

# **Waste Reduction in The Furniture Manufacturing Sector**

## **Case Study Report: Steelcase Inc.**

Prepared by the:

**Solid Waste Research Group  
School of Natural Resources  
University of Michigan  
Ann Arbor, Michigan 48109  
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# PREFACE

## PROJECT DESCRIPTION

### Overall Project Objectives

This study of solid waste reduction practices at Steelcase Inc. in the Grand Rapids area is part of a project comprising five case studies. The objective of the project is to analyze and document successful waste reduction programs implemented by commercial and industrial firms in the state of Michigan so the waste reduction practices can be transferred effectively to other firms. The information presented in these reports may also serve to suggest ideas for waste reduction which could be implemented in other industries beyond those selected for the five case studies.

The primary focus of each case study is a change or innovation in a product or process that resulted in source reduction of nonhazardous solid waste. Process, economic, and organizational/motivational analyses are performed in each study. The process analysis includes a description of the product and process changes and the amount of waste reduction achieved. The economic analysis evaluates the costs and revenues to the firm that result from the waste reduction activity. Baseline economic data, including fixed and variable costs and revenues before the intervention, are compared with the after-intervention data. An organizational/behavioral study then examines the decision-making process, incentives and organizational support, company policy, and employee attitudes related to the initiation of the waste reduction activity.

The overall benefits of waste reduction measures also depend on the reduction of societal and environmental impacts associated with the life cycle of the goods provided or services rendered. External social and environmental factors relating to each program are identified and discussed where possible.

Some of the waste reduction programs documented in this report can be implemented relatively easily, whereas others may require significant capital investment, employee training, or operational changes. Each case study attempts to identify key elements of the model waste reduction program that are necessary for its successful implementation.

### Case Study Firms

The case study firms were selected according to the following criteria: a priority of source reduction over recycling and other waste management strategies; the transferability of the waste reduction practices to other firms; information availability and accessibility; the potential amount of solid waste reduction achieved if other firms adopt the model waste reduction practices; and a diversity of businesses in terms of their SIC Code, size, organizational structure, and geographic location.

The five firms studied are the following:

1. Hudson's department stores in Michigan; retail department stores
2. Gretchen's House III in Ann Arbor; child day care facility
3. McPherson Hospital in Howell; cafeteria and patient food service
4. Packard People's Food Cooperative in Ann Arbor; grocery store
5. Steelcase in Grand Rapids and Kentwood; office furniture manufacturer

## **Project Publications**

The following documents are available through the Office of Waste Reduction Services:

- Fact Sheets - two page document to summarize waste reduction efforts of each case study firm.
- Detailed Case Study Report - a comprehensive guide to assist firms with the actual implementation of waste reduction efforts.
- Final Project Report - description of the methodology, major findings, and recommendations covering all five case studies.

A Fact Sheet and Detailed Case Study Report are published for each of the five case studies. Documents may be obtained from:

Office of Waste Reduction Services  
Michigan Departments of Commerce and Natural Resources  
PO Box 30004  
Lansing, MI 48909  
Phone: (517)-335-1178

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## **ACKNOWLEDGEMENTS**

### **Solid Waste Research Group, School of Natural Resources, University of Michigan**

The Solid Waste Research Group selected the case study firms, conducted the on-site data collection and analysis, documented the waste reduction activities, evaluated the potential impacts of these activities on the waste stream if they are adopted by other firms throughout Michigan, and prepared the case study reports. The following members of the Solid Waste Research Group participated in this project:

Jonathan Bulkley, Project Director, Professor of Civil Engineering and Natural Resources  
Gregory Keoleian, Principal Investigator, Research Fellow in Natural Resources  
Raymond DeYoung, Participating Investigator, Research Scientist  
Andy Duncan, Research Assistant  
Elise McLaughlin, Research Assistant  
Dan Menerey, Research Assistant  
Martha Monroe, Research Assistant  
Thomas Swenson, Research Assistant

### **State of Michigan Departments of Commerce and Natural Resources**

The Office of Waste Reduction Services of the State of Michigan Departments of Commerce and Natural Resources provided assistance in the selection of case study firms and in reviewing the final report. Ms. Myra Grant served as project manager and administered the grant for the Resource Recovery Section, Waste Management Division, State of Michigan Department of Natural Resources.

The information presented in this report is the sole responsibility of the Solid Waste Research Group, School of Natural Resources, University of Michigan.

**Steelcase Inc.**

Many members of Steelcase Inc. contributed vital information to this project. Special thanks are given to the following people: Simon Aguilar, Supervisor of the Energy Center and Recycling Coordinator; Don Bennett, Manager, Engineering Services; Al Dykehouse, Director of Plant Engineering and Maintenance; Sam Mancuso, Superintendent of Maintenance; Vern McCormick, Assistant Foreman, Machine Improvements Program; and Harv Ringerwole, Vice-President of Operations, Revest.



