Video conferencing: a solution to the multi-campus large classes problem?

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Abstract

Whether due to amalgamation or export education strategies, many universities now face a problem of delivering subjects, programs and courses across more than one campus. There are significant costs to students, staff and faculty of this teaching and administrative duplication. Information and communication technologies offer potential to achieve economies of scale but the effects on other things like student learning are not so clear. The objective of this paper is to report the outcomes of a video conferencing trial in an undergraduate mass lecture context. The effects on students and staff, and support issues are highlighted through a formative and summative evaluation. Surveys, focus groups, interviews, video recordings, exam results and reflective diaries provided data for the evaluations. The results will be useful both for decision-makers considering a video conferencing solution to duplication, as well as for staff potentially involved in using the video conferencing in a mass lecture context.

Introduction

The modern university faces many of the same pressures as a business. It must do more and better with less. Video conferencing is one potential solution academic managers are considering for reducing duplication. Laurillard’s (1993) observation that research on the effectiveness of information technology generally is severely lacking, applies particularly to video conferencing (Mitchell et al., 1993, 73). Frand’s et al. (1994, 20) survey of learning technologies in US business education reports that 56% of users consider the technology ineffective for enhancing classroom instruction. However, they conclude that it is too early to tell its real effectiveness. While research on video conferenced meetings, training (eg, Lundin et al., 1992) and small group teaching (eg, Martin et al., 1995; Goddard, 1995; Treagust et al., 1993) exist, the research relating to large groups in a tertiary context is both limited and unfavourable (eg, Goddard, 1995, 211).

The objective of this paper is to report the outcomes of a video conferencing trial involving mass lectures across a multi-campus university. Knowledge of these outcomes
should aid decision-makers considering a video conferencing solution to duplication. The message for potential users of video conferencing in a large group context is that the benefits may not exceed the costs.

The structure of this paper is as follows. Section 2 briefly elaborates the context leading up to the trial. The following section describes the mass lecture video conferencing trial. Section 4 discusses the results of the formative and summative evaluations. Effects on students, staff and academic managers are considered. Section 5 contains concluding remarks and suggests future directions for video conferenced mass lectures.

**Context**

Problems of duplication in the tertiary teaching context arose in the late 1980s in Australia from government amalgamation policies. For others, duplication has become evident as universities seek to establish new campuses. In response to government funding cuts, many universities have sought to expand into export education, increasing their revenue base with offshore campuses. The multi-campus scenario applies to the University of Technology Sydney (UTS), a university supporting in excess of 23,000 students. The trial itself took place in a business faculty struggling under considerable financial constraints. Reasons for the latter include the relatively lower funding per business student (as compared to a science or medical student) and the relatively higher cost of teaching part-time on-campus students (as compared to full time students) shown by Doyle (1993).

Other concerns also pointed to a video conferencing solution. A faculty requirement that subjects taught and assessed on both campuses be identical, resulted in travel or equity concerns. There are costs in time and money if the same lecturer travels between campuses. Video conferencing should make staff more productive because they could travel less and not be separated from their resources. If there is insufficient interest to justify duplicate subject offerings, students then must bear these travel costs. The final scenario is where different lecturers are used on the different campuses. While travel costs do not exist in such a scenario, students express considerable concerns about the equity of subject delivery. The latter is no surprise given the well-documented power of assessment to motivate student learning (eg, Ramsden, 1993). Concern relates to the advantage provided to the students located at the campus of the coordinating lecturer who sets the assessments.

A video conferencing trial between the two Sydney metropolitan campuses was initiated in the second half of 1995. The object of the trial was the Business Finance mass lectures, a compulsory subject of the undergraduate business degree. No attempts were made to use video conferencing for tutorials or student consultations. The purpose of the trial was to evaluate the extent to which video conferencing mass lectures would:

- be cost-effective by reducing duplication between the two metropolitan, domestic campuses. Improvements would then be expected to flow to servicing offshore campuses and increasing the capacity to provide export education.
- improve perceived equity concerns faced by students on different campuses enrolled in the same subject when different lecturers are used.
- improve the quality of learning for students. This was expected to be achieved for a number of reasons. As staff effectively halve their teaching load (in hours), they would have more time to produce better teaching material. Second, the prospect of looking a fool in a television-type context added further motivation to preparation of both teaching materials and teaching strategy. Finally, the extra features of the video conferencing equipment (e.g., document sharing and close-up interactions) were expected to make it more interesting for students.

