Reading the public mind: a novel approach to improving the adoption of new science and technology

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Some key words: Community Value Survey, Science communication

Abstract.

This paper describes a new approach to measuring and monitoring the quality of dialogue between research groups and the wider community about specific scientific matters. It is an adaptation of a proven marketing process for monitoring customer satisfaction: key drivers of community perception are elicited and measured, so that managers can respond to the issues that are most important to the community, rather than relying on their own perceptions. One important benefit of the approach is that the method provides a means of linking an overall score for the community's perceived value of a research project to an important business driver such as "Percentage of people very willing to support deployment of the research results". The method is illustrated by a case study exploring the views of the Australian public about research into genetic manipulation for pest mouse control. For the population surveyed (the community in New South Wales), some 40% were very willing to support the use of genetic manipulation to manage pest mice. If an increase of approximately 1.5 in the score for the perceived value of a research project

(measured on a scale from 1 to 10) were achieved, the prediction is that overall community support for eventual deployment would rise to about 80%. The approach would appear to have a useful role to play in assisting eventual technology adoption.

1. Introduction

The decline in public trust in science has been widely documented ; see for example Roederer (1998), The British Council (2001), UK House of Lords *Science & Technology – Third Report* (2000), and Wynne (2006). It is attributed in part to the rise of participatory democracy and democratic expectations in all spheres including science, and also to the fact that much science has become publicly invisible, by being commercial, military or simply uncommunicated. As a result the scientist, the scientific institution, the funding body and others in the research enterprise no longer receive automatic respect and there is increased questioning of their ethics, motives and, above all, of who will control the resulting technology. This is having a marked effect on the willingness of some societies to adopt some new technologies, on the speed and extent of adoption, and the level of scrutiny and regulation over it demanded by society: see *e.g.* the Australian Government's *Invest Australia*: web pages about Australia's Agribiotech Capabilities: http://www.investaustralia.gov.au/index.cfm?menuid=55743716 -508B-A0EB-6836D415A9597523. In extreme cases it leads to technology rejection ; for example, food irradiation in Australia.

Community sanction has become a pivotal element in the adoption and implementation of powerful new technologies with far-reaching effects on society, the environment and economy. Genetic manipulation, cloning, embryonic stem cell science, xenotransplants, nuclear energy, water recycling and nanotechnology are recent examples of this. In the case of genetic manipulation (GM), Australian Federal Government approval has been countered by State moratoria on the growing of transgenic crops. In the case of stem cell

science, a government unable to reach a clear decision resolved the matter through a free conscience vote of MPs in the Federal Parliament.

These developments demonstrate that the community, through the media and lobby groups, has the power to block or stall the introduction of new technologies. The failure of scientific developers to adequately inform and consult society can be a major factor in the community's decision to exercise this power. Indeed, this may apply even to non-contentious technologies; see *e.g.* Rickard (2004), the remarks by Crawford & Goss (2005) prefacing a special issue of a journal devoted to the interaction between science and society, and Kelly *et al*. (2006).

The Pest Animal Control Cooperative Research Centre (PAC-CRC) has been conducting research into the use of GM technologies to achieve safe, effective and low-cost pest control. Specifically, PAC-CRC worked to develop new biological control agents or methods for four of Australia's most damaging pest animals, namely the European rabbit, European red fox, the introduced house mouse and the common carp. (PAC-CRC reached the end of its funding period, and its work is now being continued in the Invasive Animals CRC.)

One approach taken by PAC-CRC was to develop vaccines that controlled pest animals by limiting their reproduction. Delivery of the vaccines was to be through baits, or preferably through the agency of a virus that spreads naturally through the target pest population. Such vaccines are created by genetically modifying a carrier virus to include

DNA for sperm, egg or other key reproductive proteins. The product is a modified virus that, during infection of the pest, causes an immune response which attacks the animal's own sperm or eggs and prevents reproduction. The use of fertility control vaccines holds out the promise of being more cost-effective, more humane and more environmentally friendly than current methods of control. In the case of carp, the approach has been to develop fish which are genetically altered to have no female offspring, with the intention that the proliferation of males in the population will cause it to decline.

Ultimate deployment of such methods depends on Government approval which involves a period of community consultation and comment; adoption of the science thus depends on approval by the community. This in turn depends on the outcome of an extended dialogue with the community that openly addresses and responds to all significant concerns and requirements. It is important to monitor the efficacy of such a dialogue between science and society, particularly with a view to evaluating specific communication initiatives and to identifying the issues most in need of attention.

This paper describes a survey method that is designed to address these requirements, The method was developed in the broader context of research into performance measurement for enterprises, and is an analogue of a well-established marketing process for monitoring customer satisfaction. Suitably adapted, it can provide a quantitative assessment of community perceptions over time. Further, it is possible to connect the overall survey results to potentially important factors such as the community's overall willingness to support a particular development or the deployment of a GM agent. Such a linkage can be

crucial. If, despite best communications efforts, a suitable level of support for release cannot be achieved, this would provide strong evidence that commerciali sation in Australia is not likely to be successful, thereby saving both public and private money and scientific resources for projects with a higher prospect of ultimate success.

As a final point, we note that there have been a number of less structured surveys of stakeholder perceptions in the agricultural community, *e.g*. Llewellyn et *al*. (2005) and Pahl & Sharp (2007). We believe there is scope to explore possible gains to be made from structuring such surveys as Community Value surveys.

