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# The Potential of Electronic Commerce for the Tasmanian Timber Veneer Industry

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## Abstract

*This paper reports on research conducted to determine how electronic commerce could benefit the timber veneer industry in an Australian state, and limitations that may impact on its adoption. An interpretivist perspective was used, using multiple data sources. The findings suggested that the veneer production process was inefficient and could benefit from implementation of electronic commerce technologies. Administrative systems, which support business operations in the industry, were found to have potential to improve through use of the new technologies. Although some larger timber processing organizations will be able to implement new internal systems using electronic commerce, integration with supply chain members may not be feasible. As electronic commerce is a new concept for the industry, it will require careful implementation that will need to consider the role of education, motivation and resistance to change.*

**Keywords:** *electronic commerce, timber veneer industry, production processes, supply chain, employee education*

## 1. Introduction

The timber industry is one of the most traditional in Tasmania, the island state of Australia. The annual production of the timber industry in 1999 was valued at over A\$200 million (Timber Research Unit, 1999a).

From the late 1980s the Tasmanian economy stagnated and its population declined. These factors, combined with international timber trends and competition for Tasmanian timber markets, resulted in a downturn in demand for Tasmanian timber (DSD, 1999). A need to develop new markets has been identified (Ridley and Ridley, 1999).

One market that is associated with timber consumption, but may be differentiated from it, is the demand for timber veneer products. A veneer is a thinly sliced timber sheet, usually of an attractive speciality timber, which is used for finishing applications (McWatt, 1999).

Only quality timber is used for veneer products, as each log must satisfy exacting specifications (DSD, 1999). For example, the number of knots in a log, its degree of straightness and its central pith must meet precise requirements. Consequently, veneer quality is dependent on log quality. Therefore, a study of the veneer industry must also refer to the timber industry.

Each log may have properties that make it unsuitable for use in the veneer industry, yet these may not be revealed until the log is sawn. This is particularly so for hardwood. Segregating

timber, especially by species, is problematic throughout the entire (Tasmanian) hardwood timber industry. An information deficit originates at the forest floor and impacts on each point in the supply chain, regardless of whether the timber product is resold to a secondary processor or goes directly to the final user (Nolan, G. 1998, pers. comm., 9th October). Consequently, lack of information on log quality directly affects the veneer industry.

This study sought to determine how electronic commerce (EC) could benefit the Tasmanian veneer industry's business processes and overcome the information deficit identified. Such an outcome would have possible positive ramifications for both the Tasmanian timber veneer industry and state economy. It also aimed to identify major issues likely to affect both the veneer and broader timber industry's ability to adopt EC.

Although a body of literature has documented the uptake of EC in a range of industries, there is less available on its application to the timber industry, and nothing on its potential in the Tasmanian veneer industry.

## **2. Background**

An oversupply of timber has occurred in North America and Europe (Ridley and Ridley, 1999) while the trend in many other European nations has been towards self-sufficiency (Barclay, 1998). As a consequence, international timber prices have weakened.

Due to the declining market for timber in Tasmania, 70 percent of hardwood is sold on the Australian mainland (Ridley and Ridley, 1999). Although Tasmania traditionally supplied Australian markets with value added timber products, recently there has been greater competition in this market segment from interstate timber producers (DSD, 1999).

Tasmanian veneers are mainly produced from native hardwood eucalyptus species, with some use of radiata pine and speciality species (DSD, 1999). Although hardwood eucalyptus is generally termed "Tasmanian Oak", the name is used to indicate three closely related species. The speciality species include Myrtle, Sassafras, Celery Top Pine and Tasmanian Blackwood (Forestry Tasmania, 1998).

In Tasmania, there are well in excess of 100 timber producers that range from small family businesses to large, publicly listed companies. Many hardwood sawmillers are smaller family-based organizations, which have been in the industry for generations (Ridley and Ridley, 1999). The biggest Tasmania hardwood sawmiller has a one percent share of the Australian market, while the largest Australian producer has four percent share (BIS Shrapnel, 1998).

Transforming a log of timber into a sheet of veneer is a multi-step process. The logs are continually watered and the ends greased to prevent cracking, until in the sawmill, they are cut into quarters and then into rectangular shapes, or flitches. After being checked for defects, the flitches are cleaned before being softened. The flitches are sliced, then dried. Finally, the veneers are marked with the flitch of origin before being graded and bundled (Garner, 1998).

