

**FOUNDATION FOR
RESEARCH
SCIENCE &
TECHNOLOGY**

Tūāpapa Rangahau Pūtaiao



Portfolio Evaluations

**Report on Industry Survey of Building and Construction
Research**

August 2005

**A Foundation for Research, Science, and Technology
Evaluation Report**

Executive Summary

An industry survey regarding Foundation-funded research in building and construction was completed in March – April, 2005. This was one of five research user surveys carried out in 2004-05.

Responses were obtained from 118 of the 357 organisations, 33%, identified as known or potential users of research, science and technology. These users comprised industry associations, government bodies, companies, and consultants. Building and construction is a large sector of the economy and it was impossible for us to comprehensively survey the sector. To sample the sector we tried to ensure that representative opinions were obtained from industry associations and that other individual users were included. Appendix C details users targeted by the survey.

Research and development in building and construction industry

Research and development in building and construction has a number of unique features.

- There is an industry levy for research and development, managed by Building Research. Historically this has been invested principally in BRANZ Ltd*.
- The industry levy for R&D means that the Foundation's investment is not the only large contribution to R&D within the sector. The Foundation's investment and the industry levy investment are similar in magnitude.
- BRANZ Ltd is sector-specific, an industry sponsored and managed research provider.
- The sector is large and very diverse. It contains one of the largest New Zealand companies, Fletcher Building, and many of the smallest, eg. individual builders, plumbers, architects etc. The sector also covers a wide range of interests, from commercial companies to government regulators.

(* Over the period 2002 to 2005 Building Research and BRANZ Ltd have progressively been formally separated to strengthen the distinction between Building Research as an investor of the Building Research Levy and the role of BRANZ Ltd as an industry service provider. At the time of the survey, March – April, 2005, the separate badging of the two institutions was underway, however the distinction between Building Research and BRANZ Ltd may not have been clear in the industry.)

Survey Findings

Most respondents rated R&D as important to both their industry and organisation.

The strengths of Foundation-funded research were identified as: the existence of an independent source of funding for R&D in building and construction; which can fund things not commercially related; ensure a research capability exists; and which has been innovative in encouraging industry involvement.

The different segments, industry associations, consultants, companies, and government bodies, have different levels of awareness of R&D and experience different benefits.

Awareness of Foundation-funded Research

41% of all respondents were aware of Technology New Zealand. 36% of all respondents were aware of Foundation Scholarship programs. Approximately half, 51%, of all respondents were aware of one or more of the individual Foundation-funded programs on the building and construction research list.

There are fewer PGS&T programs in this sector than in other sectors. More users were aware of individual programs than in some other sectors. At least 6 users were at least aware of each individual program. Respondents to the survey had key alliances with 18 of the 22 programs (82%).

More users were aware of Foundation-funded BRANZ programs than any other programs, both within this sector and in other sectors recently surveyed. On average one third of all respondents were aware of each of the BRANZ programs.

Benefits from Foundation-funded Research

Building and construction users, as in other sectors, rated technical solutions to technical problems as the highest contribution to their business. New or improved products were rated the second highest contribution to user's business. More users said technical solutions to technical problems were applicable to their business than other outcomes.

Overall for the sector the two most important benefits were *Goods and services for the New Zealand market* and *Improved human health, safety, and well-being*. Of those aware of Foundation-funded research in building and construction 61% received positive benefits.

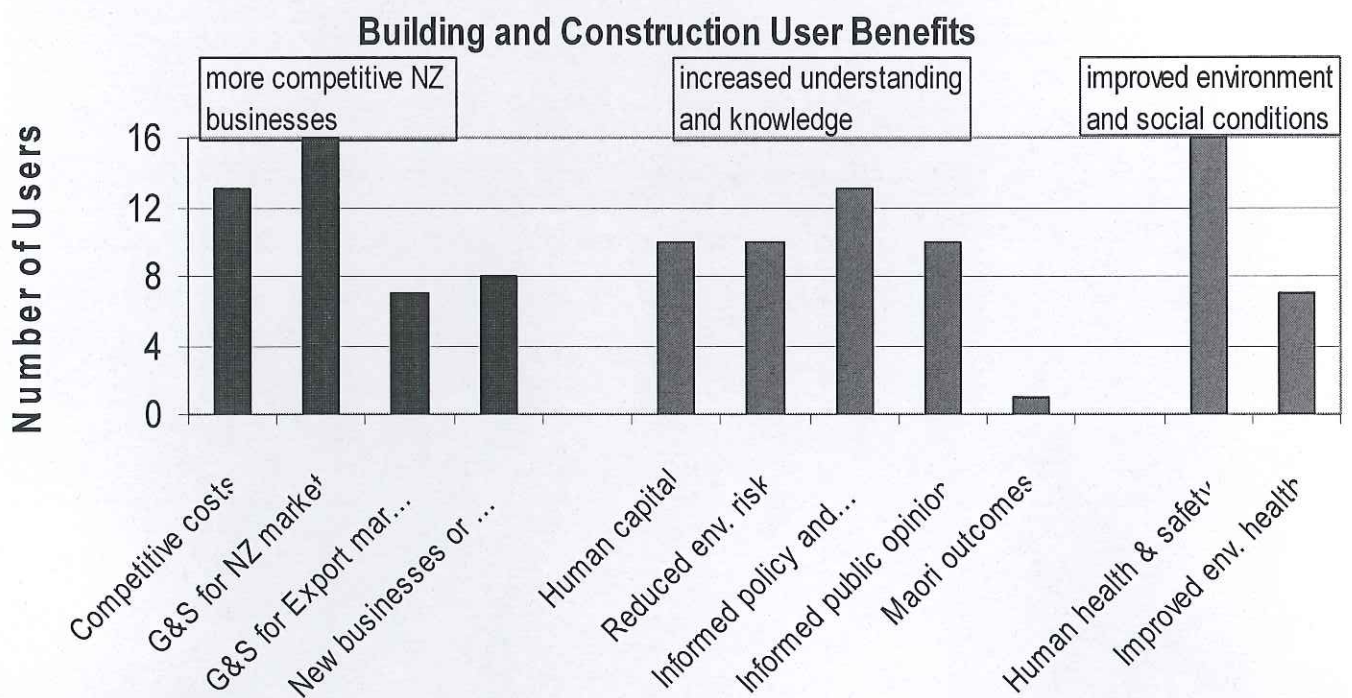


Figure A: Number of users receiving the benefits listed from Foundation-funded research. Benefits are divided into three categories: more competitive NZ business, increased understanding and knowledge, improved environment and social conditions. *Improved human health, safety, and well-being* and *new or improved goods and services for the NZ market* are the most commonly reported benefits for this sector.

Consider the two benefits selected most frequently by each type of user. Consultants, government bodies, and industry associations all had *Improved human health, safety, and well-being* as one of two most frequently cited benefits. Industry associations also selected *Informed policy and decision making*; consultants *New or improved goods and services for New Zealand*; government bodies *Informed public opinion*. (Informed public opinion was not a benefit for any of the consultants.) For companies the top two most frequently selected benefits were *More competitive production costs* and *New or improved goods and services for export markets*.

In comparison to other sectors, fewer building and construction users were aware of Foundation funded research, fewer building and construction users reported benefits, and fewer types of benefits per user were achieved.

Other issues

Other questions regarding: relationships with research providers; factors preventing use of Foundation-funded research, suggested changes, issues that need addressing, and general comments all raised the following issues.

- a. **The lack of information about Foundation-funded research.**
- b. **A lack of understanding of the Foundation and how it operates and a desire to be at least informed and preferably involved.**
- c. **The need for an industry research, science and technology strategy and a desire to collaborate in producing such a strategy and determining research, science and technology priorities.**
- d. **Better co-ordination and collaboration between Building Research and the Foundation.**

These issues are addressed by the evaluation recommendations and actions (not included here).

For research, science and technology to have a higher priority in the sector more and/or different independent involvement by industry associations and industry is required. This would create better understanding both of industry by science providers and science by industry. There are a large number of industry associations within the sector. Few of them are co-funding Foundation-funded research and few have significant research budgets.

1. Introduction

Building and Construction is a significant component of New Zealand's gross domestic product. Estimates vary, and the actual value varies, depending on a number of factors including the amount of building and construction activity but range say from 3-10%. (GDP can be measured as value added or work put in place. The exact nature of the figure quoted is not always clarified. Up to date figures are not available from Statistics NZ web site. Latest figures are for 1999.)

Sixty-eight user associations were included in the survey. This illustrates the disparate nature of the industry. There is one industry-wide confederation, the Construction Industry Council, however it has neither the industry voice nor the political impact of similar organizations in other sectors (eg VegFed or Meat and Wool Innovation). This possibly reflects the difficulty in uniting a diverse and possibly fragmented sector. The Cement and Concrete Association and the Window Association of New Zealand are two smaller confederations which appear to engage more effectively in R&D. The lack of industry-wide co-ordination makes a high industry profile in R&D difficult to achieve.

Different perspectives in building and construction are reflected in the range of research and range of opinions regarding some issues. For the purposes of this survey users were classified into four categories: government (including both central and territorial government bodies), consultants, companies, and industry associations. Consultants included principally architects and consulting engineers. Companies included both companies producing materials and products for the industry and companies actually building and constructing commercial and private dwellings. Companies are commercially focused and some say R&D is difficult when industry margins are so small. Others companies see New Zealand as a small component of an international market where R&D should be focussed on local application of international innovation. Government and industry associations generally have wider focus and more active interest in R&D. In particular many see research capability as essential for development of national standards and codes.

The building and construction industry also covers firms varying in size from the second largest in the country, Fletcher Building, to probably some of the smallest, individual painters, builders, plumbers, etc. Only generalized information on R&D spending was collected in the survey. No attempt was made to collect other demographic information.

The building and construction sector is not generally seen as research focused. Comments during survey included: *'The industry is mainly composed of non-technical people doing practical things.'* *'It is a mature industry and the rate of change is quite slow.'* Others emphasized the importance of R&D. *'R&D is very important for us to stay ahead of the competition.'*

The level of R&D funding in the building and construction sector is not as high as GDP figures might lead you to expect. Foundation funding for PGS&T/NERF for 2003/04 was \$345 million. Building and construction research accounts for 3% of this. A recent report has shown that 2.1% of Technology for Business Growth, TBG, projects are related to building and construction. An estimate of industry spending on research and development is made in Appendix B.

