

White Paper:

INDUSTRY INSIGHTS

Food, Beverage & CPG

06



End-to-End Quality Management:

An Integrated Solution to Manufacturing Quality

by EnteGreat and Siemens



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Table of Contents

Introduction	1
The Components of End-to-End Quality Management	2
• Specification Management	2
• Net Contents Control	3
• At-Line Testing	3
• Lab Testing	4
• Regulatory Compliance	4
• Traceability	4
• Hold and Release	5
Support for the Basic Challenges Facing Manufacturers	5
• Expanding the Profit Margin	6
• Responding to Customer Demand	6
• Promoting Brand Equity	7
• Bringing New Products to the Market	8
• Complying with Governmental Regulations	9
A Comprehensive Solution in One Software Package: Siemens SIMATIC® IT	9
Conclusion	10
About EnteGreat	11
About Siemens	11

Introduction

Quality cannot be ignored. Every successful manufacturing company in the Food, Beverage, and CPG industry knows and understands this basic truth. No manufacturing company can expect continued success without a firm grip on product quality. The companies that fail to maintain quality simply fail to stay in business. At the other extreme are the industry leaders who share a distinctive characteristic: they have achieved mastery over the issues surrounding quality.

A company's ability to attain this high level of success is derived from two strategies. The first is an expansive vision of what quality entails. Working from this perspective is critical, because having a narrow outlook on quality in manufacturing means never going beyond the immediate goal of avoiding serious quality failures. A narrow perspective produces a limited scope of solutions directed at a few specific problems. An expansive view recognizes that handling quality comprehensively and exhaustively adds tremendous value to the company and that the result is a broad set of solutions that dramatically support the fundamental business objectives. Under this approach, companies handle the issue of preventing serious quality failures. Rather than settling for nothing more than a reduction in risk, they go on to tackle fundamental quality issues across the board. Taking this broader step accelerates success by promoting gains toward essential business goals, such as expanding the profit margin and becoming more adept at responding to customer demands.

The second critical strategy for mastering quality is the use of cutting-edge Information Technology (IT) solutions. Manufacturing has become so complex that it is impossible to excel without extensive use of the best IT solutions

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An Integrated Solution to Manufacturing Quality

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and tools available. There is virtually no other way to successfully handle such daunting tasks as managing specifications for an ever-increasing assortment of products; organizing lab data from extensive batteries of tests; performing in-line, at-line, and near-line testing; and maintaining records to comply with governmental regulations. The companies using IT solutions intelligently in these areas are gaining clear-cut competitive advantages over the companies who fail to capitalize on the potential of the current technologies.

The IT solutions used in manufacturing have matured to such a degree that functionality now exists that address virtually any challenge faced in most manufacturing facilities. It's currently possible to construct an integrated IT approach that handles every aspect of quality for a manufacturer. That's what **End-to-End Quality Management** is all about. The integrated components contributing to this comprehensive IT solution provide far greater control over production processes, allowing companies to make impressive gains toward achieving their fundamental business goals.

The Components of End-to-End Quality Management

End-to-End Quality Management is a combination of specialized IT tools that are used along with systems implementation expertise to provide a solution set applicable to a wide array of manufacturing production challenges. The scope of the tasks performed by these IT tools can be seen by breaking down these production challenges into the following major areas:

- 1. Specification Management**
- 2. Net Contents Control**
- 3. At-Line Testing**
- 4. Lab Testing**
- 5. Regulatory Compliance**
- 6. Traceability**
- 7. Hold and Release**

In each of these areas, the use of IT solutions brings substantial improvements to both the production processes and operational performance through a focus on quality.

Specification Management

Specifications define what every product should be at every step in production; so one very direct method for improving quality is to strengthen compliance to specifications. The reason many companies have room for improvement in this area is that managing specifications can be overwhelming. Given all of the different ingredients—both raw and processed, all of the stages of production, all of the testing required, and the packaging and labeling variations, it is possible for a single product to have hundreds of different specifications. Multiply this by the variety of products in various versions being produced by one facility or by one company and the total list of specifications becomes enormous.

In order to strengthen compliance to specifications, many people throughout the company need access to the specifications. With End-to-End Quality Management, the people who need access to specifications have it, the people who need to alter specifications or create specifications have that ability, and the specifications are managed and routed for review and approval. All

of this can be done through a browser on an internal web site, and the solution even organizes specifications into groups and hierarchies to simplify searching procedures. Making a product exactly the way it should be made can happen only if everyone knows precisely what the product should be; specification management is an essential step for achieving this goal.

