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The Bubble Factory: Addressing Difficult Issues in HRM

Drew L. Harris[1]
[1]*Department of Management & Organization, Central Connecticut State University, New Britain, Connecticut, USA*

The Bubble Factory is a fish-bowl, participatory exercise wherein three to eight students participate in a "factory" that produces high-quality soap bubbles using wands and soap and glycerin solution (such as Mr. Bubbles brand) typically found in toy stores or department stores. The instructor doctors the materials prior to the exercise so that unequal results are produced across "production lines." This sets up discussion of the relative importance of individual versus situational influences, Deming-style quality problem solving, and industrial design of experiment, and discussion of the limitations of traditional HRM practices and how one might apply quality concepts to HRM. This is suitable for undergraduate (45–60 minutes) or MBA levels (45–75 minutes). *Organization Management Journal*, 11: 102–113, 2014. doi: 10.1080/15416518.2014.929934

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INTRODUCTION

Human resource management (HRM) as a discipline has struggled with the interplay between business context, organizational factors, and individual factors is developing models for performance management (den Hartog, Boseli, & Paauwe, 2004; DeNisi, 2000). This was brought into the HRM literature by the 1980s quality movement and Dr. W. Edwards Deming's outspoken criticism of performance appraisal, management by objectives, ranking, merit pay, and pay for performance based on quotas or other numeric goals (Deming, 1986, 2000; Scherkenbach, 1990) and by the growing appreciation of the challenges in using performance appraisal in complex environments (e.g., Pearce, 1987). In the 1990s theorists recognized this dichotomy in calling for studies of "situational factors" in performance appraisal (e.g., Bacharach & Bamberger, 1995; Dobbins, Cardy, Facteau & Miller, 1993; Kane, 1993). In the early 2000s, the language changed to the balance between "context—internal and external" and individual contribution (den Hartog et al., 2004).

Context enters HRM models with little controversy due to its prima facie validity. For external (to companies) context, one only need look at current and recent recessions and the adverse impact those have on firm performance and individual performance (and subsequent negative outcomes for employee—layoffs, pay freezes, benefit cuts, etc.). While internal context is more subtle, most people with work experience can relate to differences in supervision (Rhoads & Eisenberger, 2002), task and territory assignments, and other variables that the individual employee does not control, but that are implicitly factored into employee performance evaluation(Gratton & Truss, 2003).

Perhaps no one argued this latter point more forcefully than Deming (1986, Chap. 3; 2000, Chap. 2) when he argued against all traditional performance appraisals, asserting that the work environment (situational factors) dominated the production of results. The tools, inputs, procedures, demand, processes upstream and downstream, territory (for sales), and managerial interventions (tampering in Deming's language, all constrain quality and quantity of production to limits defined by the system (combined effect of these factors). While a worker might make small changes within that system, the worker's efforts are overwhelmed in scale and influence by the system. Though Deming's view was more extreme, these are the same essential points made by researchers investigating situational factors (Bacharach & Bamberger, 1995; Kane, 1993).

Through the 1990s most editions of popular human resource management textbooks included sections on quality management and described Deming's objections to performance appraisal. Though there are cases, for example, Schuler and Harris (1991), that illustrated the importance of Deming's perspective, few of these made their way into textbooks. Similarly, there were few if any experiential exercises to help students understand Deming's argument or the contemporary theorizing on the importance of contextual (situational) factors.

By the late 2000s, few human resource management textbooks even addressed the issue of quality. However, some raise the issue of situational factors when discussing performance

Address correspondence to Drew L. Harris, Department of Management & Organization, Central Connecticut State University, 1615 Stanley Street, New Britain, CT 06050, USA. E-mail: harrisdrl@mail.ccsu.edu

appraisal (e.g., Stewart & Brown, 2011, Chap. 8) and recommend that the manager investigate the potential of situation factors to influence the appraisal. Others (e.g., Snell & Bohlander, 2013, Chap. 8) treat situational factors as "contaminating factors" in performance assessment. None of these texts illustrate how to address the situational factors, nor do they provide exercises related to this topic. This exercise fills that gap.

The design of experiment component also provides an opportunity to address issues related to HRM roles in the learning organization and knowledge management (Fenwick, 2008). Students often have little idea how companies can actively experiment and what role that plays in knowledge management. The contrast between the written job descriptions and the tactical knowledge the students/employees bring to and acquire during the experience serves as fertile ground for a discussion of these difficult-to-conceptualize terms. In an advanced, master's-level class the exercise could provide a context for exploring conflicting views over the role experimentation plays in the concepts of "exploration" and "exploitation" in knowledge management (Gupta, Smith, & Shalley, 2006), where some say planned experimentation falls within exploration (Edvardsson, 2008) and others describe it as an action supporting exploitation (Baum, Li, & Usher, 2000).

One may also use an extended version of this exercise to illustrate how to assess effectiveness of training programs, an exercise similarly recommended but missing in such texts as Snell and Bohlander (2013). The extended version requires an additional 30 to 45 minutes to conduct training, run cycles after the training, and analyze and discuss the results. This would be appropriate for a course in training and development, or in knowledge management, or as a follow-up session in a general, MBA-level HRM course. The effective analysis of data in the extended version requires, at a minimum, facility with statistical *t*-tests and could include chi-squared and analysis of variance tests. Because of the extended time required (a total of 90–120 minutes), the author has only deployed the extended version in evening or weekend MBA courses where the exercise can unfold without interruption; conducting the longer version over discontinuous class sessions might require additional time to review previous work. The extended version(s) are not presented here; the author would be pleased to make an extended version available on request.

