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Australian Government
Forest and Wood Products Research and Development Corporation

The role of graduates and their education for the Australian wood processing sector – results from a forest industry survey

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The role of graduates and their education for the Australian wood processing sector – results from a forest industry survey

Prepared for the

Forest and Wood Products
Research and Development Corporation

by

R. Roberts

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Preface

While a truism, the future competitive position of an industry, including the wood processing and products industry, will in significant part depend on the skills base in the industry.

The wood processing and products industry is changing with consolidation, rationalisation and increasing technological sophistication. Traditional pathways of entry for senior plant management and operational roles, at the top end via engineering training / plant operation, or at the other end of learning on the job, may not produce either the numerical or the quality skill base the industry will need in the future. Already there is strong anecdotal evidence of competition for skills, and industry fishing in a static or shrinking talent pool.

This suggests the need for a new approach. Traditionally Australia has been strong in forestry education, although with not necessarily the students to fill all the available undergraduate places. While some forestry graduates or engineers move into the wood processing industries, there has been no undergraduate course, strongly based in engineering and materials science, in wood processing and products. Such courses appear to be working well in a number of other countries in addressing the skill requirements of industry.

This report provides results of an industry survey of future needs for graduates in the wood products industries in Australia. It suggests a serious unmet need for an industry-focused undergraduate degree in wood processing and products, and is therefore a call to action. The proposal in the report represents a real opportunity for industry and educational leaders to make a difference to the long-term future of the forest products industry in Australia.

Glen Kile
Executive Director
Forest and Wood Products Research and Development Corporation

1 Executive Summary

The wood processing sector contributes 1% to Australia's Gross Domestic Product and 7% of all it's manufacturing output. The sector employs 8% of all the people employed in manufacturing and if one includes the harvesting of wood it is the second largest manufacturing sector in Australia. Within the industry as in many other manufacturing sectors there is a significant skilled labour shortage, but the sector is almost unique in that there are no relevant tertiary degree courses at Australian Universities to provide the future managers to drive change and introduce the new technologies needed to modernise the industry and keep it internationally competitive. This paper presents the results of a survey of the need for specifically trained undergraduates within the sector, and describes an undergraduate education program that could meet the needs of the Australian wood processing sector excluding pulp and paper.

It has been generally accepted by the timber processing industry in both North America [Barrett Cohen (1996), and Bowyer (1991)] and in Australia (as will be shown by the results of the survey) that there is a critical shortage of high quality graduates entering the sector and that this is having a substantial negative impact on the competitiveness and productivity of the industry as a whole. In Australia this is compounded by a number of other factors including ageing workforce and negative perceptions about employment in the industry. Resource quality and availability issues have caused significant industry rationalisation and recapitalisation, that have greatly increased the demand for graduates. There was a strong belief that operational and technical specialists be graduates.

From the survey data there was universal industry support in Australia for an industry-focussed undergraduate degree with the survey participants stating they would employ 33 graduates per year from such a program increasing to over 50 in five years time. Below are industry views on such a program:

1. An degree course should be established specifically tailored to the wood processing industry in Australia and modeled on the highly successful Canadian program developed by the Center for Advanced Wood Processing at University of British Columbia, Vancouver, BC.
2. Ideally, the degree should be based on a four year engineering program with a significant proportion of wood science & technology courses as well as relevant science and management units.
3. The proposed program should primarily cater for the sawmilling, panels and remanufacturing sectors, and exclude pulp and paper whose needs are already met by the Australian Pulp and Paper Institute (APPI) at Monash University.
4. The program should include mandatory, paid industry placements during the long vacations at the end of the first, second and third years.
5. The Australian National University and University of Melbourne have some of the infrastructure to develop the program and should be approached to submit expressions of interest in establishing the degree program.
6. The relevant Australian Government agencies should liaise and coordinate the selection of the host institution/s.
7. The Australian Plantation Products and Paper Industry Council (A3P) and the National Association of Forest Industries (NAFI) in conjunction with the various State associations should coordinate industry efforts to assist with the development of the curriculum for the program.
8. Development and delivery of the program should be the joint responsibility of industry, the host institute and Government.
9. A3P and NAFI should coordinate industry efforts to help obtain funds to establish the program, including scholarships for students.

10. The selected university should provide resources to establish mechanisms to liaise with industry and industry associations; attract students and staff and maintain the program in the long term.

11. Continuing education programs to meet industry's need for retraining should be developed after the successful establishment of the undergraduate program.

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2 Introduction

To quote Barrett and Cohen (1996) "For our wood products industries to be globally competitive, they must have access to a high quality workforce. Industry, educators and government must, as a primary goal seek to produce graduates at all education levels with the skills, knowledge, and lifelong learning abilities required to help the wood products industry to be successful in the world economy". This was stated from a Canadian perspective,[1] where industry representatives agreed that they could not "build a sustainable competitive advantage based solely on low wages, low fiber costs, or preferred access to new technology or equipment. Rather competitive advantage must be built on two factors, 1) access to a highly motivated, knowledgable and productive workforce, and 2) the ability to productively manage both human and financial resources". This is equally true for the Australian wood processing sector.

The harvesting, and conversion of timber into finished goods is one of Australia's most significant manufacturing sectors. It is probably the largest form of manufacturing activity in regional areas. The wood processing sector contributes one billion dollars to Australia's Gross Domestic Product which equates to 7% of all manufacturing output [Australian Bureau of Agricultural and Resource Economics ABARE (2005)]. The sector employs 8% of all the people engaged in manufacturing and if one includes harvesting within the sector it is the second largest manufacturing activity in Australia. The sector has a turnover of approximately twenty billion dollars and it consumes 25 million cubic metres or tonnes of roundwood.

Bull (2006) recently described the current status of the wood processing sector. There are a total of 123 manufacturing sites converting greater than $10{,}000m^2$ p.a., employing over 45,000 people according to ABARE (2005). If one includes tim-

[1] Their study eventually led to a complete revamp of undergraduate education in UBC and led to the development of North America's most successful wood-related degree program, which has been emulated by institutions in New Zealand, Chile, South Africa and Europe.

ber products manufacturing and timber merchandising (which the former does not consider) the sector employs approximately 110,000 people according to Forest and Forest Products Skills Company (FAFPESC) (2003). Growth in employment levels has not matched growth in production of sawn timber and board products (medium density fibreboard and particleboard) which have increased by 1.6% and 4% p.a., respectively, from 1993/4 to 2003/4. In the same period turnover in the forest products industry has increased by an average of 6.5% pa. Full time employment in the sector has remained fairly static over the last 20 years with increases only occurring in part time employment [ABS (2005)], reflecting the desire by the sector for greater productivity.

Nevertheless there has been considerable investment in the sector, currently averaging $740 million per year despite the lack of growth in employment (Bull 2006). There has been a reduction in availability of mature native hardwood, and a significant increase in the availability of both plantation hardwood and softwood and regrowth hardwood material. As a result there has been a substantial rationalisation of the number of operating sawmills in Australian resulting in fewer but larger mills in all states. For example, in Victoria there were more than 270 sawmills operating in 1975, whereas today there are 75, [Victorian Association of Forest Industries (VAFI) (2005)]. There has also been a substantial change in the quality of roundwood particularly hardwood utilised by the industry.

There is a significant shortage of skilled labour in manufacturing industries in Australia and elsewhere [Ellis *et al.* (2006)]. This shortage is pronounced in the wood processing sector where there a number of issues that compound the problem. These issues were thoroughly examined in a report by the National Association of Forest Industries [Bull (2006)] on the skills shortages and training needs of the Australian Forest Industry.

This report examines the need for and the shortage of graduates in the wood processing sector. This shortage is by no means unique to Australia, however what is unique to Australia is that until now, very little has been done to address it.

2.1 Literature Review

An assessment of the general educational needs of the forest products industry in North America was made by Lyon *et al.* (1992) who expressed fears that in-house industrial expertise in the North American wood products sector had declined, along with public sector technical expertise. They stated that this was due to a reduction in enrollment in wood science and forest products degree courses. Bratkovich and Miller (1993) and Hansen and Smith (1997) conducted surveys in 1993 and 1995 to determine the educational needs of the wood products industry in Ohio, and Oregon and Virginia respectively. Brown and Niemiec (1997) conducted a survey which addressed general attitudes towards training and staff development, and interest in various subjects and training methods in sawmills in Oregon. Recently Bull (2006) undertook a detailed study of the training needs (non-university based) in the Australian wood processing sector.

A number of authors have studied undergraduate education in the forest products industry in North America. Bowyer (1991) examined the number of institutions offering wood science and technology degrees and the number of students enrolled in the degree. He found a general reduction in undergraduate enrollment coinciding, not surprisingly with a lack of availability of well educated graduates in the wood products industry.

Cohen and Maness (1995) surveyed the needs of the Canadian secondary wood processing industry for wood science education programs. They concluded that undergraduate education in Canada needed to be re-engineered to better meet the needs of industry and future employers of graduates. They found that industry rated wood physics and drying, wood adhesives and technology, wood anatomy, wood deterioration and protection and wood biology and biotechnology as being important wood-related courses. In the area of production and management education, they found problem solving rated highest, followed by cost accounting and budgets, time management techniques, systems analysis and plant layout and design. In the

mechanical processing educational area they found that quality and process control rated highest, followed by lumber processing (sawmilling) remanufacturing, CAD/CAM and timber design. Cohen and Maness (1995) also examined the type of degree program what would best meet industries' needs. They found that a four year undergraduate program was rated most highly followed by a five year undergraduate program, with both having a co-operative education component. These preferred options were followed by a one year specialisation added to undergraduate engineering or forestry degrees and finally by a one year Masters (by coursework) degree. They also noted that a co-operative program would place some of the responsibility for education on the industry.

Smith *et al.* (1998) reviewed the Wood Science and Forest Products program at Virginia Tech to measure how well it was preparing students for the workplace. This was done by determining subject areas that alumni, employers and current students felt were important to their career success, and the extent to which Virginia Tech's wood science and forest products program were addressing these areas. They found a significant imbalance between subject need, it's importance to employers and students, and consequently how effectively students were prepared for the work environment. The authors stated that many wood science and technology programs were struggling with enrollment and survival, and most were not equipped to implement the positive change brought about at the University of British Columbia, where a successful program was developed involving partnerships with industry and European educational institutes.

Most of the aforementioned authors above referred to the imbalance between the high demand for graduates and low number of students enrolled in wood science and forest products programs. Ifju (1996) described a novel idea for student recruitment in wood science and forest products programs in the US, recognising that industry needs far outstripped the supply of graduates. Winistorfer (2003) posed the question as to why the best students were going to the biological and physical sciences, engineering and medical professions as opposed to wood science and forest froducts programs. He found that most academic programs in wood science and forest products had been in decline due to an unwillingness to change and examine their academic, research and outreach programs. Such programs lacked innovation, instrumentation and the use of technology in their degrees. There were, however, exceptions which had changed their approach and employed specialist faculty members from other disciplines and backgrounds (industry) recognising that traditional knowledge of wood was insufficient to prepare students for the workplace.