**Video conference trial**

To conduct the trial, a project team was established in July 1995. The team comprised members with expertise in computing, instructional technology and academic content. There was a five-week lead-time before the first lecture for the semester was scheduled, far less than the six months suggested by consultants (Daunt *et al.*, 1994). During that time specifications were established, equipment purchased and installed, lecture theatres modified appropriately and cables installed. Staff also had a one day training session with a typical, small-group video conferencing session. Strategies for using the equipment in a mass lecture situation were brainstormed. Following the training session, efforts were made to discover previous research in the mass lecture context. While a literature search proved unsuccessful, phone discussions with several inter-state academics involved with small lecture situations provided valuable hints for adapting appropriate instructional strategies. Well-prepared lecture materials and interaction activities were the main instructional strategies suggested as well as some advice on TV-style communicating or lecturing (e.g., not wearing stripes). While the lecturing tips were handy, the instructional strategy suggestions had already been incorporated into the subject in previous semesters. McQuillan (1994) reports that any benefits of introducing technology relate to the changes in teachers’ conceptions and the consequential changes to instructional strategy rather than any introduced technology. Because of the minimal changes in instructional strategy in this trial, it was expected that the majority of effects should have been attributable to the introduction of the technology.

There were 250 students enrolled at one campus and 80 students at the other. The video conferenced mass lecture took place on a Thursday evening for 13 consecutive weeks. The preceding lecture hour was booked for equipment setup and testing. To circumvent concerns about potential inequities highlighted in Treagust *et al.* (1993), the live or local campus was alternated each week. The remote campus received the video image of the lecturer and/or teaching materials.

Video conferencing, because of costs, has traditionally been used for small group meetings. While desktop systems are now increasingly common, their use is still limited for meetings involving more than 4 people. Group video conferencing systems are more elaborate and tend to be set up in purpose-built rooms like that shown in Figure 1. The standard equipment entails one image from the remote view and the other screen showing the live image being sent. A coder-decoder system, or codec, enables images
and audio to be sent between conferencing parties. Generally speaking, the broader the bandwidth of the link, the more natural the conference session. Utilising a leased VTel 227M Quick Frame System and transmitting via a microwave link between the campuses, a very satisfactory image and audio reception was expected. The video link was transmitted at close to television quality (at 30 frames per second or 1534 kilobytes per second (kbps)). This overcame the standard problem of non-synchronisation of image and audio experienced with 128 kbps (or even 384 kbps).

A mass lecture context however, is quite different to a meeting of ten or colleagues. Even without video conferencing equipment, motivations for attending are different and interaction is more difficult. Preconceived perceptions are that lectures are more a one-way interaction of presenter enlightening or entertaining the audience. The content is typically much more structured than in a meeting of peers with a common goal to achieve. Video conferencing complicates the whole situation. Not only is it extremely difficult for remote students in a mass lecture theatre to be seen, without a portable microphone it is almost impossible to hear a student’s question. A number of preemptive strategies were therefore undertaken to improve the learning context.

To improve student concentration in the mass lecture context, it was felt that there should be more opportunities to see the lecturer. To enable a larger audience to see, the image was also projected onto a wide screen using a data projector. Because of the large lecture theatre context, neither the standard camera position (on top of the video conferencing system) nor one at the rear of the theatre could be used. A camera operator was therefore employed to provide a range of shots for the remote end. Most were close-up images of the lecturer. During student-student interactions, the camera operator would focus on some students near him who were embroiled in the learning task.

Another problem to be overcome was that the codec could only allow one image to be sent at a time. The image of the lecturer could be sent or the image of the content of
the lecture, but not both live at the same time. While more expensive systems exist for sending two images at once, an interim solution was achieved. This involved using a laptop at the live end to link lecture slides through the University computing network to a second data projector at the remote end. The software to enable remote control of a PC is called PC Anywhere. This brought the number of devices under lecturer control to three, namely the lectern panel, laptop and video conferencing tablet. Technical staff were on hand at each lecture theatre to solve minor hitches. In case of breakdown, a backup lecturer was always available at the remote campus. This person also acted as facilitator by transporting a portable microphone during staff-student interactions. Guest lecturers also made presentations over the link. The specific teaching context of the mass lecture trial is depicted in Figure 2.