Research and development in the building and construction industry needs to service all users within the industry. This survey aims to find out, amongst other things, how the Foundation investment is contributing to this.

2. Foundation-funded Building and Construction Research

Building and construction programs from 2003/4 and 2004/5 were included in a research list, see Appendix A. The list was referred to several times throughout the interview, checking awareness of individual programs, and was readily available in the web survey.

Foundation funding for these programs totals \$16.5 million. The programs cover a number of sectors. Major overlaps occur with *energy* and *engineering products and services* sectors and there are other overlaps with a number of other sectors including *tourism, transport, medical and health, industrial products* and *service industries*. Transport research was not included in this survey. Foundation funding for the programs listed, attributed to the building and construction sector, amounts to \$9.7 million.

The programs are funded across a number of Foundation portfolios. Two portfolios cover most of the research: Resilient Infrastructure and Communities (RIC or hazards research) and Optimising Physical Use and Infrastructure (ORI). A small number of programs are also funded within two other portfolios: Manufacturing Processes, Products, and Materials and Building Sustainable Cities and Settlements.

Success Story: Energy Saving for New Zealand Homes

Research, titled 'Toward the Zero Energy House' is being carried out by BRANZ Ltd, which is working with several universities and a consortium of private New Zealand and international companies.

Senior scientist and project manager, Albrecht Stoeklein, says the aim is to develop building standards that incorporate energy saving technologies, which are not merely about reducing the size of the next power bill.

The research is attempting to put a dollar value on the range of other energy saving features, known as non energy benefits, such as comfort or health benefits achieved through double glazing and improved insulation.

Further details of this research are in the Foundation's Keynotes publications. The research is attributed to both the building and construction and energy sectors.

Total research and development funding for the Building and Construction sector is unknown. It has been estimated at approximately \$40 million (see Appendix B). A building research levy, 0.1 per cent of the contract value (for contracts exceeding \$20,000) of every construction project put forward for building consent in New Zealand is payable to Building Research. In 2003 the levy payments totaled \$6.8 million; in 2004, \$9.2 million¹; and \$10.2 million in 2005. This is another large contribution to R&D within the sector, managed by Building Research and historically used for work within BRANZ. This has a significant effect on the sector.

Major Foundation-funded research providers in building and construction are (order is not significant): BRANZ Ltd; NZ Heavy Engineering Research Association (HERA); Beacon Pathways Ltd (a research consortium whose initial shareholders are Fletcher Building, Waitakere City Council, Building Research and Forest Research – now known as Scion); Industrial Research Ltd, Geological and Nuclear Sciences, Landcare, Auckland University and Canterbury University. There are a number of other providers who also contribute to the sector, see Appendix A.

¹ BRANZ Annual Review 2004

3. Building Research and BRANZ

BRANZ Ltd is sector specific; an industry sponsored and managed research provider. BRANZ Ltd is wholly owned by Building Research and provides independent services to the building and construction industry in New Zealand, Australia and Asia. The Building Research Board is nominated by industry bodies. BRANZ Ltd is focused on the building and construction industry. The role of BRANZ is well understood by industry. Building Research carries out regular surveys of industry needs and commissions industry workshops, seminars and publications.

The relationship between the Foundation and Building Research is not well understood. Some users suggested it needs clarifying. The rebranding and completion of the split between BRANZ Ltd and Building Research, early in 2005, will possibly address historical issues of the old "BRANZ" as both a research provider and another major funder of research.

The Foundation's role, what it does and how it works, is poorly understood by the building and construction industry. There is a high level of awareness of BRANZ Ltd programs compared to other Foundation-funded programs. Can the Foundation link in to the industry more through BRANZ Ltd? Can BRANZ Ltd's technology transfer and education processes be tapped into by other research providers? Can BRANZ Ltd's technology transfer and education processes be used by the Foundation to inform the industry of the Foundation's role and processes?

4. Survey Methodology

The companies, consultants, industry associations, and government bodies involved in building and construction, and participating in this survey, will be generically referred to as 'users' although some may be more properly described as potential users. Selection of users to target a broad cross-section of the industry is detailed in Appendix B.

The survey was comprised of two parts: individual interviews of 27 users and a web survey of 330 others. The same questions were covered in both the interviews and web survey. Interviews were designed to obtain more detailed information from respondents than the web survey which was kept as short as possible to encourage completion. The survey was carried out in March and April 2005, principally by Andrew Fletcher Consulting. Foundation staff did some interviews. Results presented here are based on data tabulation and analysis provided by Andrew Fletcher Consulting.

Users included in the web survey were sent email reminders if they had not responded in a specified time. Half of those who had not responded were prompted again by phone. Those who indicated that they had no intention of completing the survey were asked why and most indicated it was because they did not consider research and development relevant to them.

For analysis of survey results the users were divided into four categories: industry associations, consultants, companies, and government. Table 1 gives the numbers participating and responding to the survey in these categories.

Table 1: Response rate to survey by category and type (interview, web).

| Segment | Number listed | % responded | Interviews | Web responses | total |
|---------------------------|---------------|-------------|------------|---------------|-------|
| Industry Ass ⁿ | 68 | 38% | 8 | 18 | 26 |
| Government | 34 | 56% | 5 | 15 | 20 |
| Company | 168 | 27% | 10 | 35 | 45 |
| Consultant | 87 | 31% | 4 | 23 | 27 |
| Totals | 357 | 33% | 27 | 91 | 118 |

A similar survey of energy users was recently completed. An attempt was made to include information from 3 interviews for the energy survey. Changes were made between surveys and answers were not given for all building and construction interview questions however where possible relevant information has been included.

The response rate, 33%, is somewhat lower than for previous surveys despite similar techniques being used in the survey implementation.

5. Cofunding

Co-funders named by research organizations were included in the survey. Fourteen respondents are co-funders of research, see Table 2. None of the organizations described as consultants were cofunding research. Only one industry association is cofunding Foundation-funded programs.

Table 2: Cofunders by segment.

| Segment | Cofunders | Not cofunders |
|----------------------|-----------|---------------|
| Industry Association | 1 | 25 |
| Government | 6 | 14 |
| Company | 7 | 38 |
| Consultant | 0 | 27 |
| Totals | 14 | 104 |

Co-funders are above average spenders on R&D. Figure 1 shows annual investment in R&D and this also indicates that few industry associations have investments greater than \$100,000 in R&D. (In Agriproduction 13 industry associations invested more than \$100,000 in R&D and 11 were co-funding research. In the energy sector there are comparatively very few industry associations and none claimed R&D budgets greater than \$50k.)

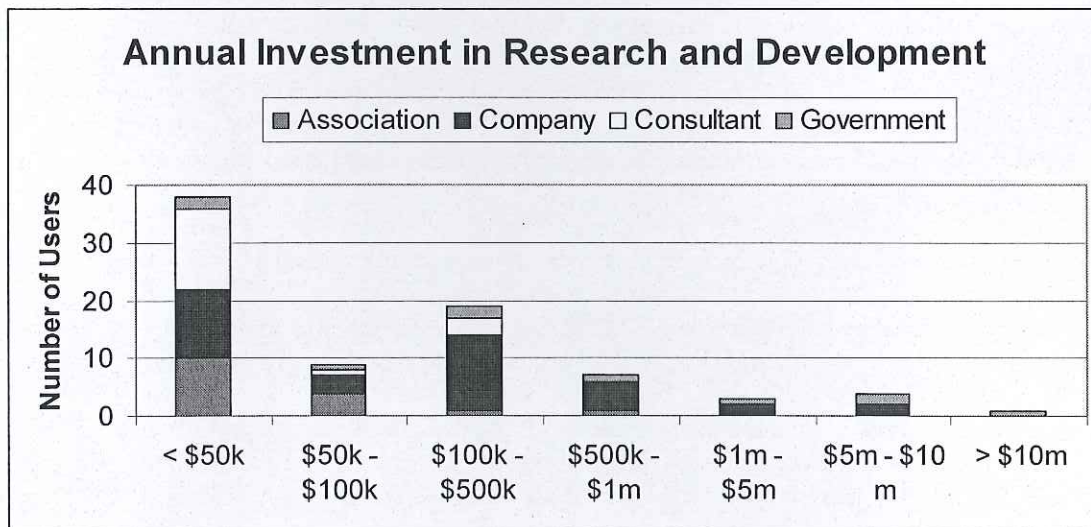


Figure 1: Annual investment in research and development. The distribution is divided by segment. Few industry associations or consultants have budgets greater than \$100k.

Industry associations are involved in Building Research, some by board representation and others through industry consultation. Levels of R&D investment by industry associations suggest they are not significantly contributing to research outside of the building research levy their members may pay.

6. Survey Findings

This section will present results of the industry survey. Comparisons are made with a similar survey, carried out in August 2004 of users of research in animal production and agritechology, plant production and harvesting. This will be referred to as agriproduction. The two sectors are both large in terms of the proportion of the economy they account for however the Foundation budget for agriproduction research is several times that for building and construction research. The two sectors have many differences some of which are highlighted by the surveys of users of R&D.

A survey of users of research in manufacturing was carried out in 2002/03. There are overlaps between manufacturing and building and construction. Some of the research programs in building and construction fall into the manufacturing portfolio. Some comparisons have been made between the two surveys and these are included as Appendix D.

6.1 Importance of R&D

Users of Building and Construction Research were asked to indicate, on a scale of 1 to 7 with 7 indicating extremely important, how important R&D was to both their industry and their organization. Average results are shown below:

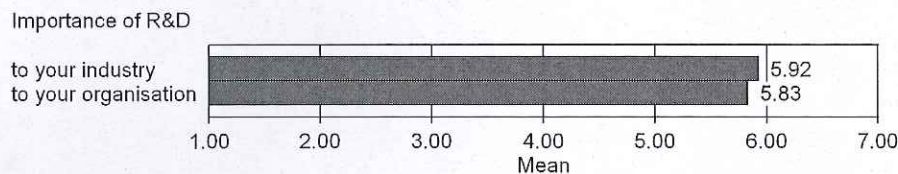


Figure 2: Importance of R&D to industry and organisation, averaged for all users.