2. Community Value Management

In the general framework for Performance Measurement developed by Dransfield , Fisher & Vogel (1999), an enterprise has to create and add 'Value' (in a sense to be defined) for five key stakeholder groups in order to gain and sustain success. These groups are: the Owners of the enterprise, its Customers, the People who work for it, its Strategic Partners and Suppliers, and the wider Community. All these stakeholder groups make some sort of investment in the enterprise – money, labour, support, technology adoption – and all have alternative possibilities for their investment , hence the need for the enterprise to provide its stakeholders with greater 'Value' than can be obtained elsewhere, to retain their support. For Customers, and so in the context of a product or service being provided, 'Value' is interpreted as 'Worth what paid for '. For People, it can be interpreted as 'Worth working for this enterprise', and so on.

Some 20 years ago, a process called Customer Value Management was devised for creating and adding value for Customers, and it has since been successfully deployed in a wide range of organisations. It is well-documented by its primary developer, Ray Kordupleski, in a book written with Janice Simpson (Kordupleski & Simpson, 2003). More recently, the process has been successfully adapted to the People stakeholder group (in several unpublished studies by ValueMetrics Australia, www.valuemetrics.com.au), and thus suggests itself as a natural path to investigate the Community as stakeholder.

The basic steps in the Community Value Management process are depicted in Figure 1.

– Figure 1 near here –

The description below is an exact parallel of what is done with Customer Value Management, so that detailed discussion of each step can be found in Kordupleski & Simpson (*op. cit*.). More detail about the selection and conduct of the focus groups, and about the survey instrument, is provided in the Appendix.

Step 1. Develop and conduct a Value Survey

1.1 *Develop a provisional Value Tree*. The starting point is the development of a so-called Value Survey, based on the concept of a Value Tree in which *Value Added for the Community* is modelled in terms of its most important quality characteristics, or 'satisfaction Drivers' as they are termed in their original marketing context . For the present context we have interpreted *Community Value* as *Worthwhile Research Project*. The Value Tree we use is shown in Figure 2.

– Figure 2 near here –

Initial discussions are held with subject matter experts to obtain their input about (a) the community's main quality characteristics ('Attributes') for Benefits and Concerns; and (b) potentially important demographic factors. Focus groups are then conducted in the community, taking account of (b), to obtain a provisional list of the most important Attributes of each Driver.

1.2 *Develop a provisional Value Survey instrument and collect data from a pilot experiment*. The provisional Value Tree is readily converted to a survey instrument. Starting with the Attributes of Benefits, survey respondents are presented with a series of requests of the form:

> *On a scale of 1 to 10, where 1 is Poor and 10 is Excellent, please rate the Research Program on the following:*
>
> *Financial benefits to farming families*
>
> *… etc. for the other Attributes*

and finally the summary request,

> *Taking account of all these factors, please rate the overall Benefits of the Research Program*.

Respondents are asked their main reason for assigning this response, leading to some qualitative data to provide additional insight when the quantitative data are analysed.

Turning to the Attributes of Concerns, the request has to be posed slightly differently to obtain ratings that increase with increasing satisfaction; thus a score of 1 equates to *Unconcerned* and 10 to *Very Concerned*.

Finally, at the top level, the request takes the form

Taking account of the overall Benefits and Concerns, please rate work being undertaken as a Worthwhile Research Program.

The result is a tree-structured set of ratings, each on a 10-point scale, as shown in Figure 3.

– Figure 3 near here –

There is one other important inclusion in a Value survey: one or two so-called "Business impact" questions that allow the overall *Value* score to be linked to higher-level business drivers. In the context of a Community Value survey, these can take the form of requests such as

On a scale of 1 to 10, where 1 is Unwilling and 10 is Very Willing, please rate your willingness to support eventual deployment of a genetically modified agent to manage pest mice

or

On a scale of 1 to 10, where 1 is Unwilling and 10 is Very Willing, please rate your willingness to support research into the use of genetic technologies to manage other pests such as foxes, cane toads, …

Again following Kordupleski & Simpson, the resulting data can then be used to create the sort of graphs depicted in Figure 4.

– Figure 4 near here –

(The fitted curves are logistic functions of the form $Y = 1 / (1 + \exp(-\beta_0 - \beta_1 x))$, anchored to the point (10, 100).) They provide the basis of deciding what sort of

improvement in the *Value* score might be sought, based on a proposed improvement in Willingness to support eventual deployment of the agent.

1.3 *Test the validity of the survey instrument.* An unusual aspect of this general approach to a satisfaction survey is that it is possible to ascertain whether something important has been omitted from the survey, either at the level of Drivers or of Attributes. The data may be analysed using a hierarchical set of linear statistical models. Thus, in Figure 2, we begin by modelling the response *Benefits* as a linear function of the explanatory variables *Financial benefits*, *Reduced spread of infection*,…, and the response Concerns as a linear function of *Native species affected*, *Hazardous to people's health*, …. In each case the quality of the model fit (commonly assessed by the multiple correlation coefficient R^2) provides a means of gauging whether all the most important Attributes (explanatory variables) are present. Finally, *Value* can be modelled in terms of its two explanatory variables, *Benefits* and *Concerns*, and again evaluated for adequacy (see *e.g.* Fisher, Lee & Sparks 2005 for a description of the method in the context of customer surveys, and further references to the literature). Should some of these models prove inadequate, it is necessary to study comments made in the survey, the results of the focus groups and, *in extremis*, to conduct further focus group work to identify the missing Attribute(s) or Driver(s).

