

# BRIDGING THE GAP BETWEEN RESEARCH AND APPLICATION -- BUSINESS PLAN SPREAD-SHEETS ARE HELPING WOOD RECOVERY EFFORTS

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## The Situation

Wood pallets break or end up in the wrong places where they are no longer useful. They become a waste problem that needs to be dealt with. Many find their way to recovery and repair facilities, but many don't and most likely end up in landfills (Figure 1). Our charge is to reduce landfilling of unwanted and discarded wood pallets and to push them into highest value uses.

Let's look at the magnitude of the pallet situation. Each year a large number of new wood pallets are manufactured using approximately 40 percent of the *hardwood* lumber and cants produced in the US (4.5 billion board feet in 1995) and less significant portions of *softwood* lumber and cants (1.8 billion board feet in 1995) (Bush and Araman 1997a). Many of the new pallets and pallets manufactured in previous years end up broken, or not needed. In 1995 over 170,000,000 wood pallets (2.6 billion board feet) were received by the pallet and container industry for repair or recycling (Bush and Araman 1997b). Almost 150,000,000 were repaired and resold to pallet users.

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**Figure 1. A typical variety of wood pallets at a landfill recovery area.**

Many wood pallets end up in landfills. The combined landfill totals (Construction and Demolition and Municipal Solid Waste) show that over 223 million pallets (6.14 million tons) passed through landfill gates in 1995 (Araman, Bush and Reddy 1997; Bush and Araman 1997c). Approximately 17 percent (38 million pallets or 1.04 million tons) were recovered, mainly to little or no revenue products. Landfill operators would welcome markets for pallets that would return more money to their facilities or companies that would recover the pallets sent to landfills. Many landfills have grinders and more would likely add grinders if they could be assured of an economical market for ground pallet material. They would also be interested in adding other equipment to increase revenues. Our business plan spreadsheet models were developed to evaluate different recovery options at landfills or at independent sites.

Grinding is the preferred option for handling pallets in landfill recovery areas. However, our research has found that discarded pallets at landfills could provide good raw materials for repairing pallets, building new pallets from used parts and could be converted into other products. But many questions need to be answered before recovery operations will consider reclaiming material from pallets at landfills. How many wood pallets are sent to landfills? Can they be recovered? Are any being recovered? Are there opportunities to increase recovery? Are there higher value options than present recovery, which at best is grinding for fuel and other low-value products? Are these options economical?

To help answer some of these economic questions and provide information for business plans, the Center for Forest Products Marketing and Management and the

USDA Forest Service Southern Research Station unit, both at Virginia Tech, have developed a computer spreadsheet model. The model focuses on pallet recovery and reuse options for the pallets prior to landfilling or in landfill recovery areas. We report on pallet recovery options and present a sample spreadsheet business plan to determine the economic potential for recovering pallet material at landfills. Lastly, we describe some current uses of the spreadsheet models helping us bridge the gap between research and application.

### **Pallet Recovery Options and Their Value**

Discarded pallets can have value based on their size, condition, and the species of wood used in the pallet parts. For example, pallets in standard sizes needing no repairs are reusable and sellable. Pallets can also be disassembled and the parts can be converted to standard or sellable sizes and sold to pallet recovery/repair companies (Figures 2 and 3). Some of the better parts could also be converted to products such as flooring, paneling or furniture (Figures 4 and 5). The values of these recovery options can be expressed in terms of a standard 48" x 40" pallet as shown in Table 1. A ground pallet (Figure 6) would be worth \$0.25 for fuel or up to \$1.00 if aboard furnish market is available. Other uses of the ground material would be densified fuel pellets, animal bedding, mulch and colored mulch. The same pallet could be worth between \$3.00 – \$6.00 if sold as a pallet or between \$2.00 – \$3.50 if taken apart for repair replacement parts. These values depend on the quality of the pallet and how many useable parts can be removed from the pallet. The 48" x 40" pallet could be worth between \$5.00 – \$8.00 in flooring produced from good deckboards with the remaining parts sold as replacement pallet parts.