## Table of Contents

1.	SUMMARY .....	1
2.	INTRODUCTION .....	2
	THE PROBLEM OF NONHAZARDOUS SOLID WASTE IN THE FURNITURE MANUFACTURING SECTOR.....	2
	WASTE REDUCTION IN THE FURNITURE MANUFACTURING SECTOR .....	2
	THE SELECTION OF STEELCASE.....	2
	DESCRIPTION OF STEELCASE INC.....	3
	CONTENT AND ORGANIZATION.....	3
3.	DETAILED CASE STUDY	
	WASTE REDUCTION THROUGH THE MACHINE IMPROVEMENTS PROGRAM .....	4
	PROCESS AND COST ANALYSIS .....	4
	Machine Improvements Program .....	4
	IMA Edge Bander Machine - Computer Furniture Plant.....	4
	Assembly Table - Computer Furniture Plant.....	5
	Conveyor Lift Shutdown - Computer Furniture Plant .....	5
	Box Drawer Roll Former Machine - Systems Plant.....	5
	Other Machine Improvements.....	6
	High Performance Roll Form Machine - Systems Plant.....	6
4.	OTHER WASTE REDUCTION ACTIVITIES .....	6
	SOURCE REDUCTION .....	7
	Packaging Program .....	7
	Uncartoned Shipments.....	7
	Packaging and Packing Material Reduction .....	7
	Reuse .....	8
	Containers.....	8
	Pallets.....	8
	REMANUFACTURING BY REVEST .....	8
	RECYCLING PROGRAM .....	8
	Corrugated Cardboard .....	9
	Fabric .....	9
	Foam.....	9
	Office Paper.....	9
	Oil .....	9
	Scrap Steel .....	9
5.	ORGANIZATIONAL AND MOTIVATIONAL ANALYSIS .....	10
	SOCIETAL AWARENESS OF THE ENVIRONMENT.....	10
	BUSINESS COSTS AND WASTE REDUCTION.....	10
	STEELCASE INC. PHILOSOPHY .....	10
	WORLD CLASS MANUFACTURING .....	10
	Machine Improvements Program .....	11
	Waste Ownership.....	11
	Quality and Durability.....	11
6.	IMPACT AND TRANSFERABILITY.....	12
	IMPACT .....	12
	TRANSFERABILITY.....	12
	Factors Enhancing Transferability of Steelcase's Waste Reduction Methods.....	12
	Impediments to Transferability of Steelcase's Waste Reduction Methods.....	13

7. CONCLUSIONS AND RECOMMENDATIONS .....	13
CONCLUSIONS.....	13
RECOMMENDATIONS .....	14
APPENDIX A. STEELCASE PROJECT REPORTS .....	A 1
APPENDIX B. PACKAGING ELIMINATION AT STEELCASE .....	B 1
APPENDIX C. WASTE REDUCTION PERSONNEL AT STEELCASE .....	C 1
APPENDIX D. SAMPLE MACHINE IMPROVEMENT FORM .....	D 1

### List of Tables

Table 1. Machine Improvements Results .....	4
Table 2. Waste Reduction at Steelcase .....	12



## 1. SUMMARY

This case study documents solid waste reduction by Steelcase Inc. at its Grand Rapids and Kentwood complexes. Waste reduction activities analyzed include the Machine Improvement Program, remanufacturing, packaging source reduction, and recycling. A group of four Machine Improvement projects were selected for study. Equipment and process changes implemented through the Machine Improvement Program have reduced material waste, machine downtime, energy consumption, and operating costs. Major findings are:

- Improvements in IMA Edge Bander reduce waste by 16.9 tons per year.
- High Performance Roll Form Machine improvements eliminate 45 tons of waste annually.
- Assembly Table modifications reduce waste by 4.3 tons per year.
- Other machine improvements result in substantial economic savings and increase production efficiency and quality.
- Machine improvements documented in this report save Steelcase \$45,420 annually.

Steelcase reduces packaging waste outside its operations by shipping products uncartoned where possible, reusing containers, and lowering the board grade of those cartons still used. Examples of these source reduction efforts are:

- Uncartoned chairs shipped with reusable foam buns to protect seat cushions and make them stackable reduce waste generation by 1,200 tons per year and save Steelcase \$890,000 annually.
- Uncartoned shipments of sixty inch binder bins reduce waste by 70 tons per year.

Pallet reuse reduces waste generation at Steelcase by 296 tons per year, and yields \$23,130 annually in pallet sales and avoided disposal costs.

Through ownership of Revest, a remanufacturing subsidiary, Steelcase contributes to solid waste reduction by refurbishing and reselling furniture that would otherwise be discarded.

Materials that are recycled, or are under consideration for recycling, include corrugated board, foam, fabric, office paper, oil, and scrap steel.