**Effectiveness of video conferenced mass lectures**

The evaluation set out to gauge effectiveness of the whole teaching and learning environment rather than focus on the video conferencing equipment *per se*. A variety of qualitative and quantitative techniques were used in the formative and summative evaluations.

**Formative evaluation**

Formative feedback was solicited through a staff interview (in week 2), a student survey (n = 239 in week 4) of students doing this subject and a co-requisite subject not utilising video conferencing, and three student focus groups (n = 25 in week 7 and 8). Unsolicited feedback from peers and students during the semester was also used for
feedback and corrective action. Technical and academic staff regularly reviewed the video record, session reports and reflective journals.

So as to encourage focus on the learning context rather than the video conferencing technology *per se*, students were asked to rate various learning resources on a five-point Likert scale ranging from 1 (= Quite useless) to 5 (= Really useful). Comparison with other resources in Figure 3 indicates that students ranked the video link (14%) neither highest or lowest as a learning resource. In contrast, guest industry experts were ranked low. This was the first of several indicators that reaffirmed the crucial link between student learning and assessment. A common perception was that information from industry experts was less valuable than that from the expert setting the exam!

The student survey revealed overall subject satisfaction rating of 7.2 (out of 10) compared well to 7.5 from previous years where no video link had been used and far higher than the co-requisite subject undertaken by the same students. The survey included open-ended questions about the subject and video conferencing in particular. About 16% of respondents expressed a sense of excitement from being involved in an innovative technology. Less than a handful felt that the equipment was getting in their way of learning such that it became the aspect in most need of improving. Both results suggest a low profile for video conferencing. Since learning is the prime objective of the subject, academic staff welcomed this outcome.

Students were asked in the focus groups to reflect on how video conferencing affected their learning and jot down their thoughts in terms of positive and negative attributes. This preceded the discussion to encourage independent evaluation. Their notes were collected and analysed. Of the 25 students that participated in the three focus groups, students made far more positive comments (ie, 76 in total) than negative ones (ie, 59) in their written comments that preceded the open discussion. These are summarised in Figure 4.
Students perceived various benefits including:

- greater equity in assessment and learning. The power of assessment in motivating students is well documented in Ramsden (1993) and others. Many commented that unlike previous studies, no student group was advantaged because they got the “better lecturer” or the “lecturer who is running the subject and writing the exam”. The video link meant that students on both campuses could have the same lecturer at the same time. This is shown in Figure 4 in that 88% (or 22 out of 25) of students had individually noted that video conferencing provided greater equity in access.

- motivational aspects by being involved in an innovative multiple media approach to mass lectures. 68% (or 17 of 25) indicated this as a positive aspect in Figure 4. Care however should be taken in attributing this result to video conferencing per se. This subject had received such comments from students in previous semesters when data projection and audio visual technologies, but not video conferencing, had been used.

- being exposed to an emerging business technology. Just over half the students noted this for the video conferencing technology. They saw this as beneficial for their future employment prospects much as PC skills were once a competitive advantage because they were not so commonly held. A similar interest was expressed with a recent Internet trial.

- an increased sense of cross campus interaction (40% or 10 out of 25 respondents). This was surprising given that there was limited direct communication from students in one lecture theatre to the other. Examples included students volunteering answers via the portable microphone or the document camera, and chats with friends on the other campus before the lecture. It seems that simple interactions like seeing and
waving to their cross campus colleagues during the lecture were seen as valuable. Competitions between campus groups during the lecture also fostered interest and concentration as well as this sense of cross campus interaction.

• better access to information flowing from a more effective presentation. Feedback from the focus groups noted significant learning benefits from the document camera. For example, students were now able to see three-dimensional objects in use (eg, financial calculator). Once again, that technology can be, and has been, used as a stand-alone presentation aid.

Students also expressed various problems with the video conferencing. These included:

• a reduction in learning time. 68% (or 17 out of 25 students) noted this problem with using a video conferenced lecture. Time for set up and shutdown of the system ate into students’ perception of their time to cover the material. While few of these technical difficulties involved complete system breakdowns, it simply took longer to do most things (eg, computer images ran slower). With three control devices, multiple actions were required to change between different teaching aids.

