

AUDITING

Turbocharge Your Preventive Action System

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In 50 Words Or Less

- A layered process audit is an ongoing chain of simple verification checks that ensure a defined process is followed correctly.
- This powerful management tool can improve safety, quality and cost savings by amplifying problem solving systems and making continuous improvement almost routine.

With increased global competition, U.S. manufacturers are relentlessly looking for new ways to improve quality and productivity and to lower costs. One quality tool—originally launched as a quality improvement initiative—can be used to do all three.

A layered process audit (LPA) goes beyond inspection of work by actually transforming a company's culture into one that embraces continuous improvement.

Accepted quality systems, such as ISO 9000 and the Baldrige criteria, specify that management is responsible for establishing and maintaining systems and procedures that effectively produce quality

results. An LPA is one way to engage leadership in verifying that the systems they assume are in place are indeed present and effective. Beyond verification, LPAs—conducted by all layers of leadership—demonstrate top leadership’s personal commitment to quality.

Hundreds of automotive suppliers have implemented LPAs. General Motors initially introduced LPAs to suppliers in 2002. DaimlerChrysler made LPAs a supplier requirement in 2004. To reduce variation in interpretation of requirements, the Automotive Industry Action Group (AIAG) published *CQI-8—Layered Process Audits Guideline* in December 2005.

Start With the Basics

In short, an LPA is an ongoing chain of simple verification checks. Through observation, evaluation and conversations on the manufacturing floor, these checks ensure key work steps are performed properly. These interactions are also an excellent way for managers to show respect for frontline workers.

Unlike management, accounting or quality system audits that result in reports to leadership, LPAs are intended to verify for operators and frontline supervisors that things are going right. If they’re not going right, the audits guide correction of the finding (nonconformance) on the spot.

If the problem recurs or is found in other work areas, then the problem might be viewed as systemic and on an exception basis, bubbling up for management review and problem solving activities.

Most often, the quality department develops the LPA checklists in conjunction with the operations

or manufacturing staff. It’s helpful to use a team approach and include those who carry out the work.

In LPAs, only the top risk items for safety and quality are incorporated into the checksheets, placing focus where it is needed most. LPA checks should be performed only on conditions that vary daily, such as the presence of machine guarding, operator craftsmanship, condition of tools and effectiveness of fail-safe devices.

Different layers of management and various staff should perform LPAs for any given line on a set

An LPA is nothing more than a disciplined way to verify that work is performed the way it was intended.

schedule. This ensures that many sets of eyes from all levels of management can view the process.

LPAs help protect operators from injury and also protect customers and plants from shipping nonconforming products. But that’s only the tip of the iceberg. It’s less costly to have fewer injuries and manufacture products correctly the first time, and LPA checksheets that focus on process inputs will help achieve first-time quality.

In every organization, things get in the way of people doing their best. For operators performing repetitive tasks, it’s sometimes difficult to repeat motions without error. Some operators might become careless, make simple mistakes or take well-intended shortcuts that change a process. Machines are also prone to error. Left unvalidated, tools can wear, machines might malfunction, and settings are adjusted needlessly.

The positive outcomes of LPAs are that you know the processes were run correctly because you were able to personally verify them. You weren’t taking anyone else’s word for it—you actually saw and touched the process. LPAs also let top management systematically become more familiar with

TABLE 1 Layered Process Audits at BorgWarner

Calendar year	ppm defective	Percentage of improvement (year-to-year)
2002	591	NA
2003	66	89%
2004	36	45%
2005	22	39%
2006 (through June)	14	36%

ppm=parts per million



shop floor activities and build a relationship between management and shop floor personnel.

LPAs are not the typical audit of the product. Instead, they are an audit of the process. In a process audit, you check to see that the operator is following the defined process. LPAs ensure that the critical process parameters, such as machine settings, temperatures, flow rates and gages, were set correctly. If the defined parameters were set correctly, the process will make good parts. In a product audit, you only check to see if the part was within specification.

One Manufacturer's Success

BorgWarner's powertrain plant in Muncie, IN, implemented LPAs in early 2003. In time, the plant's original equipment manufacturer (OEM) customer assembly plant reject rate for a specific new assembly line, measured in parts per million defective (ppm), quickly dropped almost 90%, from 591 to 66. From 2003 to 2006, the rate continued to drop and its ppm fell below 15 (see Table 1). The average ppm reduction during the past three years was 40% year-to-year.

