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QUALITY IMPROVEMENT ROUND II: SPC OR SPS?

Dr. H. J. Bajaria
President
Multiface, Inc.
Garden City, Michigan 48135

ABSTRACT

About eight years have passed since the onslaught of improvement fever took hold of automotive companies. Various facets have developed since then to make improvement fever permanent, none claiming unqualified success, however. Actually, critical business improvement indexes over these years remain unchanged in automotive industry. The investment in quality improvement efforts has been far in excess of the benefits realized. How can this be?

The current philosophy and the methods of pursuing improvement implementation has only tapped 1/100th of the total potential possible. Is it possible to understand and execute the other 99th/100? The paper offers a critique on the current direction of business and technical quality improvement approaches and offers an alternate on each facet to explain what is the other 99/100th? For example, (1) Is Statistical Process Control (SPC) a prerequisite for Statistical Problem Solving (SPS) or is SPS a prerequisite for SPC? (2) Should the investment be made in gages to do SPC or should gains made through SPC based on existing gages be applied toward that investment? (3) Should automation investment consist only of functional automation or should automation investment be proportionately distributed among functional, deterministic, and probabilistic automation? (4) Has OEM/supplier partnership produced outstanding results or can it use a renewed definition and execution approach? (5) Why is there so much investment in teaching quality improvement rather than in implementing quality improvement?

These and other examples are discussed in the paper to offer directions for round II of quality improvement efforts in automotive industry. Other industries can learn from a renewed definition of quality commitment and effective execution.

INTRODUCTION

Quality has always been a popular subject among providers as well as consumers. Providers respond when they see their market share sliding and/or the economy does not allow them to raise prices without negative effect on volume in order to make up for the losses generated through poor quality. Consumers continuously search for better options to fulfill their needs; and when new options become available, they dump the current option without scrutinizing the supposed superiority of the new option.

About eight years ago, a significant event took place. The Japanese, in general, had been slowly nibbling away at the market shares of many products, and the pace was accelerating. Consumers were finding and trying other options. The automotive industry woke up to the fact that something had to be done. The U.S. companies were ready for the jolt in their quality improvement efforts. The U.S. rediscovered Dr. Deming on the NBC program "If Japan can, why can't we!" Starting with Ford and

General Motors, many companies heard Dr. Deming's 14 points many times over.

At about the same time many other quality proponents were discovered, including Dr. Juran, A. Figenbaum, P. Crosby, D. Shainin, Dr. Ishikawa, Taguchi and others.

As we near the 90's, it would be appropriate to look back and examine the positive lessons we can carry forward and the negative lessons we can discard. Regardless of his initial strategy going into a fight, the boxer rethinks his strategy after facing round I. Similarly, after having faced Quality Improvement Round I in the current decade, we should prepare for round II.

Some positives evolved during Round I:

- Management is listening.

- Management created improvement structures and provided the necessary support to fuel those structures.

- Management has invested considerable money in training both themselves and company personnel.

- Management allowed gaging technology to be updated.

- Management invested in software to speed up improvement tasks.

- Quite a bit of literature on quality has been published.

- Quality professionals' salaries have risen.

- Many more companies have become interested in formalizing their approach to improve quality.

Some negatives are apparent, as well:

- Companies have not favorably influenced the very indexes that jolted them into starting quality improvement programs in the first place.

- Many of the resulting improvements can be attributed to "fat" reduction and not to quality-related problem solving.

- Companies have excessively invested in installing Statistical Process Control (SPC) as a system, without realization of corresponding benefits. Most such SPC efforts are still mediocre in nature.

- Companies have spent excessive effort on supplier compliance and have simultaneously tightened the quality requirements, forcing suppliers into producing "glitter" rather than true improvement.

- An excessive amount of money has been spent in classroom training on the philosophy and concepts of quality, and not enough attention has been paid to solving real problems.

It appears that the positives will provide the foundation as well as the thrust for the 90's, whereas an analysis of negatives will allow us to realign our efforts. Let us analyze what happened during the 80's.

Statistical methods offered great promise. SPC was reborn and emerged as a powerful three-letter word. However, before SPC understanding could mature, it took off in the direction of becoming a system, as opposed to becoming a problem-solving tool. Gaging technology was developed, software development mushroomed, and many new consultants were born. Widespread training took place. Before management can grasp what was happening, SPC became a gutter into which money was poured. The results to date, compare to its potential, dismal.

