

Evaluation of the Business of Science Initiative

Final Research Report

Rachel Bolstad and Rosemary Hipkins



NEW ZEALAND COUNCIL FOR EDUCATIONAL RESEARCH

TE RŪNANGA O AOTEAROA MŌ TE RANGAHAU I TE MĀTAURANGA

WELLINGTON

NOVEMBER 2003

New Zealand Council for Educational Research
P O Box 3237
Wellington
New Zealand

NZCER, 2003

ISBN 1-877293-17-2

Distributed by NZCER Distribution Services
P O Box 3237
Wellington
New Zealand

Table of Contents

Executive Summary	v
1 Introduction	1
Background to the Business of Science initiative	1
<i>Goals of the Business of Science initiative</i>	1
<i>Establishing the target audience for the Business of Science message</i>	2
Key phases of the initiative	3
Evaluation of the initiative	4
Data sources for the evaluation	4
<i>Structure of this report</i>	5
2 Phase one: Launch of the initiative	6
Tertiary institution staff perspectives on the initiative	6
<i>University of Waikato</i>	7
<i>Waikato Institute of Technology (Wintec)</i>	10
3 Phase two: The careers expo seminars	13
Characteristics of students who attended the careers expo seminars	14
<i>Students' reasons for attending the seminar</i>	14
<i>Students' current subject enrolment</i>	15
<i>Students' plans for further study</i>	16
<i>Combining science, business, and law in tertiary studies</i>	18
<i>Career aspirations</i>	19
<i>Why students were interested in particular career areas</i>	19
<i>Relevance of the Business of Science seminar</i>	20
<i>Suggestions for improvement</i>	21
<i>Students' comments on the careers expo</i>	21
Summary of findings from the Business of Science careers expo seminars	22

4 Phase three: The roadshow visits	23
Structure and content of the roadshow sessions	23
<i>The PowerPoint presentation</i>	24
<i>The interactive exercise</i>	24
<i>Time for questions</i>	25
Characteristics of students who attended the roadshow seminars	25
<i>Subjects taken by the students</i>	27
<i>Tertiary study aspirations</i>	27
<i>Combinations of interest for further study</i>	30
<i>Students' intentions to combine science and technology with business and law studies</i>	30
<i>Main messages that students got from the seminar</i>	32
<i>Perceived relevance of the seminar</i>	33
Students' ideas about future jobs and careers (survey)	35
Students' ideas about future jobs and careers (telephone interviews)	37
Profiles of the telephone interview students	38
<i>Student 20</i>	38
<i>Student 171</i>	38
<i>Student 87</i>	39
<i>Student 202</i>	39
<i>Student 222</i>	39
<i>Student 177</i>	40
<i>Student 123</i>	40
<i>Student 142</i>	40
<i>Student 187</i>	41
<i>Student 98</i>	41
Suggested improvements to the seminar	42
Summary of findings from the Business of Science roadshow seminars	42
The presenter's reflections on the roadshow seminars	43
5 Discussion	46
Goals and premises of the Business of Science initiative	46
Evidence from the evaluation with respect to the goals and premises of the Business of Science	50
<i>The target audience</i>	50
<i>Intended impact of the Business of Science message</i>	52
<i>Aspects of the Business of Science message that motivate students</i>	53
<i>The type of information/guidance that helps students</i>	53

<i>The long-term goal of the initiative</i>	54
<i>The tertiary study pathways to achieve the long-term goal of the initiative</i>	54
6 Conclusion	57
Summary of main findings:	57
7 References	60

List of Tables

Table 1	Ministry of Education data on Year 13 subject enrolment, July 1, 2002 (supplied by MoRST)	3
Table 2	Data sources for the evaluation	5
Table 3	Year level of students who completed the Business of Science seminar survey at the Waikato Career Paths Expo	14
Table 4	How students found out about the Business of Science seminars at the Career Paths Expo	15
Table 5	Students' Year 12 and Year 13 science, technology, mathematics, and business subjects	16
Table 6	Combinations of areas of interest for further study	18
Table 7	Students' intentions to include business, management, or law papers if they do a science or technology degree (n=21)	18
Table 8	Students' intentions to include science or technology papers if they do a business, management, or law degree (n= 12)	19
Table 9	Perceived relevance of the Business of Science seminars at the career paths expo	20
Table 10	Schools visited and surveys returned	26
Table 11	Year level of students who completed Business of Science roadshow surveys	26
Table 12	School science, business, and mathematics subjects that students currently take	27
Table 13	Areas of interest for further study for students who are (or are not) interested in studying business, economics, or management	30
Table 14	Students who plan to combine areas but had not thought of doing this before the workshop	32
Table 15	The main message(s) or idea(s) students got from the seminar	32
Table 16	What students liked most about the Business of Science seminar	35

Table 17	Students' future career interests	36
Table 18	Most common ideas mentioned	37
Table 19	Business of Science premises or goals versus alternative possibilities	49

List of Figures

Figure 1	Areas of interest for further study	17
Figure 2	Message written on whiteboard, or held up as a paper banner, by the presenter during the roadshow sessions	23
Figure 3	Diagram drawn on the whiteboard during a Business of Science presentation at Hillcrest High School	25
Figure 4	Areas of interest for further study (all surveyed students)	29
Figure 5	Students' intentions to include science/technology papers in a business, management, or law degree	31
Figure 6	Students' intentions to include business, management, or law papers in a science/technology degree	31

Appendices

Appendix One	Interview schedule for University of Waikato and Waikato Institute of Technology staff	61
Appendix Two	"Business of Science" student survey, careers expo June 8/9	63
Appendix Three	Business of Science phone interview questions (After June careers expo)	67
Appendix Four	"Business of Science" student survey, school roadshow visits (August/September)	68
Appendix Five	Business of Science phone interview questions (After roadshow visits)	71

Executive Summary

The Business of Science is a Ministry of Research, Science and Technology (MoRST) initiative. The initiative is targeted at Year 13 students who have studied science subjects at school, and are intending to enter courses such as business, law, or commerce at tertiary level. The aim of the project is to encourage these students to retain some science (or science/technology) papers in their tertiary degrees. In 2003, MoRST commissioned the Career Services rapuara to pilot the design and delivery of a programme of activities to promote the Business of Science message to senior secondary students in the Waikato region. The New Zealand Council for Educational Research was contracted to evaluate the pilot initiative.

The initiative was launched in Hamilton on Thursday 13 March 2003. The launch was attended by around 60 guests including secondary school leaders, careers teachers, science and commerce teachers; tertiary liaison staff from the University of Waikato and the Waikato Institute of Technology (Wintec); tertiary teaching staff in the areas of science, business, and law; science industry leaders, entrepreneurs, and the media. In June 2003, four 25-minute Business of Science seminars, designed to promote the Business of Science message to senior secondary students, were presented during the Waikato Career Paths expo. Finally, in August and September 2003, the Business of Science “roadshow” visited 17 Waikato secondary schools to further promote the Business of Science message to students.

The research questions for the evaluation were as follows:

1. How are the key messages of the various events of the Business of Science interpreted, remembered, and acted on by the participants in those events?
2. What features of the initiative and/or local contexts enhance the dissemination of the key messages?
3. What features of the initiative and/or local contexts create barriers to the dissemination of the key messages, or act to reduce their effectiveness?

Data for the evaluation was gathered alongside each of the key phases of the initiative. Following the launch, seven staff from the University of Waikato and the Waikato Institute of Technology were interviewed. Students who attended the Business of Science careers expo seminars in June, and the Business of Science “roadshow” seminars in August/September, were asked to complete a short survey form. If they were willing to be contacted for further interview, students were asked

to provide contact details. Small samples of students were interviewed by telephone several weeks after they had attending the Business of Science careers expo and roadshow seminars.

The main findings of the evaluation are as follows:

- Overall, the Business of Science events appeared to be successful in conveying their core message about the value of students combining science/technology and business/law in their tertiary studies. However, the degree to which students will actually act on this message, in terms of their university enrolments in 2004, cannot be determined within the scope of this evaluation.
- Staff from the University of Waikato and the Waikato Institute of Technology were generally supportive of the initiative. There were some examples of existing degree/diploma structures which would allow students to combine these areas at these institutions. However, some barriers or constraints for students to combine science and business/law in their degrees were also identified. At these two institutions it seems that there are currently more viable pathways for science students to pick up business/management courses in their degrees, than for business/management students to pick up science/technology courses in their degrees.
- Although targeted at Year 13 (and possibly Year 12) students, many students who came to the careers expo seminars were in Years 9, 10, or 11. The careers expo seminars seemed to attract science-oriented students, with many planning on further study and careers in a science-related area. Fewer students expressed an interested in doing law, business, or management.
- Many students found the Business of Science seminars interesting and informative. Many liked seeing examples of successful New Zealand companies in the presentation. Some students felt the seminars had given them useful information/ideas for planning their tertiary study, or had confirmed their existing ideas about what to do in their future study/careers. Other students were not sure yet, or said the seminar had “not really” had any impact on their plans and ideas for future study.
- The roadshow audience include a mixture of students with a range of backgrounds in science or business subjects, and a range of ideas and intentions for tertiary study and future careers in these areas. Just over half the roadshow students (52 percent) indicated an interest in tertiary level study in one of the following science or technology areas: science or environmental studies; engineering or architecture; computer science/IT; medicine, health, nursing, or veterinary studies; technology; or mathematics or statistics. Just under a third (31 percent) of students indicated an interest in studying business or management studies. Only 10 percent of students indicated an interest in studying law. A quarter of the students said they thought their degree would include a mixture of business, management, or law papers and science or technology papers. Approximately one-third of these students (n=18) said they had not considered combining these areas prior to the Business of Science seminar.
- The main things students suggested for improving the seminar were: having a wider range of examples of careers and study options that link science with other areas; having role models “in-person” who students could talk to about their study and career pathways; and having more information about universities and courses of study that enable students to combine

business and science, and careers that these qualifications might lead into.

- There was evidence in some schools that information about the roadshow and its potential relevance to students had not filtered through to staff in the science department.

The findings of this evaluation suggest that, in future development, the Business of Science initiative may be strengthened further by:

- recognising the range of interests and motivations of students in the target audience, and thinking about what different kinds of information different students may need to connect the Business of Science message to their own personal situation;
- using a wider range of examples of careers/businesses that combine science and business/law knowledge, for example in areas like health sciences, environmental sciences, and other areas that are of interest to “science-oriented” students;
- continuing to use examples of real people who combine science and business knowledge in their careers, and helping students to see how they might make decisions at different points in their own education and career pathway that would lead them towards similar kinds of careers;
- seeking ways to help students with the “next step”; for example, by providing information about universities and possible courses of study; or directing students to a website where they could find more information. The roadshow presenter suggested that students who attend the session could be given a free pen with a URL they could go to for this kind of information;
- seeking to secure further involvement from careers teachers, business studies teachers, and science teachers in the organisation and delivery of the Business of Science roadshow, perhaps by visiting schools prior to the roadshow to introduce teachers to some of the materials/resources/presentation, and discuss why it would be valuable for science students (and possibly non-science students) to be exposed to the Business of Science message.

Section One

Introduction

Background to the Business of Science initiative

The Business of Science is a Ministry of Research, Science and Technology (MoRST) initiative. The initiative is targeted at Year 13 students who have studied science subjects at school, and are intending to enter courses such as business, law, or commerce at tertiary level. The aim of the project is to encourage these students to retain some science (or science/technology) papers in their tertiary degrees.

In 2003, MoRST commissioned the Career Services rapuara to pilot the design and delivery of a programme of activities to promote the Business of Science message to senior secondary students in the Waikato region. The New Zealand Council for Educational Research was contracted to evaluate the pilot initiative.

Goals of the Business of Science initiative

A key driver for the Business of Science initiative is the government's Growth and Innovation Framework (GIF). The GIF outlines the government's focus on "building the conditions for long-term sustainable economic growth in order to improve the living standards of all New Zealanders". The GIF is a framework for creating the innovation New Zealand needs to achieve the government's economic and social goals.

The government's vision for New Zealand is:

- A land where diversity is valued and reflected in our national identity
- A great place to live, learn, work, and do business
- A birthplace of world-changing people and ideas
- A place where people invest in the future.

Achieving this vision relies heavily, but not exclusively, on sustainable improvements in economic performance. This requires, among other things, successful innovations (Ministry of Economic Development, 2003, p. 3).

The economic goal of the GIF is to return New Zealand's per capita income to the top half of the OECD and maintain that standing. Focal sectors for the GIF are biotechnology, information and communications technology, and the creative industries. The economic importance of innovation cuts across and underpins each of these focal sectors.

The innovation system covers all aspects of formulating an idea for a new or improved product or process through to taking it to markets – the research and development (R&D) process, the commercialisation of that R&D, entrepreneurial activity, business acumen and the availability of capital (particularly venture capital) are all part of the innovation system. Successful innovation depends on having people who can come up with, develop, manage and market new ideas (Ministry of Economic Development, 2003, p. 3).

According to MoRST, feedback from New Zealand's industry sector suggested a shortage of graduates with the combined science/technology and business skill set seen as necessary for New Zealand to reach the economic goals outlined in the GIF. Thus, the GIF also prioritises “growing and developing skills and talent”.

A population of highly skilled people also supports a higher level of innovation by facilitating the transfer of ideas, both because they are able to pick up on ideas from overseas, and because a critical mass of researchers and entrepreneurs stimulates the exchange of ideas and experience (Ministry of Economic Development, 2003, p. 9).

A broad goal underpinning the Business of Science initiative is therefore to facilitate an increase in the number of New Zealanders who have business and legal knowledge, and are also “science savvy”, so that when they embark on a business career, they are capable of making effective financial/investment decisions in the government's GIF focal sectors.

Establishing the target audience for the Business of Science message

Prior to the development of the Business of Science initiative, MoRST undertook scoping research to get a clearer picture of which point(s) in the education system students were choosing not to study science. There was much anecdote placing the problem of science attenuation at secondary school level. MoRST sought Ministry of Education data to see how many students were enrolled in various subjects in senior secondary school. Contrary to expectation, the data showed that high numbers were enrolled in Year 13 science and mathematics subjects (*see* Table 1). Fewer students took “business” subjects (economics or accounting) at Year 13.

Table 1 Ministry of Education data on Year 13 subject enrolment, July 1, 2002 (supplied by MoRST)

Year 13 subjects	Number of students
Mathematics	26739
English	19675
Art	10478
Biology	8975
Physics	8047
Geography	8194
Chemistry	7258
PE	6710
Economics	6679
History	5680
Classical Studies	5233
Accounting	3948

These findings suggested to MoRST that New Zealand’s science-graduate “supply” problems might lie in the transition from secondary to tertiary. In other words, that many students who had studied science at school, and could potentially go on to study science at tertiary level, were instead opting to pursue other degree areas.

The Business of Science initiative was therefore originally conceived to target Year 13 students who have taken sciences at high school, but may intend to drop science to study law or business degrees at tertiary level. The aim of the initiative was to encourage these students to retain some science papers in their law or business degree, or to consider doing a conjoint degree in science and business/law.

The budget for the project was enough for the initiative to be trialled in one region. Waikato was selected as the target region, because of the region’s high density of science and agricultural employers, and the presence of two tertiary institutions that offer degrees and diplomas in science-technology, business/management, and law. The decision to base the initiative in the Waikato was supported by the Hamilton CareerCentre, which had expressed interest in being involved in the project.

