1994 ASA Presidential Address

New Paradigms for the Statistics Profession

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I want to use this opportunity to present my vision of some of the changes that I believe are needed for the future of the statistics profession. I have entitled my remarks *New Paradigms for the Statistics Profession*. The word *paradigm* is derived from the Greek:

paradeigma; *para* - beside + *deigma* - example

Webster defines it as — a pattern, example, or model. I think of a paradigm simply as how we view the world. In my remarks tonight, I want to be more specific and examine *how statisticians view the world and how the world views the statistics profession*.

I want to state up front that I have a great pride in statistics, and in being a statistician. I believe very strongly in the profession — it is not just a way to make a living for me. Such pride is easy to justify since our profession influences every aspect of society. Each of us could quickly make a list of fields in which statistics has had a fundamental and profound impact such as the following:

Aerospace	Government
Agriculture	Jurisprudence
Biology	Psychology
Chemistry	Manufacturing
Engineering	Medicine
Environment	Sports

This list only scratches the surface of the universe of areas where statistics can provide great benefits. Unfortunately, the areas that actually utilize statistics is only a small subset of this universe. Furthermore, the subset employing professional statisticians is even smaller.

Last year, in his Presidential Address, Stu Hunter presented the following graph showing the number of new Ph.Ds from 1972 to 1992. Does this look like a growing profession? In addition, from 1970 to 1990 the number of statistics faculty only increased from 700 to 735. This is an annual growth rate of only 0.24%. Does this sound like a growth industry to you? If the statistics profession were listed on the New York Stock exchange, would you invest in it?

MASTER

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Figure 1. Number of new Ph.D.s in statistics from 1972-1992.

If this information is not enough to heighten your senses, consider the fact that we are currently seeing some statistics departments at our universities closing or being threatened with closure. During May I wrote a letter of support urging the regents of the University of Arizona not to close its statistics department as they were threatening to do. During June I wrote another letter of support for the University of Delaware where the statistics department is under siege by so called *forward-thinking* individuals in positions of power at the university. These universities are not isolated cases nor are universities unique in this concern, as some major industries have either eliminated or are severely cutting back on their statistics groups through dumbsizing. If you have not already done so, I urge you to read my article in the Aug-Sept 1994 issue of *AmStat News* on this subject.

Why are we not growing when there is such a potential for growth? I believe the answer is the reason that society does not place a high value on the statistics profession. It is incumbent on each of us to make efforts to change society's paradigm of the statistics profession. We need to increase our outreach efforts for the future of the statistics profession as well as for the benefit of society as a whole. If you take nothing else away from this presentation, please remember the following:

There is no lack of need for statisticians, rather there is a lack of the recognition of that need by society!

To underscore this paradigm, we need only note that we live in a society that refused to give the ASA a commemorative stamp during its sesquicentennial in 1989, but turned around and voted on their choice for an Elvis Stamp! Where is the Ed Deming stamp? Where is the effort to get one?

For the theme of this year's meeting I selected: *Increasing Statistical Awareness through Perception, Preparation, and Promotion*. This theme is really about expanding our circle of influence through outreach, since this is a way to change society's paradigm of statistics. However, we must understand that before we change society's paradigm, *we must first change our own paradigms*.

Change is not easy at any level, but it is both inevitable and necessary. Hear the words of the philosopher Eric Hoffer:

In times of change, learners inherit the earth, while the learned find themselves beautifully equipped to deal with a world that no longer exists.

The areas of perception, preparation, and promotion overlap considerably and sometimes it can be difficult to tell where one ends and the other begins. In the time I have allotted, I would like to offer my view on new paradigms for the statistics profession related to these areas, beginning with perception.

Perception. Let me start with a quote given at last year's meeting in San Francisco by Congressman Sawyer from Ohio.

"Statistics should not be a punch line on an idiot's program like Jay Leno."

This comment was prompted by a joke that Jay Leno made about pocket protector salesman having a field day during last year's annual meeting. Clearly, Jay Leno will make jokes about most any profession, but the ready acceptance of his jokes illustrates the image that statistics has with the general public.

You may want to try a simple experiment sometime. Conduct a survey in which people are asked to rank the following professions in terms of their perceived value in their lives.