Let us elaborate on what should have taken place and what did take place.

It should have been recognized that SPC efforts have four levels with increasing degree of difficulties toward upward movement with benefits proportioned to the degree of difficulty. Figure 1 explains the four levels.

	Easy to read charts	Difficult to read charts
Less expensive actions	Level 1	Level 3
More expensive actions	Level 2	Level 4

Figure 1 - Level of SPC Efforts

Level 1 requires on-line charting with the assumption that an immediate correction is possible. If these corrections/adjustments continue to repeat, then they can be given some sort of permanency through the addition of automation, lessening the dependence on SPC charting. SPC thus provides strategic guidance towards permanent process improvement. Management has mistakenly thought that the presence of permanent charts was the only thing necessary, and going beyond that level was either not given any serious consideration or was left to the discretion of operating personnel. As a result, after 7 years of SPC, few corrective actions discovered through SPC have been made permanent through automation.

Level 2 requires that money be spent to correct machines found by SPC to be contributing to instability and out-of-control conditions. Acting at this level, SPC would provide strategic proof for investing in hardware improvements. Instead, there have been a very limited number of SPC- guided hardware changes. And even today, the use of SPC is certainly not a modus operandi for justifying hardware improvement dollars.

Level 3 requires interpretation skills much higher in mathematical science than can ordinarily be grasped by operating personnel. Staff personnel need to be trained to handle such interpretation because level 3 requires more off-line than on-line work. However, instead of their developing level 3 skills, unable and/or unwilling staff suggested to management that interpretation was the job of operating personnel. In turn, operating personnel became frustrated, receiving neither any help from staff nor any sympathy from management. As a result, when under pressure, operators might show a point inside the control limits, even when the point was outside the control limits. When not under pressure, they would respond with a puzzled "Hmmmm!" On the other hand, those companies that developed understanding of other statistically based philosophies -- such as Statistical Quality Control

(SQC), Investigative Statistical Process Control (ISPC), and Statistical Problem Solving (SPS)--were able to solve their problems and have been enjoying the benefits resulting from such solutions.

Level 4 has the same degree of difficulty as Level 3, but requires a greater investment for implementation. As with Level 3, solutions demand a higher degree of investigative, interpretative, and execution skills, but, in addition, Level 4 solutions demand a financial investment. For example, money is spent to install knobs on machines for more convenient adjustments.

Many companies don't even recognize the existence of Level 2, much less Level 3, and still less Level 4.

With this historical background, let us discuss three concepts that can provide the necessary philosophical platform for capturing the vast potential for improvement that is latent or untouched.

STATISTICAL PROCESS CONTROL (SPC) - AS A SYSTEM VERSUS STATISTICAL PROBLEM SOLVING (SPS) - AS A TOOL

Figure 2 contrasts SPC as an on-line system with off-line process control and problem solving.

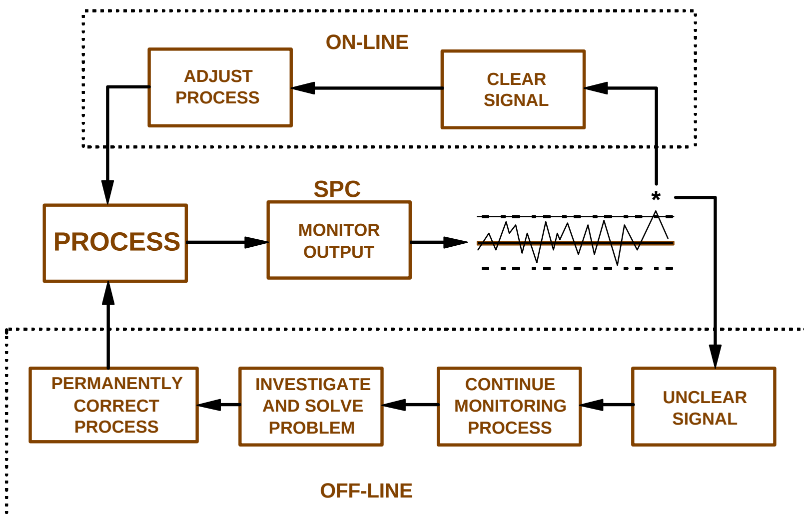

Figure 2 - SPC On-line Versus SPC off-line

Most of industry's attention to date has been given to the on-line SPC system, with continued dependency on control charts as if they were the only means to hold the gains. On the contrary, with 100 problem-solving opportunities, only three would fall in the on-line SPC category. Of those, only one would necessitate the presence of permanent charting, whereas two could be permanently corrected by means of standard operating procedures (SOPs) or hardware to eliminate the instabilities. Figure 3 shows why only 1/100 of improvement opportunities are currently being captured.

