

Dr. Deming's Red Bead Experiment

A Script for Dr. Deming's Red Bead Experiment With Modifications for Department of Energy ISMS Implementation

References:

The New Economics for Industry, Government, Education, W. Edwards Deming, Chapter 7

The Deming Dimension, Henry R. Neave, Chapter 6.

Four Days with Dr. Deming. William J. Latzko, David M. Saunders, pp. 86 - 97.

The Experiment on Red Beads, the British Deming Association. This is an excellent script, with notes for the instructor. Their home page is <http://www.deming.org.uk>

It is extremely advisable to view a video of Dr. Deming performing the beads. There are such tapes available from a variety of sources, including CC-M, Inc. (Clarifiers of the Deming Philosophy), 7755 16th Street, NW, Washington DC 20012, <http://www.cc-m.com>; and the W Edwards Deming Institute at <http://www.deming.org>

Instructors should review the EFCOG SPC Trending Primer, at http://www.efcog.org/wg/esh_es/Statistical_Process_Control/index.htm for construction of the c-chart in the critique. These materials were originally published as the "Hanford Trending Primer" and were reprinted as an attachment to the Institute of Nuclear Power Operations (INPO) Good Practice 07-007.

Applicable Internet sites:

<http://www.deming.org>
<http://www.deming.edu>
<http://deming.ces.clemson.edu/pub/den>
<http://www.deming.org.uk>

Authors:

Steven S Prevette, Fluor Corporation / Savannah River Nuclear Solutions

Steven.prevette@srs.gov
803-952-9803

Steven M Byers, CH2M Hill, currently Western Institutional Review Board, Olympia Washington
Thomas Tribble, INEEL

Dr. Deming's Red Bead Experiment

Materials:

"Red Bead Experiment" kit

Container with 3200 White Beads and 800 Red Beads

Paddle with 50 holes in it to retrieve beads

Commercial kits are available from a variety of sources, including Dr. Wheeler's SPC Press at <http://www.spcpress.com> and Executive Learning Inc. at <http://www.elinc.com/eco/store.asp?SID=1&Item=91>.

Suggestion for making your own kit:

Buy 3200 White Beads and 800 Red Beads of the same size from a craft store

Obtain a container of size such that the beads are about 5 to 10 layers deep

Build a paddle from two pieces of thin wood (approximately the same thickness as the diameter of the beads). Cut the pieces of wood to a paddle shape. Drill 50 holes (10 rows of 5) of diameter slightly larger than the beads in one piece. Glue the piece with holes on top of the second piece.

Overhead projector or computer projector

A \$20 bill (note: there is approximately a 5% chance that you will lose this money)

A bag of candy

Dr. Deming's Red Bead Experiment

Wall Charts

Initial Charts to be displayed

Do it Right
the
First Time

Take Pride
in Your
Work

Procedure
Compliance
is
Mandatory

Chart to be displayed at the end of Day 1

The Goal
is
3

Optional: Tickets (approximately 1" by 2") to be given randomly to the first 50 attendees

6 Willing Worker tickets

Willing
Worker

2 Inspector tickets

Inspector

1 Inspector General ticket

Inspector
General

1 Recorder ticket

Recorder

40 Stockholder tickets

Stock-
holder

Worker of the Day Certificate (use your creativity to make this very flowery and fancy)

White Bead Production Co.
"WORKER OF THE DAY"

TO: _____
Signed by President

Dr. Deming's Red Bead Experiment

Overhead Transparencies / Power Point Viewgraphs / Excel Spreadsheet

Job Postings

WHITE BEAD PRODUCTION CORPORATION

JOB POSTINGS: 10

6 Willing Workers. Must be willing to put forth best efforts. Continuation of job is dependent on performance. Educational requirements minimal. Experience in pouring beads is not necessary.