Finally, this exercise also provides a simple and fun vehicle for reviewing a full set of HRM activities. The typical approach to providing students a holistic experience is through a multicycle simulation or through an integrative case. This exercise does not contain the depth of a multiweek simulation. However, in 45 minutes to an hour, it gives a light, integrative review of job description, recruiting, realistic-job-preview, selection, and pay-for-performance, as well as performing the main task of illustrating the role of quality and situational factors in performance appraisal. A comprehensive experience is difficult to construct, and this exercise fills that gap.

The author has used this exercise in undergraduate human resource management and training and development courses. It has also been used in graduate-level strategic human resource management, training and development, and quality management courses. At the undergraduate level, students have reported this exercise as one of the more memorable experiences in their courses. They described it as fun while giving a realistic perspective on the challenges of performance appraisal. Occasionally, they will relate it to their school experiences where grade-performance assessment is often confounded by situational factors.

At the graduate level, where most students have extensive work experience, student feedback is bit more complex. Most graduate students expressed surprise at the realism of the exercise when translated into their work experience. Often students offer their anecdotes of workplace experiences that mirror the learning available in this exercise; their affective responses have ranged from anger at their current situation to delight in seeing the possibility of an alternative. Some express a determination to take the design of experiment process back to their workplace with the intent of altering how they engage in performance management.

INTRODUCTION TO EXERCISE

Description

The Bubble Factory is a participatory exercise wherein four to eight students (depending on level of complexity chosen) participate in a production process that produces high-quality soap bubbles (i.e., at least the size of tennis balls). There are two production lines, each with a set of tools (a wand for dipping in soap solution) and materials (soap solution). One set of tools and materials have been "doctored" by the professor so that they will produce unequal outcomes in a typical application. Students are recruited, hired, trained, and put into the work force of the bubble factory. Because of the doctoring of the tools and materials, one of the line workers will produce fewer bubbles than the other worker (and less than a quota set by the professor/chief executive officer [CEO]). The professor first coaches the underperformer, then disciplines, and then fires the student. A replacement is hired and similar results occur. The factory is stopped and the instructor leads a discussion of what has happened, the importance of situational factors (or the system), how the students might apply Total Quality Management (TQM) principles, and ultimately the design of an experiment to assess potential causes of the production disparity. An experiment is run. The data are analyzed (using tools/statistics appropriate to the level of student: undergraduate or graduate). The short version of the exercise ends at this point with a discussion of how this experience relates to HRM practices.

A longer version of the experience (not described in detail here) could include a module on designing and assessing the effects of training. An even longer version could include designing and testing a recycling program (with training). In each of these additions, a new cycle of experimental design and bubble production is required.

Rationale

This experiential learning exercise is designed for use in a general undergraduate human resource management (HRM) class or (with variations noted) in an MBA level HRM or strategic HRM course. In either case, the exercise assumes the following topic areas have been covered:

- Job analysis/design.
- Recruiting and selection.
- Performance management.
- Compensation.

This exercise arose in response to textbooks that included chapters or sections on TQM, particularly those that present Dr. W. Edwards Deming's approach to quality. It also is appropriate as a supplement to texts that refer to "situational factors" or "contextual factors" as complications to effective performance management (or for the professor who would like to introduce this topic when the text does not cover it). Often HRM textbooks offer dismissive views of Deming's approach or simplifying statements regarding situational factors (e.g., "in this case you need to take better measurements"). Vague statements without a thorough presentation of what a working manager might do if she wanted to implement some of Deming's more "radical" ideas like eliminating employee performance reviews (especially if those were based on ranking systems), eliminating management by objective (MBO) programs, and performance-based pay do not serve to educate students.

This exercise should help what can go wrong with these "traditional" HRM practices, and it illustrates how a quality-focused manager might produce better results for the firm and for employees. In particular, it is designed to show the relative dominance of systems factors over individual efforts: how to detect what is important in the system and set the stage for discussion about how to transition to a quality-based approach to HRM.

The exercise also provides a quick, fun overview of a variety of HRM functions—job description, selection, realistic job preview, training, discipline, performance evaluation, and pay for performance. As presented, the exercise frequently illustrates potential flaws in the application of these concepts.

The exercise can be conducted at three levels of detail. The basic level can be conducted in 30 minutes or less and illustrates the key points with less detail and mathematical effort than subsequent levels. The second level allows for more play and review of HRM practices; this is the level presented in the following. It takes 45 minutes to an hour, depending on how long your postexperience discussion runs.

At a higher level, especially appropriate for graduate level studies, students would be trained to improve their performance, run an experiment to assess the effectiveness and value of the training, and then apply statistics to results of their experiments (difference of means test, chi-squared test). Students might also design additional experiments to assess the effectiveness of recycling and other topics that might arise organically from the basic experiments. Extended versions are not presented here, but the author will make them available on request.