2.2 Rationale for this study

This study concentrates specifically on the need for graduates in the wood processing sector, the difficulty industry faces in obtaining them and the deleterious effects that this is having on the sector's productivity and competitiveness. It also examines the type of education program that would meet the needs of the sector in Australia. The primary wood processing sector (excluding pulp and paper) broadly encompasses sawmilling both hardwood and softwood, panels manufacture, MDF and particleboard, plywood and engineered reconstituted wood products such as laminated veneer lumber and chip production facilities primarily for export. The secondary manufacture of wood products into furniture, kitchen cabinets, windows and doors, architectural millwork and wooden building components will also be discussed briefly. This report excludes the pulp and paper sector as this sector's educational needs have traditionally been met by the various Chemical Engineering degrees in Australia as well as more specifically by the Australian Pulp and Paper Institute (APPI) at Monash University, which is attached to the Faculty of Chemical Engineering and is a joint university/industry operation.

The focus of this report is on manufacturing of wood and timber products. Hence it's scope is from the "mill door". As such it assumes the role of the forester is to organise the supply of timber to the mill door. In contrast the role of highly skilled

graduates specifically trained in wood science, process engineering and manufacturing of wood products is to effectively and economically convert wood based raw materials (either logs, chips or shavings) into a product desired in the marketplace. Therefore less attention is given in this report to the role of foresters and forestry training in wood products manufacture.

In the past forestry graduates have been highly represented at graduate entry level in the wood processing sector, however Bull (2006) reports (and confirmed by the author) that there is a significant shortage of graduating foresters required for the management of forests and roundwood production. This has resulted in a significant increase in the numbers of graduate foresters imported from overseas. Hence graduate foresters are now less likely to enter into the wood processing sector, further compounding industries labour shortages. Notwithstanding this, as will be shown later, the specific training in wood science and technology is clearly inadequate in current forestry programs in Australian universities.

Duncan *et al.* (1989) wrote an interesting study on the education of foresters and the profession's future, and the concerns he raised are equally relevant to Australia. In the US they found that the perception and value of the forests had changed substantially, and Americans are becoming increasingly concerned with preserving both private and public forests as important and valued parts of their biological, physical and aesthetic environment. This concern has been accompanied by a decreased understanding and value placed on the relationship and contribution of forests (and the wood products industry) and production foresters to the material needs of society. The negative public image of forestry and foresters has reduced the effectiveness of forest professionals in the public and private fora that affect policy, legislation, fiscal allocation, and other dimensions of environmental and renewable natural resource activities. "In addition, it has detracted from the professions's ability to attract able and dedicated young people to careers in forestry". This can equally be said about the role of forestry and associated wood processing industries in Australia in 2006.

Australian commentators have also reported on the need for, and the shortage of young foresters (graduates) and how this threatens the future of forestry-based industries [Newman (2005)]. Some wood science and technology courses are available within undergraduate forestry courses and some are available at the associate degree and advanced diploma level, but as Newman (2005) states "in spite of three good courses being offered in B.Sc Forestry degrees, there is no course that has over a three or four-year period, majors in wood products subjects".

Vocational training in the wood products industry has been adequately covered in the report by Bull (2006). This report focusses on undergraduate education for the wood processing sector.

The objective is to assess the likely future demand for graduates and to determine the structure of a wood science and technology program that would best meet industries' needs.

3 Methodology

3.1 Companies selected

Companies selected to be interviewed and surveyed were selected from a mailing list prepared by The Australian Plantation Products and Paper Industry Council (A3P), National Association of Forest Industries (NAFI), and Timber Queensland. A judgemental sample was chosen to provide a cross section of potential employers of graduates from a relevant program in wood science and technology. A small number of companies were also selected to determine their attitudes to graduates in general and their likely impact on the sector, even though they themselves were unlikely to employ graduates. Six companies in Queensland, six in New South Wales, four in Western Australia, five in Victoria, six companies in Tasmania and two in South Australia along with the four largest companies that had operations in more than one state, were visited or telephoned between June and August 2006 (Table 1), giving a total sam-

ple number of 35 operations. Primary manufacturers (sawmills, particleboard mills etc.) provided the bulk of the sample set however a number of secondary manufacturers (re-manufacturers) were also sampled. Unlike Cohen and Maness (1995) consultants, equipment suppliers, research associations or providers, and government bodies were not included. In the survey the selection of people for interviews was based on their ability to influence hiring guidelines or make executive decisions. Therefore, interviews were conducted with either the Chief Executive/Owner, or manager in charge of training/human relations.

3.2 Interview and survey process

The interview took the form of an introductory PowerPoint presentation on the scope of the timber processing sector in Australia, comparing it to the Canadian sector (which is surprisingly only about three times the size of the Australian sector)[2]. Then the program developed by the Center for Advanced Wood Processing, University of British Columbia, Vancouver, BC, (CAWP, UBC) which has been highly successful in firstly attracting high quality students and secondly producing highly sought after graduates, was described as an example of what could be achieved in Australia. The presentation also contained a description of a potential degree course that would meet the needs of Australian industry. Questions were then asked of the company's operation and as well as their need for highly trained wood science and technology graduates. The survey form was left with the interviewees to be returned at a later date. Thirty of these companies returned their surveys, which represents a high response rate of 94%.

Twenty nine companies were sent forms by mail and 30 forms were left with Timber Queensland and at a Treated Timber Conference in Sydney in June 2006. Of these mailed forms only five were returned. Most of the larger companies were visited for interview, in addition to a stratified sample of smaller family owned operations and larger secondary manufacturers (all of whom used sawn timber). Only one survey form was returned from this group. No panel re-manufacturers were visited. Therefore the total response for the survey excluding forms not directly mailed was 57%, which is satisfactory given that comparable surveys overseas have obtained much lower response rates. For example, Cohen and Maness (1995) obtained a response rate of 20% for surveys sent out to primary, secondary and tertiary[3] manufacturers.

The surveys returned included 15 hardwood sawmilling operations, 13 pine sawmilling operations, seven panel manufacturers and two re-manufacturers, one timber treatment operation and one cypress pine sawmiller. All of the sawmills have roundwood inputs of greater than $10{,}000m^3$. Four of the companies had over 1,000 employees, these were classified as large companies. Twelve had over 100 employees and were classified as medium-sized companies. Nine companies had over 50 employees and eight firms had under 50 employees, these 17 were classified as small-sized companies.

3.3 Design of survey

The design of the survey was based on methods prescribed by the Tailored Design Method [Dillman (2000)]. The survey consisted of a general description of the company including number of employees, sector, major products etc. (Appendix 1). There were a number of specific sections to the survey as follows:

- Skill types sought in hiring of future leaders, (similar to those posed by Ellis *et al.* (2006). Companies were asked to rank the skills needed of employees and scores (evaluation points) were assigned to rankings as follows; first ranking (3 points), second ranking (2 points) third ranking (1 point), and then summed. These rankings are used in the

[2]The Australian sector has a turnover of 18 billion dollars and the Canadian sector about 60 billion dollars. The Australian sector directly employs about 80,000 people whereas the Canadian sector about 250,000.

[3]including consultants, equipment suppliers, research organisations and government bodies etc.

results section to indicate the relative importance of different attributes and skills.

- Optimal mix of technical, professional and business skills in a relevant wood science and technology degree program.
- Levels of agreement with statements pertaining to undergraduate education issues in the wood products industry, the methodology here being similar to that advocated by Borich (1980) i.e. a rating of 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree and 5 = strongly disagree, was assigned to various statements relevant to educational issues in the wood products industry.
- A list of subject areas that companies see as being the most appropriate in a wood science and technology undergraduate program.
- Level of interest in retraining and professional development of existing employees.
- Preferred methods of delivery for continuous education programs for existing employees.

3.4 Analysis of data

Results are presented in tables and histograms. Statistical analysis was employed for some data using correlation matrices, ANOVA (using an unbalanced treatment structure) and regression techniques using Genstat V7[4]. Significant results are presented graphically and individual means can be compared using least significant differences *($p < 0.05$)*. However, while the results are comprehensive, they should be treated with caution in that statistical inferences on the whole population of Australian wood processors should not be made. Notwithstanding this, the level of survey returns provide valuable insights into the current state of education and skills requirements for the Australian wood processing sector and with this data indicative conclusions can certainly be drawn.

[4]Lawes Agricultural Trust

Table 1: *Companies who returned surveys ranked by number of employees. Companies >1,000 employees were categorised as large, >100 as medium and <100 as small sized companies.*

Company name	**Category**	**State**	**No. of employees**
The Laminex Group	Panels manufacture	Vic, WA, NSW, Qld	3,000
Hyne Timber	Sawmilling	NSW, Qld	1,200
Carter Holt Harvey Panels	Panels manufacture	NSW, Qld, SA	1,000
Weyerhaeuser Australia Pty Ltd	Sawmilling	NSW, Qld, SA	1,000
Auspine South Australia	Sawmilling	SA	727
Green Triangle Forest Products	Sawmilling	SA	420
Boral Hardwoods	Sawmilling	NSW	400
Dale & Meyers	Sawmilling	Qld	350
Auspine Tasmania	Sawmilling	Tas	300
Gunns WA	Sawmilling	WA	220
Wespine Industries	Sawmilling	WA	215
AKD Softwoods	Sawmilling	Vic	200
Highland Pine	Sawmilling	NSW	200
Neville Smith Industries Vic	Sawmilling	Vic	196
Britton Timbers	Sawmilling	Tas	135
Pinetec Ltd	Sawmilling	WA	106
Alpine MDF Industries Pty Ltd	Panels Manufacture	Vic	93
Forest Enterprises Australia	Sawmilling	Tas	85
Jeld-Wen Fiber of Australia	Panels Manufacture	NSW	82
Weathertex	Panels Manufacture	NSW	80
Allied Timber Products	Sawmilling	NSW	60
The Australian Sawmilling Company	Sawmilling	Vic	55
Coffs Harbour Hardwoods	Sawmilling	NSW	52
Jensen Jarrah	Remanufacturing	WA	50
Neville Smith Industries Tas	Sawmilling	Tas	50
Burnett Sawmill Pty. Ltd.	Sawmilling	Qld	42
CMTP	Sawmilling	Vic	40
Queensland Sawmills	Sawmilling	Qld	35
Tasmanian Wood Panels	Panels Manufacture	Tas	34
Wren Timbers	Remanufacturing	Qld	15
Matpine Pty. Ltd.	Sawmilling	Tas	8
Corbek Timber Preservation	Timber Treatment	Qld	6
Injune Cypress	Sawmilling	Qld	3

4 Survey Results

4.1 Hiring plans

4.1.1 Skill needs of industry

Figure 1 shows the relative importance attached to the general skills sought by timber processing companies when hiring future leaders. These general skills were: leadership, technical, business, financial, analytical and communication skills. To determine the relationship between company size and a particular skill sought, analysis of variance was used, where company size classification and skill sought were the explanatory variables.

There was no significant relationship between the size of a company and any of the skills needs of industry. There was however a significant difference ($p < 0.001$) between the skills sought. The relative importance of leadership, technical and communication skills were 22.1%, 19.9% and 20.9% respectively, and there was no significant difference between these attributes. Analytical skills was rated at 16.4% which was significantly higher than the rating for business (11.2%) which was not significantly different from financial skills (9.7%). There was no company size by skill sought interaction.

Other skills and/or attributes not included in the above categories that were seen as highly desirable included: project management skills, ability or desire to live in regional areas, attitude and personal skills, basic commonsense and passion for the industry. Capacity for innovation and entrepreneurship, and ability to work as part of a team as well as experience were also mentioned as being important.

