Final Report (Revised)

Benefit cost analysis of selected projects within the FWPA R&D program (2011)

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Prepared for

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Introduction

Forest and Wood Products Australia (FWPA) directs investment into research and development (R&D) projects that aims to increase the competitiveness and profitability of the forest and wood product-based industries. Since January 1996, FWPA has invested in over 400 projects within 14 investment priority areas.

FWPA has committed to regularly undertaking an evaluation of its investment program by selecting a representative sample of projects and evaluating these, in accordance with the protocol developed by the Council of Rural Research and Development Corporations Chairs (CRRDCC).

This report contains the results from the evaluation of a further six of FWPA's research projects. This evaluation has been undertaken during September – October 2011.

Methodology

FWPA provided URS with the six projects that it had selected for review. The projects were randomly selected from within each of FWPA's broad research themes, namely growing, processing and market-facing research (Table 1).

Table 1 Selection of projects from evaluation in 2011

Theme	Project number	Project title
Growing	PNC057-0809	Managing subtropical pines for improved wood production based on a better understanding of genetics, silviculture, environment and their interactions
	PRC179-0910	Rapid screening of commercial forestry species to *Uredo rangelii* (myrtle rust) and distinguishing *U. rangelii* from *Puccinia psidii* (guava rust)
Processing	PNB040-0708	MOE and MOR assessment technologies for improving graded recovery of exotic and radiata pines in Australia
	PN06.2029	Comparison of face bond quality tests for structural glulam
Market-facing	PNA023-0809	Pine timber roof environments in Western Australia and susceptibility to European House Borer
	PN04.2005	Maximising impact sound resistance of timber framed floor/ceiling systems

The evaluation of each project has been undertaken using a benefit cost analysis (BCA) framework. This framework involves defining a base case (or counterfactual) against which the project impacts can be assessed in terms of the project's Net Present Value (NPV), Benefit Cost Ratio (BCR) and the Internal Rate of Return (IRR).

Each BCA consider the total funds invested in a given project relative to the total benefits that the projects have conferred to Australian society, rather than just those costs (and benefits) incurred by FWPA. In addition to FWPA's funding, most of the projects have also obtained additional funding through either in-kind contributions or third-party investment. Environmental and social outcomes from the projects have been identified and described qualitatively.

Industry representatives were consulted to inform the evaluation, with supporting information and data obtained through desktop research.

The project level evaluations have been 'scaled up' using the estimated benefit cost ratios to determine the program level benefits.

Results

Project level results

Table 2 contains the summary of results for the projects. For each project, impacts are evaluated through to 20 years after the project was completed, using a five percent real discount rate. Monetary values are reported in 2010 dollars. Further details about the assessment of these projects are contained in Appendices A - F.

Table 2 Project level results

Project number	NPV ($'000)	BCR	IRR
PNC057-0809	$3,345	3.7	74%
PRC179-0910	$187	6.3	326%
PNB040-0708	$236	1.5	15%
PN06.2029	$63	2.1	36%
PNA023-0809	$6,692	5.1	70%
PN04.2005	Not estimated	Not estimated	Not estimated

Note that all BCRs are evaluated over 20 years, using a 5% real discount rate. Values are reported in 2010 dollars.
Source: URS estimates.

All of the projects for which the benefits were quantified provided positive NPVs, ranging from $63,000 to $6,692,000. There BCR's also exhibit significant variation, ranging from ranging from 1.5 to 6.3.

It was not possible to estimate the quantitative benefits of one of the projects (*Maximising impact sound resistance of timber framed floor/ceiling systems*, PN04.2005); however, its impacts are described qualitatively.

Sensitivity analysis

Table 3 presents the results from the sensitivity analysis, reflecting, for example, increased value of benefits ('high' estimates) or a reduction in the area over which the benefits accrue ('low' estimate)

Table 3 Sensitivity analysis - BCR

Project number	Low	Base	High
PNC057-0809	2.0	3.7	3.9
PRC179-0910	4.8	6.3	11.3
PNB040-0708	1.2	1.5	1.9
PN06.2029	1.0	2.1	3.1
PNA023-0809	2.5	5.1	7.6
PN04.2005	Not estimated	Not estimated	Not estimated

Note that all BCRs are evaluated over 50 years, using a 5% discount rate. Values are reported in 2010 dollars.
Source: URS estimates.

Program level results

Weighted average BCR were calculated for each of the categories (i.e. growing, marketing and processing), based on the projects that were reviewed during the 2010 and 2011 evaluations. The resulting BCRs were then applied to total funds invested in each of the categories to provide an indication of the benefits that may be expected from investment. The estimates derived from this process should be considered indicative because it is unlikely that every project within these categories could achieve the calculated average BCR.

Table 4 contains the estimated benefit and weighted average BCR, aggregated for each investment category and reflects the cumulative results for the 2010 and 2011 BCA evaluations.

Table 4 Cumulative program level results

	Number of projects	Total value invested ($'000)	Value of sample projects ($'000)	Sample projects as a % of total investment	Weighted average BCR	Estimated benefits from total investment ($'000)
Growing category	35	$17,596	$3,394	19%	13.3	$234,833
Processing category	60	$35,636	$3,490	10%	5.0	$177,791
Marketing category	49	$21,188	$2,857	13%	3.2	$68,021

Note that all BCRs are evaluated over 50 years, using a 5% discount rate. Values are reported in 2010 dollars.
Source: URS estimates.

The BCRs across the categories are all positive, ranging from 3.2 to 13.3, with the growing category projects providing higher weighted average BCRs than processing or marketing projects. Applying these BCRs to the total value invested provides an indication of the benefits that may be expected from investment in each category.

Discussion

Based on the relatively small sample of projects that were reviewed, there is not a clear trend that suggests one research theme (growing, processing or market facing) consistently yields better results than others.

The estimated IRR for the projects exhibits a very large range. These estimates should be viewed with caution because IRR results are highly sensitive to the profile of project cashflows and underlying assumptions. The IRR results are an artefact of the assumed profile of costs and benefits that, for many of the projects reviewed, occur over a relatively short period of time, mostly within five to ten years.

Although the project impacts from industry's perspective have been described qualitatively for all projects, it was considered that these did not differ substantively from society's perspective, and as a consequence, were not estimated quantitatively. For example, for the projects that were thought to result in benefits from improved efficiency/productivity, society benefits through reduced costs of production, hence potentially product prices, while industry benefits from potentially higher profits.

The environmental and social impacts of the research (relative to the base case) could not be accurately quantified for any of the projects reviewed. There are a number of reasons for this:

- of the projects selected for evaluation, many were considered to have no, or very limited, direct environmental or social impacts;
- for other projects, many of the environmental and social benefits were already captured in the benefits derived from improved efficiency. In these cases, inclusion of the environmental and social benefits would result in double-counting of the project benefits; and
- for some projects that could potentially have environmental or social impacts, quantifying the impacts within reasonable confidence intervals was not possible because of the lack of technical or market price information.

Although direct environmental and social impacts have not been identified or estimated for a number of the projects, it is important to recognise that there may be secondary environmental and social benefits associated with projects that result in productivity improvements. Through such improvement, fewer resources are required to produce the same volume of output, potentially resulting in a smaller ecological footprint and, hence, in environmental benefits. Society also benefits through the improved living standards that result from productivity improvements.

It is also important to recognise that there is a broader benefit to society from maintaining research capacity that is capable of tackling future research needs. Research capacity, particularly in terms of scientists, engineers and technicians, cannot be established quickly. Reduction in research capacity could mean that potential productivity improvements are forgone and that Australia becomes increasingly reliant on the international research effort. Both outcomes could reduce the competitiveness and performance of Australia’s Forest and Wood Products sector.

Limitations

There are a number of qualifications associated with the results:

- Estimates of costs and benefits are contingent on a range of assumptions. The assumptions underpinning our estimates are based on discussions with industry contacts and professional judgment; however they are nonetheless subjective and should be considered indicative of the order of magnitude rather than the precise values of the research.
- For many of the projects that were reviewed, identifying the counterfactual (or base case) was not always clear and it is possible that the project benefits will be either under- or over-estimated as a consequence.
- Even where the assumptions about the costs and benefits have been estimated with greater certainty, the extent to which the research results are adopted by industry will also have a significant bearing on the projects’ overall impact. In the short term (e.g. in the five years after a project is completed), it is generally easier to consider the adoption rate, because market conditions are better understood. In the longer term, adoption is more difficult to assess as there are likely to be a number of unforeseen factors that may affect adoption.

- In broad terms, research results are but one factor influencing the market for timber products and the competitiveness and profitability of businesses operating in the forest and wood products industry. Movements in the exchange rate, the price of alternative products, and residential housing starts are all factors that have a significant influence on the timber products market. It is often difficult to distinguish the effects of research from these other influences.
- The estimated program benefits should not be considered reflective of the actual benefits associated with the total investment that has been made in each of these categories, because of the variability in BCRs that is evident at the project level. Rather, the results could best be considered as a tool for guiding the investment between and within the three broad categories

Introduction

Forest and Wood Products Australia (FWPA) directs investment into research and development (R&D) projects that aims to increase the competitiveness and profitability of the forest and wood product-based industries. Since January 1996, FWPA has invested in over 400 projects within 14 investment priority areas.

