

# Continuous Improvement of Teaching: A Case Study in a Large Statistics Course

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## Summary

Continuous Quality Improvement (CQI) better known in industry as Total Quality Management (TQM), is a management philosophy which has transformed many businesses and corporations internationally and is now beginning to make strong inroads into universities, predominantly on the administrative side. This paper raises the question of whether the conceptual framework provided by CQI/TQM is a fertile one for addressing the problems involved in university teaching. It translates basic tenets of CQI/TQM into the university teaching context and outlines how these ideas have been implemented in a large, multisection, introductory statistics course. Particular attention is given to the problems of fostering steady year-to-year improvements in a course that can survive changes of personnel, and in making improvements by stimulating group creativity and then capturing the results for the future.

*Key words:* Continuous Quality Improvement; Quality Improvement; Teaching; Teacher development; Total Quality Management.

## 1 Introduction

Total Quality Management (TQM), Continuous Quality Improvement (CQI), Total Quality Service (TQS), are just some of the names applied to a management tide from industry now sweeping across higher education in the United States. Ewell (1993) quotes a recent *Business Week* survey in which 61% of U.S. College Presidents averred involvement in TQM—up from close to zero only 2 years before. Marchese (1993) recounts, “A few campus pioneers began their TQM effort in the eighties; the big wave of interest kicked in during the 1991–2 academic year; by now it’s hard to find a campus without a knot of people trying to implement the thing”. The TQM tide is also flowing, albeit less strongly, in Canada, Great Britain and Australia and there are signs in New Zealand. The May/June 1993 issue of *Change* (a publication under the editorial control of the American Association for Higher Education) and, recently an entire issue of the journal *Higher Education* (Vol. 25, No.3, 1993) were both devoted to TQM in Higher Education, but events have been moving so fast that any attempt to survey this subject is out of date before it is written. (A substantial portion of the October 1993 issue of *Quality Progress* is also devoted to TQM in education more broadly.)

TQM in higher education in the 1980’s, to the small extent that it existed, was largely a “grass roots” activity—improvement projects led by enthusiasts motivated by an interest in quality improvement for its own sake and by their knowledge of TQM in industry. Ewell (1993) identifies “an increasingly desperate set of fiscal circumstances” as the most important reason for the astoundingly rapid spread of interest in institutional TQM in the U.S. led by college presidents and top administrators. He further argues that the current severe budget shortfalls that colleges and universities are experiencing are the result of structural rather than short term problems with the financing of higher education in the U.S. Activity in Great Britain (see Williams, 1993) and Australia is a result of both budget

pressure and recent government-imposed quality-assurance regimes. For a discussion of the overlap and differences between quality assurance and TQM, see Tannock (1991), Beecroft (1993).

Of course many statisticians have long had at least some peripheral awareness of quality improvement and TQM because of the leading role of W. Edwards Deming in the development of TQM and subsequent involvement of other prominent statisticians in applying TQM in industry. However, there is now a growing realisation that TQM may also provide us with guidelines for transforming the way that we do business, the way that we do our own jobs. And for a significant proportion of us, a large part of that business is the teaching of students.

There is no question that we statisticians need to improve the quality of our teaching if we wish to advance our discipline. Statistics is still widely perceived as being "an unimportant, mechanical, uninteresting, difficult, required subject, an abstruse corner of the subject XYZ, . . ." (Minton, 1983). Although our jobs are usually more secure than those in business, the protection of those jobs is still a motivation for improvement. North American universities have long competed for students, whereas for some other countries like Australia and New Zealand, this is a new experience. A reputation for quality of teaching and service to students must be a factor in attracting the best students and in attracting outside money. And, of course, in order to gain and maintain such a reputation, we have to deliver quality.

The focus of most of the activity in budget-driven, institutional TQM has been on the administrative side of universities. In general, academics tend to be suspicious of TQM as just the latest in a long series of management fads and to be hostile to any application of business models to education. We are probably right to be nervous about institutional TQM. Elements of TQM, and even the name itself, have sometimes been misused in industry in cost-cutting campaigns as another weapon for controlling workers rather than empowering them. Whether institutional TQM works for good or for ill in higher education will largely depend upon whether the primary goals of individual administrators are to improve quality within a limited budget, or simply to cut expenditure. But as Hogg & Hogg (1995) and the pages of *Change* and *Higher Education* attest, the collection of exciting success stories about the application of TQM to the administrative side of universities is growing rapidly—stories of elimination of wasted effort and expenditure coupled with real, measurable improvements in services delivered.

The history of TQM in industry is one of a few brilliant successes, some disasters and large numbers of companies wandering lost in the wilderness. For each new area of application, TQM must be reinvented. John Ruskin once wrote, "Quality is not an accident. It is always the result of intelligent effort." TQM gives us some basic principles together with a body of specific examples that have worked elsewhere and may work for us if the situations are sufficiently similar. In addition to ideas about the management of operations, it also gives us a conceptual framework in which to analyse those operations and learn about their inner workings. Work on applying TQM to university teaching, e.g. Zahn (1990), Hau (1991), Hansen (1993), Roberts (1993), Bateman & Roberts (1993) and Hogg & Hogg (1995), is still at the "grass roots" experimental level. As Marchese (1993) says, ". . . we're years away from knowing what academic versions of TQM will appropriately look like." "Does TQM work for university teaching?" is not yet a meaningful question. The questions which we should be asking are, "Is the conceptual framework provided by TQM a fertile one for thinking about our teaching? Can it lead us to new insights? to some improved practices and improvements which are sustained?" or, more concisely, "Can TQM help us to apply our efforts more intelligently?" I hope to show that the answer to these questions is "yes".

The previous paper, Hogg & Hogg (1995), gives a brief overview of TQM as it is used in industry. This paper extends their discussion of what these commercial TQM principles might correspond to in the context of university teaching, and describes how we have tried to implement these principles in a large multi-section introductory statistics course at the University of Auckland. It focuses on processes involved in delivering a university course and on ways of managing those processes rather

than on what should be taught or how it should be taught, although specifics of the latter type occasionally arise as examples. (Wild 1994 contains some thoughts on these latter topics). Indeed the discussion is not specific to statistics per se. We have been particularly interested in mechanisms that can foster steady year-to-year improvements in a course and can survive changes of personnel. Ewell (1993) notes that it is important “to recognise that Total Quality is *total*—its pieces must fit together. Many of the pieces *are* familiar; the ‘total’ is what’s new”. Rather than simply employing elements of TQM, we are working towards building a “total” system, one in which all the pieces do fit together, but we still have a long way to go.

Section 2 discusses the situation of first year statistics at the University of Auckland. Section 3 discusses the ideas of “top management” and its leadership, teamwork, and systems in the teaching context. Section 4 discusses our “product”, the “customers” for whom we do the teaching, and our educational goals and their role. Section 5 discusses the systems we use to “measure” the attainment of goals, and for obtaining “customer” input and feedback. Section 6 deals with the systems we have put in place for quality improvement, excluding explicit staff development programmes, while Section 7 talks about human resources matters with particular emphasis on staff development. Section 8 discusses some of the cultural features of the university setting which hinder the establishment and maintenance of a TQM culture, and Section 9 discusses the approach taken to ensure the survival of the system and a quality culture despite staff turnover. This latter is extremely important because the accumulation of knowledge and expertise through time is the basis of our approach (and also of TQM).