Key phases of the initiative

The initiative was launched in Hamilton on Thursday 13 March 2003, with a presentation by Rod Oram, a high-profile business journalist and adjunct professor in the New Zealand Centre for Innovation and Entrepreneurship at Unitec. Invitations to the launch were sent to approximately 180 guests including secondary school leaders, careers teachers, science and commerce teachers; tertiary liaison staff from the University of Waikato and the Waikato Institute of Technology (Wintec); tertiary teaching staff in the areas of science, business, and law; science industry

leaders, entrepreneurs, and the media. Around 60 people attended the launch. In June, four 25-minute Business of Science seminars, designed to promote the Business of Science message to senior secondary students, were presented during the Waikato Career Paths expo. Finally, in August and September, the Business of Science “roadshow” visited 17 Waikato secondary schools to further promote the Business of Science message to students. On 17 October, Hamilton CareerCentre convened the “MORSTLY Science Career Information day”. Secondary school careers teachers and science and commerce staff were invited to hear more about the initiative and its progress to date. Approximately a dozen secondary staff attended the day.

The initiative also involved a series of media releases and newspaper articles outlining the key messages of the project, and profiling people whose careers integrate science with business or law. A full-page article about the initiative appeared in the 4–10 June issue of *New Zealand Education Review*. Articles about the Business of Science appeared in *The Waikato Times* in the week prior to the Waikato Career Paths Expo, and several advertisements and feature articles about the initiative and the seminars appeared in a 20-page Career Paths Expo supplement which was circulated with the *Times*.

Evaluation of the initiative

The research questions for the evaluation were as follows:

1. How are the key messages of the various events of the Business of Science interpreted, remembered, and acted on by the participants in those events?
2. What features of the initiative and/or local contexts enhance the dissemination of the key messages?
3. What features of the initiative and/or local contexts create barriers to the dissemination of the key messages, or act to reduce their effectiveness?

Data sources for the evaluation

Data for the evaluation was gathered alongside each of the key phases of the Business of Science initiative (*see* Table 2).

Table 2 Data sources for the evaluation

Business of Science activities	Data sources
Launch of the initiative (13 March).	Interviews with seven staff from the University of Waikato and the Waikato Institute of Technology (Wintec).
Business of Science seminars at Waikato Career Paths expo (8 and 9 June).	Researcher observation of the seminars. Exit survey of 50 students who attended seminars. Follow-up phone interviews with a sample of 13 survey respondents.
Business of Science roadshow visits to 17 Waikato secondary schools (August/September).	Researcher observation of three school visits. Survey of 253 students who attended seminars. Follow-up phone interviews with a sample of 20 survey respondents. Summative interview with the Business of Science roadshow presenter.

Structure of this report

This report is structured into six sections. Section Two reports on the launch phase of the initiative. The perspectives of a selection of science, business, management, and law staff from the University of Waikato and the Waikato Institute of Technology, regarding the practicability and feasibility of the initiative at their institutions, are reported. Section Three reports the findings from surveys and telephone interviews with students who attended the Business of Science seminars at the Waikato Career Paths Expo in June. Section Four reports on the Business of Science “roadshow” presentations made at 17 Waikato secondary schools, and discusses the results of surveys and telephone interviews of students who attended these sessions. Finally, Sections Five and Six discuss the evaluation findings and their implications for the Business of Science initiative.

Section Two

Phase one: Launch of the initiative

The Business of Science initiative was formally launched in Hamilton on Thursday 13 March. Guest speaker Rod Oram gave a stimulating address with a “future focus” on the rationale for encouraging closer links between the business and science communities in New Zealand. Amongst other recommendations, he suggested that tertiary science options should include courses that are “broad brush” and geared to generalists. He saw it as important that people wanting such generalist courses are not offered more narrowly focused “foundation courses”; that is, courses designed to give students the skills and knowledge necessary to progress on to more advanced studies in science. He also recommended the development of more interdisciplinary courses that link business, science, and humanities knowledge areas.

Tertiary institution staff perspectives on the initiative

The day after the launch, four senior staff from the University of Waikato were interviewed. These were: a senior staff member from the Law School; a student services adviser from the Waikato Management School; a senior staff member from the School of Science and Technology; and the University’s student recruitment officer. Only the student recruitment officer had attended the launch in person, but other staff from the School of Science and Technology had attended and had discussed the event with staff in the Dean’s office. Within a week of the launch, telephone interviews were carried out with three senior staff from the Waikato Institute of Technology (Wintec)’s: Faculty of Applied Technology; Department of Business Studies and Office Technology; and Department of Science and Technology. All three Wintec staff members had attended the launch.

The tertiary staff interviews canvassed the staff members’ support for the principle at the heart of the initiative, and their perspectives on potential constraints or barriers within their institutions which might impact on the success of the initiative. The interview schedule is attached as Appendix One.

University of Waikato

Support for the initiative

All those interviewed at Waikato University were personally very supportive of the initiative. However when asked whether the staff of their schools would also be supportive, some potential issues emerged. The student recruitment officer saw the initiative aligning well with the BSc(Tech) (combined Bachelor of Science and Technology) degree. In her opinion, this degree is a “wonderful package” that has advantages over more traditionally structured science degrees because students get two work placements, and two management papers as part of their course. This is a popular course and the graduates have no difficulty finding work when they graduate. She noted that school students are particularly interested in the context of forensic science, probably as a result of television programmes. The same observation was made by one of the other Deans.

Potential constraints on the success of the initiative

EFTS funding

EFTS funding is potentially a barrier to full co-operation between the various schools of the university. It was pointed out that many undergraduate students now study for double majors, often taking more papers in the process than are strictly necessary to graduate with a first degree. Students who decide to major in a science and in an area from another school are spreading their EFTS. A double major within the same school ensures bigger classes (or more variety of classes) and more funding for that school. Thus it is in the direct interests of staff within a school to keep their students within the school.

Business and computing courses are seen as growth areas of the university. One person expressed the opinion that management degrees should be about “managing something” and that the best science managers are people with science degrees. One person said that the Waikato Management School had a “predatory” attitude to competition and was the most active school in keeping all its EFTS funding within the school wherever possible.

Staff in the School of Science and Technology felt that alternative, more generalist science courses, as recommended in Rod Oram’s presentation, would require extra work to prepare and would need additional funding. It was also pointed out that not all staff in the school would have the skills and knowledge necessary to deliver such courses since they are hired for their specialist research skills. It was felt that any such development should not take place at the expense of preparation of future scientists, which was seen as the primary educative role of the school.

Campus geography

The Schools of Law, Management, and Science and Technology are all located within a few minutes' walk of each other on the University of Waikato campus. Students who choose to combine courses will have no difficulty in getting from school to school in a timely manner. However it was pointed out that the same would not be true of some other campus arrangements if the initiative should be adopted more widely in the future. For example, in Wellington, Victoria University's business and law schools are downtown whereas the science faculty is located on the Kelburn campus.

Timetable clashes

In theory, timetable clashes should not preclude students from taking courses across the various schools. The university has a central timetabling process, and schools can submit lists of courses that they do not want to clash. Where courses with larger enrolment numbers have option lines, these can be selectively used to avoid potential clashes. However, the timetable in practice is cumbersome and students need help from their "host" school to plan their degree pathways. This help is provided by key people within each school (variously titled school administrators or students services managers). There are informal networks for these staff to talk with their counterparts in other schools, although some reported that they tend not to talk about timetabling issues.

One person professed a "certain cynicism" about the extent to which plans for cross-school collaborations of the type needed to make the Business of Science initiative work will ever come to fruition. Perhaps reflecting such cynicism, staff in all schools tended to think that the liaison/student-sharing attitudinal barriers lay elsewhere – i.e. with staff in school(s) other than theirs.

Amount of contact time

There is a common perception that the high number of contact hours in science courses creates constraints that make it difficult to fit science subjects within other courses. One person made the interesting observation that science courses tend to attract school leavers who can be full-time students. Adult learners find it harder to fit lab requirements into their available study time. Evening labs, which could potentially solve this problem, would not be financially viable. Limiting lab time in more generalist courses has been tried. The School of Science and Technology recently developed a generalist geology course for archeology students, but uptake of the course has been disappointing.

Structured courses and compulsory requirements

It is common for the various schools to offer structured degree pathways, in which various papers are compulsory and choice is limited accordingly. Within the Waikato Management School the ease of fitting science papers into an existing course will depend to some extent on the specific degree pathway adopted. For example:

- The four-year *Bachelor of Management Studies* course provides space to major in a subject from another school if desired. This 26-paper degree has 13 compulsory and 13 elective papers. However, students wanting to do a second major in a subject *outside* the Management School (e.g. science) need to take *more than* 26 papers to complete their degree.
- Choice is more limited in the three-year course options. Just two elective papers can be accommodated within the *Bachelor of Electronic Commerce* degree structure.
- The *Bachelor of Communication Studies* is potentially more flexible but this degree is perceived as combining with “more creative” arts options.¹

The University of Waikato also offers a *Bachelor of Liberal Studies* degree. This three-year course specifies that study should be spread over at least two schools and four areas within those schools. This is a very flexible degree that could well accommodate the aims of The Business of Science initiative. However, one person remarked that science majors within this degree are “not very common”.

The Law School offers a combined BSc/LLB. It appears that “only a handful” of students currently choose this option. Fifteen students are currently studying for this qualification and they are seen as having a passion for science. They will also be in demand as graduates. It is also possible to graduate with an LLB with eight papers from another school and to have this acknowledged on the degree transcript, although this arrangement stops just short of a full double major.

Interestingly, most of the university interviewees discussed the combination of science with another subject area in terms of “double majors”. Such qualifications are recognised on the graduation transcript and could be accordingly seen as more valuable. Although the Business of Science initiative is specifically targeted at the inclusion of just one or two science papers in a first degree, this perception about more substantial course commitment to the selected areas might mediate against some staff seeing value in the proposal.

The student recruitment officer noted that some students ask for combination science/management degrees, and that they are aware that this is possible at some other universities. There are formal channels to feed such interest back to the relevant schools but changes to courses take a long time because of the regulatory processes involved.

Prerequisites

It appears that many students think they cannot continue with sciences at university level if they have not done at least chemistry and physics to Year 13. A generalist course in astronomy, offered by staff in the School of Education, is seen as a popular course because there are no prerequisites. An environmental science course offered by the Earth Sciences group is popular for the same reason. However, since the students targeted for the Business of Science initiative are still taking sciences in Year 13, these constraints presumably should not apply.

¹ This view was expressed by two interviewees.

Student attitudes

All those interviewed said student perceptions could be a constraint to continuing to study science in combination with another degree. Students entering university direct from school tend to base their initial choices on the subjects they have enjoyed at school. There is a perception that students are put off continuing with science because it involves “too much rote learning” or that it is “not creative”. One person thought it would be important to improve “public perceptions about scientists and what they do” for the initiative to succeed.

One person noted that students in New Zealand and Australian universities tend to specialise very quickly, in contrast to American universities where it is compulsory for students to keep their first degrees wider. This person thought it would be a “real battle” to convince people to keep a wider degree structure because they are very focused on their prospective job.

Waikato Institute of Technology (Wintec)

Support for the initiative

The Wintec staff interviewed saw merit in the initiative, and saw no significant reasons why other Wintec staff would not also be supportive. Some of the underlying principles of the Business of Science initiative aligned with directions in which Wintec was already moving. For example, the Department of Business Studies and Office Technology (in the Faculty of Applied Management) already encouraged business students to take subjects outside business and accounting as part of their studies. Under this system it was possible for business students to take some science courses, although the Business Department staff member was not sure whether any students were currently doing so. The Diploma in Technology Science offered by the Department of Science and Technology (in the Faculty of Applied Technology) allowed students to take four elective courses from across the institution, including business and engineering. The Faculty of Applied Technology also offers a Diploma of Technology, which enables students to pick up some papers in other subject areas. The Faculty of Applied Technology staff member felt there were good existing processes for science and engineering students to pick up business papers, but fewer processes working in the opposite direction (that is, making it easy for business students to pick up science or engineering papers).

Although they were enthusiastic about the initiative, the Wintec staff suggested that the initiative perhaps does not address some larger questions about student dropout rates in science between secondary and tertiary studies. One staff member thought it was important to think about why students who had done well in science and enjoyed it at school, seemed to be “turned off” doing science at a tertiary level. One possible factor was that students were receiving trickle-down messages that it was hard to make good money in science. This was thought to be particularly true in the Waikato, where the redundancies of senior scientists at research organisations like Ruakura² were commonly known and discussed within the science community. One staff member suggested

² Ruakura Research Centre: The Horticultural and Food Research Institute of New Zealand.

that students who did well at science in school were being attracted into pathways like business or law because they perceived this would lead to better career prospects.

Potential constraints on the success of the initiative

Course credits

One potential issue for running the initiative at Wintec would be to ensure that students would be able to gain the appropriate number of course credits. Currently, courses in different departments may carry different credit ratings according to the size of the course. This occasionally caused problems for students trying to find courses “the right size” to fill their required number of credits. One staff member said that this was not a huge problem overall, but it did reduce the “interchangeability” of courses across departments.

Timetabling

The Business Department staff member thought that it was feasible for the Business of Science initiative to be structured into Wintec’s existing timetabling system. However, timetabling across departments could present some administrative challenges. Different departments run courses of different lengths and cater for different types of students. There was no standard rule about things like school holidays, so course start and end dates vary across faculties and departments at Wintec. There are logical reasons for the differing course dates, (for example, catering for students who are also parents), but these have “less than helpful” outcomes for timetabling across departments.

The Business and Science Department staff members felt these issues could be worked out through communication across departments, as long as people were willing to be flexible and make the necessary changes. It was already normal practice for heads of departments to meet to talk about such issues each year. Their intentions for the coming year would be passed on to the timetabling staff. In terms of the Business of Science initiative, the staff member suggested that rather than opening up all existing courses to students, the heads of department could select a few key courses and make sure that these did not clash.

Student perceptions

In the Waikato region, redundancies and lack of funding seemed to mainly have affected senior scientists with post-graduate qualifications. Wintec’s science programme is geared towards training laboratory technicians, rather than senior research scientists. The Science Department staff member felt that Wintec was succeeding in supplying science graduates in areas where there was a need, for example, through working in partnership with Fonterra. This perhaps lessened the impact of the perceptions that jobs in science were unstable.

Current initiatives

The Wintec staff were impressed by Rod Oram's Business of Science presentation. They felt that the science-business connection was valuable and suggested that the focus needed to go both ways. For example, that scientists often seemed to lack a "business sense", and therefore would benefit from a business background in their education. The Department of Science and Technology was already looking into developing a science degree with business papers in it. The department was also about to launch a new graduate diploma called "Communicating science". The aim of the course is to make science "more friendly" for teachers, and to make communication with the public easier for scientists. The diploma includes courses on scientific journalism, science in society, and topics in communication.

The staff member from the Faculty of Applied Technology suggested that "The real challenge that we have seen is getting the level of interest in the sciences at all." The Business of Science was seen as addressing one part of this problem, but thought there was still work to be done to bring science and technology back into "centre stage" as viable career options for students.

Section Three

Phase two: The careers expo seminars

On 8 and 9 June, four 25-minute seminars about the Business of Science initiative were run during the Waikato Career Paths Expo in Hamilton. The sessions were open to anyone to attend, and were advertised in the seminar programme schedule in a 20-page supplement in the *Waikato Times*. Two feature articles about the Business of Science initiative also featured in the supplement. Schools were sent promotional information about the seminars, and a schedule of sessions was posted near the entrance to the Expo exhibition hall.

