



Addressing the 'Six Big Losses':
A New Approach to Old Problems in Process Manufacturing

W H I T E P A P E R

Introduction

As many executives already recognize, knowing that production efficiency and capacity problems exist is one thing. Effecting real and lasting change through a continuous improvement (CI) initiative is another.

Often the challenge lies in determining the root cause and the full extent of operational problems, making it difficult to determine where—and how—to begin the CI program.

But increasingly, manufacturers are discovering a surprisingly effective framework from which to tackle the CI challenge: the “Six Big Losses.” Developed in the 1970s by the Japan Institute of Plant Maintenance (JIPM), this framework enables companies to examine their efficiency problem with an unprecedented level of granularity. It also provides the necessary structure for tackling the problems, improving efficiency and capacity, reducing manufacturing costs and improving profitability.

Citing examples from process manufacturers that have successfully leveraged this proven framework, this white paper examines how approaching a CI initiative through the Six Big Losses can help improve CI success and, in turn, business performance.

Continuous Improvement: Easier Said Than Done

In an effort to optimize utilization and unlock production capacity and competitiveness, an increasing number of manufacturers have engaged in continuous improvement (CI) initiatives such as Lean Manufacturing, Six Sigma and other in-house operational improvement programs.

However, these programs are often challenging to execute. Challenges lie in the lack of operational visibility, which makes it difficult to define, begin and measure the effectiveness of a CI program. Outdated information can also be an obstacle. Manual systems and automated data collection tools provide valuable data, but that data tends to be outdated by the time anyone can take corrective action.

Lack of shop floor accountability—as well as improvement-skills and improvement-methods training—also frequently threaten CI success. Shop floor ownership is fundamental to the success of a CI initiative, since operators have the greatest control over labor and material utilization. However, without a sustainable method for delivering continuous

performance feedback to the shop floor, operators in real-time environments cannot be held accountable for performance issues.

Faced with these mounting obstacles, CI initiatives often do not deliver their promised benefits, leaving manufacturers to make uninformed decisions or to give up on the idea altogether. The company’s leadership may recognize that there is significant room for improvement. It may even have more measurements and data than ever before. But most of these metrics simply reflect what is coming out of the equipment—units produced, uptime, mean time between failure and summary data that only reveals part of the story.

A Lack of Granularity

Most often, the available data does not clearly indicate where the problems are and which issues the manufacturer should be addressing first—and it fails to help determine the true scale of the existing loss, its source, and which root causes are most costly and insidious.

In essence, most organizations lack the granularity of information necessary to determine where losses are occurring within their processes. Consequently, they cannot easily determine where to begin attacking the problem.

Paper and Spreadsheets

In an attempt to improve their visibility into these losses, manufacturers have tried to employ manual, paper-based systems on the shop floor. However, these systems tend to yield unreliable, incomplete and subjective data that is almost always out of date and mostly leads to poor decisions and subpar performance. Manual systems also cause operators and supervisors to spend an overwhelming amount of time on the administrative process of collecting and collating data, leaving little to no time to make sound decisions or to take appropriate action based on the data.

Simply put, manual systems do not drive action. Instead, they most often drive only debate and discussion. When performance does not improve, factory floor meetings become postmortem “blame sessions” about issues that occurred earlier that day or that week. And since no one buys into the quality and timeliness of the data, action is not taken and performance continues to suffer, breeding employee cynicism and distaste for new improvement initiatives.

The Missing Ingredient in MES

Once a company realizes that a paper-based system is not going to work, it will typically deploy some form of automated shop floor data collection system, often in the form of an MES (Manufacturing Execution System). But MES, while the right idea, often adds confusion and complexity. These systems tend to generate reports and a plethora of data that is difficult to act on.

Furthermore, an MES is not designed to force a change in behavior. MES can certainly produce a tremendous amount of data. But data in and of itself does not engender action. Without a feedback loop that delivers real-time information to operators on how they are performing at any given moment, operators cannot make sound decisions and take appropriate and timely action.