1.4 *Carry out the complete survey and analyse the data.* The goal of the data analysis is to be able to construct a table of the form shown in Table 1, which displays the

relative importance of the different Attributes as explanatory variables, and how the Research Program is currently rated on each Attribute.

– Table 1 near here –

Step 2. Identify the priorities with the biggest impact on the enterprise.

The complete results are used to identify which Drivers and Attributes

(a) carry the most weight, and

(b) are rated poorly,

as a basis for selecting improvement priorities. See Kordupleski & Simpson (*op. cit.*) for an elaboration of this aspect.

Step 3. Make the improvements, communicate the improvements, and re-survey.

The survey results inform the ongoing dialogue with the Community. After one identifies what needs to be worked on, the key questions are: what is an appropriate response (better explanation of the work? further research? …); and what is the appropriate way to communicate the information or improvements?

Finally, we wish to emphasize an important distinction. Customer Value surveys, focussing as they do on measuring market perceptions of delivered Value and its drivers, provide just one means of carrying out customer surveys. (The same is true of People Value surveys.) Other approaches are possible based on sociological or psychological considerations. We have chosen to base our approach on an analogue of Customer Value because it appears to provide three distinct benefits:

1. If one accepts the primary focus on Value, one can use statistical methods to verify that the most important factors affecting people's perceptions of Value have been included in the survey.
2. The approach provides a means of identifying actionable improvement priorities likely to yield the greatest improvement in Value.
3. The approach provides a means of linking Value to other important factors.

Our interest is in science communication research, rather than sociological research, with the goal of providing a short-term basis for decision and action, in other words, facilitating practical science communication activity.

3. A case study on management of pest mice

We shall illustrate the approach with an initial study that was carried out in relation to a program of research into genetic technologies for controlling pest mice.

Plagues of mice (non-native mice) occur about every year or two in Australia and were conservatively reckoned to be causing of the order of 46 million dollars of damage, over a decade ago (Caughley *et al*., 1998). PAC-CRC, CSIRO and Australian universities had shown that it was possible to modify a harmless mouse virus so that the female mice could no longer have offspring. Research was directed at showing that the virus was safe for all other animals, and that it would work in the field.

To help inform a process of community dialogue about the progress of their research, PAC-CRC commissioned ValueMetrics Australia to conduct an initial Community Value survey in 2004, focused on the people of New South Wales.

In accordance with the description of the Community Value Management process, two Focus groups were held in Sydney, and two in Albury, based on advice from the expert focus group that the important Attributes for people from coastal cities might differ from those of people from Regional and Rural areas, who are more immediately affected by mouse plagues. The expert focus group included scientists, science communicators and program managers from people from CRC itself, CSIRO, the Grains Research and Development Corporation and universities. Participants in the community focus groups were chosen to provide a cross-section of the population according to *Age, Educational level, Gender* and *Occupation*. These resulted in the development of a provisional set of Attributes, from which an initial survey instrument was developed. A fifth focus group was held in Sydney to test the wording of the statements in the survey.

Telephone interviewing was selected as the means of acquiring survey data. A specialist company, IRIS Research, were commissioned to carry out data collection. Cost limitations dictated a maximum sample size of about 720 respondents. These were divided equally between "City" and "Country" people.

The pilot survey was conducted as a series of three mini-surveys of a total of 420 respondents. After each mini-survey, the data were analysed to check the adequacy of the

model fit, with small changes to the wording of individual survey statements being made. Also, one Attribute that had been extracted from the Country focus groups (relating to whether farming communities would get a say in the deployment of the method) was found to make negligible contribution and so was eliminated from the survey, making the City and Country survey instruments identical. The common Community Value tree that formed the basis of the survey is shown in Figure 5.

– Figure 5 near here –

The main survey was then conducted with the remaining respondents, resulting in some 292 responses.

4. Results

The main findings from the statistical modelling and analysis are summarised in Figure 6.

– Figure 6 near here –

The mean rating of Community Value is $R = 8.2$, with a standard error of 0.1. The most important question is: Is this a good or a bad rating? We return to this shortly. The highest-level regression model is

$$\text{Rating}(\textit{Value}) = 0.59 \times \text{Rating}(\textit{Benefits}) + 0.11 \times (11 - \text{Rating}(\textit{Concerns})).$$

With the model-fitting approach adopted here, the regression coefficients (or *impact weights*) 0.59 and 0.11 add to the total R^2 for the model fit so that the quality of this fit has $R^2 = 70\%$. The two lower-level regressions have $R^2 = 84\%$ with Benefits as the response variable, and $R^2 = 64\%$ with Concerns as the response variable.

The quality of two of these three model fits is discussed in the next Section. Now, we return to the issue of whether an overall rating on Value of 8.2 out of 10 is a good score or a bad one. The graphs corresponding to those in Figure 4 are shown in Figure 7. We see that the current Value score corresponds to about 45% of the community being very willing (as defined by a rating of 8, 9 or 10) to support eventual use of viral methods to manage pest mice.

Discussion of case study

The following is a summary of issues of significance to communication that emerged from the surveys.

(a) Strong public support

There appears to be a very substantial base of public support for doing something about mouse plagues. This is surprisingly solid in urban as well as rural areas. While the public does not have a particular preference about the technology used it is clear that it sees a very significant national benefit in the goal of controlling mouse plagues, in addition to industry, local community and economic benefit. This offers a foundation for future public dialogue and awareness activity.

(b) Risk

There is some public concern about the riskiness of the new technology, both to humans and the environment. This is clearly an issue on which the public will need to be satisfied before there is consent to release. A formal dialogue and public consultation process is highly advisable, giving the community assurance that it has some responsibility for the final decision.