FWPA has committed to regularly undertaking an evaluation of its investment program by selecting a representative sample of projects and evaluating these, in accordance with the protocol developed by the Council of Rural Research and Development Corporations Chairs (CRRDCC).

This report contains the results from the evaluation of a further six of FWPA's research projects. This evaluation has been undertaken during September – October 2011.

URS Australia Pty Ltd (URS) has been engaged to undertake this evaluation and this report outlines the process employed to undertake the work and the results of the analysis. Section 2 of the report outlines the evaluation methodology and Section 3 provides the program-level evaluation results. A discussion of the results is presented in Section 4. Appendices A to F contain a detailed description of the projects that were assessed to inform the program-level results.

2

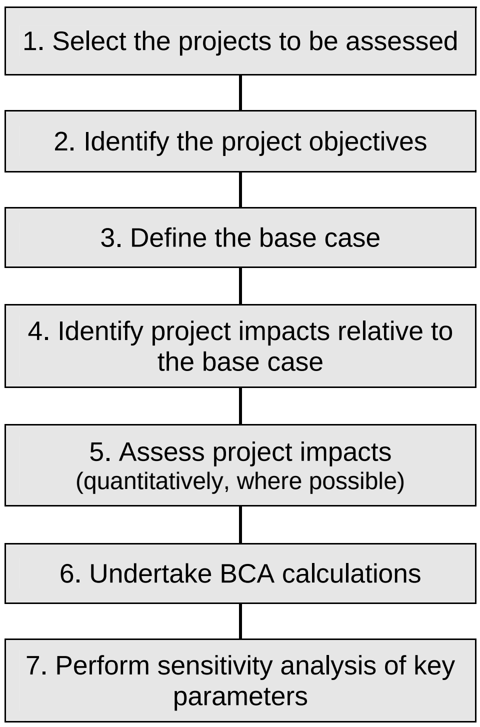
Methodology

The project approach was based on desktop research supplemented by interviews with informed industry contacts. FWPA provided URS with documentation for each of the projects. This included the original proposals and the final reports. Based on this information and information gathered from interviews with industry representatives, URS used a benefit cost analysis (BCA) framework to evaluate the projects. This framework involves defining a base case (or counterfactual) against which the project impacts can be assessed in terms of the project's Net Present Value (NPV), Benefit Cost Ratio (BCR) and the Internal Rate of Return (IRR).

The BCA has been undertaken from both society's perspective, and where relevant, from industry's perspective. A social BCA considers the total funds invested in a given project relative to the total benefits that the projects have conferred to Australian society. The approach undertaken in an industry BCA is to only include the costs and benefits that are relevant to the forest and wood products industry.

Figure 2-1 outlines the approach used to undertake the BCA, starting from the identification of the projects to be included in the evaluation. Further detail about the approach is provided in the following sections.

Figure 2-1 Approach to undertaking the BCA



2.1 Project selection

FWPA provided URS with six projects for review in this round of evaluations. The projects were randomly selected from within each of FWPA's broad research themes, namely growing, processing and market-facing research. The project title and numbers for the selected projects are presented in Table 2-1.

Table 2-1 Selection of projects from evaluation in 2011

Theme	Project number	Project title
Growing	PNC057-0809	Managing subtropical pines for improved wood production based on a better understanding of genetics, silviculture, environment and their interactions
	PRC179-0910	Rapid screening of commercial forestry species to Uredo rangelii (myrtle rust) and distinguishing U. rangelii from Puccinia psidii (guava rust)
Processing	PNB040-0708	MOE and MOR assessment technologies for improving graded recovery of exotic and radiata pines in Australia
	PN06.2029	Comparison of face bond quality tests for structural glulam
Market-facing	PNA023-0809	Pine timber roof environments in Western Australia and its susceptibility to European House Borer
	PN04.2005	Maximising Impact Sound Resistance of Timber Framed Floor/Ceiling Systems

2.2 Benefit cost analysis

Following the selection of the sample, the BCA was undertaken using the following key steps:

Specifying the objectives of the proposed projects to be evaluated

The objectives of the projects were determined based on the detailed project proposals and final reports. Where necessary, clarification of the projects objectives was sought through industry interviews.

Defining the base case (or counterfactual)

The base case is also known as the ‘counterfactual’ or ‘business-as-usual’ scenario and was defined using input from both project documentation and industry representatives. Industry representatives included:

- representatives from hardwood and softwood plantation companies;
- technical and business development managers from softwood processing companies;
- representatives from industry associations and

The base case provides the point of reference for the assessments, and each project was assessed relative to the base case over an appropriate time period. The CRRDCC Guidelines for Evaluations recommend, as a minimum, 5, 10 and 20 year assessment horizons and all projects were assessed over these horizons.

It is important to recognise that the base case is not the current situation, but rather the expected future in the absence of any change from continuation of the business-as-usual scenario. For example, the industry may receive benefits from private sector investment in processing technology, regardless of whether FWPA makes an investment in this area. Therefore the base case should incorporate these benefits to the extent possible.

In defining the base case, it was also necessary to recognise that the reference year for calculating the benefit cost ratio (BCR) differed across the projects. Accordingly, a CPI adjustment factor was used to ensure that projects with different reference years were compared on a consistent basis. All costs and benefits in this evaluation are based on 2010 dollars.

Identifying project impacts

A qualitative understanding of the likely impacts of implementing each of the projects, relative to the base case, was then obtained.

The project impacts were identified through the project proposals and final reports and were confirmed in discussions with industry representatives. Care was taken to avoid double-counting of benefits and costs. For example, if the benefits of an investment resulted in an increase in the value of wood production (primary market) it was not counted a second time in relation to an increase in employment (secondary market) that this may have caused.

In undertaking this step, an attempt was made to distinguish between benefits from society's perspective and those from industry's perspective.

In economic analyses, benefits from society's perspective can differ from industry's perspective. For example, consider a project that resulted in an increase in demand for timber products relative to steel. From industry's perspective the benefit is considered to be an increase in market share, and is calculated based on the change in gross revenue. However, from society's perspective an increase in demand for timber products comes at the expense of competitor products such as steel. In this case, the benefit to society is estimated with reference to the change in cost of using a timber-product compared with, for example, steel, to perform a given function/task. If timber becomes the lower-cost, preferred material, the increase in gross revenue for timber producers needs to be adjusted for the revenue forgone for steel producers to determine the net benefit to society.

The following approaches were taken to assessing the benefits from society's perspective:

- for projects that could result in *efficiency gains*, benefits were estimate according to the potential reduction in operating costs (hence product costs) at the relevant point in the supply chain; and
- for projects that could result in *increases in final product value*, benefits were estimated according to the potential increase in gross value of the products ex-primary processing mill, i.e. using retail prices.

The following approaches were taken to assessing the benefits to industry:

- for projects that could result in *reductions in the cost of production*, the benefits were estimated according to the potential increase in profit. However, it should be noted that these benefits are equivalent to the benefits to society and therefore not estimated separately.
- for projects that could result in an *increase in market share*, benefits were estimated according to the potential increase in revenue assessed at the relevant point in the supply chain.

From both perspectives, there is a very important qualification relating to any benefits that may accrue as a result of improvements in timber product quality or reduced processing costs. Structural timber is considered to be a commodity product and the ability of any single enterprise to differentiate their products and gain a competitive advantage in terms of price or profits will be limited to early movers. These benefits are only likely to accrue for a short period of time before the rest of the market is selling a similar quality product, or has made similar reductions to costs that result in reductions in the product price. Because of this, the benefits associated with most of the projects were assumed to diminish relatively rapidly, for example within five to ten years.

Assessing project impacts

Following the confirmation of the impacts in physical or qualitative terms, the magnitude of costs and benefits was estimated. The most convenient metric for analysis is to measure costs and benefits in monetary terms (i.e. 2010 dollars). This is most straightforward where the project resulted in changes to the quantity or value of goods and services that are traded in markets, and hence have an associated market price. For example, the benefit of a project that results in increased forestry production can be measured by the increase in revenue arising from that project. Similarly, reductions in operating costs are a monetary measure of the benefits of a given project.

Some project impacts produce a benefit or confer a cost to society that are not reflected in market transactions of goods and services. For example, environmental improvements are widely recognised as a benefit to society. However, due to inherent difficulties in assigning property rights to these benefits, markets do not exist for the goods and services provided by the environmental resource. As a result, no market price exists to value these benefits. Where projects were thought to result in a social or environmental benefit, these were described qualitatively, but were not quantitatively estimated.

Undertaking the BCA

Once the impacts associated with the projects were quantified (as far as possible), the stream of costs and benefits were converted into a single measurement at a point in time by discounting.

Discounting is a common approach to accounting for costs, benefits or outputs that occur over different time periods. The process of discounting enables the direct comparison of amounts of money that accrue in different time periods. Discounting gives greater weight to initial benefits and costs and less weight to those in the distant future. The CRRDCC guidelines specify a real discount rate of five percent, which was used for the analyses.

The difference between the discounted sum of the costs and benefits associated with the project is known as the net present value (NPV). The NPV provided the basis for a number of different decision criteria, including:

- Benefit-cost ratio (BCR) – comparing benefits as a proportion of costs;
- Internal rate of return (IRR) – the discount rate at which the present value of the costs of the investment are equal to the present value of the benefits of the investment (i.e. NPV = 0).