Improvement opportunity	Percent contribution	Emphasis on
Incapable processes	85	SPS
Difficult to understand charts	12	SQC/ISPC/SPS
Hardware controls for known actions	1	Creativity
Formation of standard operating procedures	1	Conformity
Presence of permanent control charts	1	On-line SPC

Figure 3 - Distribution of Emphasis Necessary to Improve Quality

U.S. industries have been trying to perfect product control since 1946, with only a few top companies having achieved it. Our attention is now on perfecting SPC as a system. From the history of trying to perfect product control, we can extrapolate that SPC as a system does not have much of a chance of being perfected, at least not in the near future. And even if it were to be perfected, it will only tackle 3% of total problem-solving opportunities--1% effectively and 2% (those that rely on human instructions) ineffectively.

Most of industry's investment has gone into perfecting that 3% potential. SPC charts, SPC clocks, SPC pins, SPC cards, SPC stands, SPC data collectors, SPC clipboards, SPC hats, SPC gages, SPC software are plentiful. There is a positive aspect behind such paraphernalia: If companies were to realign their thinking to attack the unattended 97%, most of the SPC knowledge acquired could be used for that purpose. However, to admit that such is the case, management would have to show tremendous courage to realign their efforts. Those who show such courage will truly capture the meaning of "quality improves productivity".

It is difficult for many to realize that 85% of all processes are incapable. From a business viewpoint, this may be an acceptable starting point for new products, new ventures, or anything new, for that matter. However, to hold that status quo is a major mistake.

The fundamental reason for 85% incapability problems is the chronic mismatch between expectations for the process output and the ability of the process to meet those expectations on a consistent basis. This gap is referred to as process incapability. However, what is initially true does not have to remain true forever. This gap can be worked on from two directions. One direction is to examine the understanding of process capability and improve it by first monitoring process output (SQC), next dissecting it (ISPC), then selecting variables that influence it (SPS), and finally putting the variables into optimum position (SPS). The second direction is to examine the realistic nature of output expectations; when expectations are unrealistically tight, relaxing them narrows the gap.

Companies do not systematically attack incapable processes. Instead, they build systems to minimize the damage generated through such processes. If they were to reassess their SPC philosophy and turn in the direction of SQC, ISPC and SPS, there would find a realizable gold mine awaiting them.

Figure 4 defines the functions of SPC (Statistical Process Control), SQC (Statistical Quality Control), ISPC (Investigative Statistical Process Control), and SPS (Statistical Problem Solving).