THE EXERCISE

Learning Goals

The primary goal of the exercise is to present an alternative, consistent with the Deming approach to total quality management (TQM), to many standard HRM practices. The components of the approach include perceiving the work system as a complete system, diagnosing systemic problems, designing and conducting industrial experiments, and engaging in continuous process improvement. In an extended (MBA-level) form, the exercise provides a context for gathering and applying statistics, designing training, and assessing the effects of training. Secondary goals include a (brief) review of job design, recruiting, selecting, discipline, and pay for performance. The exercise explicitly illustrates some potential weaknesses and abuses of these systems.

A. *The physical setup* in a typical classroom would have a table or desk front and center (visible to all) with "work stations" (i.e., bottle with bubble solution, wand, and paper towels) on the right and left of the table (separate from each other so that the students will not accidentally mix up their solutions and wands). The students who are hired as workers will stand by their work stations during the exercise. The quality inspector needs to be able to move from one work station to the other and not obstruct the view of the audience. The accountant should be positioned where she or he can record the results of each production run and make those visible to the audience (on overhead slide, whiteboard, computer with projector, etc.). The instructor should be out of the way but able to see, direct, and comment on what is happening. (Note: If a factory manager is included, the manager directs the round-by-round action. In the undergraduate, short version, this has proved to be sufficiently time-consuming and distracting that the author no longer uses this role in those situations. Similarly, the roles of quality analyst, statistician, and trainer have only been used in graduate-level courses and when those courses allow for a longer exercise—90 minutes or more.)
B. *Steps in exercise* (timing for individual parts listed by step): Complete (undergraduate) version 40–60 minutes; extended version 60–90 minutes (the summary times

given reflect 10 years of experience in running the exercise; the component parts may not add exactly to the total because the professor has considerable latitude in how much time each component takes, how much to leave to students' inductive learning, how much humor to inject, surprise findings, etc.).

a. Physical setup (1–2 minutes).
b. Framing of exercise—a mini-lecture and demonstration (2–5 minutes).
c. Introduction to the Bubble Factory—description of "factory," work product, jobs/positions to be filled (3–5 minutes).
d. Recruiting and selection—asking for volunteers, providing a realistic job preview, testing for competencies and selection (5 minutes).
   i. Quality inspector (QI) (1–2 minutes).
   ii. Accountant (1 minute).
   iii. Willing workers (WW) (1–3 minutes each).
e. Setting up production—getting "employees" positioned and reviewing their job responsibilities (1–2 minutes).
f. Run first cycle—In alternating sequence, each WW dips the wand into the bottle of solution and blows as many tennis ball sized bubbles as he or she can from that single dip. The QI (1–2 minutes), using a tennis ball as a guide, assesses and counts out loud the number of qualifying bubbles that WW has produced. When the wand/WW can no longer produce bubbles the QI and Accountant confirm the number of qualifying bubbles produced and the accountant records the official count. Note: If there is a supervisor, the supervisor may also be included in verifying the count and in settling disputes about the quality of the bubbles.
g. Run cycle 2 (1 minute)—same as first.
h. (Optional) Provide 1-minute manager coaching (1–2 minutes). If the instructor has covered the "One Minute Manager" this would be an opportune moment to show a potential flaw in use of such simple coaching techniques.
i. Run cycle 3 (1 minute).
j. Issue "warning" to failing worker (1 minute). This is the beginning of the progressive discipline process. If the experiment has been set up correctly this WW with the doctored solution will certainly fall below the quota (for reasons discussed later, the other WW may also fall below the quota and be subject to discipline as well).
k. Run cycle 4 (1 minute).
l. "Fire" failing worker(s) (2–3 minutes).
m. Recruit, select, orient a replacement WW (2 minutes).
n. Run cycle 5 (1 minute).
o. Run cycle 6 (1 minute).
p. Offer MBO plan (instead of warning/discipline) to failing WW (2 minutes).
q. Run cycle 7 (1 minute).
r. Stop and discuss what is happening.
   i. Without formal use of diagnostic tool, instructor provides design of experiment format (4 × 4 matrix for measuring two variables at two levels) (3–5 minutes).
   ii. With formal diagnostic tools (e.g., fishbone diagram), students design experiment (5–10 minutes).
s. Run designed experiment—eight cycles (8 minutes).
t. Analyze results.
   i. Informal comparisons of marginal results—add results in rows and columns for each of two variables and compare the totals (3 minutes).
   ii. Formal marginal analysis, perform *t*-test on marginal results and chi-square calculations for matrix (5–8 minutes).
u. (Optional) Add training component (10–15 minutes).
   i. Provide training (3–5 minutes)—In this, the instructor demonstrates how to cut off bubbles when they are the correct size, minimizing loss of soap solution due to bubbles larger or smaller than optimal quality.
   ii. Run experimental cycle—eight cycles (same sequence as previous experiment) (8 minutes).
   iii. Analyze results—This involves a simple *t*-test on pretraining totals for workers versus post training results (3–5 minutes).
v. (Optional) Add recycling component. Recycling is where the WW catches a blown bubble with the wand, gently pops the bubble (so that the soap from the bubble is returned to the wand's reservoir), and blows another bubble. This is most effective when several bubbles (two-thirds of a WW's normal capability) have been blown and not recycled. (Popping the bubble risks breaking the film across the opening of the wand and/or splashing soap off the wand. Both are less likely if the wand is not at full solution capacity.) (10–15 minutes).
   i. Provide training (3–5 minutes).
   ii. Run experimental cycle (5 minutes).
   iii. Analyze results (3–5 minutes).
w. Discuss, debrief, review learning objectives.
   i. Informal version (5–10 minutes).
   ii. Formal version (5–10 minutes).