Consistent with the CRRDCC guidelines, all three decision criteria are reported.

2 Methodology

Sensitivity analysis

Sensitivity analyses were undertaken on the parameter values of key costs and benefits to determine the relative significance of these variables in the overall evaluation. These analyses were undertaken for each project.

Aggregation of project evaluation

The project-level BCR's were 'scaled-up' based on the total expenditure in each of the three investment categories to provide a program-level evaluation for these categories. The aggregation process included the results from the 2010 program evaluation.

Results

The following section contains a summary of the BCA results for the projects that were reviewed. Further detail relating to these results, including sensitivity testing, are contained in Appendices A - F.

3.1 Project results

Table 3-1 presents the summary results for the projects. For each project, results are evaluated through to 20 years after the project was completed, using a five percent real discount rate. Monetary values are reported in 2010 dollars.

All of the projects for which the benefits were quantified provided positive NPVs, ranging from $63,000 to $6,692,000. There is also significant variation in the BCRs, ranging from ranging from 1.5 to 6.3.

It was not possible to estimate the benefits of the *Maximising impact sound resistance of timber framed floor/ceiling systems* (PN04.2005) project in quantitative terms; however, industry representatives indicated that the project findings have been utilised in further research, for example, in the re-writing of the industry *Wood Solutions Guides* 1, 2 and 3. Further details of the project benefits are included in Appendix F.

Table 3-1 Project level results

Project number	NPV ($'000)	BCR	IRR
PNC057-0809	$3,345	3.7	39%
PRC179-0910	$187	6.3	326%
PNB040-0708	$236	1.5	15%
PN06.2029	$63	2.1	36%
PNA023-0809	$6,692	5.1	70%
PN04.2005	Not estimated	Not estimated	Not estimated

Note that all BCRs are evaluated over 20 years, using a 5% real discount rate. Values are reported in 2010 dollars.
Source: URS estimates.

3.1.1 Sensitivity analysis

Table 3- presents the results from the sensitivity analysis, reflecting, for example, increased value of benefits ('high' estimates) or a reduction in the area over which the benefits accrue ('low' estimate). The results continue to be positive for all under the low scenario sensitivity analysis. Further information about the assumptions that underpin the sensitivity analyses are contained in the relevant appendices.

Table 3-2 Sensitivity analysis - project BCRs

Project number	Low	Base	High
PNC057-0809	2.0	3.7	3.9
PRC179-0910	4.8	6.3	11.3
PNB040-0708	1.2	1.5	1.9
PN06.2029	1.0	2.1	3.1
PNA023-0809	2.5	5.1	7.6
PN04.2005	Not estimated	Not estimated	Not estimated

Source: URS estimates.

3.2 Program results

The results obtained for each category have not been aggregated to obtain a measure of the overall benefits achieved from FWPA's entire investment portfolio. This was based on the assessment that such aggregation would not be reflective of the potential benefits. Rather, aggregation has been undertaken at the category level (i.e. growing, marketing, and processing). Table 3-3 presents the aggregated results for the growing, processing and marketing category projects. The results are cumulative, and include the results from the 2011 assessment as well as the 2010 assessment.

Table 3-3 Cumulative growing, processing and marketing categories aggregation

	Number of projects	Total value invested ($'000)	Value of sample projects ($'000)	Sample projects as a % of total investment	Weighted average BCR	Estimated benefits from total investment ($'000)
Growing category	35	$17,596	$3,394	19%	13.3	$234,833
Processing category	60	$35,636	$3,490	10%	5.0	$177,791
Marketing category	49	$21,188	$2,857	13%	3.2	$68,021

Source: URS estimates.

The BCRs across the categories are all positive, ranging from 3.2 to 13.3, with the growing category projects providing higher weighted average BCRs than processing or marketing projects. Applying these BCRs to the total value invested provides an indication of the benefits that may be expected from investment in each category. However, the aggregation required to calculate these potential benefits means that the estimates should be considered indicative only. Not every project within these categories can be expected to achieve the estimated average BCR.

Discussion

4.1.1 Project results

The projects exhibit a range of values in relation to NPV measured over the twenty years following project completion. There is also significant variation in the BCRs, ranging from 1.5 to 6.3, when assessed over the twenty years following project completion.

Based on the relatively small sample of projects that were reviewed, there is not a clear trend that suggests one research theme (growing, processing or market facing) consistently yields better results than others.

The estimated IRR for the projects exhibits a very large range. These estimates should be viewed with caution because IRR results are highly sensitive to the profile of project cashflows and underlying assumptions. The IRR results are an artefact of the assumed profile of costs and benefits that, for many of the projects reviewed, occur over a relatively short period of time, mostly within five to ten years.

Although the project impacts from industry's perspective have been described qualitatively for all projects, it was considered that these did not differ substantively from society's perspective, and as a consequence, were not estimated quantitatively. For example, for the projects that were thought to result in benefits from improved efficiency/productivity, society benefits through reduced costs of production, hence potentially product prices, while industry benefits from potentially higher profits.

4.1.2 Environmental and social impacts

The environmental and social impacts of the research (relative to the base case) could not be accurately quantified for any of the projects reviewed. There are a number of reasons for this:

- of the projects selected for evaluation, many were considered to have no, or very limited, direct environmental or social impacts;
- for other projects, many of the environmental and social benefits were already captured in the benefits derived from improved efficiency. In these cases, inclusion of the environmental and social benefits would result in double-counting of the project benefits; and
- for some projects that could potentially have environmental or social impacts, quantifying the impacts within reasonable confidence intervals was not possible because of the lack of technical or market price information.

Although direct environmental and social impacts have not been identified or estimated for a number of the projects, it is important to recognise that there may be secondary environmental and social benefits associated with projects that result in productivity improvements. Through such improvement, fewer resources are required to produce the same volume of output, potentially resulting in a smaller ecological footprint and, hence, in environmental benefits. Society also benefits through the improved living standards that result from productivity improvements.

It is also important to recognise that there is a broader benefit to society from maintaining research capacity that is capable of tackling future research needs. Research capacity, particularly in terms of scientists, engineers and technicians, cannot be established quickly. Reduction in research capacity could mean that potential productivity improvements are forgone and that Australia becomes increasingly reliant on the international research effort. Both outcomes could reduce the competitiveness and performance of Australia's Forest and Wood Products sector.

4.1.3 Benefit cost analysis framework

BCA is widely used and is considered the most appropriate methodology to evaluate R&D investments. In this review, the BCA framework has been used to estimate the benefits and costs associated with the projects from society's and, where relevant, industry's perspective. There are nonetheless elements of the framework that prove challenging to apply to the analysis of R&D investments. Discussion of these elements follows:

Describing the counterfactual

The focus of the BCA framework is the identification and project impacts relative to a base case (or counterfactual). For some projects, the counterfactual is relatively straightforward to define, for example *Managing sub-tropical pine species for improved wood production* (PNC057-0809) because it involves a case where either the research is undertaken or it is not, with straightforward implications for the benefits that are derived in the form of reduced costs of production. However for others, such as *Screening of commercial forestry species for myrtle rust* (PRC179-0910) and *Pine timber roof environments in WA and susceptibility to European House Borers* (PNA023-0809), the counterfactual involves making assumptions about the probability that particular events will occur, which are independent of the project findings, but which nonetheless have implications for the project impacts. Our approach to such projects has been to be conservative in our assumptions to account for the inherent certainty surrounding the counterfactual.

Market impacts

Another aspect of the BCA methodology is the need to quantify impacts in a common unit of assessment; namely, the monetary value of the impacts. This is relatively straightforward for projects that result in, for example, changes in the volume or value of timber produced. However, it is less straightforward for projects where the benefits are not readily quantified in monetary terms, for example those projects that take the form of avoided future research effort or the maintenance of research capability. However, the 'non-market' impacts are an important source of new knowledge, which can provide on-going benefits, long after the market benefits have been displaced.

Implementation costs

For a number of projects, such as the *MOE and MOR assessment technologies for improving graded recovery of exotic pines in Australia* (PNB040-0708) and PNA023-0809, industry representatives identified that costs would be incurred to adopt the project findings. These costs include items such as new capital equipment, software upgrades, and associated costs of installation, training, operation and maintenance. These costs are important in considering the net project benefits; however, to include them requires a modelling approach that builds from the enterprise level up to provide an industry level perspective. To better understand the implementation costs would require more consultation with industry. The modelling approach in this review is a top-down approach and implementation costs have not been incorporated. It's not clear if this will result in an under- or over-estimate of project impacts as this would be determined at the level of the individual enterprise.

Internal rate of return

The projects' estimated internal rates of return (IRR) vary considerably, with some vey high results. These estimates are largely an artefact of the assumed profile of costs and benefits that, for many of the projects reviewed, are assumed to occur over a relatively short period of time, mostly within five to ten years.

IRR assumes reinvestment of interim cash flows in projects with equal rates of return. Therefore, IRR can overstate the annual equivalent rate of return for a project whose interim cash flows are reinvested at a rate lower than the calculated IRR. This can be problematic, especially for high IRR projects, since there is frequently not another project available in the interim that can earn the same rate of return as the first project.