• increased potential for disruptive behaviour (52% or 13 out of 25). Current audio technology limitations in large lecture theatres meant that student chat at the remote end could not be heard by the lecturer and controlled. Unless the cameras were pointed to the right place in tight focus, it was difficult for the lecturer to notice disruptive students so they could be controlled. Many remote students treated the lecture like a television session when the live lecture was alternated to the other campus. Students were more likely to chat or walk in and out at the remote end. Students reported that these disruptions could dramatically affect their concentration and learning. The presence of a facilitator was not sufficient to reduce the noise even when attempts were made to do so.

• a perception that the money could be better spent (40% or 10 out of 25). It was obvious by the investment in the equipment and the number of support staff involved that the experiment was costly. Suggestions included diverting the money to making tutorial class sizes smaller (currently minimised at 30 students) or longer.

• reduced access to the lecturer (40%). Many students prefer to discuss things personally and would rush to discuss things at the conclusion of a lecture. This was problematic for remote and local students. Remote students had reduced access because they could not do this privately and because there was often a rush to shut down the equipment to vacate for the incoming lecture. Furthermore, students could not have their corridor discussions on the way to the next lecture because the lecturer was not physically there. The shutdown rush and extra number of students meant that even local students had reduced access. A handful of students felt sufficiently strongly about having a face-to-face session that they alternated their campus attendance to coincide with that of the lecturer.

• reduced staff-student interactions. 25% noted this as a problem of the video conferencing. Mass lectures by definition discourage extensive interactions with individual students. Students have commented that they already feel somewhat self-conscious interacting with staff during a lecture. This may occur either because they feel they are wasting their colleagues’ valuable listening time or because they might be
embarrassed by their contribution. While various strategies work to encourage interaction in a normal mass lecture, even bright, confident students who normally make valuable contributions, avoided these opportunities in the video conferencing sessions. Projecting their image onto the screen made them very self-conscious. Even in small group video conferences, some chairpersons close the local image to reduce this distraction. Interactions were harder also for remote students because it was harder for them to initiate an interaction because they could not be as easily seen or in fact heard. Such interactions also took longer with remote students because the facilitator had to relay their statement or get the portable microphone into their hands. Limitations with current audio technology mean that it is difficult in a large lecture theatre to distinguish adequately between genuine questions and students simply chatting.

• timetable related problems. The lecture start and finish times were not synchronised between campuses. This idiosyncratic organisational problem caused a disproportionate amount of aggravation. Students were already sensitive to a reduction in face-to-face lecture time from the technical hitches and delays during interactions and this exacerbated their concerns.

Several strategies to minimise the effects of these unfavourable aspects of video conferencing were implemented. For example, students volunteering answers were not projected in tight focus onto the screen. More opportunities for asking questions were structured into the lecture action plan, including a conscious attempt to alternate them between campuses. The final evaluation below records the effectiveness of these strategies.

**Summative evaluation**

Summative feedback at the conclusion of the video conference trial included a student survey (n = 246), three interviews with selected students and formal peer review by two colleagues. In addition, transcripts of focus groups and interviews were analysed, as were the reflective journals kept by academic and technical staff. Exam results were compared with those from the previous semester (for Business Finance) and a similar co-requisite subject (Financial Markets). In both cases, the traditional method of a two-hour face-to-face lecture were utilised. The evaluation data were used to edit a four minute video clip reporting the trial outcomes. The effects on students, staff and support issues are each discussed in turn below.

**Student perceptions**

The feedback from students attending the video conferenced mass lectures indicates a number of perceived costs and benefits. Table 1 details averages and standard deviations for student responses to six statements using a five point Likert scale (where 1 = strongly disagree and 5 = strongly agree). They confirm the focus group finding (shown in Figure 4). Students perceived the most significant benefit from the technology was the improved equity in assessment (with an average of 4). In other words only 9% of students disagreed with statement 1.1. As indicated by the average agreement of 3.8 to statements 1.2 and 1.3, the majority of the remote students felt that the
image and audio quality of the lecturer were fine. In each case only 10% of respondents disagreed or strongly disagreed.

Statements 1.4 and 1.5, with averages of 2.8 and 3.2 close to neutral response, indicate that limited progress had been made in improving interactions by the end of semester. Some 28% of students surveyed still felt more self-conscious because of the video link. 39% still felt it was more difficult to interrupt when the lecturer was live at the other campus.