Net Contents Control

Every manufacturer carefully monitors the amount of a product that ends up in each package, bottle, or can. Making certain that no package is under weight or under volume is crucial for avoiding fines from governmental regulatory agencies. It is also crucial for maintaining standards of retail appearance so that consumers feel good about buying the product. The most common approach is to package products with slightly more net contents than the amount given on the label, thus guaranteeing that every package meets the requirements. The extra amount of product is typically called "overpack" or "giveaway."

When a manufacturing company produces package after package of a product day-in and day-out all year long, even minute reductions in overpack can translate into massive annual savings in material costs. In-line weight measurement provides a perfect example of the role IT solutions can play in reducing overpack. If a box of cereal should contain 20 ounces, and if the margin of error for controlling the net weight is plus or minus 1 ounce, then the manufacturer will have to set a target of 21 ounces in order to prevent any boxes from being under weight. After installing in-line weight measurement,

however, the margin of error can be significantly reduced, thus allowing for a target much closer to 20 ounces, perhaps as close as 20.05 ounces. In-line sensors record the weight of each box, spot up or down trends, and send the data to the control mechanisms that determine how much cereal goes in each box, constantly adjusting the controls to ensure that the target is achieved. The weight changes may be minute, but the cost savings can be huge.

At-Line Testing

In-line, at-line, and near-line testing all share the same objective: improve quality through the faster turnaround of test results. By performing tests in-line, or as close to the line as possible, manufacturers get test results faster, so results get into the manufacturing process more quickly, allowing operators to make corrections or to take other actions faster. With in-line and at-line testing, an even faster and more direct method can be utilized by setting up a closed loop that sends feedback results directly to the manufacturing process, which provides better control of the process and better control of overall product quality.

Open-loop and closed-loop Statistical Process Control (SPC) and Statistical Quality Control (SQC) are common examples of at-line quality testing. Using SPC/SQC, manufacturers take samples, perform one or more tests on the samples, get the results immediately, and enter the results into the SPC/SQC tool either manually or automatically. The SPC/SQC tool then uses statistical methods to analyze the results, plot the results against the targets and limits, and determine which corrective

End-to-End Quality Management: An Integrated Solution to Manufacturing Quality

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actions should be taken. Open-loop SPC/SQC presents the results and the recommended actions to operators, so that they can use this knowledge to make decisions as they see fit. Closed-loop SPC/SQC automatically enacts corrective actions based on the results and the defined rules for making corrections.

Lab Testing

The amount and variety of tests required at most food, beverage, and CPG plants is formidable. A short list of the types of analyses would include tests on incoming raw materials; finished goods tests for attributes, such as moisture, fat, protein, density, and viscosity; various tests for compliance to specifications at every stage in production; microbiological tests for the presence of contaminants; packaging tests; and sensory tests for such qualities as taste, smell, and appearance.

The way testing is managed affects not only the quality of the product but also the efficiency and productivity of the production processes. Given that most plants use some type of lab to perform the majority of these tests, using specialized IT tools can significantly streamline the testing process. By providing mechanisms in the lab that support the production lines and that deliver test results in seconds, rather than in minutes or hours, downtime on lines is reduced and quality failures are caught more rapidly. The result is an increase in productivity and a decrease in waste and rework.

Regulatory Compliance

USDA and FDA requirements overlay the entire production process for food manufacturers. A prime

example is HACCP: Hazard Analysis and Critical Control Points. A great deal of process information must be collected, stored, and reported to the government in very specific and detailed formats, and without proper HACCP compliance, the product must be scrapped. In too many cases, the methods companies use to handle compliance reporting involve significant amounts of time spent collecting data on paper and then manually entering it into computer databases.

Using better IT tools to address regulatory compliance tasks frees this labor for other purposes, while at the same time increasing the accuracy of the data by reducing the opportunities for human error. In many cases, the data is already contained in plant control systems, but without the right tools, there is no way to gather and organize the relevant information for reporting purposes. Through electronic collection and storage, the government's regulations are met thoroughly and accurately, and accomplished with only a fraction of the labor required for manual data collection.

Traceability

All quality improvements help to minimize potential product recalls, but the IT tools for material/product tracking and tracing focus more specifically on this vital goal. Many food, beverage and CPG products on the shelves of retail stores contain a long list of ingredients and have gone through a complex series of production processes. The implications of this are that a large number of variables must be considered any time a product failure is discovered. Without the use of IT tools that create product genealogies, finding the cause

of some product failures would be extremely time consuming, if not impossible.

