigned to the correct hierarchy level (as shown in Figure 12). This enables data analysis to be performed at the most appropriate organizational level—such as across a particular plant—and it also ensures that Enact users have restricted visibility and user rights exclusively within their area of responsibility. This is an important security consideration.

Process Models are an innovative and powerful feature within Enact that further support standardization. Process Models are logical visual representations of a physical manufacturing process (as shown in Figure 13). While a Process Model can be used in isolation to represent a standalone process, they may also be linked to other input and output Process Models. For example, a soda mixing process, a PET bottle blowing process, a label printing process, and a Cap receiving hopper process may all be inputs in to a “bottle filling” Process Model. The output of that Process Model would be a final filled, labelled, and capped soda bottle that then becomes the input of another process—such as a carton packing process.

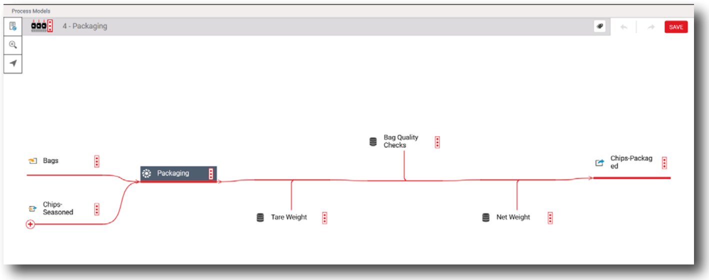


Figure 13: Process Models

Each Process Model is also used to define what data collections need to be performed as part of that process, such as fill level check, label checks, and cap torque tests. These standardized Process Models—along with associated data collection configurations—can then be re-used across all manufacturing facilities with the same processes. Any change made to a data collection or quality check requirement is immediately implemented across all processes using that single Process Model. This standardized approach to data collection pays dividends by enabling the analysis and comparison of data across the enterprise without the requirement for any form of data transformation or preparation.

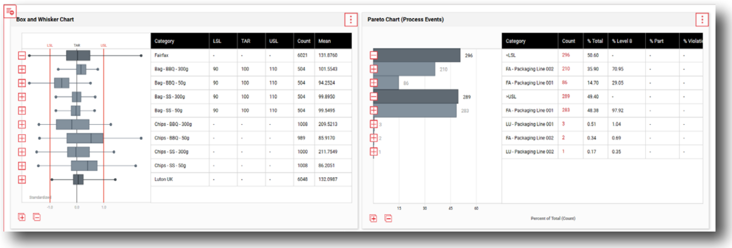


Figure 14: Box & Whisker and Pareto Charts

With all data stored within Enact in a centralized and standardized data repository—and with built-in data visualization capabilities—enterprise analysis and comparison becomes effortless. For example, Figure 14 shows a Box & Whisker and Pareto chart. A Box & Whisker can be used to compare performance across any dimension, such as by shift, product, line, plant, process, region, and across time periods. This enables senior management and continuous improvement teams to immediately identify the source of greater risk and performance bottlenecks or identify high performing areas that can be used as benchmarks for other areas. Pareto charts can be used by maintenance engineers to identify more prevalent equipment issues and root causes, enabling them to direct maintenance efforts to areas that will provide the greatest return.

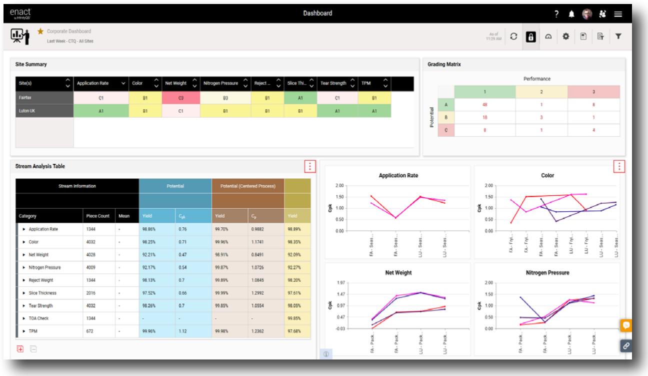


Figure 15: Aggregate KPI Dashboard

The Enact data aggregation engine provides automatic and efficient updates to aggregate KPIs at predetermined intervals, and across very large data sets. These aggregate KPIs includes statistical metrics such as Cpk, Ppk, Mean, and Standard Deviation, as well as Net Content specific KPIs such as Giveaway % and Overfill % LSC (Label Stated Content). Aggregate KPI data can be viewed on dedicated dashboards using a variety of pre-built visualizations as illustrated in Figure 15.

One of the major challenges with enterprise-level analysis comparisonlies in the fact that traditional metrics—such as Cpk, Ppk, or PPM—each tell one piece of your company's process performance story. But trying to fit an entire site's performance into a single number yields incomplete information. For example, suppose two sites have the same Ppk value. Are they really performing exactly the same? What if one site has a Ppk of 1.3 and the other has a Ppk of 1.4. How meaningful is that difference?

The answers depend on how the sites stack up to each other. Are production rates similar at each site, or is a single line or product masking a problem? Are all packaging lines performing with similar consistency, or are some performing better than others? Do the sites manufacture the same products and same mix of products? Does one site have a different or older infrastructure? Do both sites have operators with a similar experience level and turnover rate? Do both sites run a similar shift schedule?