C. *Number of participants:*

a. Minimum four (three willing workers and one quality control manager).
b. Typical five
   Three willing workers—blow bubbles.
   One quality control manager—observes blown bubbles

and determines whether they meet quality requirement—as large as tennis balls.
One accountant—counts and records the number of high-quality bubbles.

c. Possible additions (typically not deployed in undergraduate courses): Factory manager—hires all other employees, supervises the execution of production cycles, and provides coaching, discipline, and firing.
Quality analyst—leads discussion of what could improve performance of the production system.
Statistician—performs calculations from experimental data.
Trainer—walks willing workers through the exact methodology used in producing high quality bubbles at the Bubble Factory. (If well qualified, may provide additional training in how to produce optimal sized bubbles.)

D. *Appropriate level*: undergraduate and graduate (two levels presented).

E. *Materials needed*: Slides (see Appendix), two sets of soap bubble solution and wands for blowing soap bubbles (the stick with a circle on one end typically found in children's soap bubble bottles). One soap solution and one wand should be "doctored" as described in the following; a tennis ball; paper towels for cleanup; and markers for overhead, chalkboard, whiteboard (as appropriate to the learning environment).

Helpful hint: Mr. Bubbles brand bubble soap, available in most stores where toys are sold, has proven to be of higher quality than various other brands tested. You could conduct the experiment simply using Mr. Bubbles and another brand, but the differences might be so subtle as to confound the point of the exercise. You can also create your own soap solutions; numerous websites such as bubbleblowers.com/homemade.html provide recipes for high-quality solutions. The point is to have two sets of tools and materials that have distinctly different performance characteristics.

F. *Preparation for students:* This exercise is most effective if presented immediately after covering either performance management, pay for performance, or quality management (depending upon what topics and what sequence the professor uses). All of these assume the topics of job design and description, recruiting, selection, performance management, and compensation have been covered. There is no special preparation assignment for this exercise.

G. *Preparation for instructor*: The instructor needs to do the following:

a. It is very helpful if the instructor practices blowing bubbles until he or she can consistently produce at least a couple of tennis ball-sized bubbles with one dip of the wand into the soap solution. This level of competency will allow the instructor to conduct the basic exercise. With practice (following the description that follows), the instructor can acquire to the skill to regularly produce six to eight high-quality bubbles from a single dip. Unless the instructor masters this level of competency (six to eight high-quality bubbles per dip) it will be difficult to conduct the optional training and recycling modules.
How to regularly produce six to eight high quality bubbles from one dip:

i. The key to this level of production is to cut off a bubble once it has reached the desired, tennis-ball size. This limits the use of soap solution to the minimum necessary to produce a quality bubble, thereby maximizing the number of quality bubbles (producing larger than tennis-ball-sized bubbles adds no extra value).

ii. You cut bubbles by dipping the wand into the soap solution (without agitating the solution), raising the circle-end of the wand so that it is approximately two to four inches from your lips, and blowing gently and steadily to create a bulge of soap solution that is the size of a tennis ball, then "cutting" the bubble off of the wand with a sharp, upward movement of the wand that separates and seals the bubble. The motion should be quick enough to cut the bubble while not being so violent as to fling soap off of the wand. A slight twist of the wand (top of circle back toward your face) while cutting will help seal the bubble. An upward cut works slightly better than a downward cut because you are less likely to fling off the soap solution.

iii. Once the bubble has been cut off, there should still be a film of soap solution across the circle and more bubbles can be blown without additional dipping into the soap solution. With good-quality soap solution, a normal wand, and some practice, one should be able to blow six to eight bubbles from a single dip in the bottle of solution. There are a variety of bubble videos online that can help you master this technique (e.g., http://www.youtube.com/watch?v=kvrsAhuvs3M&feature=related shows the first of a delightful series of physics lessons on soap bubbles and http://www.youtube.com/watch?v=ZIYUZrYzTfc shows various tricks one can perform with soap bubbles).

b. The instructor doctors (alters) one soap/water solution and wand. The ideal doctored solution (from a pedagogic perspective) will have enough excess water added to allow only two to five bubbles from a single dip (assuming a "normal" quality produces six to eight bubbles). About 10% additional water, by volume, added to your normal solution should produce differential results adequate for this exercise (again, you will do better to experiment with your two solutions to assure you have a differential effect). A experiment showed that using two unaltered brand versions—Mr. Bubble (as the high-quality solution) and Magic Bubble (as the low-quality solution)—will produce adequate contrast to illustrate the principles of this exercise. If you make your own solution, you will need to experiment to attain an appropriate level of contrast.