### **The Economics — Sample Recovery Operation**

To help private or public operations evaluate the feasibility of pallet recovery, we have developed a computer spreadsheet model (a workbook will be published in 1999). The computer model requests basic information describing the pallet recovery project being considered. Among the input information requested is equipment and facility requirements, labor requirements, incoming pallet quantity and type, material processing plans, tipping fee rates, and product selling prices.

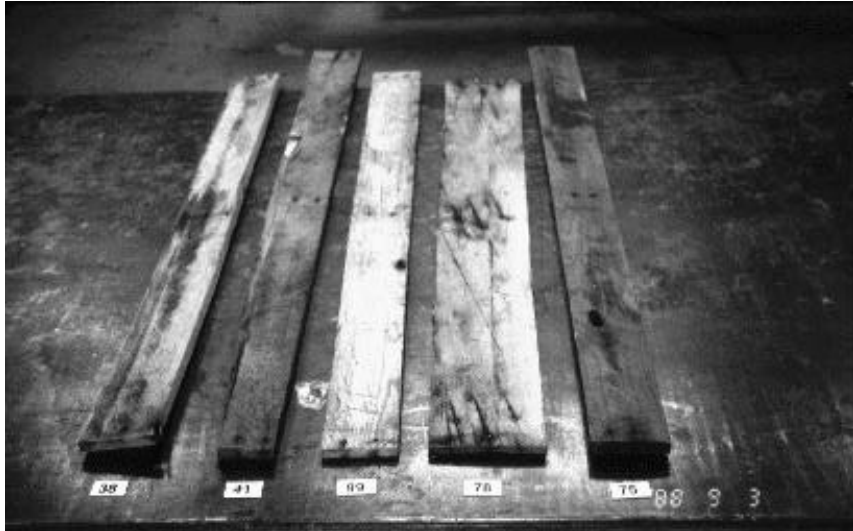
The spreadsheet model uses the input parameters to simulate the pallet recovery project's operations and to estimate the project's cash flows. Output includes a summary report, tables displaying the flow of material through the project's operations, revenues by source, and a complete cash flow analysis table. Charts illustrating the sensitivity of profits to tax rates, cost of capital rates, revenues by product or service, and key cost categories are also generated.



**Figure 2. Recovered pallet parts ready for reuse to repair broken pallets.**



**Figure 3. A replacement part being used to repair a pallet.**



**Figure 4.** Red and white oak pallet parts usable to make flooring, furniture or paneling.



**Figure 5.** Red oak flooring made from used pallet parts.

**Table 1. Pallet recovery option values.**

Pallet Recovery Option	Value of a Standard 48" x 40" Pallet
Ground for use as fuel or mulch @ \$10/ton	\$0.25
Ground for use in board products @ \$40/ton	\$1.00
Resold without repair <sup>a</sup>	\$3.00-\$6.00
Disassembled for repair replacement parts <sup>b</sup>	\$2.00-\$3.50
Disassembled for flooring and replacement parts <sup>c</sup>	\$5.00-\$8.00

<sup>a</sup>Standard size pallets not needing repair but of different grade or quality.

<sup>b</sup>Value range depends on number and type of reusable parts obtained from discarded pallet.

<sup>c</sup>Value based on number of parts useable for flooring and the yield in flooring blanks from the parts and the remaining parts that can be sold as replacement parts.



**Figure 6. Current recovery method of grinding pallets with tub grinders to usable fiber as used at landfill recovery areas.**

The summary report includes the initial cost of the pallet recovery project and the profitability using the net present value, the internal rate of return, and the modified internal rate of return methods. The tonnage of wood diverted from landfilling or grinding and the recycling efficiency is indicated as well as the total labor cost over the life of the project. Lastly, in the summary report the average revenue generated per pallet recovered is estimated.