4.1.2 Technical and production and operations personnel hiring requirements

Companies were also asked how many technical specialists and production/operation personnel[5] would be hired in 2006 and in five years time.

[5]Production manager, process engineer or supervisor etc.

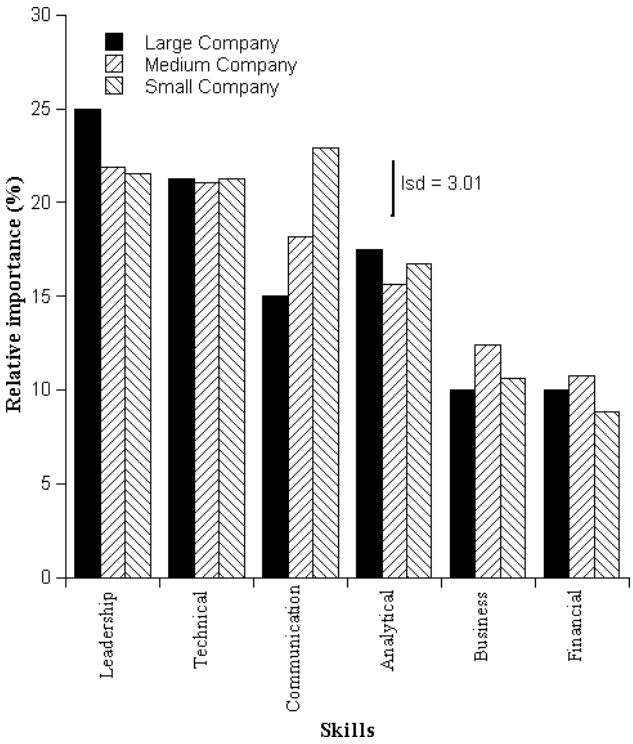

Figure 1: *Summary of skills sought in hiring future leaders. LSD bar is at the 95% confidence level.*

In terms of technical specialists to be hired in 2006, on average large companies wanted to hire five employees, medium companies, two employees and small companies one employee. In five years time, large companies stated that they would hire 12 technical specialists and medium and small companies three each.

In terms of production/operations personnel, large, medium and small companies wanted to hire four, four and two personnel, respectively in 2006. In five years time large companies would hire 13, medium companies would hire six and small companies would hire four production/operations personnel.

4.2 Education

Companies were asked about their hiring plans for technical and production specialists in the current

year and in five years time. Obviously larger companies wanted to hire more people in total, however all companies stated that they would need considerably more technical and production personnel in five years time, by at least twice the current requirements. Of the companies sampled, large companies would require two to three graduates per year from a wood science and technology degree in Australia modeled on the one at CAWP in UBC. Medium companies would require one per year and small companies would require one graduate every two years. It can be estimated that these requirements could double in five years time. From the sample set, and if the wood science and technology degree was available, 33 graduates would be required[6] per year. Therefore in five years time this could increase to over 50 such graduates that would be required by industry. It was stressed during the interviews that this was not based on initial hiring but was *an on going yearly requirement*. Some of the larger companies that already have substantial graduate intakes would however prefer to hire graduates from a program similar to the one at UBC. This graduate requirement by industry did not include forestry graduates.

Looking at a proposed degree program (which will be discussed in Section 5.4) survey respondents were asked what was the optimal mix of technical/operational skills training, leadership skills training, and business skills training, as a percentage. There was no significant relationship between the size of the company and the type of skills preferred. There was a significant difference ($p < 0.001$) between the skill type sought and the rating where the average rating of technical/operational skills training was 43.5%. The average rating for leadership skills training was 30.2%. The average rating for business skills training was 25.5%. Figure 2 shows results for large, medium and small companies.

Companies were then asked whether or not they would be willing to employ a student or students

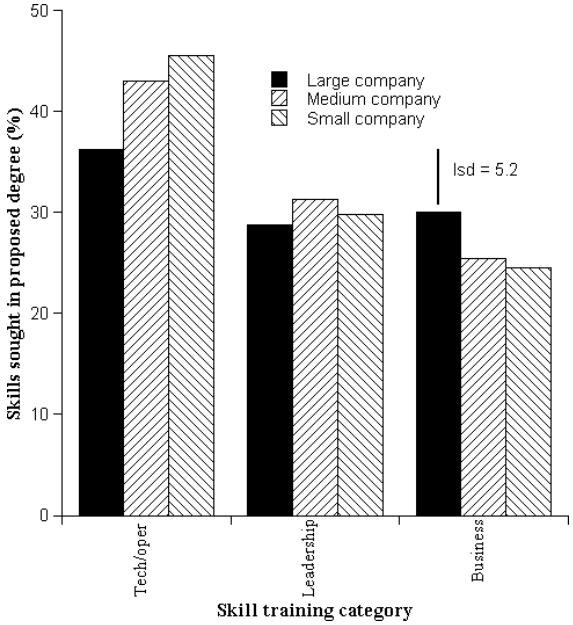

Figure 2: *Skills training mix sought in proposed degree*

for a three month internship as part of their educational requirements. All but two companies said that they would. When asked the question about whether the company would be willing to become involved in helping to set the direction of the education program of the proposed degree, all but three companies said yes.

Companies were then given a series of questions to be rated 1 = strongly agree to 5 = strongly disagree pertaining to educational issues in the wood products industries. These are shown in Figure 3 and Table 2. There was a significant difference ($p < 0.001$) between the rating of the questions, but there was no relationship between company size and the rating of each question nor was there any interaction between company size and each question.

[6]This did not include Gunns Timber in Tasmania who returned an incomplete form and as such were not included in the sample set. Their graduate requirements including foresters are six to ten per year.

Table 2: *Ratings of levels of agreement to statements as they pertain to educational issues in the wood products industries*

Statement	**Strongly agree**	**Agree**	**Neither agree nor disagree**	**Disagree**	**Strongly disagree**	**Average rating**
(a) There is a strong shortage of well-qualified professionals in the wood products industry	25	7	1	0	0	1.27
(b) Wood products educational programs should focus on technical topics	5	21	6	1	0	2.09
(c) Wood products educational programs should focus on management skills	3	18	9	2	0	2.39
(d) Universities should strive to develop international partnerships for delivering educational programs in wood and fibre technology	8	14	11	1	0	2.15
(e) Retraining existing employees is a priority in the wood products industry	7	16	8	0	1	2.21
(f) The appropriate training for a management track employee is in commerce or accounting	0	3	11	12	7	3.70
(g) In the future, there will be a greater need for highly skilled wood products professionals	16	14	3	0	0	1.61
(h) In order to succeed, today's wood products professionals require a broader range of skills than they did ten years ago	18	13	2	0	0	1.52
(i) There is an abundance of relevant educational programs from which to choose new management employees	1	3	8	10	11	3.82
(j) Wood products educational programs should include internships and industry placements	16	15	2	0	0	1.58
(k) Managers in the wood products industry require a university degree in advanced wood processing	1	11	14	7	0	2.82

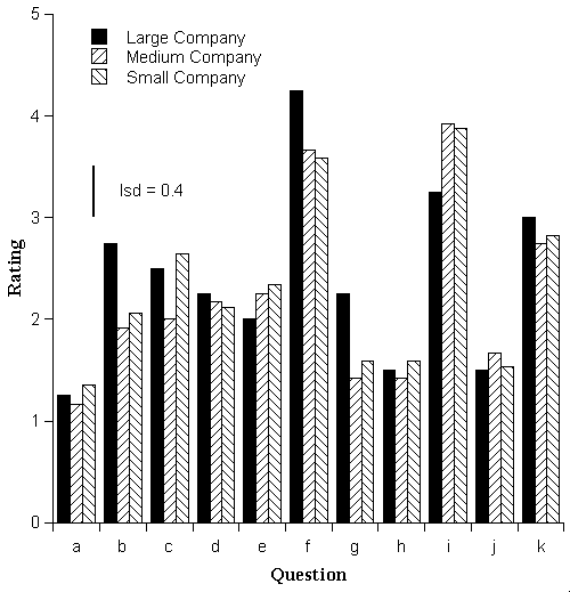

Figure 3: *"Ratings of the questions asked in Table 2 rated by company size".*

4.2.1 Educating new industry entrants

The next section of the survey involved rating subjects grouped into three areas in an undergraduate program (wood, engineering and commerce) as being appropriate (rated 1) or otherwise (rated 0). The potential subjects are listed below in Table 3, which also gives the average response. There was a significant difference ($p < 0.001$) between different subjects as well as a significant interaction between company size and subject ($p = 0.025$). Table 3 shows the subjects in order of average rating, as well as giving the rating stratified by company size and the rating within each size bracket. Naturally the results will be biased toward subjects relevant to sawmilling as the majority of the respondents were sawmillers, however this is considered valid in the Australian context as by far the largest majority of primary wood processing companies operate sawmills.

All of the companies wanted the subject leadership to be a part of the degree program and the next three most desired subjects fell in the category area of engineering subjects; control systems, project and operations management and manufacturing technologies. The next four most highly rated subjects were related to management followed by wood science and technology courses.

Of the subjects grouped under wood, those that rated highest were wood structure and quality issues, value-added wood products processing, primary wood products processing, and wood physics and drying[7]. None of the larger companies required forestry and forestry practices due to their employment of foresters, who possess such knowledge.

Of the subjects grouped under engineering, the top four were control systems, project and operations management[8], manufacturing technologies, and electronic circuits and devices. However none of the larger companies wanted electronic circuits and devices, engineering materials or CAD/CAM subjects because they employ specialist engineers, with such knowledge.

The six most sought after subjects in the commerce grouping of subjects were; leadership which every company wanted, HR management and strategies; managing organisational change; management, people and organisations and organisational behaviour. There was a significant difference at the 90% confidence level ($p = 0.094$) between company size and the need for the subject of business ethics. Only 25% of the larger companies wanted the subject whereas over 67% of medium companies and 77% of small companies wanted the subject of business ethics included in any proposed degree.

When asked about whether there were any other subjects not in the list referred to above that would be of interest to companies, two respondents stated that statistical methods for quality control, general statistics and problem solving should be added. Other subjects were financial management accounting (in an industrial context),

[7]Most of the sawmills visited had serious concerns about the availability of people who understood drying of timber at more than a basic operational level.

[8]After timber drying skills, this was the next most sought after skill in general discussions with industry during the interview process.

sales and marketing, and subjects for the wood composites industry i.e. for both particleboard and medium density fibreboard. The largest manufacturer has an in-house low-cost manufacturing philosophy that they would like to see in any course as well, however this could be accommodated in one of the subject areas referred to above.