- By recycling corrugated cardboard, Steelcase can save \$218,000 annually and divert 3,500 tons of waste from landfills.
- Office paper recycling diverts 138 tons of material from state landfills each year, and saves Steelcase \$7,920 annually.

The impact of waste reduction practices detailed in this report could be substantial, because many machine improvements and recycling programs at Steelcase are readily transferable to other manufacturers.

Steelcase Inc. has integrated waste reduction into the company's general strategy concerning costs, quality, environmental impact, and public image. Participative management at Steelcase creates an organizational structure that encourages all employees to be involved in waste reduction and production improvements. The success of Steelcase's waste reduction programs may be due, in large part, to the active participation of employees at all levels of the company. Other manufacturers wishing to adopt similar waste reduction strategies may find the methods discussed in this report are more transferable when accompanied by an organizational structure similar to that of Steelcase.

## 2. INTRODUCTION

### THE PROBLEM OF NONHAZARDOUS SOLID WASTE IN THE FURNITURE MANUFACTURING SECTOR

There are 352 furniture manufacturers in the state of Michigan. The furniture manufacturing sector generated 30,700 tons of nonhazardous solid waste in Michigan in 1983.<sup>1</sup> A major component of this waste is packaging material, primarily corrugated cardboard. Other constituents include: scrap wood and steel, sawdust, foam, fabric, and office paper.

### WASTE REDUCTION IN THE FURNITURE MANUFACTURING SECTOR

Furniture manufacturers can reduce waste by process and machine improvements which may also increase efficiency and lower costs. Reduction of packaging and packing material is an additional important strategy for lessening waste production in this sector. As many shipments as possible can be sent in reusable packaging, and all packaging and packing can be designed to reduce material requirements and enhance recyclability. Sawdust, steel, fabric, wood, foam scraps, oil, and other materials resulting from manufacturing can also be reused or recycled. Designing products to be durable and easily repaired extends product life and significantly reduces the number of items discarded each year.

### THE SELECTION OF STEELCASE

Steelcase successfully practices a variety of source reduction activities. This case study focuses primarily on the reduction of manufacturing scrap through machine and process improvements. Other waste reduction activities at Steelcase include: reduced packaging for product shipments, recycling programs that divert materials from landfills, and a remanufacturing program in which used office furniture is purchased, refurbished, and resold. Product life extension through remanufacturing reduces the rate at which furniture is discarded as waste.

In addition to a successful waste reduction program, other characteristics made Steelcase well-suited for this case study: its waste reduction practices are transferable to other manufacturers, information was readily available, and a substantial amount of solid waste reduction could be achieved if these practices were implemented throughout the state.

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<sup>1</sup> *Pollution Abatement Costs and Expenditures*; Current Industrial Reports, Bureau of Census, U.S. Dept. of Commerce, 1983. (MA-200(83)-1)

## DESCRIPTION OF STEELCASE INC.

Steelcase is a privately owned, multinational corporation based in Grand Rapids, Michigan. Steelcase produces metal and wood office furniture, computer furniture, seating, fabrics, desks, tables, credenzas, filing cabinets, office lighting, and personalized amenities. It has manufacturing plants in eleven countries, with 20,700 employees worldwide and 14,300 domestic employees. Its consolidated North American net sales were \$1.9 billion in 1989, a 21.5% market share.

Steelcase operates facilities containing 20 million square feet of floor space worldwide; 17 million square feet are located in North America. Steelcase owns the following subsidiaries: Stow and Davis, a manufacturer of fine wood furniture with 1.2 million square feet of facilities and 754 employees in Kentwood, a suburb of Grand Rapids; Steelcase Design Partnership, headquartered in New York; Atwood Corporation of Lowell, Michigan; Hedberg Design Systems, East Windsor, CT.; and Revest, a furniture remanufacturer with facilities in Atlanta and Dallas.

The Grand Rapids area complexes studied in this report are all Steelcase entities and do not include subsidiaries such as Stow and Davis. Steelcase's Grand Rapids area facilities employ 8,614 people and encompass 10,597,457 square feet of floor area. Included in this figure are 12 manufacturing and support buildings, corporate headquarters, and a corporate development center.

## CONTENT AND ORGANIZATION

This report focuses on the reduction of manufacturing waste through machine and process changes. Other waste reduction practices at Steelcase are also described. The report is divided into the following main sections:

- A detailed case study containing process and cost analyses of selected machine improvements
- Description of other waste reduction activities such as recycling, packaging reduction, and remanufacturing
- Organizational/motivational analysis of waste reduction programs at Steelcase
- A discussion of the transferability of Steelcase's practices to others in the manufacturing sector and a general overview of the possible impact of such waste reduction practices on the state's waste stream
- Conclusions and recommendations

Although this case study report presents several successful waste reduction practices, it is not meant as a comprehensive guide to waste reduction for the furniture manufacturing sector. Other resources include: the Office of Waste Reduction Services, Michigan Departments of Commerce and Natural Resources, and the U.S. Environmental Protection Agency.<sup>2</sup>

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<sup>2</sup> Manual for Waste Minimization Opportunity Assessments; U.S. EPA Hazardous Waste Emergency Research Lab, April 1988 (EPA/600/2-88-025); and Waste Minimization Manual; Developed by University of Michigan School of Natural Resources, for U.S. EPA; Draft, July 1990.

