

# Spillover benefits from TBGs

A report prepared for the Foundation for Research Science and Technology  
by Infometrics Ltd, August 2001

## **Objective**

1. The focus for this work is to identify the types, and nature, of spillover and value added effects that are being achieved from businesses undertaking Technology for Business Growth (TBG) funded R&D projects.
2. The Foundation is looking for recommendations, based on evidence of spillovers, to help it enhance the positive impacts of TBG grants.

## **Definition**

3. Spillover is defined here to mean – “*indirect or unexpected benefits to other users from the up-take of research, including consumer surpluses generated through competition and diffusion of knowledge through development of technical skills. These benefits can also arise from the creation of new knowledge platforms that substantially modify processes, products or services*”.
4. This definition implies that we are looking for benefits beyond the company that does the investing such as the uptake of the technology by third parties, or knowledge being transferred as people shift companies.
5. Benefits that arise within the investing company might normally be regarded as being part and parcel of the initial rationale for the R&D investment, and therefore not a spillover or unexpected benefit.
6. There may, however, be some unexpected benefits arising within the investing company that could be regarded as spillover benefits for the purposes of this work – new products/ideas, increased credibility with customers that helps sell other products from the company, increased commitment from staff/key shareholders for change in company strategy.
7. So in this work we are looking for benefits that flow to other firms/organisations as well as unexpected benefits that arise within the company, from undertaking R&D projects.
8. In this sense we are focusing on trying to enhance the total returns from supporting R&D investment. That is, not just achieving a successful outcome for an R&D project but contributing to lifting firms’ performance/ capabilities generally. And also generating wider public benefits in terms of lower cost products and services, generic technology, an increase in the number and quality of people capable of conducting commercial R&D work.

## **Overview**

9. A general observation from this work is that there are a wide range of benefits that individual firms create for themselves and others as they carry out R&D projects. Although many of

these are anticipated gains, there is evidence that firms are often surprised by some of the benefits that do emerge from undertaking R&D work.

10. Furthermore, just as a new technology, like the internet, generates activity ripples well beyond the initial innovation, so R&D activity stimulates action on a wide front beyond the specific projects. In this sense almost all R&D projects will contribute to these ripples or spillover benefits, although it is difficult, if not impossible, to measure the contribution individual projects make.
11. In this report, and the work that lies behind it, we attempt to identify the sorts of benefits that emerge from firms undertaking R&D projects and make some suggestions as to how the Foundation could enhance the impacts via its TBG grants.
12. We present our conclusions and recommendations immediately below.
13. In the remaining sections of the report we examine in detail the types of benefits that appear to be associated with undertaking R&D projects - this work is where the conclusions and recommendations are drawn from. Finally, in Appendix I we set out the approach we used for this work and a list of the companies and organisations interviewed.

## **Conclusions**

14. Virtually all R&D projects will generate some benefits. Most of these will come directly from the project and be captured by the firm undertaking the work – new products, increased sales, etc.
15. In addition to these direct benefits firms that undertake R&D projects will generally experience at least some unexpected benefits ranging from a significant change in company strategy as commitment to R&D rises; to new relationships with outside suppliers; to increased credibility amongst customers and investors.
16. These benefits are captured mainly by the firm and are therefore not strictly spillover benefits. But because they are unanticipated (not directly related to the R&D project) we have included them as benefits relevant to this work.
17. It is important to note that benefits – whether direct or indirect – are likely to take time to emerge. Measuring spillover benefits flowing from TBG funded R&D is difficult at the best of times, but is especially so given the relatively short period of time the TBG programme has been running. This work has focused on getting firms to indicate what benefits they think have flowed from TBG-funded projects. Ensuring good data collection from firms will eventually provide useful quantitative evidence of spillover benefits.
18. Traditional spillover benefits – those captured by others – do flow from TBG-funded projects. They include:
  19. Increased demand (both in terms of volume and technical expertise required) faced by subcontractors to the TBG recipient company
  20. Increased knowledge and in some cases products and ideas for those providing research services to the project leading to expansion of the technological base of the economy

21. The spawning of new businesses as people with experience of R&D projects leave to set up their own companies
22. An expanding pool of experienced people as more firms undertake R&D work and attract or train appropriate staff
23. Three of the companies interviewed for this work were foreign-owned. There was no discernible difference in actual or potential spillover benefits from these companies compared to locally owned and operated firms.