## ***2.1 EC Benefits and Barriers***

The following definition of EC (Kalakatoa and Whinston, 1996) was used for this investigation:

*...a modern methodology that addresses the needs of organizations, merchants and consumers to cut costs, while improving the quality of goods and services, and increasing the speed of service delivery.*

Significant benefits associated with the adoption of EC by industry have been suggested (Cameron and Clarke 1996; Lawrence and Keen 1997). These include exposure to new markets, improved intra- and inter-organizational communication, improved access to information sources and the removal of geographic boundaries. These benefits have the potential to help alleviate the problems experienced by the Tasmanian timber and veneer industry.

Most Tasmanian hardwood producers are small to medium sized industries (SMEs). Significant barriers to the adoption of EC by SMEs have been reported (Cameron and Clarke 1996; Crawford 1998), including:

- Technology phobia;
- Inability to plan strategically;
- Cost of participation;
- Limited knowledge, skill or interest;
- Lack of business reasons to adopt.

Ridley and Ridley (1999) suggested additional inhibitors to EC adoption will apply to the Tasmanian timber industry because of its unique characteristics. These are the rugged and remote location, and limited literacy skills of those involved in logging and primary processing. The characteristics are expected to cause implementation problems, including the non-availability of telecommunication infrastructure, and a need for “ruggedised hardware” and appropriate software selection and training.

## ***2.2 The International Timber Product Industry and EC***

Examples of EC use in the international timber industry have been presented below to illustrate its potential.

A Finnish website, Woodmarket, is linked to 20 sawmills in Scandinavia and the United Kingdom (UK). The site allows parties to query, tender and obtain price information (Woodmarket 1999). Beacon Forestry runs electronic auctions and tender sales for the timber industry in the UK (Bentley, 1999).

Recently, dedicated software and hardware became available to assist the timber industry to use EC. Using log tags, a log and tracking system allowed tracking of production, inventory and sales of logs and chips via hand held computers (McCormick, 1997). Traditionally, to maximise production from a log, timber imperfections needed to be marked manually before the cutting position was chosen (Ridley and Ridley, 1999). However, automated timber handling systems use machine vision systems to identify log defects (Mississippi State University, 1999a). Moreover, sawmills in Mississippi utilise “camera, laser, scanning,

imaging and process control software” to determine sawing decisions with a high degree of accuracy (Mississippi State University, 1999b).

### ***2.3 The Tasmanian Timber Product Industry and EC***

The level of technology in many Tasmanian milling operations is limited. To increase awareness of EC, the Australian federal government granted funds to form the Tasmanian Electronic Commerce Centre (TECC). Both the TECC and the Tasmanian Timber Promotion Board (TTPB) promoted understanding of the potential of EC for the industry. In 1996 Tasmanian timber producers created a common producer web site and increased electronic communications. Large national timber organizations with Tasmanian branches have implemented EC systems to a limited extent (Ridley and Ridley, 1999). However, there is restricted co-ordination between industry competitors (Nolan, G. 1998, pers. comm., 9th October).

A commercial web site, *Tasmanian Timber on the Web*, and a professional information site, *Timber Building in Australia*, are funded by the TTPB (Ridley and Ridley, 1999).

A recent Tasmanian timber study identified strategic options for EC adoption. In the same study, some information flows within the timber industry were mapped (Timber Research Unit, 1999b).

## **3. Methodology**

### ***3.1 Epistemology and Research Design***

An investigation of issues that affect the veneer industry demanded that personal feelings, broad organizational issues and industry-wide concerns be studied. These requirements were most adequately addressed from an interpretivist viewpoint.

Qualitative methods were employed alongside the interpretivist epistemology, as is usual practice. Some quantitative survey questions were included to supplement and complement the qualitative methods (Neuman, 2000). The study’s external validity was strengthened through use of multiple data sources (Neuman, 2000). Interviews, document analysis and a survey were used to gather and validate information.

Yin (1994) recommended the case study method when examining contemporary events, particularly when behaviour cannot be manipulated. A Tasmanian veneer producer (hereafter referred to as “Veneerworld”) was selected as a single case study. A single case study approach could be justified for this study for the following reasons (Yin, 1994):

- It provided an opportunity to study a previously unobserved area;
- It was a unique case.

When the current study began in mid 1998, it appeared to be the first to investigate the application of EC to either the Tasmanian timber or veneer industry. Due to the characteristics of the Tasmanian timber industry reported above, the industry was considered to be unique.