You doctor the wand by flattening the serrated edges around the soap-holding circle using one of the following means: sanded (rubbing sand paper across the tops of the serrations), shaving (using a knife or box cutter to cut off the tops of the serrations) or melting (using a thin, flat instrument like an old knife, heat the knife tip until it is hot enough to melt plastic, then gently run the flat surface against the serrated edges of the wand). Your goal is to diminish the soap-holding capability of the wand so that when dipped into a normal solution it will produce two to five bubbles.

Before you run the experiment you should have both wand and solution altered. (Note: You could only alter one, but the richness of the experimental design would be diminished. If you choose to only alter one factor, altering the solution is more reliable and dramatic.) The combination of doctored wand and solution should consistently produce one to four bubbles with a single dip. If you would like to increase the number of good bubbles possible from your "good" solution you can add a few drops of glycerin (available at pharmacies) to the "good" solution. Glycerin increases the surface tension (cohesive properties) of the soap solution. A typical 6-oz bottle of bubble solution should last for 6–10 presentations. The solutions do not appear to degrade in quality over time.

You should test your soap solutions the day before the experiment (it may also help to practice blowing bubbles). If the solution appears to not function normally you may wish to shake the solution (in case it has separated or settled) several hours before the presentation. However, you want to avoid having a froth or foam of bubbles in the bottle during the presentation (do not let students shake or agitate solution during the experiment) as this diminishes the consistency of bubble production. Note: If material does become frothy during the experiment, you will want to include that in your discussion as it surely does alter the consistency of bubble production. However, unless you have backup solution you will not be able to test for the differences caused by the froth because it may take an hour or more for bubbles in the bottle to dissolve.

c. It is always helpful to review the process, to have blank forms (either overheads or a table drawn on a whiteboard behind the projector screen) for recording the experimental results, and to practice/test materials before presentation.

H. *PowerPoint (or overhead) slides*—see Appendix.

TEACHING NOTE

(This note assumes the instructor has read through the steps of the process.)

General Ideas and Concerns

This experience allows considerable freedom for the instructor to be creative and it requires a fair measure of flexibility in the instructor because it involves live experiments, which, by definition, have unpredictable results. Because there is a small amount of "setting up for failure" built into the experience, the instructor would be well served to take care in two areas.

First, humor will help ameliorate the potential for hurt feelings among students who get "fired." If the instructor says the experience/role play should be fun and then laughs and perhaps pokes fun at the process, then the first student who does not get hired (if that happens) or the first student who gets fired will more likely play along without negative emotional response. Affirming and, perhaps, apologizing to the "fired" student(s) after the experiment has been run may also serve to keep relationships with students upbeat about this experience. (You may also want to let them "prove" their bubble-blowing ability after the experiment has run its course. A surprising number of students who have been fired expressed a need to prove themselves capable when the experience is not stacked against them).

The second factor to keep the mood upbeat is choosing among potential candidates those who have shown a willingness to play. Because the experiment is run well into the term, the instructor should know students well enough to know who is comfortable with a surprise and, more importantly, who is not. The professor should also be open to surprises here, too. Sometimes otherwise reticent students will want to get into the "play," especially if the course has not had experiential exercises before.

Framing the Experience

A useful way to frame the experience for students to place it as a fun break from other activities in the class to both review some HRM practices as a whole and to explore what might be included in a (Deming-style) TQM approach to HRM. On the day of the experience, we suggest that you come with the intention that this will be fun as well as educational.

Things That Have Helped Along the Way

1. Starting the simulation: Slides 1 and 2 (Appendix); Step a (described earlier). Keeping the materials out of sight before you start the simulation allows for an element of surprise. As the description of the Bubble Factory and its strategic intent unfolds, most students find it amusing to see their instructor blowing soap bubbles.
2. Giving an overview of the jobs to be filled: Slides 3–7; Step b. In reviewing the jobs to be filled, asking students about the quality of the job descriptions, what is missing, and how you might reach a qualified candidate pool can serve as a nice, fun reminder of those practices. I have found that "remembering" that the job descriptions do not include educational attainment can add humor, for example, suggesting the "Accountant" needs an MBA in accounting and then suggesting that the "Supervisor" needs a PhD in management.
3. Recruiting and selecting: Slides 3–7; Step c. The recruiting process typically involves asking for volunteers. When a pool of candidates has volunteered, you will want to interview them, test them against job descriptions. (e.g., Ask the Accountant to step 10 paces away and then ask them to count to 20. You affirm their qualification in that they can both hear you and count to 20.)

   QI: You should recruit the quality inspector (QI) before the Accountant and Willing Workers. That allows two fun opportunities—your testing of the QI allows for more amazing professor bubble-blowing skills and for possible banter about integrity (blow a small bubble and see whether the QI candidate gives in to gentle pressure from you to rate it as "good"). The second advantage is that you can use the QI during the Realistic Job Preview for the Willing Workers, again opening the opportunities for humor and play (e.g., some candidates have jokingly offered bribes to the QI so they can be hired, which opens the door for short discussions of how that happens in the workplace).