## **Recommendations**

24. The following recommendations are intended to provide ideas about how to enhance the potential spillover benefits from encouraging firms to undertake R&D projects.

### *Just do it!*

25. Given that most R&D projects do generate at least some spillover benefits, the best way to enhance the benefits available would be simply to encourage more firms to undertake more R&D work.

### *Encourage use of outside research providers*

26. There is evidence from this work that spillover benefits are more likely and more numerous where projects involve an outside research provider. Originally firms receiving TBG grants were required to use public sector research providers. That requirement was relaxed around 1997, and there has been an increase in the number of private research providers and also the amount of R&D work undertaken purely in-house.
27. Strategies that encourage firms undertaking TBG-funded R&D projects to use outside firms either for research or as subcontractors to develop components, software, etc are likely to lead to more spillover benefits, than if the work is conducted solely in-house. The Foundation could give greater weight to projects that involve outside research.
28. However, as one person with considerable experience of TBG projects noted, purely in-house projects are often more commercially successful because of the degree of focus and speed, than those involving outside providers. There may be, then, some conflict here between enhancing spillover benefits and encouraging successful business R&D.
29. On the face of it the use of foreign research providers would seem to limit the potential spillover benefits available to New Zealand, and therefore ought to be discouraged if the Foundation is looking to enhance such benefits. We think this would be short sighted. Companies that make the decision to use foreign research providers do so on the basis that it will increase the likelihood of success for their R&D project and therefore maximise the contribution to future business growth - the primary focus of the TBG programme, not spillover benefits.

### *Holistic approach to business growth*

30. By their very nature spillover benefits are indirect and are therefore not always obviously related to specific (TBG-funded) R&D projects. However, ensuring that TBG funding works in closely with other sources of business assistance could enhance broader benefits.

31. Maximising the growth potential of a company is unlikely to rest solely on assisting it to undertake R&D. Other business assistance (TradeNZ, Industry NZ, or venture capital investors) coming in alongside, or immediately after TBG funding could significantly increase the wider economic benefits available, as firms are helped through major transition points on their growth path.

#### *An investment strategy*

32. Pr-active follow-up of projects could enhance spillover benefits. Some projects will fail to fulfil their promise because of technical difficulties. Assistance to solve such bottlenecks will in some cases lead to realising all the originally expected gains and more. Having to search for an alternative technical solution may well lead to a whole new range of products, or breakthrough products that open up far bigger opportunities.

33. The Foundation cannot be expected to scrutinise all projects that do not meet expectations. But by identifying and keeping close to *large* and *technically challenging* projects the Foundation will be more aware of potential bottlenecks that could be removed by additional assistance. A pilot programme could be set up that took a small number of appropriate projects to see whether more funding/assistance from TBG (or other TechNZ programmes, or other business assistance programmes) would significantly boost available gains.

34. In other words and “investment” approach for TBG might enhance both the direct and indirect benefits from R&D projects. That would mean a more flexible approach to funding from both parties. That is, the Foundation (in conjunction with MoRST) could consider providing second and third round funding in exchange for the recipient agreeing to pay back some or all of the subsequent round funding. By taking an investment approach the Foundation is likely to ensure more of its TBG projects are more successful.

35. The “investment” approach may favour larger projects where a significant amount of money has been invested which for want of some further injection of funds (or other assistance) could languish or even die.

36. The Foundation could have a sliding scale of project-extension funding to support completion. That is, an initial 50/50 funding could be followed up with one third funding for an extension of the initial project so long as it still had obvious prospects, and possibly 25% funding for a third tranche of funding for the same project. Clearly stringent tests would need to be applied for subsequent funding, and in some cases that funding could be in conjunction with say venture capitalists. Multiple funding rounds are typical of the venture capital market and are a logical way of managing what is a particularly uncertain business activity.

