Continuous Improvement Through Standardization

What they lack in pizazz, standards more than recoup in sustaining manufacturing progress.

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Standardization has been important to industrial progress since the dawn of mass production, and it will continue to be so. Yet standardization is a widely misinterpreted function of manufacturing. To gain the greatest manufacturing performance improvement leverage, we need an understanding of related discipline and activities.

"Standardization" evokes earlier images. For many manufacturing executives, the image is not an exciting one. These executives may have started by writing industrial engineering standards in one form or another — those dull, detailed listings of machine, method, material, and time, nested in archival tomes somewhere in a production office. These weighty writings can be referenced whenever someone needs to get to the bottom of "how it really should be done." When referenced at all, such standards generally are used to make a point in an argument —which may or may not settle the argument.

Personal experience with other "standards" can be just as tiresome. The term is applied very broadly:

Government standards:
Regulations and codes.

Industry standards:
Fasteners, wire gages, containers, bar codes, and what seems like an infinite list of things covered.

Company standards:
Nearly every aspect of life is referenced: materials, training, costs, times, and so forth. Bills of material and leadtimes are standards essential to both engineering systems and materials systems, for instance, and product specifications are standards for both engineering and quality.

Although they're essential to the fabric of corporate communication, standards are not regarded as having much pizazz. The term "standardization" seems to connote repressed creativity — standards prevent us from doing everything in any way we choose. That is their purpose. Not all deviations are improvements. Properly used, standards are tools of progress.

Choosing the Best Method

Difficulties in understanding the use of standardization are not new. Henry Ford discussed this situation nearly 60 years ago:

"To standardize a method is to choose out of many methods the best one and use it. Standardization means nothing unless it means standardizing upward.

"What is the best way to do a thing? It is the sum of all the good ways we have discovered up to the present. It therefore becomes the standard. To decree that today's standard shall be tomorrow's is to exceed our power and authority. Such a decree cannot stand. We see all around us yesterday's standards, but no one mistakes them for today's. Today's best, which superseded yesterday's, will be superseded by tomorrow's best. That is a fact which theorists overlook. They assume that a standard is a steel mold by which it is expected to shape and confine all effort for an indefinite time. If that were possible, we should today be using the standards of one hundred years ago, for certainly there was then no lack of resistance to adopting what goes to make up the present standards.

"Industry today, under the impulse of engineering ability and engineering conscience, is rapidly improving the standards. Today's standardization, instead of being a barricade against improvement, is the necessary foundation on which tomorrow's improvement will be based.

"If you think of 'standardization' as the best that you know today, but which is to be improved tomorrow — you get somewhere. But if you think of standards as confining, then progress stops."[1]

Ford was a supporter of continuous improvement, and many of his ideas are the root of the development of Just-In-Time production. However, the relationship of standards to this improvement process is not heavily publicized.

Consistency and Quality

Standards promote consistency, and consistency is one of the major foundations of good quality. *Use* of a standard assures that once a better method has been found, all in an organization will use it until something better supersedes it. However, merely issuing a standard in writing does not do this. Discipline in the development and use of standards does, and that is part of progress.

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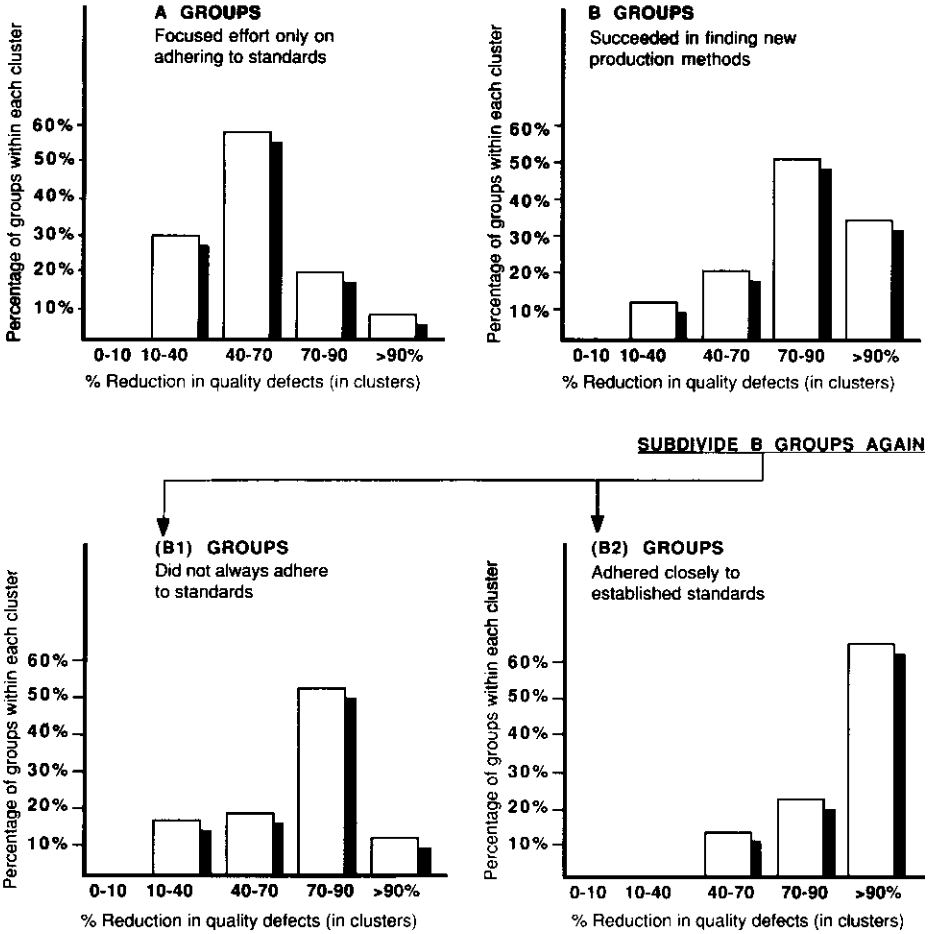