Traceability allows companies to trace every finished goods item back through production to determine which batch it came from and which raw materials or ingredients went into it, as well as which equipment was used, which personnel were involved, and which suppliers provided the raw materials. There is also the ability to start with any raw material, any ingredient, any processed ingredient, or any batch, and then match each with the associated finished goods. With these capabilities, containment is increased, because the scope of a product failure can be established quickly. And, by tracking finished goods through warehousing and distribution, companies can increase the chances of keeping a recalled product from ever reaching a retail outlet.

Hold and Release

The practice of holding a finished product until final quality testing is completed may sound simple in theory, but it is far more complicated in practice. There may be different levels of holds: hold in the plant for further tests, hold in the warehouse for rework, or hold at the distribution center for final quality confirmation. Hold and release procedures can also be used in similar ways for raw materials and work-in-process (WIP) materials.

Managing every lot of raw materials, WIP materials, and finished goods, while determining the quality status of each, presents a complex information and logistical challenge. The use of IT tools that can perform material track, trace and genealogy, streamlines this process and ensures that the integrity of each lot is handled accurately.

Shorter hold times help to reduce inventory costs, and greater accuracy reduces the chance that a bad lot is released inadvertently.

Looking at the solutions to the production challenges in these major areas demonstrates the potential of the IT tools that make up End-to-End Quality Management, but the information here provides only highlights of what these tools can actually accomplish. Many of the benefits derived from using these tools build upon each other. Improvements in quality reduce rework; reductions in rework bring increases in productivity; productivity improvements make it possible to reduce inventories; and so on. In both direct and indirect ways, all of this works to support the fundamental purpose of moving the business forward and helping the business achieve its strategic goals.

Support for the Basic Challenges Facing Manufacturers

One of the first rules for the effective use of information technology is that every new piece of software installed must function to support the basic objectives of the business. There is no advantage to purchasing a new system simply because it appears to be an impressive feat of computer programming. New systems should be added because—and only because—they provide a clear and concrete benefit to the company.

The benefits of End-to-End Quality Management are distinctly clear and concrete. The components of this system improve manufacturing processes in ways that ensure support for the following fundamental business challenges that drive manufacturing companies:

End-to-End Quality Management:

An Integrated Solution to Manufacturing Quality

by *EnteGreat and Siemens*

- **Expanding the Profit Margin**
- **Responding to Customer Demand**
- **Promoting Brand Equity**
- **Bringing New Products to the Market**
- **Complying with Governmental Regulations**

A clear sense of these business issues is essential to understanding how End-to-End Quality Management adds value to manufacturing.

Expanding the Profit Margin

All manufacturers drive to expand profit margins, but doing so is acutely difficult for many companies due to an assortment of factors that all work to constrain price increases. To begin with, big-box retailers control a large segment of the market, and their success comes from offering products at low prices. Another factor is that mass-market brands are facing price competition from the growth of private labels. These battles for market share have implications beyond an increase in sales volume, because owning a brand that has achieved category dominance enables a manufacturer to command greater leverage with retailers.

Given the pressures working to inhibit price growth, attempts to expand the profit margin must focus primarily on cost. The result is that companies are working aggressively to improve efficiency, eliminate waste, and increase productivity, so that operating costs can be reduced. The effort to reduce costs has always been the cornerstone of margin expansion, and the current business climate is forcing manufacturers to find new ways to pursue this end.

End-to-End Quality Management helps reduce costs in many ways. Labor costs go down because quality improvements translate into less time spent dealing with the results of quality failures. Paperless reporting for regulatory compliance means significantly less time spent entering data by hand, and increased first-pass yields reduce the time spent on rework. Material costs go down as well, both because of the improvements already mentioned and for other reasons, such as reducing overpack. Another factor is that greater efficiency and increased productivity allow companies to respond more quickly to demand, which enables them to keep inventories at lower levels, thus reducing inventory costs. And better management of raw material quality with suppliers saves both time and expense.

Responding to Customer Demand

One of the major shifts in manufacturing is the move from a supply orientation to a demand orientation. Companies who were once able to use pre-set inventory levels as a guide for production scheduling are now being forced to respond quickly to customer orders. The supply chain has tightened and manufacturing plants are being asked to play a central role in accommodating the rapidly changing needs of customers.