## 2 First Year Statistics at Auckland

Stage 1 Statistics at the University of Auckland currently involves approximately 2,500 students taught in 12 sections (streams) on three campuses. The general tendency is for each lecturer to teach a section for a whole year, although sometimes people double or triple up for a shorter period of time. We operate using a common core of material with some subdivision into different courses which serve different application areas (e.g. business). Four sections use computers packages, the rest do not. This results from financial and space constraints. Most of the activity is on the City Campus. Here we operate a 40-hour-per-week drop-in help service in the so-called Assistance Rooms staffed by about 10 different tutors (working differing numbers of hours). Further Tutors assist students in the Computer Laboratory. A Tutor-Administrator takes care of a great deal of the administrative burdens and also manages the tutors and markers (approximately 40 of them). The team is headed by a Coordinator, with overall responsibility for all of the courses, backed up by course convenors who have primary responsibility for the factors that differentiate their courses from the common core. We produce our own textbook, a coursebook that we call the “Study Guide”, and a computer manual.

Many of the systems that we have developed in our attempts to implement TQM within this operation could be transferred easily to the running of other multisection university courses. Our operation is big enough to share some of the characteristics of the way a Department operates as well as those of a normal university course. Thus, some of the systems we have developed may often be more naturally applied at a Department level while others are useful for a single-teacher course.

## 3 “Top Management” and Teamwork

*“Top Management” and its Leadership:* TQM can be applied to any sub-operation. Several years ago, Chris (C. M.) Triggs and I took hold of the operation we then had “ownership” of and began to try to transform that. Our operation was Stage 1 Statistics and, for that operation, we were “top management”. Of course our “ownership” was far from complete. There are many important factors we have no control over such as the reward system for teaching staff. But there is still a great deal

one can do without waiting for a perfect world.

*Mission/Policy:* Our mission (to provide excellent courses in terms of content and assessment, and excellent service to students) and policies, which include policies on educational and delivery goals for the course, form the first section of our team's Quality Manual. A summary of the policy is printed in the Study Guide given to students.

*Teamwork:* Universities have had a world view that has at its centre the ideal of the brilliant and innovative individual who must be protected from interference at all cost. TQM has a world view based upon the group. But this need not lead us to being mired in mediocrity since TQM is concerned with capturing the elements of brilliance that individuals can provide and harnessing them for a common purpose. In teaching, we have to try to capture as much as possible of what makes our best teachers good and transfer that to everyone in the group now and for the future. We may not be able to make everyone a superb teacher, but we should be able to raise the average level.

The main decision-making vehicle in our system is the weekly meeting of the course-management team (which contains all of the lecturers, student representatives and several additional personnel). Where possible, and it almost always is, we make our decisions by consensus. This gives everyone ownership. Our documentation emphasises the importance of team participation. A similar team-meeting approach is being taken with the Assistance Room tutoring operation. Our biggest difficulty lies in extending to the students the "all-one-team" culture, and the feeling that they too are responsible for improving the quality of the course. This theme is taken up in Section 8 which discusses cultural impediments to TQM and Section 9 which discusses our current strategies for overcoming the problem.

#### **4 Customers, Processes and Goals**

In this section, we will examine the ideas of "product" and "customers", some of our major processes, and the setting of goals. These things are too interrelated to be defined separately. In quality assurance terms, it is normal to define the product first but, as is typical with complex operations, the product we provide is different for different customers.

Words of commercial origin such as "customer" can cause difficulties in academic environments (see Section 8). The idea of "the customer" is completely basic to TQM. The TQM notion of "customer" is much more general than "purchaser" in the normal commercial sense. It is the answer to the question, "Who are we doing this for?" One way of finding the customers that matter is to ask ourselves "what interests do we have to satisfy in order to 'prosper'?" Here, of course, the answers depend upon what "prospering" means to us, but if we cannot define that, we have no rational basis for our decisions. For our team "prospering" largely involves advancing our discipline and the contribution it makes to society, contributing to the well-being of our students, protecting our jobs and the institution what we work within, and having fun in the process (although necessarily in that order). Although the discussion over the next few paragraphs is in terms of first year statistics, the ideas are fairly general.

The customers for our first year statistics courses are many and varied. They include: the students; the lecturers (and Departments) of subsequent courses for which our courses are a requirement; future employers of our students; the discipline of Statistics; and society as a whole. (Particularly where courses are compulsory part of a degree programme, we might also regard our own Departments and Faculties as customers.) For the students, the "products" we contribute towards providing are education and qualifications. All customers listed above apart from the students gain their benefit from our efforts through the increased knowledge and expertise of the students coming out of the course, i.e. through educated students. Thus the students occupy the unusual position of being both customers and product.

The multifaceted customer described above for the Stage 1 statistics course is too ill-defined to be of much use for forming such goals and strategies for quality improvement. It helps to identify the four most important processes involved in our operations:

- (i) the *curriculum development process* which includes defining and updating course content,
- (ii) the *teaching process* in which we help students to master the curriculum as an input to
- (iii) the *learning process* which goes on in the students. Finally we have
- (iv) the *assessment process* by which we certify that a certain quantity of knowledge/skills have been acquired.

These processes are closely related and we will investigate some of the relationships and suggest how these relationships may be used as the paper develops. The list above is not exhaustive—going along with the above are *administrative processes*. Our main interest is in yet another learning process, that by which the teaching team learns to manage and improve the set of processes above. A thorough analysis of all the process (i) to (iv) in terms of inputs and outputs, suppliers and customers, and the needs of those customers is a large, but necessary, undertaking. Here we will settle for making a few observations.

All of the customers we have listed above have important, if sometimes conflicting, interests in the outputs of the curriculum process (that the content and thinking skills taught are the “right” ones), the learning process (that students learn sufficient of the curriculum at acceptable “cost”), and the assessment process.

As we have noted, the curriculum development process defines the body of knowledge and the intellectual skills we want students to acquire and involves consideration of the needs of all of the customers listed above. Apart from the other university courses which require parts of the statistics programme, it is very difficult to ascertain what the customers think their curriculum needs are. To the extent to which one can, they tend to be very vaguely defined, often coming down to some idea of general numeracy, and on the part of students, employability. Determining customer needs must be easier when dealing with a whole degree programme serving a small well organised profession than it is when you are involved with general education and a single course. Our market research in terms of the needs of each type of customer is limited and informal. Mostly, it consists of talking to people who have an interest whenever we have the chance: to lecturers of other courses, to students, and to ex-students about what parts of our courses they have found useful and what we should have taught them; to practising statisticians and to colleagues around the world about what they think is useful and important. By acting as statistical consultants on a wide variety of practical problems we also develop and update our own experience about what parts of statistics are most useful in the real world. The intellectual content of our courses has been arrived at by balancing various demands: conveying the “big ideas” of our discipline, teaching as much as possible of those aspects of statistics we think will be most useful in the lives and future careers of our students (we believe that if we can do this the needs of “society” are also met), catering for the explicitly expressed statistical needs of the courses that use our courses as prerequisites, and trying to be realistic about what students can achieve in one year.