Adapted from Figures 3-8 and 3-9, p. 53 of *Managerial Engineering* by Fukuda. The author states total n=86 groups, but not the n's in each category. For the statistically-minded, however, attempting to replicate n's from the percentages and compare distributions by chi-square gives a significance at least at the .05 level between (B-1) and (B-2). It is off the chart in significance if Fukuda dichotomized groups, which appears to be the case.

Figure 1. *Quality improvement using CEDAC and adherence to standards.*

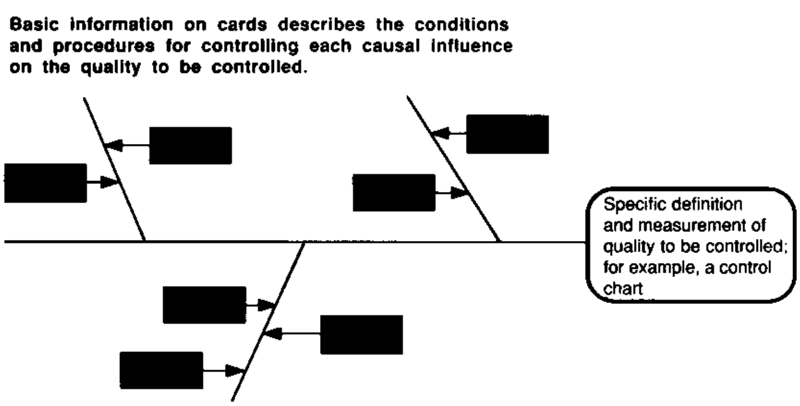

Figure 2. *Basic CEDAC.*

For a lesson in the value of a good standardization in practice, visit a McDonald's restaurant anywhere in the world. Compare one of their outlets to a franchise that "can't quite get its act together." Personal appeal of a Big Mac is not the issue. Consistency is, and a Big Mac is a Big Mac is a Big Mac — anywhere — like it or not.

Consistency is a major factor in quality performance and quality production. How do you know if you have effective standardization? Watch a multi-shift operation, such as a plastic molding operation, at shift change. If the first action of a number of operators is to begin tweaking the setup conditions of the previous shift, standardization has a way to go.

Why do the operators do that? Because no one has a fixed idea what the proper operating conditions of each part on each press should be. The quality specifications for acceptable parts also may be slightly "adjustable." Everybody then has a different idea about it in practice, although the specifications and standard sheets may have been around long enough to have turned yellow. The reasons why operators alter running conditions vary. They may be attempting to touch up the quality of the part, or make the machine run a little better, or just "lay it in a groove" so they do not need to check it for a while as they research the point spreads for the weekend ball games.

Unraveling this situation and arriving at "correct" operating conditions takes work picking through many variables. Specifications, mold, maintenance, material — all should be free enough of variance that every operator can set the equipment to the same settings and agree that those are the best. Standardization is a disciplined company-wide *practice* as well as a procedure. Operators need not only be aware that a standard exists, but must understand it and agree with it. Otherwise, they will not follow it.

Practice is the backbone of detailed improvement. Without this discipline, improvements once attained cannot be held.