With an average of 3.2 in statement 1.6, nearly half (ie, 48%) of all respondents felt that remote students were still disadvantaged. This was despite preventative efforts and strategies following the formative evaluation. This confirms previous research by Treagust (1993). The only consolation to this fact is that the disadvantage was equitably shared since the remote end was alternated each week.

Open-ended responses yielded similar results to the previous survey. Only 10 from 115 (9%) open-ended responses attributed the video link as the best thing about the subject. Not one student indicated that the video link was the aspect of the overall subject needing most improvement. Some 44% (or 39 out of 88 responses) attributed the equity of access to expert and material as the best thing about the video link. Ranking on other positive aspects mirrored the focus group responses in Figure 3. The aspects of the video link most needing improvement were better remote images (24%) followed by better remote audio (20%), particularly in relation to interactions. While some 17% indicated that it could not be improved, the remaining reasons included disruptive remote students, the intrusiveness of the camera and lost learning time.

Staff perceptions
There are a number of benefits to staff involved in video conferenced teaching. These include:

- reduced duplications in teaching time and travel time and reduced inconvenience of being away from their resources. Reduced duplication means staff can be more productive in their preparation of learning materials and undertaking research.
- incentives to be better prepared to meet students learning needs. Thinking about the needs of students at the remote campus raised a number of issues that needed to be
addressed. For example, how were remote students going to see what was happening? How could non-verbal clues on student learning and concentration be ascertained? How could interaction activities be achieved? How could the document camera be best utilised? What materials and plan needed to be in place if the link failed? Would students expect it to be more professional because it was like television?

- access to the document camera, a powerful technology that is almost standard with group video conferencing. As noted elsewhere by Martin et al. (1995), the document camera is a useful teaching aid particularly because it can easily show three-dimensional, coloured objects in various foci. It is also a powerful crowd-control aid. Focusing the camera tightly on a disruptive student is a powerful way of disciplining them without having to say one word, thus improving the learning environment.

- access to a video record of one’s teaching which is useful to remedy deficiencies.

- access to relevant expert guests who otherwise could not get to the lecture location.

- no changes in students final results. There was no significant difference in students’ marks compared with the previous semester where the traditional approach was used (t = 1.4, p = 0.16). There was no significant difference in students’ marks between campuses in that semester (t = –0.86, p = 0.39) which had also been the case in the previous semester (t = 1.19, p = 0.24). Nor was there any significant difference between each campus results over the two semesters (t = –0.52 and p = 0.6 for one campus and t = 1.77 and p = 0.08 for the other). This result supports that found by McQuillan (1994). No significance is expected because the subject had already been re-engineered in previous semesters to incorporate a number of strategies to achieve deeper learning. Not surprisingly however, there was a significant difference between the final results on this subject and the similar co-requisite subject (p = 0.000). This could reflect a whole range of differences in the design of the teaching, learning and assessment context.

The disadvantages to staff of video conferencing mass lectures included:

- a greater need to prepare materials and plan for effectively using them. At least in the first instance this is quite time consuming. Evaluating student understanding is easier in a traditional face-to-face lecture. One can rely much more on eye contact, students’ questions and answers during or following such face-to-face lectures. Preparing administrative announcements in advance for example meant a consistent and clear message could be confidently communicated to students at both campuses joined by video link. To some extent, the introduction of any technology will require more preparation because it needs to be incorporated into the instructional strategy. However, the fact that there was no significant difference in student exam results or satisfaction ratings indicates that the change to the instructional strategy was minor.

- a greater reliance on other people to make a lecture work. Unlike an overhead projector that is simple to use, video conferencing equipment currently can not work in a mass lecture context without computing and/or instructional technology support people. A greater risk of error is likely because academic and technical staff have more devices and links to maintain. If the equipment fails in a mass lecture situation, more students are affected. Time wasted is critical and rescheduling is impossible. Students expressing dissatisfaction can dent one’s confidence. Technical support
services must be both responsive and efficient or academic staff will not risk using the equipment. Improvements must be undertaken so the equipment complexities become transparent. This would also make it less costly in terms of staffing.

- a restriction on lecturing style. Staff must think through the ramifications of what remote students are seeing. Things like on what one focuses (ie, at the camera not the monitor), the degree to which one moves or interacts with (more self-conscious) students or even the clothes one wears become important. Schiller et al. (1993) and others have already noted these things. Staff must therefore prepare for and practise with the technology, adapting their teaching style to optimise student learning.