### ***3.2 Methods Used***

Yin (1994) stated that interviews provide the richest source of information for case studies. Tape-recorded, semi-structured interviews were used in this investigation. During the interviews, notes were made on non-verbal cues, environmental settings and related issues.

Interviewees were conducted with five of the six senior employees from Veneerworld. Because of the interconnectivity between the general timber and veneer industries, people outside Veneerworld were also interviewed. Two managers from a Tasmanian tree producing organization (hereafter referred to as “Timberworld”), as well as a Tasmanian timber researcher and a Tasmanian EC consultant, were interviewed to investigate issues which could impact on the veneer industry’s ability to adopt EC. The last two interviewees had had broad contact with Tasmanian hardwood timber producers. Participants were contacted more than once to allow for participant validity, and questions were chosen that were relevant to each group.

Document analysis was used to model information flows within Veneerworld to identify any information duplication or problems.

A questionnaire was released to the 60 factory staff at Veneerworld’s plant about their views on technology and organizational change, to investigate possible barriers to the implementation of new systems in the work environment. Veneerworld management reviewed the questionnaire to confirm its relevance for employees. Instrument reliability was to be established by re-surveying some respondents.

Questionnaires were left in the “lunch room” for four days for employees to complete. A covering letter was attached which stated that management would see only the collated responses, and assured anonymity and confidentiality. A sealed box was left for completed questionnaires.

### ***3.3 Analysis Approaches***

Qualitative data analysis involves breaking down rich descriptions of events, classifying emergent themes and establishing their interconnections (Dey, 1993). Analysis of the interview data was undertaken following the process represented in Figure 1, which has been adapted from Neuman (2000).

In order to reveal how information was transferred between stages of the production process, it was planned to analyse documentation gathered from Veneerworld.

It was planned to analyse the open-ended survey questions by drawing out themes before identifying patterns, while the quantitative questions were to be analysed descriptively.

## **4. Analysis**

Analysis was undertaken of the data collected from the interviews, documentation and survey.

## 4.1 The Interviews

Interview respondents were grouped into three categories, Veneerworld management, Timberworld management and external parties.

Timberworld is one of Tasmania's largest managers of timber resources. It supplies logs for all sectors of the industry, including pulp, sawlog and veneer.

### 4.1.1 Veneerworld Interviews

The interviews conducted at the Veneerworld factory examined the veneer production process from an information flow perspective, investigating areas where EC could assist. Another aim was to identify any potential difficulties within the organization for implementation of EC. The comments below were representative of themes that emerged after analysis of the interview transcripts and notes.

One theme related to data duplication and data handling during the production cycle, with individual logs recorded two to five times during the production process:

Double handling [is a] ... key area...it would make a lot more sense if it [data] were going straight into some sort of database.

*Interviewees hinted at a fully "integrated" system, where details were entered only once, making it possible to get rid of middlemen.*

Several interviewees indicated a need for additional data. Improvements to the inventory system and integration with the production process were also suggested. The following comment concerned difficulties in tracking the timber through the production process:

*As the timber moves through each production stage, it becomes hard for us to maintain information such as which flitch it came from...information about the product should be entered into a system during the production cycle.*

However, several interviewees commented that a barcode would be "shaved off" during production. Tracking timber would also have benefits for inventory control. One Veneerworld employee remarked on difficulties in reconciling the stock take of logs and records in "...our paperwork system".

Another theme that emerged related to the information and reporting needs of the organization. Several interviewees wanted better recovery information, which would allow log tracking to the end product, after having entered data once. Information sharing between the organization and its supply chain members arose several times. Veneerworld saw the value of electronic communication with trading partners, particularly for payments and information-sharing applications. However, the following reservation was expressed:

*The ability for us [Veneerworld] to exchange information electronically with them [suppliers and customers] is going to be limited probably to the larger organizations...I can't really see that ever changing.*

Several interviewees identified the customer ordering system as requiring improvement. Currently, when customers faxed an order to Veneerworld:

*...someone has to physically go and see if the stock is actually there. There's no system in place to do it automatically.*

The customer's data are entered into a spreadsheet and the production inventory system is updated manually. Then data are re-entered on a note that accompanies the order, and then again on an invoice which is sent to the customers. Although there was recognition that the procedure was inefficient and costly, the understanding was also expressed that to capture the potential benefits of EC, total integration needed to occur between internal business processes and trading partners of Veneerworld.