The fluctuating nature of customer demand compels companies to strive for a degree of flexibility far beyond previous expectations. Plants must be able to schedule and execute production to match highly dynamic market changes and to accommodate aggressive promotional campaigns. If a marketing campaign causes a sudden spike in sales, the plant needs to have the ability to

increase production accordingly.

But the desire to respond quickly to demand is contingent on an even more rapid exchange of information. Therefore, a central element of demand-driven manufacturing is closer communication with customers, which allows manufacturers to obtain accurate and timely information about product promotions and sales.

Customers, whether they are other companies or retail consumers, have learned that they can expect a level of responsiveness from manufacturers that was unheard of in the past. Finding ways to increase customer fulfillment has become a strategy for gaining a competitive advantage, and the manufacturing companies that develop flexibility within demand-driven supply networks are coming out ahead.

Companies using End-to-End Quality Management gain greater flexibility by virtue of the increase in efficiency and productivity. Scheduling can be adjusted to fit tighter deadlines and to accommodate the dynamic flow of customer demand. Another critical benefit of implementing End-to-End Quality Management throughout all manufacturing facilities is the standardization of manufacturing business processes, which promotes even greater production flexibility. When every plant follows the same business processes and all personnel have access to the same manufacturing data, there is more opportunity to move the production of specific products from one plant to another as needed to accommodate tight scheduling.

By giving manufacturers comprehensive control over their manufacturing processes, End-to-End Quality Management also provides vital support for responding

to customer demands when customers want to change or modify specifications. Manufacturers who are trying to test for quality after the fact are lagging behind the manufacturers who have adopted practices that build quality into products from the beginning. When customers want new products or changes to specifications, the manufacturers who have made the shift forward on handling quality can respond effectively, because they have eliminated the typical trial-and-error process that many other companies must use. Manufacturers using End-to-End Quality Management know how to change the specifications, how to change the manufacturing processes, and how to ensure that the changes are done correctly the first time.

Promoting Brand Equity

Research and direct experience have clearly proven the immense value of a well-established brand that commands consumer loyalty and trust. For this reason, manufacturers are constantly making efforts to protect current brands, to elevate the status of new brands, and to extend the market reach of brands by leveraging popularity already achieved with consumers.

Since it takes only one highly-publicized recall to tarnish the name of a popular product, manufacturers are compelled to go to great lengths to avoid such catastrophes. Other factors that affect the public's perception of a product are retail appearance and availability, which means that brand loyalty is additionally contingent on consistent packaging quality and steady retail access. Brand equity also plays a role in the competition for retail shelf space, and the proliferation of brands has created intense battles

End-to-End Quality Management:

An Integrated Solution to Manufacturing Quality

by *EnteGreat and Siemens*

for coveted space at major retailers. Thus, the practices of leveraging existing brands and creating new brands have become strategies not only for increasing market share and boosting sales, but also for securing retail space.

The benefits surrounding brand equity that come from the use of End-to-End Quality Management are indispensable. The tracking and tracing capabilities of product genealogy tools significantly reduce the risk of having a damaging recall occur in the first place, while also limiting the scope of any product failures that do happen. The IT tools used in Specifications Management, At-Line Testing, Lab Testing, and Hold and Release provide solid and sustained improvements to the quality of manufactured products and manufacturing processes. In these ways, End-to-End Quality Management helps to ensure that no matter when a product is made or where it is made, it looks, feels, and tastes the exactly the same. With this increased capability to deliver a product that consistently satisfies customers' expectations, manufacturers can guarantee that their brands gain power and status.

Bringing New Products to the Market

Manufacturers cannot afford to be complacent in today's food, beverage and CPG markets. Success is fleeting and continued success often depends upon an ability to respond to an ever-changing retail environment. The combination of countless dietary fads, rapidly changing lifestyles, and evolving health concerns presents both difficulty and opportunity. There is great potential for

new products, but determining which new products to bring to the market presents serious challenges.

The next step is actually making the new product, which requires close collaboration among several different company departments. Research and Development, Marketing, Production, and Finance all have a role to play as new products are developed and introduced. The need to respond to developing trends in a timely manner means that companies must foster two vital skills in their collaborative processes: speed and flexibility. The challenge is to get the new product into the hands of consumers more quickly than ever before.