When used effectively, LPAs can find and reduce the variation prevalent in any production workplace. When variation of product is reduced, operations flow more smoothly, and customer satisfaction and employee morale increase. This, in turn, can lead to significant cumulative cost savings.

During the past two years, many automotive parts suppliers have implemented LPAs. OEMs see LPAs as one of the most powerful activities to make good suppliers better, or take great suppliers and prevent their quality metrics from declining.

Many customer quality concerns are caused by not following the process or by having a false sense of security that the error proofing in place still works. By eliminating errors that would otherwise be caught during inspection—or worst-case scenario, by the customer—LPAs have a significant impact on reducing wasteful costs of rework, sorting and tending to customer quality concerns. With higher yield rates and less downtime, throughput productivity measures also are improved.

This can be clearly seen in the BorgWarner powertrain plant. Using the final assembly line as an example, the line supervisor conducts audits during each shift daily. Each week, the area manager audits the same line using the same checksheet the supervisor used. Each month, the plant manager

TABLE 2 Example of Audit Layers And Frequencies

Layer	Example	Audit frequency
1	Supervisor	One per shift every day
2	Area manager	Two per week
3	Plant manager	One per week

does the same using the same checksheet as the supervisor and area manager.

Other companies might choose different audit layers and frequencies. Be sure to check with your customers to determine whether they have specific requirements. Table 2 provides the audit layers and the frequencies used most often by DaimlerChrysler suppliers.

People Respect What You Inspect

Though relatively new in name, the concept of LPAs will not be foreign to plant floor management. An LPA is nothing more than a disciplined way to verify that work is performed the way it was intended. When supervisors and managers are too busy or distracted to verify work and provide feedback, there are some potentially negative consequences. These consequences are costly because:

- Errors and omissions might occur without correction.
- Poor habits develop and can become the *de facto* standard.
- Employees might become frustrated and unmotivated when they receive no feedback on performance for extended periods of time.

It's been said that people will listen to what you say, but they'll do what you inspect. By nature, human beings are flexible, innovative and error prone. Regardless of an operator's experience, knowledge and attentiveness, the lack of timely, relevant and accurate feedback is sure to have a negative impact on performance.

LPAs give operators subtle but well-deserved recognition. LPAs show respect for operators by telling them whether they are complying.

Nothing Is Immune to Variation

LPAs are not as technically sound as error proofing, so LPAs should never be counted on as a detection



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control. But even error proofing is not always shielded from variation and failure. Though sometimes called fail-safes, these devices can be misaligned, damaged, miscalibrated or even turned off. Also, human error can undo almost any system or safeguard. According to Meta Group, a technology consultancy, using technology to combat errors is only 20% of the solution. The company culture that interacts with the technology makes up the other 80%.

When the requirement is zero defects, the only way to ensure no shipment of nonconforming product is to develop a culture in which each person works toward “the right way the first time, every time.” An organization’s quality culture is just as important—if not more so—than its quality system (for example, its equipment, procedures and training).

Auditors must evaluate observations against established standards and requirements. Since a person unfamiliar with a process cannot indisputably judge whether a setting or task is proper or correct, LPA questions must include a description of the specific requirement.

For example, rather than verifying that the tool was set up correctly, a checklist question might verify that the drill bit was “fully seated in the pocket and rotates without wobble.”

Conducting LPAs is easy. Developing LPA questions takes careful thought and effort.

Front Line, Not Front Office

Truth be told, it’s really the front line, not the front office, that impacts quality minute by minute.

Let’s look at how an audit can be carried out on the plant floor. A work area might have a checklist with five to 12 questions specific to the related work processes. Every shift of every day, the area’s supervisor will walk the line and check all the items on the checksheet. This will usually take 10 to 15 minutes each shift, or it can be completed during the supervisors’ regular walks around the department throughout the day.

A checksheet question might be, “Is the press temperature set between 190 and 195 degrees Fahrenheit?” The question might appear if the temperature setting was deemed critical to the quality of the product.

If an LPA checksheet item is found to be noncompliant (for example, the temperature was found to be too low at 187 degrees), the situation should be fixed immediately. LPAs should verify conformance to process specifications and remedy any discrepancies found. LPAs should not be used solely to create lists of findings and recommended actions.

If the problem is caught early, there might be no impact to the part’s quality and the root cause could be fixed immediately.

During every shift, many work elements were verified at the BorgWarner plant. When possible, noncompliances were corrected immediately. If they could not be fixed, additional checks were made to verify product conformance, and action items were communicated to the responsible individuals. Sample questions from the Muncie plant’s LPA checksheets are in Table 3.