37. To support this “investment” approach it would be sensible to have a project/ company information set that provides an audit of the project at completion (first stage) and identifies the state and potential of the business - financial strength, manufacturing systems, clear and established route to market, company strategy, etc. This information would be essential in deciding whether to provide extension funding.

#### *Encouraging risk taking*

38. There are peripheral benefits that emerge from undertaking R&D and arguably those firms that receive funding via TBGs are more likely to generate unrelated benefits than firms that fully fund their own R&D. The latter may be more inclined to carry out their work purely in-

house, whereas TBG funded projects, almost by definition, will be undertaken by firms willing to use outside assistance.

39. Although evidence to support this claim is thin, the two firms (interviewed as part of this work) that were funding their own R&D tended to be very focused and self contained. Whereas firms receiving TBG funding appeared to be more willing to "try things" and possibly trip over new ideas, especially where they worked with outside organisations as part of the project.
40. The implication is that if the Foundation were prepared to be more risk tolerant (accept a higher degree of uncertainty about the cost and benefits of a project) then it would be funding projects that might well generate more and bigger spillover benefits.

#### *Leverage from industry research*

41. Although we did not specifically look at the relationship between investment in industry research and leveraging the spillover benefits from TBG-funded projects, there do appear to be some opportunities. We note a significant number of primary sector related projects receive TBG funding. Better co-ordination between some of these projects and Research for Industry funding might well enhance spillover benefits from the TBG programme.

#### *Encouraging foreigners to invest in R&D*

42. Foreign-owned firms have often found it more difficult to obtain government funding for R&D projects than locally-owned firms. Clearly overseas owners capture the direct benefits, but there may be circumstances where the spillover benefits are significant for the local economy. Formal training, exposure to new areas of R&D, knowledge transfer to local research providers, etc, not to mention the potential growth in output from the local operation are all potentially significant benefits for the local economy.
43. The ability of foreign-owned companies to leverage research is generally far greater than local firms that generally lack the global infrastructure to fully and quickly exploit their R&D.
44. Encouraging foreign-owned firms to undertake R&D would help attract foreign investment to New Zealand and would also contribute to building a higher income/ knowledge economy.

### **Spillover benefits**

#### ***Introduction***

45. We can divide benefits into three broad categories:
- Direct or expected gains from carrying through R&D projects
  - Unexpected benefits arising *within* the firm from projects undertaken
  - Benefits that are captured or available to people and organisations outside the recipient firm – traditionally regarded as public spillover benefits
46. We discuss these below. The latter two are examined in detail using material from 21 firms and organisation interviewed for this study (see Appendix I for details of the work programme underpinning this report).

### ***Direct or expected benefits***

47. Direct benefits are the ones that would generally be outlined in a firm's application for a TBG grant. As part of the evaluation of TechNZ undertaken by Infometrics in 2000/01, around 200 TBG recipients were surveyed to quantify some of the key direct benefits firms gained from their grants. In summary, firms reported gains in employment, exports and turnover, that could be directly related to TechNZ funded projects.
48. Firms undertaking TBG-funded projects reported gains in turnover over the past three years of around \$1m on average. Recipients attributed approximately a third of these gains directly to the TBG funding from TechNZ.
49. This result should be interpreted with care given the difficulty firms have in making a direct connection between outcomes and TBG funding, and also the relatively recent commencement of many of the projects. The benefits flowing from undertaking R&D projects will often take years to become fully apparent.
50. Other direct benefits include the development of R&D capabilities within the firm, establishment of a new core product with potential variants, and close links with outside research providers.
51. The direct benefits should be readily identified from the company's application for a TBG grant. For this work we selected companies that had received significant TGB funding (more than \$200,000), so almost all the projects were substantial. In virtually all cases the direct benefits were obvious.
52. In the sections below we look at the indirect or unexpected benefits that appear to arise from firms undertaking R&D projects.