(c) Lack of information

The survey clearly identified a lack of public information about the issue and technology in question as one serious issue (a weight of 14% with a rating of 7.5). It is not only a case of providing information to the public, but of *being seen* to provide it. Information provided must be clear, straightforward, transparent, and in plain language, it must admit risks as well as benefits and discuss them objectively and it must concede uncertainties and indicate what might be done in certain eventualities.

(d) Australia's image

Though less prominent than the above issues, there is a significant public concern for Australia's good name in the world, which will need to be addressed during communication of this technology. This contains both positive and negative components – the benefits to Australia for having been a world leader in safely and successfully

implementing a new biocontrol strategy, and the consequences both reputational and economic of having made a mistake.

It will be necessary to show that these issues have been carefully thought about and that we are in a position to capitalise on any benefits or limit damage resulting from anything that may go wrong.

(e) Final assessment of case study

The initial phone survey indicates public support for the control of mouse plagues. However it also indicates the need for a well-thought-out and planned dialogue process over the release of any GM virus, giving the public a genuine sense of being able to air its views and concerns and contribute to the decision.

It will be essential to constantly monitor public opin ion and its key drivers throughout the technology introduction process in order to understand fully the community view at the time and respond to areas of perceived need for information and consultation in a timely and responsible fashion.

Conclusions

Learnings from quantitative aspects

(*i*) *Approach to data collection.* Community surveys can be very expensive, especially if conducted by personal interview or telephone. In the present instance, telephone surveys were used. Our experience is that this method of acquiring data tends to result in quite noisy results (although see (*ii*) below for an additional cause of variability). A CATI (Computer Aided Telephone Interview) operator provides a limited amount of information across a telephone line, a respondent is not in a position to study it or think much about his/her answer, and the CATI operator tends not to be able to provide clarification about specific points. In the future, and based on our experience with another survey, we will experiment with Internet panels: see the discussion in Fisher, Lee & Cribb (2006).

(*ii*) *Quality of model fits*. Generally, with Customer Value surveys, one seeks to obtain hierarchical regression models that explain at least 70% of the variation. In our experience, Customer Value data tend to be rather less variable than Community Value data, probably because the general issues being considered and the particular Attributes being rated are more concrete in the Customer setting. Given these comments, we feel that the actual fits that were obtained (R^2 = 70% for the highest level regression model of Value as a function of Benefits and Concerns, R^2 = 84% with Benefits as the response variable, and R^2 = 64% with Concerns as the response) were very encouraging. Generally, one would hope to explain rather more than 64% of the variation; however, there was nothing in the qualitative comments solicited from survey respondents that helped us to identify another Attribute for Concerns. In future studies, we would make

one significant change to the basic Value Tree. We believe that significant gains in modelling might be achieved by the addition of a third Driver of Value, namely one relating to priority for expenditure on environmental problems. Whilst people may well see a lot of benefit in the research, and be quite unconcerned about potential perils, they may well feel that there are rather more pressing issues worthy of research attention. The addition of this Driver together with attendant Attributes might well help improve both the prediction of Value and the model fit for Concerns.

General points

From these initial experiments we conclude that Community Value Analysis shows promise as a technique for smoothing the path to adoption of new science and technology through a process of consultation which helps to give the community a sense of ownership of the decision.

A smoother path to adoption also implies that economic, social and environmental benefits from new science and technology will be delivered sooner and a more substantial return on public research and development investment captured. It also assumes that scientists and decision-makers respond adequately to issues of concern to the community. In the case of commercial technologies it offers the opportunity to be 'first to market' with an informed view of likely consumer response.

The process is also valuable in that it can provide scientific organisations with advance notice of likely community reaction to new science and technology. This applies

particularly to the so-called 'disruptive technologies' capable of changing society significantly, notably biotechnology and nanotechnology. This provides scientists with the opportunity to:

- discontinue research which is likely to meet with community rejection, rather than running a high risk of wasting scarce resources;
- modify research so that the delivered outcome is more acceptable to the community;
- improve communication to address particular issues of concern, interest or demand for more information on the part of the community or subsets of it;
- understand the broad issues driving public opinion for and against a particular technology or innovation and respond to them appropriately;
- understand these drivers of public opinion as they change with time, thus enabling a quicker and more effective response to public wishes and concerns; and
- understand better the likely consumer response to new technologies.

From the point of view of science communication, the most significant benefit arising from the case study was that it provided clear insight into the *drivers* of community attitudes. This is a substantial advance over the existing situation, in which scientists and technology decision-makers very often make assumptions about community perceptions of benefits and concerns and the acceptability of the technology, based on their own feelings. Having invested so much time, expertise, money, enthusiasm and personal commitment in a new technology, its developers are not usually well-placed to judge the

public's attitudes towards it, especially if some of those attitudes are questioning, negative or hostile.

Thus, "Benefits to family farmers", "Economic benefits to Australia" and "Health and well-being of the Australian Community" were the highest weighted and highest rated of the community's perceived benefits of the research. In the absence of this information, the managers and scientists involved may well have continued to put most emphasis into promoting the humaneness as a key benefit of the technology – as indeed was the case in the past.

In the case of Concerns, no issue stood out as being substantially more or less important than any other. However, the fact that "Will the costs outweigh the benefits?" is weighted and rated more highly than "Could the virus get into the food chain?" is instructive in developing the technology. To that point, public information provided by PAC –CRC had concentrated to a far greater extent on the nature of the virus under trial than the benefit:cost ratio or public safety aspects of the work. The Community Value approach indicated that a change in emphasis was warranted, to improve dialogue with the community.