### 3. DETAILED CASE STUDY: WASTE REDUCTION THROUGH THE MACHINE IMPROVEMENTS PROGRAM

The on-site research for this case study was conducted at several of Steelcase's 14 Grand Rapids area facilities. Steelcase operations in this area generated approximately 13,000 tons of solid waste in 1990. Some of this waste is burned in a Grand Rapids incinerator that produces 8,000 pounds of steam per hour.

#### PROCESS AND COST ANALYSIS

An integral part of waste reduction at Steelcase is the Machine Improvements Program. It is a proactive program to improve production processes by reducing material waste, machine downtime, energy consumption, and operating costs. This study is concerned primarily with material waste that traditionally enters the municipal solid waste stream.

Waste reduction achieved by the Machine Improvement Program is documented at Steelcase in individual project reports. Each Machine Improvement report includes a physical description and cost analysis. Copies of a select group of project reports from Steelcase are included in Appendix A. Over the last several years, hundreds of Machine Improvement projects have been implemented and documented by the company. The Steelcase project reports do not analyze savings in waste disposal costs resulting from waste reduction. A set of four Machine Improvement projects are described in the following subsection.

#### Machine Improvements Program

Table 1 shows how the four machine improvements reduced waste and lowered costs at Steelcase.

Table 1. Machine Improvements Results

Machine Improvement	Project Cost	Net Annual Savings	Payback Period (mo.)	Annual Waste Reduction (tons)
IMA Edge Bander	\$543	\$8,587	0.71	16.9
Assembly Table	\$174	\$20,697	0.1	4.3
3 Conveyors	\$1,750	\$8,415	2.07	-
Box Roll Former	\$404	\$7,721	0.6	-

#### *IMA Edge Bander Machine* - Computer Furniture Plant

This machine bands the edges of tables and desk tops with a laminated plastic strip. A table top is first cut to width, then rotated and squared with a one eighth inch cut. Tops were occasionally not cut squarely because mechanical switches failed to sense the top as it was delivered.

When tops were not cut squarely, they were disposed of as scrap. This occurred three or four times per day and interfered with the plant's production schedule. To improve the reliability of the machine, photoeye sensors were installed to sense tops as they entered the cutting unit and switches upgraded. A blow-off fan was also installed to keep the photoeye sensors clear of dust.

The cost of these improvements was \$543 and the net annual saving was \$8,587. The IMA edge bander machine improvement resulted in a 25% materials savings, and significantly improved production scheduling. The payback period for this improvement was 0.71 months.

Sensor improvements and other adjustments reduced waste production by three 45 pound pieces of composite board per day. Projected to a 250 day annual production schedule, IMA edge bander improvements will reduce waste production at Steelcase by 16.9 tons per year.

#### *Assembly Table - Computer Furniture Plant*

Desks and tables are assembled here. Previously, various pieces occasionally fell out of position, unnoticed by assemblers until it was too late to readjust them. Poorly positioned pieces were cut off and reassembled.

Eight supports now hold pieces in position until the glue has dried. This one-time improvement cost \$174 and resulted in a net estimated annual saving of \$20,697. The payback period was 0.1 month.

Before this improvement, eight 3.6 pound pieces of wood trim were scrapped per day over a 300 day annual production schedule. The new support system reduces waste generation by 4.3 tons per year.

#### *Conveyor Lift Shutdown - Computer Furniture Plant*

Prior to this improvement, conveyors ran continuously during the day, delivering pallets once every 15 minutes. Due to the automatic nature of this system, errors along the conveyor route or at lifts occasionally went unnoticed for a time, causing damage to some palleted packages.

A machine improvement engineer reprogrammed the controller to operate the conveyor and lift only when a specified amount of product accumulated, eliminating unnecessary electricity use when the conveyor was not needed. Changes in the conveyor and lift operation also reduced package damage. After reprogramming, conveyors stopped until they received a full load of pallets, then switched on until all the pallets had gone through the line. Conveyors ran for three minutes after shutdown to ensure that all pallets have gone through before shutting down again. The conveyor run time decreased from ten hours per shift to 0.4 hours per shift, and waste from packaging damage was reduced by 30-40%.

Conveyor reprogramming reduced electricity consumption and maintenance. Production down time decreased, and a smaller maintenance staff for the conveyors is now needed. In addition, conveyor improvements extend system life (belts, rolling gears, motors and chains) by an estimated four times. Noise levels in the production areas also decreased.