The higher a project's internal rate of return, the more desirable it is to undertake the project. Assuming all projects require the same amount of up-front investment, the project with the highest IRR would be considered the best and undertaken first. However, not all projects have the same up-front investment and, hence, it may not be a meaningful measure for comparing between projects.

For these reasons, URS considers NPV and BCR to be more appropriate measures of investment performance.

4.2 Limitations of the analysis

There are a number of qualifications associated with the results:

- Estimates of costs and benefits are contingent on a range of assumptions. The assumptions underpinning our estimates have been based on discussions with industry contacts and professional judgment; however they are nonetheless subjective and should be considered indicative of the order of magnitude rather than the precise values of the research.
- For many of the projects that were reviewed, identifying the counterfactual (or base case) was not always clear and it is possible that the project benefits will be either under- or over-estimated as a consequence.
- Even where the assumptions about the costs and benefits have been estimated with greater certainty, the extent to which the research results are adopted by industry will have a significant bearing on the projects' overall impact. In the short term (e.g. in the five years after a project is completed), it is generally easier to consider the adoption rate, because market conditions are better understood. In the longer term, adoption is more difficult to assess as there are likely to be a number of unforeseen factors that may affect adoption.
- In broad terms, research results are but one factor influencing the market for timber products and the competitiveness and profitability of businesses operating in the forest and wood products industry. Movements in the exchange rate, the price of alternative products, and residential housing starts are all factors that have a significant influence on the timber products market. It is often difficult to distinguish the effects of research from these other influences.

4.3 Implications for future evaluations

The evaluation results are based on a range of assumptions, many of which were made in the absence of specific guidance in the project documentation. The reliance on these assumptions such as those that have been made during this evaluation could be reduced by gathering some of the relevant information at project design, or at commencement, or at the latest, at project closure. In particular, it would be useful for project proponents to consider and report their views on the base case at the time of requesting funding. At this time the alternative routes for development of technology or information are usually much clearer than they are after the project has been completed.

4 Discussion

It would also be helpful if project proponents were able to undertake the following steps:

- When undertaking the benefit cost analysis as part of the project proposal, proponents clearly articulate the reasons for assumptions. In some cases the data presented for projects reviewed in this study were based on hypothetical outcomes, rather than detailed analysis; and
- At the end of the project, and as part of the deliverable, project leaders could specify the expected impacts of the project and how the information required to measure the impacts could be gathered and analysed.

It is important to recognise that project proponents are not independent of the analysis and may have an interest in inflating the predicted benefits. In addition, the project proponents are not always the best qualified to asses the impacts. For example, a geneticist does not necessarily have an appreciation of the factors that drive timber prices. Therefore, some form of independent review will still be necessary and project proponents should draw on industry assistance for information about impacts and adoption.

In broad terms, this evaluation has found there is a need for improved industry statistics throughout the value chain. For example, the estimates of the impacts of PN06.2029 (*Comparison of face bond quality tests for structural glulam*) could be improved from national production data. The coordinated collection and reporting of such statistics would benefit the whole of industry and would assist project proponents (and independent project evaluators) to better determine the value of project impacts and returns on industry research and development.

References

Adam, C. Y. (2006) *Comparison of face bond quality tests for structural glulam*. (Final report) Project number: PN06.2029.

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Chung, H., Dodd, G., Emms, G., McGunnigle, K., Schmid, G. (2006) *Maximising impact sound resistance of timber framed floor/ceiling systems*. (Final report) Project number: PN04.2005.

Cunningham, R.J., Collins, D., Vagg, L., and Grimm, M. (2010) *Pine timber roof environments in Western Australia and its susceptibility to European House Borer*. (Final report) Project number: PNA023-0809.

Harding, K.J., Nester, M.R., Dieters, M.J., Zbonak, A., and Copley, T.R. (2010) *Sub-tropical exotic pine taxa, growth, form and wood properties comparisons across multiple sites in coastal Queensland in: thinning and clearfall age trials; in family and clonal hybrid pine trials, and in a genetics x fertiliser x weed control trial*. (Final report) Project number: PNC057-0809.

PN04-2005 Project proposal for Maximising impact sound resistance of timber framed floor/ceiling systems.

PN06.2029 Project proposal for Comparison of face bond quality tests for structural glulam.

PNA023-0809 Project proposal for EHB Field Roof Testing.

PNB040-0708 Project proposal for Selected strength and stiffness predictors from inline systems and vibrational analysis devices using chemometrical tools for structural grading of slash pine and radiata pine.

PNC057-0809 (formerly PN048.3029) Project proposal for Managing sub-tropical pines for improved wood production based on a better understanding of genetics, silviculture, environment and their interactions.

PRC179-0910 Project proposal for Rapid screening of commercial forestry species to *Uredo rangelii* (myrtle rust) and distinguishing *U. rangelii* from *Puccinia psidii* (guava rust)

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Forest and Wood Products Australia and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 9 August 2011.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between 11 August 2011 and 7 February 2012 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Appendix A Managing sub-tropical exotic pine plantations for improved wood production (PNC057-0809)

A.1 Project need

The growth, branching habit and wood properties of sub-tropical pines are different to *Pinus radiata* (radiata pine) grown in temperate regions, which comprises the majority of Australia's plantation softwood estate. Much of the existing research into softwood genetics and silviculture has focussed on the radiata pine resource, with relatively less attention given to sub-tropical species such as slash pine (*Pinus elliottii* var. *elliottii*, PEE), Caribbean pine (*P. caribaea* var. *hondurensis*, PCH) and their F_1 and F_2 hybrids.

Table A-1 presents the areas of sub-tropical and tropical softwood plantations in Queensland and northern New South Wales as at June 2010.

Table A-1 Sub-tropical and tropical exotic pine areas (June 2010)

	Southeast QLD	Northern QLD	Central QLD	Northern NSW	Total (ha)
Slash pine (PEE)	16,319	3	16	1,928	18,266
Caribbean pine (PCH)	31,611	12,848	6,207	45	50,711[1]
Pinus hybrids	63,828	63	5,485	8,165	77,541[2]
Other species	1,448	78	3	2,521	4,050[3]
Sub - total	*113,206*	*12,992*	*11,711*	*12,659*	*150,568*
Clear-felled area (to be replanted)	3,353	559	594	450	4,956
Total	*116,559*	*13,551*	*12,305*	*13,109*	*155,524*

[1] 98% PCH; [2] Mainly PEExPCH; [3] Mainly *P. taeda* and *P. patula* (excludes *P. radiata*)

Source: Harding, K.J. et al. 2010.

Given this substantial resource, further research was considered necessary to improve knowledge of the interactions between silviculture and genetics on the growth rate and wood properties of sub-tropical pine species.

A.2 Project objective

The project objective was to explore ways to increase the future volume, production and wood quality from sub-tropical softwood plantations. The project explored differences between taxa, within taxa (families versus clones), and impacts of site and silviculture (weed control and fertiliser effects).

A.3 Project costs

The total project cost was $730,747 (Table A-2), which comprised investment of $340,000 from FWPA and $390,747 from third party collaborators. These costs were incurred over the financial years 2008/09 to 2010/11.

Table A-2 Project costs

Operating costs	Capital costs	In-kind	Total
$340,000	$-	$390,747	$730,747

Source: Project proposal documentation

Implementation costs

The costs of implementing the project results relate primarily to adopting the research findings within the breeding programs for forest growers. These are not considered to be significant because the project findings do not require the acquisition of capital equipment, nor does it require a change to operations that would incur additional expenditure.

A.4 Project benefits

Industry representatives consider the project has resulted in improved knowledge regarding the growth, acoustic velocity and wood density of various commercial sub-tropical pine taxa, at thinning and clearfall age. The results are expected to support decision making regarding alternative genetic and silvicultural strategies for the production of structural softwood products.

Benefits from society's perspective

The benefits to society from this project were expected to comprise *reduced costs of production*, *improved yields* and *improved product quality* from sub-tropical softwood plantations.

- *Reduced cost of production*

Industry representatives suggested that the project results would allow cost savings to be made in relation to clonal testing. This is because the project found "*limited potential for finding outstanding, variable families for testing under clonal deployment, yet good potential for finding a suite of outstanding full-sib families with low variability for deployment in full-sib family forestry*". This led to the decision to discontinue clonal testing and focus instead on selective breeding of superior families. Industry representatives consulted in relation to this project estimated the cost reductions arising from the decision to discontinue clonal testing and deployment was approximately $400/ha for ongoing plantation establishment. Industry representatives suggested that this benefit would accrue each year, until such time competitive pressures would have led to an equivalent reduction.

However, industry representatives indicated that only a portion of this reduction can be attributed to the project because the decision to cease clonal testing has also been based on a number of other research projects. Industry representatives could not estimate the proportion that is attributable to the project; however, given the project results provided confirmation of the decision to discontinue clonal testing, it is assumed the project made a substantial contribution to the overall benefits. For the purposes of this review, URS has assumed that 25% of the reduction in costs can be attributed to the project; that is, the direct benefit of the project is estimated to be around $100/ha for plantation establishment.

Industry representatives also suggested that, on the basis of the project findings, the intensity of early silvicultural activity, for example weed control, could be reduced without substantially affecting yield. It was estimated that the project could result in reduced establishment costs of about $100/ha planted. Industry representatives suggested that only a proportion of the reduction can be attributed to the project; however, given the project results provided confirmation of the decision to change silvicultural practices, it is assumed the project made a substantial contribution to the overall benefits. Based on discussions with industry representatives, URS estimates this to be approximately 25%, or a cost reduction of $25/ha planted.