Table 3: *Average rating (1 = all companies wanted subject, 0 = no company wanted subject) of subjects companies consider to be the most appropriate in an undergraduate program.*

Category Grouping	**Subject**	**Overall Rating**	**Rating Large Company**	**Rating Medium Company**	**Rating Small Company**
Commerce	Leadership	1.0	1.0	1.0	1.0
Engineering	Control Systems	0.97	1.0	1.0	0.94
Engineering	Project & Operations Management	0.91	1.0	0.92	0.88
Engineering	Manufacturing Technologies	0.85	0.75	0.92	0.82
Commerce	HR Management & Strategies	0.85	0.75	0.67	1.0
Commerce	Managing Organisational Change	0.82	0.75	0.83	0.82
Commerce	Management, People & Organisations	0.79	0.75	0.83	0.77
Commerce	Organisational Behaviour	0.76	0.5	0.67	0.88
Wood	Wood Structure & Quality Issues	0.70	0.25	0.92	0.65
Wood	Value-Added Wood Products Processing	0.70	0.25	0.75	0.77
Wood	Primary Wood Products Processing	0.67	.50	0.92	0.53
Commerce	Business Ethics	0.67	0.25	0.67	0.77
Wood	Wood Physics and Drying	0.64	0.5	0.83	0.53
Engineering	Electronics Circuits & Devices	0.64	0.0	0.83	0.65
Commerce	Entrepreneurship & Innovation	0.61	0.75	0.50	0.65
Wood	Forestry & Forestry Practices	0.52	0.0	0.58	0.59
Wood	Forest Products Marketing	0.49	0.5	0.58	0.41
Engineering	CAD/CAM	0.49	0.0	0.5	0.59
Engineering	Mechanics of Materials	0.46	0.25	0.5	0.47
Engineering	Engineering Materials	0.46	0.0	0.5	0.53
Wood	Engineered Wood Products	0.39	1.0	0.25	0.35
Wood	Wood Preservation	0.36	0.0	0.42	0.41
Engineering	Composite Materials	0.33	0.25	0.25	0.41
Wood	Wood Finishing	0.33	0.0	0.25	0.47
Wood	Timber Engineering	0.30	0.25	0.33	0.29
Engineering	Robotics	0.27	0.25	0.25	0.29
Wood	Wood-Based Panel Products	0.24	0.5	0.08	0.29
Wood	Wood and Resin Chemistry	0.24	0.25	0.08	0.35
Commerce	International HR Management	0.0	0.0	0.0	0.0

Bull (2006) stated that the skills development needs in the wood processing sector included supervisory and management training, environment and industry knowledge. As can be seen from Table 3 these would be covered in any proposed undergraduate program.

Companies were asked to list some of the most common management track jobs that might be offered to a new industry entrant with an undergraduate university education. The following is a list of these jobs:

- Production manager/supervisors
- Project engineer/officer
- Environmental engineering
- Project management
- Process improvement roles
- Team leader/supervisor
- Continuous improvement role (not necessarily process related)
- Site supervisor
- Green mill manager
- Dry mill manager
- Site manager
- Quality/technical manager
- Group manager
- QA systems
- Project based work
- Process engineering
- Timber engineering
- Technical supervision
- Process maintenance roles
- Production scheduling
- Sawmill management
- Seasoning (kiln drying research)
- Production optimisation
- New technology projects

4.3 Industry retraining and professional development

The next section of the survey looked at how a proposed degree course could assist existing employees in a company irrespective of whether the employees had an existing undergraduate degree. The first question asked was whether or not a company was interested in the retraining and professional development of their workforce. This was rated from 1 = very interested to 10 = not at all interested. There was no significant relationship between the size of a company and the interest in retraining (large companies were rated at 2.75, medium companies 2.5 and small companies 2.65), and the average rating for all companies was 2.6, indicating a very strong interest in retraining employees. The only company that expressed a contrary view was a small wood panels producer with one internal customer who freely admitted that their future was in doubt. Interestingly, one of the largest panel producers had a completely neutral view on employee retraining. Figure 4 shows the distribution of the responses.

Companies were asked how many employees they currently retrain. Larger companies said on average they would retrain 88 employees on an annual basis, medium companies 14.1 and small companies 9.5 employees. Companies were then asked whether this was likely to increase, stay the same or decrease. No company said that they would reduce the level of retraining, and there was no significant difference in the size of a company and whether a company would increase the level of training or keep it the same, with slightly less than half the companies stating that retraining levels would increase (48.5%).

Companies were then asked to list the three most common areas of retraining and professional

development that management and technology employees are engaged in. These are listed below in no particular order:

- Leadership
- People skills
- Accounting
- Project management
- Logistics
- Business skills & management
- Graduate certificate of management
- Advanced diploma wood products
- Legislative compliance - safety etc.
- Employment law etc.
- Continuous improvement practices
- Certificate four retail & admin supervision
- General legislative compliance
- People management
- Electronics
- Metals skills
- Wood seasoning & drying
- Manufacturing technology
- Control/scanning systems
- Recent advances in technology
- Machining of timber
- Sales & margins
- Wood properties
- Time management
- Frontline management
- CAD/CAM
- Control systems engineering
- Adhesives
- OH & S
- Quality control
- Timber treatment
- Senior management development program
- Timber technology

Companies were asked to rank the three most preferred methods of delivery for the retraining and professional development of management and technology employees, with rankings from 1 to 3 with 1 being the most preferred method of delivery. There were four potential methods of delivery. These are shown below in Table 4. The most popular option was compressed off-campus delivery followed closely by compressed on-campus delivery. The popularity of these options obviously reflects pressures on employers not to release key staff members for any great length of time. Hence it is not surprising that regular courses run on campus did not elicit numerous responses. Distance education was also seen as problematic with a reasonable level of response but a much lower rating than the other options. This finding was unexpected as there are a number of existing distance education courses, which in the light of this finding are viewed as being ineffective (see Section 5).

Companies were then asked if they had formal training programs in place for trades/production employees. 23 companies responded had such programs (see the list below), whereas ten companies said that they did not. There was a significant relationship ($p < 0.001$) between the size of a company and whether or not such formal training programs existed. All of the large companies had formal programs, as did 91% of the medium companies. In contrast only 47% of the small companies had formal retraining programs. Listed below are some of the formal retraining programs currently in operation in the wood processing sector.

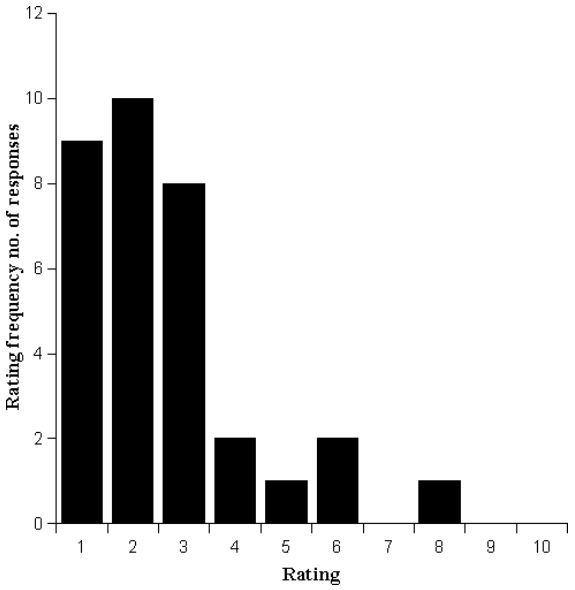

Figure 4: *Level of interest shown in retraining and professional development of existing employees 1 = very interested, 10 = not at all interested.*

Table 4: *Rankings (1 - 3) of preferred methods of delivery for retraining and professional development of management and technology employees.*

Preferred method of delivery of course	**Number of responses**	**Average rating**
Compressed on-campus (3 weeks on campus)	28	2.0
Compressed off-campus (2 - 5 days at company)	29	1.7
Regular on-campus (13 weeks on campus)	5	2.0
Distance education (internet, video, independent study)	25	2.1

- Courses arranged though Australian Institute of Management and technology vendors (prefer 2-5 day courses, away from site)
- Apprenticeship courses based on trades
- Plant operation
- Competency based training
- Post trade studies
- Operators courses by FAFPESC
- Managers: Frontline management
- Traineeship for production staff as appropriate
- Apprenticeships for wood machining
- Trade certificate in wood machining
- Boiler license
- Senior management & development program
- Front line management
- Timber technology

Companies were asked whether or not they would accept on-line e-based courses for non-management and non-technical employees. Twenty-six companies said they would support such courses while six said they would not. There again appeared to be no relationship between the size of a company and whether or not they would support e-learning. This was a similar response elicited when companies were asked to state their preferred method of delivery of courses for existing employees.

Companies were also asked whether they would be willing to consider education and retraining for their non-management and non-technical employees via on-line distance education. Twenty-four companies said that they would and eight said they would not. The reasons given for a negative response were varied. One company stated that the

average school leaver age was 13-14 yrs and therefore they encountered low levels of literacy and numeracy amongst their employees. Hence e-based learning, it was argued, would not be suitable for them. Another company said that they doubted whether employees would actually stick to the task. This particular employer also had a problem with employee turnover. Another response was that companies didn't believe e-learning translated into improved on the job performance (generally), however, they noted exceptions. Another stated that they did not support distance education because employees need a much more practical approach to studies, and theory alone was insufficient. Another company did not support the concept of distance education because they thought it would be difficult to manage staff learning due to long working hours required and they were reluctant to stipulate after-hours requirements. This was an interesting comment, which can be interpreted in different ways; either the employer is very concerned with the employees' welfare outside of the workplace or the employer does not think that study should be done within working hours.

The companies were then asked to list eight preferred distance education courses based on the list in Table 3. Table 6 shows the frequency of the responses. Note that this is different from the results in Table 3 which was relevant to courses required for a full time undergraduate degree. The following results are for retraining *existing* employees. Overall there were 44 responses for courses in the wood grouping, 46 in the commerce grouping. There was least interest (28 responses) in the engineering category.

Table 5: *Distance education courses that would be of most interest to employees within companies from the list in Table 3.*

Category Grouping	**Most appropriate subject**	**No. of companies wanting subject**
Commerce	Management, People & Organisations	10
Commerce	Leadership	10
Wood	Wood Structure & Quality Issues	9
Wood	Wood Physics and Drying	9
Engineering	Control Systems	8
Engineering	Project & Operations Management	7
Engineering	Manufacturing Technologies	7
Commerce	Managing Organisational Change	7
Wood	Value-Added Wood Products Processing	5
Wood	Wood Preservation	5
Commerce	Organisational Behaviour	5
Commerce	HR Management & Strategies	5
Engineering	Electronics Circuits & Devices	4
Commerce	Entrepreneurship & Innovation	4
Wood	Engineered Wood Products	3
Wood	Forestry & Forestry Practices	3
Wood	Primary Wood Products Processing	3
Wood	Forest Products Marketing	3
Wood	Wood-Based Panel Products	2
Wood	Wood Finishing	2
Engineering	Composite Materials	2
Commerce	Business Ethics	2
Wood	Wood and Resin Chemistry	1
Wood	Timber Engineering	1
Commerce	International HR Management	1
Engineering	Engineering Materials	0
Engineering	CAD/CAM	0
Engineering	Mechanics of Materials	0
Engineering	Robotics	0

Finally companies were asked if suitable courses were available at a reasonable cost, approximately how many of the company's employees would enroll in at least one on-line distance education course per year. 16 companies said that they would enroll four of their employees now, rising to nine in five years time.

4.4 General observations by survey participants

The following observations relate to feedback given to the author during the structured interviews. Note that even though this report concentrates on the processing of timber a number of comments arose about the availability and quality of current graduates, particularly foresters. A medium-sized softwood mill was concerned that it is difficult to hire commercially astute foresters, and that any course developed for timber processing should contain some forestry units. It also saw the professional development area as being highly desirable. The company wanted to see certificate and graduate diplomas available for existing employees it was not satisfied with what is currently offered. It feels that it would be beneficial if suitable people from within their operations could participate in a structured program of professional development leading to a formal qualification while remaining on the job. Release for on-campus courses for periods of two to three weeks at a time would be feasible, any longer than that would tend to break continuity of tasks and people would lose touch with their work. Releasing people for long periods would not work for this company.