Finally, a significant benefit of the Community Value approach is its ability to monitor the drivers of community attitude on an ongoing basis and respond by fine-tuning public outreach accordingly. The current survey was conducted in the absence of any anti-GM campaign; nor was there a mouse plague at the time. Community attitude can be expected

to be modified by events or new knowledge. Traditional survey methods that simply seek an overall attitude at one point in time will not provide sufficient information as to *why* members of the community may have formed either a positive or a negative attitude to a new technology and how that may alter in the face of new developments.

We submit that the Community Value approach described in this paper can contribute greatly to the quality of the dialogue between scientists and the community, by enabling clearer and more timely science communication focussed on audience needs and concerns. It provides a new way for science to listen to community views – both informed and uninformed - about new technologies and work out the best path to adoption.

The prospects for successful adoption will in turn influence the choice of science to be carried out, how it is performed, its goals and the likely success and speed of its adoption, leading to resources being directed to those projects with greater prospects for successful uptake and hence to a better return on public or industry science investments.

Acknowledgements

We are grateful to Martin O'Shannessy (Illawarra Regional Information Service) for his generous cooperation in acquiring survey data, and to Professor David Steel (University of Wollongong) for helpful discussions about technical aspects of telephone surveys.

Appendix: Focus groups and conduct of survey

A1. Selection and conduct of Focus groups

Detailed discussion of the purpose of the focus groups in developing Value Surveys can be found in Kordupleski & Simpson (2003). Here, we provide some specifics for the Pest Mice project.

The initial discussion with experts was used to generate an initial list of Attributes for each Driver, that is, a list of the most important factors that the experts believed contributed to the community's overall satisfaction about a particular Driver. The material obtained provides input to the conduct of the focus groups held in the community. Budgetary considerations meant that two focus groups could be conducted in each of two locations in New South Wales, with a follow-up focus group to test the wording of the survey instrument. It was the advice of the experts that the locations should be in a city, and in a regional centre near to a wheat farming community. Sydney and Albury were selected for the purpose. A professional agency was contracted to organise the focus groups. The criteria provided included: 10–12 people per focus group; allowance for the demographic factors, age, gender, occupation, educational level.

Participants were given an initial briefing about the general issue of pest mice and the line of research being pursued, after which there was a short general discussion. Following this, a facilitated process was followed to elicit what they thought the community would see as benefits of the research and possible areas of concern. Material obtained from the earlier discussion with experts was tested during this phase. Multi-voting was used to summarise the resulting data.

A2. Development of preliminary survey instrument

The provisional lists of Attributes of Benefits and Concerns were then turned into provisional statements in a draft survey (*cf.* Step 1.2 in the main text). These statements were then tested for clarity of interpretation in a final focus group in Sydney, together

with some introductory text explaining the purpose of the survey. Overall, some 51 people participated in the five focus groups.

A3. Fine tuning of survey instrument

There is no guarantee that someone listening to information at the end of a telephone line will comprehend material as well as someone sitting in a focus group. We embarked on a series of three small pilot telephone surveys totally about 420 respondents, to validate (using statistical analysis) the adequacy of the provisional sets of Attributes and Drivers as predictors, and to improve the wording in the survey instrument. Statistical analysis of the first few pilot surveys indicated that the model fits were not satisfactory, which appeared to be due, at least in part, to respondents not understanding what was being asked or why. The company contracted to conduct the telephone research also monitored the performance of its CATI operators to decide who were best at conducting the interviews.

The final versions of the Introduction and the survey statements are reproduced below.

IRIS used standard random dialing sampling practices to obtain samples or respondents balanced for the key demographic variables selected by the expert group.

Details of survey

Introduction (respondents living in cities; slightly modified for regional and rural communities in NSW)
You may be aware that plagues of non-native mice occur in Australia about once every three years. Each plague costs the Australian community about 125 million dollars in damage to crops. Groups working to solve this problem are the Research Centre for Pest Animal Control, the CSIRO and a number of Australian universities. These groups have found that it is possible to produce a genetically modified version of a harmless mouse virus that controls mouse plagues by preventing female mice from having babies. This is a world first scientific breakthrough and research is now under way to make sure the virus is safe for all other animals and that it will work under real world conditions. The reason for this survey is to get people's views about the benefits of using a virus like this to control plagues of mice and to find if you have any concerns about the approach. There are two main parts to the survey. First I will read out a number of possible

benefits and ask you to rate how you think the proposed method will perform in providing that benefit and we will ask about any concerns you may have later in the survey

We will use a scale of 1 to 10 where 1 means Poor and 10 means E xcellent. [‘Don’t know’ was provided as an option.]

1.1 Benefits to farming families such as better incomes and improved health and welfare.

1.2 Economic benefits to the whole Australian community such as cheaper food prices and better export income

1.3 Environmental benefits such as less competition for native animals and plants.

1.4 Enhancing Australia's international image through cleaner grain exports and recognition of our scientific expertise

1.5 Health and welfare benefits to average Australians through cle aner homes and food and fewer diseases carried by mice

1.6 A more humane approach than poison as the mouse is not killed or hurt.

Given your responses on these potential benefits, how do you rate the benefits of the proposed viral control method overall?

What was the main reason you gave it?