Specifically at the BorgWarner plant, extensive errorproofing was built into press fixtures with a variety of sensors. The LPA auditors ran several checks of each fixture daily to verify that the press would fault when any of the required components were omitted.

Turbocharge Preventive Actions

Implementing an LPA is like putting a turbocharger on both a plant’s pre-

TABLE 3 Sample Layered Process Audit (LPA) Checksheet Questions

LPA check item	Yes	No	Comments
Is nonconforming product contained and separate from conforming product?			
Does the press stop when the cup plug is omitted (error proofing verification)?			
Are machine settings consistent with those specified on the setup sheet?			
Are employees wearing the proper personal protective equipment (safety glasses, shoes and ear plugs)?			
Is all product in the cell identified with a part number and production status?			
Does the part meet specification, using go/no-go gage 555748 (deep hole drill)?			
Checking part, does the gage read less than 0.004 test-in reliability?			



ventive and corrective action systems. An LPA can amplify the power of problem solving systems so solutions are put into place—and stay in place. Then continuous improvement becomes a way of life. Benefits can be significant without additional manpower.

Daily LPAs identify problems far upstream, perhaps days or weeks before a customer might otherwise identify a problem. Management involvement in the LPAs and regular reviews of the most frequent nonconformances help guide the appropriate resources to fix the problem.

A well-executed LPA makes management's presence on the plant floor commonplace. When managers routinely take the time to understand operators' concerns, operators become more willing to volunteer suggestions for improvement and question potentially detrimental situations. That's why LPAs can make such a significant impact on people and operations.

Before every flight, an aircraft's pilot has a checklist to make sure all systems work before heading down the runway to take off. An LPA checklist is similar in that it identifies the important items in the process to ensure a quality product. It can be used at start-up or, more commonly, throughout the day. When the flight, or day, goes smoothly, managers and operators can use the time saved to work on improvement of marginal processes and further preventive action.

Verify, Verify, Verify

Like any other change effort, implementation of an LPA requires high level management commitment, awareness, understanding and thoughtful planning to ensure connection to other systems. If any of these are missing or shortchanged, it's likely you'll be pushing uphill. The effort to implement and even conduct daily audits will far exceed any benefit.

The simple action of a plant manager completing a 15-minute LPA checklist for one assigned area of the plant each week broadcasts the message that verification of proper process control as priority.

In the big picture, LPAs are part of the checks and balances needed to ensure that defined systems are followed. During the audits, leadership is checking that people are following the systems, and at the same time they're getting feedback to ensure that the systems are effective.

Getting to the Heart of the Matter

The law of entropy tells us that systems deteriorate over time. Even corrections put into place today might be ignored, forgotten or misplaced tomorrow, next week or next month. A working LPA system would add a new question to a plant's existing checklist related to holding a new corrective action in place.

For example, a new question might be, "Misbuild

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one casing by omitting the bracket. Does the [new] errorproofing device at station 15 detect a missing bracket and guide the casing onto the rework table?"

In this example, if the error proofing is known to be working on every shift, it's unlikely a casing will be built and shipped without the bracket ever again. As previously experienced problems are prevented from recurring and risks are controlled through LPA verification, managers and operators have more time to do the work at hand without the frustration and distraction of investigation, downtime and consequences imposed by the customer.

With LPAs verifying that desired methods stay in place, firefighting is reduced and more time is left for project work and continuous improvement activities. Like a turbocharger, LPAs can give more power to your preventive action system with no outside energy required.

More Than Just a Single Audit

You can't expect to find all problems by doing a 15-minute check once each shift. But conducting



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brief LPAs every day on elements critical to quality that are most likely to vary can have a tremendous impact on safety, quality and cost. An LPA is a tool to help manage a work process and keep it from going off course. A consistently performed process creates a stable product, reduces costs and increases productive work time.

Companies that see the value of the LPA strategy choose to perform LPAs for their own benefit, not to satisfy a customer requirement. Targeted questions, adherence to daily audits and management follow-through on issues found during daily audits are key indicators of a plant's genuine commitment to its customers and its employees, and of its ability to get better.

By ensuring that standardized procedures are in place, an organization will move from one that minimally complies to one that has quality, conformance to product, and process requirements as its top priorities.

Improvements in customer quality can save thousands of dollars in sorting, containment and corrective actions. Within a few months of properly implementing LPAs, improvements can be seen in customer quality, repair and rework, productivity, safety and even employee morale.

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