One of the core benefits generated by End-to-End Quality Management is that all types of collaboration are greatly facilitated—collaboration within companies, collaboration between companies and suppliers, and collaboration between companies and customers. This is particularly evident in the area of Specifications Management, because the IT tools used make it possible for everyone to have access to the same data and to communicate and collaborate concerning specifications. As new products are developed and introduced, this ability to work together efficiently supports the goals of speed and flexibility. Additionally, the use of End-to-End Quality Management familiarizes people throughout the company with every aspect of the manufacturing processes. As a result, everyone gains more thorough knowledge of what bringing a new product to the market entails, which further enables people to work quickly, creatively, and collaboratively toward common objectives.

Complying with Governmental Regulations

Food, beverage, and CPG manufacturers work with an extensive amount of governmental oversight that affects every phase of production, from receiving raw materials through shipping the finished product and including the task of ensuring complete accuracy on the mandatory labels that give nutritional content. Failing to comply with regulations can bring not only substantial fines, but also the more serious consequence of bad publicity, which can severely damage a company's reputation.

Regulatory compliance breaks down into two basic tasks. First, manufacturers must follow strict rules governing various production processes, and second, they must document that the rules were followed. The rules governing production dictate many of the details that become a standard part of plant procedures, and the documentation requirements force companies to keep comprehensive and exhaustive records verifying compliance.

All of this makes manufacturing costs go up. This is especially true when documentation chores are handled by the labor-intensive method of keeping records on paper and then manually entering them into databases. In the end, manufacturers are pulled in opposite directions. There is constant pressure to keep costs down, but it is imperative to ensure thorough compliance with governmental regulations, regardless of the expense.

For companies who have yet to make the transition to paperless reporting for regulatory compliance, End-to-End Quality Management will make a world of difference. The IT tools used in this area dramatically reduce labor and significantly improve accuracy by providing automated

data collection and reporting. But documentation is only one of the benefits. By providing real-time visibility into production processes, End-to-End Quality Management enables operators to correct many problems before they become compliance issues. And as manufacturing processes are improved and standardized, the occurrence of problems decreases and the routine of ensuring compliance becomes more solid.

A Comprehensive Solution in One Software Package: Siemens SIMATIC® IT

The reality of manufacturing information technology today is that even though solutions exist to handle every quality issue, the entire range of tools needed is rarely found within a single software package. The exception to this rule is Siemens SIMATIC® IT Manufacturing Execution System. SIMATIC® IT incorporates a complete suite of the solutions and tools required to address quality comprehensively within manufacturing, providing all of the components defined in End-to-End Quality Management.

Having everything in one package eliminates many integration issues, because it eliminates the need to design, program, and maintain interfaces between multiple manufacturing systems from different software companies. But integrating with corporate systems like Enterprise Resource Planning (ERP) systems or other plant floor systems like HMI/SCADA is a separate matter, which is also a serious problem for many manufacturers. In response to this need, Siemens has created highly effective interfaces for data flow between SIMATIC® IT and the

End-to-End Quality Management:

An Integrated Solution to Manufacturing Quality

by EnteGreat and Siemens

ERP systems being used at the corporate level and between SIMATIC® IT and the HMI/SCADA systems used on the plant floor.

Conclusion

Every food, beverage, and CPG manufacturing company in business today is addressing quality in some form or fashion, but only a select few have embraced a broad vision of what quality entails. These forward-thinking manufacturers are using cutting-edge information technology tools in an aggressive effort to make substantial and sustained progress toward strategic business objectives. This approach accelerates the company-wide standardization and maturation of manufacturing business processes and fosters a corporate culture that seeks continuous improvement. For all of these reasons, companies who use End-to-End Quality Management as an integrated solution to the undeniable issues surrounding quality in manufacturing gain a distinct advantage in a highly competitive industry.

About The Authors.



EnteGreat is a manufacturing consulting and systems integration company, serving primarily Fortune 500 manufacturing companies across North America. Rather than offering just technical solutions, the EnteGreat team is focused on helping clients implement supply chain and manufacturing IT systems that deliver measurable business outcomes from the project conception stage to world-wide rollout. The company helps its clients develop and implement continuous improvement initiatives for both manufacturing and supply chain operations that are facilitated by information systems solutions. For more information, please visit our web site: www.entegreat.com.

SIEMENS

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Contact Us.

1900 International Park Drive
Birmingham, AL 35243
Phone: 205-968-3050
Email: marketing@entegreat.com
Web: www.entegreat.com

Contact Us.

1201 Summeytown Pike
Spring House, PA 19477
Phone: 215-646-7400
Web: www.sea.siemens.com

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06



1900 International Park Drive, Suite 200
Birmingham, Alabama 35243
phone: 205.968.3050 fax: 205.968.3858
www.entegreat.com