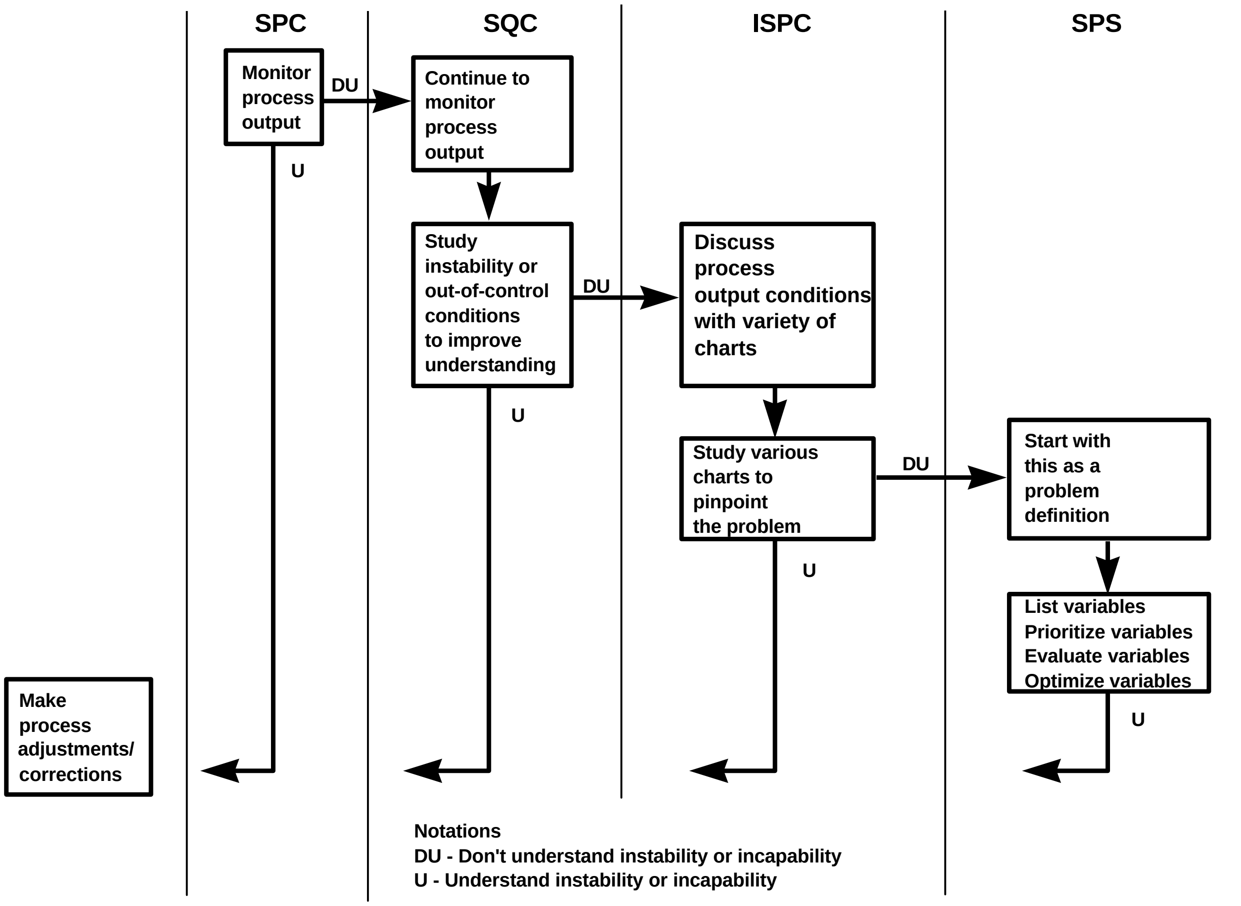

Figure 4 - SPC, SQC, ISPC, and SPS Functions

OEM - SUPPLIER PARTNERSHIP DICTATES FOCUS ON 1/100th OF IMPROVEMENT POTENTIAL

The automotive companies have invested in organizational structures to improve their supplier network. While their intent is quite noble, their strategy and execution style leaves much to be desired. Strategy refers to doing good things in the right order. Execution style should create a spirit of partnership through a helping attitude. Let us examine both of these issues.

We can start with a basic premise that everybody in the pipeline must improve in order to deliver a quality product at a competitive price to the marketplace. That is, the OEM must improve, their suppliers must improve, and their sub-suppliers must improve.

We can create a second premise that, in order to improve, we must understand our own processes first so that process variables can be controlled to produce the minimum output variation possible. Based on these two premises, all concerned should begin improvement efforts in their own operations. Having gained experience in improvement science, plus the management and organization of improvement, companies can begin to spread such experience to their supplier base. Improvement messages can only be effective if they are related after the sender's successful execution of improvement.

Instead, OEMs have insisted on their supplier doing SPC, who, likewise, have insisted on their suppliers doing the same, and the unstoppable chain reaction began. As a result of this approach, just about every company concluded that the only thing that could affect their process was incoming material. This notion resulted in an UPSTREAM CONTROL model, as shown in Figure 5.