One question asked during the Veneerworld interviews related to possible resistance to change of factory employees as a result of the introduction of new technology. An example of this kind of response was:

*...I think it's not so much a resistance, it's more an education thing...A lot of people don't understand a lot about computers in general, what they can and can't do, that sort of thing.*

Management was seen as willing to change, but the factory employees would require convincing. A common perspective was that education was the best way for management to combat resistance to change during the introduction of EC.

A key issue that emerged during all Veneerworld interviews was the disadvantage of dependence on electronic systems, a view that was captured well in the following comment:

*OK, if something happens with an electronic system, if something happens to that, we've got to address the problem of does it bring all your production to a stop.*

#### *4.1.2 Timberworld Interviews*

The interviews conducted with management at Timberworld were used to gain an understanding of a large Tasmanian tree producer's perspective on EC in the timber/veneer industry, and to highlight any potential problems. Due to the busy schedule of Timberworld's management, the interviews were difficult to arrange. For example, one interview was rescheduled three times. The interviews were held in Timberworld's office in Hobart, the state capital, and each ran for 30 to 40 minutes. The themes given below emerged from analysis of the interview transcripts and notes.

When asked to define EC in their own words, the interviewees at Timberworld emphasised "buying and selling of products over the Internet" and "adding value" to products through EC. There was obvious recognition of some of the primary benefits that EC can provide business.

A common theme was an expectation of significant resistance to change. The following comment exemplified this viewpoint:

*...the other [smaller timber organizations] ...would be difficult to convince [of the benefits of EC]...*



The approach recommended for overcoming resistance was:

*...some significant education, and the way that we've tried to introduce change is by demonstrating the work first.*

During interviews, Timberworld management identified many potential benefits to both the timber and veneer industries from implementing EC, for example:

*A spin-off of EC in the timber industry may be that it would drive a more consistent product and presentation by the various producers.*

An associated benefit of the “spin-off” was a less fragmented industry that could allow large orders to be filled through multiple suppliers, which was currently difficult. Another perceived benefit was greater emphasis on “marketing” rather than “selling”, and a more strategic approach. At present:

*...[many] timber producers are only concerned about...day-to-day issues...*

Timberworld interviewees believed that stock control, timber tracking, species information and relationships between supply chain members could be improved using EC approaches. The company had investigated use of a 3D laser scanning and tagging system to improve recovery from each log. The system allowed log scanning to determine its quality and grade, which could benefit customers by allowing better tracking of grading before cutting. Such a system would save Timberworld:

*...quite a bit of money...[for example] [a]t the moment, all the sawlogs are measured by someone physically measuring the log and banging the dimensions on the end [of the log].*

Many comments concerned supply chain issues. Concern was expressed about the ability of many supply chain members to participate in an industry-wide EC solution:

*Almost none of our customers have computers that could easily be used for the transfer of electronic data...EDI, that sort of thing.*

The self-monitoring of stock levels in small to medium sized timber producers was considered problematic:

*They have a very vague idea of what's in the yard...if an order came in which required some sort of recutting of the timber, they'd have to [check]...manually to work out if they had it or not.*

Interviewees revealed that Timberworld would like a co-operative supply chain, perhaps one where every supplier contributed to a central repository of timber inventory. This arrangement would facilitate filling of larger orders. However, there was recognition that few industry members would be ready for the investment.

Timberworld recognised that external assistance would be needed to implement EC in the timber industry. Moreover, it was considered that EC needed to be integrated gradually:

*You could do it step-wise, and you'd probably have to do it that way, but you'd have to design the whole system first, in order to catch all the savings.*

#### 4.1.3 External Parties

The two external interviewees were selected because of their independent knowledge of the Tasmanian timber industry. The interviews of approximately an hour each were conducted at the offices of the Timber Research Unit in Hobart, after the interviews at Veneerworld and Timberworld. This timing offered potential for validation of issues raised in previous interviews. Themes that emerged from the external parties after analysis of the interview transcripts largely related to the willingness and readiness of timber and veneer organizations to adopt new solutions to problems, rather than just adopt new technology.

The external parties suggested that as the industry in general did not have a strategic outlook, many organizations needed to be shown the benefits of EC. This perspective was typified in the following comment:

*I think they [industry members] would be willing to adopt new technology to improve supply chain relationships if it was shown to have many benefits...if they could appreciate it in both the production and managerial sense.*

Furthermore, one interviewer believed industry members were “only going to do it if there’s a quid in it”. These and other statements confirmed the comments made by Veneerworld and Timberworld that “everything takes a bit longer in this industry”.