- additional distractions to the learning environment. Crowd control of a normal mass lecture is hard at the best of times. Combining this in cross campus situation with a restricted sense of what is happening at the noisier remote campus complicates one’s delivery of learning material. A further complication is the need to remember which buttons to push (on laptop, lectern panel and video conferencing control tablet) to achieve different things. Not only are these distracting, but they take time to manage. In particular, focusing the camera is time-consuming. Fortunately there are systems being purpose-developed for mass lectures that are far more transparent to use for lecturers.

- a massive increase in stress caused by the above. Clearly some of this would abate with more experience.

**Support issues**

There is a range of effects academic support managers need to consider in regard to video conferenced mass lectures. There are potential gains in:

- productivity by a reduction in duplication, inconvenience and travel expenses.
- access to a greater potential pool of students (eg, distance education).
- student satisfaction arising from better-prepared lecturers and equity in access.
- economies of scale in using the video conferencing equipment for other purposes, such as small group research or administration meetings, to many of which the technology is better suited.

The costs of video conferencing mass lectures for academic support managers include:

- substantial up-front resource implications (eg, buying or leasing the equipment and adequate cabling, upgrading rooms, providing adequate security against theft or sabotage).
- substantial and increasing operating costs. Support services must be efficient and responsive to users needs or the equipment will simply gather dust.
- supporting equipment that is constantly being superseded.
- mechanisms to deal with vocal student dissatisfaction when things go wrong.
- a need to incorporate the side effects in strategic planning (eg, setup and shutdown, training, timetabling).
- greater accountability on a daily basis from users as usage increases.

The extra costs of video conferencing these mass lectures amounted conservatively to $53 (or £26) per minute! With overseas transmission currently several multiples of
that figure, exporting video conferenced mass lectures on a regular basis appears not cost-effective at this stage as well.

Concluding remarks
This paper reports the outcomes of a video conferencing trial involving mass lectures across a multi-campus university. Prior expectations were that mass lecture video conferencing would be more cost-effective and improve equity in access concerns expressed by students previously. It was also expected that the quality of learning for students would improve because staff would have incentives to be better prepared and the technology would enable better presentations and interactions.

Only one of these expectations was realised to any extent. The primary benefit students perceived was the equal treatment and access to experts and information they could receive because the mass lecture was video conferenced. While the document camera in particular was a valuable teaching aid, it can be used independently of the video conferencing equipment. Student satisfaction with lectures and the subject were unchanged on previous years.

Echoing Goddard (1995, 209), students and staff felt the lecturing, learning activities and interactions were not improved. They were also slower. Other disadvantages were the time lost through technical difficulties and the greater likelihood for distractions at the remote campus. Students at the remote campus felt disadvantaged despite various preventative strategies.

The equipment could become more cost-effective than experienced in this trial if it were integrated into the network system so video conferencing could be transmitted to many rooms. However, its usage in a mass lecture context is less attractive given the additional pressures and stresses on academic staff in delivering material, and given what we know about how students learn. A cheaper option, given the constraints on interaction in a mass lecture context anyway, may be to simply videotape the lecture. The tape could then be replayed at multiple times and other locations and the video conferencing equipment could be used effectively then for questions at the end. The tasks for which the medium was really first designed, namely administrative meetings, small group teaching and research seminars, appear to offer greater and significant productivity improvements. Hence a permanent video conferencing system appears inevitable when these uses can be included in the cost-benefit equation.

In terms of future directions for video conferenced mass lectures, further research is needed to clarify when and how it can work better. The messages from this experiment relate to technical, staff and organisational factors. They comprise:

1. Ensuring any system is simple to use and comes with upgrade and maintenance guarantees.
2. Using video conferencing in a mass lecture context only if lecturing staff have some motive for participating, are confident with their content, competent in crowd
control, are adequately trained and are supported by reliable and efficient technical services.
3. Resolving any organisational encumbrances to its success (e.g., timetabling, equipment booking) and initiating an awareness and incentives program to maximise the chances of success.
4. Implementing an ongoing process of evaluation.

Acknowledgements
The author gratefully acknowledges the contribution of Reg Collins, Jo McKenzie and Graham Partington. All errors remain the responsibility of the author.

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