### ***Unexpected internal benefits***

53. In carrying out R&D projects, firms will often generate positive but totally unexpected outcomes that are largely captured within the firm. These might be closely related to the project, or they may be quite unrelated but nonetheless of genuine value for the company's overall performance.
54. The sort of benefits we are talking about here that emerged from our interviews include:  
*Increased management and staff buy-in to the idea that technology is a crucial ingredient for business growth carried through to business strategy and investment plans.*
55. Although a number of firms acknowledged that R&D projects had helped reinforce or promote the importance of technology to the company's business strategy there was one firm that clearly demonstrated the unexpected gains to business thinking as a result of a successful R&D project.
56. The project was championed by one of the three owners. He persuaded his colleagues to hire, on a temporary basis, an outsider to oversee the project. The project met the top end of the range of expectations, and convinced the two sceptical owners that investment in R&D is

crucial to driving the business forward. They have decided to retain the R&D project manager on a permanent basis and use him to drive a sustained commitment to R&D.

57. Furthermore, the success of the project has helped persuade factory floor staff that new technology can significantly improve productivity, which in turn makes the business and their jobs more secure. It also highlights the importance of continuous improvement right through the organisation.
58. Clearly success is very persuasive in generating buy-in for a shift in strategy, and in this case the R&D project has been an emphatic driver of change within the company. The extent of the change that has occurred was certainly not anticipated when the project was being planned and implemented.

*Broadening the technology platform within companies (software expertise; testing facilities that can be used for one project useful for others, skills of the people).*

59. There are two perspectives on extending the capability to take-up and apply new technology – the in-firm building of capabilities (the focus here), and economy-wide broadening of technology platform (discussed below).
60. As firms conduct R&D projects they are forced to develop a range of facilities and expertise that is important to the project, but can also be used in other areas of the firm's activities (Hamilton, Water and Farr).
61. For example, specialist software people required for R&D projects were often retained after the project had been completed. Their skills could be effectively used elsewhere in the company to improve performance and expand business opportunities.
62. In one case a firm had invested in cadcam software and equipment that had subsequently lifted them into a new area of business as well as raising the overall productivity of the firm. Without the stimulus of the project they certainly would not have invested in cadcam at that time.
63. Skilled people brought in for a particular project have often been retained after the project has been completed because of their knowledge and commitment to the business. Clearly the ability of the company to retain specialist or temporary staff depends on the size and performance of the company, and possibly the success, or otherwise, of the R&D project.

*Raising the credibility of the firm amongst its customers and competitors by demonstrating clear commitment to technology and new product development. A higher profile also helps attract high calibre employees.*

64. Firms that push the technology frontier will build a reputation for innovation and progress. Several of the firms interviewed pointed to the broader benefits they generated by being able to demonstrate their technical prowess either in terms of the performance and features of their product, the association they have with high profile research providers, or the conferences they address.
65. One company argued that by presenting a paper at a prestigious conference, it raised awareness of their company and its products within the industry in which it competed. In this sense the investment makes a valuable contribution to building the company's image/ profile.

66. Another company that relied heavily on university research for their product, argued that as the academic responsible for the basic research presented papers the company would often be mentioned for its work in applying the technology.
67. There was some evidence that firms heavily committed to R&D activity created themselves a profile and credibility that helped attract potential employees. This unexpected benefit is difficult to quantify.

*Profile and quality of business management helps attract venture capital.*

68. The process firms must go through to secure funding from TechNZ for R&D projects ensures that the firm has a clear business plan. One firm interviewed acknowledged how important the process of having to meet TechNZ application requirements had been to setting out a formal business plan. That plan had become a central document to the business and had been used as the core of a business plan to attract new capital and think about international expansion.
69. Undertaking R&D projects within the context of a TBG grant helps:
- Improve management practices and lay down basic information about the business
  - Indicate the business is looking to grow by investing in technology
  - Identify the company as looking for funding
70. All these factors take the business closer to the point it is of interest to venture capital investors.
71. Interestingly, the Foundation's client database is probably a rich source of information for venture capital firms and could be seen as yet another spillover benefit from the TBG programme. This point may well become more important as the Venture Investment Fund is implemented.

*Learning to deal with outsiders*

72. In some cases firms lack experience in building relationships with outside organisations, institutions and businesses not directly related to their activities. Having to negotiate their way through the application process, inter-face with TechNZ people, and possibly dealing with outside research providers helps build important capabilities within firms.
73. If a TBG really does lead to significant business growth the managers are likely to have to deal with a much wider range of third parties – patent office, venture capital, foreign distribution businesses, etc. The ability to interact with these important people from outside the business is crucial. Undertaking TBG projects help develop these capabilities.