- *Improved yield:*

The project found that the Caribbean pine (PCH) and the slash X Caribbean pine hybrid (PEE X PCH) have similar stem volumes on average across a range of sites. Furthermore, the yield from these species and hybrids are likely to be higher than from slash pine.

However, industry representatives indicated the decision to plant PEE X PCH hybrids was made in the 1980s and could not be attributed to the project findings. The project is considered to have validated this decision, but it is not considered to have resulted in additional yield improvements, relative to that which would be obtained in the absence of the project. Given this, the yield benefits have not been included in the benefit cost analysis.

- *Improved product quality:*

The project identified hybrid families and clones that are characterised by desirable growth and form, combined with superior wood quality traits. Breeding programs that utilise these hybrid families and clones are expected to result in structural products with improved stiffness.

However, in URS's opinion, an improvement in timber stiffness is unlikely to result in a significant increase in price as structural pine is a commodity product, for which the market is typically not responsive to quality improvements, provided the product still meets the specifications for a particular grade. However, the deployment of plantations with genetic material selected for improved stiffness may result in an increased proportion of log products meeting higher stiffness grades.

Benefits from industry's perspective

With savings in the cost of production, it is assumed that industry has the potential to benefit from an increase in profit of $125/ha (comprising $100/ha from the savings on clonal testing and $25/ha for reductions in the intensity of early silvicultural activity). Given this, the benefits to industry are considered to be equivalent to the benefits to society and are therefore not estimated separately.

The results of this project are not expected to increase the market share of structural pine products and nor is there likely to be an increase in price associated with improved product quality given the commodity nature of the structural softwood timber market.

Environmental and social

If the project findings regarding the reduction in the intensity of early weed control and fertiliser application are adopted, then there is potential for environmental benefits to be achieved through reduced herbicide and fertiliser use. The environmental benefits to society have not been estimated separately, but are partly incorporated in the reduced costs of production, outlined above.

There are not considered to be any significant social benefits, for example through greater resilience of the local community from additional local employment, associated with this project.

A.5 Base case

The base case is considered to be the situation without the project occurring. That is, the reduction in the costs of production and the improvement in quality would not otherwise have been achieved. However, Forestry Plantations Queensland Pty Ltd (FPQ) is the main forest growing company in Queensland and it has an active plantation improvement program. Without the project, representatives suggested that the reductions in the cost of production and quality improvements may have been achieved over time. However, these are likely to have occurred at a slower rate. This has been considered in the adoption rates assumed for this project.

A.6 Adoption relative to base case

Representatives from FPQ indicated that the project findings have been adopted in its plantation improvement and maintenance program. Given this, it is considered that project findings have had an adoption rate of 100%, commencing in the first year following completion of the project.

The benefits from avoiding the need for clonal testing and deployment that are attributable to the project are assumed to be $100/ha planted. The benefits from reducing the costs of establishment attributed to the project are assumed to be $25/ha planted. The area over which the project benefits are estimated to apply is 4,000 ha. This represents the average area that is replanted to hybrid pines each year by FPQ.

The benefits of adoption are assumed to continue for five years. After this time, it is assumed that competitive pressures would have led to equivalent reductions in the costs of production, effectively reducing the project-related benefits to zero by year 10.

A.7 Summary

Table A-3 presents a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively.

Table A-3 Summary of project impacts and adoption

Impact element	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Reduced cost of production – avoided clonal testing & deployment	Yes	$100/ha established	100%	0%*	0%*
Reduced cost of production – avoided establishment costs	Yes	$25/ha established	100%	0%*	0%*
Costs					
Project costs	Yes	$730,747	-	-	-
Implementation costs	-	-	-	-	

* Note that, it is assumed that the project benefits have dissipated at this time.
Source: URS estimates - based on primary and secondary sources.

A.8 Evaluation

Table A-4 presents the evaluation results, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a twenty year period using a five percent discount rate.

Table A-4 Evaluation results

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$2,731	$3,345	$3,345
BCR	2.8	3.7	3.7
IRR	-	-	74%

*Assumes 5% real discount rate. Values are 2010 dollars.
Source: URS estimates.

A.8.1 Sensitivity analysis

High scenario

Table A-5 presents the results from a sensitivity analysis that assumes the benefits that can be attributed directly to the project accrue for seven years, before becoming zero in year 9, as it is assumed competitive pressures would have led to equivalent reductions in the costs of production, effectively reducing the project-related benefits to zero. All other assumptions are unchanged.

Table A-5 Sensitivity analysis - high estimate

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$2,731	$3,506	$3,506
BCR	2.8	3.9	3.9
IRR	-	-	74%

Source: URS estimates.

Low scenario

Table A-6 presents the results from a sensitivity analysis that assumes the benefits that can be attributed directly to the project accrue for three years, before becoming zero, in year 5, as it is assumed competitive pressures would have led to equivalent reductions in the costs of production, effectively reducing the project-related benefits to zero. All other assumptions remain unchanged from the original analysis.

Appendix A

Table A-6 Sensitivity analysis - low estimate

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$2,037	$2,037	$2,037
BCR	2.0	2.0	2.0
IRR	-	-	68%

Source: URS estimates.

Appendix B Screening of commercial forestry species for myrtle rust (PRC179-0910)

B.1 Project need

Myrtle rust, caused by *Uredo rangelii*, is a recently identified fungus that was detected on four properties in the central coast region of NSW in April 2010. *U. rangelii* is considered to be within the guava rust complex of plant pathogens. Guava rust, caused by *Puccinia psidii,* is a significant disease of *Myrtaceae* in South America and several other countries. *U. rangelii* has so far been found on *Agonis flexuosa, Callistemon viminalis* and *Syncarpia glomulifera* (turpentine) in Australia.

When the project proposal was developed, it was not known if the disease caused by myrtle rust was significantly different to that caused guava rust. Thus, there was concern that myrtle rust would cause significant disease to native *Myrtaceae* in Australia, including other commercial forestry species.

At the time that this project was proposed, there was an urgent need to test the susceptibility of commercial forestry species (e.g. *Eucalyptus globulus, E. grandis, E. pilularis, Corymbia variegata* and *Melaleuca spp.*) to myrtle rust.

B.2 Project objective

The project objectives were to:

- undertake artificial inoculation trials with a range of commercial forest species to determine whether they are susceptible to myrtle rust;
- conduct a multi-gene phylogenetic analysis of multiple collections of guava rust and myrtle rust from South America, Hawaii and Australia (NSW) to determine whether these two species can be distinguished; and
- to inform the immediate response actions of the National Biosecurity Committee and the Plant Health Committee.

B.3 Project costs

The total project cost was $37,384 (Table B-1), which comprised investment of $21,842 from FWPA and $15,542 from collaborators. The cost was incurred entirely in 2010.

Table B-1 Project costs

Operating costs	Capital costs	In-kind	Total
$21,842	$ -	$15,542	$37,384

Source: Project proposal documentation

Implementation costs

The costs of implementing the project results relate to making a decision about the most appropriate response to the outbreak. Prior to the project commencement, it had already been decided that myrtle rust could not be eradicated. Hence, the project implementation costs relate to the nature and extent of the containment program.

It has not been possible to incorporate these containment costs as they have and will vary at the individual enterprise / jurisdictional level, and will likely vary depending on the risk preferences of forest growers and public sector decision-makers.

Appendix B

B.4 Project benefits

The project found that at least 15 species are susceptible to myrtle rust and, as such, it does not appear to have a restricted host range. This supports the observation that myrtle rust is part of the guava rust complex and likely to have a similar host range. Most significantly, the project findings indicate that key commercial forestry species are susceptible, including those used in plantations and native forestry in NSW and Queensland.

The project findings also suggest that *U. rangelii* does not represent a genetically distinct species from *P. psidii.*

Project benefits from research of this nature are not readily quantified, but are considered to include:

- costs of determining and implementing the most effective management regime; and, hence
- potential damage that could occur in the event of an outbreak.

However, for the purpose of this review, URS has assumed the project has contributed to a reduction in the potential damage caused by an outbreak of myrtle rust.

Benefits from society's perspective

The benefits to society from this project were expected to encompass outcomes that assist to reduce myrtle rust management costs, reduced damage to mature forests, and avoided costs of replanting young trees,. For the purposes of this review, URS has focussed on quantifying the avoided costs of replanting, because young trees with immature foliage are particularly susceptible to myrtle rust outbreaks.

- *Avoided cost of replanting:*

In estimating the benefits of the project, URS has assumed that the project findings have provided forest growers with the information that will enable them to respond to potential outbreaks more quickly and hence, to avoid the costs of replanting areas of young trees that may be infected.

Research[1] that has been undertaken subsequent to the conclusion of the project suggests that there are extensive areas throughout Australia's forestry estate that coincide with the potential distribution of myrtle rust. For the purposes of this review, URS has assumed that forestry regions within Queensland and New South Wales are at greatest risk. Over the period 2009-10, the area of new hardwood plantations that were planted in these regions was approximately 20,000 ha. For the purposes of this review, URS has assumed that this area is most susceptible to being damaged from an outbreak. URS has also assumed that 1% of new plantation areas may need to be replanted if an outbreak of myrtle rust occurs. This is assumed to be net of the areas that would ordinarily be replanted, if the project had not been undertaken. It should be noted that this percentage is used for illustrative purposes, only and does not reflect the results of a detailed assessment.