Respondents rated R&D as important to both their industry and organization. There was not a big difference between industry and organization however R&D was seen as slightly more important to the industry than individual organizations. More cofunders said R&D was highly important to their organizations than non-cofunders. Cofunders rated importance to industry and organization similarly whereas, on average, non-cofunders rated the importance of R&D to industry higher than to their organization.

On an individual basis there are a range of opinions. Some companies and consultants consider R&D as a commercial imperative to maintain leadership in the industry. Others see R&D as important at times. One respondent said, *'We are a mature industry and in my 25 years in the business nothing has changed really.'*

Government organizations uniformly considered R&D important. Some industry associations didn't see research as being relevant to them however most did see it as important for their members. Other associations did see research as important.

6.2 Value of R&D

Respondents were asked to indicate which areas of NZ R&D are of value to their industry and organization. Again values for industry were slightly higher than for organizations:

industry (organization)

81% (75%) selected applied research (eg standards, energy efficiency) as being of value;

76% (74%) selected technology development; and

69% (65%) selected basic research (eg new materials, modeling of water wicking in buildings).

Most government organizations, 85%, said all types of research were of value to the industry. Most industry associations, 92%, thought applied research was of value to the industry. Most consultants, 85%, thought basic research was of value whereas only 51% of companies thought basic research was of value to the industry.

More companies thought basic research was of more value for their organizations, 60%, than for the industry, 51%. More companies and consultants thought technology development was of more value for their organizations than for the industry. Otherwise organizations generally indicated that research was more important for the industry than for their organizations.

Individual comments cover a range of opinions:

'All three areas are really important to the industry.' (government, association)

'We're such a small country that basic research is better done by people in other countries with more resources and bigger budgets rather than us trying to reinvent the wheel here with limited resources. Applied research, taking findings from overseas and applying it here, is the key.' (consultant)

'Basic research tends to be focused on housing. NZ builders are basically focused on houses and there are very few construction companies in NZ focusing on technology development in the wider sense.' (consultant)

'The industry doesn't do a lot of basic or even applied research. The industry is particularly bad at converting its knowledge into practice. Technology transfer is a big issue for us at an industry level.' (company)










'Our organisation is not involved in research, we are a lobby group. We are involved at the point of saying what should the strategic directions for research in NZ be for the sector, rather than worrying about the detail.' (industry association)

'Our organisation provides strategic direction.' (industry association)

6.3 Sources of information on R&D

The question: *Thinking about the different types of organizations from which you obtain research and development information, what are your main sources of information on research and development?* was asked in the survey. Table 3 provides responses.

Table 3: Sources of research and development information.

| Where do you obtain research and development information? | | | |
|---|--------|----------|---|
| | Counts | Percents | Percents |
| | | | 0 100 |
| BRANZ | 85 | 72% |  |
| Industry Association | 73 | 62% |  |
| Within your own organisation | 64 | 54% |  |
| NZ Universities | 51 | 43% |  |
| Overseas research organisations | 51 | 43% |  |
| Other NZ company | 35 | 30% |  |
| Crown Research Institutes | 31 | 26% |  |
| Other | 24 | 20% |  |
| No Answer | 2 | 2% |  |
| Totals | 118 | 100% | |

Almost three-quarters, 72%, of all respondents say that BRANZ is a source of information. BRANZ, Industry Associations, and own organizations are the three most common sources. For the 14 cofunders who responded, 10 (71%) sourced information from overseas research organizations, 10 from their own organizations and 9 from BRANZ. As a sample of those involved in research it is significant that overseas is ranked as an important source of information.

A similar question was not asked in other surveys.








6.4 How information obtained

Those who were interviewed were asked about their source of information on R&D. Over half of respondents used all seven listed sources of information: industry/trade publications, conferences/workshops/seminars, internet sources, direct contact with external researchers, overseas contacts, science journals, industry consultants.

Industry/trade publications and conferences/workshops/seminars were most frequently used being cited by 22 of the 27 interviewed (81%). In agriproduction the most frequently cited source was direct contact with external researchers, 84%, and only 64% used industry/trade publications. In building and construction only 67% of interviewees used direct contact with external researchers to obtain information. There are significantly fewer Foundation-funded researchers in building and construction than in agriproduction.

6.5 Relationships with research organizations

Table 4: Relationships with research organisations.

| With which types of research organisations does your organisation have a relationship? | | | |
|--|--------|----------|---|
| | Counts | Percents | Percents |
| | | | 0 100 |
| BRANZ | 19 | 70% |  |
| NZ Universities | 17 | 63% |  |
| Crown Research Institutes | 11 | 41% |  |
| Other NZ company | 10 | 37% |  |
| Overseas research organisations | 10 | 37% |  |
| Other | 14 | 52% |  |
| No Answer | 1 | 4% |  |
| Totals | 27 | 100% | |

Cofunders tend to have more relationships than non-cofunders, 70% of cofunders are working with BRANZ and 70% with universities. Cofunders are more than twice as likely as non-cofunders to be developing/commercializing new products.

The relationships were mostly for the following purposes: using research knowledge or new technology in business processes (56%); collaborating in research (52%); obtaining research and development support/consultancy for your business (48%); and developing /commercializing new products (44%). Less than 20% of respondents said purchasing/ implementing intellectual property for your business and supplying graduates to support research and development in the business were purposes of relationships.

Interviewees were asked for general comments on their relationships with research providers. Three main themes arose around comments from a number of respondents. Some of these

issues arise in response to other questions, occurring a number of times throughout the survey.

- 1) **The difference in approach or “gulf” between academic researchers and industry.** Researchers and industry obviously do not have a good understanding of each other. More specific comments included:
 - a) Specific goals and aims of research vary.
 - b) Academics are unable to understand/meet timelines.
 - c) Research is too academic and theoretical, and not sufficiently focused on commercial outcomes and clear answers.
 - d) Researchers need a clear brief and defined questions to answer.

This problem needs both sides to move for resolution. There are some indications that those involved in consortia, both in building and construction and other sectors, do not experience this problem. Collaboration between researchers and users may lead to better understanding of each other’s perspectives and requirements.

- 2) **Concerns about the FRST-funding process:**
 - a) Too time-consuming, bureaucratic and “political”.
 - b) Research providers pairing up with industry partners is “tokenism” and the process is very “shallow” with industry partners used to “rubber stamp” applications so researchers can get grant money.
 - c) Foundation-funded research budgets need to allow time for researchers to work in the field and spend time with the industry. This requires a higher overhead for which there is no cost recovery.

- 3) **Perceptions of BRANZ and Building Research.** Specific comments about “BRANZ” were not requested but due to its influence and perceived position as a leader in the sector “BRANZ” was singled out for comment. (Note again that at the time of the survey the distinction between Building Research and BRANZ Ltd is unlikely to be understood.) The following key points were raised:
 - a) “BRANZ” has become a very commercial operation – fee for service.
 - b) “BRANZ’s” relationships with industry have become polarised over time.
 - c) “BRANZ” is perceived by some to be feathering their nest and no longer independent.
 - d) “BRANZ” is sector specific which is really good.
 - e) We have a close relationship with “BRANZ”.

Negative comments tended to come from companies and consultants and positive ones from associations and government.

- 4) **Other comments:**
 - a) Relationships are based on personal networks, both in NZ and overseas.
 - b) There are some fundamental problems at the universities. The issue is the competitiveness between them.
 - c) We have a good relationship with universities which ends up in useful information that’s accessible.

6.6 Awareness of Foundation Programs

41% of all respondents were aware of Technology New Zealand. 36% of all respondents were aware of Foundation Scholarship programs. 51% of respondents were aware of Research for Industry programs. Some were not familiar with the name ‘Research for Industry’ but when prompted some did acknowledge some awareness of programs.

14 of the 118 survey respondents, 12%, had applied for Technology New Zealand funding. Six respondents had applied for scholarship funds.

6.7 User Awareness

Respondents were asked which of the 22 programs in the research list they were aware of, either from the name of the program, the objective leader's name, the program leader's name, and/or the institution's name. Only 52%, 61 of the 118 respondents, could identify any of the individual programs. (In Agriproduction 78% of respondents could identify at least one of the 74 individual programs.) Figure 3 shows the number of respondents aware of the number of different programs (only including those who were aware of 1 or more). In the figure black indicates the sum of the number of programs each user was aware of, involved with, or had a key alliance with. Ie. Three users were aware of all 22 programs, two users were only aware of all programs, one was aware of 20 and had either key alliances or involvements with 2 others. Very few organizations have more than 2 key alliances.

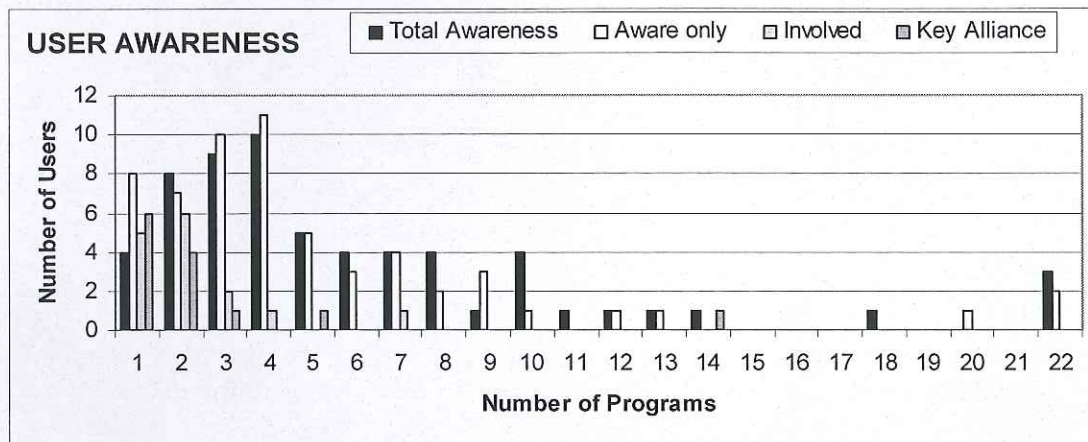


Figure 3: Number of users aware of a number of programs. Awareness can be either aware only (white), involved (yellow), or key alliance (blue). The sum of these three levels of awareness is shown in black. For example three users are aware of all 22 Foundation-funded programs in building and construction. Two of these are only aware of all 22 programs. One has involvement or key alliances with 2 of the programs.