***Public spillover benefits***

74. Traditionally spillover benefits have been seen in terms of economy-wide and social impacts from carrying out a particular activity. It is clear from debate about how to lift New Zealand's economic performance that R&D is an important element. Implicit in this widely supported argument is that R&D has economy-wide benefits, either through faster business growth (the

focus of TBGs) or through fostering innovation and the accumulation of knowledge on a broad front.

75. In this work we have identified three ways in which an individual R&D project undertaken by a private firm may have wider, or public, spillover benefits:

*The firm lifts its demand for skilled labour expanding opportunities for New Zealanders, possibly boosting wages, and creating a bigger pool of skilled labour to attract other firms.*

76. A number of firms interviewed had increased the number of people working in R&D. In some cases this amounted to adding an extra person or appointing a senior person to take responsibility for this area of activity on a full time basis. In some companies the number of R&D staff had increased significantly from a handful to over 30 in one case and from around 30 to 50 in another.

77. One company with a large R&D function was looking to develop a training programme to ensure they had a steady stream of competent engineers for their business.

78. These largely internal decisions create spillover benefits in at least two ways. Firstly it means there are greater opportunities for graduates to find employment locally in areas of leading edge technology. Secondly by increasing the number of people involved in R&D work in closely related areas these firms are establishing a bigger pool of labour to draw from. That in turn makes it easier to attract new investment into the industry/sector.

79. There is growing evidence that companies that invest heavily in R&D and translate it into growth inspire at least some employees to start new companies that are heavily R&D oriented (examples include: Swichtec out of Tait communications, SPEDA out of Tait, 4RF Communications out of Marine Air Systems).

80. This spawning process could be seen as the single biggest spillover benefit from firms investing in R&D. Tait's commitment to R&D has been a factor in the development of at least two other firms that have created substantial employment, exports, taxes and wealth for the local economy.

81. The process is probably driven out of medium-sized companies rather than small companies, and revolves around ownership issues. Tightly held ownership (Tait) will encourage people to move out and start their own companies. Or where there is an ownership change key individuals may be in a good position to exit with capital and recapture the atmosphere of direct business ownership by setting up a new company.

*Subcontractors are encouraged to develop new components/ techniques to meet the demand from the primary R&D project. By being pushed into new areas some of these subcontractors will open up new opportunities for their business.*

82. Where firms' R&D projects are focused on producing a physical product outside firms are often involved in supplying components or expertise. At least three firms interviewed (DMC, Invensys, Dixon & Haddon) pointed to benefits outside suppliers involved in particular R&D projects would have captured.

83. We interviewed (by phone) two of these "subcontractors" to tease out what benefits they had enjoyed as a result of being involved in R&D projects. In both cases there were clear

benefits. In one case (Diometrics) the firm had had to purchase new equipment to do the job required for the R&D contract, but had also had to learn how to make the new product. Investment in both physical and human capital has opened up new markets (including exports) for this firm's output. In turn it has created downstream demand for other closely related businesses.

84. The other subcontractor was involved with an engineering project as a sub-partner, rather than an arms-length subcontractor. Their input was contributed at cost for an equity share of the final product. In this sense the prime TBG recipient was able to further reduce its risk as well as broaden its R&D base in exchange for allowing others to benefit from the success of the project. The sub-partner was already very R&D focused, although had never sought a grant from TechNZ.