Dentist	Lawyer
College Professor	Minister
Doctor	Pharmacist
Engineer	Teacher
Farmer	Statistician

Do not be surprised to find *statistician* at the bottom of the rankings you obtain — even with lawyers in the list!

We can all recount the reactions we have received at social functions when you tell someone, who happens to ask, that you are a statistician. People will refer you to a

doctor, to a real estate agent, to a barber, even to a lawyer, but how many times have you heard, "I know a great statistician that you should see?"

Why is the statistics profession not more highly valued by society? A lot of it has to do with the *perception* that *WE* have created. Roger Hoerl, Jeff Hooper, Pete Jacobs, and Jim Lucas (1993) wrote a white paper concerning survival skills for statisticians. In this paper they state:

"... the statistical profession holds a small view of its responsibility to society."

Let's look at that responsibility by considering the 95%+ of college graduates whose only exposure to statistics is one or two undergraduate statistics courses. We have some individuals in our profession — Dick Scheaffer, Jim Landwehr, Doug Zahn, Ron Snee, and Roger Hoerl, to name but a few, whom I would term as heroes for their efforts to cause us to focus on the importance of such courses.

We simply must recognize the impact these courses have on our profession and they must have a higher priority in the university system. At the ASA Winter Conference held in Atlanta last January, Ron Snee listed some root causes regarding the design and delivery of statistical education in which he included *unstated or incorrect goals*. I agree with Ron. If goals are unstated, they will not be achieved. If they are incorrect, they will not produce the desired result.

I sometimes wonder if we think the only people who employ statisticians are other statisticians. Hoerl et al refer to the *inward* focus of the statistics profession and state:

"We are our own best customers. Much of the work of the statistical profession is intended for other members of the statistical profession."

We need to realize that the students in these service courses are our future clients and employers. Our job is neither to entertain them nor to make them professional statisticians, but it is our responsibility to convey a sense of the *value of statistics* to them.

I would like to challenge everyone teaching statistics to look at their courses in terms of customer satisfaction and to set a goal of making significant improvements each year. Have you ever seen a class start with "I'm Professor Jones, this is the course syllabus, and now let me define what we mean by a quantitative variable...?"

There is no attempt to create student interest and buy in with this approach. A mental exercise that I have done on many occasions is to think about interesting and novel ways to start the first day of class. Each faculty member in a department should do this independently and then make their presentations to the rest of the faculty. Their pooled efforts would very quickly produce some very effective approaches.

A short term outlook would say that I cannot afford the time to waste the first day of class creating student buy in. We must change our paradigm and look beyond the first day or even the entire semester. We must be focused on the future of the statistics profession. Such a focus makes it clear that we cannot afford not to create student buy in. Bob Mason has told me that he works harder preparing for the first day of class than any other day.

I wrote this talk last January, far before I saw the program for this meeting in the May issue of *AmStat News*, in which I was pleasantly surprised to see a session scheduled for Thursday that is entitled "The First Day of Class."

Ron Snee, writing about what's missing in statistical education, says:

"People will study statistics if they see value in it."

Let me ask you to think for a minute about why you go to the annual meeting or other similar meetings. Clearly, you are not being forced to do so, rather you see value in going to sessions and interfacing with your colleagues.

On the other hand, the all too frequent attitude of students is *"I have to take statistics."* Wouldn't it be great if we could change that attitude to *"I get to take statistics."* This would be a major paradigm shift!

Some in the audience may now be thinking that I have been away from the classroom too long, or have spent too much time in the New Mexico sun. Be that as it may, my point is quite simple — these courses provide us with an opportunity to convince students of the value of statistics. For most of them, this is the only opportunity that we will ever have to do so. It is worth recalling the adage that you only get one chance to make a good first impression. Otherwise, I fear that we are dealing ourselves a fatal blow with respect to our future customers and missing a golden opportunity to reach out to society.

Last year, I took the lead in helping the ASA develop vision and mission statements to serve as a guide on where we are headed as an organization and how we are going to get there. I am quite pleased that many of the organizational units within the ASA have developed their own vision and mission statements. I believe the time and introspection that go into the development of such statements is of utmost value. Each of us could profit by developing such statements for ourselves and for our respective organizations. For example, a statistics department might have the following vision.

Every student who takes a statistics course from us will regard it as the most valuable course they had in college.