There are a small number of respondents with very high levels of awareness or involvement. Three were aware of all 22 programs. Of the 61 respondents with awareness of any Foundation-funded programs, most, 50%, were only aware of up to 4 programs.

Thirteen users, 11% of the 118 respondents, had key alliances. Most users have only one or two key alliances. (In agriproduction 15% of respondents had key alliances).

6.8 Awareness by program

There are a relatively small number of programs, 22, for a large sector, building and construction. Even considering this, levels of awareness are high. Each program has at least 6 users aware or involved, see Figure 4. (In agriproduction some programs were identified by only 3 users, however there were about three times the number of programs.)

BRANZ Ltd programs had the highest levels of awareness. On average one third of all respondents were aware of each of the BRANZ Ltd programs. (In agriproduction at most 10% of respondents were aware of any program.) The next highest levels of awareness were for the BEACON program, in which Building Research is a participant. There were 9 other programs, from a number of different providers, with more than 10% of respondents aware of them.

BRANZ Ltd has an established technology transfer program with regular seminars, workshops, and industry publications. 'BUILD', the BRANZ Ltd industry publication, this year won an award for the best industry publication from the Magazine Publishers Association. This technology transfer program is obviously successful at informing the industry about BRANZ Ltd R&D programs.

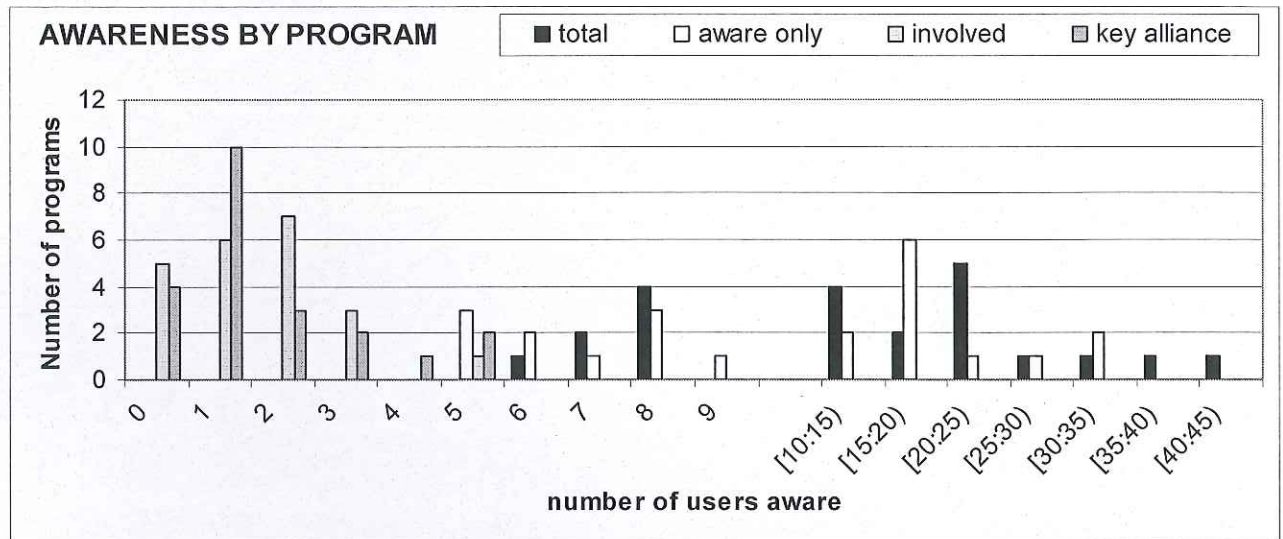


Figure 4: Number of users aware of each program. ie There is one program with between 40 and 45 users (survey respondents) aware of it. As for figure 3, key alliances are shown in blue, involvement in yellow, and aware only in white. The sum of these three levels of awareness is shown in black. There are two programs with five key alliances. All programs were identified by at least six survey respondents.

Key alliances

The existence or number of key alliances should not be used as a measure of program success. Not all programs are suitable for the establishment of key alliances. The existence of key alliances does provide information on the type of programs in the sector. 82% of building and construction programs have key alliances with respondents to the survey (50% in agriproduction). As in agriproduction most building and construction programs (10) have only one key alliance, although some have more. Four programs have no key alliances, three programs have four or five key alliances.

Awareness by segment

Awareness was highest amongst industry associations and government bodies. Companies and consultants were similar with less than 50% of respondents aware of any individual programs in the research list, see Table 5.

Table 5: Those with no awareness and some awareness of individual programs, by segment.

| No. programs aware | 0 | 0 as % | >0% | Total |
|--------------------|----|--------|-----|-------|
| Association | 9 | 35% | 65% | 26 |
| Company | 26 | 58% | 42% | 45 |
| Consultant | 14 | 52% | 48% | 27 |
| Government | 8 | 40% | 60% | 20 |
| Total | 57 | 48% | 52% | 118 |

Of those with awareness of some programs, see Figure 5, fewer companies are aware of high numbers of programs and government bodies tend to have higher levels of awareness.

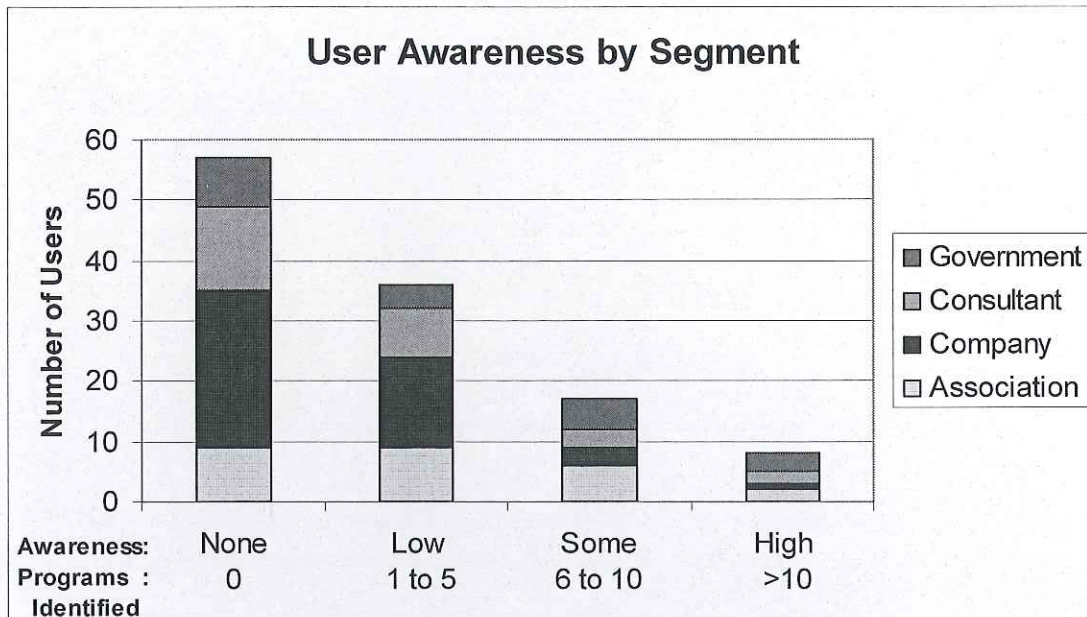


Figure 5: User awareness, number of users aware of a number of programs, with users identified by segment: government, consultant, company, and association. Awareness is grouped into four categories. Numbers are small however there are tendencies for fewer companies to be aware of high numbers of programs and fewer government bodies and industry associations to be aware of low numbers of programs.

Awareness by spend on R&D

There is a general trend for users to be aware of more Foundation-funded programs as they spend more on R&D, see Figure 6. There were 37 users who did not answer the question on spend on R&D. The category of \$1m - \$5m runs counter to this trend (although numbers are very small). Those spending >\$5m on R&D are generally aware of more Foundation-funded programs than average. However some respondents with small R&D budgets have very high levels of awareness of Foundation-funded programs.

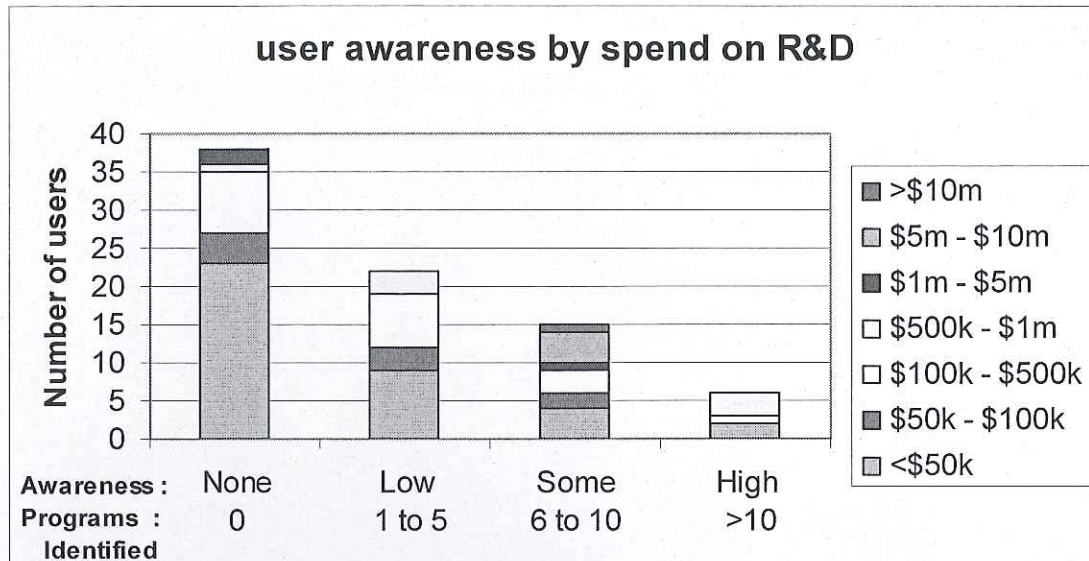


Figure 6: User awareness, number of users aware of a number of programs, with users identified by spend on research and development. There were 37 respondents who did not answer the question on spend on R&D. Awareness is grouped into four categories. As users spend more on R&D they are more likely to be aware of Foundation-funded programs.