“Relying on streams of raw data and outdated analysis can be compared to driving a car blindfolded and then getting a report at the end of the day detailing every accident you caused,” says David Gallagher, operations director for Greencore Cakes and Desserts, one of Europe’s leading ambient cake and dessert manufacturers. “A report on yield and cycle time three days later is not very useful to a busy operator whose primary task is to keep the line moving at that very moment. What operators need is real-time and relevant information they can use to avoid ‘accidents’ as they approach obstacles.”

In terms of continuous improvement, this string of potential failures puts manufacturers back to square one: managing production operations in the dark. This can be especially frustrating for executives that recognize that they are still sitting on a potential 20 to 50 percent opportunity for performance improvement—yet they are still unsure of how to capitalize on that opportunity.

A New Approach to Address Old Problems

Increasingly, companies working in process manufacturing environments are discovering a surprisingly effective framework from which to tackle the CI challenge: the “Six Big Losses” approach. Developed in the 1970s by the Japan Institute of Plant Maintenance (JIPM), the Six Big Losses framework enables manufacturers to examine their efficiency problem with an unprecedented level of granularity.¹

The Six Big Losses	Loss Category
1. Equipment failures 2. Set-up and changeovers	Utilization (Availability)
3. Idling and minor stoppages 4. Reduced speed operation	Rate Loss (Performance)
5. Scrap and rework 6. Startup losses	Yield (Quality)

Besides measuring the product coming out of a machine, the Six Big Losses framework helps a manufacturer delve deeper into production performance by better determining what could have come out of the machine and where effectiveness is suffering. The framework categorizes the reasons why 100 percent efficiency is not being attained into three major areas—downtime (availability), speed losses (performance) and defect losses (yield)—which are then broken down further into six distinct categories.

Overall Equipment Effectiveness, or OEE, offers a simple numerical representation of what is causing the inefficiency gap, providing daily information about how effectively equipment is running and which of the six loss areas need improvement. (OEE is represented as Availability Rate × Performance Rate × Quality Rate). Breaking these constituent parts into the Six Big losses enables producers to not only calculate a holistic performance metric but to also delve into the underlying categories affecting performance.

This proven framework has enabled hundreds of manufacturing organizations to determine with great precision, the root cause of their inefficiencies. It provides the necessary structure for tackling the problems, improving efficiency and capacity, driving down costs and improving profitability. For manufacturers focused on removing capacity constraints, the framework can also help unlock additional capacity while reducing manufacturing costs and improving profitability.

Adopting Adequate Technology

At the same time, improving manufacturing performance through a focus on the Six Big Losses requires a move from spreadsheets and paper-based systems to real-time performance management technology. Accurately measuring OEE and the Six Big Losses manually or with spreadsheets is not only extremely difficult, it also fails to provide granular visibility into each of the six performance areas.

Real-time performance management technology reliably supplies relevant information that a shop floor can use quickly. It enables the real-time visibility and transparency into production performance necessary to eliminate unproductive finger-pointing, making action unavoidable. And today, this technology should be readily available to manufacturers, requiring little if any overhead for customization.

Using the 'Six Big Losses' Framework to Improve Manufacturing Performance

Addressing the Primary Area of Opportunity

Figure 1 below depicts a hypothetical scenario in a process manufacturing plant. This company recognizes that in any given shift, it is running at an average efficiency rate of 48 percent. What it doesn't know, however, is what composes the 52 percent opportunity for improvement. The company may know that a certain percentage of that opportunity represents a loss that cannot be recouped in the short-term—necessary cleanup and essential mechanical changeover, for instance. However, that still leaves the company with a significant opportunity for improvement.

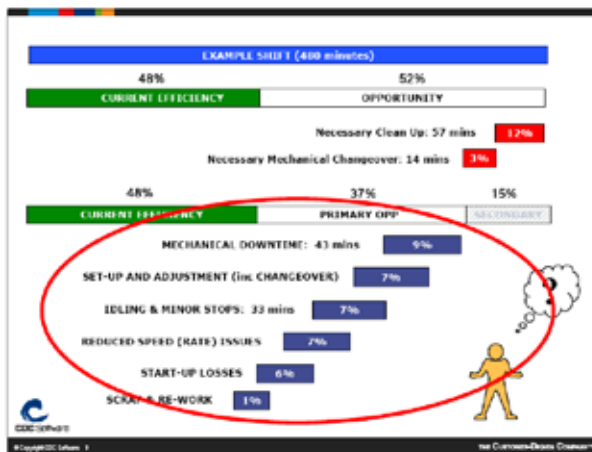


Figure 1.