Now we move into the second main part of the survey. In this part I will read out a number of possible areas of concern and ask you to tell me whether or not you are concerned about the issue I read out using a ten point scale. In this scale a score of 1 means that you are very concerned about the issue and a score of 10 means that you are personally unconcerned. Remember we are just after your opinion. Here is the first possible concern

2.1 The possibility that the virus might affect other animals or humans by mutating or jumping species or through misuse.

2.2 The possibility that the virus could get into the food supply

2.3 Whether scientists, Government and business involved will keep the Australian community informed

2.4 Whether the costs of developing and using the approach will outweigh the benefits

2.5 Possible negative impacts on the environment especially native plants and animals

2.6 The impact of using a genetically modified organism on Australia's international image

2.7 The possibility of trade bans from other counties because we are using a genetically modified organism.

Given your responses on these concerns, how would you rate your level of concern overall in relation to this proposal? A score of 1 is not concerned at all and a score of 10 is very concerned.

What was the main reason you gave it that rating?

3.1 Taking account of the Benefits and the Concerns, on a scale of 1 to 10, where 1 is Not worthwhile and 10 is Very worthwhile, please rate this as being a worthwhile research project.

4.1 On a scale of 1 to 10, where 1 is Not at all willing, and 10 is Very willing, please rate your willingness to support the use of this method for control of mice.

4.2 On a scale of 1 to 10, where 1 is Not at all willing, and 10 is Very willing, please rate your willingness to support research into viral methods for control of other pests such as rabbits and foxes.

4.3 On a scale of 1 to 10, where 1 is Not important, and 10 is Very important, pleas e rate how important it is for the community to be consulted on research like this.

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Figure 1

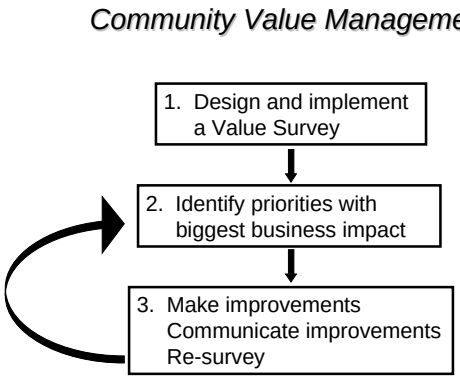


Figure 1. The basic improvement cycle for the process of managing Community Value. It is precisely modelled on the process of m anaging Customer Value, developed by Ray Kordupleski.

Figure 2

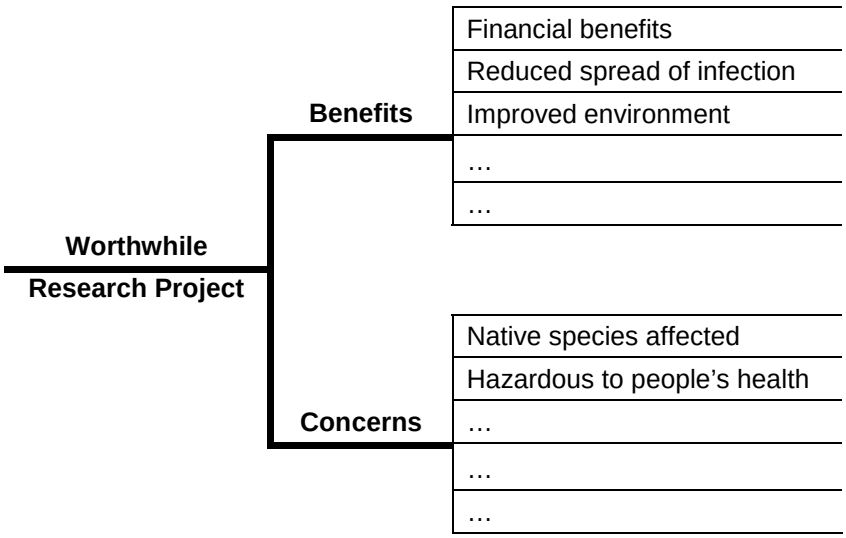


Figure 2. A Community Value Tree, showing the key drivers (*Benefits* and *Concerns*) of *Community Value* (described as "Worthwhile Research Project", in the present study). The main Attributes determining satisfaction with each driver are found from focus groups, and used as the basis of a Community Value Survey.