The teaching process stands out in that it has only one customer group, namely, the students. Members of the customer list above, apart from the students, are really customers of the learning process, a process in which teachers are suppliers and students are the workers. Moreover, the performance of the teaching process can only be determined indirectly via the performance of the learning process—and rightly so—teaching has been effective if and only if it has helped students to learn (and to want to learn). The learning process depends at least as much on the efforts of the student as it does upon anything we do. Most of our customers have a legitimate interest in the output of the learning process, e.g. in such (albeit inadequate) cost-efficiency measures as proportions of

students passing. Therefore, it is definitely part of our jobs to try to improve the learning process by inspiring the students to greater effort. The assessment systems we have been using are fairly standard among university courses and we have not yet given any real consideration to the needs of the external customers of the assessment process. However, we have worked on student reactions to the assessment process and on using the assessment process to improve the learning process.

Our approach to teaching is built on the belief that the goals students are expected to reach should be stated as fully and unambiguously as possible. The course content is defined to be the contents of the textbook and the “Study Guide” coursebook we provide to students. Assessment is described in detail. For example, the chapter-by-chapter study notes contained in the Study Guide discuss the types of test and examination questions the students can expect to get on the material in that chapter and index all questions of that type that we have used over the previous three years. To cope with our size/resource problems, we are using multiple choice tests and exams. We cope with the limitations of multiple choice testing by trying to be creative about the type of questions used, and by putting more emphasis upon assignment work that stresses open ended thinking and written communication skills. A side benefit of multiple choice has been the ability to target individual ideas.

As far as the teaching process is concerned, the task of the teaching team is to enable students to reach the educational goals of the course as efficiently as possible. One often hears teachers saying, “You shouldn’t spoon feed students. They’ll never learn to stand on their own feet”. This almost sounds plausible, but all too easily becomes an excuse for sloppiness. By saying that the effort students have to put in to achieve the goals of the course should be minimised, there is no implication that students cannot be challenged, that they should not have to show initiative, that they should not have to learn to draw on their own resources, to go out and research topics. These could, perhaps more properly should, be included as goals of any course. But then, as with all goals, we should be planning ways for students to reach these ones efficiently. Student learning-time is a limited resource which should not be wasted.

The detailed definition of goals has several functions: (i) reassurance (students find it is reassuring to know exactly what is expected of them), (ii) it enables us to more effectively use the assessment process to motivate students and focus their efforts on the things we most want them to learn (more about this in Section 6.5), and (iii) to enable the students to give us useful feedback about how *we* are performing. A corollary of the twin facts that students are the sole customers of the teaching process and that we are among the suppliers to their learning processes, is that we should try to involve students fully in improving teaching services. For us, these services include written materials, lectures, tutorials, and drop in help at the Assistance Rooms and Computer Laboratories. The educational and assessment goals of the course and also the goals of each of the services provided must be clearly communicated to students if they are to make informed judgements and useful contributions to the improvement of the teaching they receive.

## **5 Measurement, Feedback and Customer Input**

We use the word “measurement” in a very loose sense meaning any way of monitoring or checking up on opinion or performance. There is always a trade off between the value of information and the cost of obtaining it; normally the most important cost in our situation is our own time. As a result, we sometimes use quick and dirty methods of gathering information.

### *5.1 Attainment of Educational Goals*

Most of the time, we think of the assessment of students in terms of measuring how well a student has learned the lessons of the course. Indeed this is its primary purpose; it is the basis upon which we award the grades which “certify” the outgoing student’s capabilities. A second important aspect of

assessment is often overlooked. Assessed work also provides our best measures of the effectiveness of the teaching process. If many students cannot answer a particular question that we would want them all to be able to answer, the TQM response would be to change the things we are doing in order to remedy the situation, not to blame the students. It is important, therefore, that assessment information be captured to pinpoint problem areas. From there, we can endeavour to find out why the problems are occurring and then to effect changes in teaching practice and student learning. Our methods are described in Section 6.5.

## 5.2 *Student Opinion*

Gradually over time, we have built up a variety of mechanisms to catch student opinion. We began with standard questionnaire-based student evaluations which we ran, and continue to run, twice-yearly. However, student evaluations are best thought of as providing a report card on past performance. The information comes too late to be of much use for making changes that affect that year. At best, we can make mid-year corrections. This subsection is concerned with methods that give more timely information. Although we will give little emphasis to the historical development, our most recent change has been to integrate student representatives from each section into our regular course-management team meetings. We have been delighted by the willingness of the students to voice their opinions.

A form of immediate “measurement” that has been in operation for a year is the “Oops! Report” complaints procedure. Complaints have two uses. We can try to eliminate the causes of complaints and we can monitor the levels of various classes of complaints. The “Oops! Report” complaints forms can be used by students to register any type of complaint. If they put their name on the report, we promise them feedback on the action being taken on their complaint within a week. A single form, called the “Oops!/Eureka! Report” form, is used both for complaints and improvement suggestions (“Eureka!”). A copy of the report form is given in the “Study Guide” coursebook that students receive and loose copies are widely available at many locations. An earlier suggestion box system is still running parallel with “Oops!/Eureka”.

All lecturers now use fairly regular (e.g. every lecture or every week) “two-minute surveys” of about 10 students (c.f. Mosteller 1988). Those who have used the system in the past found it made only very small demands on their time and was good for detecting problems early, thus permitting a quick response. Student suggestions led to important improvements in our lecture presentation. The cumulative effect of daily feedback also makes it very difficult for a lecturer to ignore persistent or obviously valid student concerns. Small numbers (e.g. 10) are used so that processing the results takes minimal time and also to minimise the frequency with which students get asked to fill out a survey in order to try to avoid consumer resistance. Such resistance soon develops anyway. The best ways to counter it seem to be to keep the surveys very brief (e.g. only 2 or 3 questions) and to give feedback in class about what you are learning from the surveys—the students need to be shown that these irksome surveys actually benefit them. My surveys tend to ask for what was best and worst (most difficult to understand or boring) about the lecture, and either for suggested improvements to the course or for their biggest complaint about the course.

Methods such as complaints forms and two-minute surveys to small samples are good for the timely identification of potential issues of concern, but are unreliable as a means of determining how widely felt a critical response is, or how popular the implementation of a suggestion would be. We have found that many of the criticisms received are obviously valid; things we know we should have thought of ourselves but either had not or had not yet been acted upon. Seeing them in print tends to spur us into action. For example, some of my overheads lately had some out of date page references on them. I was aware of this, but in my rush, I had not corrected them. The first complaint was enough to make me more careful thereafter. However, when we do feel the need to take a sounding

on a particular issue, a quick show of hands in class demands little effort from staff or students and seems to work adequately. We want to keep paper work to an absolute minimum.