Career Services rapuara engaged a science teacher in her twenties to present the seminars. Prior to teaching the presenter had done a double degree in science and law. At the time of the expo, she was about to leave teaching to begin a Masters degree in Law at the University of Waikato. Her teaching experience, and her educational background in both science and law, lent themselves well to the Business of Science message. At the beginning of each session, the presenter gave a brief PowerPoint presentation outlining the main messages of the Business of Science initiative. Each session also featured a guest speaker who talked to students about how their own careers fused science with business and/or law. On 8 July, the speaker was David Whyte, a research scientist whose company develops milk analysis techniques for the dairy industry. On 9 July, the speaker was Kate Wilson, a patent attorney who works in intellectual property patenting. Students were given a folder containing half a dozen one-page profiles of David, Kate, and other people whose careers involved combinations of science and business or legal knowledge and skills.

The number of students who attended each Business of Science session varied from 3 to over 20. Survey forms were handed out to students as they entered the seminar room and collected as they left. This yielded a very high survey response rate. A total of 50 survey forms were completed. Although an exact count was not taken, this appeared to be at least 90 percent of students who attended the session. Nineteen students indicated on the survey that they were willing to be

contacted later for a phone interview, and supplied their contact details. Thirteen students (all Year 12 or 13³) were interviewed between 7 and 21 July.

Characteristics of students who attended the careers expo seminars

The Business of Science initiative is primarily targeted at Year 12 or 13 students who are intending to enrol in tertiary study in 2004. While 58 percent of students who completed a survey were in Year 12 or 13, over a third were Year 9, 10, or 11 (*see* Table 3). Most of these younger students were accounted for by a group of ten Year 10 students from Melville High school who came to one session together. The four “other” students were a first year university student, a graduate student, an adult high school student, and one person who did not specify.

Table 3 Year level of students who completed the Business of Science seminar survey at the Waikato Career Paths Expo

Year level	Number of students
Year 9	1
Year 10	13
Year 11	3
Year 12	13
Year 13	16
Other	4
Total	50

Students’ reasons for attending the seminar

Half the students who completed the survey came to the careers expo as part of a school group. These students were from six schools: Melville High School (10 students), Hauraki Plains College (4 students), Te Aroha College (4 students), Te Awamutu College (4 students), Thames High School (2 students), and Fairfield College (1 student). The remainder came with family or friends (21 students), or on their own (3 students).

One-third of the students said they had specifically planned to attend the Business of Science seminar when they came to the expo. Table 4 shows how students heard about the seminar. More than half seemed to have heard about the seminar before they arrived at the careers expo, although thirty-eight percent said they did not know about it until they arrived at the careers expo that day. Of those who had already heard about the seminar, students had most commonly found out about it from a school noticeboard or newsletter (28 percent).

³ Students who were Year 11 or younger were not contacted for telephone interviews.

Table 4 How students found out about the Business of Science seminars at the Career Paths Expo

How students found out	Students (n=50) %
Did not know about it until they came to Expo	38
School noticeboard or newsletter	28
Newspaper	14
Friends or family	12
Careers teacher or Guidance counsellor	8
Science teacher	6
Other	6

Note: Table percentages have been rounded to the nearest whole number.

The telephone interview students were asked what prompted them to go to the Business of Science seminar. Most said they went because they thought the seminar would be interesting or useful as they were taking science and/or business-related subjects at school, and were considering continuing one or other of these areas at tertiary level. A few students had simply gone on the advice or recommendation of a parent, friend, or careers adviser.

Dad said it would be useful. (Year 12 student, telephone interview)

Students' current subject enrolment

The seminar seemed to attract students who were already taking sciences at school. Table 5 shows the science, technology, mathematics, and business-related subjects that Year 12 and 13 students were taking.

Table 5 Students' Year 12 and Year 13 science, technology, mathematics, and business subjects

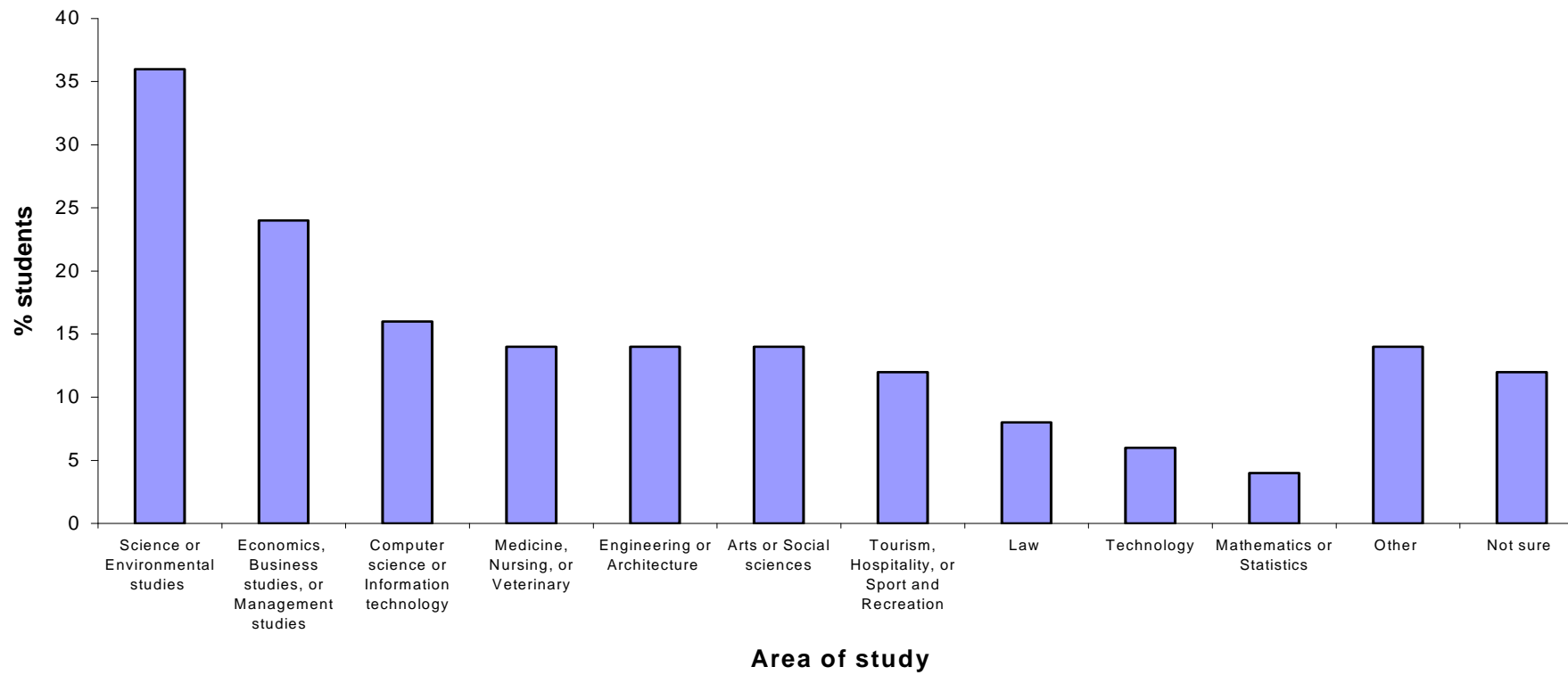
Subjects taken	Number of students	
	Year 13	Year 12
Biology	9	7
Chemistry	4	7
Physics	7	3
Science	6	1
Statistics	14	0
Calculus	10	1
Mathematics	-	1
Accounting	6	5
Economics	6	1
Technology	1	0

Students' plans for further study

Most of Year 13 students (14 out of 16) said they planned to go to university in 2004. One Year 13 student planned to go to a technical institute, and one had no plans yet. Ninety percent of the Year 9–2 students planned to stay at school next year.

All students (Years 9–13) were asked what kind of degree, programme, or area of study they thought they might do if they went on to further study. Students were given a range of options to choose from and could select more than one option. Over a third of students indicated an interest in science or environmental studies (*see* Figure 1). About a quarter indicated an interest in economics, business, or management. Fewer students were interested in studying computer science/IT; medicine, nursing, or veterinary studies; engineering or architecture; or arts or social science (7 students each). Only four students indicated an interest in studying law.

Figure 1 Areas of interest for further study



The careers expo seminars

Fifty percent of students indicated they were considering two or more areas for further study. Table 6 shows the number of students who indicated an interest in any combination of sciences, business, or law subjects.

Table 6 Combinations of areas of interest for further study⁴

	Economics, business studies, or management studies	Law	Science or environmental or studies	Engineering or architecture	Computer science or information technology	Medicine, health science, veterinary	Mathematics or statistics
Economics, business studies, or management studies		2	4	1	2		1
Law	2		2		1		1
Science or environmental studies	4	2		5	5	3	1
Engineering or architecture	1		5		2		
Computer science or information technology	2	1	5				
Medicine, health science, veterinary			3				
Mathematics or statistics	1	1	1				

Combining science, business, and law in tertiary studies

Twenty-one students were considering doing science or technology at tertiary level. Eight of these students said they thought they would include business, management, or law papers in their degree (*see* Table 7). Nine were not sure yet.

Table 7 Students' intentions to include business, management, or law papers if they do a science or technology degree (n=21)

	Yes	Not sure yet	No	No response
Number of students	8	9	3	1

Twelve students said they were considering doing business, management, accounting, or law at tertiary level. Of these, three said they thought they would include science or technology papers in their degree (*see* Table 8). Seven were not sure yet.

⁴ Students who chose three or more subject areas may be represented more than once in this table.

Table 8 Students’ intentions to include science or technology papers if they do a business, management, or law degree (n= 12)

	Yes	Not sure yet	No	No response
Number of students	3	7	1	1

Career aspirations

Students were asked what sort of job or career they were interested in pursuing. Seventeen students (34 percent) expressed interest in a career relating to science or environmental studies. Examples included:

- wildlife management, conservation, animal care;
- something to do with the ocean;
- geology;
- microbiologist;
- molecular biology or astrophysics; and
- science/engineer.

Eleven students described careers relating to business, management, or accounting (for example, “manager, financial” or “some sort of management”). Only four students indicated an interest in a career in either science or business/law, or a combination of science and business/law (for example, “Animals/Business/Agriculture”, or “biotechnology and accounting”). Eight students did not answer the question.

Why students were interested in particular career areas

Two-thirds of the students explained why they were interested in particular jobs or careers. Students’ explanations fell into three main categories:

- Due to a personal interest in the area/subject (38 percent).
- Because they had done well or enjoyed this subject at school (22 percent).
- Due to the influence of a parent, role model, or mentor (10 percent).

Many students gave only very brief reasons for their career interests (e.g. “because I am interested in this” or “I like doing this subject at school”), and just under half did not respond to the question at all. However, a few students gave more specific reasons for their career interests. For example, one student said they were interested in a career as an “accountant or manager of science/drug company” and became interested in this career “from a career liaison visit”. Another student was interested in “some sort of management and perhaps psychology” and became interested in this “from a family friend who does management and is really well-paid”. Another was interested in nursing because “my aunty is a nurse and I am a very ‘people person’. I enjoy talking and I am very interested in medicine.”

Relevance of the Business of Science seminar

Students were asked to rate the relevance of the Business of Science for them. Sixteen percent said it was “extremely relevant”. Most students (68 percent) said it was “possibly relevant”. Only eight percent felt it was probably not relevant or not at all relevant for them.

Table 9 Perceived relevance of the Business of Science seminars at the career paths expo

	Percentage of students (n=50)
Extremely relevant	16
Possibly relevant	68
Probably not relevant	6
Not at all relevant	2
No response	8

Students’ recollections of the main message of the seminar

In the follow-up telephone interviews, most students recalled the main messages of the seminar to be as follows:

- That it is possible and useful to combine science and business or science and law in tertiary degrees.
- That there are many career opportunities for people who have backgrounds in both areas.
- That in the future, business and commerce will play a big part in science.
- That science is an important background for many jobs.

A few students said they couldn’t really remember the main message of the seminar. One student said he didn’t think he could remember any message from the seminar, but said he was “amazed” to hear one of the presenters (David Whyte) telling about how he dropped out of school, then went on to university and did science and business, “and now he is doing so well”.

About half the telephone interview students felt the seminar was personally relevant for them, because they had already been thinking about combining science and business and/or law in their degrees prior to the seminar. For these students, the seminar had reinforced their interest in combining these disciplines.

I was already thinking about doing some management papers (with a chemistry degree). It gave me a shove in that direction. (Year 13 student, telephone interview)

I think [the seminar] has [had an impact on my plans], I’m now thinking more towards doing a BSc(Tech) degree. (Year 12 student, telephone interview)

Other students thought the seminar was interesting, but probably not directly relevant to them.

Interesting, but I don’t think I will take business with my science degree. (Why?) I’m just not interested. (Year 13 student)

[It was] sort of [relevant], but I've kind of changed, I've decided not to do anything in science at university. (Year 13 student)

Suggestions for improvement

Most interviewed students felt that they had got enough information from the Business of Science seminar, although several suggested the session could have been improved by:

- making the session somehow more interactive;
- giving more information on specific courses you can do to mix science and business/law, and where you can do these;
- having more examples of people doing different jobs which combine science and business/law.

One student thought it was not clear enough what the seminar was going to be about.

When I saw the name of it, asked the info people downstairs what it was about. They said it was what sciences you need for what sorts of jobs. So it would be good if they gave clearer information about what it was going to be about. (Year 12 student, telephone interview)

One student said it was better to have a “real person” explaining their job and how they got into their career, than reading about it in the Business of Science handout. Several students commented that they enjoyed hearing the personal stories of David Whyte and Kate Wilson.

[Kate Wilson] talked about how she liked physics, well that's kind of like me. I like science but also maths and accounting. (Year 13 student, telephone interview)

It was good hearing about how [David] dropped out of school and went on to Uni and is now doing really well, I thought that was a really good message. (Year 12 student, telephone interview)

Several students said it was “hard to say” whether the Business of Science seminar had had any impact on their plans for the future. However, most students felt the Business of Science seminar would be useful for students of their age, because many young people would not know that you can combine two disciplines in your degree, nor why it might be advantageous to do so.

...because if we don't have anyone to tell us about stuff, we're not really going to know. People our age don't really go out and look for this stuff. (Year 13 student, telephone interview).

Students' comments on the careers expo

Although students were somewhat ambivalent about the personal value of the Business of Science seminar, most students had found the careers expo in general to be very useful. Many used the careers expo to find out about careers or courses offered by different universities.

The careers expo seminars

[The careers expo] helped me to find out more about jobs, the good and bad things about them. It helped me to make up my mind a bit more. (Year 13 student, telephone interview)

[The careers expo] was great. The Otago lady got my address and has been sending me stuff, information about Pharmacy [courses] and registration etc. (Year 13 student, telephone interview)

More information on where to go. I always had the idea I would do chemistry. The Expo helped me narrow it to either Waikato or Otago. (Year 13 student, telephone interview).

However, one student found that the careers expo had been little help.