Figure 3

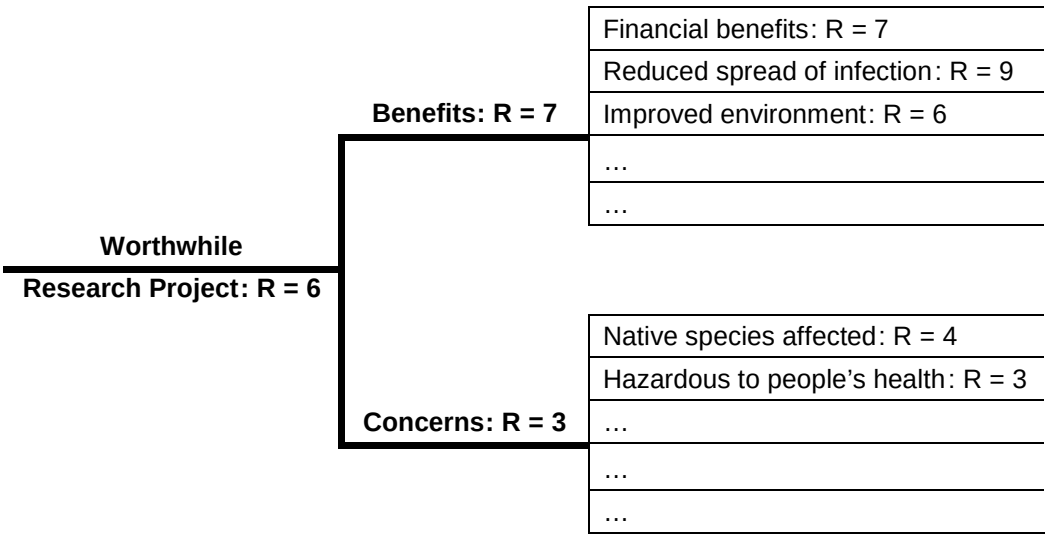
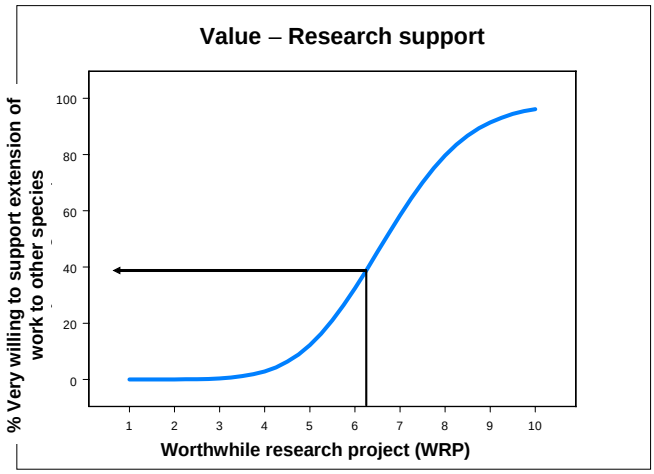


Figure 3. Illustration of structure of data from an individual respondent. For a given Driver, individual Attributes are rated first, followed by assignment of an overall rating for the Driver. For Benefits, ratings have the interpretation that 1 = *Poor*, and 10 = *Excellent*, whereas for Concerns, 1 = *Unconcerned* and 10 = *Very concerned*.

Figure 4

(a)



(b)

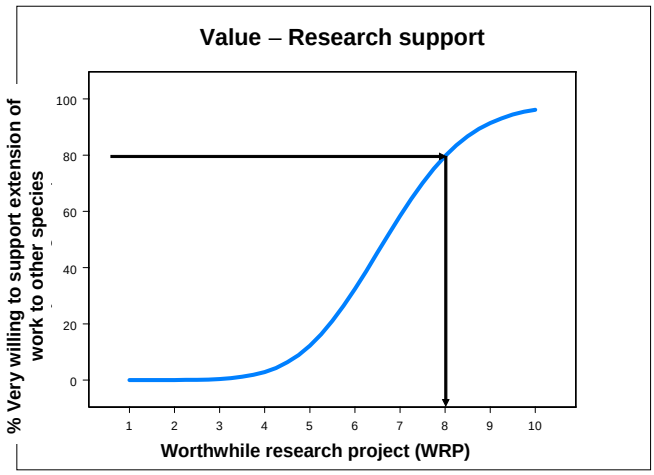


Figure 4. (a) Linking the overall mean rating on *Community Value* to a higher-level business driver. A mean rating of 6.3 corresponds to some 40% of the community very willing (as defined by a rating of 8, 9 or 10) for *Willingness to support eventual deployment of a genetically modified agent to manage pest mice* . (b) If community support needs to be at least 80%, this implies that the overall *Value* score will need to be lifted to around 8, providing a meaningful target for the dialogue process.

Table 1

	Impact weight		Mean rating	
Attribute	Previous	**Current**	Previous	**Current**
Financial benefits	–	**23**	–	**7.5**
Reduced spread of infection	–	**17**	–	**7.5**
Improved environment	–	**5**	–	**6.3**
…	–	**11**	–	**5.1**
…	–	**9**	–	**5.8**
…	–	**14**	–	**7.1**
Benefits		R^2 = 79%	–	**6.4**

Ratings have a precision (95% confidence interval) of ± 0.38

Table 1. The goal of the statistical analysis is to identify the relative importance of the different Attributes as explanatory variables. The unused columns labelled *Previous* are included simply to emphasize the role of the survey instrument as a monitoring tool. The effect of improvement initiatives can be assessed by looking for changes in the mean ratings of the Attributes. Changes in the relative importance of the Attributes will be signalled by changes in the impact weights (*i.e.* the regression coefficients in the fitted linear model). See the discussion in §4.