By approaching this challenge through the Six Big Losses framework—which helps identify and categorize the specific gaps and opportunities—this organization can now begin to focus on mining these improvement opportunities, prioritizing the most pressing issues and then solving the right problems.

Big Loss No. 1: Mechanical Downtime (Availability)

When it comes to downtime, it is not enough to simply recognize that downtime is a problem. It is critical to also understand the causes for that loss. Furthermore, to drive change, it's important to break up downtime into its constituent parts. Besides reason codes, decision makers need to know if the downtime was caused by general wear and tear, operator error or maintenance technician delay, for instance. They also need to know how long the downtime lasted and how long it took for the operator to respond, for maintenance personnel to identify the problem, and for the operator to get the line up and running again.

"Having an easy way to accurately track maintenance response times has helped reduce downtime by making everyone more accountable for downtime and for getting the lines back up to speed," says Mike Winn, production manager at Nellson Nutraceutical's Powder Division, a leading outsourced formulator and manufacturer of functional bars and powders.

"Now when a line goes down, the operator immediately triggers an alarm for the maintenance shop. When the technician gets there, the operator clicks the 'maintenance arrived' button and the system automatically records the response time. In the past, it used to take maintenance up to an hour to respond. But with the increased visibility, technicians are now averaging five to ten minutes—and there's no longer a dispute between operators and technicians about how long it took them to get there."

It is also important that the right people are empowered to make the data actionable. For instance, the operator may be the person reporting the observed fault or symptom, but it's the technician who can actually report the root cause. Both are needed to close the gap. And in most cases, the operator and the technician are the only individuals who can provide the key information needed to address root causes.

Finally, the data collected must be 100 percent accurate—and that's where paper-based systems often fail. Trying to capture data manually requires that someone pick up a log at the end of the shift and report all the rate downtime they experienced during their shift. But in a fast-paced production environment, this is a futile task. The chances of someone remembering every detail about the last eight hours are slim, which means that only a fraction of the data will ever be captured.

Big Loss No. 2: Setups and Changeovers (Availability)

An operator with no changeover target and no real-time visibility into how he or she is performing against that target cannot be expected to work toward minimizing changeover time. But in an environment in which equipment operators, supervisors and plant managers have full transparency into actual changeover times against targets, the dynamic is very different.

When provided with an allowance detailing how long each changeover should take, a video clip or diagram that explains how to complete the changeover, and an end-of-shift report that provides detailed feedback on actual changeover performance against the target, operators tend to change their behavior.

Greater clarity into root causes can also lead to significant performance improvements. The ability to analyze changeovers by crew, shift or product and to easily determine when and where performance spikes are occurring allows managers to identify potential training issues.

Analysis into setup time variability can also reveal causes that were previously unknown or simply ignored. For instance, Marsan Foods, a manufacturer of prepared and packaged food for large retail, food service and healthcare customers, recognized that it was having problems with its “sealer”—the machine that seals food trays after filling. Not only was it a recurring problem (it was responsible for nine percent of all downtime), but the problems only occurred at the start of the morning shift.

Improved data collection and drill-down analysis, combined with feedback from factory floor personnel, revealed that the root cause of the film breakage was excess moisture left after the machine was cleaned and sanitized overnight. By installing a more powerful air gun to dry the equipment, Marsan was able to quickly resolve the problem. Overall, the company has improved its changeover times from an average of 45 to 60 minutes, to only 34 minutes.

Big Lost No. 3: Idling and Minor Stops (Performance)

This category often represents a tremendous area for performance improvement. Idling and minor stoppages typically lead to other costly problems, in addition to lost time. In fact, even the smallest stoppage can kill the entire flow of a line in many production environments.

Fortunately, this is also one of the easiest areas to improve when the proper technology and feedback systems are in place. And in most cases, taking corrective action involves simple, painless changes in working practices rather than major capital investments.