How's that for a paradigm shift! Its certainly a long way removed from Bob Hogg's 1991 comment in *The American Statistician*:

"To be blunt, many of us are lousy teachers, and our efforts to improve are feeble. So students frequently view statistics as the worst course taken in college."

Last month I had a meeting with the convention coordinator at the Albuquerque Hilton in which the subject of statistics came up. She said the only thing she could remember about statistics was *"null and void."* Today I gave an interview to a feature writer for one of the Toronto newspapers. He stated that statistics was viewed as a difficult course and said nothing about its usefulness. We must make the effort required to change such paradigms!

A consultant might have the following vision:

Every person that I consult with will truly gain an appreciation for the usefulness of statistics and will become a customer for life.

Let me move to another area where I believe a paradigm shift is needed to bring about changes in perceptions. I once attended a meeting in which the chair of a committee that had reviewed a highly publicized risk study written by engineers, was very critical of the study for what he termed, their use of bad statistics. I asked him why statisticians were not involved when their expertise was so clearly needed. He replied that statisticians are of two types, Bayesians and classicists — and the two don't speak to one another!

Who is responsible for creating this impression? Certainly not the engineering community. I have used this example because I believe it illustrates how easy it is to convey a bad or misleading impression. We need to realize that even in joking, we run the risk of conveying the impression, that even as trained professionals, we cannot agree. Therefore, why should anyone perceive value in what we have to offer. Perceptions like this are difficult to overcome and are very harmful to the statistics profession. Unfortunately, we bear the responsibility for creating them.

Let me close my remarks on perception with a potpourri of less serious examples of how each of us can make small paradigm shifts that will contribute to increasing society's perception of the value of statistics:

- We should quit quoting Disraeli: "Lies, Damned Lies, and Statistics". Lets change it to "Lies, Damned Lies, and Politics." After all, we need to give credit where credit is due.
- Let's replace "How to Lie with Statistics" with "How to tell the Truth with Statistics."
- We need to minimize our use of the expression "in the real world." What does this convey to the person who hears it — quite simply, what we are doing is not real world!

- We are also guilty of using such expressions as "quick and dirty" analysis. Let me ask how many in the audience would seek medical help from individuals known for their "quick and dirty" medical procedures?

Let me now turn to the area of preparation.

Preparation. If we are to impact society's paradigm of the need for statisticians, then it is essential that we take a careful look at how we train professional statisticians. Let me start this discussion by quoting two of my very good friends, whose opinions I hold in high esteem. At the ASA President's Invited presentation at last year's Fall Technical Conference across Lake Ontario in Rochester, Stu Hunter stated:

Unfortunately, the fact that statistics is a profession containing both tradesmen and scholars is simply not broadly recognized. Many of our academics see the profession of statistics solely through the prism of scholarship, emphasizing the production of PhD's and the publication of papers in the refereed literature.

As part of his well publicized quality journey, Bob Hogg wrote:

It seems universities sometimes pretend that all of its doctoral students will teach at Berkeley. While one can hope a few will, it is good to remember that most will serve either at liberal arts colleges or in business or in government work. Mentoring must therefore be done in "people skills" as well as technical skills and research.

Since these individuals are both well-respected and long-time members of the academic community, I need not be concerned that these comments will be interpreted as an indictment of the academic community on my part. However, I do think that on the basis of these comments it is reasonable to ask what drives current training.

Is it the need for the acquisition of technical skills including theory? I doubt that any of us question the need for sound technical skills, but does the acquisition of these skills, in and of themselves, provide a guarantee of success in either academe or industry?

What is required for success? I believe that it is as simple as *determining our customers needs* and then proactively working toward their attainment. Of course, this implies an inherent underlying assumption that we have recognized that each of us has customers and that ours is a customer-driven profession.

At last year's annual meeting, David Moore asked us to view education as a business and noted that many, if not most, colleges and universities *tend to be inattentive to customers*. Hoerl et al take a broader view and state that *little value is placed on serving customers outside the statistics profession*.