I went to the careers expo because I wasn't sure what to do. I went to the careers expo to get some idea (and you didn't really get that?) No, I needed more like a one-on-one person, and that's kind of hard for a careers expo. (Year 13 student)

Summary of findings from the Business of Science careers expo seminars

- Although targeted at Year 13 (and possibly Year 12) students, many students who came to the careers expo seminars were in Years 9, 10, or 11.
- The seminars seemed to attract science-oriented students, with many planning on further study and careers in a science-related area. Fewer students expressed an interest in doing law, business, or management.
- Phone interview students could generally recall the main messages of the seminar, but had mixed views about whether it had been relevant for them. Some students said the seminar had given them ideas or confirmed their existing ideas about what to study next year.
- Several phone interview students said they especially liked hearing the guest speakers describe their own educational and career pathways. Some students said they could not recall the "message" of the seminar, but remembered parts of the speakers' personal stories.
- Suggested improvements to the seminar included: making the session more interactive; giving more information on specific courses you can do to mix science and business/law, and where you can do these; or having more examples of people doing different jobs which combine science and business/law.

Section Four

Phase three: The roadshow visits

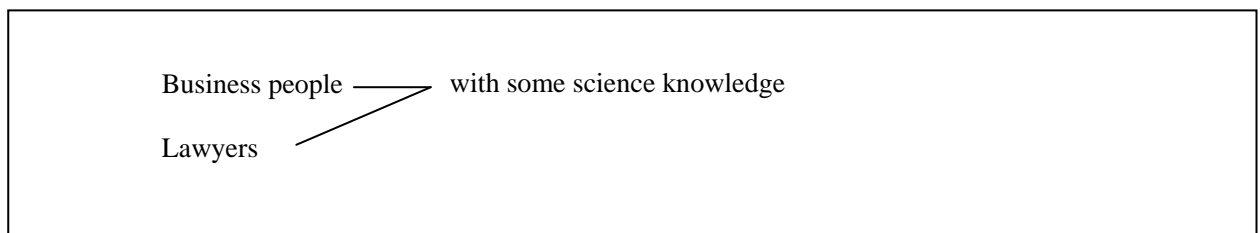
In term three (21 July–19 September), the Business of Science “roadshow” visited 17 secondary schools in the Waikato region. Initial contacts with schools to arrange the roadshow visits were made through Career Services rapuara. In most cases, the roadshow sessions were organised through the school’s careers adviser.

Structure and content of the roadshow sessions

Each roadshow session lasted approximately one hour. In each session, the three basic elements of the presentation were a PowerPoint presentation and talk, an interactive activity, and time at the end for questions. The presenter would begin most sessions by introducing herself and describing her own educational and career pathway. After leaving school, the roadshow presenter did a double degree in science and law, because she was interested in both. She had gone into science teaching for a few years, and was now about to begin her Masters degree in environmental law. The presenter talked about how her science background put her in a good position to follow her personal area of interest, namely, to investigate the science and politics of international climate change policy and legislation.

Early in the session the presenter introduced the idea that the message of the presentation was about the importance of having “business people with science knowledge”. As well as being conveyed verbally, this message was written up where students could see it during the session (*see* Figure 2).

Figure 2 Message written on whiteboard, or held up as a paper banner, by the presenter during the roadshow sessions



The basic elements of the workshop session are briefly described below.

The PowerPoint presentation

The PowerPoint presentation showcases examples of New Zealand companies that have been successful in using science or technology knowledge to create and market innovative products or processes. These include:

- Motueka Nets, a Nelson company which designed the “stealth” fishing net, which creates 20 percent less drag. The company now sells these nets world-wide.
- Vega Industries Limited, a Porirua company which produces marine lights and has a contract to supply the United States coastguard service.
- McIntosh Timber Laminates, an Auckland company which “adds value” to timber exports through the design and production of laminated timber ceiling kitsets.
- ViaLactia, Fonterra’s biotech research subsidiary, which seeks to identify and commercialise genes and methods of selection important to the dairy industry.

During the showcasing of these examples, the presenter reinforces several key messages, including:

- that New Zealanders are good at innovation;
- that innovative New Zealand companies have done well in the international marketplace; and
- that enormous gains in profitability can be made by companies which “add value” to primary export by applying specialised science and technology knowledge to develop a more innovative product.

However, the presentation suggests that New Zealand has typically been less good at commercialising its innovations, or making the transition from a \$5 million dollar business to a \$30 million dollar business. This has left New Zealand “knowledge” open to be bought out by overseas investors.

The PowerPoint presentation gives two such examples:

- Navman, a company which designs and produces global positioning systems (GPS). Navman won the Trade NZ Supreme Exporter of the Year 2002, but was sold to an overseas company in June 2003.
- Glaxo, originally a baby food manufacturer and pharmaceutical company, which was sold overseas and became GlaxoSmithKline.

The interactive exercise

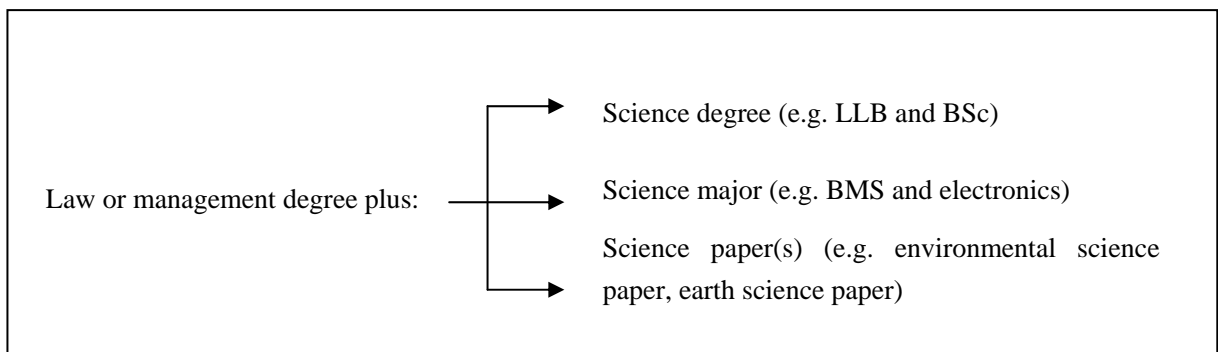
During the interactive part of the session, students are given laminated cards with different kinds of jobs described on them. These include: journalist, patent attorney, mediator/arbitrator, economist, general manager. The students are asked to discuss in pairs or small groups why the

job on their card might require a combination of science and business/law knowledge. After a few minutes of discussion, students are asked to call out some of their ideas to the rest of the group.

Time for questions

In the last 10–15 minutes of the session, the presenter summarises some of the main messages from the Business of Science initiative and invites students to approach the presenter to ask any questions they may have. In some cases the roadshow presenter used a whiteboard before or during the session to write up possible options for combining science and business and/or law in a degree, and referred to this in discussions with students (*see* Figure 3 for an example).

Figure 3 Diagram drawn on the whiteboard during a Business of Science presentation at Hillcrest High School



Characteristics of students who attended the roadshow seminars

An NZCER survey was given to all students who attended the sessions at 15 of the schools. In most cases, all students at each session completed and handed in a survey form. A total of 253 survey forms were collected (*see* Table 8.)⁵ An NZCER researcher attended and observed three of the roadshow visits: St Peter’s (Cambridge), Matamata College, and Hillcrest High School.

⁵ Surveys were not completed by students at two schools (Te Awamutu College and Waikato Diocesan) due to a shortage of time during the roadshow visit.

Table 10 Schools visited and surveys returned

Name of School	Number of surveys returned	Student year level(s)
Cambridge High School	26	Year 13
Church College of New Zealand	11	Year 13
Hamilton Girls' High School	4	Year 12 and 13
Hamilton's Fraser High School	47	Year 12 and 13
Hauraki Plains College	1	Year 13
Hillcrest High School	22	Year 13
Matamata College	12	Year 13
Melville High School	21	Year 12 and 13
Mercury Bay Area School	14	Year 12 and 13
Morrinsville College	14	Year 13
Ngaruawahia High School	14	Year 11, 12, 13
Piopia College	9	Year 12 and 13
St Peter's (Cambridge)	29	Year 11
Te Kauwhata College	18	Year 12 and 13
Thames High School	1	Year 13
Waihi College	10	Year 12 and 13
Total	253	

One-third of the students surveyed indicated their willingness to be interviewed by telephone, and provided contact details. Twenty students were selected for telephone interview.⁶

Table 11 shows the year levels of all students who completed a survey. Although the target audience for the Business of Science initiative is students who are currently in Year 13, around 45 percent of the students were in Year 11 or 12.

Table 11 Year level of students who completed Business of Science roadshow surveys

Year level	% of students surveyed (n=253)
Year 11	12
Year 12	33
Year 13	54

1% of respondents did not answer the question.

Table percentages have been rounded to the nearest whole number.

⁶ The twenty were chosen at random, and replacement choices were made when students were not reachable after two attempts. The sample is not intended to be representative of all students who attended the surveys. Because not all students who attended the roadshow sessions provided their contact information, it was not possible to draw a truly random sample for the phone interviews.

The phone interviews suggested that the circumstances that led students to attend the roadshow session varied. In some cases, students said that their careers adviser had personally recommended the session.

[The careers adviser] interviews us, and I mentioned I was interested in a career in business or science, so he recommended it to me. (Year 13 student, phone interview)

Other students said their careers adviser, a science teacher, or an accounting teacher, had advertised the session in the daily school notices or recommended it to the class. Four of the telephone interview students said they had just turned up to their regularly scheduled science or accounting class, and found the roadshow presentation had replaced their normal teaching that period. One Year 13 student stumbled across the presentation in the senior common room, and stayed to listen because it seemed relevant for her.

Subjects taken by the students

Table 12 shows the percentages of students currently taking science,⁷ mathematics, and business⁸ subjects at school. Overall, more students were enrolled in science and mathematics than business subjects. Only 38 percent took at least one science and at least one business subject. Less than 5 percent took technology.

Table 12 School science, business, and mathematics subjects that students currently take

	% of students
At least one mathematics subject	81
At least one science subject	77
At least one business subject	60
At least one mathematics and at least one science subject	63
At least one science and at least one business subject	38
At least one science subject, no business subjects	39
At least one business, no science subjects	22

Note: Table percentages have been rounded to the nearest whole number.

Tertiary study aspirations

Most of the Year 13 students were bound for tertiary study in 2004. Three-quarters (75 percent) of the Year 13 students said they planned to go to a university, and ten percent planned to go to a technical institute or college of education.

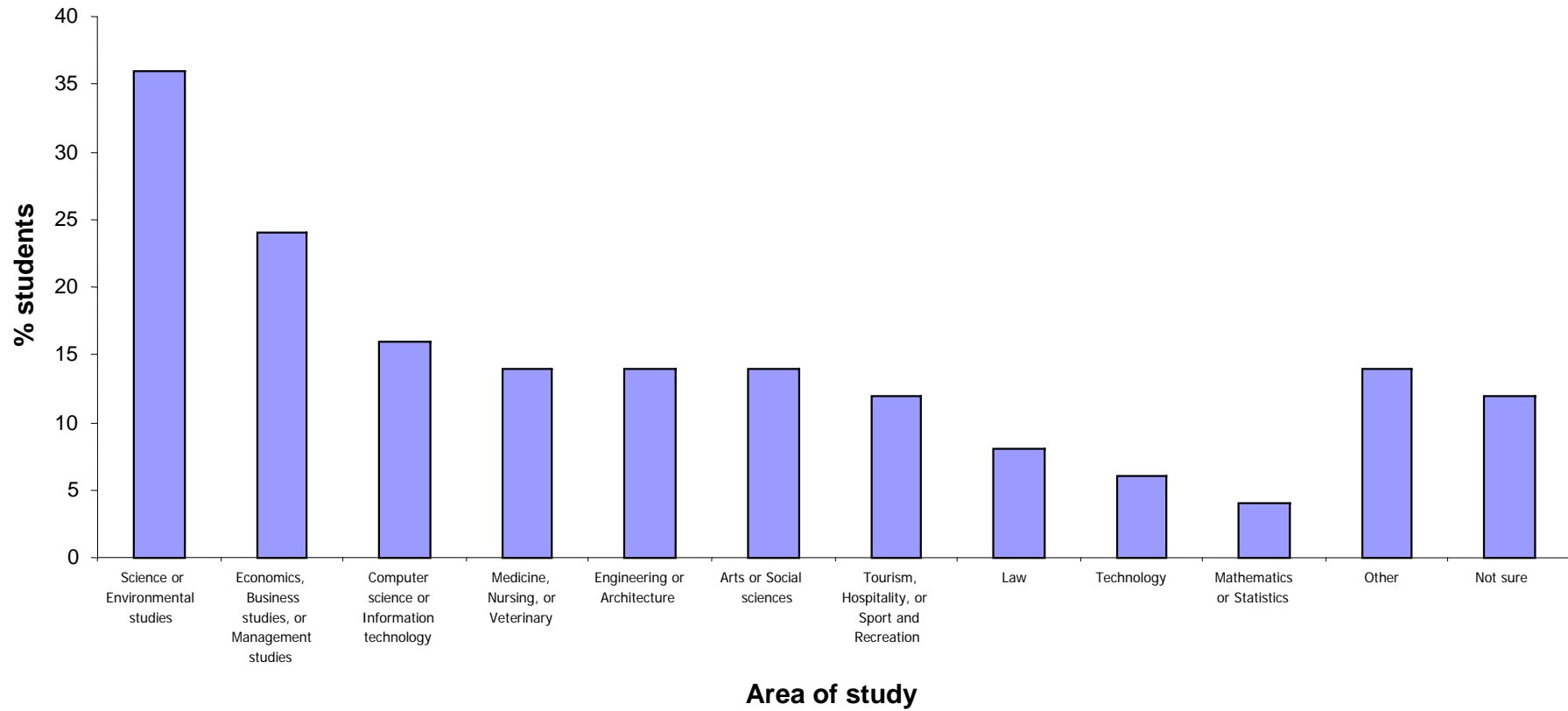
All students (regardless of current year level) were asked which areas they were interested in for further study. Students could choose more than one area of interest. As shown in Figure 4, 40

⁷ E.g. physics, biology, chemistry, earth science.

⁸ E.g. economics or accounting.

percent of all students indicated an interest in studying economics, business studies, or management studies at tertiary level. Although this was the single most popular category, 52 percent of students indicated an interest in one or more of the following “science and technology” areas: science or environmental studies; engineering or architecture; computer science/IT; medicine, health, nursing, or veterinary studies; technology; or mathematics or statistics. Only 10 percent of students indicated an interest in studying law.

Figure 4 Areas of interest for further study (all surveyed students)



Combinations of interest for further study

Many students indicated an interest in two or more areas of study. Table 13 shows other areas of interest for students who indicated an interest in studying business or management, compared against students who did not indicate an interest in studying business or management. As the table shows, students who were considering studying business or management were more likely to be interested in law, and tourism, hospitality, or sport and recreation, while students who were not considering studying business or management were more likely to be interested in engineering, architecture, medicine, health science, nursing, veterinary studies, and technology. About equal proportions of “business-interested” and “non-business-interested” students were interested in science or environmental studies, and computer science or information technology.

Table 13 Areas of interest for further study for students who are (or are not) interested in studying business, economics, or management

	% of students considering studying economics, business, or management who are interested in this area (n=102)	% of students NOT considering studying economics, business, or management who are interested in this area (n=151)
Science or environmental studies	19	19
Engineering or architecture	8	18
Computer science or information technology	16	15
Medicine, health science, nursing, veterinary	6	23
Technology	3	11
Law	17	5
Tourism, hospitality, or sport and recreation	21	11
Arts or social sciences	9	12
Mathematics or statistics	5	3
Other	7	19

Note: Table percentages have been rounded to the nearest whole number. Students who indicated an interest in three or more areas may be represented more than once in this table.