To illustrate the program and the potential economics of recovering pallets at a level higher than grinding, we created the following hypothetical operation. In this operation, we

- separate standard 48" x 40" pallets needing no repairs to sell to pallet users.
- disassemble most of the remaining pallets and salvage usable parts for sales to pallet recovery/repair companies.
- grind the remaining parts or bad pallets into fiber as is currently common.
- consider the possibility of, at a later time, separating the best parts for conversion to products such as flooring, furniture or paneling.

The sample recovery operation that we simulate would

- receive 420 pallets per week in year 1, growing to 600 pallets per week in year 5.
- charge normal recovery area tipping fees (\$35.00/ton).
- offer a pallet pickup service for a higher tipping fee (\$45.00/ton).
- sell approximately 60 48" by 40" pallets/week not needing repairs in year 5 (\$4.50/pallet).
- dispose by grinding 90 pallets/week due to thin boards or an insufficient number of recoverable parts.
- disassemble 450 pallets/week with industrial band saw dissemblers in year 5 (this translates into 13 pallets/hour or .2 pallets/minute).

- process if needed the recovered pallet parts to standard or demanded lengths with crosscut saws.
- sell the recovered pallet parts to recovery/repair companies (\$0.20/deckboard, \$0.50/stringer and \$0.20/half stringer).
- ∨ employ 6 part-time workers or 3 full-time workers.

The above operation in year 5 would:

- collect \$107,000 in total revenue (\$30,000 in tipping fees, \$13,500 in whole pallet sales, \$23,500 in stringer sales, and \$40,500 in deckboard sales per year).
- ∨ receive 30,000 pallet or 787 tons of wood, recycle 513 tons of pallets and parts, and grind 274 tons of wood per year.
- achieve a 65 percent recycling efficiency in solid wood recovery (if the ground material is sold or used at the landfill this could approach 100 percent).
- return \$3.58/pallet received.
- cost \$62,000 to establish (purchase and setup equipment, building, etc.) and attain a 12.6 percent internal rate of return.

## **Bridging the Gap**

The spreadsheet program is being used by several groups to plan and test the feasibility of pallet recovery operations. A Minnesota waste reductions and proper use group has used the spreadsheet program to plan a pallet recovery operation that will start by recovering pallets and pallet parts and, later in the project life, make flooring. A western Massachusetts group, focused on new recycling technology, has and will continue to use the model to plan and evaluate a pallet recovery and repair operation. They may add flooring at a later date. Several people in western Virginia used information from a model analysis to determine if their planned recovery operation has merit. A Virginia Tech forest products management course uses the spreadsheet program to develop potential recovery operation possibilities as a learning tool. A West Virginia University class uses the model to show students the benefits of spreadsheet modeling and forest products recovery operations. Several other groups have requested the model to analyze their situations. The spreadsheet



program is helping us successfully transfer our research results, while allowing users to analyze many possible recovery situations.

## Summary

Substantial quantities of wood pallets are disposed in US landfills each year, thus rendering the potentially valuable resource useless. In total, it has been estimated that 223.6 million pallets were taken to Municipal Solid Waste and Construction and Demolition landfills in 1995. Only 37.9 million pallets were recovered and not landfilled. Most recovery was to low or no revenue uses (Araman, Bush and Reddy 1997; Bush and Araman 1997c).

We have shown that it can be economical to establish an independent pallet recovery operation and to expand pallet recovery/recycling efforts in landfill wood/yard waste facilities. Either recovery operation could include:

- separating standard 48x40 pallets needing no repairs to sell to pallet users.
- disassembling most of the remaining pallets and salvage the good or cut-back parts for sales to pallet recovery/repair companies.
- sorting out the best parts for conversion to products such as flooring, furniture or paneling.
- grinding the remaining parts or bad pallets into fiber as currently being done.

Pallet material recovery/recycling at landfill wood/yard waste facilities can be economical, while reducing pressure on landfill capacity, supplying needed products back to the pallet world, while reducing hardwood and softwood timber demands. We hope to encourage the sending of more pallets to modified and new recovery operations for high-value recovery and not landfilling.

The computer spreadsheet model is helping to bridge the gap between research and application in creating well-planned pallet recovery operations.

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