There was no obvious difference in total awareness or key alliances by portfolio.

Comments on Awareness

Many of the comments on awareness of programs were along the lines of ‘If we knew what was going on, like being sent a copy of this list (the list of Foundation-funded research in building and construction) at regular intervals, we’d be more aware and be able to follow up on things of interest.’

A number of users commented that there should be more industry input into what the Foundation funds. Not only does industry feel they not involved, they are not aware of how the processes work, or what is involved.

Building Research already has processes to consult industry about research priorities. These processes are to be a collaborative effort with Standards New Zealand and Department of Building and Housing in future. Building Research have regularly carried out industry needs surveys in the past. The Foundation is informed by Building Research of the outcomes of this survey. The Foundation needs to inform industry how industry needs are incorporated into Foundation research priorities and processes.

6.9 Benefits from Foundation-funded research

Respondents who were aware of Foundation-funded research were asked if their organization had seen any benefits from Foundation-funded research in the last three years. 67 respondents said they were aware of Foundation-funded research. 24 of these said they had seen benefits and 20 said they were unsure. 21 said they had not received any benefits from Foundation-funded research.

Co-funders were more likely to say they had received benefits. Consultants and government bodies are more likely to have seen benefits from research than companies and industry associations.

Table 6: Benefits from Foundation-funded research by segment. More government bodies and consultants had received benefits than companies or industry associations.

| | Overall 67 | Category | | | |
|--|------------|--------------------|-----------------------|-----------------------|------------------------|
| | | Company 33%, 22 | Consultant 19%, 13 | Government 19%, 13 | Association 28%, 19 |
| In the last 3 years has your organisation seen any benefits from Foundation-funded research in building and construction? Yes | 36%; 24 | 27%; 6 | 54%; 7 | 46%; 6 | 26%; 5 |
| Unsure | 30%; 20 | 32%; 7 | 23%; 3 | 31%; 4 | 32%; 6 |
| No | 31%; 21 | 41%; 9 | 23%; 3 | 8%; 1 | 42%; 8 |
| No Answer | 3%; 2 | 0%; 0 | 0%; 0 | 15%; 2 | 0%; 0 |
| Totals | 100%; 67 | 100%; 22 | 100%; 13 | 100%; 13 | 100%; 19 |

6.10 Contribution of FRST-Funded Research

Respondents to the survey who had seen benefits from Foundation-funded research were asked to rate the contribution to their business of this research in the development of specific outcomes. The rating used a 7-point scale, where 1 = Not Useful, 4 = Moderate, and 7 = Very Useful. The chart shows the mean scores.

Contribution of Foundation-funded R&D to your organisation

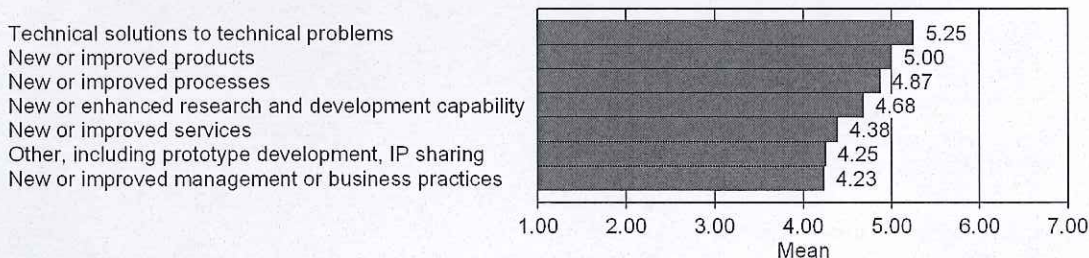


Figure 7: The seven listed benefits were rated on a scale of 1 to 7 where 1 is not useful and 7 very useful. Average ratings are shown. Technical solutions to technical problems were considered most useful.

All of the ratings were above the mid point of the scale (“moderate”). Technical solutions to technical problems were rated highest.

Building and construction users rated the contribution to their business higher than agriproduction users, on average by 0.27 points. The highest contribution to building and construction, technical solution to technical problems, was rated on average at 5.25, 0.69 points higher than the highest contribution to agriproduction, new or improved products. The lowest contribution was the same for both sectors, new or improved management or business practices, but was rated 0.32 points higher for building and construction than agriproduction.

Different types of organisations rated specific outcomes differently. Companies rated new or improved products highest, consultants new or enhanced R&D capability, government technical solutions to technical problems, and associations new or improved processes.

Figure 8 shows the distribution of ratings for each specific outcome. Technical solutions to technical problems is the most relevant outcome (blue measure) and is also rated most highly (black measures).

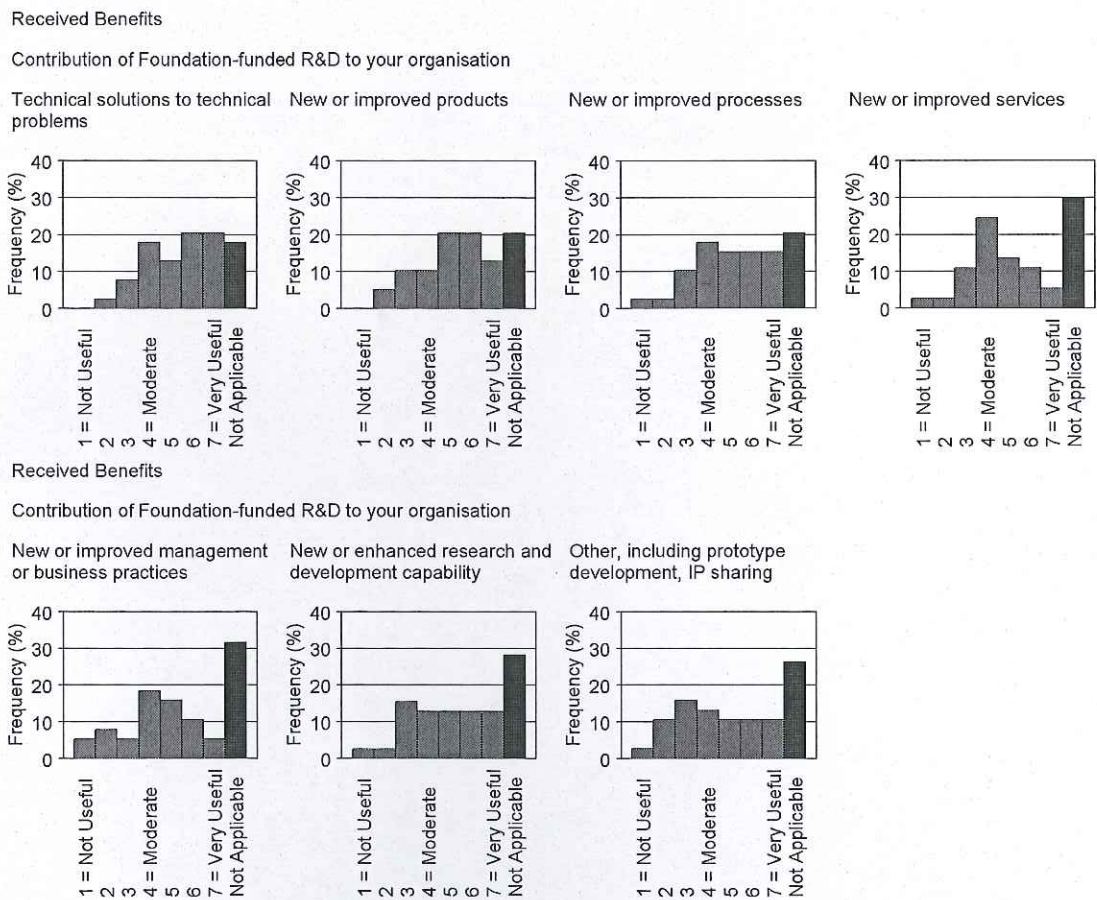


Figure 8: Rating distribution for each type of benefit. Blue shows applicability and black the rating given. Technical solutions to technical problems were considered the most applicable benefit as well as the most beneficial.

6.11 Benefits gained

Respondents were asked if they had seen any benefits from Foundation-funded research. If they had, they were asked which of the following benefits their company or organisation gained from the outcomes in the previous question:

- More competitive production costs
- New or improved goods and services for the NZ market
- New or improved goods and services for export markets
- Significant new business or market opportunities
- Development of human capital and skills
- Improved environmental health
- Reduced environmental risk
- Informed policy and decision making
- Informed public opinion
- Improved human health, safety and well-being
- Improved capability-building and outcomes for Maori
- None/not applicable
- Other

57 respondents answered this question. The benefits they received are shown in Figure 9. The benefits are grouped into; more competitive NZ businesses; increased understanding and knowledge; and improved environment and social conditions. 22 (39%) said they received no benefits at all from Foundation-funded research in building and construction or the question was not applicable. This group included 4 government organisations, 4 consultants, 6 associations, and 8 companies. In agriproduction only 23%, of those who answered the question, said they received no benefits at all.