One of the lessons of control charting is the value of "on-line" information. Asking periodically during a lecture for a show of hands as to whether you are going too fast or too slow is far superior to a survey after the event. Similarly, after each major argument in mathematical statistics classes I ask for a show of hands of those who thought they understood the argument (in contrast to the usual practice of asking those who did not understand to display this publicly for obvious psychological reasons). If the "hit rate" is too low, we can then identify the parts of the argument that are causing problems and try to address them immediately.

System-wide complaints we have received over the years have mainly centered on large-class problems connected with assignments, their marking and handling. Early problems with inconsistency or unfairness of marking (40 different markers) have essentially stopped with tighter marking schedules, better instruction of markers and the psychological effects of returning total marks out of 10 instead of 40. Even though, internally, assignments are still marked out of 40 and then rescaled, absolute differences between the marks of friends seem more important than relative differences! We have changed our systems for taking in assignments and redistributing them. Last year there were still problems with the piles getting mixed up and people experiencing difficulty in finding their work which have partly been solved with assignment cover sheets. One student complained that a problem in the book reinforced a racial stereotype. The problem was duly changed. There were several complaints that a tutor was using sexist putdowns of the mathematical abilities of female students. The person in question turned out not to be part of our course-team, but the experience has sensitised us to another area of training for our tutors. Banter between assistance-room tutors has been misinterpreted on one or two occasions and we have made them aware of this. Complaints on my two minute survey have changed gradually. Complaints about readability and layout of overheads and about nervous habits have largely disappeared. Nowadays, I get complaints if I rush topics at the end of a lecture (which I deserve) or if I do not seem to be putting out as many handouts as I had been. Some students complain about topics being boring, or covered too fast or too slow, or not getting to take enough notes but there are no clear patterns and the complaints are often balanced by even more respondents taking a completely opposite view.

In 1992, we began a drive to try to attract improvement suggestions from students. A suggestion box was established and we announced that monetary prizes (\$80) given each term for the best improvement suggestions received, however they came to us. The intent was to signal to students that it is important for them to contribute to improving the services they receive and that we will be receptive to suggestions. In fact, more and better suggestions came from anonymous two-minute surveys than as consciously contributed suggestions. The flow of suggestions increased after the winner of the first prize was announced but the quality of suggestion has often been embarrassingly low. Perhaps this is not unusual when soliciting suggestions from customers. We are persevering with the prizes for another year in the hope that it will be more productive when combined with better efforts to persuade students that we are all in this together. It has recently been suggested to us that rather than awarding a few large prizes, a better TQM practice is to offer many smaller awards to encourage volume. This year we will try rewarding all suggestions with chocolate bars. One of our members suggested that rather than just making general requests for suggestions, we might do better by also asking at staggered times for suggestions in particular areas.

Student suggestions have resulted in, for example, changes to the layout of the *t*-tables, better systems for returning assignments, the production of additional handouts, better use of overhead projector slides (sliding new slides up from the bottom in rooms with a single overhead projector so that slow people can get the last of the old slide), tutorials aimed at poorly prepared or struggling students (this is in addition to the 40 hour individual help service), and an accelerated section for the very well prepared students that uses fewer lecture hours.



There are important psychological aspects to the soliciting of complaints, improvement suggestions, etc. A formal mechanism is useful even where its main effect is simply to create a more conducive atmosphere for informal communication and improve students' attitudes to the teaching team. It has beneficial effects upon teachers too. We put more effort into anticipating problems and making improvements so that we will not get complaints!

In 1992, we were studied and helped by a project group from a third year TQM course that included former students of the first year statistics courses (see Acknowledgement). A standard TQM and marketing tool that we have not yet tried is to set up some "customer-focus groups" involving students. The idea of such groups in our context would be to cultivate free ranging discussion in relatively small groups around particular topics to stimulate ideas and uncover areas of potential concern or possible improvements. It is hoped that a project team will attempt this in the coming year. Nor have we tried "improvement teams" involving current students (see Hau 1991, Hansen 1993).

### *5.3 Involving Customers as Suppliers*

After the students themselves, a very important and readily accessible customer group is made up of the Departments whose students are required to take our Stage 1 courses. We have talked to client departments about their needs in terms of technical content and changed our content to better cater to those needs. We have greatly increased the emphasis on practical data analysis and statistical thinking, expanded the range of techniques covered, and have simplified some theoretical developments or postponed them to the following year to keep the student workload realistic.

When first asked, professors from client departments sometimes say they do not actually need our statistics courses to contain applications from their own subject area. Some go further and say they would actually prefer their students to be broadened. However, there is another side of it. When students are forced to take a course as a required part of a course of study, many will understandably become very negative, both about the course and being forced to take it, if they cannot see the direct relevance of the course to their own real interests. Not only does this create bad feeling but it also impedes learning. It is clearly to the advantage of the client department that this does not occur. In statistics anyway, members of the client departments should be much better placed to find the exciting, relevant applications than the members of our teaching team. We have approached several Departments asking for their assistance in providing statistical applications which are relevant for their students. However, in our experience such requests end up permanently at the bottom of in-trays without personal visits and active following up of the request.

Just as most statisticians believe that having a statistician on a team involved in quantitative research leads to better quality research, my belief is that a course in statistics for a particular subject area should benefit from having a subject-matter specialist join the statisticians on the teaching team. In both cases, the purpose can only be realised if the team really works as an integrated team. We have extended open invitations to some client Departments for their staff to lecture sections of our course on a semi-regular rotating basis as a means of assuring that the course materials cater adequately for their area of application. Ideally, we want experienced academics with a broad knowledge of both their own subject area and the place of statistics within that subject area. We have had no takers at this level yet. Since all of our most important client departments are stretched in terms of staffing, it is probably unrealistic to expect them to release their best lecturers for teaching statistics courses even though they would be reimbursed for doing so. However, as a step in the right direction a recent PhD in experimental psychology who is a very good teacher (the Psychology Department is a major "customer") began teaching one of our sections last year. He has achieved a good deal of what we had hoped for. A similar idea, which we have not used at this level because of the very large number of sections in the course, is to involve guest lecturers from a variety of backgrounds.

## 6 Improvement Systems

When we decided to make quality improvement a focus, after some useful initial gains, we began to feel that we were making little progress. This is a common experience. Thereafter it became necessary to analyse what we do more deeply in order to make further progress.

### 6.1 Time Cycles

In teaching university courses, we operate in regular time cycles. At our university, the basic cycle is the academic year. Elsewhere, it may be a quarter, a term, or a semester, but we will talk in terms of yearly cycles. It is necessary to distinguish between improvement within a year and year-to-year improvement. Although there is some potential for improving the way a course runs over the course of a year, the potential for substantial improvement in the long term comes from using the lessons learned over the current year to make improvements for the future. Much of our approach stems from considering the problems of building year-to-year continuous improvement into a system which has a significant amount of staff turnover (e.g. senior faculty are rotated through these courses with an approximately 3 year term) and where a majority of lecturers are often PhD students, temporary faculty, visitors, or inexperienced new appointments. In some years we have had as few as two senior faculty on the lecturing team at any one time. Continual turnover is a feature of the teaching of many university courses. It has positive and negative features. On the positive side of the ledger comes new ideas and enthusiasm. On the negative side is “loss of memory”.