Benefits from industry's perspective

Industry representatives consulted for this review indicated that the benefits to industry are considered to be embodied in the benefits to society and are therefore not estimated separately.

[1] Cannon, A.M. (2011) *Myrtle Rust – Forest Industry Issues Paper*. Prepared for FWPA

Environmental and social

The project benefits described above have focused on the commercial forestry industry, however, myrtle rust can also affect non-commercial forests. Given this, if the project results in an outbreak being identified and successfully contained, it is expected that this would result in less damage to non-commercial forests and, hence, reduced damage to biodiversity and habitat for wildlife.

Social benefits may also include avoidance or reducing the need to quarantine national parks.

The values of biodiversity, habitat and recreation are not readily quantified in markets for goods and services and have not been estimated in this review. However, they are nonetheless important potential benefits if through adoption of the project findings, there are fewer outbreaks of myrtle rust.

B.5 Base case

Under the base case, it is assumed that young trees with vulnerable foliage would need to be replanted if infected and the cost of production would therefore increase.

B.6 Adoption relative to base case

Industry representatives suggested the major forest growers in the regions where the outbreaks were first identified have been quick to respond to the project findings. On this basis, URS has assumed adoption of 100% of the total area of new plantings in the first year following completion of the project.

However, as the stands of young trees mature and becomes less susceptible, and as other mitigation effort increases, the benefits directly associated with the project are expected to diminish, such that by year 5 (i.e. 2014 / 15) it is assumed that the benefits revert to zero.

B.7 Summary

Table B-2 presents a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively.

Table B-2 Summary of project impacts and adoption

Impact element	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Reduced cost of growing – avoided costs of replanting	Yes	$700/ha established	100%	0%*	0%*
Costs					
Project costs	Yes	$730,747	-	-	-
Implementation costs	-	-	-	-	

* Note that, it is assumed that the project benefits have dissipated at this time.
Source: URS estimates, based on primary and secondary sources.

B.8 Evaluation

Table B-3 presents the evaluation results, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a twenty year period using a five percent discount rate.

Table B-3 Evaluation results

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$187	$187	$187
BCR	6.3	6.3	6.3
IRR	-	-	326%

*Assumes 5% real discount rate. Values are 2010 dollars.
Source: URS estimates.

B.8.1 Sensitivity analysis

High scenario

Table B-4 presents the results from a sensitivity analysis that the benefits of the project are experienced over a longer period before diminishing to zero by year 10. All other assumptions are unchanged.

Table B-4 Sensitivity analysis - high estimate

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$286	$366	$366
BCR	9.0	11.3	11.3
IRR	-	-	331%

Source: URS estimates.

Low scenario

Table B-5 presents the results from a sensitivity analysis that assumes adoption in the first year following completion is only 50% of the total area of new plantations. By year five, it is assumed that adoption declines to zero. All other assumptions are unchanged.

Table B-5 Sensitivity analysis - low estimate

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$134	$134	$134
BCR	4.8	4.8	4.8
IRR	-	-	165%

Source: URS estimates.

Appendix C MOE and MOR assessment technologies for improving graded recovery of exotic pines in Australia (PNB040-0708)

C.1 Project need

The processing of softwoods for structural products involves several processes and associated costs. Ideally, wood that is unlikely to achieve MGP10 grade or better would be diverted into another product stream prior to kiln-drying and dry mill processing to avoid spending unrecoverable processing costs. Existing tools lack the accuracy desired for cost-effectively screening green logs and boards.

This project was designed to contribute to the development of early sorting technologies and was anticipated to result in improved utilisation of the softwood plantation resource and, for softwood processors, improved processing efficiency.

The project was designed to improve the capacity of mills to more accurately grade material prior to drying processes, by enabling better separation of wood with a grade less than or equivalent to MGP10. The calibration was anticipated to ensure that a greater volume of wood processed in dry mills will achieve the grade/s required to justify the value-added expenditure.

There was also a need to provide industry with specification guidelines to address the lack of consistency, reliability and hence, comparability of existing machine grading systems.

C.2 Project objective

The project objective was to develop a method applicable to Australian conditions, to accurately predict the strength and stiffness of green logs and boards prior to entering the drying chain. By grading green logs and boards prior to drying, the project's objective was to improve structural (MGP) grade yields and reduce processing costs associated with drying material that is subsequently found to not make grade requirements for strength and stiffness.

The project aimed to achieve the following specific objectives:

- selection of a consistent, reliable and accurate device in the green mill that will reject material that will not make MGP10 later in the process; and
- improved correlation of grading parameters in the dry mill with both modulus of elasticity (MOE) and modulus of rapture (MOR) using new analytical methods and a combination of devices.

C.3 Project costs

Research costs

The total project cost was $450,000 (Table C-1), which comprised investment of $235,000 from FWPA and $215,000 from third parties. These costs were incurred over the financial years 2006/07 to 2008/09.

Table C-1 Project costs

Operating costs	Capital costs	In-kind	Total
$230,000	$5,000	$215,000	$450,000

Source: Project proposal documentation

Implementation costs

The implementation costs associated with this project relate to upgrading grading machinery within softwood sawmills. Industry representatives suggested this could cost $125,000. In addition, if the technology is adopted for assessing green boards, some processors may find that their green mill sorting yard needs to be reconfigured to obtain the full benefit of the project. Industry representatives suggested this could cost in the order of $50,000 - $80,000.

These once-off costs are incurred at an enterprise level and should be considered relative to the cost of existing grading equipment. It has not been possible to incorporate these costs as they will vary at the individual enterprise level and will likely vary depending on the age of existing machinery, and the broader financial position of each enterprise. Because of these difficulties, the implementation costs have not been included within the BCA. As a consequence, it should be noted that the estimated metrics may overstate the value of this project to society and industry.

C.4 Project benefits

Benefits from society's perspective

With adoption of the project findings, that is, installation of upgraded grading machinery, the project benefits from society's perspective were expected to result in reduced costs of production.

- *Reduced costs of production:*

The project documentation suggest that gross production savings of $70 - $85/m^3 could be achieved by diverting green logs and boards away from the dry kiln that are not going to subsequently achieve structural grade. However, the costs of processing the green logs and boards, which are not subsequently kiln dried, need to be considered. Given this, URS has assumed that the net production savings could be approximately 60% of the gross production savings (i.e. $50/m^3).

Benefits from industry's perspective

With adoption of the project findings, it is assumed that processors have the potential to benefit from savings in the cost of production of $50/m^3. Given this, the benefits to industry are considered to be equivalent to the benefits to society and are therefore not estimated separately.

The results of this project are not expected to increase the market share of structural pine products and nor is there likely to be an improvement in price associated with improved product quality given the commodity nature of the structural softwood timber market.

Environmental and social

The social benefit from this project is encompassed in the efficiency gains associated with the reduced costs of production that are estimated to result from the project.

Industry representatives did not consider there were environmental benefits directly associated with the project.

C.5 Base case

The base case is considered to be the situation without the project occurring. That is, that the reduction in the costs of production would not have been achieved.

C.6 Adoption relative to base case

It is assumed that the project results are potentially applicable to the total volume of dried coniferous (softwood) structural sawn timber produced annually in Australia. URS estimates this to be about 55% of the total volume of softwood sawn timber produced each year. Furthermore, the proportion that is currently dried but does not make grade is assumed to be 1%. This means the volume over which the project benefits may apply, without consideration of adoption, is estimated to be approximately 24,000m^3 in 2009/10[2].

Given the project has potential to reduce costs of production, URS considers there would be relatively strong incentives to adopt the technology. However, it is expected that adoption would also be tempered by the capital costs associated with implementing the project findings and the remaining life of current grading systems. Based on this, it is assumed that adoption began in 2009/10, with approximately 5% of volume impacted by the technology. Adoption is assumed to increase until the project benefits apply to 20% of the annual production in 2013/14.

Beyond 2013/14, it is assumed that competitive pressure on costs of production would have led to alternative methods of increasing efficiency in processing, thereby reducing the project-related benefits to zero by 2015/16.

C.7 Summary

Table C-2 presents a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively.

Table C-2 Summary of project impacts and adoption

Impact element	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Reduced costs of production	Yes	$50/m^3	20%	0%*	0%*
Costs					
Project costs	Yes	$450,000	-	-	-
Implementation costs	No		-	-	-

* Note that, it is assumed that the project benefits have dissipated at this time.
Source: URS estimates, based on primary and secondary sources.

C.8 Evaluation

Table C-3 presents the evaluation results, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a twenty year period using a five percent discount rate.

[2] It should be noted that this volume is assumed to change over time in line with forecasts of sawntimber production.

Table C-3 Evaluation results

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$157	$236	$236
BCR	1.4	1.5	1.5
IRR	-	-	15%

*Assumes 5% real discount rate. Values are 2010 dollars.
Source: URS estimates.

C.8.1 Sensitivity analysis

High scenario

Table C-4 presents the results from a sensitivity analysis that assumes the project-related benefits are 25% greater (i.e. $62/m^3). All other assumptions are unchanged.