   WW: The hiring of Willing Workers requires special care. You should use the undoctored combination of wand and soap. You need to have students who can produce two to four bubbles without any training. You may want to use this opportunity to introduce the explicit work rules (in part so that you do not have job candidates shaking or agitating the solution). Couching this as a "Realistic Job Preview" is a nice review of that concept. If you have volunteers who cannot do this (a surprising number of students are not able to blow several tennis-ball-sized bubbles on command), then you tell them you will get back to them (or have a prepared rejection letter or some other humorous way of telling them they are not hired) and interview other candidates.
4. Bubble production: Slides 8–10; Steps d–p.

   Pacing and material handling. If you use a supervisor, allow the supervisor to set the pace for the first two cycles. You will make a point to the supervisor (if used) and to the workers that they have been assigned a work station with tools and materials that are their responsibility. They must treat their materials carefully and by the rules. Comments like "a responsible worker takes care of their tools and workstation . . . cleanliness is next to . . . etc." provide a context for having the students using the assigned tools and keeping them separate, at least for some time, without it being obvious that the materials have been doctored.

   Quota and coaching. You may or may to want to comment on performance discrepancies in the first two rounds, but by the third round you will want to intervene with two steps: Announce a production quota (perhaps just above the average of the better performing student) and give the poorer performing student a bit of typical coaching without actually training the poor performer (using the One Minute Manager format is amusing, especially if students have encountered this in a principles course or elsewhere).

   Progressive discipline. After the coaching and quota, the next below-quota cycle should result in a formal reprimand and warning. You may want to create a written record of this (imitating corporate records). For the sake of time, you will want to fire the underperformer in the next sub-par cycle (typically the next cycle). This is a time when you may want to quickly review the steps in a progressive discipline program—verbal warnings, written warning, plan for improvement, documentation of failure, and termination. Modeling effective or ineffective termination is a fun thing to do here, too (e.g., have the supervisor "escort" the terminated employee from the workplace).

   Hiring after firing. After terminating a Willing Worker you will want to hire a new worker. If students are not already protesting that the scenario is rigged, you might want to subtly make sure the new hire is tested with the undoctored solution. In terms of data recording, you can either use the same recording sheet (slide 10 in Appendix) or start a new one. To move the exercise along you will want to quickly reprimand the new, poor performer.

   Pay for performance. At this point a particularly engaging intervention is to offer a bonus—pay for performance. The author typically puts a $20 bill on the table and tells the student something like: "I really want you to succeed. As the CEO, I've been reading about pay for performance, and I am offering you this twenty dollar bonus if you can meet my quota this cycle." Students may find it difficult to believe the offer. However, once convinced, they will earnestly try. About half of the students in this situation perform below their previous cycles and about half perform equal to their previous cycle. (The author has never lost the $20.) The prevailing theory for the reduction in performance attributes that to a loss of breath control due to increased excitement.

5. Inquiry and design of experiment: Slides 11–14; Step q. By the time a second Willing Worker has "failed" most students will suspect something is causing the difference between the two work stations. Depending on the time you want to spend on the quality diagnosis techniques (fishbone charts, systems diagrams, control charts) you can either do this quickly or dig into some details. Students will quickly suspect the solution.

   Using a fishbone diagram with tools, materials, environment, people, and so on (as shown in slide 13) prompts for major categories of investigation. Students will likely hypothesize about the influence of the wand (tools), the process (perhaps another technique . . . this comes in handy if you plan to include the training phase after the first level of experiment), the physical location (a surprise result once occurred in a TQM course where design of experiment was the primary focus—we found that location in the room had a small and statistically significant effect; it appeared that air conditioning vents and their related air flow and relative humidity made a small difference in the number of bubbles that could be blown from a single dip), and the people (rarely are individuals equal in what they produce).

   Decide on factors to test. After some diagnosis and hypothesis, have the students vote on the two most likely causes of difference. Ninety-five percent of the time they will choose the solution and the wand (you will have to decide whether to proceed with other options, in which case you need to have a chart like exhibit 14 that is not labeled, or you can guide them to the wand and solution). Depending on the students' preparedness, either you will have them design the experiment or you can guide the design.

   Sequencing and recording experimental results. Slide 14 presents a format for guiding and recording the events from an experiment. The small numbers in the upper left corners of each box provide a sequence for conducting the bubble blowing cycles during the experiment (to control for practice/sequencing bias). The methods for conducting the experiment should follow the procedures used during "production," in part, to control for procedures.

6. Analyzing the results: Slides 15–16; Step s. Slide 15 shows an example of how numbers might be recorded from an experimental cycle. After recording the individual dips and bubble production an examination of the marginal totals provides evidence of the root causes of variance. With adequately doctored solution and wand, most experiments will yield obvious results such as those shown. If the results are not obvious, they may not be worth pursuing. This is another lesson from the experimental process—in a live situation you do not know a priori what is significant and what is not. In an MBA-level course this would be an appropriate place to review difference of means t-test and chi-squared test on overall significance.

   Handling "accidents" during experiment. Students may want to test further, particularly if one of the Willing Workers performs unusually poorly on a particular dip—for example, laughing or coughing during the bubble production. You can allow a re-dip or you could present the multiple-measure design represented in Slide 16.