It is not enough to have one course taught brilliantly to one group of students in one year by one outstanding teacher. We need ways of permanently sealing improvements into the system as a whole so that there is a tendency for the course to get better each time it is taught, regardless of who teaches it. To accomplish this we have to identify elements of the delivery process which can be improved continuously. These elements include: (i) *Teaching materials*; (ii) *Procedures and job guidelines*; and (iii) *Staff development programmes*. Teaching materials, (i) lend themselves naturally to being saved and re-used from year to year (discussion follows in Section 6.3). Items (ii) and (iii) are areas that require practices and ways of thinking that are new to us and, we think, to most academics. Guidelines and Procedures are discussed in Section 6.4. Consideration of staff development, a very important part of continuous improvement, is postponed until Section 7.

### 6.2 Quality Meetings

Our system is driven by weekly Team meetings which are focused on quality improvement. Indeed, it was Chris Triggs’ initiation of these meetings several years ago that began our movement towards TQM. Two sets of Team meetings have been going on. The first consists of a group made up of the lecturers, the Course Administrator and other invited participants (e.g. experienced tutors, and sometimes the head of the academic staff development office HERO, or members of other Departments). Although this meeting is also a medium for communication and makes policy decisions, most of the time is given over to quality improvement issues. Standard items on the agenda keep attention focused on feedback from students and improving teaching (more about this later). More recently, a second weekly meeting (of the Assistance Room tutors) was instituted. Besides the intended effects of improving communication and keeping the focus on quality improvement, the meetings have increased staff motivation and fostered team spirit.

### 6.3 Teaching Materials

Over time, the curriculum of the course must be adapted and modified so that it better serves its audience, the aspirations of the teaching staff, and makes better use of new technology. The

curriculum is defined in the textbook and the Coursebook. The teaching materials we use follow. The point is not so much the materials themselves but identifying opportunities for improving materials.

*Textbook:* We have our own customised text which, in the past, has been printed yearly and thus we have been able to incorporate new and rewritten material every year. However, the book will be formally published this year, thus slowing the process of updating and improvement. We plan on putting out new editions every 3 or 4 years and I envisage that the current authors will be joined or even replaced by new principals on the course team who have a particular interest in changing the text to (i) make its mix of topics more up to date and useful to its audience, and (ii), to take account of the experience of the teaching team with approaching and presenting ideas over the intervening years.

*Coursebook:* We call this book the “Study Guide”. It is updated, and can thus be improved, annually. It will become an ideal place to test material which is new or is to replace current material in the textbook. At present this book contains: a description of the aims of the course; a description of the quality philosophy of the course team, its relationship to the services provided by the teaching team, and its relationship to grades and the assessment process; administrative information; Study Notes giving pointers on how to study and how to use the services provided by the teaching team; chapter-by-chapter Study Notes highlighting the most important ideas in the chapter and giving assessment details (assignments, tests and exams) about that chapter, i.e. what the teaching team are looking for; answers to the problems in the textbook; of examinations and term tests; and a test to diagnose important weaknesses in mathematical background coming into the course and advice about using backup services to remedy deficiencies.

*Introduction to the computer system/computer manual:* Used only in those sections that use computers, it is also updated and printed yearly. It has just been rewritten because of a change of computer package.

*Overhead projector slides, and lecture enrichment materials:* This is an evolving stock. A standard agenda item of the weekly meeting of the teaching team calls for discussion of new ideas for enrichment materials for the lectures on the current/index Chapter and topical items (e.g. datasets, stories, experiments).

*Handouts:* Assignments and their answers are given as handouts. Handouts also provide a good way of disseminating ideas people get at the last minute. Where it makes sense to do so they will be incorporated into the text or Study Guide for the following year to reduce the amount of paper shuffling. This year, several of our team have been using so-called *interactive* (or gapped) *handouts* regularly in their lectures—handouts in which the key details are left out and have to be filled in by students, and which also contain activities and points for group discussion. The motivation for interactive handouts is to force students to keep alert and thinking actively in class while minimising the time spent on unproductive copying.

*A series of video tapes:* We use purchased programmes, principally the “Against All Odds” series (see Moore 1993). Obtaining new programmes is part of improvement in this area, but more importantly, improvement entails improving the way we use the existing programmes in lectures. For example, we have been mapping the “Against All Odds” series, focusing on stories rather than technical exposition, to make it easier for individual lecturers to choose short excerpts to complement their lectures. Reviews include opinions of the usefulness of stories and statistical ideas that might be drawn out of a story.

#### 6.4 Guidelines and Procedures

Another canon of quality management is that everyone should know what his or her job is and how that job should be done. (Additionally, people need feedback on how well they are doing.) We now have documentation covering most aspects of our operation. These are evolving documents that aim to capture the experience of the team over time and thus act as the memory of the system—a means by which the system can continue to learn even though the memories of individuals are lost due to people leaving the team or simply the natural limitations of human memory.

For tasks or procedures that lend themselves to step-by-step descriptions, *Procedures* have been written. Parts of the operation that are too complicated for the procedural form of documentation are covered by documents called *Guidelines*. The Guidelines cover the deepest most important parts of the operation, for example, lecturing (in general); lecturing (chapter-by-chapter); tutoring; the setting of assignments; and the setting of tests and examinations. Guidelines are intended to clarify what the goals and principles are that we should be basing our activity upon. They also contain pieces of useful advice and accounts of past experience. All sets of Guidelines are also subject to regular review.

Let us take the setting of assignments as a particular example. The Guidelines for this activity describe: the educational goals of assignments and philosophical stands that we make (e.g. only using real data and keeping a good deal of context with the data); writing styles; types of questions; catering to different client markets; the amount of time they should take to answer; and ideas for ensuring that students reach the learning/thinking goals of the assignment efficiently with a minimum of mechanical drudgery. In addition to these Guidelines, there are procedures which describe who does what and when (e.g. our quality assurance procedures, printing and distribution) in a step-by-step manner. A similar set of documents describes the marking/mark recording/assignment return process. (Recall here that we are dealing with 2,500 students.)

In the main, documents relating to a task are provided at the time the task is to be done rather than sitting about as a large unread manual.

*Procedures and continuous improvement:* We use documented Procedures for two closely inter-related reasons: (i) reducing variability in service, and (ii) improving performance over time. Too much variability in the system makes the diagnosis of problem areas extremely difficult. Having procedures with steps spelled out enables us to improve performance over time by locating and changing those steps which are causing problems. Flow charting of the steps involved has revealed places where procedures are unnecessarily complicated or confusing. The primary function of all of our procedures is to act as a means of improving service performance. For this to happen, the procedures must be followed, but followed critically with a view to improving the procedure itself for the next time it is used.

Many procedures have steps build into them whose purpose is quality assurance. For example, our examination paper typically has about 25 pages of multiple choice questions containing considerable fine detail that has to be correct. Our students sit their exams in more than 30 different rooms. We cannot afford to make mistakes. Tests and examinations are initially set by part of a team, then checked by others, who then combine with the setters to produce the final version. One or two team members are kept out of all earlier parts of the system so that when the rest of us are satisfied that we have finally got it absolutely perfect, they come fresh to a detailed checking of the final version. We test assignment questions on assistance room tutors before they go out to students.