Table C-4 Sensitivity analysis - high estimate

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$298	$396	$396
BCR	1.7	1.9	1.9
IRR	-	-	20%

Source: URS estimates.

Low scenario

Table C-5 presents the results from a sensitivity analysis that assumes the project-related benefits are 25% less (i.e. $38/m^3). All other assumptions are unchanged.

Table C-5 Sensitivity analysis - low estimate

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$16	$76	$76
BCR	1.0	1.2	1.2
IRR	-	-	9%

Source: URS estimates.

Appendix D Comparison of face bond quality tests for structural glulam (PN06.2029)

D.1 Project need

When testing the quality of the face bond in structural glulam, Australian manufacturers of glulam have typically used a ‘dry cleavage’ test because this is a simple and quick method of testing. This practice only partially conforms to the requirements of the Australian standards, which requires both wet and dry cleavage tests be undertaken.

Concurrently, there had also been a push by industry to have the cleavage testing accepted within the international standards for the manufacture of glulam. These standards specify that cyclic delamination testing techniques be applied to determine the quality of the face bond.

This project was needed because rigorous, independent, quantitative results were required to demonstrate the relative effectiveness of each testing method.

It should be noted that there are limited data available in the public domain on the production, gross value and costs of production of glulam. As a consequence, URS has made a number of assumptions for this assessment, based on input from industry representatives consulted during the review, and the understanding that glulam competes primarily with large dimension solid timber beams in structural applications.

D.2 Project objective

The project objective was to compare different methods of testing the quality of the face bonds within structural glulam beams. The different testing methods were the dry and wet cleavage test and the cyclic delamination test.

A secondary objective was to use the test results to support an application for inclusion of the dry and wet cleavage test procedures within the ISO glulam manufacturing standards.

D.3 Project costs

The total project cost was $36,000 (Table D-1), which comprised investment of $33,000 from FWPA and $3,000 from the Glue Laminated Timber Association of Australia. For the purposes of this review, the costs are assumed to have been incurred entirely in 2005.

Table D-1 Project costs

Operating costs	Capital costs	In-kind	Total
$36,000	$-	$-	$36,000

Source: Project proposal documentation

Implementation costs

The costs of implementing the project results relate to the installation of wet testing processes. These costs include the installation of an autoclave and associated training and operation. These costs have not been included in the analysis; however, they are not considered to represent a barrier to adoption.

D.4 Project benefits

The project results were not conclusive in relation to the superiority of cyclic delamination relative to wet cleavage methods; however, the project found that dry cleavage testing consistently had the worst performance. The researchers recommended that the dry cleavage test, on its own, is not suitable for the quality assessment of face bond joints.

Benefits from society's perspective

With better-quality products entering the market there is likely to be a reduction in the incidence of end user complaints about products and potentially requirements for replacement products. The benefits are assumed to be reflected in lower costs of providing products that comply with performance standards, and hence, responding to customer complaints regarding under-performing products.

Although better-quality end products are anticipated, the commodity nature of the structural timber market is such that it is not considered likely that the potential quality improvements would be reflected in a higher price.

Benefits from industry's perspective

With savings in costs associated with responding to product quality issues and customer complaints, it is assumed that processors have the potential to benefit from an increase in profitability. Given this, the benefits to industry are considered to be equivalent to the benefits to society and are therefore not estimated separately.

The results of this project are not expected to increase the market share of structural pine products, nor are there likely to be improvements in price associated with improved product quality given the commodity nature of the structural softwood timber market.

Environmental and social

The social benefit associated with the project is encompassed in the reduced costs of production that are estimated to result from the project.

Industry representatives did not consider there to be any environmental benefits directly associated with the project.

D.5 Base case

Without the project it is assumed that a full-time member of sales staff could spend 5% of their time responding to underperforming products and customer complaints. The total cost of this time, and product reviews and replacement where required, is estimated to be up to $10,000 per annum per enterprise. The Glulam Laminated Timber Association of Australia has a total of 12 members. For the purposes of this review, URS has assumed that this represents most of the glulam manufacturers in Australia. Given this, the estimated total potential cost to industry is estimated to be around $120,000 per year. Noting total glulam production in Australia is estimated to be around 60,000 m^3 per year, this indicates the average cost per unit product is around $2/$m^3$.

Customers and end users also bear a cost in relation to rectifying under-performing products. These costs relate to time and inconvenience, but have not been included in this analysis as specific consultation with customers would be required.

D.6 Adoption relative to base case

Society's perspective

It is estimated that as a result of adopting the project findings, the value of the time spent in customer negotiations could be reduced to 20%, that is, approximately $2,000 per enterprise per year, or $0.40/m^3 for total glulam production.

Industry representatives contacted for the review indicated that the two largest manufacturers of glulam, which account for approximately 80% of production, installed, or were in the process of installing wet cleavage testing in their processes before the project results while the research was underway.

It is therefore assumed that the project benefits would apply to 80% of total annual production in the first year following completion of the project. It is assumed that competitive pressure from the manufacturers that have already adopted wet cleavage testing means that adoption increases to 100% (i.e. all enterprises) of total annual production by year 6. It is then assumed that project benefits decline towards zero by year 10.

D.7 Summary

Table D-2 presents a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively.

Table D-2 Summary of project impacts and adoption

Impact element	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Reduced product returns and time on negotiations	Yes	$0.2/m^3	80%	20%	0%
Costs					
Project costs	Yes	$36,000	-	-	-
Implementation costs	No	-	-	-	-

* Note it is assumed that the project benefits have dissipated at this time.
Source: URS estimates, based on primary and secondary sources.

D.8 Evaluation

Table D-3 presents the evaluation results from society's perspective, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a twenty year period using a five percent discount rate.

Table D-3 Evaluation results

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$29.1	$62.6	$62.6
BCR	1.5	2.1	2.1
IRR	-	-	36%

*Assumes 5% real discount rate. Values are 2010 dollars.
Source: URS estimates.

D.8.1 Sensitivity analysis

High scenario

Table D-4 presents the results from a sensitivity analysis that assumes the estimated benefit reduced negotiations and product returns is 50% greater, that is, $\$0.6/m^3$. All other assumptions are unchanged.

Table D-4 Sensitivity analysis - high estimate

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$73.1	$123.4	$123.4
BCR	2.2	3.1	3.1
IRR	-	-	62%

Source: URS estimates.

Low scenario

Table D-5 presents the results from a sensitivity analysis that assumes the estimated benefit reduced negotiations and product returns is 50% less, that is, $\$0.2/m^3$. All other assumptions are unchanged.

Table D-5 Sensitivity analysis - low estimate

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	($14.9)	$1.8	$1.8
BCR	0.7	1.0	1.0
IRR	-	-	6%

Source: URS estimates.

Appendix E Pine timber roof environments in WA and its susceptibility to EHB (PNA023-0809)

E.1 Project need

European House Borer (EHB) is an exotic pest that can infest seasoned, untreated pine wood and timber, pine furniture and structural pine timber in buildings. EHB can cause serious damage to untreated structural pine timber to the point where it can cause collapse in application.

EHB was found in Perth in January 2004 and the Western Australian (WA) government initiated an Emergency Pest Response Plan, which focussed on surveillance and containment of the pest. Response activities during the period 2004-07 indicated EHB was confined to the greater Perth metropolitan area. A national EHB Emergency Plant Pest Response Plan (EHB EPPRP) was funded in 2006 to contain and potentially eradicate EHB. However, in 2010 the eradication program was deemed to be unviable and the project was wound down over 2010/11. With the ending of the EHB EPPRP, all of WA (and potentially the rest of Australia) was considered to be at risk from infestation.

As a consequence, legislation that would require pine timber products to be treated by either heat treatment or fumigation with methyl bromide has been proposed.

However, since the initial infestation, no further infestations had been found in house roof or wall framing. Industry questioned the need for the legislation and considered that one reason for the apparent lack of subsequent infestations had been that EHB cannot survive the high temperatures in Perth roof spaces during the summer months.

The national Scientific Advisory Panel to the containment and eradication program and the pine timber industry recommended that the effect of summer roof temperature hypothesis needed to be tested, to determine if treatment was required.

E.2 Project objective

The project objective was intended to determine if EHB beetles could initiate and sustain infestations in untreated pine framing in roof spaces under Perth's climatic conditions. In addition, the project results were anticipated to clarify whether timber would require insecticide treatment in areas where EHB are established.

E.3 Project costs

The total project cost was $1,682,500 (Table E-1), which comprised investment of $600,500 from FWPA and $1,082,000 from third party collaborators. The project was undertaken over a three year period, with costs incurred during the financial years spanning 2007/08 to 2009/10.

Table E-1 Project costs

Operating costs	Capital costs	In-kind	Total
$1,192,000	$490,500	$-	$1,682,500

Source: Project proposal documentation

Implementation costs

Processors will incur costs in conforming to the proposed legislation. These costs may include the construction of new treatment facilities or altering existing facilities to incorporate treatment processes.

URS has not been able to estimate the costs of constructing new or additional processing equipment as they would vary considerably across industry enterprises. For the purpose of this assessment, URS has focussed on the additional unit cost of production that incorporates treatment of structural timber.