Interviewees were asked how Veneerworld would be affected by the willingness of the rest of the timber industry to adopt new technology. Both interviewees perceived that if Veneerworld implemented internal systems for an EC infrastructure, the willingness of trading partners to adopt EC would affect its ability to reap the rewards of the investment. Furthermore, it was considered that each organization would benefit differently from EC.

One of the external parties referred to the manner in which the Tasmanian timber industry had previously solved problems, an issue also raised by Timberworld:

*The industry does have a history of addressing common problems in an agreed common way...a lot of their technical issues over time have been solved by people like the CSIRO, working co-operatively with one or two of them [organizations] and then spreading the results over many.*

When interviewees were asked about Timberworld’s role in the change process, they indicated that as a supplier of logs to Veneerworld and other organizations, it may not be able to drive the process as it would not be seen as neutral. Although Timberworld could offer opportunities to participate in EC, it could not demand it.

When interviewees were asked who would drive the changes in the veneer supply chain, they commented that it was possible to work down the supply chain but not the reverse. One of the external parties stressed that Veneerworld could not say to a customer, “we will only sell you veneer if you follow our information management system”, because the customer could buy elsewhere. However, the point was made that if the customer made the same demand of Veneerworld, the situation would be reversed. However, another possibility was:

*...all those buyers could sit down with Veneerworld and say let's set up a system and then hire someone to set it up for them...then it's a co-operative thing.*

The external interviewees indicated that Veneerworld could benefit from new technology. The production processes most likely to benefit were considered:

*Obviously their production line will benefit [from EC]. They can cut down administrative loads by automating a lot of the information gathering along the production line...and their core systems would hang off that.*

The information requirements of Veneerworld and their customers arose as a key theme from the interviews. The external parties could see a role for large tree producers to supply information, such as environmental certification, with the logs. For example, when customers bought a veneer product, they could be given product information by Veneerworld that was supplied by Timberworld.

Finally, one theme that arose from all three groups, was concern about the time it would take for EC adoption. They considered that it could take five years or ten years to achieve effective EC implementation in the Tasmanian timber industry, as exemplified by:

*...I think if you want a sort of collective, co-operative network of people [implementing EC in the timber industry], you're talking five to ten years.*

#### *4.1.4 Documentation Analysis*

Concerns raised in the interviews about data duplication and redundancy were confirmed through analysis of documentation collected from the Veneerworld production cycle, which can be seen in Figure 2. At each stage of production, it was noted that often employees manually recorded some of the same data onto paper forms. Each production stage kept track of data, but information was not shared between stages.

#### *4.1.5 Survey Analysis*

The response rate to the survey of Veneerworld's factory staff was 5 out of the 60 factory staff. Consequently, reliable, representative results could not be established. Following discussion with Veneerworld's management, no follow-up to the survey was undertaken, in the belief that the same result would occur. During this discussion, Veneerworld's management indicated that most employees were not interested in why things had to be done a certain way. They simply needed to know "when and where to do it". The poor survey response and the reaction of Veneerworld's management validated some issues raised in the interviews. The former may indicate resistance to change and a need for education, while both may reveal restricted communication between factory staff and management.

## **5. Findings**

Multiple findings were derived from the several data sources. Triangulation was possible because of the multiple data sources.

The issues that emerged from data analysis were regrouped into the two main areas below, and then categorised further:

- Issues Internal to Veneerworld
- Issues External to Veneerworld

### ***5.1 Issues Internal to Veneerworld***

#### *5.1.1 Information Flows*

Currently data are entered manually into paper-based forms. Many details are copied to separate forms at each stage of production. Management would like an integrated database system that could track the process from raw material to end product and control inventory, linked to backbone systems. Daily production and costing reports would be more useful than monthly reports.

While Veneerworld had the capability to develop EC systems, its trading partners may not have the same capability or perceived need.

#### *5.1.2 Data Handling*

A bar-coding system was seen as unsuitable to track veneer production details. Veneerworld management suggested that factory employees could use a computer at each production point to enter relevant details. This would enable an integrated factory system to supply administrative and inventory data, the elimination of “paper-shuffling” and the generation of production reports.

#### *5.1.3 Resistance to Change*

Veneerworld believed that its employees would “probably just go along with it” (change associated with EC adoption). A “don’t care” attitude from employees may reflect limited communication between them and management. More communication may be required for change to be successfully implemented. Moreover, resistance to change is a common occurrence and may be encountered if EC was introduced into the veneer industry.