But to achieve positive, sustainable improvements in this area, information must be captured on a minute-by-minute basis. Moreover, it's important to establish a process by which shop floor personnel can quickly and easily indicate the reasons for stoppages as they occur. All too often operators have no way of communicating constant and repetitive line performance problems to senior management, so the problems continue unabated.

It is also critical that the feedback system be automated, not paper-based. Paper forms take too long to use in a fast-paced, real-time environment. They also lead to inaccuracies and discourage shop floor personnel from entering the information as it happens.

For instance, beverage producer Calypso Soft Drinks Limited was experiencing problems with the accuracy and consistency of minor downtime data. “If there were two minutes and 22 seconds of downtime, it might be recorded by one operator as two minutes and by another as two and a half,” said James Holmes, Calypso's IT director.

“At daily production meetings, we would realize that we were about 70 minutes, or five percent, short on allocated downtime, according to what operators were recording in their paperwork,” he said. “We knew it had gone somewhere, but it was unallocated. Automating the collection and analysis of data from the shop floor has eliminated this problem and enabled us to focus on addressing the causes of these stoppages.”

Big Loss No. 4: Reduced Speed Operation

Providing factory floor personnel with full, real-time visibility into line speed can have a dramatic effect on performance. Often referred to as the “Hawthorne effect”—a term used to describe behavioral changes when an individual knows his or her actions are being observed—improved performance is often immediate and significant.²

Naturally, the objectives for most manufacturers include improvements in speed. But in addition, the objectives should include the ability to achieve an optimal balance between efficiency and product quality. In that case, the organization's performance management system should enable comparisons between production runs of the same product and by different operators. This can help executives better understand what the line was actually running when the line speed decreased, so that a comparison can be made between variables such as operator, speed and product quality.

A greater degree of granularity can also help identify equipment issues. For instance, drill-down analysis enabled Marsan Foods to determine that incorrect settings following an equipment change were making one of their lines run slower than it should have. Correcting these settings enabled the company to immediately improve its line rate from 79 percent to 85 percent.

Big Loss #5: Scrap and Rework (Quality)

In terms of scrap and rework, knowing the size of the loss is not enough. To improve performance, manufacturers also need an accurate indication as to the source of the loss. For instance, the number of products that are being rejected at the filler, the number being rejected at the capper and the reasons for each of those rejections.

Once again, because this information is difficult to capture manually as it happens—and because it often resides in a number of locations and systems—manufacturers lack the visibility necessary to make accurate changes. What's needed is a way to automatically capture the information and immediately feed it back to the individuals who can take action as soon as significant yield problems arise.

Also, to ensure that the minimum amount of product is scrapped, it is important to capture every single scrap instance as they occur and note how each of those correlates with other variables at the time of the loss—such as actual temperature, humidity and other key production factors that could conceivably impact quality.

For instance, food processor Heinz Single Service, a manufacturer of sauces, condiments and vinegars, was experiencing problems with its mayonnaise lines. Temperature changes can cause mayonnaise viscosity to vary considerably, which in turn affects the rate of flow through the machinery and the amount of fill.

To prevent underfilling and to avoid constant tweaking, operators were resorting to higher fill settings. But that also meant that if the lines were already running overweight, scrap would be increased even further.

After deploying a real-time performance management system and a closed feedback loop, the overfilling problem was completely eliminated. Timers and alerts now notify operators when product samplings must be made. Results for each line are then automatically recorded, prompting the operator to make necessary adjustments to the settings as needed.

"We immediately reduced giveaway by one percent, which saved us a substantial amount of money right away," said Jane Buckley, manufacturing manager at Heinz Single Service.

Big Loss # 6: Startup Losses (Quality)

Most manufacturers in process manufacturing environments experience a certain level of product loss in virtually every startup routine. However, if getting a line running at full running speed requires an operator to cycle the line two or three times, losing product in the process, there is generally an opportunity for improvement.

By having greater visibility into the affect of different variables on overall performance, managers can better determine the startup conditions that are more conducive to waste, as well as the reasons for those conditions and how they can be addressed.

Moreover, embedding the standard operating procedure into the process can help operators determine exactly how the equipment should be set up, drastically minimizing the amount of waste during startup. Changeover alerts can also be helpful. For instance, notifying the operator that he or she should be running the equipment at a certain rate or temperature can help minimize these unnecessary losses during a changeover.