Another medium-sized softwood sawmilling company stated that a university degree is a good idea, however diploma or other targeted training (for existing employees) could also be a very effective way of meeting their needs.

A small hardwood sawmiller predicted an overall labour shortage due to the booming mining industry. It sees a potential solution to this through automation especially in wood machining and downstream materials handling. Consequently it is focussed on adopting world's best practice. It also had concerns about forestry graduates. It sees the need for more people doing forestry, but in their opinion current graduates are not effective as forest managers and accordingly their training needs to be more focussed on production forestry. Such courses should be be separated from environmental science courses to give the program the required focus. Unless there are changes to the current forestry degree programs it sees the need to develop a "production forestry school". It also sees a very serious lack of good quality people coming into the industry at an entry level. Furthermore, it is very concerned about where their future managers will come from and would prefer to have "process" type people. This organisation has undergone a significant shift in resource quality in recent years.

A medium-sized hardwood sawmiller specifically wanted wood scientists who are skilled at timber drying. A medium-sized panels manufacturer said it would like graduates to be able to perform at a group or shift manager level.

A small hardwood sawmill stated that in small mills HR is very important. It sees a future in keeping the resource and selling timber off saw to overseas markets for remanufacturing and re-importing. This would maintain current investment and employment levels. As the resource changes, however, companies may either have to retool and recapitalise or do more work offshore.

Another medium-sized hardwood sawmiller, sees resource security as being the biggest issue. It sees a long term future in hardwood if they can maintain access to the resource. It sees a future where they obtain access to forests on private land and where ownership of the timber would be shared. The company would employ it's own foresters. It is also interesting to note that this company wants to see highly knowledgeable sales people as the owner lamented the fact that with large hardware chains, there is a smaller pool of people with specialist timber selling expertise.

Another small hardwood sawmiller, recently experienced a substantial reduction in the quality of roundwood that it receives. As a result it has had to invest millions of dollars on very sophisticated new optimising and kiln drying equipment. This

has led to an urgent need for more highly skilled employees to run such equipment including graduates.

A large softwood and hardwood sawmilling company currently has a cadet system where four cadets at the graduate level are employed each year. This cadetship includes on-the-job training projects. This company indicated that they would take graduates from the proposed course. It sees skills shortages as being directly related to the very poor public perception of the timber industry. Interestingly within the company some existing managers perceive graduates to be a threat, but this perception is changing.

A small panels producer did not see a need for graduates in a family business. It is particularly concerned about taking someone on and then losing them to another employer thus transferring valuable operational and commercial knowledge to another company. It also believes that their company is not viable in the long term.

A medium-sized softwood sawmill stated that in the past employees and managers found people with academic knowledge threatening, but it has found that this perception can be reduced if graduates are linked with experienced mentors. However, it is concerned whether there would be enough suitable mentors available in their company. The company stated that mill and business owners need to know what talented academically trained people can offer. It would also like their operational/technical professional to be taught financial and accounting subjects but acknowledge that these could be included in a general commerce unit.

A medium-sized hardwood sawmill stated that the knowledge to operate newer sawmilling equipment (to cut lower quality logs) is higher than in the past. Thus it has 4-5 people being trained at any one time. It sees the need for graduates with environmental and generalised engineering along with commerce expertise.

A medium-sized regrowth hardwood sawmill finds that succession planning is a big issue and sees the need for a graduate intake accordingly.

A medium-sized softwood sawmilling company would fund an undergraduate provided that the student would agree to be bonded. It would take two forestry graduates and two graduates from the proposed course per year. It would also sponsor post-graduate students, one in forestry and one in wood science and technology funded on a similar basis as the undergraduate students. It would try to seek students from regional areas. It would also like to see a post-graduate MBA course in finance related to forestry or wood science and technology. It also stated that regionally based institutions are the preferred option as they have more empathy with industry and education in the country (regional areas).

A medium-sized softwood sawmilling company interviewed by phone accepted the need for people with greater skills. It already takes one graduate per year and would sponsor a student from the proposed course. It believed that there is now less of a need for manual skills and a greater need for processing skills.

5 Discussion

5.1 Introduction

The discussion is sub-divided as follows: 1, role of graduates in the sector; 2, industry support for a tertiary degree relevant to their needs; 3, alternative structures for the proposed degree. Methods of attracting students to the course are discussed as is the role of industry, government and finally universities in the establishment and on-going maintenance of the program. There was considerable interest and support for the proposed project by industry. Timber Queensland was very supportive and committed to supporting the project with its members. The CEO of the Victorian Association of Forest Industries (VAFI) comments that one of the aims that requires immediate action is that "Victoria's forest industries should aim to be the world's best managed, ecologically sustainable and recognised as such", and in the "Vision 2025" statement in the same document reference is made to "Enhanced Research, Science and Innovation", "New

Products and Markets", as well as "Employers of Choice with Enhanced Skills, Jobs and Training". The document also refers to increasing the number of employees in mills with recognised qualifications, and increased participation of employees in ...professional development programs. Therefore, one can anticipate that these industry associations will provide strong support for an undergraduate program in the wood products sector.

5.2 Role of specialist graduates in the wood processing sector

Most of the companies interviewed (as well as commentators in the field) lament the fact that there are not enough graduates in the Australian wood processing sector. One therefore needs to reflect on the role of graduates in the sector and whether they are crucial to the ongoing success of companies that manufacture wood products. There is no ambiguity about the need for foresters to procure timber and for engineers, both mechanical and electrical to oversee maintenance, repair and modification of existing equipment and the installation and commissioning of new equipment. However, are these professionals ideally suited to optimise the performance of such equipment both existing and new, and do they understand the properties of the raw material that has to be processed? In other words can foresters or engineers cover all the skills needed for the wood processing industry in Australia, even if they were available? The following discussion attempts to answer this question.

Bowyer (1991) stated "If insufficient graduates (wood science and technology) are being produced, then the people taking the jobs lack knowledge of the material - its properties, conversion technologies, and limitations. The cost to the wood products industry would be high". In Australia given that the quality and type of resource is changing to greater regrowth and plantation hardwood roundwood and younger plantation softwood roundwood, the need for people with a deep knowledge of the material (mainly found in graduates of wood science and technology) is fundamental to the economic conversion of wood to a product desired in the marketplace.

To further understand the role of graduates in wood science and technology, one needs to look at the following definitions by Ellis (1964).

Wood Science ...that body of knowledge applicable to wood as a material, including its origin, properties and characteristics.

Wood Technology ...follows as the application of such knowledge in the conversion and processing of wood for use.

Wood Technologist ...applies wood science and related scientific knowledge in making wood more useful to man and... requires not only an expert knowledge of wood science, but additionally a sound understanding of industrial manufacturing equipment and methods *and/or an understanding of the process by which products are conceived, designed, distributed, and sold (i.e. marketing)*[9].

On the basis of these definitions, foresters and engineers are not suitably qualified as wood technologists, and as such not able to meet the need for wood technologists in the Australia wood processing sector.

The importance of wood technologists to the wood processing sector in Europe and North America has long been well accepted [Bowyer (1991), Smulski *et al.* (1991), Lyon *et al.* (1992), Bratkovich and Miller (1993), Cohen and Maness (1995), Barrett and Cohen (1996), Ifju (1996), Brown and Niemiec (1997), Hansen and Smith (1997), Smith *et al.* (1998), Winistorfer (2003), Bumgardner *et al.* (2005)] which accounts for the significant number of degree courses offered (albeit most with low student numbers yet with high industry demand). However, this has never been the case in Australia, although as seen below (Table 6) some courses that are relevant to a wood science & technology degree are offered in universities that already educate undergraduate forestry students. Australia is the only major industrialised country with a significant wood processing industry that lacks a relevant tertiary degree program. Since one would expect that the value of a wood technologist in the wood processing industry in Australia would

[9] *italicised section modified from Bowyer (1991)*

be the same as anywhere else in the world, there is no doubt that this has and is disadvantaging Australian industry.

There is no doubt that in any manufacturing venture, wood products included, there will always be a need for highly experienced operators who have been promoted "through the ranks" to fill some managerial positions and partially satisfy companies' succession plans. However, one need only look to the definition of a wood technologist to understand the need for a higher level of education and training than is currently on offer in Australia, and for the education of individuals able to maximise the potential of what is a very heterogeneous raw material. In addition the high level numerical and statistical skills which are so important in areas of total quality management, statistical process control and complex problem solving are usually mainly taught at universities and would be essential for graduates of the proposed course (as the survey showed). One need only read the daily press on the issue of the lack of numeracy skills of school leavers to realise that these skills are unlikely to be taught at anywhere else but a university. In addition with ever increasing demands on resources, and the need for further value-adding and new product development to justify use of such resources [VAFI (2005)] the need for graduates highly trained in wood science and processing, is beyond doubt.

The role of specially trained industry-focussed graduates has long been accepted in industries such as food production, mining, aeronautical engineering and oil recovery to name just a few. Therefore it is difficult to understand why a degree relevant to the wood processing sector has not evolved in Australia. The wood processing industry has for decades been dominated by small-to-medium sized operations manned by unskilled and semi-skilled labour, and this may explain why there has been a lower demand for graduates than in other countries. However, industry rationalisation and significant changes to resource availability and quality [VAFI (2005)] have changed this situation and have led to a need for greater technical skills in the industry. The increasing size, sophistication and mechanisation of existing timber mills will further increase the need for engineers/wood technologists [Bull (2006)]. Not only do large and medium-sized wood processing companies realise the need for wood science and technology graduates but small operations, for whom the impact of resource availability and quality has probably been the greatest, also have the same opinion. In an era where financial performance is paramount (and justifiably so) wood processing companies seek future leaders (graduates), with leadership and technical skills foremost, followed by communication and analytical skills (Figure 1). Surprisingly, business and financial skills were those that were least sought. There was unanimity amongst companies (large and small) in the prioritisation of skills sought. There was also unanimity that obtaining people with such skill sets was extremely difficult.

Other skills and/or attributes that were seen as highly desirable included: project management skills, innovation ability and entrepreneurship. These along with the ability to work as part of a team as well as experience were the main attributes sought. Companies also saw the ability of future leaders to live in regional areas, and a positive attitude and good inter-personal skills as being highly desirable along with basic commonsense and a passion for the industry. Given the small pool of suitably qualified individuals currently within the industry, there is a lot of poaching of people from other organisations within the sector to fill vacancies[10]. This is increasing labour costs.

Most wood processing companies lack the ability to train people in wood science and technology in house and this limits their ability to optimise processes, as opposed to just operating a process i.e. as has been done in the past, (there being a large difference between the two). The former is about linking knowledge and a fundamental understanding of the process to increase productivity to world class levels, whereas the other is passively accepting the status quo. Achieving competitive advantage demands a very high level of technical

[10]The author's own experience and with information gained from interviews.

skills and these are much more likely to be found and developed further in graduates with a degree that focusses on the needs of industry and overall scientific and engineering excellence.