Procedure failures or inadequacies may be obvious or may come to our notice through student complaints. Failures should lead to putting more resources into quality assurance steps and/or basic changes in the procedure.

6.5 Involving feedback from the student assessment process

An important set of feedback and improvement cycles concern examinations, tests and assignments, and student performance on these. Feedback loops are depicted in Fig. 1.

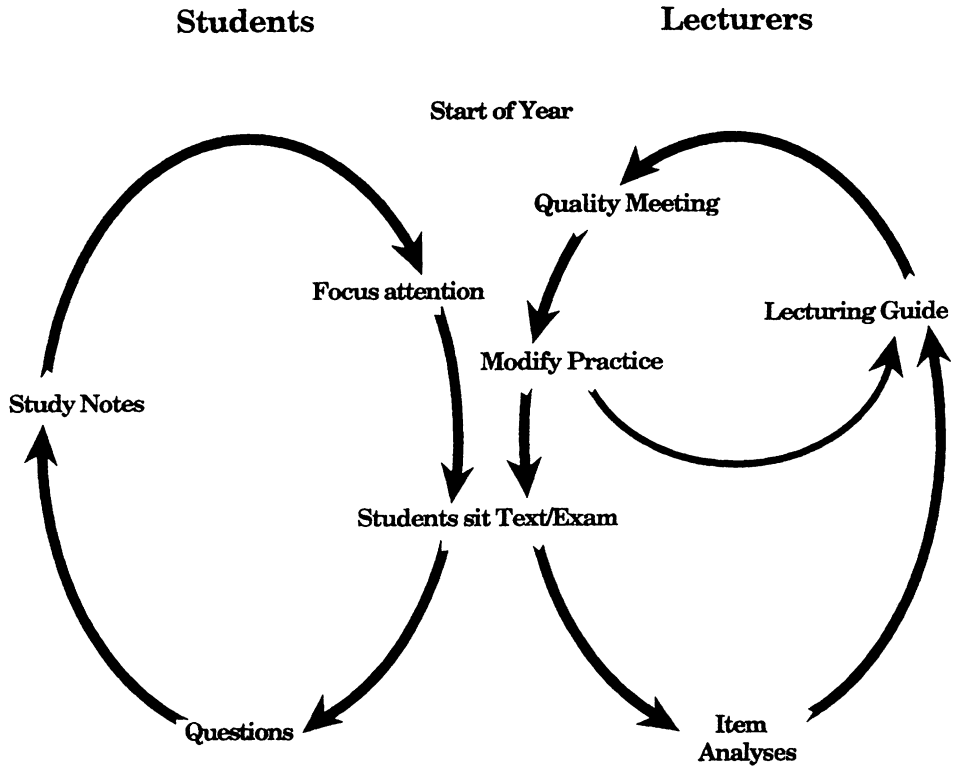


Figure 1. Test/Exam Feedback Loops

On the student side, past examination and test questions are used to focus student attention on the ideas that we most want them to learn. Past examinations and tests affect student learning patterns whether you want them to or not. We consciously take advantage of this reality. One mechanism for doing this, the chapter-by-chapter study notes in the Study Guide, were described earlier. Each year we get a new set of questions, questions which we try to ensure are even better targeted than those that have been asked in the past. This loop therefore is aimed at improving student learning.

On the other side of the diagram we have a loop whose purpose is the improvement of lecturing practice. The feedback comes from item analyses of test results and reports from assignment-markers. We have had a problem in the past with these sitting unread in drawers. Now summaries of this information, concentrating on problem areas, go into the guidelines for lecturing on the particular chapter. Summaries about problem areas abstracted from reports from assignment markers also go into the guidelines. These problem areas are discussed in our regular meetings at the relevant times of the year (e.g. before and during the teaching of a particular chapter). Modifications of our teaching practice are recorded in the Guidelines for the following year. These discussions also produce changes in the teaching materials, particularly the textbook and Study Guide.

## 7 Human Resources

### 7.1 General Considerations

As part of implementing TQM, we have had to give attention to aspects of “management” that we have really never considered before. We have a formal hierarchical line of authority in case of conflict, although, both in practice and as a matter of policy, almost all major decisions taken by consensus.

Formal *job descriptions* have been developed (along ISO9000 lines) that enable incoming staff members to get a much better picture of what will be expected of them. Job descriptions set quality goals and include a commitment to quality improvement. Job descriptions can change over time as the team redefines aspects of its role. A second type of document is the *job specification*. These documents list the qualities and skills required in a person taking on the particular job. Ideally, where appointees do not fulfil the specification criteria, the deficiencies would be made up by training.

### 7.2 Motivation

We want staff to have the “right” attitudes to their jobs, which in our situation means: (i) being motivated by an empathy for students and a desire to do one’s best for them, (ii) a commitment to continuous improvement, and (iii) a willingness to work as part of a team.

In our experience, these elements have largely come naturally to the lecturing team through professional pride and the weekly team meetings. The elements above have been reinforced by the standard form of Agenda for the Course Team Quality Meeting, and are a subtext of every part of our documentation. In addition the initial (kickoff) meetings of the three groups: Lecturers, Tutors, and Markers, have the objective of sending staff into the year with the attitudes above and with some enthusiasm and excitement about the job that lies ahead.

### 7.3 Training and Development

The third big area in which we can seek improvement, after teaching materials and system documentation, is in the skills of the personnel involved in the team. Improvement in team skills can be achieved through hiring or training. We are very seldom in the position to pick and choose with regard to filling our lecturing and tutoring slots. Often we are scrambling to find enough qualified people to fill all the slots. On-going staff training and support are the only real ways forward.

Academics tend to be well educated for teaching in terms of subject-matter content and most of us are reasonably good at educating ourselves about the theoretical aspects of our own subject matter. But when it comes to the processes involved in teaching, we are not very good at all—as almost any highschool-teacher graduate will only too happily inform us. Very few of us ever received even initial teacher training. We have received no training at all about teamwork or continuous improvement. Some team members also have very little applied statistical experience.

Staff training and development is far too important an area to be left to an outside organisation such as our academic-staff (faculty) development office HERO. Responsibility for staff development should be taken by the team leadership itself using the staff-development office as a resource. We have been very fortunate in having had the advice and support of John Jones, Director of our faculty development office from the outset.

Many of the Quality systems we have already described are ways of fostering “staff development”. The guidelines for lecturing, tutoring, setting assignments, tests and examinations, marking, etc. are intended to function as accumulating storehouses of knowledge which the current team draws upon. Standard Agenda items of the weekly Course Team Quality Meeting prompt discussion about the teaching that is going on at the moment and that which is imminent. These discussions help us to

learn from one another's ideas and experiences. We accumulate and share overhead transparency slides so that everyone's classes can get the benefit of any individual teacher's ideas.