Students’ intentions to combine science and technology with business and law studies

Two questions were asked to gauge students’ current plans in relation to combining science and technology with business, science, or law in tertiary study. Figure 5 shows students’ responses to the question “If you are thinking of studying business, management, or law, do you think you will include any science or technology papers in your degree/diploma?” Figure 6 shows students’ responses to the question “If you are thinking of studying science or technology, do you think you

will include any business, management, or law papers in your degree/diploma?" The two questions yielded very similar response patterns. Just under a quarter said yes, just under 10 percent said no, and 40–45 percent were not sure yet. Fifteen percent of students answered yes to both questions.

Figure 5 **Students' intentions to include science/technology papers in a business, management, or law degree**

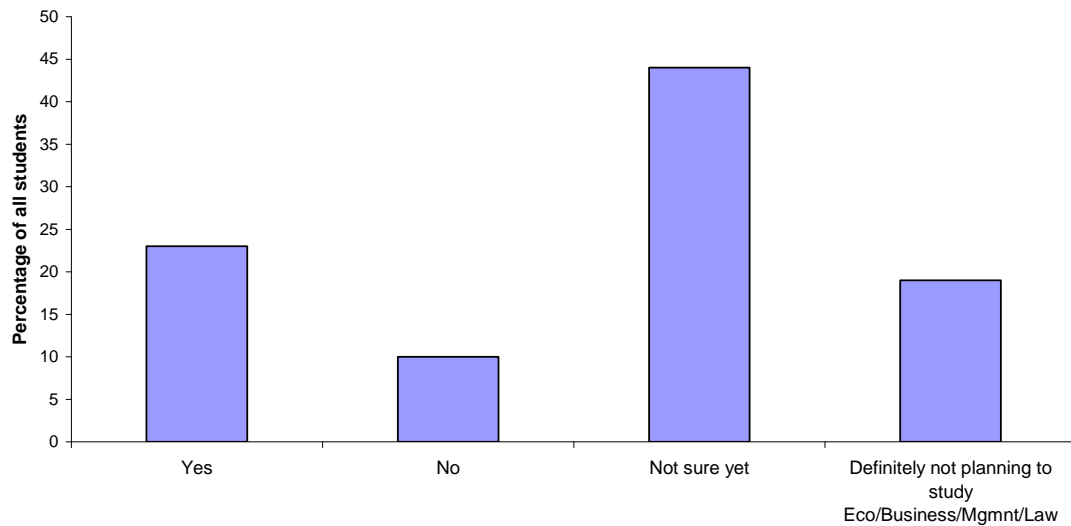
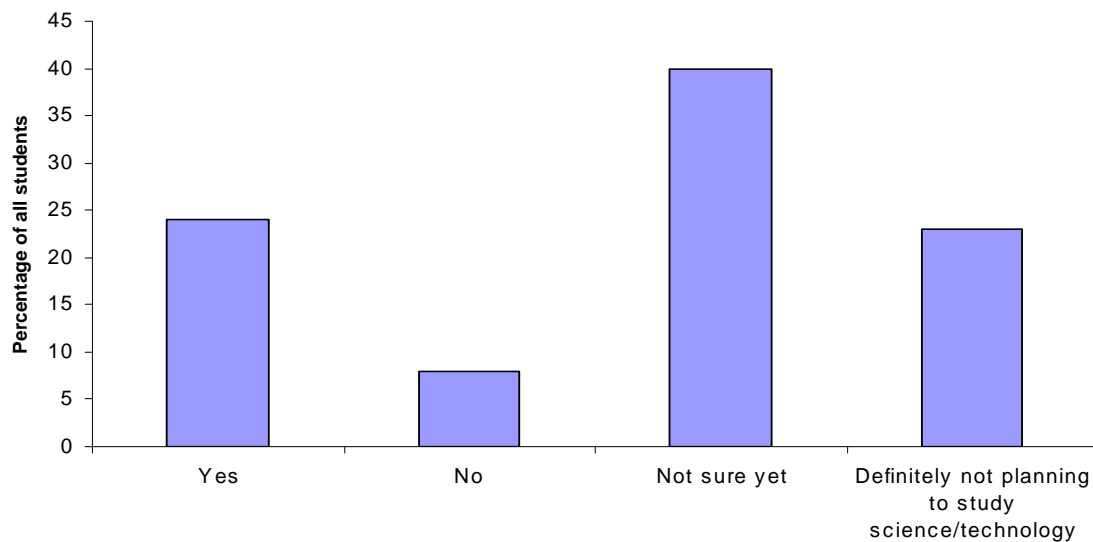


Figure 6 **Students' intentions to include business, management, or law papers in a science/technology degree**



Students were also asked whether they had thought about combining these areas prior to seeing the Business of Science presentation. As Table 14 shows, approximately one-third of students who thought they would combine these areas said they had not considered doing this before the Business of Science workshop.

Table 14 Students who plan to combine areas but had not thought of doing this before the workshop

	Total	Number of students who had not considered combining these areas before the Business of Science seminar
Students who think they will include science or technology papers in a business, management, or law degree	59	18
Students who think they will include business, management, or law papers in a science or technology degree	60	18

Main messages that students got from the seminar

Students were asked to indicate the main message or idea they got from the seminar. The responses were coded and categorised to identify and quantify the most common kinds of responses. If students' responses included more than one message or idea, their responses were coded into more than one category. As Table 15 shows, just under half the students said the main message was that combining science and business/management/law was a good idea, for example, because it opened up a range of career opportunities.

Table 15 The main message(s) or idea(s) students got from the seminar

Main message or idea	% of responses
Retaining science, or combining science with law/business/management is a good idea, or opens up more career options	49
Science offers lots of opportunities, is a growing area, or helps you to understand things better	18
Science is economically important to New Zealand, or New Zealand needs to invest in New Zealand knowledge and businesses	13
There are lots of options to choose from, or you can combine areas	8
Science might enable me to make a lot of money	7
Other	7
No response	10

Note: Table percentages have been rounded to the nearest whole number. Table percentages do not sum to 100%, because some students' responses were coded into more than one category.

The following are some typical examples of this kind of response:

Combining science and business can be awesome and really helpful. (Year 13 student survey response)

If you are planning on doing a science degree, throw in a business masters, or vice versa. (Year 11 student survey response)

Eighteen percent of responses alluded to the benefits of studying science, without specifically mentioning the combination of science with business/management/law.

Science is very useful. (Year 13 student survey response)

That science can benefit a lot of different types of job situations. (Year 13 student survey response)

Thirteen percent of responses mentioned the importance of science and business knowledge for New Zealand's economy.

New Zealand has a lot to offer the world, but we need more scientists and business managers teaming up together to help the economical growth of New Zealand rise successfully. (Year 13 student survey response)

To get more New Zealanders to combine science with technology, and keep the science in New Zealand. (Year 11 student survey response)

Seven percent suggested that doing science, or combining science with other areas, might enable them to make good money.

That combining business and science is a good way to set up your degree and helps you find more jobs and makes you more money. (Year 13 student survey response)

Further analysis of the survey responses shows that only 11 percent of students who answered this question did not mention either the value or benefits of science, or the value of combining science with business, management, or law. For example, eight percent of students said the main message of the seminar was "to keep options open" or "there are lots of different areas and you can combine areas".

Most of the twenty students interviewed by telephone in October could still recall the main messages of the seminar, although several commented that it was harder to remember the details of the presentation. One student could not remember anything at all from the seminar, and another had only a vague recollection that the seminar's message was that "science is in a lot of things".

Perceived relevance of the seminar

The survey asked students whether they thought the Business of Science seminar was relevant for them. Thirteen percent felt it was "extremely relevant", while 76 percent said it was "possibly

relevant". Only six percent said the seminar was "not at all relevant".⁹ Phone interview students had mixed views about the seminar's relevance for them. Students who said they found the seminar relevant usually said they had already been thinking about science, business, or law options for future study or careers.

Yes, because I've been trying to figure out careers I can do using my science. I was aware of a lot more things after [the seminar] (Phone interview, student 98)

Others said the seminar was relevant because it gave them new ideas or options to consider.

Yes, 'coz I'm still deciding what to do next year. I'm interested in the idea of a conjoint degree - I hadn't thought of that before (Phone interview, student 123)

However, several students said the seminar was interesting but not particularly relevant for them. Some students said this was because they were still in Year 12, or were not taking science subjects this year, or were "just not interested in science". Other students felt they already knew the things that had been covered in the seminar.

It was interesting but I found a lot of the stuff I already knew about. It was more about the entrepreneurial stuff, I was hoping it would be more on universities and stuff. (Phone interview, student 171)

I didn't find it that interesting. I already had those ideas [about what I want to do]. (Phone interview, student 20)

Students were asked what they liked most about the seminar. Almost a third of students did not answer the question. The responses of those who did answer the question were coded and categorised to give frequency information (*see* Table 16).

⁹ Due to a production error, the roadshow survey did not have a "probably not relevant" option for this question.

Table 16 What students liked most about the Business of Science seminar

What students liked best about the seminar	% of responses
It was fun/interesting/engaging/informative	12
The stories of successful businesses/companies/products	12
Thinking about why science and business is a good combination	11
Getting ideas for future study	9
The visuals/slideshow	9
Seeing “real” examples of exciting or interesting jobs (without specific reference to science)	7
Seeing examples of jobs/careers in science	6
Group work/discussion/interactive activity	5
No answer	31

Note: Table percentages have been rounded to the nearest whole number. Table percentages do not sum to 100%, because some responses were coded into more than one category. Responses given by fewer than 5 % of students are not shown in this table.

Many of the comments were very brief or non-specific (for example “finding out the information” or “interactive”). Some examples of more detailed comments are shown below.

The slideshow and practical examples which illustrated examples of the message of the workshop. (Year 12 student survey response)

It gave me some ideas and has convinced me to continue science at Uni, along with my business management. (Year 12 student survey response)

I was reassured by that business science offered a lot because I wasn’t sure about the science part. (Year 11 student survey response)

Case studies of businesses that have become big through business and science. (Year 12 student survey response)

Finding out how to increase your profits when selling overseas. (Year 12 student survey response)

It just shows and proves that you do need science no matter what you want to do. (Year 12 student survey response)

Seeing achievements of NZ businesses and knowing that we NZers can be the best in the world. (Year 13 student survey response)

Students’ ideas about future jobs and careers (survey)

Table 17 shows the broad range of career interests students listed on their survey forms.

Table 17 Students' future career interests

Career area	% students
Business/government/economic/management/accounting	31
Science/environmental/veterinary	18
Health/medical (human)	12
Computer/ICT	10
Law	8
Electronics/electrical/automotive engineering/mechanics	7
Teaching	7
Sports-related	7
Arts/multimedia/film/music/drama	7
Design/architecture/engineering/technology	6
Hospitality/tourism	6
Farming/agriculture	5
Research	3
Journalism	2
Other service industry	1
Other	12
Not sure yet	4
No answer	14

Consistent with their plans for tertiary study (*see* Figure 4, page 29), many students (31 percent) named careers that involved business, management, or accounting knowledge. Careers involving science, environmental studies, health and medicine, veterinary sciences, or computers and ICT were also popular. In some cases, students named several specific career interests.

Advertiser, pilot, fitness trainer. (Year 13 student survey response)

Viticulture and Oenology, Commerce. (Year 13 student survey response)

Pharmacy. Law with accounting. (Year 13 student survey response)

Medicine. If I don't get into medicine I'll try for radiation therapy and if not that a science degree that will maybe lead to teaching. (Year 13 student survey response)

Biology. Physiotherapist. Time and management officer. Educational Psychiatrist. (Year 13 student survey response)

Some students referred to a general area of interest.

Something with engineering. (Year 13 student survey response)

Researcher in bio or some other sciences. (Year 12 student survey response)

Others described attributes of a job that would interest them.

A rich career. (Year 12 student survey response)

Anything that earns a lot of money and is not stressful. (Year 12 student survey response)

Students' ideas about future jobs and careers (telephone interviews)

To develop a richer picture of students' thinking about future careers, the following question was asked in the telephone interviews:

At this point in your life, you might not be exactly sure of the kind of job you want to do. However you may have some thoughts about what would make a job enjoyable, interesting, or rewarding for you. Right now, what kind of things do you think will be important to you when you are choosing jobs in the future?

Table 18 shows the most common ideas mentioned by the 20 telephone interview students.

Table 18 Most common ideas mentioned

Things that will be important in a job	Number of students who mentioned this (n=20)
Interactions with people/workmates	9
A job where you keep learning/a job which changes/is challenging	6
Income	5
Making a difference/giving something back/helping people or the environment	5
Not at a desk all day/outdoors/physical	5

It is interesting that few students talked about specific areas of knowledge or fields of expertise in answer to this question. Some of the students' comments are shown below.

Just that I'd find it interesting, not get bored, a lot of variety. That the qualifications would lead you into other jobs. Not too office-based, maybe get to do a lot of travel. I think I would have to be kept interested. (Phone interview, Year 13 student)

...the [workplace] environment, how friendly people are. I don't want to work with people that are 'harsh'.... I think if you really like what you do.... (Phone interview, Year 13 student)

...Being able to help people, give something back. Making them feel better. (Phone interview, Year 13 student)

Profiles of the telephone interview students

This section uses survey and phone interview data to present a snapshot profile of a selection of ten students who attended the Business of Science roadshow. These ten were chosen to illustrate a range of different views and perspectives about the seminar, and how it connected with the student's current plans and ideas for the future.

Student 20

Student 20 is a male Year 13 student at a high school in a small town near Hamilton. This year he is taking chemistry, physics, calculus, and statistics. He found out about the Business of Science seminar from his physics teacher, and went along because he was thinking about doing something in business and science in his future. However, he said he didn't find the seminar that interesting because "they basically said the same thing as I already wanted to do". His intention was to go to university to be an inventor and "make some money".

There's a lot of scientists out there who can't make a lot of money. I will market what I think is good.

Student 20 said the seminar had not had much impact on his plans and ideas for the future because he "wasn't listening that hard". He was hoping the seminar would show more examples from "big businesses" like Sony, or companies involved in electronics, computing, or game design. His goal for the future was to be his own boss, and to have a big company, and "to feel like I'm doing something big".

Student 171

Student 171 is a female in Year 13, who attends school in a small town about 45 minutes' drive from Hamilton. Student 171 went to the Business of Science seminar on the advice of her careers adviser. This year, she is taking biology, chemistry, accounting, and statistics. She plans to go to university next year, and is interested in studying economics, business, or management studies, and/or medicine, health sciences, nursing or veterinary. She is interested in a career in accountancy or management, or medical and agricultural science. She felt that the seminar was interesting, although she "already knew a lot of the stuff" that was talked about.

It was more about the entrepreneurial – I was hoping it would be more on the Unis and stuff.
(Student 171, phone interview)

At the time of the interview, student 171 was thinking of doing business management at the University of Waikato, and including some science papers into her degree. She felt that the Business of Science seminar "sort of gave me a better idea of what I can get out of science... I was already going to go into accounting. It helped me to see how science can contribute." However, student 171 thought it would have been good to get more information about

qualifications that combined business and science, and more information about how these could lead into careers.