*Outside research providers involved with projects broaden their knowledge base, which can be helpful in developing new areas of research and investigation.*

85. One of the classic spillover benefits from undertaking R&D projects is the dispersion/transfer of technology and ideas to others. Clearly most firms that undertake R&D projects try to protect their ideas and therefore limit spillover benefits occurring. Nonetheless, as new products are delivered to the market the new technologies and ideas embodied in them are obvious to those interested. This impact is probably relatively limited where the company is involved in a highly specialised product or service.
86. Where outside research providers are involved with R&D projects it seems logical that the spillover benefits are likely to be wider and more readily available than if the project is undertaken purely in-house. Certainly there was evidence from this work and the Evaluation of TechNZ<sup>1</sup> that where firms used outside providers such as universities broader/ spillover benefits did exist. In basic terms the benefits are: funding for research; and those involved gain valuable knowledge and experience.
87. Although research providers are constrained in terms of being able to use specific knowledge, they are able to apply what they know to new areas of research. In the case of Medservices at Otago University (the Pharmacy School), it carries out R&D on behalf of several New Zealand companies that have received TBG funding. It seems highly likely that new techniques/procedures that are relevant to formulating new products will be applied relatively quickly across more than one R&D group given that the research provider is essentially the same for all. Similar spillovers will occur to varying degrees within CRIs.
88. Where there is an obvious and dominant research provider the general spillover benefits are likely to be greatest. From our interviews for this work we found evidence within universities, CRIs and WRONZ of spillover benefits from individual TBG-funded R&D projects. The benefits ranged from simply broadening their knowledge and information base in a particular area to the discovery of new techniques/products/ideas that could be taken further and offered to others on a commercial basis.
89. From almost any R&D project involving an outside research provider some spillover benefits will emerge. The benefits will vary from a few crumbs to important new developments.

---

<sup>1</sup> Evaluation of Technology New Zealand; MoRST; Infometrics Ltd; March 2001

---

## Appendix 1

### **Approach**

To gather evidence of spillover benefits we conducted in-depth interviews with 20 firms, at least 15 of which had received TBG grants and two firms that had undertaken R&D projects without assistance from TechNZ.

In selecting the firms to be interviewed we took into account the following:

- Geographic spread
- Size of business
- Stage of development
- Length of time since first TBG grant
- Sector or industry the firm was in

In most cases the firms and organisations were interviewed directly. Several were interviewed by telephone.

The **interview guide** followed the terms of reference:

- How firms have achieved value from investing in R&D / technology
- The relative importance of key value drivers, such as -
  - Development of technical capability/advantage for new products, processes or services
  - Global/niche market development
  - Cost/other advantage
- The process through which the value added was achieved including the contributions of, for example, technological development of new products/processes/services, technical/other collaboration and strategic alliances.
- The nature and extent of any spillovers achieved. Specifically, did the technology development contribute to -
  - Development of new technological strategy or culture in the business?
  - Increased willingness/ability to manage technical risk?
  - Increased technical capability/employment of more technical staff/increased linkages with research providers?
  - Other diffusion of new knowledge through creation of technology platforms leading to a 'cascade' of products/processes/services by that company or other companies?

An important area of spillover benefit is the impact of TBG grants on building the R&D infrastructure, by encouraging firms to use outside R&D providers. As part of this work Infometrics spoke with four R&D providers.

### **Firms interviewed**

		Estimated no. of R&D people
1. DMC Stratex Networks	\$817,594, 1997/98	50
2. Waters and Farr Ltd,	\$293,000, 1999/00	1
3. Comsol (Computer Solutions) Ltd,	\$311,000, 1995/96	3
4. Pyrotek Products Ltd,	\$390,000, 1995/96	3
5. Crusader Engineering Ltd,	\$450,000, 1999/00	1
6. Sanford Ltd,	\$400,000, 1999/00	5
7. GlobalPro International,	\$424,632, 1998/99	4

8. Ancare NZ Ltd	\$293,625, 1998/99		4	
9. Dixon & Haddon Structural Steel Ltd	\$245,000, 1998/99		1	
10. CWF Hamilton Ltd	\$705,000, 1999/00		18	
11. Agrimm Technologies Ltd	\$268,981, 1998/99		2	
12. NZ Wool Scourers R&D Group	\$350,000, 1996/97			
13. NZ PAC Ltd,	\$488,000, 1998/99		2	
14. Invensys		}	10	
15. Diemetrics				
16. Kinetic Engineering			non-recipients	3
17. 4RF Communications			30	
18. IRL (Pyrotech)		}		
19. Canterbury Manufacturers Assoc			research providers	
20. Materials Performance Technologies Ltd				
21. Massey University				