#### *5.1.4 Education*

It appeared that education would be required in the veneer organization to overcome the organizational change concerns of factory staff. Moreover, education may have a positive effect on the relationship between staff and management. Where staff feel involved in the change process, they may be more likely to embrace the technology.

#### *5.1.5 EC Enabling Technologies*

The study found that there may be applications for EC technology within the veneer industry. Some of these included:

- A system to track products for marketing purposes. Bar-coding technology could be used once the veneer product is ready for sale. Crates may be coded with information including species and specifications, which could be passed on to customers.

- E-mail could be utilised more effectively to benefit the whole industry, for example, to distribute logging information.
- The World Wide Web offered the industry opportunity to market itself locally and internationally. An intranet site to service buyers and sellers would be appropriate for secure, routine transactions. A public website may be suited to promotions, product information and pricing.

Many participants believed that maximum benefit to Veneerworld and the broader timber industry would come through a co-operative network of information relationships throughout the supply chain. However, most interviewees saw this as unlikely in the short term.

Unlike some industries where business processes may be re-engineered to complement technological solutions, the veneer production process may not be so easily changed. However, it appeared that elements of EC could be utilised to facilitate business processes in the veneer industry.

## ***5.2 Issues External to Veneerworld***

### *5.2.1 Industry Co-operation*

Timberworld interviewees perceived that more consistent product presentation could come from a co-operative system, enabling international orders to be fulfilled collaboratively, perhaps through a centralised merchandising body.

The data suggested that no single organization had the power to drive the required changes, but instead they had to be driven jointly. This meant promoting awareness of EC benefits across the industry.

### *5.2.2 Supply Chain Relationships*

Customers of the timber and veneer industry have a range of information requirements. Timber producers require information regarding timber species, environmental certification and timber specifications. However, little information is currently available. Potential exists for information from tree producers to be passed in electronic format to other organizations that value add, and then to customers, using EC to make it available.

### *5.2.3 Resistance to Change in the Industry*

Resistance to change may be the greatest threat to the implementation of EC in the Tasmanian timber/veneer industry. Timberworld believed that significant resistance to change would occur.

### *5.2.4 Educational Requirements*

Significant EC education and demonstration will be required, particularly for veneer factory employees, if EC is to be successful.

### *5.2.5 Motivation for EC Adoption*

EC can allow businesses to cut production costs, increase profit or lower costs to the consumer. Traditionally, the adoption of technology is influenced by competition. External competitive pressures have increased motivation for EC adoption by the timber industry.

### *5.2.6 Strategic Focus*

The timber industry is accustomed to solving old problems with traditional remedies, which may not work when organizations try to solve new problems. Evidence suggested that the Tasmanian timber industry will need to develop a strategic focus towards EC. New solutions to complex problems need to be developed, adopting new technology where necessary to facilitate this.

## **6. Conclusion**

No attempt has been made to generalise the conclusions of this study to other organizations, industries or regions, because of the predominantly interpretivist approach taken, based on a single case study. Nevertheless, the findings are largely consistent with those of other studies that have investigated the introduction of EC into different industries and regions (for example, Gregor and Menzies, 1999; Ridley and Ridley, 1999). Other examples of concurrence have been noted below, where relevant.

Further research is required before EC can be implemented in the Tasmanian veneer and timber industry in an integrated manner. Although mapping of business process information flows and communications within the timber industry has begun (Timber Research Unit, 1999b), more is needed. Moreover, investigation is needed of the most effective means of undertaking industry-wide education, to reduce resistance to change. Resistance to change has been noted in other EC studies, for example Amos and Cooper (1995).

The study findings suggest that tangible benefits are likely to accrue from the introduction of new information systems and improvements to business processes at Veneerworld. There is potential for Veneerworld to benefit from improvements to its production system, in particular its data handling, which will reduce duplication and redundancy. Improvements to this process alone may provide significant cost savings and justify substantial investment in new technology, as well as having a positive impact on administrative and inventory systems. The capacity to produce timely production reports and costing information is likely to advantage the organization.

Furthermore, improvements in communication with supply chain members are also likely to benefit Veneerworld. This would allow suppliers and customers to access inventory information, order products, make payments and obtain product information more easily.

The last two sets of findings support benefits of EC that have been identified in a range of industries (Cameron and Clarke, 1996; Lawrence and Keen, 1997, Crawford, 1998).

Intangible benefits may include improved relationships with customers and suppliers, increased product awareness through on-line marketing and a more coherent industry.