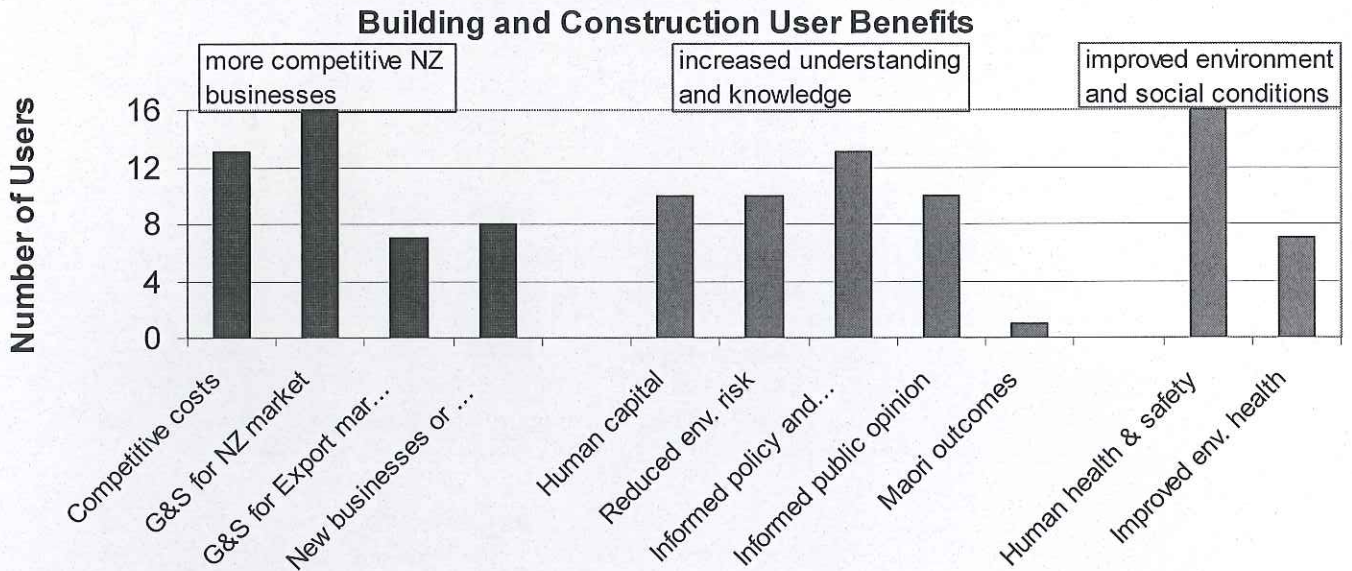


Figure 9: Number of users receiving the benefits listed. Benefits are divided into three categories: more competitive NZ business, increased understanding and knowledge, improved environment and social conditions. *Improved human health and safety* and *new or improved goods and services for the NZ market* are the most commonly reported benefits.

35 respondents (64%) said they received benefits. *Goods and services for the New Zealand market* and *Improved human health and safety* were the most common benefits. Comparisons can be made with agriproduction whose benefits are shown in Figure 10. In building and construction fewer users were aware of Foundation funded research, fewer users reported benefits, and fewer types of benefits per user were achieved.

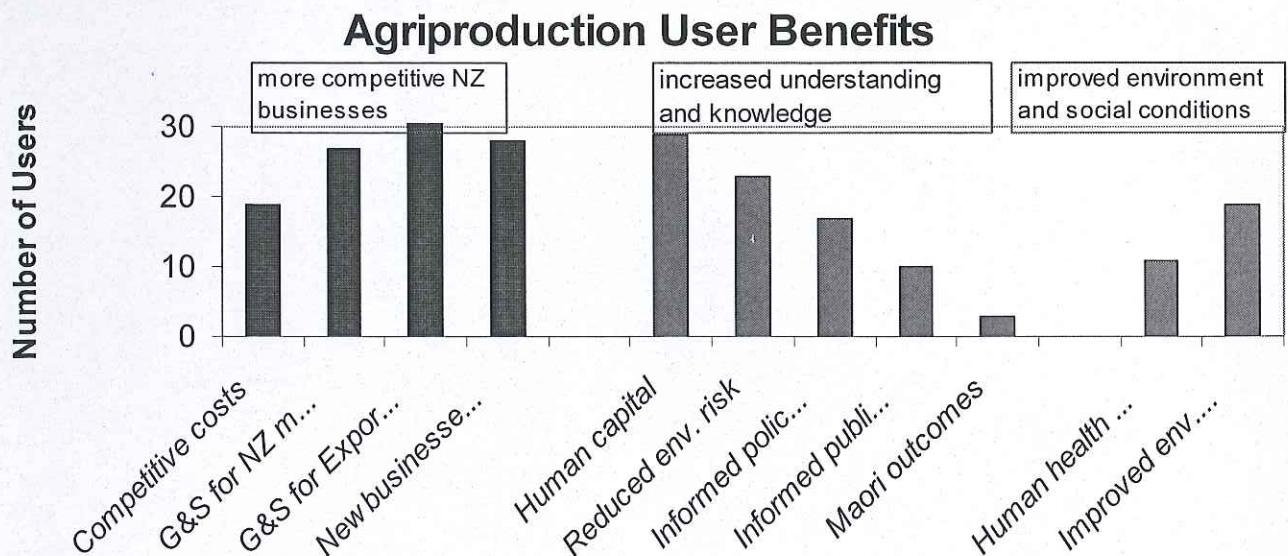


Figure 10: Number of users receiving the benefits listed, as for figure 9, but for agriproduction rather than building and construction. Differences can be seen in the number of types of benefits reported, as well as the distribution.

Users consider that benefits from Foundation-funded research in building and construction and agriproduction are different. *Competitive costs* and *Goods and services for the NZ market* are the most important business benefits for the building and construction sector. *Goods and services for export markets* and *Significant new business or market opportunity* are the most important business benefits in agriproduction.

Improved human health, safety and well-being is only a minor benefit in agriproduction whereas it is one of the two most important benefits in building and construction. *Development of human capital and skills* is the second most important benefit in agriproduction but although important is not outstandingly so in building and construction.

For the different types of users there were also differences in which benefits were experienced, although numbers are small and should be interpreted with care. *Improved human health and safety* was one of the two top benefits for industry associations, consultants, and government bodies. It ranked very lowly for companies (only 1 company said it was a benefit). Industry associations said *Informed policy and decision making* was the other of two top benefits. Consultants said *New or improved goods and services for New Zealand market* was the other of two top benefits. Government bodies said *Informed public opinion* was the other of two top benefits. (This was not a benefit for any consultants.)

Companies said they received fewer types of benefits than any other part of the industry. Companies' two top benefits were: *More competitive production costs* and *New or improved goods and services for export markets*. These were two highly ranked benefits for agriproduction also. These two benefits were not given by any government bodies in building and construction.

Cofunders, on average, received approximately 1.5 times more different types of benefits than non-cofunders. Four of the eight cofunders who answered this question said they achieved the following benefits: *Informed public opinion, development of human capital and skills, Significant new business or market opportunities*. Three of the eight cofunders who answered the question also said they received: *Improved human health, safety and well-being, More competitive production costs, New or improved services for export markets*.

6.12 Strengths of Foundation-funded research

Interviewees were asked to comment on the strengths of Foundation funded research. Several themes emerged in these comments including:

- ◆ Funding is available. Some particularly emphasized that the funding is independent, that the Foundation has a system for determining priorities with a reporting mechanism. That the Foundation is funding research looking at new and better ways of building.
- ◆ The Foundation can fund things *not* commercially related, can fund things without immediate commercial return. (Some saw this as positive, others saw the lack of a commercial focus as negative.)
- ◆ Foundation funding ensures a research capability exists within NZ who can be consulted on issues.
- ◆ The Foundation has been innovative in terms of research structures, particularly in encouraging industry involvement in research and industry research provider co-operation.

6.13 Factors preventing use of Foundation-funded R&D by category

Table 7: Factors preventing organisations using Foundation-funded research. Overall values and numbers by segment are shown.

| 151 | Overall 118 | Category: | | | |
|--|-------------|-----------------------|--------------------------|-----------------------|------------------------|
| Factors preventing organisations using Foundation-funded research | | Company 38%, 45 | Consultant 23%, 27 | Government 17%, 20 | Association 22%, 26 |
| Lack of information on research | 57%; 67 | 71%; 32 | 59%; 16 | 40%; 8 | 42%; 11 |
| Lack of contact with researchers (eg Crown Research Institutes, BRANZ) | 32%; 38 | 44%; 20 | 26%; 7 | 25%; 5 | 23%; 6 |
| Limited research and development capability in your organisation | 24%; 28 | 13%; 6 | 22%; 6 | 20%; 4 | 46%; 12 |
| Differences in approach between your organisation and researchers | 19%; 22 | 24%; 11 | 15%; 4 | 15%; 3 | 15%; 4 |
| Research and development is not within the scope of your business | 18%; 21 | 13%; 6 | 15%; 4 | 25%; 5 | 23%; 6 |
| The Foundation's research and development is not relevant to your business | 15%; 18 | 16%; 7 | 15%; 4 | 5%; 1 | 23%; 6 |
| Research results not presented at right time | 12%; 14 | 13%; 6 | 7%; 2 | 15%; 3 | 12%; 3 |
| Intellectual property restrictions (eg ownership, access, licence fees) | 8%; 10 | 13%; 6 | 7%; 2 | 5%; 1 | 4%; 1 |
| Research results not presented in understandable form | 8%; 10 | 7%; 3 | 11%; 3 | 15%; 3 | 4%; 1 |
| None | 7%; 8 | 2%; 1 | 15%; 4 | 5%; 1 | 8%; 2 |
| Unsure | 6%; 7 | 2%; 1 | 7%; 2 | 5%; 1 | 12%; 3 |
| Other | 15%; 18 | 16%; 7 | 11%; 3 | 25%; 5 | 12%; 3 |
| No Answer | 6%; 7 | 4%; 2 | 11%; 3 | 10%; 2 | 0%; 0 |

Participants were asked what factors, if any, prevented them from using Foundation-funded research. Only 7% of respondents said no factors prevented them from using Foundation-funded research and half of these were consultants.

Lack of Information was the most commonly cited factor, cited by over half, 57%, of all respondents. This included 71% of company respondents, 59% of consultants, but only approximately 40% of government and industry associations.

Other factors, experienced by a quarter to a third of respondents, were *Lack of contact with researchers* and *Limited research and development capability in your organisation*. The other two factors, experienced by 15 to 20% of respondents, were *Research and Development not within the scope of your business* and *The Foundations research and development is not relevant to your business*. There were not a lot of differences between companies, consultants, government and business. However almost twice as many company respondents, than government or industry associations, said a lack of information was a problem.

Building and Construction is similar to agriproduction in which factors were considered most important. However higher percentages of respondents in building and construction said the factors were a problem. In Agriproduction only 33% of respondents, compared to 57% in Building and Construction, said *Lack of information* was a factor preventing use of Foundation-funded research. *Lack of contact with researchers* was also significantly higher in Building and Construction, 32%, as compared to agriproduction 20%. The next three factors were reported by similar percentages in both sectors. Possibly the good performance by BRANZ in communicating research has created greater expectations. Possibly communication in the sector, of Foundation-funded research, is particularly bad.