7. Discussing lessons learned (to this point): Slide 17; Step s. Allow the students to thrash through what this might mean in practice. Some students may deny that such situations exist in the workplace. Students with significant work experience will likely see several implications immediately—they know of instances where they or a co-worker was penalize or rewarded by having a better work environment: a better sales territory, better equipment, additional equipment, better supplies, and so on. They may discuss the nature of incentives and how incentives encourage corruption of a system. If students do not have examples, you will want to provide some or ask prompting questions.

8. (Optional) Training Slide 18; step t. If you decide to add the training module, you will want to have practiced your "cutting" technique so that you can teach students how to improve their performance. You might like to ask whether there are any expert bubble blowers in the class who have not yet participated and would like to train others. Often if there is a student who has young children, that student will be familiar with efficient bubble blowing; this is an opportunity to affirm that person's ability to contribute due to the diversity of the class.

   Practice after training. After the demonstration of the upward cutting technique for controlling bubble size, the Willing Workers should be allowed two or three training dips to master the technique. Then rerun the experiment (for comparison purposes you should continue to use both solution/wand combinations). Record the results in the design of experiment chart in Slide 18 (or 13) and compare to the run prior to training. You should be able to demonstrate from this how companies could, if they conducted an experiment, measure the effectiveness of training and therefore its value.

9. (Optional) Recycling: Slide 19. The recycling addition is much like the training step just described. You have to train the students on how to recycle, allow them to practice, and then run the experiment. If you choose this option it is recommended that you practice before class so that you can reliably improve your performance and so that you understand the nuances of controlling the bursting of the caught bubble. Effective recycling can take a trained bubble blower from an average of 8–10 bubbles up to 15–20 bubbles. In debriefing, you might also want to point out how much less cleanup would be required with recycling (soap solution

will build up on the floor and table surface after all these experiments).

Recycling is accomplished by catching bubbles that have been blown on the wand, then popping the bubble so that the soap solution from the bubble rejoins the solution on the wand. Some solution is invariably lost when popping the bubble on the wand, so there is a limit to recycling—just as there is a limit to material quality during most "real" recycling activities. One of the "tricks" to effectively recycling the bubbles is to wait until the wand is nearing the end of its holding capacity (approximately one-third of its normal capacity remains).

10. Reviewing: Slide 20. As with all good experiences, you will want to review the findings and the key learning points. We think the key points that will stand out for students are listed in Slide 20, but you may find additional insights and unexpected results during the live and unpredictable experiment. Acknowledging the students who participate helps set the stage for future participation and helps reinforce the positive affect this experience should produce.

Good luck and have fun!

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APPENDIX

Slide 1:

Bubble Factory—Purpose

- Demonstrates Deming-style quality management regarding performance issues (including performance management).
- Points to limitations of standard theories studied thus far.
- Illustrates use of industrial design-of-experiments.

Slide 2:

Bubble Factory—Strategic Intent

- Build high-quality (tennis-ball sized) soap bubbles.
- Use resources efficiently.
- Treat employees with dignity and respect . . . after all, they are our most expensive variable cost.

Slide 3:

Bubble Factory—Organization

- CEO—[*professor's name*].
- Positions to fill:
  - Supervisor [optional, not recommended for undergraduates].
  - Quality Inspector.
  - Accountant (data recorder).
  - Two Willing Workers.

Slide 4:

Bubble Factory—Job Descriptions

- Supervisor:

Work responsibilities:

- Schedules work, monitors progress.
- Provides feedback to employees.
- Accountable for resources used.
- Enforces production quotas.
- Not responsible for hiring or firing.

Qualifications:

- Think while observing and/or talking.
- Organize people, provide clear direction.
- High level of ethical behavior.

Slide 5:

Bubble Factory—Job Descriptions

- Quality Inspector:

Work responsibilities:

- Measures output of willing workers.
- Assesses output against quality standards (tennis-ball-sized soap bubbles).
- Announces the results of each measurement (loudly and clearly so that the accountant may record results).
- Provides a count of quality bubbles at end of a production run.
- Compares count to that of accountant; resolves differences.

Qualifications:

- Can visually compare two objects and determine relative size.
- Can hear and keep track of announced counts.
- Write legibly in large and small font.
- Add a column of numbers.
- High level of integrity.

Slide 6:

Bubble Factory—Job Descriptions

Accountant:

- Records the results of each production run.
- Compares count to that of Quality Inspector and resolves any differences.
- Provides results to Supervisor/CEO.
- Provides summary reports as requested by CEO.

Qualifications:

- Able to visually perceive shapes and sizes with accuracy.
- Speak with a loud voice.
- Count to 20.
- High level of integrity.

Slide 7:

Bubble Factory—Job Descriptions

- Willing Workers:
  - Produce soap bubbles using exact procedures prescribed by company.
  - Produce as many high-quality bubbles as possible during each production run (single dip in soap solution).
  - Participate in workers' councils or other quality improvement processes as requested.

Qualifications:

- Reasonable control of breath and hands.
- Responsive to directions and training.

Slide 8:

Bubble Factory—Work Process

- Hold "wand" in dominant hand, grip bottle of solution with nondominant hand, making sure to agitate the solution **as little as possible** (leave bottle on stable surface—grip is only to stabilize, not pick up).
- In a single, smooth motion dip wand into solution, let it remain motionless for up to 2 seconds, then gently retract from solution. (Do not stir or agitate solution; do not tap on sides of bottle when retracting.
- For up to 2 seconds, allow any excess solution to drip back into bottle.