In addition, we have introduced a programme aimed at improving lecture presentation skills. When first introduced, this programme consisted of a first visit early in the year to every lecturer from either John Jones of HERO or Maxine Pfannkuch (who at that stage trained highschool teachers and also taught on our team). These people observed a lecture and gave advice. The system included at least one follow-up visit, and as many more as required (by mutual consent). The system grew from there. It now includes peer visits (each of us visiting others), both to learn from one another and to give advice. There was no resistance to the idea of professors visiting one another's classes as all of us wanted to improve our skills. Naturally, most people are nervous when "on show" in this way, especially on the first few occasions. There has been a consensus that we tend to learn more from watching others teaching the material that we are also teaching than we do by being watched. In the coming year, the videotaping of lectures on these visits will become a regular feature. We also hope that as we become experienced observers, we might identify and target particular areas where we need training.

A realisation developed early that we could only go so far with the visits, that they tended to address relatively minor, even cosmetic aspects which were often soon corrected. Further gains would require in depth analysis. This realisation spawned the guidelines for lecturing (and guidelines for observing lectures), the systems of Section 6.5, and teaching workshops. We have held workshops on models for lecturing about statistics, general lecturing skills, asking and eliciting questions, and the use of group and active learning activities in large lectures. I believe that opportunities for substantial improvement lie at the interface between presentation and content.

More attention will soon have to be given to staff development for tutors and markers. New tutors attend a HERO workshop. However, the main "training" for tutors comes in the form of the Guidelines and their weekly meetings. The markers only have guidelines, marking schemes and encouragement to telephone whenever they need any clarification or advice. There have simply been too many of them to find a clear hour to involve them in meetings. Running several meetings is an option but would be rather expensive.

## **8 Cultural Impediments to TQM**

### *Reactions to business language*

The industrial origins of TQM and the language of business is a very real barrier to its widespread acceptance within academia. Both academics and students (outside of business schools) tend to recoil against such language. For example, press reports in 1992 reported an Auckland University Council ruling that students were not, and were not to be referred to as, customers. There are various reasons for the antipathy. Part of it stems from the ideological struggles between governments and universities in many parts of the world over business models that governments try to impose on universities. There is the suspicion that it is all a means of reducing spending and attacking academic freedom, and will lead to depressed standards. Another cause of antipathy is the idea, widely held within universities, that ours is a "higher calling" than business and that commercial models must therefore be woefully inadequate. It may be politically unwise to call students customers. Yet elements of the customer model—seeing students as people to whom we owe our jobs, whose needs we should strive to meet and exceed, and to whom we owe superb service, should be a valuable counter to some historically entrenched arrogance.

Academic antipathy to the language of TQM is a serious problem. Anything inessential which can prevent messages of substance from being heard is better avoided where possible. We have only recently realised that the "quality" section of our own Study Guide contains too much "quality" jargon and probably this paper does too. Recently when speaking about these topics to academic

audiences, I have been working on ways of introducing TQM without any reference to business or business language until the underlying logic of the approach has been established. This avoids the negative and simplistic reactions to TQM concepts such as “customer” which can close minds. In addition to a new language for a new context, we should also try to avoid the revival-meeting sales hype that so often accompanies TQM and may work in business but which immediately puts most academics on their guard.

### *Lack of institutional commitment*

Lack of institution-wide commitment to TQM also poses serious problems. We said that “top management” in our system as it now exists is the Stage 1 Statistics Co-ordinator. However, the co-ordinator’s role is transferred over time to people inside our Department but outside the present team. There is no mechanism by which we can guarantee that future coordinators will share our quality improvement ideals. All we can do is to try to persuade. Maintaining the TQM approach will limit the ability of a new co-ordinator to come in and make wholesale changes. Some fear that restrictions imposed by “management” will limit individual creativity. However, what we get from making wholesale changes without first learning from the past is not improvement over time, but rather a recipe for increased variability. The TQM approach aims to capture (and indeed stimulate) creativity, but to do it in a controlled way which prevents heightened variability from obscuring whether average quality is improving or getting worse. It seems to me that in the context of our system, the best time for large changes is the second and subsequent years of the co-ordinators tenure.

### *Students*

Since the students are the customers of our teaching process and we are suppliers for their learning process, it should be to everyone’s advantage if a spirit of “all one team” can be built involving teaching staff and students, where the students also take some responsibility for improving the quality of the course and its delivery. To make students feel that they are part of the team entails a huge cultural change. Because of the age gulf, and the fact that the us-versus-them mind set (in which the students are passive recipients of teaching and the teaching staff have the power to damage their lives by awarding bad grades) is so well established, building an “all one team” atmosphere may well be impossible in the short term. Our prizes for improvement suggestions were a step towards involving students in this way, albeit of limited success. Our system now tries to attack the us-them mentality by defining the assessment goals in great detail as has been previously described. The idea is that if the assessment hurdles are perceived as pre-set in concrete, the teachers lose their personal draconian potential and can be seen as coaches helping the students to get over those pre-determined hurdles. It should be much easier to form an all-one-team relationship with a coach than it is with an examiner. Having all this set out in the Study Guide coursebook is not enough. The attitudes of lecturers and tutors, as transmitted to the students, also have to reinforce the message.

### *Teaching staff*

With the people involved in our team over the last few years, building an “all-one-team” atmosphere has not been a large problem. Our problems are with following procedures and meeting deadlines. We are hopeless at it. In a commercial environment problems such as this can be approached by adjusting the reward system, but we have no control over how people are rewarded. The TQM approach is quite foreign in an academic setting. In our hearts, most of us do not believe in any need to be systematic. We bridle at the merest suggestion of being managed. Following procedures



closely and meeting deadlines is an anathema to us—things that lesser mortals may be compelled to put up with, but which are the antithesis of academic life. It all smacks of mindless bureaucracy and conspiracies to keep us away from the things that are really important like research. At least these are unspoken prejudices that I have held.

Following well documented procedures is central to the TQM approach to quality and quality improvement. Meeting deadlines is a necessary prerequisite for reaching many of our quality goals. Moreover, a failure to do so can make other people's lives much more difficult. To give TQM a fighting chance, we have to be able to overcome the deep seated antipathy to deadlines and procedures. To change systems in order to prevent future failures, we have to expose our current failures to scrutiny. To know whether we are making progress we need data on frequency and type of failure. This means that current failures have to be brought to notice. But the "reporting" of the failures of others to "officialdom" is also against academic tradition, particularly if the failure is "merely" a failure to follow a procedure or meet a deadline. Our tradition is to grumble to one another in private. We have a real problem here although we are getting better as we see some of the problems that last minute rushes can cause.

We do not want to suggest that improvement is almost entirely "failure driven". Failures do pinpoint places where improvements are necessary, but ideas for improvements come from a myriad of sources: suggestions from customers, staff-development workshops, conference papers, seminars, reading and conversations with others about how they do things. For example, Snee (1993) and papers at the 1994 ASA winter meeting are already affecting our teaching practice. Moore (1993) will add several new ideas to our use of video in lectures.