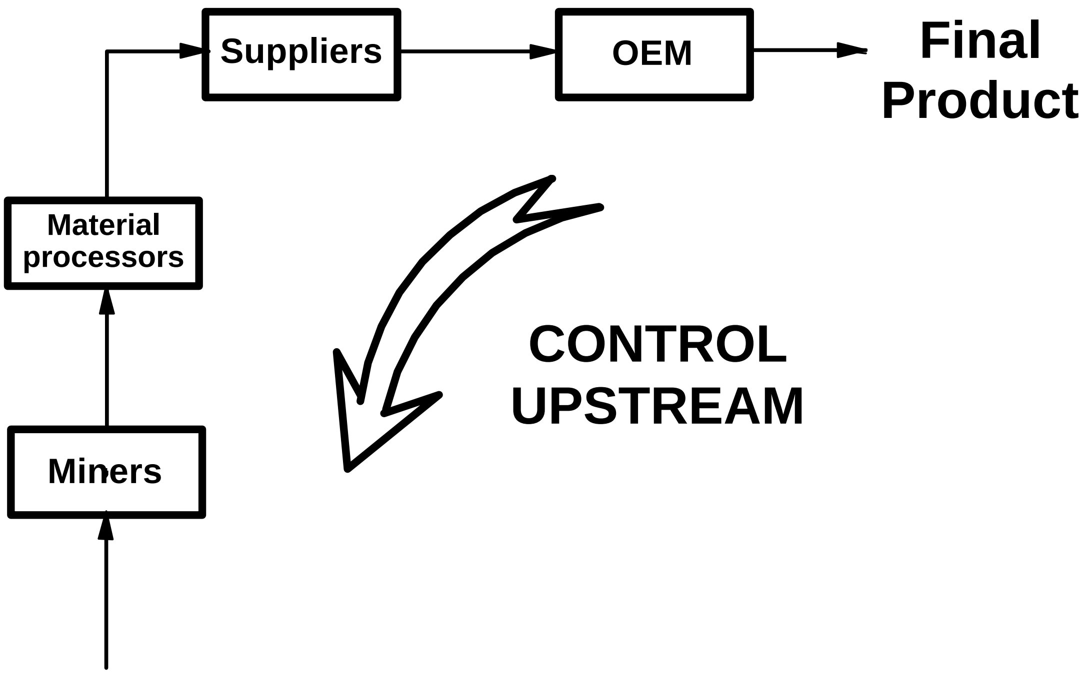

Figure 5 - Control Upstream Model

A different perspective on the improvement scene is portrayed by the FORGIVE DOWNSTREAM model of improvement. Figure 6 depicts the emphasis in the forgive downstream control orientation.

The forgive downstream model accepts the fact that there is natural variation at the very starting point of the process. When it is found that the downstream process reacts differently at the upper limit of the incoming material versus the lower natural limit of the incoming material, this approach tries to find a variable that can forgive such variation, and then goes on to facilitate the adjustment in the form of hardware, along with the necessary intelligence to know how to make the connection between the undesirable variation and the adjustment. If the means to adjust already exist, then the control downstream approach advocates the determination of interactions between these adjustments and the incoming material.