5.3 Industry Support for a Wood Science and Technology Degree

The companies surveyed stated that there was a very significant shortage of well-qualified technical and operational professionals. They also stated that their current graduate requirements were 33 and this would increase to well over 50 in five years time, if a degree in wood science and technology was developed[11]. Most were very supportive of the whole concept of such a degree and particularly the idea of industry placements being a part of the curriculum. Most companies said that they would employ students in such a placement program. Some also said that they would support students with a form of cadetship on the basis that they would be bonded for an agreed period of time after graduation. There was also general dissatisfaction with what universities currently offer, as is evidenced from the fact that all but three companies who responded to the survey expressed a desire to become involved in helping set the direction of the proposed education program.

Most companies agreed that the proposed wood products educational program should focus on technical and operational skills training. There was also agreement that in the future there will be a greater need for highly skilled wood products professionals, and that in order to succeed, today's wood products professionals require a broader range of skills than they did ten years ago. This was clearly the case in the hardwood sector, where mills have had to adapt to a lower quality resource as well as different market demands by significantly increasing the level of automation and optimisation in their mills.

Most companies surveyed rated technical skills higher than management skills in any degree program. This is probably because many medium and large companies have access to management training programs such as the Mt Eliza Business School, and in-house management courses, external frontline management courses. Furthermore people with MBA's are readily available. There was certainly not a belief that the appropriate training for management track employees is commerce or accounting, which again shows the importance of technical leadership, given that most companies employ specialist accountants.

There was great concern that there are not many relevant educational programs from which to choose new management employees with a high level of technical expertise. To overcome this problem, companies stated that universities should develop international partnerships for delivering educational programs in wood and fiber technology. Accordingly, in the last three years there has been interest shown by larger companies in sending Australian students to overseas institutes particularly the Center for Advanced Wood Processing in Vancouver, Canada. A number of Australian wood processing companies have employed students from European and North American institutes such as the University of Applied Sciences in Rosenheim, Germany, which has had a very high reputation in Australia (and was used as the model for CAWP at UBC [Cohen and Maness (1995)]).

There was general agreement by industry that current forestry graduates do not have the necessary skills to work in processing roles in the wood and timber industry. However, foresters are still highly sought after for forest management and timber procurement and demand at present appears to be outstripping supply according to Bull (2006) (also confirmed during interviews conducted as part of this project). Some of the recommendations below to attract students into a wood science and technology course are equally relevant to attracting students to a forestry degree. The ability to attract students or for that matter any skilled employees was a major concern of industry participants and has been examined by Bull (2006).

In conclusion, it is essential for any proposed degree to have the strong support of industry and

[11] Gunns's Tasmania figure of six graduates required per year is not included in this figure as it did not differentiate between foresters and wood technologists.

for this to occur it should focus on their needs. Therefore, the course content for any degree must be primarily technical. It was also seen as highly desirable by all industry participants for the degree to involve industry placements.

5.4 Proposed wood science and technology degree

Cohen and Maness (1995) stated that in North America there is a need in wood science and technology degrees for a new emphasis in two broad areas, which holds equally true for the Australian wood processing sector.

1) Transferable skills including, leadership, communication and problem solving etc. and

2) An area categorised as applied technical training which is given the same level of academic respect in European Universities of Applied Sciences as more academically oriented subjects. As a result educators of any new program may be needed to teach students technical skills and for this to occur it would be desirable if they had industry experience or a willingness to learn new skills. Cohen and Maness (1995) also stated the need for an industry placement program thus placing some of the responsibility for technical education on the industry and other organisations that require trained graduates.

It was accepted by almost all of the companies interviewed for this survey that a specific undergraduate degree course in wood science and technology was required in Australia, and need for points 1) and 2) above was very strongly endorsed.

The requirement for the proposed wood science and technology degree to be heavily weighted in favour of technical and operational subjects has been amply demonstrated in the previous section (see also Figure 2).

From the survey results it is clear that the course should include foundation courses on wood material science such as wood structure and quality, and wood physics followed by a series of subjects relevant to processing including primary wood products processing, value-added wood products processing, drying, forest products marketing and forestry and forestry practices[12]. The proposed degree should also include engineering subjects such as engineering materials, manufacturing technologies, electronic circuits and devices, mechanics of materials and engineering materials[13] and control systems. project and operations management was seen as highly desirable because wood processing companies see the need to adapt the way they do business by re-capitalisation, restructuring, and implementing other major changes, not necessarily by the traditional route of cost cutting. This was seen as necessary because of changes to resource, market demand as well as significant pressure from imports from countries that have large resource bases and lower labour costs. While not considered part of the survey, knowledge of environmental compliance was also seen as highly desirable.

The six most sought after subjects in the commerce grouping of subjects were; leadership, HR management and strategies; managing organisational change; management, people and organisations (which would include OH & S), organisational behaviour and business ethics. It is interesting to note that there was a significant difference at the 90% confidence level ($p = 0.094$) between company size and the need for the subject of business ethics. Only 25% of the larger companies wanted the subject whereas over 70% of medium companies and 81% of small companies wanted business ethics included in the proposed degree.

From the section on hiring of technical and operational leaders it was clear that analytical skills were highly sought after in addition to technical, engineering and business skills. The lack of a high level of numeracy in the sector was a consistent theme and most companies stated that there were very few people capable of carrying out sophisticated statistical and numerical analysis. It is also

[12] Except for large companies who did not want the subject forest and forest practices because they employ foresters to manage procurement and want graduates from this course involved wholly within the mill.

[13] None of the larger companies wanted electronic circuits and devices, engineering materials or CAD CAM subjects as they would be expected to have specialist engineers to fulfill these functions, however most of the smaller companies did.

interesting to note that not one company mentioned a lack of computer skills. The inference from this is that computer skills are now considered so generic that there is no need for any special course designed to teach them. In fact most companies have there own proprietary software to manage, production planning, stock control, finances and order to remittance etc., and this would be considered as part of on-the-job training for any new employee (let alone new graduates.)

All of the large companies wanted engineered wood products as a subject in the proposed degree program. Of the large companies, only sawmillers wanted the unit wood structure and quality issues, i.e. no panel manufacturer, which is not surprising given that most panel producers do not use roundwood.

The survey results show that smaller companies see graduates from this program as multidisciplinary engineers with some traditional disciplines of engineering as opposed to the larger companies who see them strictly as process engineers with a detailed knowledge of wood science, separate from the traditional disciplines of engineering. The number of smaller companies involved in value-added processing that were surveyed was only three, and this may explain the low priority given to subjects specifically relevant to their needs such as CAD-CAM and wood finishing.

The proposed degree should therefore be a broadly focussed engineering degree including science courses to cover the requirements for wood materials sciences, statistical analysis, applied mathematics, and physics. There needs to be a heavy emphasis on engineering courses where new courses specific to wood processing would be taught. These requirements would enable students to complete an engineering degree. A unit on environmental law taught in an engineering context would be needed to give students an understanding of environmental compliance, which is now fundamental to the way businesses operate. A business financial management course as well as courses on human and organisational management and other highly rated courses listed in Table 3 should also be included.

The concept of industry placements had universal strong support with virtually all participants stating that they would participate in such programs even though a few did not see themselves as being large enough to require graduates[14]. The value of adopting the industry placement education model is threefold:

1) It would introduce students to working in a process environment (most of whom would never have had any such experience) i.e. how to work safely, use PPE[15], how to interact with large mobile equipment etc. It would also give them an advantage following completion in that they would require less initial training than their competitors.

2) It would introduce students to working with individuals who by circumstance had not attained their level of education. It does not matter how bright the students are, if they can't effectively communicate with existing employees, and can't influence them, they would be unsuited to management. As the students would be employed at a base level during industry placements, it would break down barriers between employees and students that might be more difficult with a new graduate in a more senior role. It would also give the students a unique perspective on the business that they most certainly would not get as a graduate in a more senior role, i.e. hands on experience.

3) Most wood processing industries are regionally based, and one of the biggest concerns with companies is attracting young people to such areas from the larger metropolitan areas. Industry placements would be a way of allowing students to experience life in a regional area. From a personal perspective as a forester and when employed in the wood processing sector I can attest to the attractions of living in rural Australia. Numerous other foresters, many of whom had no previous experience of living in rural regions, have also expressed the same opinion. Overseas, in Canada, the industry placement program run by CAWP as part of the wood products processing degree at UBC is seen as an essential part of preparing students to

[14]This could change after exposure to high quality students.

[15]Personal protective equipment

work in rural regions.

The industry placements could occur in the long vacations after the second, third and fourth year of course work. In addition it is possible that a full semester could also be used probably in the fourth year giving students over 12 months of practical industry experience. The placements would involve students being employed on a casual basis thus carrying out day to day operations. However, at each placement they would be required to conduct a project that would be agreed to by both the industry partner and the university supervisor/lecturer that would have to be written up, presented to both the company and the university and formally assessed as a compulsory part of the degree. It is also possible that a final honours year could involve a longer industry placement allowing students to complete a project with a very substantial research component[16].

Table 6 shows courses on offer at ANU, University of Melbourne and Southern Cross University that could form part of a wood science and technology degree. The University of Melbourne is the only one of the three that requires compulsory work experience as well as an industry project.

[16]The author has had successful experiences of this from both Rosenheim and ANU Dept. Forestry.

Table 6: *Current courses on offer at ANU, University of Melbourne and Southern Cross University relevant to an industry focussed degree that met with the approval of industry. All are courses within various Bachelor degrees with the exception of Wood Products Management at Melbourne which is offered as an associate degree or advanced diploma. Note the list of courses is not a complete list for any of the degrees from the universities referred to.*

University	**Relevant courses for a Proposed Wood Science & Technology degree**	**Available in Current Program**
ANU	Forest products	Forestry
ANU	Math & applications 1	Science
ANU	Math & applications 2	Science
ANU	Discovering engineering	Engineering
ANU	Electromechanical technologies	Engineering
ANU	Advanced physics 1	Science
ANU	Introduction to materials	Engineering
ANU	Australia's forests	Forestry
ANU	Business reporting & analysis	Commerce
ANU	Mechanics of materials	Engineering
ANU	Systems dynamics	Engineering
ANU	System design	Engineering
ANU	Mgmt. of people & org.	Commerce
ANU	Human res. mgmt.& strategy	Commerce
ANU	Into. prog & algorithms	Engineering
ANU	Manufacturing technologies	Engineering
ANU	Manufacturing systems	Engineering
ANU	Entrepreneurship & innovation	Commerce
ANU	Engineering management	Engineering
ANU	Engineering materials	Engineering
ANU	Software construction	Engineering
ANU	Engineering law	Engineering
ANU	Law and the environment	Law
Southern Cross	Product development & Marketing	Science
Southern Cross	Wood science & utilisation	Science
Southern Cross	Quantitative analysis	Science
Southern Cross	Using financial information	Science
Southern Cross	Fundamentals of management	Science
Melbourne	Wood & Timber products	Forestry
Melbourne	Experimental design & analysis	Forestry
Melbourne	Wood processing & products	Wood products management
Melbourne	Managing staff	Wood products management
Melbourne	Occupational health & safety	Wood products management
Melbourne	Project management	Wood products management
Melbourne	Wood science	Wood products management
Melbourne	Information technology & communication	Wood products management
Melbourne	Leadership & working in teams	Wood products management
Melbourne	Financial management 1	Wood products management
Melbourne	Timber resources	Wood products management
Melbourne	Improving asset reliability	Wood products management
Melbourne	Evaluating process effectiveness	Wood products management
Melbourne	Wood products marketing	Wood products management
Melbourne	Wood biodeteriorating agents	Wood products management
Melbourne	Work skills 1	Wood products management
Melbourne	Mathematics A	Engineering
Melbourne	Applied mathematics	Engineering
Melbourne	Physics A	Engineering
Melbourne	Control systems 1	Engineering
Melbourne	Quality engineering	Engineering
Melbourne	Production engineering	Engineering
Melbourne	Human resource management	Engineering
Melbourne	Statistics for mechanical engineers	Engineering