2 Inspectors. Must be able to distinguish red from white; able to count to 20. Experience not necessary.

1 Inspector General. Same qualifications as Inspectors. Have a loud voice.

1 Recorder. Must write legibly; good in addition and division; must be sharp.

Data Sheet

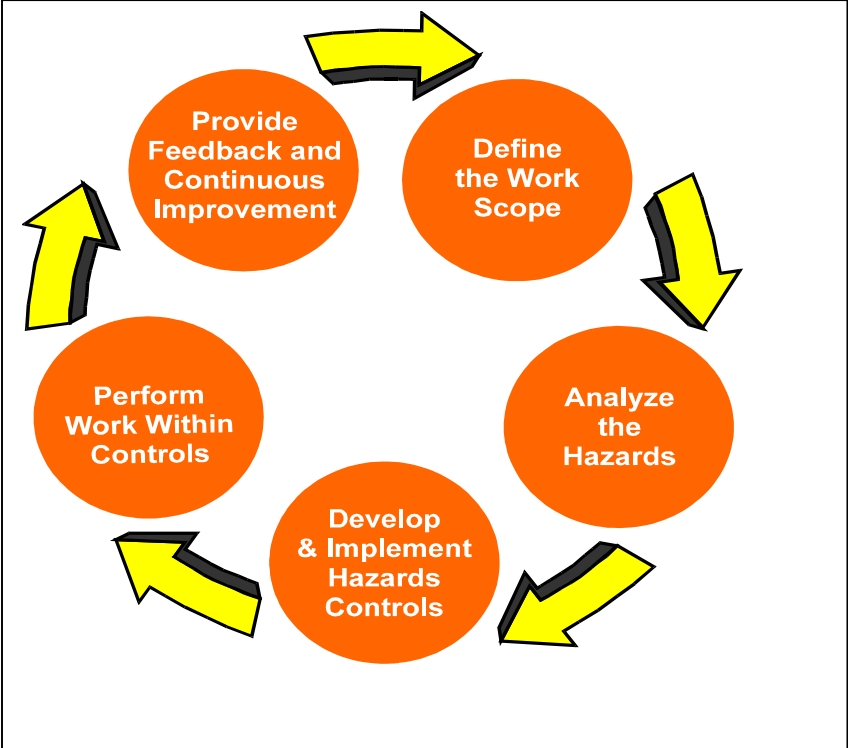
Willing Worker	Day 1	Day 2	Day 3	First 3 Days	Day 4
1					
2					
3					
4					
5					
6					
Total					

Blank Chart

Day 1	Day 2	Day 3	Day 4

Dr. Deming's Red Bead Experiment

ISMS Core Functions (or use site specific ISMS logo)



Dr. Deming's Red Bead Experiment

Procedure (make 6 copies)

<p><i>WHITE BEAD PRODUCTION CORPORATION</i> Procedure WBD-HT81-C: White Bead Generation.</p> <p><u>Required Tools and Materials</u></p> <p>Paddle, for retrieval of beads. Container, with beads.</p> <p><u>Process Steps</u></p> <ol style="list-style-type: none">1. Ensure paddle holes are empty of all beads.2. Grasp the paddle by the handle. Ensure that the holes are orientated facing upwards.3. Slide the paddle down into the beads until paddle is covered with beads. Pick up paddle to 4 inches above the bead level.4. Tilt paddle at a 47 degree angle to release excess beads.5. Withdraw paddle, ensuring that one bead is in each hole.6. Present to Quality Control for count of beads produced.7. Empty paddle back into bead container.	<p>6/5/07</p> <p>Annual Reviews</p> <p>2007 _____</p> <p>2008 _____</p> <p>2009 _____</p>
--	---

The Roles

The Foreman. Leads the workers in producing beads.

The President (or alternately, the CEO or the Government Contracting Officer). Executive in charge of the company and contract. The script can be easily modified to make the President a government official, if that is desired.

Dr. Deming's Red Bead Experiment

	<p>Preparation</p> <p>Setup the wall charts labeled "initial charts to be displayed". Setup a table with the bead container on one end of the table. On the other end, position two chairs (for the inspectors). Place a chair in front of the overhead projector for the recorder.</p> <p>If the audience is large (50 or more people), use tickets given out to 50 people randomly prior to starting.</p> <p>I. Opening Comments</p> <p>FOREMAN: "I am <insert your name>, Foreman of the White Bead Production Corporation. I would like to welcome you to the expansion of our contract within <fill in the name of your site>. I would like to introduce the President of our company <insert President's name></p> <p>PRESIDENT: "Welcome to the White Bead Production Corporation. We are expanding our contract to produce white beads for the Department of Energy, and are here to recruit new workers. I am told that all of you in this room are above average willing workers. That is good, as our company only hires above average workers. The Foreman will now select the new hires."</p> <p>If tickets were used, the Foreman calls forward those with "willing worker" tickets. Otherwise, the Foreman asks for six volunteers. Have the willing workers stand beside the table with the bead container, in a single file, on the opposite side from the two inspector chairs.</p> <p>The Foreman then calls forward the two inspectors (or asks for volunteers). Direct the inspectors to their chairs. FOREMAN: "Quality Assurance is not to mingle with the workers. We have two independent inspectors to assure a quality count of the beads</p>	<p>See tickets</p> <p>Display view graph of Job Postings</p>
--	--	--