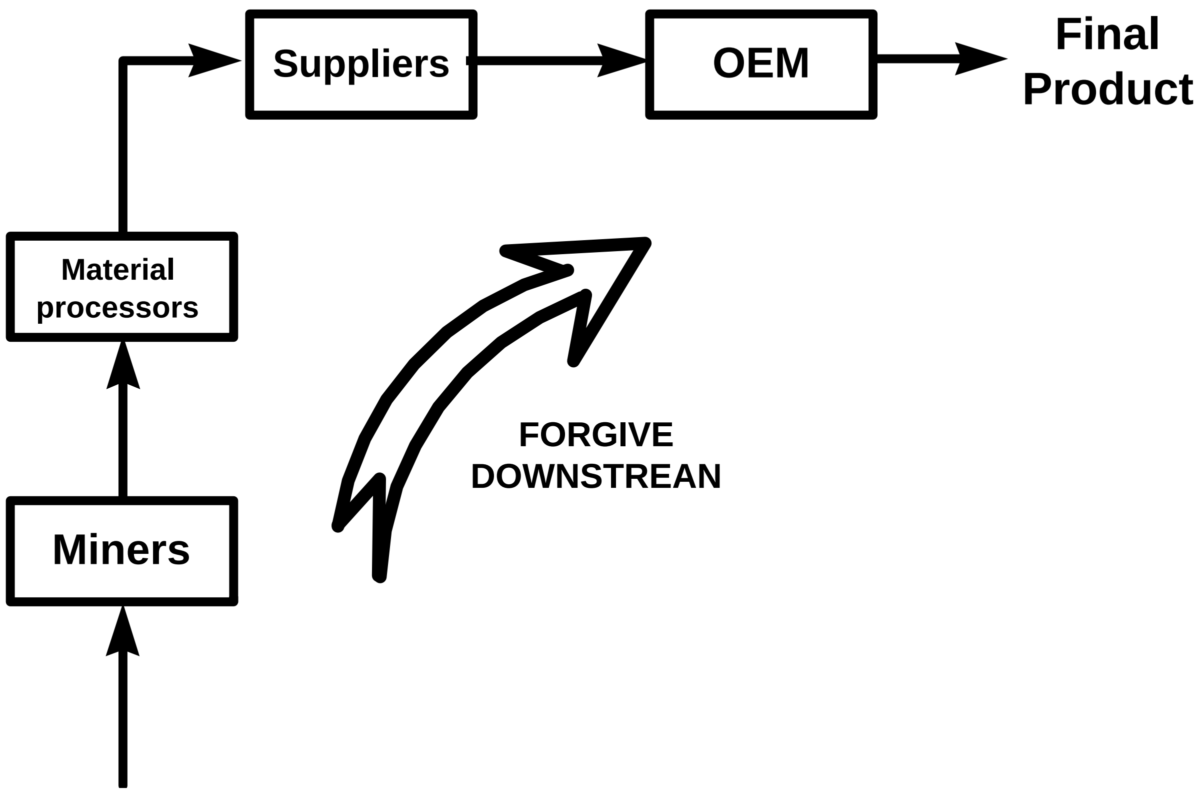

Figure 6 - Forgive Downstream Model

TRAINING IN QUALITY IMPROVEMENT CONCEPTS VERSUS EXECUTION OF QUALITY IMPROVEMENT PROJECTS

Many of the Quality gurus recommended massive training as a response to the removal of many ills. Management responded with enthusiasm and agreed to invest heavily in training. However, the whole training effort was poorly executed. Figure 7 illustrates the stratified training model that industry followed.

The emphasis in stratified training was on who should get trained in what. It was assumed that once everybody was trained, problem solutions would be under way. However, this has not been the case. Many of the people who got involved as trainers were neither trainers by profession nor knowledgeable in the subject matter, but they did find quality improvement training a form of gainful employment. Because most never learned the fundamentals of the manufacturing, design, or administrative processes that they sought to advice on, their efforts fizzled. Still, management became addicted to the training model. What started out as a promising medicine became a drug addiction in which overdoses actually produced undesirable results.

An alternate model could have been followed. The Infusive Training Model, as depicted in Figure 8, tries to attack multiple objectives simultaneously. These objectives are: (1) Foster teamwork, (2) Educate employees, and (3) Solve inherent problems.

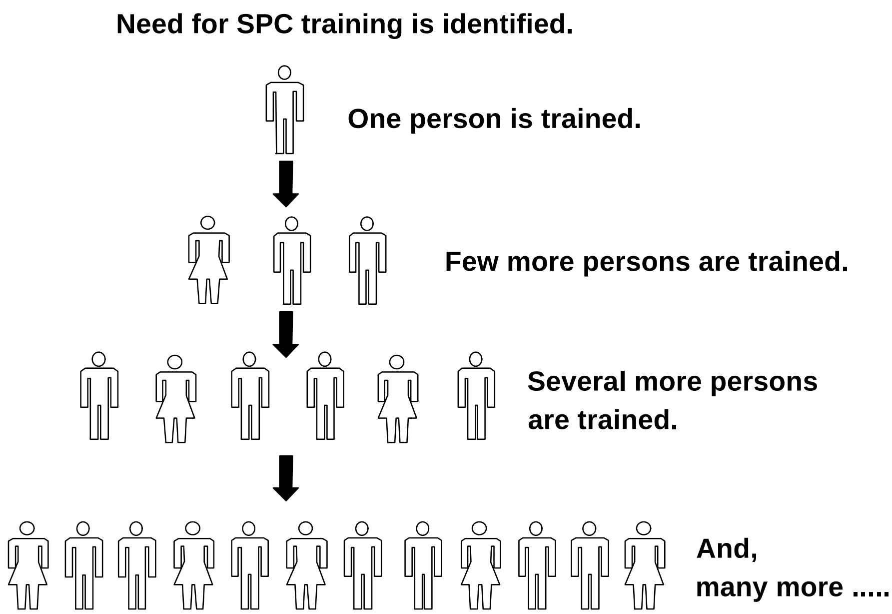

Figure 7 - Stratified Training Model

The first objective stresses the formation of a team. Most difficult problems require teamwork for achieving their solutions. Teamwork needs to be cultivated in realistic, meaningful situations, not through hypothetical classroom situations.

The second objective is concerned with the education of employees. The language of productively solving or preventive problems is statistics-- not statistical methods per se, but statistical thinking. The workforce at large and the scientists in particular are not well versed in statistical thinking and the effective use of statistical methods. Still, a course or two in statistics is hardly a match for what is actually required to solve an inherent problem. Once again, the use of statistics can be taught with a simple vocabulary while solving a live problem, rather than with an academically smoothened articulation of a problem in the classroom.