Ryuji Fukuda emphasizes this strongly in his discussion of quality improvement, particularly in conjunction with his CEDAC method (**C**ause and **E**ffect **D**iagram with the **A**ddition of **C**ards). One of the primary problems the method is intended to address is the differences in perception of operations by different people, just as in the case of the plastic molding operators. The CEDAC approach is powerful if a group applies it with diligence; but doing that consistently is a problem in Japan, as it might be elsewhere, and two of his exhibits bring that out.[2]

CEDAC is a very basic addition of a communications method to the Ishikawa cause-and-effect diagram. Many variations are possible. The whole idea is but one approach to a large subject area — design of experiments, but one which recognizes one of the major problems of experimentation involving many people — consistency of direction through discipline and communication. How many engineers have wondered in the morning what an operator did on the night shift?

As Fukuda points out, adherence to a standard is an important element in making progress. If you do not know where you are, you cannot be sure where you are going. That is a very basic concept. But basic is not easy.

The conclusion of Figure 1 is that adherence to standard is very important to progress. Even the "A" groups which mostly emphasized adherence, not experimentation for improvement, made good progress. This is because once someone else made an improvement, they followed the new standard. The biggest gains came from the B(2) groups which did both. One of the problems of improvement is holding gains once made.

Visibility and Operator Responsibility

When touring a top Just-In-Time plant, one factor to look for is visibility of operator standards and directions. Instructions for anything important should be out where operators can see them, not filed away and forgotten.

Another important practice: Make operators (and supervisors) responsible for the correctness and currency of their instructions. They may not write them in the original, but they use them and interpret them. Once they know that their work methods are correct, the instructions should describe them clearly enough that another experienced operator can use the instructions to perform the same job in a correct manner. Rotate workers in their positions from time to time to try this out.

In many plants the "working standards" are kept in people's heads. Changes in procedure are communicated, but only one or two persons understand them thoroughly. If they happen to be absent or are transferred, regression in procedure occurs. The evidence of this is found in dog-eared, dirty, little notes, such as "Check with Bill about this." If "Bill" is not convenient to locate, the operator will figure it out as best he can. Unresolved quality problems, or other problems, lead to more headaches. As a result, standardization is not effective.

Writing a standard is an exercise in communicating detail. A standard should not be a legal document useful for fixing blame after errors are made, but a working tool communicating to everyone necessary how to perform properly, perhaps even with an explanation of "why" thrown in. This process is one of the major reasons for face-to-face communication between staff (engineers) and hands-on personnel.

Writing Standards

Experience in doing this job well is not developed in a few days —the time frame is more like a few years. It does not help if writing standards is considered by many to be "grub" work of little consequence (both Ford and Ohno considered writing a standard of this kind to be among their most valuable educational experiences.) The details are the bedrock of manufacturing improvement.

In the Toyota system a standard consists of three parts:

1. *Cycle time:* The time allowed for performing one cycle of making the part derived from the cycle time of use for the part (inverse of the frequency of use of the part at assembly). If the cycle time of use substantially changes, the method for making it may substantially change, a change in fabrication procedures roughly analogous to rebalancing an assembly line. The objective is to come close to making parts at the rate they are needed.
2. *Sequence and detail of work:* Specifics of how to do it, and how to do it correctly. How to accomplish each of the specifications required, failsafe methodology to be employed, and so forth.
3. *The standard WIP:* This is related to the amount of time allowed to recover from a problem should one occur, allow for possible changes in mix of parts required, and so forth.

Standards are also written for setups in order to perform them quickly. These standards are very important to quality. The first piece made from a subsequent setup should be identical to the last one made from the prior setup. If machine, tooling and procedure are developed to this point, any extra tool wear from frequent setups should disappear, and the checking of quality at setup times should add to the assurance of it. Well-done setup reduction is a process very much like any other experimentation to be performed in production, subject to the methods of standardization.

Figure 3 diagrams the way in which standardization fits into the overall approach to "Just-In-Time manufacturing" in the repetitive