Dr. Deming's Red Bead Experiment

	<p>produced."</p> <p>The Foreman then calls up the Inspector General. The Inspector General is to stand behind the two inspectors. The Foreman calls up the Recorder. The Recorder sits in front of the overhead projector.</p> <p>FOREMAN: "I am the foreman of the White Bead Production Company. We make pure white beads, untouched by human hands. We sell them to the US Department of Energy, don't ask me what they do with them. We have a fixed priced contract, none of those mamby-pamby cost plus contracts like the other contractors have. I have been given a process to produce white beads designed by our fine engineering group. It is, therefore, perfect and will not be changed. This company prides itself in its work, and therefore we expect you to have pride. That is why we have made sure that we chose only above average workers. Also, we are a completely fair company. The future of your job is completely dependent upon your performance. What could be more fair? There are plenty of replacement workers out there if you can't cut it."</p> <p>The Foreman then gives the data sheet viewgraph to the Recorder, and has the Recorder display the viewgraph.</p> <p>Optional: Show a stack of DOE Orders and local procedures as being the basis for the WBD procedure.</p> <p>FOREMAN: "We will now collect your names for the payroll. Each worker, will in order, state their first name and spell it."</p> <p>The Foreman asks each willing worker to state their first name, and spell it. Force them to spell it. Then repeat the name to the recorder to have them record it in the Willing Worker column. If the recorder gets ahead of the Foreman, correct the Recorder by stating "procedure compliance is mandatory, don't get ahead of me".</p>	<p>Display "Data Sheet" Viewgraph</p>
--	---	---------------------------------------

Dr. Deming's Red Bead Experiment

	<p>The Foreman should ask the workers if they are up to date on their required annual site general worker training.</p> <p>The Foreman provides each worker with a copy of the procedure.</p> <p>(Optional) Have the workers sign a "required reading" form, acknowledging that they have read the procedure.</p> <p>FOREMAN: (to the workers) "Now I'm going to give you your on the job training. Are you ready? We make our white beads by dipping this paddle into the beads in the bowl, letting the beads roll over the paddle. Then lift the paddle to 4 inches above the beads, and tilting the paddle at exactly 47 degrees. If you do it right, you end up with all white beads and all holes in the paddle filled. Now I have allowed some defects so that you'll know what they look like."</p> <p>FOREMAN (to the inspectors) "After you have got your paddle filled, you show it to the two inspectors. They record their separate findings on a slip of paper. Then the Inspector General compares the numbers shown to him by the two inspectors and calls out in a loud voice the number of defects, then dismisses the worker who returns to the end of the line."</p> <p>FOREMAN (to the inspector general) "So you say '<no. of red beads>, Dismissed!' in a loud voice"</p> <p>FOREMAN (to the Recorder) "The recorder writes the number announced by the Inspector General in the appropriate column next to the worker's name."</p> <p>FOREMAN (to all) "Now this a quality company, but we also believe in high productivity, so there will be no talking! We discovered long ago that allowing</p>	<p>Handout copies of Procedure to Willing Workers</p> <p>Dip paddle into beads</p> <p>Pickup the paddle to 4 inches</p> <p>Tilt 47 degrees</p> <p>Show paddle to workers</p> <p>Show paddle with beads to the two inspectors. Have them write down the number of red beads.</p> <p>Make the inspector general say this. Make him/her say it again, because he/she wasn't loud enough.</p> <p>Show the recorder where the number should be put.</p>
--	--	--