The customers of academe tend to be many and varied and range from students to the corporate sector. What kind of feedback is the corporate sector likely to give to

the academic community? Let me share some comments that I have heard from colleagues:

- Communication and presentation skills are fundamental keys to success. Courses are needed on improving communications skills:

Listening Skills 101
Presentation Skills 101
People Skills 101

- Work with your customer to determine what type of training is needed.
- Evaluate the quality of your product.
- Recruit students from engineering and the sciences as statisticians are poor scientists and focus too much on the esoteric.
- Statisticians need to be trained to add value to their projects beyond basic statistical applications. We need to be recognized as broad-based innovators.
- Focus training on *creating* jobs for statisticians by the contributions they can make as a result of their training.

At the President's Invited Address yesterday we heard Dr. Bill Spencer, the President and CEO of SEMATECH, tell us that applied statistics was a competitive necessity in the semiconductor industry. Let me illustrate my latter points with an example from SEMATECH, where marathon tests are frequently conducted on new equipment. One test that I am familiar with costs \$50,000 to set up, \$35,000 a week to conduct, lasts for 15 weeks, and has a total cost close to \$600,000. The number of failures during the test is recorded and the statistician is asked to provide a 60% confidence interval for the mean time between failures.

This is easy for the statistician to do. However, if the statistician's training has focused on becoming a broad-based innovator, they should be asking if the engineer would prefer a procedure that reduced testing time and minimized total expected costs, including the cost of losing customers by shipping equipment that does not meet customer expectations. The engineer would be unlikely to bring this thinking to the table, but they will be very receptive to it, as will management.

I like the statement made by Jon Kettenring:

"Industry needs holistic statisticians who are nimble problem solvers."

Now that I have pointed out some areas of concern, what can WE do about it? I say WE, because WE need to recognize that this is not only an academic concern, rather it is a fundamental concern that influences society's paradigm of the statistics profession.

I think that one of the most effective ways we can address the issues that have been raised is through the establishment of closer relationships between industry and academe. I have strongly encouraged increased interactions between these entities. Refer to this as customer-supplier relationships if you wish. We had an excellent opening session at this meeting with a panel discussing beneficial aspects of closer interactions.

At last year's meeting in San Francisco and again at this meeting, subgroups of the Department Chairs/Institutional Members of the ASA and the Corporate Members of the ASA held joint meetings to discuss areas of mutual interest. Many promising ideas are coming out of these meetings and results have already been achieved, as evidenced by the listing in the January issue of *AmStat News* of over 30 industrial internships for students. These internships need to continue to grow because they have a powerful impact on preparing students to meet the needs of the corporate world, and this is only the tip of the iceberg compared to what can be accomplished.

I have encouraged academe and industry to work together and form partnerships. I believe that this is our best hope to bring about meaningful and lasting change. *The problems we face today are too complex for any one entity to solve in isolation.* In my mind, not having academe and industry working together makes no more sense than hitching two teams of horses to the opposite ends of a wagon.

Partnerships can have a very positive impact on training. Earlier this year, I visited the Statistics Department at the University of South Carolina. They have created a master's degree program in industrial statistics. A unique feature of this program is that students must have two years of industrial experience before they can get into it. The faculty has worked with industry to modify their courses to meet the needs of their customers and have gone to teaching during off hours when students are available. Iowa State is just starting an innovative program in which they will videotape courses for use by individuals at General Motors interested in pursuing a Master's degree .

Partnerships can also form the basis for a formal mechanism for wide spread two-way employee exchanges. These exchanges are very beneficial to both parties. I have had several professors work for me over the years. These relationships have opened up new areas of research for them, established sources of funding, and enabled them to carry this experience back to the classroom. I have benefitted from their assistance, particularly from them being able to devote a block of time to a particular messy, complicated, and time-consuming problem that is also of interest to them. Opportunities have been opened up for the placement of students.

It is important that exchanges not be viewed as a one-way street, because industry has a lot to offer by coming to academe. It is also important to extend the bounds of such exchanges and not limit them to those institutions that happen to be linked geographically.

Is there a role for the ASA in forming partnerships? Absolutely! The ASA can play a major role and serve as a facilitator in forming partnerships. Consider how easy it

was for the ASA to get information out to all its members regarding the internships for students. We need to make partnerships a priority and address them on a broad scale. Let me now turn to the last area.

Promotion. Joel Barker, in his book *Future Edge*, states there are three keys to the future of any organization that wants to participate fully in the twenty-first century. These keys, which apply to both profit and nonprofit organizations, are:

- Anticipation
- Innovation
- Excellence

Excellence is derived from the philosophy of Deming and Juran, and simply represents the price you pay to play the game. *Innovation*, when combined with excellence, gives you the competitive edge. *Anticipation* provides you with the information that allows you to be in the right place at the right time with your excellent innovative product or service.