Three conveyor and lift systems were modified for a total cost of \$1,750. Estimated yearly savings were \$8,415, and the payoff period was 2.07 months. The cost efficiency and brief payback period of this machine modification led to similar improvements on several different conveyor systems in the computer furniture plant and in the production distribution center (PDC). These modifications were an early Machine Improvement project. Conveyors are now often started and stopped manually.

#### *Box Drawer Roll Former Machine - Systems Plant*

This machine's sensor had been malfunctioning during start-ups and after breaks, causing approximately 25 door bodies to be scrapped per week. To correct the problem, a machine

improvements engineer installed a different sensor at the entry side of the machine to prevent products from entering the machine in the case of a malfunction.

Cost of the project was \$404 for labor and material. The net cost saving was an estimated \$7,990 per year and the payback period was 0.6 months.

### **Other Machine Improvements**

Other machine improvements reduce costs by reducing energy consumption, reducing material requirements, or otherwise making a process more efficient. They do not necessarily eliminate solid waste. An example of a significant waste reducing machine improvement follows.

#### *High Performance Roll Form Machine - Systems Plant*

No economic data were available for this machine improvement. New computer hardware and software were installed on the High Speed Roll Form Line, allowing faster processing of motor commands and faster response to those commands. Accuracy of the Flying Cutoff on the new system tripled after the improvements. On the old system, the Feeder could only be tuned with difficulty, and adjustments were soon lost, forcing reduced production rates. Dramatically improved accuracy on the new system can be maintained by software tuning which does not deteriorate. Line speed can thus be increased and is no longer a significant factor in accuracy. Improvements on the Flying Cutoff and Feeder reduce scrap from 2-5 parts at start up to 0-2 parts each start up. The only major cause of cutting errors now is variation in the steel feedstock. Improvements to the High Speed Roll Form Machine save 70,000 parts per year and reduce solid waste by 45 tons annually.

## **4. OTHER WASTE REDUCTION ACTIVITIES**

Steelcase generated 13,000 tons of solid waste in 1990; by 1992 the company will be generating 15,000 tons per year. Steelcase's Grand Rapids area incinerators do not have the capacity to burn all the waste generated by its operations. Approximately 7,500 tons were incinerated in 1990, and the remaining 5,500 tons were disposed in a landfill. Steelcase estimates that tipping and hauling fees for waste disposal were \$334,000 in 1990.

The tipping fee is currently \$39.07 per ton. In several years, that price is expected to be around \$100 per ton. Hauling adds another \$65 per ton to Steelcase's waste disposal costs. This cost includes labor for hauling, but does not account for labor involved in gathering waste at individual plants. In fiscal 1990, total solid waste disposal costs (not including incineration) were \$678,000.

Motivated by increasing disposal costs, Steelcase initiated a partial study of its nonhazardous solid waste stream in 1988. Waste loads were weighed at several plants and assessed for materials that could be sold, given to the community, or reused. After contacting various recycling firms, Steelcase determined that materials recovery and recycling could lower disposal expenses and reduce environmental impact of its manufacturing operations.

## SOURCE REDUCTION

### Packaging Program

Strategies followed by Steelcase for packaging source reduction include: uncartoned shipments, reusable packaging, and packaging and packing materials reduction. Packaging engineers in the Physical Distribution Department research ways to reduce the amount of packaging required for certain products. Although packaging research at Steelcase is primarily motivated by economic considerations, it also results in significant solid waste reduction.

Packaging does not represent a solid waste problem for Steelcase because it is shipped from the plant with products and presumably never returns. Nevertheless, elimination of packaging by Steelcase decreases the company's indirect contribution to the solid waste stream.

#### *Uncartoned Shipments*

Steelcase ships unpackaged furniture as an established practice. Conversion from cartoned to uncartoned products at Steelcase was a trade-off between two conflicting factors: savings in packaging material, contrasted with reduced efficiency of storing, handling, and shipping those uncartoned products that can not be stacked. New methods of protecting uncartoned shipments allow most to be stacked, increasing shipping productivity. Steelcase is currently shipping 40% of its orders uncartoned. Several substitutes for protective cartons have been used: expanded polystyrene buns, corrugated desk caps, blankets, and stretch wrapping.

Polystyrene buns protect chair cushions, allowing uncartoned chairs to be stacked in the staging area without damage. Buns are reusable and are backhauled to the factory by delivery trucks. Shipping chairs in buns rather than cartons reduces solid waste generation by 1200 tons per year and saves Steelcase \$890,000 annually.

Sixty inch binder bins are also shipped uncartoned. This practice reduces possible waste discards outside Steelcase facilities by an additional 70 tons per year.

Corrugated cardboard desk caps fit both ends of a desk. A pair can be used on a desk of any length, so only the depth of the desk matters. As a result, three standardized sizes can be used for all models. Blankets are also reusable and help minimize contributions to the solid waste stream by replacing single-use containers. Stretch wrapping can protect items from dust and other intrusions, eliminating some of the disadvantages of uncartoned shipments.