However, the potential for Veneerworld to utilise the full potential of EC will depend on the readiness of the timber industry to adopt it. Benefits to a particular organization appear relative to the degree of cooperation and willingness to participate in changes to its supply chain. This finding is congruent with conclusions drawn by Gregor and Menzies (1999) from a study of EC in the beef industry. The current study does not question the ability of organizations such as Veneerworld to adopt new technology. Instead, it questions the effect the EC readiness of the timber industry will have on a particular organization to make full use of EC technology and practice.

The major potential inhibitor of the adoption of EC in the Tasmanian timber veneer industry appears to be lack of co-operation, a finding that is congruent with those of Amos and Cooper (1995) and Premkumar, Ramamurthy and Nilakanta (1994). Unless a co-operative approach is taken to the development of EC in the broader timber industry, some organizations will develop their own systems. Such systems may be incompatible with those of others, preventing an industry-integrated system. A co-operative approach to EC in the industry seems distant, unless there is a significant shift away from a day-to-day focus, and towards a strategic focus. Until this occurs, timber organizations may not see potential in EC, or be prepared to work co-operatively as an industry to find new solutions, with negative implications for the effective adoption of EC in the Tasmanian timber veneer industry.

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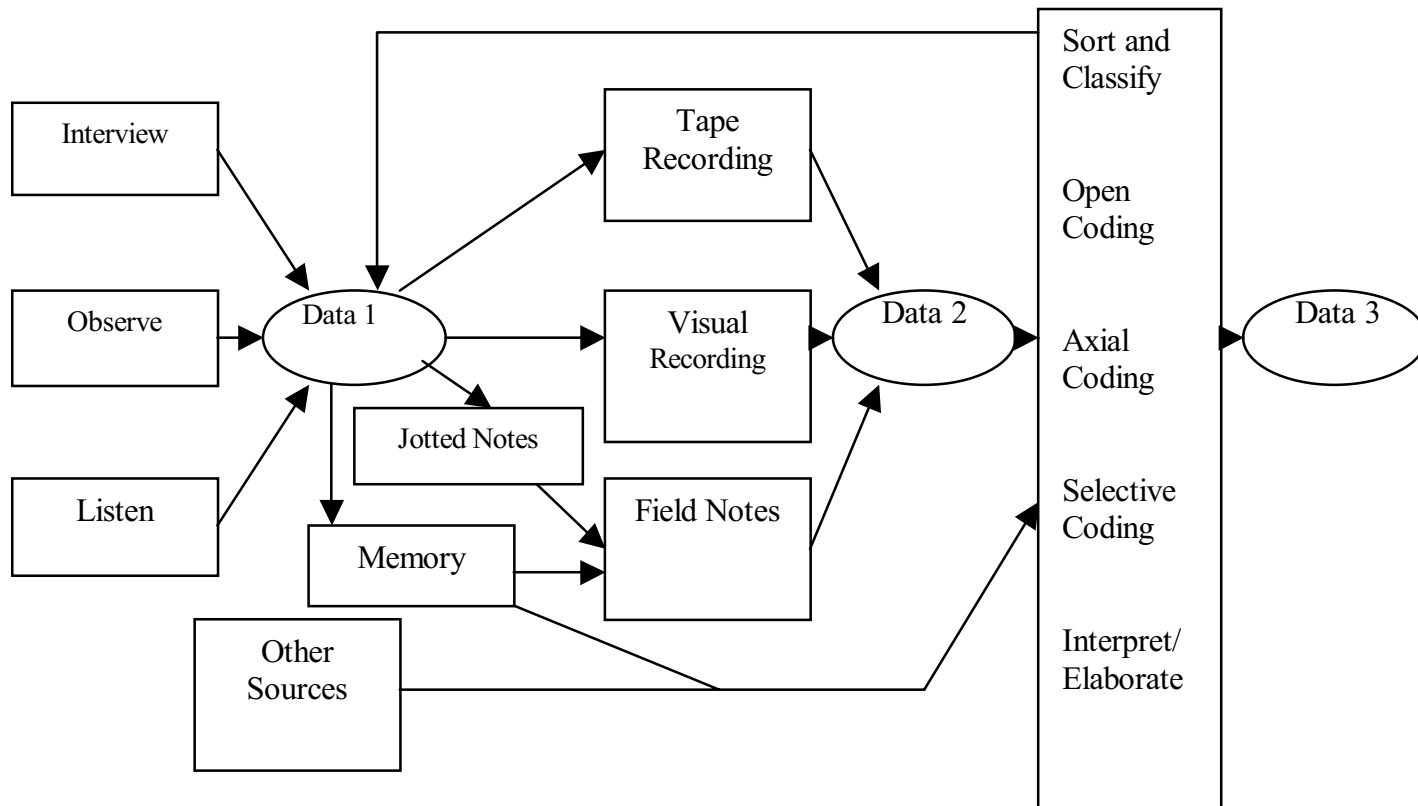
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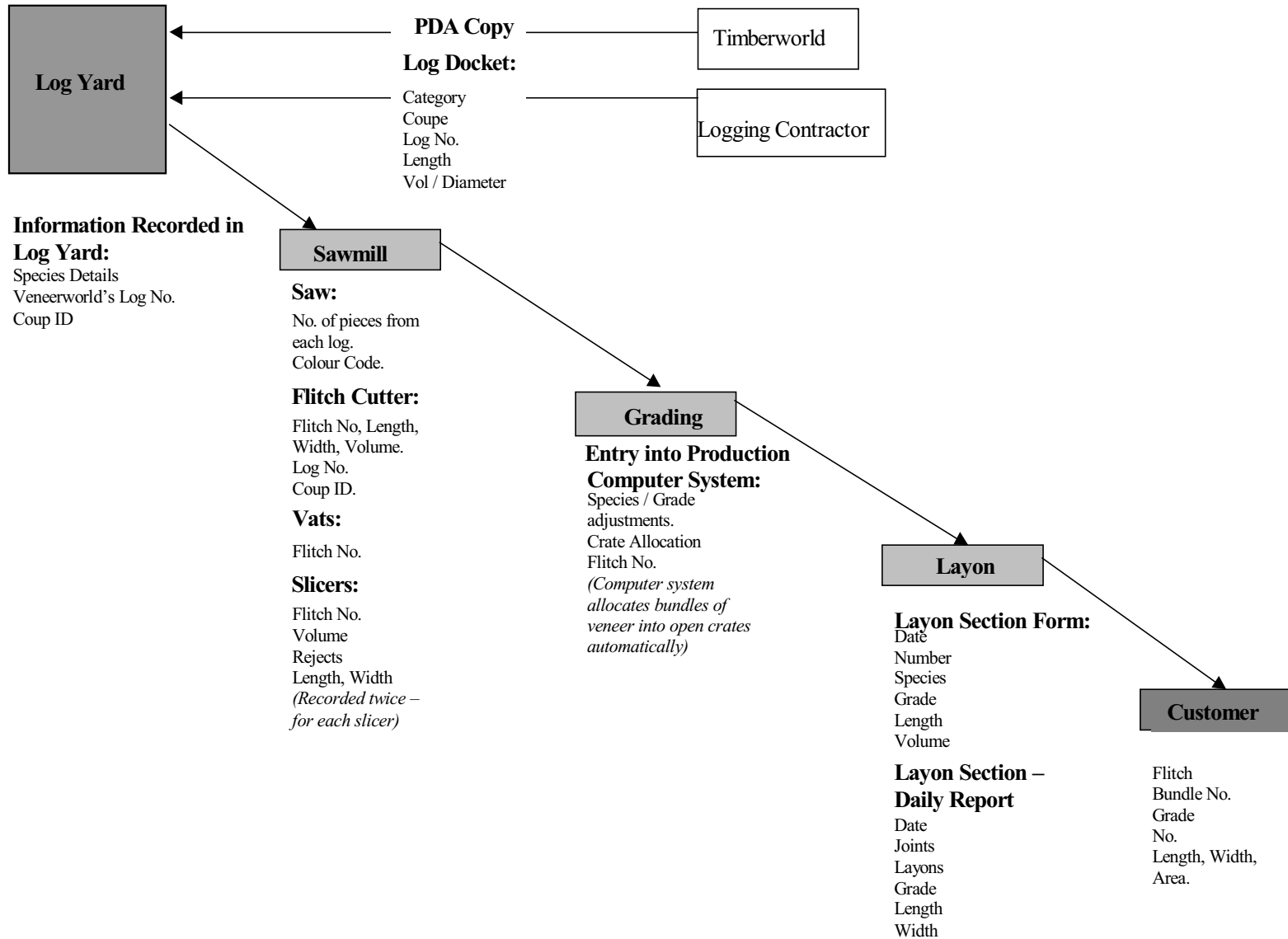
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**Figure 1. Data Analysis Process Undertaken with Interview Data (Adapted from Neuman, 2000)**



**Figure 2. Model of Information Flows in Veneerworld's Production Process**