In a university environment, there is a fine line to be walked between academic freedom and systematic quality improvement. TQM stresses that variability is the enemy of systematic quality improvement and that reduction in variation is often synonymous with improved quality. Our drive to systematise has reduced variability, not only in administration but also in the delivery of teaching. We have reduced variability in course content in the following senses. Changes from year to year are evolutionary. The examinable content of the course is defined independently of the different sets of lecture notes. It is the contents of the textbook (apart from explicitly excluded sections) whether or not everything has been covered in class. We all stick to a defined time schedule for covering chapters, the schedule being updated from year to year. All students in the same course sit the same tests and examinations and work on the same assignments. Tests and examinations for different courses have a substantial common core—we only include necessary differentiation between courses. The benefits include predictability for lecturers of subsequent courses and the freeing up of time previously wasted on duplication of effort so that it can be spent on producing better, more interesting and current materials. There are benefits in terms of fairness to students, both actual and perceived. Variability in quality and standards between sections is unfair to students who are slotted into particular sections not by choice but by the vagaries of the timetable. We do not have sections in which getting good grades is harder than in others. Students are not penalised in terms of grades by taking a more challenging version of the course. Is there any freedom in this? Lecturers have freedom to lecture as they wish within the timeframe and freely contribute to change provided they can get the agreement of others. (Our sharing of ideas about teaching also reduces variability.)

## **9 Public Exposure**

Our system makes a public commitment to quality in the student's Study Guide which includes a summary of our Quality Policy. It makes many promises about the services we will deliver and the way we will deliver them right down to what the students need to do to achieve the best grades (if they meet the published performance standard they get the grade). A public commitment to quality involves real risks. As all teachers know, there are many factors making up what is popularly

considered a great course. The teacher has little control over a number of these factors. It is a very rare statistics course that achieves ratings anything like those which are almost commonplace in subjects such as psychology or english literature. Why is it that this course which has promised “quality” has turned out to be less interesting, worse taught, and has had more administrative failures than some other course that made no such promises? It can all look quite ridiculous. We try to make the point that our commitment is part of a systematic attempt to improve the quality of our offerings. We say that we are not the best, but that our long term goal is *to become the best*. Any yet that message may well be lost amongst all the other things the students hear or have to read.

A low risk approach would be to toil away at quality improvement in the dark. However, in an academic environment where the system rewards research in preference to teaching and where there is a high turnover of staff with newcomers having little or no initial commitment to systematic quality improvement, making up-front public commitments is probably necessary for the survival of the programme. To survive its parents and deliver long term quality improvement, the system needs to be given sufficient momentum for it to be easier to maintain than it is to stop. We want to make quality an integral part of operations and believe that public promises are a way of ensuring that this happens. If we make promises to students in an environment that has complaints mechanisms which students find unthreatening, we simply have to deliver on those promises.

By making public promises we automatically raise expectations. This leads us into conflict with the most basic principle of service quality. Service quality is often defined (from the customer’s point of view) as the difference between the quality of service that is expected and the quality of service that is received. If expectations are raised then it becomes so much more difficult to give customers the feeling that they have experienced excellent service. To use promises of quality to keep the system alive, we involve ourselves in a very difficult balancing act. We have to promise sufficient to compel ourselves to make further improvements and to prevent ourselves from slipping backwards, but we have to be able to realistically deliver more than we promise.

Our promises, and the way they have been written, also have another goal, namely to involve the students as members of the team. We need them to be actively involved in reporting problems and pointing out areas which need to be improved. To do this they have to know what is going on.

## 10 Discussion

I hope that I have demonstrated that TQM can in fact suggest useful models for the delivery of university courses, that it can help us apply our efforts more intelligently where it is embraced and sensibly interpreted by university teachers themselves for educational ends rather than being imposed from the outside as an accounting device. This paper has discussed a great many ways in which the Stage 1 Statistics team at the University of Auckland has been attempting to turn “continuous improvement” into reality. A natural reaction is that all of this looks like a great deal of work. But is it worth it?

What have we accomplished since first beginning to experiment with TQM? Administrative systems that previously experienced problems are now running smoothly. We have generated a great deal of staff enthusiasm, of team spirit, the generation and sharing of ideas about teaching at a level that was never there before, a new awareness of teaching issues that we had never even thought about before, a willingness to be involved and take responsibility for new initiatives, a deepening of friendships, some general improvements in ratings and unsolicited expressions of appreciation. The “teaching professionals” watching the team have commented on a marked improvement in our performance as lecturers. The contents of our course are better aligned with the needs of our customers. Several new Departments are now requiring our courses. Student numbers have more than doubled as has retention to second year which is now approaching 50%—this from what we have regarded as largely a service operation. (Admittedly, there are other factors in the growth apart

from our efforts.) Reduced variation in the content and teaching means that teachers of follow on courses can have better assurance about what they are getting. We have taken a much deeper interest in how students learn and in the great variety of natural learning styles that students have (e.g. Snee 1993). We are responding by providing a broader range of experiences to cater to this variability in students.

Now the work. Formulating and documenting our systems has taken a great deal of work for one or two of us. The ideas in this paper have taken several years to develop. With some TQM elements, we ticked boxes for quite a while before feeling that we had developed any real insight. And yet for most members of our team, the teaching effort required has been no more onerous than any other course. In many ways it has been easier. By working as part of a team that shares the workload, and shares and archives teaching materials to reduce time spent on reinventing wheels, we make the time needed to attend meetings and undertake improvement projects. The temptations of putting in too much more work (at the expense of other responsibilities) have come from an increasing awareness about teaching and learning and from no longer being satisfied with our past performance as teachers.

There are many hard questions that we have addressed inadequately. Primary amongst these are issues of measurement. Are the goals being met? Are the students learning more? Certainly on the test items that we are now deem to be most important they are, but are we just training people to jump through multiple-choice hoops drawing on short term recall and skills which quickly fade from memory? Applying these “how-do-you-know” questions to teaching effectiveness leads immediately into deep areas of educational research. So far, we have only taken advantage of what we know about the results of existing research and also applied common sense—we have vastly decreased emphasis on test items drawing on rote memory in favour of items that seek to draw on understanding and interpretation. We have tried to do the big obvious things first. Another measurement issue is the following. In TQM “process-oriented” measurements (e.g. class attendance) are preferred to outcome-oriented measurements (e.g. test results) in the quest for improvement (Robert Wehrle, comment on my talk at 1994 Winter Conference of the ASA). Can we as teachers and statisticians come up with some really useful measures of this type?

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## Résumé

L'amélioration soutenue de la qualité (ASQ), mieux connue dans le milieu industriel sous le nom de gestion de la qualité totale (GQT), est une philosophie de gestion qui a transformé de nombreuses entreprises et sociétés un peu partout dans le monde, et qui commence à faire des percées importantes dans les universités, surtout au plan administratif. L'auteur vise à déterminer si le cadre conceptuel de l'ASQ/GQT peut permettre de résoudre les problèmes qui se posent dans le contexte de l'enseignement universitaire. Il adapte les principes fondamentaux de l'ASQ/GQT en fonction de l'enseignement universitaire et donne un aperçu de la façon dont ces idées ont été mises en oeuvre dans un cours général d'introduction à la statistique comportant plusieurs sections. Une attention particulière a été portée à la difficulté d'améliorer année après année un cours pouvant survivre aux changements de personnel et de la perfectionner en stimulant la créativité du groupe, puis en enregistrant les résultats à des fins de référence ultérieure.

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