#### *Packaging and Packing Material Reduction*

Board grade reduction decreases the weight and cost of those cartons still used. Many furniture containers have been redesigned to require less material while maintaining structural integrity. Such redesigned containers perform as well as the more material intensive containers they replace.

In addition, Steelcase has been able to stretch the plastic wrap used for some packages by an additional 50%, significantly reducing material requirements. Packing materials are also distributed more efficiently within packages, reducing overall requirements. All these strategies reduce potential waste production outside Steelcase's operations while saving money.

A partial list of packaging reduction and elimination measures employed at Steelcase is given in Appendix B.

## **Reuse**

### *Containers*

Parts and components can be shipped to subsidiary plants in reusable metal containers or wooden shooks which are then returned to the distribution point. Backhauling empty containers for reuse avoids additional energy inputs for transportation and is more efficient, in terms of energy and materials management, than recycling single-use containers.

### *Pallets*

Wooden pallets are sold to Kamps Pallets, a major pallet supplier in the Grand Rapids area, for one dollar each. In the 14 months that a pallet reuse program has been operating at Steelcase, 13,800 pallets have been recovered. Each pallet weighs 50 pounds, so the Steelcase pallet reuse program has diverted 346 tons of material from state landfills, or 296 tons per year. Steelcase received \$10,160 for the pallets sold to Kamps and avoided \$13,500 in landfill fees and \$3,315 in hauling fees. Total revenues and avoided costs for the 14 month period were \$26,975. Kamps Pallets also hauls any irreparably damaged pallets which result from Steelcase's operations at no charge.

## **REMANUFACTURING BY REVEST**

Revest, a recently acquired subsidiary of Steelcase, extends the useful life of furniture through remanufacturing. Furniture materials are thereby diverted from landfills or incinerators. The beneficial impact of Steelcase's remanufacturing on the solid waste stream has not been quantified. Some typical remanufacturing operations are:

- Refinishing of metal surfaces
- Repair of scratches, dents, and holes
- Re-upholstering of panels and chairs
- Re-lamination of work surfaces
- Replacement of defective parts

Because Revest provides an outlet for used furniture, Steelcase dealers can offer buy-back and trade-in agreements to purchasers of new furniture. Revest also offers loading, hauling, and storage services to customers.

## **RECYCLING PROGRAM**

Steelcase has been recycling scrap sheet steel for many years. Other materials have recently been examined for their recycling potential. In November and December 1988, Steelcase began the initial phase of its recycling investigation in two plants. For two years, each plant recorded data on waste composition to identify materials best suited for recycling.

Steelcase also investigated markets to determine whether outlets exist for recovered material. A complete waste stream assessment has not yet been performed at Steelcase. Because components of the waste stream vary dramatically between those Steelcase facilities studied, the relative importance of various recoverable materials cannot be accurately estimated. An alphabetical list of materials currently being recycled, or targeted for future recycling, follows.



## **Corrugated Cardboard**

Steelcase currently burns much of its corrugated board waste in an incinerator that generates 8,000 pounds of steam per hour. Because a market exists for old corrugated board, Steelcase recently decided to recycle corrugated waste and use its limited incinerator capacity to burn other combustible components of the waste stream, thereby reducing overall waste hauling and tipping costs.

According to a November 1989 internal Steelcase report, recycling corrugated cardboard would annually divert 3,500 tons of material from landfills and save \$218,000.

## **Fabric**

Fabric can be recycled in some locations, but market prices for recovered material are low. However, at those plants where fabric represents a substantial percentage of total discards, fabric recycling could result in substantial savings through avoided landfill costs.

## **Foam**

Some recycling outlets for foam exist, and foam scrap has a limited market value in these locations. Again, avoided landfill costs provide an incentive to recycle for Steelcase facilities producing large amounts of foam waste.

## **Office Paper**

Segregated paper commands a market price of about \$100 per ton. Starting in late October 1990, Steelcase began recycling office paper at Corporate Headquarters. As of November 30, 1990, 13.3 tons have been collected, avoiding \$520 in landfill fees and \$244 in hauling fees. Extrapolated over a one year period, Steelcase will divert 138 tons of material from landfills and save a total of \$7,920 in avoided landfill and hauling fees from this one program alone. An office paper recycling program began at Corporate Services on December 10, and a similar program will be instituted at the Corporate Development Center in January 1991.

## **Oil**

Used oil must be tested for contaminants before it is recycled. Approximately \$90,000 can be saved annually by recycling oil.

## **Scrap Steel**

Last year Steelcase decreased its scrap steel disposal by one percent. The scrap rate is tracked monthly by weight. Louis Padnos Iron and Metal Company, a Holland scrap dealer, purchases collected steel scrap of all sizes from Steelcase.