Examination of Table 6 shows that there are some important subject areas (seen as strongly desirable by industry) that are not covered in the current degrees on offer. These are listed below:

- Wood physics and drying
- Timber engineering
- Engineered wood products
- Primary wood products processing (sawmilling)
- Value-added wood products processing
- Wood preservation
- Wood structure and quality issues
- Wood finishing
- Wood based panel products
- Manufacturing technologies
- Composite materials
- Managing organisational change
- Entrepreneurship and innovation

The proposed wood science and technology degree would have to combine the subjects already on offer with some of those in the above list. Given the degrees currently on offer, there are four possible options for the delivery of a wood science & technology degree:

1. Option 1; a four year science degree involving wood science and technology, engineering and commerce units.
2. Option 2; a four year engineering degree involving science (including wood science and technology units) as well as engineering and commerce units.
3. Option 3; a four year double degree (science/engineering) involving wood science and technology as well as commerce units.
4. Option 4; a postgraduate possibly Masters course of two years duration for any graduates with a general science, forestry or engineering degree. ANU and the University of Melbourne is proposing to develop a National Professional Forestry Coursework Masters Program in conjunction with the University of Tasmania and Southern Cross University. It will be a two year program, one year Graduate Diploma followed by a one year Master's by coursework and research or internship (could be industry placement).

Each of these options has advantages and disadvantages, the option of a four year degree allows students industry placements at the end of years one, two and three and thus it is believed that a four year degree would be the most desirable as this would enable sufficient time to be devoted to practical work in an industrial environment. Industry placements will be an essential part of the program and such placements also ensure industry buy in to the concept. The advantage with a master's program is that it enables graduates to undertake the course after completing a general undergraduate degree such as will be the case in Melbourne. However a one year master's program would not be desirable as it would not enable sufficient time for industry placements. However if the master's program were to be of two years duration where one of the years could involve significant industry placement, the resultant duration of the program would be five years (assuming that a general undergraduate degree would be of three years duration) which would not engender much industry support especially if they were to sponsor students with cadetships/scholarships etc., or if they were allowing their existing employees the option of studying full time. Given that the requirements of industry are for process engineers the option of a general science or forestry degree with wood processing majors would not be as beneficial as a degree based on an engineering program that would satisfy the requirements of Engineers Australia formerly the Institution of Engineers of Australia.

As there was a desire for a heavy emphasis on

engineering type subjects in what is primarily going to be a process and manufacturing degree it is believed that the best option is Option 2, a four year engineering degree involving wood science and technology, science and commerce units. However it must be emphasised that the degree must involve science and other subjects as detailed above. Bull (2006) specifically identifies the shortage of process engineers as part of the skill shortage in the wood processing sector and thus this degree would satisfy this demand. Option 4 (Master degree) is not considered to be a viable option given the strong demand for engineering graduates.

In Canada it has been shown that student recruitment for a degree in wood products processing is greatly assisted if the parent university is very attractive to students. This situation exists at the University of Melbourne or ANU (the two most highly rated universities in Australia). Both have forestry departments, as well as engineering, law, commerce and economics departments and Melbourne has a campus at Creswick where it would be possible to establish industrial-scale facilities such as the one at CAWP, where students could use the latest in wood processing equipment. Likewise, ANU has a furniture design and manufacturing facility where students can obtain valuable experience in hands-on value added wood processing. In addition both universities are well funded, have strong research infrastructures and attract high quality students. It may even be possible to share the program between the two. Southern Cross University does not have an engineering faculty or research infrastructure of ANU or Melbourne.

It was thought highly desirable by all but three of the companies interviewed that they take an active role in setting the direction for the education program. A number of companies were displeased by the direction of research being carried out on behalf of the timber industry and wanted to see a more practical and hands on approach to the selection of research topics. Hence the interest in setting direction for the proposed course (to make sure it meets their needs). It can also be anticipated that once established that the program could offer post-graduate degrees, and a number of companies stated that they would support post graduate students (as well as undergraduate students) following graduation, if the students agreed to work for the company for a minimum period after graduation.

It would be desirable to set up a continuing education program following the establishment of the proposed degree, as there appeared to be a strong desire by industry to further educate it's managers and technical/operations personnel. Before such a program is established the needs of industry should be examined further and the entry qualifications for any programs should be determined. In addition the delivery mechanisms must also be looked at and all of this activity could detract from the effort needed to set up the degree program.

5.5 Attracting students

This report primarily focusses on the need and demand for graduates by Australia's wood processing sector. However, obviously there will be no graduates if students are unwilling to enroll in a wood technology program. As mentioned above, it is difficult getting students to study forestry. It is essential therefore that to meet industry's needs that the proposed course attract sufficient numbers of the best and brightest students. As Winistorfer (2005) asks, why do the best young student minds (in North America) go to the sciences, engineering, or medical professions rather than wood technology. A lot of academics have discussed the causes of the decline in the number of students attracted to wood science and technology programs in North America. The same people lament the fact that there is a serious deficit in the number of wood science and technology professionals in industry, research organisations and government. One of the main reasons for this is thought to be the perception that the industry from the forest through to the mill door and warehouse is environmentally irresponsible, dirty, dangerous, poorly paid and unsophisticated. The industry is also primarily located in regional areas where traditionally it has been difficult to attract professionals. These perceptions will be difficult to change in the short term, therefore significant

effort would be needed to attract students to the proposed program. Experience at UBC has shown that it is possible to attract students to a wood products program by having a dedicated recruiting program that consists of the following elements (in order of importance):

1. Dedicated dynamic recruiter able to change students perceptions of the industry by making in-class presentations.
2. Scholarships to attract students to the program and to reduce financial pressures on them during their degree.
3. Paid industry placements for students and the active involvement of industry in the program.
4. Dedicated academic and staff who focus on student needs, and employ innovative approaches to teaching to make the course as interesting and exciting as possible (thereby reducing rates of attrition during the program and attracting students from other disciplines to the program).

If all these elements are combined and the program has the full backing of industry, government and a host university there is no reason why an Australian wood technology program should not be successful.

Bowyer (1991) stated to increase student recruitment into wood science & technology degrees several actions might be taken as follows:

- Development of joint industry/university recruitment programs.
- Use of alumni in recruiting efforts.
- Development of 5th-year wood science and technology programs for the purpose of providing second major opportunities for students training in other fields.
- Establishment of more and better funded scholarships.
- Hiring of specific people who have responsibility of recruiting (This is currently done at UBC).
- Offering wood material related courses to students in other degree courses. Bowyer states that this will help to spread information about responsible harvesting of forests, proper use of wood and will likely serve to attract greater numbers of students to the wood science and technology programs.

Ifju (1996) found that a number of institutions offered wood science & technology degrees actually hired students from wood science and technology courses to recruit other students especially those who had not declared their major. The results were that such institutions doubled their student intake. It would certainly be necessary at the outset for any university wanting to develop the proposed program to appoint a student recruiter and industry placement coordinator similar to the one at UBC to attract students to the program as well as co-ordinate it's industry placement program.

5.6 Role of industry, universities and government

5.6.1 Industry

If industry want this program to succeed (and there is strong evidence to support this) then they will be required to commit substantial funds or make in-kind contributions to assist in providing infrastructure for the program. This project cannot be funded solely by a university. The Canadian wood processing sector provided C$8.5 million through an industry levy to set up CAWP at UBC.

Industry will also have to fully support the concept of paid industry placements of students during the degree course, however results from the survey indicate that this should not pose any difficulties for most companies. Obviously they will also have to hire the graduates from such a program at competitive salary rates, but again given current graduate intakes this is not seen as an insurmountable problem. In a competitive labour market, if wood

processing companies are not willing to pay realistic salaries to graduates then quite simply they will not obtain them. In addition it is very important for industry to assist with student education by hosting student excursions to various plants.

It would also be the role of industry and industry associations to strongly advertise such a course especially at high schools in regional areas to attract students and especially to educate teachers about the value of a professional career in the industry. Industry and industry associations should also be willing to offer scholarships to potential students especially in regional areas where the timber industry is mainly located. These local industries could participate in school-industry partnerships [Australian Timberman (2005)]. This would not only help potential students in regional areas complete high school but could also assist them in making the transition to university.

A combination of all of the above would help to attract sufficient numbers of students to make the course viable at a university thereby satisfying industry needs. In the longer term it is critical that industry associations improve the profile of wood-based industries as has been recommended in Bull (2006).

A cadetship type program where students are funded by industry on the condition that they are bonded for a period of time after graduation would be an effective way to obtain students. As mentioned above, one softwood sawmilling company has indicated it would be willing to fund students (undergraduate and postgraduate) on this basis. Finally, it is absolutely essential that industry identifies a "spokesperson" or champion willing to convince government of the importance of the proposed initiative and it's urgent need for suitably educated people.

5.6.2 University

It would be expected that if this project gets further support, then universities wishing to develop the proposed wood science and technology degree should submit expressions of interest. A selection process would need to be established that would include industry representatives, government entities and independent experts with experience in running wood-related academic programs. Once selected the successful university would help develop the course by hiring or re-assigning sufficient academic and support staff to establish the program. The university would also have to provide space to establish a workshop and teaching/research facilities. It would also be expected that the university would facilitate the integration of the desired courses into a coherent degree program preferably in an engineering department. It would be essential for the university to demonstrate that it can provide the funds for the ongoing maintenance and replacement of equipment as well as for recruiting students.

5.6.3 Government

The role of government could be to provide funds (along with industry and the selected university) to establish and run the program. The Australian Government has stated that it will provide 1,000 Commonwealth-supported engineering places at universities from 1 January 2008. This is as a result of the demand of engineering skills is expected to exceed the supply of engineering graduates in the coming years. Universities will be able to utilise the places in particular areas of engineering which are most in demand. It has been demonstrated in this report that there is a significant demand for engineering graduates in the wood processing sector.

In Canada the Federal Government provided six million dollars of funding and the Provincial Government allocated seven and half million dollars. These funds were allocated to an endowment that funds the academic program in perpetuity. The proposed program meets a demonstrated need in Australia and provides support for rural communities and should receive the support of government. It is believed that industries that support this project could be eligible for tax benefits under the current research and development tax concessions.

5.7 Costing

It is anticipated that if the proposed course was set up in an established engineering faculty as proposed above, additional staffing levels could be kept to a minimum. A full professor would be required as a director, at a salary of $165,000 gross, a senior lecturer specialising in wood processing would also be required, costing $125,000. A technical officer handling the workshop equipment costing $90,000 would be desirable along with an clerical/administrative person, costing $85.000. Thus the annual cost would be in the order of less than $0.5m. It is impossible to give an estimate of building/workshop costs as this would be primarily a function of where the centre was located and what infrastructure already exists. The Center for Advanced Wood Processing in Vancouver was set up as a greenfield operation that cost $22m. This funding was made up of $6m from the Federal Government, $7.5m from the Provincial Government and $8m from industry. This included what can only be described as a magnificent building that would have taken the majority of the funds. Obviously such a building is not proposed here. Thus the establishment cost would be considerably less. It must be stressed however that more detailed costing models need to be carried out however such was not within the scope of this report.