Figure 5

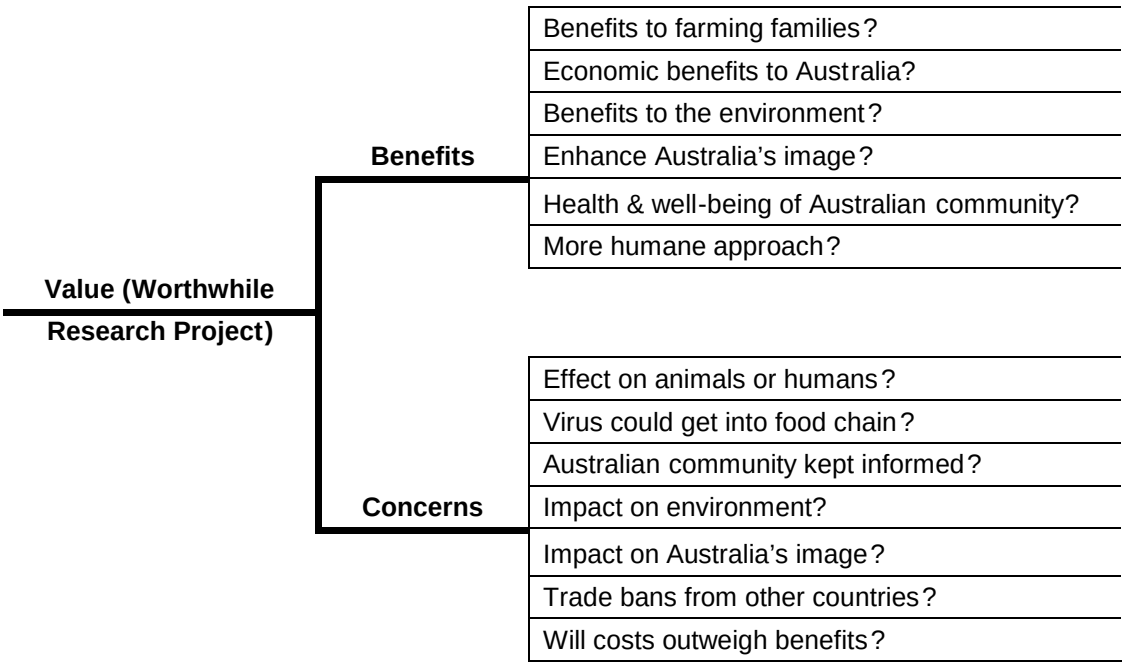


Figure 5. Basic Value Tree developed for survey of the Community's view about the research program into genetic technologies for controlling pest mice.

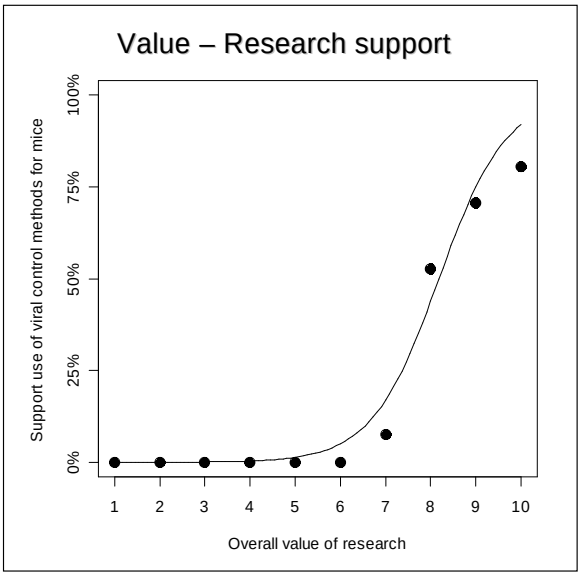
Figure 6

R		W	R	Driver	W	R	Attribute
					15%	8.8	Benefits to farming families?
					23%	8.3	Economic benefits to Australia?
		59%	8.3	Benefits	10%	8.2	Benefits to the environment?
					5%	8.3	Enhance Australia's image?
					22%	8.3	Health & well-being of Australian community?
					10%	7.9	More humane approach?
8.2	Value						
					13%	8.1	Effect on animals or humans?
					8%	8.0	Virus could get into food chain?
					14%	7.5	Australian community kept informed?
		11%	6.6	Concerns	10%	6.9	Impact on environment?
					12%	5.6	Impact on Australia's image?
					12%	6.2	Trade bans from other countries?
					13%	8.1	Will costs outweigh benefits?

Figure 6. Results of statistical analysis. *R* and *W* refer, respectively, to the mean ratings and regression weights. 95% confidence intervals for the mean ratings on *Value*, *Benefits*, *Concerns*, *Attributes* (Benefits) and *Attributes* (Concerns) are, respectively, ±0.2, ±0.2, ±0.3 and ±0.35. With the model-fitting approach adopted here, the weights on a given regression add to the total R^2 for the model fit. Thus R^2 = 70% for the highest level regression model of *Value* as a function of *Benefits* and *Concerns*, R^2 = 84% with *Benefits* as the response variable, and R^2 = 64% with *Concerns* as the response variable.

Figure 7

(a)



(b)

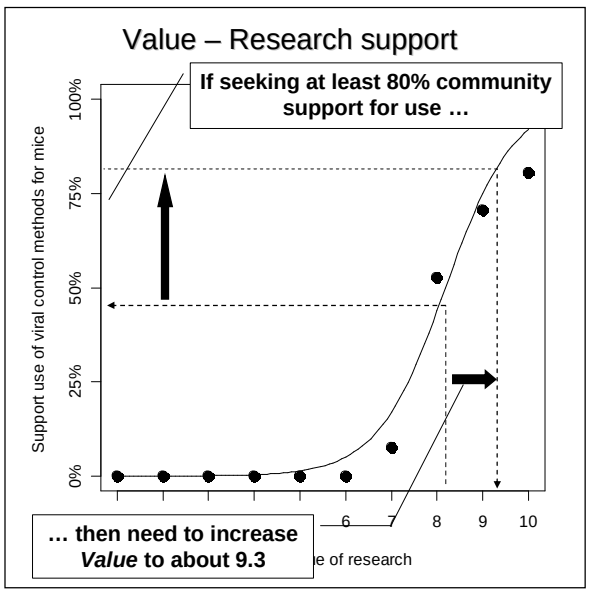


Figure 7. (a) Linking the overall mean rating on *Community Value* to a higher-level business driver. A mean rating of 8.2 corresponds to some 45% of the community very willing to support eventual use of viral methods to manage pest mice. (b) If community support needs to be at least 80%, this implies that the overall *Value* score will need to be lifted to around 9.3, providing a meaningful target for the dialogue process.