6.14 Suggested changes

Respondents were asked what changes could be made to ensure that Foundation-funded research in building and construction is more directly relevant to their business. The key themes that come through are:

- Communication:
 - Raise awareness of the Foundation and the programmes it funds.
 - Information should be more widely disseminated, easier to access and easier to understand.
- Closer contact between research organisations and industry:
 - Industry wants a more active role in directing and guiding strategy.
 - More consultation by researchers with end users.
 - Consultation to determine industry R&D objectives and priorities.
- Foundation processes:
 - Needs to be less bureaucratic and easier to follow.
 - Application process should be less time and labour intensive.
 - More transparency in the allocation of funding.
 - Raise awareness of what research is funded and how respondents can apply for assistance.
 - Setting up of programmes should align with industry planning cycles.
- Programmes should be:
 - More relevant.
 - Practically oriented.
 - Focused on specific commercial interests.
 - More holistic and include more “social” research.

The most consistent themes are around the need for greater communication, and the desire of industry to have a greater involvement and input into the direction of research.

6.15 Issues

Respondents were asked what issues needed addressing to get better value for money from research and development spending in the building and construction sector. The key issues that respondents say need addressing can be summarised as:

- More proactive communication and wider dissemination of information.
- Greater input from industry into strategic direction, to ensure practical and appropriate research with commercial results and to avoid duplication.
- A co-ordinated and collaborative approach between researchers, industry, and government agencies.

Some specific comments, relating to other issues included:

'Research providers should be more open and co-operative with each other. Major projects could be shared amongst several institutions (e.g. weather-tightness).'

'Have some sort of forum where organisations can provide input.'

'Look at wider commercial opportunities outside NZ.'

'Need more wholistic approach to building buildings and cities not just narrow scientific outcomes.'

'Focus on currently identified problems rather than on needless or wantless innovation.'

'Educate industry on how building and construction fits into the new portfolio structure'.
(There is not a specific portfolio allocated to building and construction.)

'Look at urban affairs and urban issues.'

'Target minority areas (eg rural) from time to time.'

'Fund dissemination of results.'

'Assimilate needs of different parts of the industry.'

'Development of a research strategy, involvement of industry in development of the strategy, and coordination between BRANZ and the Foundation in strategy. Also consultation about research priorities.'

'There's a whole suite of research around sustainability, green building, whole of life costing or life cycle costing of products and systems, recycling of construction waste and social health. The Foundation is not addressing these issues.'

'More co-ordination between government organisations involved.'

'More collaboration.'

6.16 General comments

To conclude the survey respondents were asked for any general comments. Some general themes arose:

- ◆ In all categories respondents want a greater level of communication about the research programmes funded by the Foundation, and a wider dissemination of information. They feel the Foundation should be more proactive with regard to communication.
- ◆ Several respondents perceive the Foundation as being overly bureaucratic, disconnected from industry, not easy to deal with, and somewhat inflexible regarding the funding application process.
- ◆ Others say they don't know about the Foundation, are unaware of what the Foundation funds, and don't understand what the Foundation is there for and

how the Foundation operates. They feel that the Foundation should raise its profile and do more to communicate with industry.

- ◆ There is also a degree of confusion about BRANZ and the Foundation and where funding for programmes originates. Again this is tied in with the need for greater communication and wider promotion to the industry as a whole. There needs to be bridge building between Building Research and the Foundation.

More specific comments included:

New Zealand is too small to invest heavily in Research. Why do we need our own codes? Very few countries in the world develop their own codes. Why don't we just use Australia's?

There will always be a gap between research, its presentation and practical implementation, a methodology for this needs to be developed.

Research should not necessarily have an overseas export focus.

7. Conclusions

The following issues have arisen throughout the survey, in response to many of the questions:

- a. The lack of information about Foundation-funded research.
- b. A lack of understanding of the Foundation and how it operates and a desire to be at least informed and preferably involved.
- c. The need for an industry research science and technology strategy and a desire to collaborate in producing such a strategy and determining research, science and technology priorities.
- d. Better co-ordination and collaboration between Building Research and the Foundation.

There are a large number of industry associations within the sector. Few of them are co-funding Foundation-funded research and few have significant research budgets. A better understanding both of industry by science providers and science by industry is required. It would be useful to engage industry associations as the first step in developing this understanding.

Appendix A

User Survey

FRST Funded Research Programmes – Building and Construction Sector

| Research Provider | Research Programme & Objectives | | Research Team (Research Leader in bold) |
|--|--|--|--|
| Beacon Pathway Ltd | Housing Advances for Environmental Responsibility and Sustainable Living Dr Russell Burton | Policy and Regulation | Lynda Amitrano |
| | | Neighbourhoods | Megan Howell |
| | | New Technologies | Jeremy Warnes |
| | | Market Transformation | Ann Smith |
| BRANZ Ltd | Towards the zero energy house | Towards the zero energy house | Albrecht Stoecklein |
| | An energy demand model of NZ residential buildings Nigel Isaacs | Energy demand model | Dr Michael Camilleri |
| | | Energy use in residential buildings | Andrew Pollard |
| | Weather-tight buildings | Wicking and diffusion | Dr Malcolm Cunningham |
| | | Ventilation drying | Mark Bassett |
| Durable materials | | Dr Mark Jones | |
| Opus Ltd | Built environment for sustainable communities | Urban environments for intensified living | Dr Vincent Dravitzki |
| GNS | Improvements to earthquake resistant design Dr Jim Cousins | Improvements to seismic isolation devices | Dr Bill Robinson |
| | | Improvements to seismic modelling procedures | Dr Graeme McVerry |
| | Geological hazards and their mitigation Dr Kelvin Berryman | Earthquakes from source to surface | Dr John Zhao |
| | | Hazard impacts | Dr David Johnston |
| | | National hazard models | Dr Mark Stirling |
| | | Understanding landslide and ground failure processes | Stuart Read |
| | | Geological studies of active faults | Russell Van Dissen |
| | | New technologies and system development | Dr Ken Gledhill |
| | | Volcanism: eruption dynamics and surface processes | Dr Colin Wilson |
| | Understanding tsunami processes and impacts | Ms Gaye Downes | |
| | Post-earthquake functioning of cities Dr Jim Cousins | Performance-based earthquake engineering | Andrew King |
| Construction systems to reduce seismic impacts on underground services | | Dr Peter Davenport | |
| New applications of seismic isolation | | Dr Bill Robinson | |

| Research Provider | Research Programme & Objectives | | Research Team (Research Leader in bold) |
|---|---|---|--|
| IRL | Smart and durable materials and structures Dr Catherine Dickson | Smart building materials | Dr Emilio Calius |
| | Building innovation through geopolymer technology | Geopolymer science development | Dr Catherine Nicholson |
| | | Geopolymer composite materials | Dr Neville Miller |
| | | Geopolymer durability and modelling | Dr Jon Morris |
| | New technology rural bridges Graeme Finch | Composite materials performance | Dr Emilio Calius |
| | | Design optimisation | Dr Henry Sun |
| | | Economic and performance modelling | Terry Batten |
| Landcare | Low-impact urban design | Performance of LIUDD | Dr Charles Eason |
| Massey University | Building resilient communities in response to volcanic risk | Building understanding of North Island volcanic risk | Associate Professor Vince Neall |
| NZ Heavy Engineering Research Association | Enhanced steel building performance in high risk events | Stage 2 development of the slab panel design procedure | Charles Clifton |
| | | Floor isolating system for superior seismic response (FISSER) | |
| | | Influence of fabrication quality on seismic performance. | Dr. Wolfram Woerner |
| | Composite Structural Assemblies – New Export Products | Establishment of composite structural assembly performance requirements | Charles Clifton |
| | | Composite structural assembly performance evaluation | |
| | | Composite structural assembly product development | |
| | | Development of composite structural assembly manufacturing concepts | Dr. Wolfram Woerner |
| | Composite structural assembly sector development | Dr Wolfgang Scholz | |
| University of Auckland | New materials for phase-change thermal storage | Microencapsulated phase change materials for thermal storage | Associate Professor Mohammed Farid |
| | UKU sustainable earth-fibre housing | Optimise end-user adoption of technology and trial results | Rau Hoskins |
| | | Technology for earth fibre composite material | Brian Morgan |
| | | Full scale trials and commercialisation strategy | Mr Te Kipa Morgan |
| | Retrofit Solutions for NZ | Retrofit Solutions for post-1970 RC buildings | Dr Jason Ingham |
| | | Retrofit solutions for pre-1970 buildings | |
| University of Canterbury | Future Building Systems | Damage resistant modular structural frame and wall systems | Professor John Mander |
| | | Damage resistant building floor systems | |
| | | Energy efficient cladding and wall systems | Dr Larry Bellamy |
| | Organisational systems | Legal and contractual frameworks | Dr Erica Dalziell |

| Research Provider | Research Programme & Objectives | | Research Team (Research Leader in bold) |
|---------------------|---|---|--|
| University of Otago | Mitigating CO2 emissions through enhanced uptake of energy efficiency | Residential energy efficiency upgrades analysis | Associate Professor C. R. (Bob) Lloyd |
| Canesis | Functional, safe built environments | Reduction of particulate indoor air pollutants | Simon Causer |
| | | Reduction of gaseous indoor air pollutants | Steven McNeil |

Appendix B

Estimate of total spending on Research and Development in Building and Construction

Anecdotal numbers of total spending on Research and Development in the building and construction sector are available (eg John Duncan, Building Research, estimates \$22-26 million). It is surprising, for an industry commanding ~10% GDP, that there are no specific figures on funding of Research and Development. It would be a major exercise to establish a robust figure for such a large industry sector.

A question was asked regarding investment in research and development in the Foundation evaluation survey of building and construction. Response to this question, together with specific questions to some organizations, and information on funding and co-funding of Foundation-funded programs on building and construction allows us to make an estimate. This estimate suffers from many deficiencies, some listed below, but hopefully provides a context within which to view the Foundation's investment.

Foundation funding

For Foundation-funded research organisations in building and construction, including universities and CRIs, we will assume their (Foundation-funding plus direct co-funding) times the allocation to the building and construction portfolio is their total spend in this area. (Including co-funding may overestimate the total figure. Co-funding may come from private companies who may also have counted it.) Cofunding is classified as either related or direct. We have restricted the calculation to include only direct co-funding. BRANZ and HERA were approached individually and asked to estimate their total spending on R&D.