Dr. Deming's Red Bead Experiment

	<p>workers to chit-chat distracts them from hard work. Now we wouldn't want that, would we? Also, there will be no quitting. We allowed that to happen once at <name another site>. We won't let that happen again. Are there any questions?"</p> <p>If a worker asks a question, the Foreman asks them "Why?" If the worker still wants to ask a question, tell them to write out there question, or mark up the procedure. If they do this, the Foreman should take the paper from them, fold it up and put it in the Foreman's pocket. State "I will submit this to the next meeting of the engineering group". If any more questions are asked, fire the worker. Get a replacement from the audience.</p> <p>II Day One.</p> <p>Foreman: Have the workers, in sequence, come forward and draw their production of beads. Arbitrarily watch some workers very closely for compliance with the procedure (especially the 47 degrees), relatively ignore others. Do watch for "cheating", such as removal of red beads, dumping the paddle in for a second try, undercounting by inspectors. If anyone does get caught, fire them, talk to them about their "ethics", and get a replacement from the audience.</p> <p>FOREMAN: (to first worker after number is announced) "This is the <u>white</u> bead company. You are not to be making red beads."</p> <p>FOREMAN: (to second worker) If 2nd worker better than 1st: "We have an improving trend, I am very pleased" If 2nd worker worse than 1st: "Did you not see how the first worker did this? Why could you not get as few red beads as they did?"</p> <p>FOREMAN: Make comments on performance to all workers as they complete. Praise the QA inspectors for their accurate counting.</p>	<p>First Worker draws beads</p> <p>Second Worker draws beads</p> <p>Remaining workers draw beads and are counted</p>
--	---	--

Dr. Deming's Red Bead Experiment

	<p>Foreman: At the end of the "day", have the recorder total the number of red beads for the six workers, and announce this number to the President.</p> <p>PRESIDENT: "The customer is very displeased with the excessive number of defects. We must do better. However, I do want to recognize the outstanding worker of the day."</p> <p>Foreman: Determine which worker had lowest number of red beads. Send that person (or persons if there is a tie) to the "President's Office".</p> <p>PRESIDENT: "This company believes in recognizing superior performance. Therefore it is my pleasure to give you this certificate as worker of the day. Also, please take this token of our appreciation. [<i>in a lowered voice</i>] But please don't make this known to your co-workers. We have some morale problems here, and your reward could be adversely reacted to by your peers."</p> <p>FOREMAN: [Name the name of the person with the most red beads], come here. Now you had the most red beads. I do not understand. Do you not see how everyone else was able to do better? See [insert a worker's name], there? They got only [number] red beads. I am afraid I must put you on probation. The future of your job depends upon improving upon your performance. This is only fair."</p> <p>PRESIDENT: "But management must do its part. And we have been remiss in not providing you a goal for your performance. Without a goal, how could you know what to do? So, management has determined that your goal is to get three or less red beads"</p> <p>FOREMAN: "I am very impressed with our company management. And now we understand the goal. The goal is to get three or less. That will be recorded in the Multi Year Work Plan."</p> <p>III Day Two</p>	<p>Give worker certificate</p> <p>Give worker piece of candy</p> <p>Worker returns to line</p> <p>Display "Goal is 3" poster</p>
--	---	--

Dr. Deming's Red Bead Experiment

	<p>The foreman leads each worker through producing beads. Compare each worker's performance to their first day's performance.</p> <p>Most likely, the "worker of the day" will do worse. If this is so, the Foreman should tell them that "the award must have gone to your head".</p> <p>Most likely, the "probationary" worker will do better. If this is so, the Foreman should comment on their improvement and attribute it to the President's "fine management technique".</p> <p>FOREMAN: "I do not understand all this variation in the results! We keep following the same procedure, but we keep getting different results. What is wrong with you workers?"</p> <p>After all six have completed, have the recorder total the number of red beads for the day.</p> <p>FOREMAN: "Mr. President, I must report that we made [number] red beads today. That performance is significantly [better / worse] than yesterday."</p> <p>PRESIDENT: "I am very displeased. The customer is very unhappy. But we have a solution. Management sees that we are not offering monetary incentives. The workers are not motivated. Therefore, we will institute a bonus program. The next worker to reach to target of three will receive this bonus."</p> <p>(optional) Institute a program for improvement. Make it similar to a real program at your site. For example, use "STAR" (Stop Think Act Review).</p> <p>FOREMAN: "We are about to start the third day's production. Now you workers should know that our company uses performance appraisals to rate and rank our workers. All good companies do that. And your appraisals come due at the end of the third day, the</p>	<p>Each worker draws beads in sequence</p> <p>Review Day One's "worker of the day" performance</p> <p>Review Probationary worker performance</p> <p>Determine if more or less red beads were made from "yesterday"</p> <p>Lay a twenty dollar bill on the table near the bead container.</p> <p>Post poster appropriate for improvement initiative</p>
--	---	--