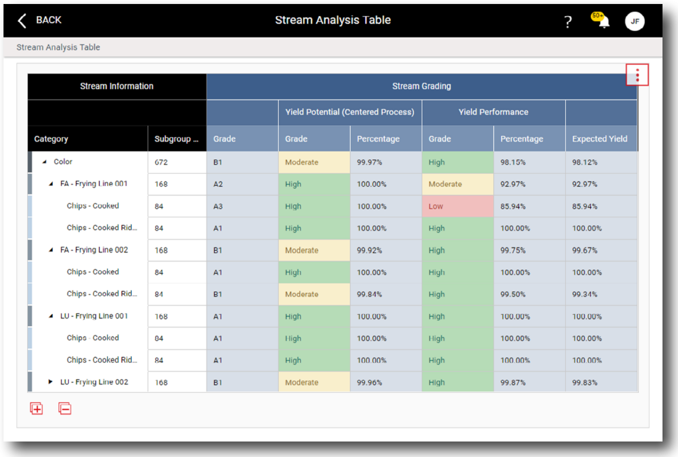
Each of these factors will affect a metric such as Ppk in a different way. Knowing how a site performs doesn't tell you if that site is performing to its full potential. If you have a site that has poor performance, who should address that problem? A site supervisor? A Six Sigma Black Belt? An equipment maintenance expert? An equipment vendor? That's not to say these metrics don't add value—they just don't tell the whole story.

The unique enterprise grading capability of Enact assists manufacturers in solving these problems. Grading provides a summary analysis of individual data streams—the data provided by the unique combination of a single feature measured for a single part running on a single process—that can be aggregated to provide a grade for each critical feature of an entire process, part, or site. This gives you the benefit of rolled-up comparisons without losing the granularity of the raw data. Enact grading handles all this automatically, providing a simple letter-number combination. For example, A3 or B1 represents both expected and potential yield. Together, these yield metrics reflect performance in a way that enables prioritization:

- Stream potential (A, B, C) The letters A, B, and C in the grade correspond to a high, moderate, or low stream potential. Stream potential represents the optimal yield of which a process is capable under the current level of variability—presuming that the process is absolutely on target.

- Stream performance (1, 2, 3) The numbers 1, 2, and 3 correspond to a high, moderate, or low stream performance. Stream performance is a ratio of the stream's expected yield to its potential yield (i.e. Performance = Expected Yield/Potential Yield).

Enact grading enables manufacturers to view a single 3x3 grading (as shown in Figure 16) for the entire organization or for a particular site, for example, providing an executive summary of overall performance. Clicking a single cell within the matrix displays an instant drill-down to more detailed analysis of that grading (as shown in Figure 17)—providing the contextual information required to understand where performance bottlenecks or compliance risks are more prevalent, and enabling the investigation and corrective actions to be directed to where they are most urgently required.



BACK

Stream Analysis Table

Stream Analysis Table

Stream Information		Stream Grading					
			Yield Potential (Centered Process)		Yield Performance		
Category	Subgroup ...	Grade	Grade	Percentage	Grade	Percentage	Expected Yield
Color	672	B1	Moderate	99.97%	High	98.15%	98.12%
FA - Frying Line 001	168	A2	High	100.00%	Moderate	92.97%	92.97%
Chips - Cooked	84	A3	High	100.00%	Low	85.94%	85.94%
Chips - Cooked Rid...	84	A1	High	100.00%	High	100.00%	100.00%
FA - Frying Line 002	168	B1	Moderate	99.92%	High	99.75%	99.67%
Chips - Cooked	84	A1	High	100.00%	High	100.00%	100.00%
Chips - Cooked Rid...	84	B1	Moderate	99.84%	High	99.50%	99.34%
LU - Frying Line 001	168	A1	High	100.00%	High	100.00%	100.00%
Chips - Cooked	84	A1	High	100.00%	High	100.00%	100.00%
Chips - Cooked Rid...	84	A1	High	100.00%	High	100.00%	100.00%
LU - Frying Line 002	168	B1	Moderate	99.96%	High	99.87%	99.83%

Figure 17: Stream Grading Analysis

Conclusion

Net content performance and compliance is one of the most important and challenging areas of food and beverage packaging operations. Any deviation from optimal performance results in unnecessary operational costs with a direct impact on profitability, as well as exposing the manufacturer to external compliance and reputational risks. Yet without the right platform in place, achieving optimal net content performance and compliance can be a resource intensive and inefficient process.

Enact provides manufacturers with a highly capable solution that overcomes these challenges by covering the entire lifecycle—from data collection to shop floor monitoring and control to executive analysis of enterprise-wide performance.

While this Enact Use Case has emphasized and demonstrated Enact's capabilities specifically for net content optimization, its capabilities extend to cover the entire manufacturing process.

About InfinityQS®

Celebrating its 30th year, InfinityQS® is the leading global provider of Manufacturing Quality Intelligence software and services. Powered by a robust Statistical Process Control (SPC) analytics engine, the company's solutions—Enact® and ProFicient™—deliver unparalleled visibility and strategic insight across the enterprise, from the shop floor to the boardroom. This extensive deep-dive capability enables manufacturers to improve product quality; decrease cost and risk; improve compliance; and make strategic, data-driven business decisions. Headquartered near Washington, D.C. and with offices in Seattle, London, and Beijing, InfinityQS has thousands of customers around the world, including Ball Corporation, Boston Scientific, Graham Packaging, and Medtronic. For more information, please visit www.infinityqs.com.