## **5. ORGANIZATIONAL AND MOTIVATIONAL ANALYSIS**

Factors influencing waste reduction practices of Steelcase Inc. can be divided into four categories:

1. Societal awareness of the environment
2. Business costs associated with the environment
3. Company philosophy and policies
4. Steelcase's World Class Manufacturing program

The first two categories are not unique to Steelcase. They could be the basis for similar waste reduction activities in many other businesses. Factors in the third and fourth categories are more specific to Steelcase and are instrumental in establishing an organizational environment that encourages waste reduction.

### **SOCIETAL AWARENESS OF THE ENVIRONMENT**

Society's awareness of natural resources and environmental issues has increased during the past two decades. As a result, businesses are scrutinized by regulators, employees, and the public. Managers and workers are thus motivated to be more concerned about the impact on the environment of their working activities, and this can lead to an increased corporate interest in waste reduction and resource conservation.

### **BUSINESS COSTS AND WASTE REDUCTION**

As the costs of natural resources, energy, and waste disposal have increased, so has the desire to eliminate some of these costs through resource conservation and solid waste management.

### **STEELCASE INC. PHILOSOPHY**

Steelcase management seeks good relations with its customers, employees, and the surrounding community. A large manufacturing company inevitably affects the environment, but Steelcase attempts to reduce the environmental impact of its operations as much as possible.

### **WORLD CLASS MANUFACTURING**

Steelcase's strategy for manufacturing improvement is named World Class Manufacturing. This program helps create an organizational and attitudinal framework in which solid waste reduction becomes an integral part of the company's management and production activities. The development and implementation of solid waste reduction measures are not assigned to a single manager or department, rather all employees are encouraged to participate in manufacturing improvements.

World Class Manufacturing (WCM) comprises five principles:

- Employee Involvement
- Elimination of Waste
- Product Group Focus
- Quality
- Throughput

WCM provides a formal organizational structure that integrates waste reduction into employee activities and management decision making.

Employee Involvement is the central principle of WCM. Steelcase's participative management program actively enlists employees in decision making. Teams of approximately ten people meet at least one hour per week to develop new ideas, make recommendations, and plan innovations. Each team adopts projects designed to make environmental responsibility an integral part of daily activities.

Waste Elimination includes all waste: labor, energy, and material. Every activity at Steelcase should ideally add value to products, if not, it is eliminated.

Product Group Focus links process and design operations to promote standardization and enhance manufacturability.

Throughput is the rate at which a customer's order is transformed into sales dollars. Improved throughput reduces lead time and maximizes manufacturing efficiency.

The following programs are the result of World Class Manufacturing principles.

### **Machine Improvements Program**

This program is an integral part of waste elimination at Steelcase. It was initiated by a foreman in 1986 to reduce machine down time. Every maintenance person is now considered a machine improvement expert, and suggestions about improvements are actively sought from line operators and engineers. A special form was created for submitting machine improvement ideas. A sample form is included in Appendix D.

Two or three maintenance personnel, including a millwright, machine repair specialist, or electrician, are selected at each plant to serve on a full-time machine improvement team. Ideas for improvements are analyzed and documented and project reports are disseminated to other plants by these teams.

### **Waste Ownership**

For two and one half years, personnel at Steelcase conducted partial studies of the company's solid waste stream and considered possible waste reduction methods. Because of this research and a strong emphasis on waste reduction, the company can now track portions of its waste stream. Steelcase currently requires each plant to be accountable for its own waste generation.

As an example, the origin and amount of scrap steel produced is recorded, and reduction efforts are then effectively targeted. The ownership of waste and resulting responsibility for disposal encourages departments to reduce waste generation and improve the production efficiency of their respective products.

### **Quality and Durability**

Quality is one of the five principles of WCM. Steelcase seeks to produce high quality, durable products that require infrequent repair or replacement. Steelcase underscores its commitment to quality by offering ten year warranties on its products. Items designed to have long service lives and be repairable do not directly affect Steelcase's waste stream, but such a manufacturing and design strategy decreases solid waste generation by customers.

## 6. IMPACT AND TRANSFERABILITY

### IMPACT

Steelcase's goal of "zero waste to the landfill" is probably not attainable because incinerator ash usually weighs 10-20 percent of the incoming solid waste. However, waste reduction achieved at Steelcase through machine improvements, reuse of containers and materials, and recycling is significant. The amount of material diverted from landfills by various waste production programs at Steelcase is presented in Table 2.

**Table 2. Waste Reduction at Steelcase**

<b>Activity</b>	<b>Annual Reduction</b>
4 Machine Improvements	66 tons
Uncartoned Chair Shipments	1200 tons
Uncartoned Binder Bin Shipments	70 tons
Pallet Reuse	296 tons
Paper Recycling	138 tons
Corrugated Recycling	3500 tons

The figures in Table 2 do not represent a comprehensive quantification of waste reduction at Steelcase. None of the general waste reduction strategies practiced by Steelcase are confined to the furniture manufacturing sector. Reduction of the state's solid waste stream could be substantial if other manufacturers adopt the strategies detailed in this report.