6 Conclusion and Recommendations

The ability of the wood processing sector to source high quality professionals to take on technical and operational leadership roles, will be critical to it's future success. This is of national significance because the industry is one of Australia's largest manufacturing sectors, and unlike the other sectors has never had high level educational programs tailored to meet what would otherwise not be available in Australia. Without it companies will either have to employ graduates unsuited to the task or try to import people from overseas who lack experience in many important areas (eucalypt processing).

The proposed engineering degree should be based on the recommendations below. The program could be situated at either The Australian National University or University of Melbourne and integrated into existing programs and not associated with any existing training organisation or other university. All of the data above that demonstrate a strong need for a wood technology program are based on sampled companies current status and take no account of any new industry expansion or developments. Bull (2006) identifies many new areas of investment and expansion in the sector which will obviously increase the demand for graduates from the proposed degree. The data are also based on the companies sampled and no inference is drawn on the total population of the wood processing sector in Australia. It also does not include forestry graduate requirements or any requirements for the pulp and paper industry. A deliberately conservative approach has been taken, however, it is believed that the graduate numbers required now by the sampled companies would make it worthwhile for a university to establish the proposed program.

The following are recommendations from this report:

1. An degree course should be established specifically tailored to the wood processing industry in Australia and modeled on the highly successful Canadian program developed by the Center for Advanced Wood Processing at University of British Columbia, Vancouver, BC.

2. Ideally, the degree should be based on a four year engineering program with a significant proportion of wood science and technology courses as well as relevant science and management units.

3. The proposed program should primarily cater for the sawmilling, panels and remanufacturing sectors, and exclude pulp and paper whose needs are already met by the Australian Pulp and Paper Institute (APPI) at Monash University.

4. The program should include mandatory, paid industry placements during the long vacations at the end of the first, second and third years.

5. The Australian National University and University of Melbourne have some of the infrastructure to develop the program and should be approached to submit expressions of interest in establishing the degree program.

6. The relevant Australian Government agencies should liaise and coordinate the selection of the host institution/s.

7. The Australian Plantation Products and Paper Industry Council (A3P) and the National Association of Forest Industries (NAFI) in conjunction with the various state associations should coordinate industry efforts to assist with the development of the curriculum for the program.

8. Development and delivery of the program should be the joint responsibility of Industry, the host institute and Government.

9. A3P and NAFI should coordinate industry efforts to help obtain funds to establish the program, including scholarships for students from rural regions of Australia.

10. The selected university should provide resources to establish mechanisms to liaise with industry and industry associations; attract students and staff and maintain the program in the long term.

11. Continuing education programs to meet industry's need for retraining should be developed after the successful establishment of the undergraduate program.

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A Appendix

Industry Needs Assessment Survey

INDUSTRY NEEDS ASSESSMENT SURVEY

University Based Education for the Australian Wood Products Processing Industry
Forest and Wood Products Research and Development Corporation
Fax Back by December 30, 2005 to: 02-61250732
or Mail to Dr Ray Roberts, 23 Greville St Prahran Vic 3181

COMPANY INFORMATION:

We would like to ask some questions pertaining to your company. In answering the following questions, please consider your entire company involved in wood processing (not one division or plant).

1. Which sector(s) best describes your company?
(check (✓) all that apply)

- ❑ Pulp and Paper
- ❑ Wood Composites/Plywood
- ❑ Sawmilling
- ❑ Remanufacturing; Furniture Cabinets etc
- ❑ Supplier *(please specify)* _____
- ❑ Consultant *(please specify)* _____

2. Please list the three (3) most common products that your company produces:
   1. _____
   2. _____
   3. _____

3. Who is responsible for hiring graduate entry level employees?
_____

4. How many full-time employees work in your company? _____

5. How many are in operational and technical positions? _____

HIRING INFORMATION:

6. Please indicate your potential hiring plans (number of new employees) for the year 2005 and in five years.

TECHNICAL SPECIALISTS
(eg. Technical officer, quality control supervisor)
Year 2005 ⟶ # employees _____
In 5 years ⟶ # employees _____

PRODUCTION/OPERATIONS PERSONNEL
(eg. Production manager, process engineer, supervisor etc.)
Year 2005 ⟶ # employees _____
In 5 years ⟶ # employees _____

7. Please give an indication of the types of operational and technical employees that your company is currently seeking.
_____
_____
_____

8. In hiring future leaders, several different skills are sought. Divide 100 points among the following six (6) skill sets according to the importance that you place on each when hiring new employees. *(total should add up to 100 points)*

Leadership Skills	_____	Financial Skills	_____
Technical Skills	_____	Analytical Skills	_____
Business Skills	_____	C'munication Skills	_____

9. Are there any other skills not mentioned in Question 8 that you consider when hiring new employees?
_____
_____
_____
_____

EDUCATION:

The Forest and Wood Products R & D Corporation is currently investigating the demand for an undergraduate education program, (two potential programs are attached) designed to produce highly trained people capable of filling technical, production and leadership positions within the Australian Wood Products Processing Industry. In addition, we are seeking to establish the demand for industry re-training which could be offered via courses developed in parallel with the establishment of an undergraduate program in wood products processing.

10. Do you support the concept of an undergraduate program in wood products processing?

❑ YES ❑ NO

11. Would your company hire graduates from the program?

❑ YES If YES, how many per year on average?
_____ graduates

❑ NO If NO, why not?
_____
_____

12. The proposed degree program would attempt to incorporate technical, professional and business skills training in its curriculum. In your opinion, what is the optimal mix of these three training areas? *(total should add up to 100%)*

Technical/operational Skills Training	_____ %
Leadership Skills Training	_____ %
Business Skills Training	_____ %

13. Would your company be willing to employ a student for a 3 month internship as part of their educational requirements?

❑ YES ❑ NO

14. Would your company be willing to become involved in helping to set the direction of the education program?

❑ YES ❑ NO

15. Please state your level of agreement with each of the following statements as they pertain to educational issues in the wood products industry. *(For each statement, please circle one number indicating your level of agreement, according to the following key.)*

KEY
Strongly agree = 1 agree = 2 neither agree nor disagree = 3
Disagree = 4 strongly disagree = 5

There is a shortage of well-qualified professionals in the wood products industry.	1 2 3 4 5 6
Wood products educational programs should focus on technical topics.	1 2 3 4 5 6
Wood products educational programs should focus on management skills.	1 2 3 4 5 6
Universities should strive to develop international partnerships for delivering educational programs in wood and fibre technology.	1 2 3 4 5 6
Retraining existing employees is a priority in the wood products industry.	1 2 3 4 5 6
The appropriate training for a management track employee is in commerce or accounting.	1 2 3 4 5 6
In the future, there will be a greater need for highly skilled wood products professionals.	1 2 3 4 5 6
In order to succeed, today's wood products professionals require a broader range of skills than they did ten years ago.	1 2 3 4 5 6
There is an abundance of relevant educational programs from which to choose new management employees.	1 2 3 4 5 6
Wood products educational programs should include internships and industry placements.	1 2 3 4 5 6
Managers in the wood products industry require a university degree in advanced wood processing.	1 2 3 4 5 6

EDUCATING NEW INDUSTRY ENTRANTS:

16. In terms of your company's needs, which of the following subjects would be most appropriate in an undergraduate program? *(check six (6) within each subject area)*

WOOD

- ❑ Engineered Wood Products
- ❑ Forestry and Forestry Practices
- ❑ Primary Wood Products Processing
- ❑ Value-Added Wood Products Processing
- ❑ Forest Products Marketing
- ❑ Wood-Based Panel Products
- ❑ Wood Finishing
- ❑ Wood Structure & Quality Issues
- ❑ Wood and Resin Chemistry
- ❑ Wood Physics and Drying
- ❑ Wood Preservation
- ❑ Timber Engineering

ENGINEERING

- ❑ Electronic Circuits & Devices
- ❑ Manufacturing Technologies
- ❑ Control Systems
- ❑ Engineering Materials
- ❑ CAD/CAM
- ❑ Mechanics of Materials
- ❑ Project & Operations Management
- ❑ Composite Materials
- ❑ Robotics

COMMERCE

- ❑ Organizational Behaviour
- ❑ HR Management & Strategies
- ❑ Business Ethics
- ❑ International HR Management
- ❑ Management People & Organizations
- ❑ Managing Organizational Change
- ❑ Leadership
- ❑ Entrepreneurship & Innovation

17. Are there any other subjects not in the above list that would be of interest to your company?

_____

_____

_____

18. List some of the most common management track jobs that your company might offer a new industry entrant with an undergraduate university education.

_____

_____

_____

INDUSTRY RETRAINING & PROFESSIONAL DEVELOPMENT:

19. Please indicate your company's level of interest in the retraining and professional development of its employees. *(circle the appropriate response)*

Very interested 1 2 3 4 5 6 7 8 9 10 not at all interested

20. On average, how many of your company's management and technology employees go through formal retraining or professional development per year?

_____ # employees / year

21. Is the above number expected to increase, decrease or stay the same in the next five years?

❑ increase ❑ decrease ❑ stay the same

22. Please list the three (3) most common areas of retraining and professional development that management and technology employees in your company are engaged in.

1. _____
2. _____
3. _____

23. Please rank the three (3) most preferred methods of delivery for retraining and professional development of your management and technology employees? *(rank from 1 to 3, with 1 being the most preferred method of delivery)*

_____ **compressed on-campus courses** (3 weeks on campus)
_____ **compressed off-campus courses** (2 to 5 days at company)
_____ **regular on-campus courses** (13 weeks on campus)
_____ **distance education** (internet, video, independent study, etc.)
_____ **other** *(please specify)* _____

24. Does your company have formal training programs in place for trades / production employees?

❑ NO
❑ YES If YES, please describe briefly ...

_____

_____

_____

25. Do you support the idea of offering courses on-line via the Internet? ❑ YES ❑ NO

26. Would your company be willing to consider education and retraining for their employees via on-line distance education?

❑ YES **If YES, please answer question 27 & 28**
❑ NO if NO, why not?

_____

_____

27. Please list 8 distance education courses that would be of most interest to employees at your company from the list of courses on question 16. *[list in order of most appealing courses]*

_____
_____
_____
_____
_____
_____
_____
_____

28. If suitable courses were offered at a reasonable cost, approximately how many of your company's employees would enroll in at least one on-line distance education course per year?

Currently: _____ # employees / year

In 5 years: _____ # employees / year

THANK YOU FOR TAKING THE TIME TO FILL OUT THIS SURVEY!

****

If you are interested in participating further in our study of the demand for an Education Program in Wood Products Processing or you would like to receive a copy of the survey results, please leave your contact information below.

Name (s): _____

Organization: _____

Address: _____

Phone: _____

Fax: _____

Email Address: _____

❑Yes, please send me a copy of the survey results.

Do you have any additional comments pertaining to education, retraining and professional development in the wood products industry?

_____
_____
_____
_____
_____