Critical Success Factors in Continuous Improvement Initiatives

Continuous improvement, by definition, requires fundamental changes on the part of manufacturers. This simple understanding help to explain why many CI programs are unsuccessful in producing desired results. Yet process manufacturers that have successfully deployed CI initiatives often leave behind clues to their success. Besides approaching

the problem with a focus on the Six Big Losses, many organizations that have succeeded with CI have also placed a heavy emphasis on the following factors.

One version of the truth. Aside from their other shortcomings, manual systems leave too much to interpretation—and attempting to solve production efficiency problems without having one version of the truth is futile. In order for a CI program to succeed, everyone in the company must speak the same language with regard to these problems. Having one version of the truth eliminates debate and ensures that everyone is focused on addressing root causes.

Accountability at the shop floor. Some of the most valuable business intelligence in a manufacturing environment resides with the shop floor employees. By empowering operators with the tools they need to solve the efficiency problems within their work centers, the shop floor becomes a highly valuable contributor to continuous improvement success, rather than a barrier.

Closed-loop approach. Manufacturers must also work to institute a closed feedback loop that delivers real-time feedback to operators via shop floor terminals. Providing shop floor personnel with information about how they are performing reduces anxiety and also creates the incentive for operators to take appropriate and timely action. “The system isn’t used as a stick to beat the operators, but as something that gives them real measures against which they can improve,” says Calypso’s Holmes. “It’s a tool to help the company grow and to allow us to recognize and acknowledge improvement. It can be very motivational in that sense.”

Standard framework for deploying CI across multiple lines and facilities. The systems and processes deployed in a CI effort must be repeatable across multiple production lines and across multiple plants. This ensures that CI is not just an ad hoc activity but rather it becomes a consistent, predictable and repeatable method across the entire company. As such, CI then provides the best-practice methodology for problem solving on a broad scale.

Real-time, actionable information. An MES can certainly generate an enormous amount of data. But manufacturers today don’t need more data; they need metrics and effective analytical tools that enable supervisors and managers to quickly identify the root cause of problems. By providing operators with real-time visibility and transparency into production performance, action becomes unavoidable.

Easy for operators to use. Finally, the deployed technology must be easy to use. To ensure full adoption, the system must provide a clear interface for operators working in a fast-paced environment, including intuitive screen layouts and options. Information must be presented in an unambiguous format and allow control without operators having to think through complicated commands or steps.

Conclusion

For manufacturers in process manufacturing environments, driving sustainable operational improvements is no longer an option—it’s a requisite for survival. By employing the “Six Big Losses” framework to guide their continuous improvement journey, these companies can finally examine their efficiency problems with an unprecedented level of granularity. And when used in conjunction with practical, real-time performance management technology, this focused approach provides the necessary structure for tackling these problems, improving efficiency and capacity, reducing manufacturing costs and improving profitability.

About CDC Factory

CDC Factory is the first packaged manufacturing operations management system that transforms manufacturing performance by empowering people to take immediate action. By standardizing the best practices of lean manufacturing, OEE and continuous improvement, CDC Factory provides a real-time framework that unites scheduling, operations, quality and maintenance. Specifically designed for food and beverage, pharmaceutical and consumer packaged goods manufacturers, CDC Factory enables real-time decision making with relevant visibility at all levels in the organization, from factory floor operators to executive management. Leading manufacturers are using CDC Factory to reduce operating costs and waste, increase production capacity, improve customer service and employee satisfaction, and minimize risk by assuring regulatory compliance.

For more information, visit: www.cdcfactory.com

References

1. Japan Institute of Plant Maintenance (JIPM). <http://jipms.jp/english/index.html>. 2. Bumstead, Jon and Bruce, Andy. "Rediscovering Continuous Improvement." Accenture. http://www.accenture.com/Global/Research_and_Insights/Outlook/By_Alphabet/RediscoveringImprovement.htm.
2. Draper, Steve. "The Hawthorne, Pygmalion, Placebo and Other Effects of Expectation." Department of Psychology, University of Glasgow. <http://www.psy.gla.ac.uk/~steve/hawth.html>.