[The seminar] told you about jobs but not how you can get there. (Student 171, phone interview)

Student 87

Student 87 is a male Year 12 student at a college in the Thames/Coromandel area. Student 87 heard about the seminar through the school notices, and attended because it sounded like it would cover the career areas he was interested in. This year he is taking biology, economics, chemistry, and accounting. In 2004 he plans to do Year 13, then in 2005, to study accounting, and “after that probably do something sciencey”. He is currently thinking about doing this at the University of Waikato, or Massey in Auckland. He thought the seminar was well presented and interesting, and that it was relevant for him.

I would be quite interested in looking at doing a science degree with accounting. (Student 87, phone interview)

Student 202

Student 202 is a female Year 12 student at a Hamilton high school. This year she takes accounting, technology, and mathematics. She encountered the Business of Science seminar when she walked into her accounting class. Student 202 thought the main message of the seminar was “to take science as well, not just business or accounting”. After Year 13, student 202 thought she would do a degree in business, management, or accounting, at the University of Waikato. She thought the seminar was interesting,

...but I just don't like science, so I don't think I will take it.

Student 222

Student 222 is a male Year 12 student at a college approximately 20 minutes away from Hamilton. He found out about the Business of Science seminar from his careers adviser. This year he is taking physics and mathematics. Next year he plans to do Year 13, and after that, to go to a technical institute to do a degree in computer technology. He is definitely not planning to study business, management, or law, but thinks he might include business or management papers in his computer technology degree. Student 222 felt the main message he got from the seminar was that “you can actually use science with the job that you go into”. This was relevant for him “because I'm taking physics, you need that to go into a job as a computer technician”. However student 222 didn't think the Business of Science seminar had any impact on his plans or ideas for the future “because I already kind of knew what I was going to do”.

Student 177

Student 177 is a male Year 13 student at a Hamilton high school. This year he takes accounting, sports science, and marketing. He did not know about the Business of Science seminar until he arrived in his accounting class on the day of the roadshow visit. Next year he plans to go to university. He is interested in studying either accounting or sports science at the University of Waikato, and would be interested in a career as a personal trainer or a PE teacher. Student 177 remembered the main message of the seminar as being that “there are more opportunities in science”. He felt the seminar was relevant for him in some ways, “but mostly not” because he was not taking science subjects in Year 13. He thought the seminar was good, but did not feel it had helped him make any plans or decisions for next year.

Student 123

Student 123 is a female Year 13 student at an area school in the Thames-Coromandel district. She found out about the seminar from her careers adviser, and went along because she is planning to go to university next year to study either business or science. This year, she is taking biology, chemistry, and earth science. She found the seminar relevant and interesting because she was still deciding what to do next year. She was interested in the idea of doing a conjoint degree, and had not considered this option prior to the Business of Science seminar. Since the seminar, she had looked at different universities to see which ones offered mixes of business and science. She is currently thinking about going to the Auckland University of Technology to study physiotherapy, health science, or perhaps marketing. She enjoys health science and thinks that business studies could help her to make good money. She thought the seminar was good but suggested that more information on career opportunities and where you can do combined science/business degrees would be useful.

Student 142

Student 142 is a female Year 13 student at a high school in a small town near Hamilton. This year she is taking biology, chemistry, and statistics. She heard about the Business of Science seminar through the school notices, but wasn't sure what it was about, and was not going to attend. However, by chance she came into the common room when the seminar was starting, and found it interesting enough to stay. Student 142 found the seminar relevant because she likes science, and was looking at a way of going into a science area after high school. She is interested in biogenetics, and felt the Business of Science seminar had had an impact on her ideas for the future.

It made me want to do science, language, and management... I want to include all those three for my knowledge...I was going to just do science and management, but now I'm going to take leadership skills [as well].

However, before doing this, student 142 was planning to do a year at a performing arts school, with a major in vocals and a minor in dance “so I get a break doing something I love”. In spite of her interest in science, student 142 had some misgivings about what it would be like to work in the science industry. She was worried that people often had to hide their knowledge, and that they could get fired for “knowing too much”.

It really sucks that people have to hide their knowledge, they can't share their ideas. I really hate that about sciencey stuff. It's all so top-secret... I would want to have an environment where I could bounce ideas off other people. It's hard when the whole science [field] is set up that way...its scary, it sort of keeps me away from science - you'd get so cynical and cold...

Student 187

Student 187 is a male Year 13 student at a Hamilton high school. This year he is taking biology and accounting. He did not know about the Business of Science seminar until he arrived in his accounting class. Student 187 said the seminar was interesting, but not very relevant for him because “I don't have a clue what to do when I leave school.” Student 187 was not sure what kind of job or career he was interested in for the future, but thought it would have to be “something hands-on, where you are learning while you are doing it”. He felt the seminar had not helped him make any plans or decisions, and would have liked more information about career paths.

Student 98

Student 98 is a female Year 12 student at a college approximately one hour's drive from Hamilton. This year she is taking biology, chemistry, physics, and mathematics. She found out about the Business of Science from her careers adviser, and went along because it sounded interesting and because “I'm taking all the sciences and really enjoy them.” After she does Year 13, student 98 plans to go to university. She is interested in doing a degree in radiography, or something to do with animals or zoology, or possibly law. The main message she got from the seminar was that science is not just biology, chemistry, etc., but that “you can use it in a lot of different ways, in different jobs”. She found the Business of Science seminar interesting and relevant.

...because I've been trying to figure out careers I can do using my science. I was aware of a lot more things after [the seminar].

However, student 98 said the seminar had “not really” had an impact on her plans and ideas for the future, because she had already planned to go into an area involving science.

Suggested improvements to the seminar

Just over three-quarters (76 percent) of surveyed students did not suggest any changes or improvements to the seminar, or said it was fine as it was. However, a few students suggested that the seminar could have included more information about other areas.

Include more information about environmental science. (Student survey response)

Include other sciences, like health sciences, biomedical. (Student survey response)

Include less industrial manufacturing examples. (Student survey response)

I was quite interested in the arts side of it as well but that wasn't part of the presentation. (Student survey response)

A few students thought the PowerPoint presentation had been too rushed or that the session should have been longer. Only four students said that the seminar should have been optional, that they were not the right "audience" for the Business of Science message, or that they had not been given the right information before the seminar.

I don't think you [the presenter] knew one of the classes was a science class. But if it was directed at science students to do business [it]would be good. (Student survey response)

Let us know what it is. We were told it was just for management or commerce. Nothing about science. Sorry, I know it's not your fault. Apart from that, yeah it was good. (Student survey response)

The telephone interview students suggested the seminar could be improved by giving more information about different career options, and where students could do combined degrees. One student suggested it would be good to meet people who had combined these areas in their study or careers, so students could talk to them in person. Another suggested it would be helpful to provide some sort of further contact details so that students who were interested could "take it a step further".

I sort of thought it would be cool to get more info about qualifications... It told you about jobs but not how you can get there. (Phone interview, Year 13 student)

...how we could get involved, more info about career paths. (Phone interview, Year 13 student)

Summary of findings from the Business of Science roadshow seminars

- Just over half of the 253 students surveyed about the roadshow seminars were currently in Year 13. A third were in Year 12, and 12 percent were in Year 11.
- Seventy-seven percent of students currently took at least one science subject, 81 percent took at least one mathematics subject, and 60 percent took at least one business subject. However,

only 38 percent took at least one science and at least one business subject. Thirty-nine percent took at least one science subject, but no business subjects, and 22 percent took at least one business subject, but no science subjects.

- Just over half (52 percent) indicated an interest in tertiary level study in one of the following science or technology areas: science or environmental studies; engineering or architecture; computer science/IT; medicine, health, nursing, or veterinary studies; technology; or mathematics or statistics. Just under a third (31 percent) of students indicated an interest in studying business or management studies. Only 10 percent of students indicated an interest in studying law.
- A quarter of the students said they thought their degree would include a mixture of business, management, or law papers and science or technology papers. Approximately one-third of these students (n=18) said they had not considered combining these areas prior to the Business of Science seminar.
- The main messages students reported from the seminar were:
 - that retaining science, or combining it with law, business, or management, is a good idea or can open up more career options (49 percent);
 - that science offers lots of opportunities or is a growing area (18 percent);
 - that it is economically important for New Zealand to invest in science knowledge or New Zealand businesses (13 percent);
 - that there are lots of options to choose from and you can combine areas (8 percent);
 - that science can enable students to make good money (7 percent).
- Students had mixed views about the relevance of the seminar for them personally. Those who found it relevant said it had given them new ideas for their study or career, or had helped confirm ideas they had already considered. Some students felt they already knew what they wanted to do, so they found the seminar interesting, but did not think it had impacted their plans or ideas.
- Most students did not suggest changes or improvements to the seminar. Some students suggested that the seminar could have included other career or study areas, or different kinds of examples (for example, health sciences, environmental science, or arts subjects).
- Phone interview students suggested that more information about university courses and career opportunities would have been useful. Students also suggested having people they could meet and talk to about combining science and law or business in their own study or careers.

The presenter's reflections on the roadshow seminars

As a final comment on the Business of Science roadshow seminars, there was evidence that in some schools, information about the roadshow and its potential relevance to students had not filtered through to staff in the science department. The roadshow presenter suggested that in

future, it might be more useful to liaise directly with science department staff to organise the roadshow visits. For example, it may be useful to attend a science department meeting earlier in the year, to introduce science teachers to the Business of Science message and to demonstrate some of the materials/resources/presentation, and discuss why it would be valuable for science students to be exposed to the Business of Science message. Anecdotal feedback from staff who did attend the seminars indicated the seminar was well received, and was felt to be worthwhile for students. She felt it was important for teachers to be present at the session, so that they could provide “next step” support and advice to students who wanted further advice or guidance about tertiary study or career options. The idea of a Business of Science website was also suggested as a way of providing further information for students who were interested. The roadshow presenter suggested that students who attend the session could be given a free pen with a URL they could go to for this kind of information.

The presenter also noted that the seminars seemed to work best with about 25 students. Smaller groups generated less discussion and interaction; with larger groups, presentation tended to become more lecture-like. When the sessions were presented in lecture theatres, it was harder for the students and presenter to move around and interact. Classroom settings were felt to be more “personal”, and allowed for better group discussion and feedback.

She also suggested that term two (rather than term three) was a better time for the roadshow visits, because term two is longer and generally less crowded for teachers and students.

Section Five

Discussion

This section discusses the evaluation findings and raises some general issues that have emerged from the research. To draw useful conclusions from the evaluation data, it is useful to reflect on the context in which the Business of Science initiative was developed, and to make explicit some of the goals and premises upon which the initiative is based. By bringing these to the forefront of the discussion, it is possible to use the evaluation data to consider which of these goals and premises¹⁰ are (or are not) supported by the evaluation, which premises may need to be revised, refined, or revisited in light of the data gathered in this evaluation, and which remain open to further investigation.

Goals and premises of the Business of Science initiative

The Business of Science initiative was originally conceived to target Year 13 students who have taken sciences at high school, but may intend to drop science to study law or business degrees at tertiary level. The aim of the initiative was to encourage these students to retain some science papers in their law or business degree, or to consider doing a conjoint degree in science and business/law. In media coverage for the initiative (e.g. Evans, 2003), it has been clearly stated that the Business of Science does not aim to turn students away from business studies and persuade them back into science. Rather, it seeks to convince students that business and science make a good combination for tertiary study, and will broaden the array of career options open to students. Thus, the project aims to provide Year 13 students with information about the direction of New Zealand's economy, and the future of its big growth industries, in order to influence students' decisions about what to study at university. As an exploratory initiative, one aim of the initiative is to establish a better understanding of the influences behind Year 13 students' degree course choices, and to see if the extra information on what a future, rather than present, New Zealand will look like, will change their views on subject choice (Meylan, cited in Evans, 2003, p. 5).

¹⁰ In this context, “goals” refers to the explicit or implicit aims of the initiative, and “premises” refers to implicit assumptions that could be inferred from the initiative.

The main goals and premises for the initiative can be summarised as follows:

- The main target audience for the Business of Science message is “science-able” students who are choosing not to study science, but to study areas like law and business instead.
- These students need to be convinced to retain sciences in their law or business degrees.
- Students will pick up the key messages of the initiative from the Business of Science seminars, and that this will have an impact on students’ choices and ideas for future study and careers.

Unpacking these ideas further, the content of the Business of Science presentation is based on the premise(s) that:

- students will recognise the message that there are significant economic benefits (both for the New Zealand economy, and for students personally) in careers which combine science/technology with business and/or law;
- personal economic rewards, or knowing they could make a positive contribution to New Zealand’s economic growth and development, are motivating ideas for these students;
- giving students examples of successful New Zealand companies that have developed and capitalised on science or technology knowledge, and examples of people whose careers involve a mixture of science and business/law, will enable students to envisage themselves in future careers that will combine science/business/innovation; and
- students will act on the ideas presented in the Business of Science seminars when making their tertiary study choices.

Finally, the Business of Science implicitly assumes that:

- students can intentionally plan an educational pathway that might lead them to become a successful “science-savvy” business person, entrepreneur, or innovator;
- taking undergraduate science courses in a degree/diploma in another area (i.e. business or law) will help students to become “science savvy”, and ultimately, to make better choices, decisions, and investments (relating to science and technology) in their chosen field; and
- educational pathways that combine science/business/law are currently possible and plausible at the tertiary institutions at which students might choose to study.

These goals and premises have played a role in shaping the Business of Science initiative, and the way in which the Business of Science message has been presented to students, teachers, and tertiary staff. Because the initiative is currently a “pilot project”, this evaluation allows the opportunity to look carefully at each of these goals and premises, and consider how useful or appropriate each one is in the context of the overall aim of the initiative. The next section considers how each of these goals and premises might be assessed in light of the evaluation findings. In some cases, the evaluation data suggests alternative possibilities that may need to be considered. For example, Table 19 summarises the main goals and premises of the Business of Science initiative (the left-hand column), and suggests some alternative possibilities that may merit further consideration in future development of the Business of Science. Data from Sections

Two to Four of this report will be used to explore which goals and premises found support in the evaluation, which goals and premises may need to be revised or reconsidered against an alternative premise, and which premises are open to further investigation.