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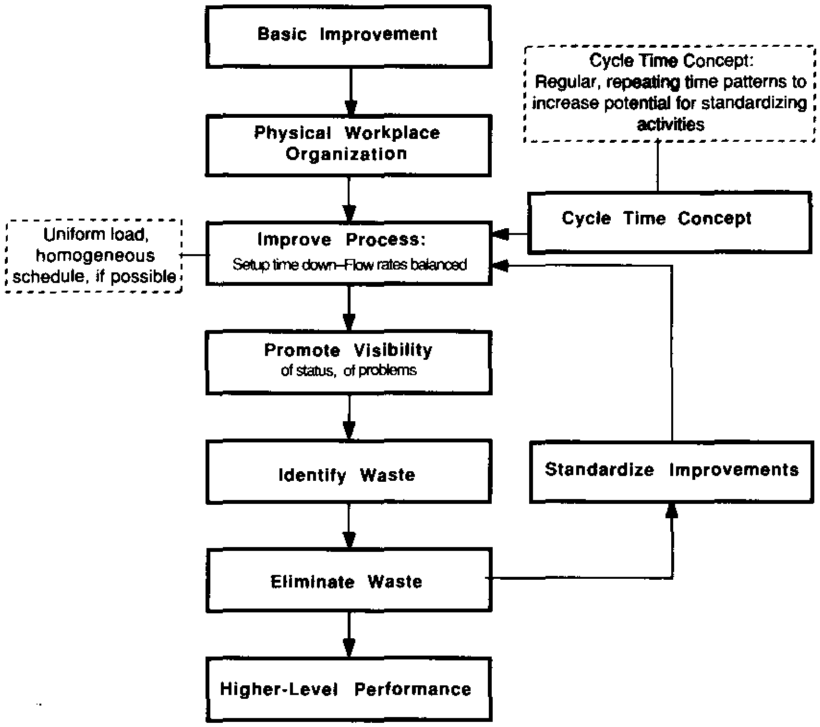

Figure 3. *Continuous improvement through standardization.*

case for companies which have the potential for it. However, standardization is still important for companies whose potential for repetitive work is somewhat limited.

Done well throughout an organization, standardization should clarify everyone's job, if not make it easier. Improvements should be possible to prove, and one person's improvement not undone by others. Standardization affects every aspect of manufacturing. It is part of the glue holding things together. Some examples:

- Drawing methods
- Bills of material
- Engineering change methods
- Tooling development
- Specifications
- Gaging, test methods, test equipment
- Maintenance procedures
- Programming documentation
- Order entry
- Work-to-schedule discipline.

How Standards Work

NOK, Inc., is a company owned by Japanese, but now with many Americans in the management of the plant at LaGrange, GA. It is not Toyota. The company is developing itself to perform needed operations, as is true of any company, but the development of standardization is an important part of their process. One can see the philosophy of effective standardization at work.

At NOK, standardization is used with at least four kinds of understanding, and perhaps more:

1. Unification of concept — cohesive action. A single activity fulfills multiple objectives. Simplicity. For instance, much of the detail of their quality system is packed together into one unified chart.
2. Documented, consistent procedures and conditions: quality, methods, maintenance, and so forth; *detail* is provided.
3. Retaining one-time improvements in practice until better are found.
4. A step-by-step methodology for questioning old assumptions and developing new improvements. In brief, this methodology is: Seek causes (Ask why five times, etc.). Solve. Check solution. Standardize. Do it again.

The perception by each person of job scope and responsibility is strongly affected by this methodology. Production control has a major responsibility for quality, and quality control is essential to stay on schedule. There is no strong separation of functions. For instance, a single tag in the standard container serves to gather information for both quality and for materials control. They think of one system, not many, and the system design comes from the mental set and not the other way around.

NOK is doing well, but they have not gone as far as they can go. Their case illustrates the construction of a very powerful manufacturing system, brick by brick.

[1]Ford, Henry (with Samuel Crowther); *Today and Tomorrow,* Doubleday, Page & Co., New York, pp. 80-81.
[2]Fukuda, Ryuji; *Managerial Engineering,* Productivity, Inc., Stamford, CT, 1983. This portion of his book is based on his paper which won the Nikai Award, an adjunct to Deming Award competition, in 1978.

Author:
Robert W. Hall has taught Operations Management at the Indianapolis campus of Indiana University for 16 years. Before that, he worked for Eli Lilly, Inc. and Union Carbide Corporation. His undergraduate degree was in Chemical Engineering from Rose-Hulman Institute of Technology, and he received the doctorate in Production Management from Indiana University. He is a Certified Fellow of the American Production and Inventory Control Society, and a founding member of the Association for Manufacturing Excellence. He has consulted with numerous companies and made presentations for many professional societies in the U.S. and abroad. His special area is the improvement of industrial management and he has made comparative studies of American and Japanese industrial practices. Dr. Hall is the author of: *Driving the Productivity Machine* (APICS, 1981), *Kawasaki* USA (APICS, 1982), *Zero Inventories* (Dow Jones, 1983), and *Comparison Study of Just-In-Time Production of American and Japanese Manufacturers* (AME, 1985).