Slide 9:

Bubble Factory—Work Process (Continued)

- Raising wand to face, hold approximately four inches (one hand width) from lips with circle perpendicular to lips.
- Gently blow to produce bubbles.
- Only tennis-ball-sized (or larger) bubbles qualify as high-quality bubbles; since we only sell high-quality bubbles any smaller bubbles are waste.
- Continue blowing bubbles until all the solution on the wand has been used; return to the wand to its resting place and note the count of high-quality bubbles recorded by the quality inspector and accountant (this is the end of one production run).

Slide 10:

Bubble Factory—Results

Cycle	Worker 1:	Worker 2:
1		
2		
3		
4		
5		
6		
7		

Slide 11:

What happened?

- What do numbers say?
- Are they fair? Why? Why not?
- What about management interventions . . . did they work?
- What now?

Slide 12

Bubble Factory—Systems View

- Control chart (stability of system?).
- Search for root causes of systemic problems—variance, averages.
- Fishbone chart.
- Hypothesis development.
- Designing experiments.

Slide 13

Bubble Factory—Fishbone Diagram (Diagnostic)

```
People        Methods        Environment

    \            \             \
     \            \             \
      \            \             \
    ____________________________________\ Problem, Quality Issue
      /            /             /          /
     /            /             /
    /            /             /

Materials     Tools/Equipment     Design
```

Slide 14:

Bubble Factory—Experimental Design

	Worker 1		Worker 2		
	Bottle 1	Bottle 2	Bottle 1	Bottle 2	Row Wand
Wand 1	4	8	3	1	
Wand 2	5	2	6	7	
Column					
Bottle					
Worker					

Slide 15

Bubble Factory—Experimental Results
(Sample Results)

	Worker 1		Worker 2		
	Bottle 1	Bottle 2	Bottle 1	Bottle 2	Row Wand
Wand 1	4	8	3	1	**18**
	6	**2**	**8**	**2**	
Wand 2	5	2	6	7	**10**
	4	**1**	**5**	**0**	
Column	**10**	**3**	**13**	**2**	
Bottle	**23**			**5**	
Worker	**13**		**15**		

Slide 16

Bubble Factory—Experimental Results
(Repeated Measure)

	Worker 1		Worker 2		
	Bottle 1	Bottle 2	Bottle 1	Bottle 2	Row Wand
Wand 1	7	15	5	1	
Wand 2	10	3	11	14	
Wand 1	6	16	12	9	
Wand 2	13	4	2	8	
Column					
Bottle					
Worker					

Slide 17

Bubble Factory—Discussion

- What seemed to matter (what do the numbers say)?
- What management intervention would be appropriate now?
- Why don't more companies use experimental design?
- What have we learned about traditional HRM views on MBO, pay for performance, and so on?

Slide 18

Bubble Factory—Training

New Instructions:

1. After blowing tennis-ball-sized bubble and while it is still "attached" to the wand, "cut" the bubble with a quick (but not violent) upward movement of the wand.
2. Practice through two to four dips of "good" solution.
3. Using both sets of tools and materials go through experimental cycle.

	Worker 1		Worker 2		Row Wand
	Bottle 1	Bottle 2	Bottle 1	Bottle 2	
Wand 1	4	8	3	1	
Wand 2	5	2	6	7	
Column					
Bottle					
Worker					

Compare grand totals against first experiment.

Slide 19

Bubble Factory—Recycling

1. For each tools/material combination estimate the half-life of a dip (i.e., if the typical bottle–wand combination is 8, the half-life is 4).
2. When blowing bubbles, upon reaching the half-life of the dip, start catching the bubbles on the wand and allow them to burst. Do not force the bursting as this will disrupt the fluid sheet across the wand opening.
3. Continue blowing and catching bubbles until the sheet of liquid across the wand opening is gone.
4. Practice with two to four dips.
5. Again, cycle through the experimental cycle, and then compare grand totals.

	Worker 1		Worker 2		Row Wand
	Bottle 1	Bottle 2	Bottle 1	Bottle 2	
Wand 1	4	8	3	1	
Wand 2	5	2	6	7	
Column					
Bottle					
Worker					

Slide 20

Bubble Factory—Key Points

- System dominates performance most of the time.
- Without good records and experiments, a manager cannot tell what is a root cause of a problem.
- Design of experiment need not be elaborate (not require high-powered statistics) to produce useful results.
- Classic management practices can be cruel and ineffective without good information.

ABOUT THE AUTHOR

Drew L. Harris, Professor of Management & Organization at Central Connecticut State University (CCSU), leads the Entrepreneurship program at CCSU. His research focuses on holistic approaches to "what works"—for individuals, organizations, and communities—and on structures and activities thatL enable more effective learning. He has invented and tested this and other experiential exercises for use in classroom and consulting. Dr. W. Edwards Deming, the inspiration for this article, was a mentor and friend while Dr. Harris was a graduate student at New York University, where he earned his MBA and PhD. Dr. Harris can be reached at harrisdrl@ccsu.edu.