Dr. Deming's Red Bead Experiment

	<p>next day of work. Now I am very proud of you. We have a fine incentive program in place. You have your targets. You have your quality assurance program and improvement program. You know what to do. Now let's do it!"</p> <p>IV Day Three</p> <p>Have the six workers draw beads. Remind them of the motivational posters, the goal, the \$20, and any improvement initiative. If someone does get three or less beads, give them the money. There is a low probability (5%) chance that this will occur during day three or four.</p> <p>After the six willing workers complete, have the recorder total the read beads for the day.</p> <p>FOREMAN: "We made <state number> red beads today. Our results are still disappointing, but we will soon correct that. We will perform personnel appraisals today, ranking the workers, and giving feedback to the workers. Recorder, please total the results for each worker's first three days, and enter that number in the 'first 3 days' column."</p> <p>When the recorder completes, read off the name of the worker with the least red beads. Have that worker come to the front of the line. Continue as you have the second, third, fourth, fifth, and sixth place workers take their positions. If there is a tie, evaluate each worker for "trends". That is, look at the day 3 performance and see who was better (improving trend).</p> <p>FOREMAN: "I do not understand. I thought we hired only above average workers, yet it is clear that three of you are above average, but three are below average. It took us three days to determine this, but at least now we know. Mr. President, we have completed performance appraisals, and have ranked the employees, and have determined who is above average and who is below average."</p>	<p>The 6 workers draw beads and results are recorded.</p> <p>Recorder performs calculations</p> <p>Workers are ranked in order from first to sixth.</p>
--	---	---

Dr. Deming's Red Bead Experiment

	<p>PRESIDENT: "Our contract is in jeopardy. The customer is going to rebid our contract unless we can eliminate defects. I have a plan. We will retain our best workers, our above average workers. We will dismiss the below average workers. Foreman, please accomplish this plan."</p> <p>FOREMAN: "[Name the names of the three below average workers], you are dismissed. You are thanked for putting forth your best efforts, but it is clear that your performance has been substandard. You may collect your severance pay and take your seats."</p> <p>FOREMAN: [to the remaining workers] "The future of this company depends upon you. If we do not succeed, <insert name of another site> will get this work. You are our superior workers. We are sure you will pull through for the company. But we must keep up bead production, so you will work double shifts from this day forth."</p> <p>V. Day Four.</p> <p>Have the best worker come forward and draw beads twice. Simply have the recorder record the results for in the first two rows of the Day 4 column, names no longer matter. Do the same for the remaining two workers. Have the recorder sum up the Day 4 red bead total.</p> <p>FOREMAN: "I do not understand. We kept our best workers, but [had one of our worst days / showed no substantive improvement]. Mr. President, we made [number] red beads today."</p> <p>PRESIDENT: "I am dismayed. The customer is furious. The customer has canceled our contract. We are out of business. Foreman, please dismiss the work force."</p> <p>The Foreman has the workers, inspectors, and recorder take their seats after giving them each a piece of candy. Pick up the twenty dollar bill, if it was not awarded.</p>	<p>Give the dismissed workers candy.</p> <p>The three workers perform their work twice.</p>
--	---	---

Dr. Deming's Red Bead Experiment

	<p>End of role play.</p> <p>VI. Critique</p> <p>Shift away from the role playing. The Foreman, President, or another instructor should cover the following material.</p> <p>VII. Control Chart</p> <p>Make a c-chart control chart. [Instructor become familiar with http://www.efcog.org/wg/esh_es/Statistical_Process_Control/index.htm prior to performing this exercise]</p> <p>Plot the individual data on the blank chart. Determine the overall average of the data. This should be approximately 10. Draw a horizontal line across the chart at the average value. Determine the square root of the average. This is the standard deviation of the data. Add the average plus three times the standard deviation to get the upper control limit (usually approximately 19). Draw this as a horizontal line on the chart. Subtract three times the standard deviation from the average to get the lower control limit (usually about 1). Draw this as a horizontal line on the chart.</p> <p>Review the data. Point out that no points are outside the control limits, that there are [most likely] no significant trends on the chart, following the criteria of the EFCOG SPC Trending Primer and/or INPO Good Practice 07-007.</p> <p>INSTRUCTOR: "What does this mean? During the exercise, the foreman gave very detailed feedback to each worker on how many beads they got. The foreman and the president reacted to every change in the numbers. What does the control chart tell us? The numbers were not changing. They ranged from 1 to 19 and averaged about 10. Very predictable. There was a common process that made all these results, with common causes at work.</p>	<p>Place blank chart on overhead</p> <p>The final version of the chart should be similar to that in the excel file.</p>
--	---	---