Table 19 Business of Science premises or goals versus alternative possibilities

Business of Science premises or goals	Alternative possibilities
The target audience	
<p>1a. The main target audience for the Business of Science message is science-able” students who are choosing not to study science, but to study areas like law and business instead. These students need to be convinced to retain sciences in their law or business degrees.</p>	<p>1b. The target audience for the Business of Science includes students with a range of different ideas and intentions about future study in science/technology, law, and business.</p> <p>1c. The target audience includes students who intend to study science or technology, (not business or law), with a view to moving into a science-related career. These students could be convinced to pick up some business or law in their science degrees so that they will be more “business-savvy” or “law-savvy” scientists.</p> <p>1d. The target audience includes students who have taken business and mathematics at school but not science. These students may be “not interested” in science, or perceive they cannot pursue science at tertiary level. Is there still a pathway for these students to become “science savvy”?</p>
Intended impact of the Business of Science message	
<p>2a. Students will pick up the key messages of the initiative from the Business of Science seminars, and this will have an (observable) impact on students’ perceived choices and ideas for future study and careers.</p>	<p>2b. Students’ perceived choices and ideas for future study and careers are not impacted by the Business of Science seminars.</p> <p>2c. It is difficult to discern the impact of the Business of Science seminars on students’ perceived choices and ideas for future study and careers, because the impact is subtle or occurs over a long term.</p>
Aspects of the Business of Science message that motivate students or capture student interests	
<p>3a. Students will recognise that there are significant economic benefits (both for the New Zealand economy, and for students personally) in careers which combine science/technology with business and/or law. Personal economic rewards, or knowing they could make a positive contribution to New Zealand’s economic growth and development, are motivating ideas for these students.</p> <p>4a. Showing students examples of successful New Zealand companies that have developed and capitalised on science or technology knowledge will enable students to envisage themselves in future careers that will combine science/business/innovation.</p> <p>5a. Showing students examples of people who have careers that combine science/technology and business/law will enable students to envisage themselves in future careers that will combine science/business/law.</p>	<p>3b. Many factors motivate students to pursue particular areas of study or career, including: personal interest in a subject area, a desire to help other people.</p> <p>3c. Some students’ study or career choices are not motivated by personal economic incentives, or knowing they could make a positive contribution to New Zealand’s economic growth and development.</p> <p>4b. Some students may not relate to these particular examples of successful New Zealand companies. Different kinds of examples may be needed to enable these students to envisage themselves in future careers that will combine science/business/innovation.</p> <p>5b. Some students may not relate to these particular examples of people who have careers that combine science/technology and business/law. Different kinds of examples may be needed to enable these students to envisage themselves in future careers that will combine science/business/innovation.</p>

Business of Science premises or goals	Alternative possibilities
The type of information/guidance that helps students	
6a. Giving students the general message about combining science and business/law is enough to influence their study decisions. Specific guidance on possible study or career pathways is not as important.	6b. Giving students the general message about combining science and business/law is not enough to influence their study decisions. Students need specific guidance on possible study or career pathways.
The immediate goal of the initiative	
7a. Students will act on the ideas presented in the Business of Science seminars when making their tertiary study choices.	7b. Students' tertiary study choices are more strongly influenced by other factors (for example, family or peers); these may outweigh the impact of Business of Science ideas on students' final choices and decisions.
The long-term goal of the initiative	
8a. Students will become "science-savvy" business people or lawyers, who make good decisions or investments in science-technology-related areas.	8b. Students will become "business-savvy" or "law-savvy" scientists and technologists.
The tertiary study pathways to achieve the long-term goal of the initiative	
9a. Students can intentionally plan an educational pathway that might lead them to become a successful "science-savvy" business person, entrepreneur, or innovator.	9b. The pathway to becoming a "science-savvy" business person, entrepreneur, or innovator is complex and irregular; educational choices don't matter as much as factors such as chance, timing, person-to-person connections, individual personality, etc.
10a. Educational pathways that combine science/business/law are currently possible and plausible at the tertiary institutions at which students might choose to study.	10b. It is currently difficult for tertiary institutions to provide educational pathways for students that combine science/business/law, due to structural or perceptual constraints or barriers in these institutions.
	10c. Pathways exist for students to combine these areas in their studies, but student uptake of these pathways/combinations is limited.
11a. Taking undergraduate science courses in a degree/diploma in another area will help students to become "science savvy", and to make better choices, decisions, and investments (relating to science and technology) in their chosen field.	11b. Undergraduate science courses currently offered in tertiary institutions are not geared towards creating "science-savvy" individuals; rather, they focus on foundational knowledge and skills that students require to become more expert in particular science disciplines.
	11c. The kind of science courses that non-science majors need to become "science savvy" differ from those currently offered.

Evidence from the evaluation with respect to the goals and premises of the Business of Science

The target audience

The Business of Science was originally conceived to target a hypothesised group of students – namely, Year 13 “science-able” students who, for whatever reason, were poised to move away

from science and into business, management, or law studies in their tertiary studies (*see* point 1a. in Table 19). However, the student surveys from the careers expo and roadshow seminars suggested the presentations attracted a range of students (including those at younger year levels), with a range of existing ideas and intentions for tertiary study and future careers. Many students who attended the June careers expo seminar thought they would study science at tertiary level, and aspired to a career involving science. Fewer of these students indicated an interest in business, management, or law studies.

Just over half (52 percent) of students surveyed at the August-September roadshow presentations indicated an interest in tertiary level study in one of the following science or technology areas: science or environmental studies; engineering or architecture; computer science/IT; medicine, health, nursing, or veterinary studies; technology; or mathematics or statistics. Around a third (31 percent) were thinking of studying business or management. However, 22 percent of students were currently taking economics or accounting but did not take any science subjects.¹¹ Thirty-nine percent of students were currently taking science subjects but did not take economics or accounting. This suggests that the seminar audience included students with a range of backgrounds in science and business subjects, and a range of ideas and intentions with regard to future study in these areas.

The evaluation suggests that it is useful to consider the “sub-populations” of students who may be in the seminar audience. To illustrate, four examples which seem to be supported by the student profiles in Section Four (*see* pp. 38–41) include:

1. students who are already firmly convinced that they want to combine science/technology with business or management at tertiary level (*see* student 20, p. 38);
2. students who definitely intend to study “science/technology/mathematics”¹² at tertiary level, but may be open to ideas and options for “adding value” to their education by taking business/law/other subjects (*see* student 87, p. 39);
3. students who are weighing up whether to do “science/technology” OR another area, but may be open to ideas and options for doing both (*see* student 123, p. 40);
4. students who are heading towards business/law, but have not taken science to Year 13, or are “just not interested” in science (*see* student 202, p. 39).

Students in any of these groups may benefit from the Business of Science message that it is viable and useful to combine science studies with studies in other areas. However, each sub-group may

¹¹ This may reflect the way that the roadshow seminars were organised at each school. In some cases, the seminar seemed to have been advertised to students by teachers or careers advisers, and student attendance was optional. In other cases, whole classes of science or accounting students were required to attend the session.

¹² That is, they were interested in one or more of the following areas: science or environmental studies; engineering or architecture; computer science/IT; medicine, health, nursing, or veterinary studies; technology; or mathematics or statistics.

want slightly different kinds of additional information in order to see how they connect this idea with their own personal circumstances. For example, students in the second category may have taken science subjects at school with the view that they would enter science at tertiary level. These students may not have taken business subjects at a senior level, and may not see themselves as potential candidates to take business, management, or law papers at tertiary level. These students may want to know how (or whether) they can “pick up” these areas at first-year university level. Students in the second and third category may need advice on how to act on their intention to combine science/technology with business/law, and/or reassurance on why it might be to their advantage to do so. Finally, some students in the fourth category might decide after seeing the presentation that, even without a previous background in science, it still may be possible for them to become “science-savvy” business people or lawyers. These students may want to know whether it is possible for them to “pick up” science at tertiary level, and if so, what sort of science(s) they could pick up.

Intended impact of the Business of Science message

The intention of the Business of Science initiative is that students will pick up the key ideas and messages presented in the seminars, and that these will have an impact on students’ perceived choices and ideas for future study and careers (*see* point 2a. in Table 19). The results of the student surveys and telephone interviews suggest that most students did pick up the Business of Science’s key messages, for example:

- that it is useful or valuable for future careers to combine science and business/law studies;
- that science is an area of growth and opportunity; and that it is economically important for New Zealand to invest in knowledge and innovation in science/technology;
- that it is possible to combine areas in one’s study/career; and
- that science can be a profitable career area.

There is evidence that the seminar did influence some students’ ideas and choices for tertiary study. Around 20–25 percent of students who attended the roadshow seminars thought they would combine science/technology with business/law; about 7 percent had not considered doing this before the Business of Science seminar. However, other students, particularly in the telephone interviews, said the seminar had “not really” had an impact on their plans and ideas because they already knew what they wanted to do (although some students felt that the seminar had affirmed their existing plans or ideas). Unsurprisingly, the impact of the seminar for students appears to vary from individual to individual, so that the seminar has an obvious impact for some students (*see* point 2a., Table 19), while for other students it has no impact (*see* point 2b., Table 19) or the impact is difficult to discern because it is subtle, or occurs over a long term (*see* point 2c., Table 19). It should be noted that, in the context of this evaluation, it is only possible to discuss what students said they *thought* they would do in their tertiary studies. Data on students’ actual tertiary subject enrolment in 2004 is not able to be collected as part of this evaluation.

Aspects of the Business of Science message that motivate students

The economic benefits of combining science/technology and business feature strongly in the Business of Science message. The roadshow presentation features a number of New Zealand companies that have succeeded through innovation and ingenuity, and the ability to develop and market products or processes using science and technology knowledge. Companies like MacIntosh Timber Laminates that have “added value” to primary products through the application of knowledge and innovation are given as examples. The careers expo seminar, and the Business of Science handout for students, featured examples of people whose jobs involve combinations of science and business/law. Since the overall goal of the Business of Science initiative is for students to consider how *they* might pursue an educational or career path that spans science and other disciplines, the implicit premise is that students will find these stories and human examples personally motivating or inspiring (point 3a.), and these examples help students to envisage themselves in future careers in these areas (points 4a. and 5a.).

The evaluation suggests that many students found the examples of successful New Zealand businesses interesting, or felt proud to see the achievements of these New Zealand companies. This was reflected in a number of students’ comments on what they liked best about the seminar (*see* pp. 33–35). Several students who were interviewed after the careers expo seminar expressed enjoyment in hearing the two guest speakers describe the pathways that led them to their current careers. However, there were also some students who suggested that the presentation should include examples from other areas like health science, biomedicine, or environmental sciences (*see* p. 42). When asked what sort of things they thought would make a job enjoyable, interesting, and rewarding for them, phone interview students mentioned a range of things, including: the amount or nature of interactions with people/workmates; having a job which is challenging or changes over time; doing something which helps people; being outdoors or not at a desk all day; as well as the amount of money they earn (*see* p. 37). With the students’ wide range of personal interests and motivations, there is a possibility that some students might not recognise a place for themselves in the Business of Science message, or may develop a perception about working in a commercial science environment which turns them away from this area (for example, *see* student 142’s comment on p. 40). It may be useful to broaden the Business of Science presentations to include other/different examples of combined science/business/law careers that would appeal to students with all these different interests and personal motivations (*see* points 4b. and 5b. in Table 19).

The type of information/guidance that helps students

The Business of Science seminars focused on the general message that it is valuable for students to combine science/technology with business/law in their tertiary studies. Students were not given specific details about which institutions they could study at, or the kind of degrees/papers they could enrol in, presumably because this fell beyond the remit of the initiative. (Although the roadshow presenter did give students some examples of degree structures that could accommodate

mixtures of science and business/law (*see* Figure 3, p. 25).) However, some students in the evaluation said they wanted more information about university courses and programmes of study that they could enrol in. Most interviewed students who attended the careers expo commented on how useful the expo stalls had been in this respect (*see* p. 21).

Several students responded positively to hearing the guest speakers at the careers expo seminar talk about their own educational and career pathways (e.g. *see* students' comments on p. 21). Some students who were interviewed after the roadshow presentation said it would be good to have access to people/role models whom they could talk to, to find out more about study pathways and career prospects that are available through a combination of science and business/law.

The long-term goal of the initiative

The background material for the initiative states the main long-term goal of the initiative is to show students who are poised to move into the fields of business and law the value of retaining their sciences. The reason for this is so that in the future, they will become “science-savvy” business people (or people with legal knowledge), and thus make good decisions and investments in science and technology-related areas (*see* point 8a. in Table 19). An alternative possibility is that the initiative could show students who are poised to move into science and technology fields the value of picking up business or legal studies so that they become “business-savvy” or “law-savvy” scientists/technologists (*see* point 8b. in Table 19).

The tertiary study pathways to achieve the long-term goal of the initiative

One implicit premise of the Business of Science initiative is that students can intentionally plan an educational pathway that might lead them to become a successful “science-savvy” business person, entrepreneur, or innovator (*see* point 9a. in Table 19). An alternative possibility is that this sort of pathway is complex and irregular, and that factors such as chance, timing, personal contacts, and peoples' individual interests and motivations play a significant role in the process (*see* point 9b. in Table 19). Although it is beyond the scope of this evaluation to speculate whether one premise is more or less plausible than the other, it is interesting to consider how or whether the second perspective could be emphasised more strongly in the Business of Science message, and whether this would assist students to relate themselves to the Business of Science stories. Some students' comments about the guest speakers at the careers expo seminars suggest that these students “connected” personal stories of *actual* study and career pathways, even if they could not recall the details of the Business of Science message (e.g. *see* pp. 20–21).

The Business of Science initiative works on the assumption that educational pathways that combine science/business/law are currently possible and plausible at the tertiary institutions at which students might choose to study (*see* point 10a. in Table 19). However, two alternative

possibilities are: that it is currently difficult for tertiary institutions to provide these kinds of combinations due to structural or perceptual constraints or barriers (point 10b.); or that these pathways are possible, but are taken up by few students (point 10c.) The tertiary staff interviews carried out after the Business of Science launch (*see* Section Two) suggest that all three of these possibilities occur to some extent. At the University of Waikato, the Bachelor of Science (Technology) degree enables science students to pick up management papers in their degree. In the other direction, degrees that could potentially allow students to include science papers in a management programme (e.g. the Bachelor of Management Studies, the Bachelor of Electronic Commerce, or the Bachelor of Communication Studies) have constraints that would make it difficult for students to accommodate science papers into these degrees. The combined BSc/LLB degree enables students to do a double major in science and law, but it seems that few students choose this rather demanding degree option. Other constraints and barriers to cross-disciplinary programmes mentioned by University of Waikato staff included: competition for EFTS between schools; workload issues that could arise for students trying to combine science courses (which have a high number of contact hours) with other courses; and students' perceptions or attitudes towards particular subject areas, based on their previous experiences with these subjects at school.

At Wintec, there appeared to be fewer structural barriers for students to combine areas, and pathways already existed for science students to pick up business papers. However, while it was theoretically possible for students to combine papers in the other direction, this did not seem to occur in practice.

Finally, the premise that combining undergraduate science papers in a law or business degree or diploma will help students to become "science-savvy" (*see* point 11a. in Table 19) is an open question. Rod Oram's address at the launch of the Business of Science initiative alluded to the need for careful consideration of whether existing undergraduate science courses are suitable for non-science majors, or whether different kinds of courses are needed. As the Business of Science pilot initiative was based in the Waikato region, this evaluation has only considered this question in the context of the University of Waikato and Wintec. Staff in the University of Waikato's School of Science and Technology suggested that to mount such generalist courses would require additional funding and preparation time, and that not all staff in the school would have the skills and knowledge necessary to deliver such courses. However, Wintec was about to launch a new graduate diploma called "communicating science", a course designed to make science "more friendly" for teachers, and to make communication with the public easier for scientists. The diploma includes courses on scientific journalism, science in society, and topics in communication.

It is not possible in this evaluation to comment on possible options and pathways for students to combine science with other subjects at other tertiary institutions. However, it may be useful for MoRST to gather further information in this area. It may also be useful to seek examples of tertiary institutions that have mounted science courses geared towards non-science students, to find out how and why these courses have been established, and to see how successful they have been in attracting students doing non-science degrees.