(1) FRST funding of programs appearing in the building and construction research list.

| | FRST \$ (1) /\$1000 | FRST B&C \$ (2) /\$1000 | %B&C *Direct cofunding /\$1000 | Total B&C |
|-------------------|------------------------|----------------------------|-----------------------------------|----------------|
| Building Research | | | | \$4219k |
| HERA | | | | \$2800k |
| CRIs | 9858 | 4931 | 305.25 | \$5236.25k |
| Universities | 2362 | 1825 | 118.51 | \$1943.51k |
| Other | 1473.5 | 1261.25 | 1242 | \$2503.75k |
| Other B&C (3) | | | | \$ 134k |
| | | | | \$16,836,510 |
| Totals | 13,693.5 | 9,764 | 1970.76 | \$16.8 million |

(2) allocation to B&C portfolio of programs appearing in the building and construction research list.

(3) FRST programs with a small B&C contribution not appearing in research list.

Foundation programs in the building and construction research list are funded through more than one sector including funding from e.g. energy, hazards, and transport sectors. Including all funding and cofunding for programs on the list would significantly increase the B&C spend as columns 1 and 2 above indicate. This estimate has taken a conservative approach in this instance and where ever a question arose as to applicability either to building and construction or as inclusion in R&D. If there was a question, the value wasn't included.

Private companies

Need to estimate funding on R&D by private companies. In the user survey respondents were asked to indicate the range of their annual investment in research and development. This did not specify in the building and construction sector and for some respondents this may include work in other sectors not just building and construction. For this reason we will exclude those respondents classified as 'government' from the calculations. They are most likely to have

cross-disciplinary interests. The contribution of the government sector (other than through the Foundation) is calculated separately below. Other points to consider include:

- Not all involved in the industry were surveyed, although attempts were made to include all large corporate players and those who may have an interest in R&D.
- Response rate for the survey is 33%.
- 25% of respondents said the question was 'not applicable' to them, either they did not spend on R&D or they did not want to disclose their spending on R&D.
- Those spending more on R&D may be more likely to respond to the survey.

| Range | company | consultant | government | association |
|-------------|---------|------------|------------|-------------|
| <\$50k | 12 | 14 | 2 | 10 |
| \$50-100k | 3 | 1 | 1 | 4 |
| \$100-500k | 13 | 3 | 2 | 1 |
| \$500k-\$1m | 5 | | 1 | 1 |
| \$1-5m | 2 | | 1 | |
| \$5-10m | 1 | | 2 | |
| >\$10m | | | 1 | |
| Total | | | | |

| Range | multiplier | respondents | |
|-------------|------------|-------------|----------|
| <\$50k | \$25k | 36 | \$ 900k |
| \$50-100k | \$75k | 8 | \$ 600k |
| \$100-500k | \$250k | 17 | \$4250k |
| \$500k-\$1m | \$750k | 6 | \$4500k |
| \$1-5m | \$2.5m | 2 | \$5000k |
| \$5-10m | \$7.5m | 1 | \$7500k |
| >\$10m | \$10m | 0 | 0k |
| Total | | | \$22750k |

To calculate total industry expenditure estimates of the percentage of companies, associations, and/or consultants surveyed could be included and multipliers for the above numbers calculated. However this would require considerable effort and results would be of questionable value in view of the points listed above.

To improve this estimate a dedicated effort on behalf of companies would be required.

Other Government Departments

The following government departments/bodies were approached and their estimates follow:

| | |
|------------------------------------|---------|
| Department of Building and Housing | \$500k |
| Centre for Housing Research | \$235k* |
| Housing New Zealand | \$1200k |
| Marsden Fund | \$0 |
| Total other government | \$1935k |

The Centre for Housing Research has indicated that their budget is increasing in 2005/06 to \$610k with cofunding arrangements with other government bodies (eg MED, TPK, MSD). This is possibly indicative of a growing level of housing research investment across government agencies.

TEC will distribute ~\$70 million this year through the PBRF fund. By 2006 this figure will be ~\$250 million. This is devolved funding and currently there is no attempt to find how the funding is distributed across industry sectors. Universities would need to be approached

individually for their spending on R&D in building and construction and the source of this funding given to prevent double counting as they are also funded through the Foundation and other sources.

A recent report has shown that 2.1% of Technology for Business Growth, TBG, projects are related to building and construction. A similar figure could be assumed for TEC. Then approximately \$1.5 million, from \$70 million spending this year, could be attributed to building and construction and the TEC contribution would increase to ~\$5.5 million when the total devolved TEC funding is increased to ~\$250 million. The actual figure would be very interesting to know.

Conclusions:

- Spending on research and development is estimated at:

| | |
|------------------------------|-----------------|
| Research providers | \$16.8 m |
| Other Government departments | \$ 1.9 m |
| Private companies | \$22.7 m |
| Total | \$41.4 m |

- Funding for R&D in private companies is of a similar order of magnitude to that within research organizations.
- The Foundation's contribution is approximately half of research provider's budget in the area.

Appendix C Users Targeted by Survey

Building and construction is a large and very diverse sector. It contains one of the largest New Zealand companies, Fletcher Building, and many of the smallest, eg. individual builders, plumbers etc. It covers a wide range of interests including: manufacture of building products; development and implementation of industry codes; design and planning; and building and construction of structures.

The list of companies, organisations, and government bodies for survey was compiled from a number of sources: information on co-funders provided to the Foundation by research organisations; companies applying for GPSRD grants in associated research areas; a list of companies supplying building and construction products provided by Trade and Enterprise New Zealand; and other companies and organisations, thought relevant, selected from a web search. A wide selection of known users and potential users was required to represent a broad cross-section of the building and construction industry. Known users included those involved in Foundation-funded research. Potential users came from other industry contacts and sources.

A web search revealed recursive lists of associations and companies involved in building and construction. A list of sixty-eight industry associations was compiled by comparing a number of web lists. Emphasis was placed on ensuring that the associations were comprehensively covered and those companies more likely to be involved in research: designers, planners, and engineers. The Association of Consulting Engineers, New Zealand and the New Zealand Institute of Architects were approached and provided member lists. Thirty to forty companies were selected for survey from each of these lists, ensuring a geographical spread and a range of company sizes. Selected companies, based on involvement in the building and construction industry, were also included from member lists of the following organisations: Designers Institute of New Zealand, Earthquake Engineering New Zealand, Steel Construction Industry, New Zealand Construction Industry Council. As well as member lists, many building and construction industry web sites contain lists of companies involved in the industry. These were checked to ensure that major industry players were included in the survey. Lists on the following web pages were consulted: Building Research, Te Puna Web Directory, New Zealand Institute of Quantity Surveyors, Building Industry Federation, Resene. There were many other lists of companies and associations involved in the building and construction industry. New lists ceased providing significant numbers of new associations or companies. Those companies included on our survey list generally had their own websites and these were checked to ensure relevance to the building and construction industry. Site Safe New Zealand, which targets the construction industry, has a list of over 1000 member companies. Not all of these companies are relevant to research and development and it was not possible for us to survey this number of companies.

A number of central government bodies were included in the survey: Department of Building and Housing, Standards New Zealand, Ministry for Environment, Transfund, Local Government New Zealand, and Housing New Zealand. Also a number of local and regional councils were included. Some of these territorial government bodies are co-funders of Foundation-funded research. Co-funders were specifically selected for inclusion in the survey and a number of other councils were included to balance the perspective.

The final survey lists included 27 companies/organisations selected for interview and 330 companies/organisations selected for the web survey.

Firms were contacted prior to the survey and asked to identify the person best suited to respond to a survey on research, science, and technology, specifically Foundation-funded programs in building and construction. Interviewees were sent a list of questions prior to the interview and it was not uncommon for them to indicate that they had consulted with colleagues to provide replies.

APPENDIX D

Comparison with User Survey of Manufacturing

A user survey was carried out in manufacturing in 2002/03. Although there are differences in the survey methodology details, similar topics were addressed. Some differences and similarities between manufacturing and building and construction can be seen.

The manufacturing survey was limited to companies and did not identify and survey any relevant government bodies or industry associations as potential users of manufacturing research. Consultation with these groups to review manufacturing RS&T used the survey findings and there was no disagreement with the findings and conclusions. Building and construction has obvious government bodies and industry associations who stand to benefit from PGS&T research and these were included in the survey. In 2002/03 the Foundation funded approximately \$60 million worth of research in manufacturing in both PGS&T and Technology New Zealand funds. This covered a large number of programs in very diverse sectors. Building and construction research is only funded to ~\$10 million across 22 programs in PGS&T funds only. Although all within the building and construction sector, very diverse requirements are made of this research, from government regulation to commercial products and health and safety issues.

In manufacturing a high awareness of TechNZ programs was seen. This is in part due to the way companies were selected for interview, based largely on Foundation databases. Only 2.1% of TBG grants are in the building and construction sector. A simple allocation cannot be made to manufacturing, due to its spread across a number of sectors but it would account for significantly more than 2.1%. Awareness of TechNZ in building and construction was low, <50% of respondents knew what TechNZ was, 12% had applied for funding.

A similar level of awareness of PGS&T research was seen in the manufacturing survey and the building and construction survey. In building and construction 48% of respondents were not aware of any research. In manufacturing 36% of those interviewed and 47% of the web-survey were not aware of any research. More detailed comparisons cannot be made because of differences in survey methodology. It would appear as though levels of awareness are similar.

Of the users surveyed in manufacturing, 17% had collaborations or connections between the company and a research provider. In building and construction 18% of users surveyed had either involvement or key alliances with a research program. This implies a similar level of involvement in PGS&T programs. However again, care must be taken interpreting these figures as the surveys used very different techniques to construct a sample group for survey.

Less than 50% of PGS&T research in manufacturing had co-funding or partnerships with NZ manufacturers surveyed. 82% of the building and construction programs had key alliances with users in the survey. Thus building and construction research seems to have significantly more key alliances than manufacturing research in general. (This generalisation needs to be treated with caution, the manufacturing programs may have had more key alliances not reflected in the users chosen for the survey. Also terminology has changed between the two surveys, partnerships and key alliances may not be comparable.) There were a very large number of research programs in manufacturing survey whereas there are a relatively small number of programs in building and construction.