Dr. Deming's Red Bead Experiment

	<p>Each individual's results were not predictable. The foreman could not understand why the individual results varied. Actions were taken based upon individual results - "worker of the day", ranking workers in performance appraisals, offering incentives, putting workers on probation. But none of these actions had an effect.</p> <p>The reason is that each action taken during the exercise assumed that there was a special cause for each worker's result. If only the worker would try harder, be more motivated, follow the procedure etc.</p> <p>The principle here is common causes versus special causes. So many times we treat things as if there was a special cause to each individual result, rather than focusing on the common causes across the whole system."</p> <p>VIII ISMS Core Functions - the process as is.</p> <p>INSTRUCTOR: "The ISMS Core Function "wheel" can help us with properly looking at common causes versus special causes. Let us first look at the process 'as is', the way we did it.</p> <p>Define Workscope. What was the workscope?</p> <p>Identify Hazards. What were those?</p> <p>Hazard Control - what did we do?</p> <p>How effective were they?</p> <p>Perform Work - we used the procedure. Was the procedure effective?</p> <p>Why was the procedure ineffective?</p>	<p>Ask the "worker of the day" what he/she did to be the "worker of the day"</p> <p>Show an overhead of the ISMS core functions</p> <p>"Make white beads"</p> <p>"Don't get red beads"</p> <p>Procedure, posters, goals, incentives</p> <p>Not very</p> <p>Too constrained, did not allow for worker input</p>
--	---	--

Dr. Deming's Red Bead Experiment

	<p>The procedure did not use a graded approach. This was really a low risk activity. The limitation to have a 47 degree tilt was nonsense. But if this was a high hazard job, specific limitations like the 47 degree tilt would have been appropriate, if it prevented injury or equipment damage. But the procedure used in the exercise added no value.</p> <p>Feedback - we did lots of feedback. QA inspectors counted the number of beads, the number of beads each worker got was painfully reviewed with each worker, between the foreman and the president.</p> <p>Was any of the feedback during the exercise effective? Why not?</p> <p>Why was the goal of 3 ineffective? What is the effect of various goals and targets? The \$20? Did anyone 'cheat' during the exercise? What was the effect of ranking the employees. Did it improve performance? How did the workers feel? Why do we do performance appraisals?</p> <p>What were the common causes that led to Red Beads being gathered?"</p> <p>IX ISMS Core Functions - What should we have done.</p> <p>Instructor: The workscope "make white beads" was probably sufficient. So was the hazard identification. But what could we have done better to control the hazard?</p> <p>What would have been a better way to perform work?</p>	<p>Query the audience for examples of graded approach</p> <p>The feedback focused on special causes, never worked on the common cause issues with the process.</p> <p>Usually not beneficial. Causes fear, incentive to cheat</p> <p>The mere existence of the red beads was a common cause.</p> <p>Remove the red beads from the supply</p> <p>Pick out white beads by hand (though inefficient, getting rid of the red beads in the first place is better)</p>
--	--	--

Dr. Deming's Red Bead Experiment

	<p>What would be better forms of feedback?</p> <p>How could results from the control chart be used to change the process in the future?</p> <p>(Optional) Include a discussion of the Plan-Do-Study-Act cycle, and compare it to the ISMS core functions.</p> <p>X. Conclusion</p> <p>INSTRUCTOR, and FOREMAN, and PRESIDENT. Ask for opinions from the audience. Ask for examples of "red beads" in their day to day work.. If time is available, go through the handout file, if not, provide the handout to the attendees for later use.</p>	<p>Use the control chart to determine that we needed to find common causes, not special causes.</p> <p>Ability to recognize what does cause improvement and what does not.</p>
--	---	--