Conclusion

Summary of main findings:

- Overall, the Business of Science events appeared to be successful in conveying their core message about the value of students combining science/technology and business/law in their tertiary studies. However, the degree to which students will actually act on this message cannot be determined within the scope of this evaluation.
- Staff from the University of Waikato and the Waikato Institute of Technology were generally supportive of the initiative. There were some examples of existing degree/diploma structures which would allow students to combine these areas at these institutions. However, some barriers or constraints for students to combine science and business/law in their degrees were also identified. At these two institutions it seems that there are currently more viable pathways for science students to pick up business/management courses in their degrees, than for business/management students to pick up science/technology courses in their degrees.
- Although targeted at Year 13 (and possibly Year 12) students, many students who came to the careers expo seminars were in Years 9, 10, or 11. The careers expo seminars seemed to attract science-oriented students, with many planning on further study and careers in a science-related area. Fewer students expressed an interest in doing law, business, or management.
- Many students found the Business of Science seminars interesting and informative. Many liked seeing examples of successful New Zealand companies in the presentation. Some students felt the seminars had given them useful information/ideas for planning their tertiary study, or had confirmed their existing ideas about what to do in their future study/careers. Other students were not sure yet, or said the seminar had “not really” had any impact on their plans and ideas for future study.
- The roadshow audience included a mixture of students with a range of backgrounds in science or business subjects, and a range of ideas and intentions for tertiary study and future careers in these areas. Just over half the roadshow students (52 percent) indicated an interest in tertiary level study in one of the following science or technology areas: science or environmental studies; engineering or architecture; computer science/IT; medicine, health, nursing, or veterinary studies; technology; or mathematics or statistics. Just under a third (31 percent) of students indicated an interest in studying business or management studies. Only 10 percent of students indicated an interest in studying law. A quarter of the students said they thought their degree would include a mixture of business, management, or law papers

- and science or technology papers. Approximately one-third of these students (n=18) said they had not considered combining these areas prior to the Business of Science seminar.
- The main things students suggested for improving the seminar were: having a wider range of examples of careers and study options that link science with other areas; having role models “in-person” who students could talk to about their study and career pathways; and having more information about universities and courses of study that enable students to combine business and science, and careers that these qualifications might lead into.
- There was evidence in some schools that information about the roadshow and its potential relevance to students had not filtered through to staff in the science department. The roadshow presenter suggested that in future, it might be more useful to liaise directly with science department staff to organise the roadshow visits. For example, it may be useful to attend a science department meeting earlier in the year, to introduce science teachers to the Business of Science message and to demonstrate some of the materials/resources/presentation, and discuss why it would be valuable for science students to be exposed to the Business of Science message.¹³

The findings of this evaluation suggest that, in future development, the Business of Science initiative may be strengthened further by:

- recognising the range of interests and motivations of students in the target audience, and thinking about what different kinds of information different students may need to connect the Business of Science message to their own personal situation;
- using a wider range of examples of careers/businesses that combine science and business/law knowledge, for example in areas like health sciences, environmental sciences, and other areas that are of interest to “science-oriented” students;
- continuing to use examples of real people who combine science and business knowledge in their careers, and helping students to see how they might make decisions at different points in their own education and career pathway that would lead them towards similar kinds of careers;
- seeking ways to help students with the “next step”; for example, by providing information about universities and possible courses of study; or directing students to a website where they could find more information. The roadshow presenter suggested that students who attend the session could be given a free pen with a URL they could go to for this kind of information; and
- seeking to secure further involvement from careers teachers, business studies teachers, and science teachers in the organisation and delivery of the Business of Science roadshow, perhaps by visiting schools prior to the roadshow to introduce teachers to some of the materials/resources/presentation, and discussing why it would be valuable for science

¹³ This presumes that science students will continue to be the primary target audience for the Business of Science message. If the initiative aims to target a wider audience (e.g., to include business students who have not taken science to Year 13), teachers from other departments may need to be introduced to the initiative and its potential relevance for their students.

students (and possibly non-science students) to be exposed to the Business of Science message.

References

Evans, S. (2003, June 4–10). Where science meets business. *NZ Education Review*, pp. 5.

Ministry of Economic Development. (2003). *Growth and innovation framework: progress report*. Wellington: Ministry of Economic Development.
http://www.med.govt.nz/irdev/econ_dev/growth-innovation/implementation-progress.pdf
[Access date 27.10.2003]

Appendix One

Interview schedule for University of Waikato and Waikato Institute of Technology staff

1. Were you able to attend the presentation about the Business of Science initiative last night?

Yes No

2. If yes, what is your understanding of what MoRST and the Careers Service hope to achieve from this initiative? (*If no, briefly outline the project and address any questions about it*)

3. Do you see merit in the idea of encouraging law students to take one or more science papers?

4. From your point of view, is this an initiative that could work at this university?

Yes No

Why/why not?

5. Are there any *structural* constraints that could preclude students enrolled in the School of Law from taking one or more science papers? (please explain)

Possible examples:

- timetable issues
- geography of campus
- course structure issues
- other

6. If yes, how easily do you think these barriers could be removed?

7. Do you think there are any other types of constraints that could render the initiative unsuccessful?

Possible examples:

- philosophical differences
- attitudinal differences
- different educational approaches

8. In your opinion, how easy would it be to overcome these types of constraints (if any)?

9. How do you think other staff in the School of Law might respond to this initiative?
10. Are there any *formal* processes for dialogue between the schools regarding potential interconnections between courses in the various schools of this university?
11. Are there any effective informal channels by which such dialogue might take place?
12. Are there any other comments you would like to make about the initiative?

Appendix Two

“Business of Science” student survey, careers expo June 8/9

The New Zealand Council for Educational Research is doing an evaluation of the “Business of Science” initiative you have just attended. Please help by filling out this short survey. It only takes 3 or 4 minutes to complete.

1. Who have you come to today’s seminar with? (Please choose ONE)

- 1) I came on my own
- 2) I came with friends or family
- 3) I came as part of a school group (Name of your school _____)

2. Was this seminar (The Business of Science) something you had planned to attend today?

- 1) Yes
- 2) No

3. How did you find out about the Business of Science seminar? (you may choose more than one)

- a) Didn’t know about it until I got here today b) Newspaper
- c) Science teacher recommended it d) Careers teacher or Guidance counsellor recommended it
- e) School notice, newsletter, or noticeboard f) Friends or Family
- g) Other (please specify)_____

4. What year level are you at school?

- 1) Year 9 2) Year 10 3) Year 11 4) Year 12 5) Year 13 6) Other (Please specify)

5. Which (if any) of the following subjects do you take?

Subjects	a) Tick if you take this subject <input type="checkbox"/>	b) How do you feel about this subject? (circle a number on the scale)				
		Very negative	Neutral		Very positive	
a) Biology	<input type="checkbox"/>	1	2	3	4	5
b) Chemistry	<input type="checkbox"/>	1	2	3	4	5
c) Physics	<input type="checkbox"/>	1	2	3	4	5
d) Science	<input type="checkbox"/>	1	2	3	4	5
e) Technology	<input type="checkbox"/>	1	2	3	4	5
f) Economics	<input type="checkbox"/>	1	2	3	4	5
g) Accounting	<input type="checkbox"/>	1	2	3	4	5
h) Calculus	<input type="checkbox"/>	1	2	3	4	5
i) Statistics	<input type="checkbox"/>	1	2	3	4	5
j) Mathematics	<input type="checkbox"/>	1	2	3	4	5

6. At this stage, what is the MAIN thing you think you will do next year? (Please choose ONE)

- | | |
|---|--|
| <input type="checkbox"/> 1) I have no plans yet | <input type="checkbox"/> 2) Stay at school |
| <input type="checkbox"/> 3) University | <input type="checkbox"/> 4) Polytechnic/Technical Institute |
| <input type="checkbox"/> 5) Teacher's college/College of Education | <input type="checkbox"/> 6) Get an apprenticeship in a trade |
| <input type="checkbox"/> 7) Do a training course (e.g. at a private training establishment) | <input type="checkbox"/> 8) Get a job |
| <input type="checkbox"/> 9) Go travelling | <input type="checkbox"/> 10) Other (please describe) |

7. If you plan to go on to further study, what kind of degree, programme or area of study do you think you might do? (you may tick more than one)

- | | | |
|--|---|---|
| <input type="checkbox"/> a) Not sure | <input type="checkbox"/> b) Economics, Business studies or Management studies | <input type="checkbox"/> c) Law |
| <input type="checkbox"/> d) Science or Environmental studies | <input type="checkbox"/> e) Engineering or Architecture | <input type="checkbox"/> f) Computer science or information technology |
| <input type="checkbox"/> g) Medicine, Nursing or Veterinary | <input type="checkbox"/> h) Technology | <input type="checkbox"/> i) Tourism, Hospitality, or Sport and Recreation |
| <input type="checkbox"/> j) Arts or Social sciences | <input type="checkbox"/> k) Mathematics or Statistics | <input type="checkbox"/> l) Other (please describe) |
-

8. What sort of career or job are you interested in?

9. How did you become interested in this career or job?

10. Do you feel the Business of Science seminar was relevant for you personally? (Please choose ONE)

- 1) Extremely relevant 2) Possibly relevant 3) Probably not relevant 4) Not at all relevant

11. If you are planning to study Business, Management or Law, do you think you will include any Science or Technology papers in your degree/diploma?

- 1) Yes
- 2) No
- 3) Not sure yet
- 4) I'm not planning to study Business, Management, or Law

12. If you are planning to study Science or Technology, do you think you will include any Law, Business, or Management papers in your degree/diploma?

- 1) Yes
- 2) No
- 3) Not sure yet
- 4) I'm not planning to study Science or Technology

13. Please tick the day and time of the session you attended

- 1) Sunday 11 a.m.
- 2) Sunday 1 p.m.
- 3) Monday 11 a.m.
- 4) Monday 12 p.m.

14. Would you be willing to be contacted for a short interview about your tertiary study plans later this year?

- 1) Yes
- 2) No

If you answered **YES**, please give us some contact information:

Your full name:

Name of your school:

What is your home telephone number? ()

What is your email address?

THANK YOU FOR YOUR TIME

Appendix Three

Business of Science phone interview questions (After June careers expo)

Hi, I'm Rachel from the New Zealand Council for Educational Research. In June, you filled in a survey form at the *Business of Science* seminar at the Hamilton Careers Expo. On your survey form you wrote that you were willing to be contacted for a short telephone interview. Do you have 5-10 minutes now to answer some questions about the seminar you attended, and about what you think you might do next year or after you leave high school?

(If no) Can I ring you back at a more convenient time?

1. **Can you tell me what prompted you to go to the Business of Science seminar?**
2. **What was the main message or idea that you got from the seminar?**
3. **Was the seminar interesting or relevant for you personally? (why/why not?)**
4. **What are your current plans (for the future)?**
 - **Can you talk about why these areas interest you?**
 - A. **Has the *Business of Science* seminar had any impact on your plans and ideas for your future?**
 - B. **Has the careers expo in general had any impact on your plans and ideas for your future?**
5. **Do you think attending the *Business of Science* seminar is useful for students of your age? (why/why not?)**
6. **Is there anything that you think could have been improved about the seminar?**
 - **Do you feel you got enough information from the seminar?**
 - **Is there anything else you would have liked to know about the *Business of Science*, or how it might be relevant for you?**
7. **Is there anything else you would like to say, or do you have any questions for me?**

Thanks for your time. The things that you and other students have said will help the *Business of Science* organisers to plan future initiatives like the sessions you attended.

Appendix Four

“Business of Science” student survey, school roadshow visits
(August/September)



The New Zealand Council for Educational Research is doing an evaluation of the "Business of Science" initiative. Please help by filling out this short survey. The information on these questionnaires will be scanned. **To help the scanner to read your answers correctly please fill in the bubbles (O) by shading them in. Please do not use ticks or crosses as they can confuse the scanner!** If you want to change your answer please fill in an alternative bubble, and put a **X** through the answer you wish to delete.

1. What is the name of your school? _____

2. What year level are you at school?

- Year 9 Year 10 Year 11
 Year 12 Year 13 Other (please specify)

3. Which (if any) of the following subjects do you currently take?

- Biology Chemistry Physics Earth Science Technology
 Economics Accounting Calculus Statistics Mathematics

4. At this stage, what is the MAIN thing you think you will do next year? (Please choose ONE)

- I have no plans yet Polytechnic/Technical Institute
 University Teacher's college/College of Education
 Other (please describe) _____

5. If you plan to go on to further study, what kind of degree, programme or area(s) of study do you think you might do? (you may shade in more than one bubble)

- Not sure Engineering or Architecture Tourism, Hospitality, or Sport and Recreation
 Economics Business studies or Management studies Computer science or information technology Arts or Social sciences
 Law Medicine, Health Sciences Mathematics or Statistics
 Science or Environmental studies Nursing or Veterinary Other (please describe) _____
 Technology _____

6. If you are thinking about studying Business, Management or Law, do you think you will include any Science or Technology papers in your degree/diploma?

- Yes I'm definitely not planning to study Business, Management, or Law
 No
 Not sure yet

7. If you are thinking about studying Science or Technology, do you think you will include any Business, Management or Law papers in your degree/diploma?

- Yes I'm definitely not planning to study Science or Technology
 No
 Not sure yet

8. If you are thinking about combining Science or Technology subjects with Business, Management, or Law subjects, had you already thought about doing this before today's Business of Science workshop? (please shade in the bubble which best applies to you)

- Yes, I was definitely thinking of combining these areas in my degree/diploma before the workshop Yes, I was vaguely thinking about combining these areas in my degree/diploma before the workshop No, I had not really thought about combining these areas in my degree/diploma before the workshop

9. What was the main message or idea that you got from the *Business of Science* workshop?

10. Do you feel the *Business of Science* workshop was relevant for you personally? (Please shade in ONE bubble)

- Extremely relevant Possibly relevant Possibly relevant Not at all relevant

11. What did you like MOST about the *Business of Science* workshop?

12. Can you suggest any changes/improvements that could have made the workshop more relevant or useful to you?

13. What career(s) or job(s) are you interested in?

14. Would you be willing to be contacted again for an interview about your plans for the future?

- Yes No

If you answered **YES**, please give us some contact information

Your full name _____

What is your home telephone number? _____

What is your email address? _____

THANK YOU FOR YOUR TIME

Appendix Five

Business of Science phone interview questions (After roadshow visits)

Hi, I'm Rachel from the New Zealand Council for Educational Research. Last term, you filled in a survey form about the "Business of Science" presentation you attended. On your survey form you wrote that you were willing to be contacted for a short telephone interview. Do you have 5-10 minutes now to answer some questions about the seminar you attended, and about what you think you might do next year or after you leave high school?

(If no) Can I ring you back at a more convenient time?

- 1. How did you find out about the seminar, and why did you attend?**
- 2. What was the main message or idea that you got from the seminar?**
- 3. Was the seminar interesting or relevant for you personally? (why/why not?)**
- 4. What are your current plans (for the future)?**
 - Can you talk about why these areas interest you?
- 5. Has the *Business of Science* seminar had any impact on your plans and ideas for your future? (why/why not?)**
- 6. Is there anything that you think could have been improved about the seminar?**
 - Do you feel you got enough information from the seminar?
 - Is there anything else you would have liked to know about the *Business of Science*, or how it might be relevant for you?
- 7. At this point in your life, you might not be exactly sure of the kind of job you want to do. However, you may have some thoughts about would make a job enjoyable or interesting for you. Can you talk about what kind of things you think will be important for YOU when you are choosing jobs in the future?**
- 8. Is there anything else you would like to say, or do you have any questions for me?**

Thanks for your time. The things that you and other students have said will help the *Business of Science* organisers to plan future initiatives like the sessions you attended.