I agree with Barker's observations and I try to follow his keys in my work. However, I have found that you need to have an active *promotion* effort to complete the package, or as we frequently say in my business, we need a marketing plan. Let me share some ideas with you on promotion.

Earlier this year, the ASA receive an invitation from the Institute of Industrial Engineers to co-sponsor their Third International Symposium on Productivity and Quality Improvement with a Focus on Government. The IIE produces 45 conferences and seminars each year for their membership base of 35,000. The IIE identifies industrial engineers as the *change masters* in leading the way in re-engineering and process improvement.

What a golden opportunity for the statistics profession! We have a chance to form a partnership that would provide us with a very positive way to promote the statistics profession. But we need to do much more than just lend our name to this conference, we need to start an active dialogue with the IIE and see if we can develop relevant continuing education courses, most likely through our Q&P and SPES sections, that meet the needs of their members.

As Hoerl et al have pointed out, we have spent too many years with an internal focus and developing courses to be taught to our own members. We can no longer afford this narrow focus. We might also see if we can sponsor joint sessions at their meetings showing the usefulness of statistics in meeting their needs. We need to set up a display booth at their meeting showing how statistics can save resources and improve their product.

Let me provide one simple example to illustrate this latter point. At last year's Fall Technical Conference, Garry Athoe and Richard Snary, statisticians employed by GM of Canada, and Jock MacKay of the University of Waterloo made a presentation

showing how they had improved hardness measurements on recycled steel. Their work resulted in saving the company millions of dollars.

This is the kind of result that will get management's attention and create a demand for statisticians — *if they are made known*. In my business, we refer to this as a *success story*. In this era of tight budgets, it is imperative that we publicize such stories. Our profession has an abundance of success stories, but we too often take them for granted.

Our criteria for publicizing the results of such studies focuses on whether any new statistical methods were developed when we should be asking if any new jobs created for statisticians. *We continue to focus inward when the real benefit to the profession lies in an outward focus.*

The good news about the IIE invitation is that the door has been opened for increased interaction. The bad news is that the IIE extended the invitation, rather than the ASA taking the initiative. The IIE is just one example of where we need to look to promote the statistics profession with other associations.

Ron Snee has called on the ASA leadership to help enable the development of partnerships between statistics and other disciplines. We need to make this a top priority and move on it now — not study it for several years. If we don't fill the need, someone else will. The window of opportunity is not going to wait for us to make up our minds.

Let me share a brief illustration of how we have used promotion to good use at Sandia. I began heading up a program with Motorola in July 1991 to evaluate an environmentally conscious low-residue soldering process, which eliminates the need for cleaning with ozone-depleting chemicals used in the manufacture of printed wiring boards such as found in your personal computers and automobiles.

We felt that the technology was so promising that we needed to take actions to promote it while making industry aware of our abilities to meet their testing and optimization needs in this area. We summarized our findings in a very attractive report that we distributed widely. We quickly organized a conference over a six-week period to get information on our program out to industry. More than 175 individuals representing 96 firms attended. A second conference scheduled for November to hear the results of a follow up program should attract hundreds.

Since the conclusion of the first program we have had inquiries from more than 300 companies and organizations as a result of our promotion efforts. The success of this program has brought favorable attention to the labs, an increased level of funding and projects to our department, but more important, it has created jobs.

The statistics profession needs to follow the lead of industry and look for success stories and publicize them. There is no shortage of success stories, just a lack of promoting them. This is an area that we need to take more seriously and get actively

involved in. Let's keep in mind that we do not have to be in industry to do promotion, we can undertake active promotion efforts in the classroom, or with the clients for whom we consult.

In closing, let me say that I strongly believe that if we are to grow and prosper as a profession, we must expand our circle of influence through outreach to society. If we are to increase our sphere of influence, then it is incumbent on each of us to ensure that we put more into the profession than we take out of it. In this presentation, I have tried to explain how I think this can be accomplished through changes in our paradigms.

It has been said that a great person is an ordinary person with determination. Let's all accept this as a personal goal and see how it increases society's awareness of the value of the statistics profession.

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