E.4 Project benefits

The project found that EHB adults can mate, lay eggs, hatch larvae and bore into kiln-dried structural pine. Furthermore, the project found that temperature of itself does not prevent infestation of pine by EHB. Given this, the project team concluded that pine products will require insecticide treatment consistent with Australian Standards AS1064, in areas where EHB are established.

Benefits from society's perspective

The project benefits from research of this nature are not readily quantified in monetary terms, particularly because legislation was already proposed that would require the treatment of pine products. Given this, the benefits of the research largely relate to confirming that legislation is necessary to protect society from large scale infestations of EHB and potential impacts on the performance of structural timber in application. There are two scenarios for the realisation of these benefits. These are:

- Firstly, if the project found that treatment was not required to reduce the risk of EHB infestation – then industry may have a case to argue against the proposed legislation's impact on increasing industry's cost of production, potentially unnecessarily and resulting in an inefficient use of resources;
- Secondly, if the project found that treatment was required to reduce the risk of EHB infestation – it would remove the industry uncertainty regarding the need for legislation.

For the purpose of this review, URS has assumed the benefit from the project is reflected by the value of the increase in the costs of production, because without the project, legislation could potentially result in an unwarranted increase in the cost of production. This may appear counter-intuitive, as an increase in the cost of production is typically not considered a beneficial outcome.

Benefits from industry's perspective

Industry benefits from avoiding the costs associated with implementing unnecessary legislation are considered to be equivalent to the benefits from society's perspective, and, hence, have not been estimated separately.

Environmental and social

With adoption of the project findings, the social benefits of this project relate to an increase in the confidence that buildings will not be infested by EHB. Furthermore, treatment in accordance with AS1064, is also considered to protect against other pests, such as subterranean termites.

The environmental impact of adopting the project findings may result in adverse environmental outcomes because of the requirement for an increased use of insecticides. However, such adverse impacts are assumed to be outweighed by the social benefits.

Neither of these benefits could be readily quantified by industry and hence, have not been included in analysis of the project's impacts.

E.5 Base case

At the time the decision to invest in the project was made, the base case was represented by the industry without the project. That is, legislation was proposed to be introduced, however, there was uncertainty regarding whether it was necessary and warranted. For the purposes of assessing the potential impact of the project, URS has assumed that legislation has been implemented; however, at the time of writing, it was still under consideration. The decision to proceed with legislation suggests that there was a potential for significant damage to be incurred and the cost of this damage would be greater than the cost of complying with the new treatment requirements.

E.6 Adoption relative to base case

For the purposes of this review, URS has assumed the project impacts apply across the volume of structural sawn timber that is produced in WA. Total production of sawn timber in WA has averaged 235,000m^3 per year in recent years. Of this, it is estimated that approximately 55% is processed for sale in the structural timber market. In other words, the volume over which the benefits of the project apply, without allowances for adoption, is estimated to be 130,000m^3 per annum.

The estimated difference between the treated and untreated price of MGP10 at the mill gate is estimated to be \$70 - \$80/m^3. In the absence of data, URS has assumed this represents the cost of producing treated timber and potentially some transportation, plus business margins. Factoring these other costs and business margins, the cost of treating timber is estimated to be in the order of \$20 - \$40/m^3, and assumed to be \$30/m^3.

The project benefits are assumed to apply across 100% of the industry in the year following completion of the project (2010/11), on the assumption that legislation would apply to the entire WA softwood processing sector. However, it is assumed that processors move to install processing facilities relatively soon after legislation is introduced. On this basis, it is assumed that the benefits of the project decline such that by year 5 (2014/15) benefits apply to only 10% of production. Beyond this time, it is assumed that the benefits decline such that by year 10, competitive pressures would effectively diminish the project benefits to zero.

E.7 Summary

Table E-2 presents a summary of the main project impacts (benefits and costs) relative to the base case and indicates whether the impact has been estimated quantitatively.

Table E-2 Summary of project impacts and adoption

Impact element	Estimated (yes/no)	Parameter value (net)	Adoption relative to base case		
			Year 5	Year 10	Year 20
Benefits					
Avoided costs of unnecessary legislation	Yes	\$ 30/m^3 applied to 130,000m^3 p.a.	100%	0%*	0%*
Costs					
Project costs	Yes	\$1,682,500	-	-	-
Implementation costs	No	-	-	-	-

* Note it is assumed that the project benefits have dissipated at this time.
Source: URS estimates, based on primary and secondary sources.

E.8 Evaluation

Table E-3 presents the evaluation results from society's perspective, including estimates of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) over a twenty year period using a five percent discount rate.

Table E-3 Evaluation results

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$6,216	$6,692	$6,692
BCR	5.1	5.1	5.1
IRR	-	-	70%

*Assumes 5% real discount rate. Values are 2010 dollars.
Source: URS estimates.

E.8.1 Sensitivity analysis

High scenario

Table E-4 presents the results from a sensitivity analysis that assumes the estimated benefit reduced costs of production is 50% greater, that is, $45/m^3. All other assumptions are unchanged.

Table E-4 Sensitivity analysis - high estimate

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$10,149	$10,864	$10,864
BCR	7.6	7.6	7.6
IRR	-	-	93%

Source: URS estimates.

Low scenario

Table E-5 presents the results from a sensitivity analysis that assumes the estimated benefit reduced costs of production is 50% less, that is $15/m^3. All other assumptions are unchanged.

Table E-5 Sensitivity analysis - low estimate

Evaluation measures	Year 5	Year 10	Year 20
NPV ($'000)	$2,282	$2,521	$2,521
BCR	2.5	2.5	2.5
IRR	-	-	37%

Source: URS estimates.

Appendix F Maximising impact sound resistance of timber framed floor/ceiling systems (PN04.2005)

F.1 Project need

Industry research suggests that the general perception of Australian residential building occupiers is that timber inter-tenancy floor/ceiling systems do not perform as well as other building materials when compared on an acoustic basis. This is particularly the case when considering impact sound transmission from the floor above.

A new timber-based design was required to address the problem of poor impact sound insulation so that architects and developers can make more informed decisions when it comes to selecting floor materials for new medium-rise buildings (3-4 stories).

F.2 Project objective

The project objective was to provide the construction industry with a design for timber-based, inter-tenancy floor/ceiling systems that would provide impact sound insulation performance that compares favourably with equivalent structures made from concrete. The design was intended to comply with the proposed acoustic regulations within the Building Code of Australia (BCA).

It was also anticipated that the timber-based design would be simple to construct and cost-effective relative to a concrete slab. In this way, it was anticipated that a design could be produced that could compete with concrete slab designs.

F.3 Project costs

The total project cost was $581,500 (Table F-1), which comprised investment of $276,000 from FWPA and $305,500 from third party collaborators. The project was undertaken over 2004-05.

Table F-1 Project costs

Operating costs	Capital costs	In-kind	Total
$276,000	-	$305,500	$581,500

Source: Project proposal documentation

Implementation costs

The implementation costs associated with adopting the designs that were developed as part of the project include extension activity to raise awareness of the new design. A representative of the industry also suggested that there would be costs associated with constructing the new designs, but the value of these costs could not be accurately determined for this review.

F.4 Project benefits

The project has resulted in the development of a number of design recommendations that, when adopted, are expected to produce a timber floor with low-frequency performance equal to a concrete floor.

Benefits from society's perspective

The benefits to society from this project were expected to relate to improved knowledge.

The project results have included the development of a novel theoretical model for describing the low-frequency impact insulation performance of a timber floor. At the time of the final report for the project, it was intended that the model would be described and published in international journals. In this way, it is anticipated that the project results will advance research into low-frequency impact insulation performance.

Industry representatives also indicated that the project findings have been utilised in further research, for example, in the re-writing of the industry *Wood Solutions Guides* 1, 2 and 3, which are guides for ensuring that timber-framed designs for townhouses and multi-residential dwellings comply with the Building Codes of Australia.

Benefits from industry's perspective

The project was designed with a view to improving perceptions of timber-based flooring systems and, hence, to increase the market share of medium-rise construction market.

Although industry representatives identified the abovementioned benefits as attributable to the project, these representatives were not able to quantitatively estimate the value of these benefits because the level of adoption to date is considered to have been minimal.

Environmental and social

The environmental impact increased use of timber-based systems has the potential to result in a reduction in the number of concrete floor/ceiling systems that are constructed. Concrete is a less environmentally sustainable material than timber and, hence, greater use of timber has the potential to result in an improved environmental outcome.

With adoption of the project findings, the social impact may result in improved satisfaction with timber-based floor/ceiling systems.

However, it was not possible to quantify either of these benefits in a monetary basis.

F.5 Base case

Discussion with industry representatives suggest that the research would not have been undertaken and acoustically competitive timber-based floor/ceiling design systems are unlikely to have been developed.

F.6 Adoption relative to base case

Industry representatives reported that adoption of the project findings has been limited and has not resulted in increased demand for timber-based floor/ceiling systems. One industry representative suggested that further extension would need to be undertaken, in addition that that already undertaken as part of the project.

On this basis, this review found that there has been minimal adoption of project findings to date.

F.7 Summary

URS considers there is potential for the project to result in an increase in demand for timber-based floor/ceiling systems. However, industry representatives could not, as yet, identify a significant change in demand and hence URS has not quantitatively estimated the value of the project benefits.

Given the research was undertaken five years ago, URS considers there is unlikely to be a significant change in demand without further extension activity.

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