The third and most important objective is to solve problems in order to continue our faith in both the teamwork approach and employee education. Unless one begins with a real-life problem, teamwork principles and the applicability of statistical methods can remain questionable. Besides, the training investment will pay for itself with every problem solved.

The infusive training model successfully addresses all three objectives. First, it selects a real-life problem, most likely with guidance from an improvement council based on waste, inefficiency, and other indicators. Next, team members are chosen who are directly or indirectly involved in controlling the process and product variables.

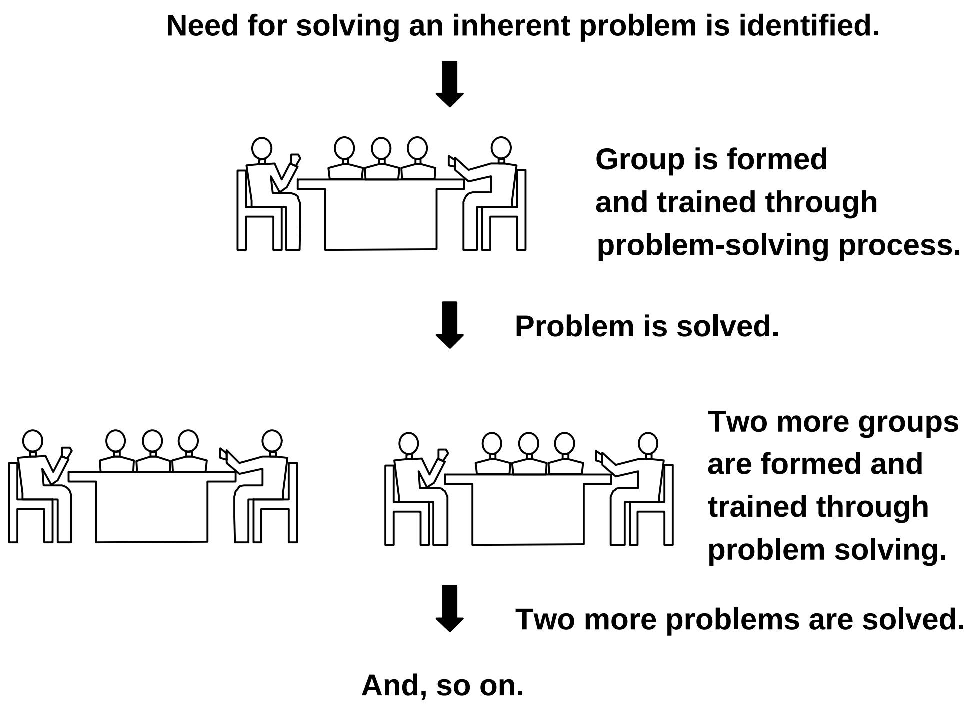

Figure 8 - Infusive Training Model

Team members attack the problem by fulfilling three functions: Each member is a teacher in the sense of imparting his/her knowledge to the rest of the team; each member is a student in the sense of learning various aspects of the problem from the others; and each member has equal influence in the sense that variables are chosen for detailed investigation by majority opinion. There is also a facilitator (similar to a conductor in the orchestra) who can keep the problem-solving process moving smoothly.

The infusive training model offers a dynamic approach for attacking many unresolved problems, and even has the potential to define problems in situations that have not been considered problems before.

SUGGESTIONS FOR ROUND II QUALITY IMPROVEMENT PROGRAMS IN THE AUTOMOTIVE INDUSTRY

Unless the automotive industry begins a systematic movement toward the efficient execution of what has been learned in the 80's, it is difficult to predict its future. For Quality Improvement Round II, it should specifically scrutinize the following suggestions:

A. Increase the use of SPC as a problem definition tool, as opposed to the exclusive use of SPC as a real-time process control philosophy. Augment the use of SPC by SQC, ISPC, and SPS to solve inherent problems.

B. Take time to understand the FORGIVE DOWNSTREAM model of improvement, as opposed to insistence on the CONTROL UPSTREAM model of improvement. Make initial investments in executing the forgive downstream model.

C. De-emphasize classroom training on quality improvement methods. Instead, encourage training in front of live problems to gain the triple benefits of teamwork, employee education, and return on investment through solved problems.