### TRANSFERABILITY

Steelcase links waste reduction and environmental responsibility with product quality, reduced costs, profit sharing, and public image. As a result, employees identify their own waste reduction activities with the general success of the company and with environmental preservation.

Waste reduction practices studied in this report can be adopted by many manufacturing companies outside the furniture sector. Appendix C provides a list of waste reduction activities at Steelcase and the names of employees associated with each program.

#### *Factors Enhancing Transferability of Steelcase's Waste Reduction Methods*

- Machine improvements at Steelcase significantly reduce waste generation.
- Reducing waste through machine improvements increases productivity, enhances competitiveness, and reduces costs.
- Many other waste reduction methods at Steelcase significantly reduce costs. Substantial motivation for waste reduction was provided by these cost savings, a factor that all manufacturers should share with Steelcase.
- None of the documented waste reduction methods are confined to furniture manufacturers. Other manufacturers can adopt similar methods to reduce waste generation, lower costs, and increase competitiveness.

### *Impediments to Transferability of Steelcase's Waste Reduction Methods*

- Formal mechanisms, such as participative management that actively involves employees, are a key to the success of Steelcase's waste reduction programs. Companies lacking such an organizational structure may have less success with their waste reduction programs.

## **7. CONCLUSIONS AND RECOMMENDATIONS**

### **CONCLUSIONS**

- Process changes and machine improvements result in significant source reduction of solid waste at Steelcase. Steelcase diverts 66 tons of material from state landfills annually through just the machine improvements reviewed in this report.
- Machine improvements saved Steelcase money. Process and machine improvements frequently reduce inputs of labor, energy, and raw materials while also lowering pollution and solid waste generation. The machine improvements documented in this case study saved Steelcase \$45,420 in one year.
- Other source reduction methods practiced by Steelcase lower waste generation. Shipping 40% of office furniture uncartoned, reusing packing and containers, and reducing board grade of cartons still used substantially lowers waste discards by customers and at Steelcase.
- Successful examples of packaging source reduction include: shipment of uncartoned binder bins, reducing waste by 70 tons per year; and employment of reusable foam buns that allow chairs to be shipped uncartoned, thus reducing annual waste generation by an additional 1,200 tons. Shipping chairs uncartoned saves \$890,000 annually.
- Pallet reuse diverts 296 tons of waste from state landfills each year and yields \$23,130 annually from sale of pallets and avoided disposal costs.
- Remanufacturing of used furniture by Revest, a subsidiary of Steelcase, is a profitable business activity that reduces waste.
- Recycling can reduce waste generation at Steelcase even further. A newly instituted, partial paper recycling program will reduce waste generation by 138 tons annually at Steelcase and save the company \$7,920 per year. Recycling corrugated board could divert another 3,500 tons from landfills each year, at an annual savings of \$218,000. Fabric, foam, and oil could also be recycled.
- The success of Steelcase's solid waste reduction activities depends on several factors: a strong corporate policy to reduce waste, employee participation, cost effectiveness, and integration with other business activities.
- Impact on the state's waste stream could be substantial if other manufacturers followed waste reduction programs similar to those of Steelcase.
- Waste reduction programs implemented by Steelcase are not specific to the furniture manufacturing industry and can be readily transferred to other manufacturing sectors.

## **RECOMMENDATIONS**

Based on the case study of Steelcase Inc., manufacturers and other businesses interested in waste reduction should consider the following recommendations to facilitate the implementation of individually designed waste reduction programs.

- Review the waste reduction activities practiced by Steelcase. Process and machine improvements, along with packaging reduction, reuse, and recycling can be adopted by all manufacturers.
- Perform process and cost analyses to evaluate the technical and economic feasibility of each waste reduction plan.
- Contact recycling companies for information on collection, hauling, and sale of recyclable materials.
- Make waste reduction an integral part of product design. Extending the useful life of a product by designing for durability and reusability is an effective strategy for minimizing waste.
- Establish a corporate policy to encourage waste reduction.
- Mobilize employees by enlisting their participation and by integrating solid waste reduction with other business activities.

APPENDIX A. STEELCASE PROJECT REPORTS

Machine Improvement  
Cost Saving Analysis

Project: IMA Edge Bander Machine A/N 3141  
MI # 26-90  
Date 09-89

Project Description : Tops are being cut out of square because the mechanical switches are not sensing the the top. Photo eyes were installed to make sure the tops were sensed entering the unit. A blow off was also installed to keep the eyes clear from dust.

Est. Cost Savings Rate	Hours	1st Year	2nd Year	3rd Year
Production Labor		0	0	0
Maintenance Labor		0	0	0
Machine Utilization		0	0	0
Production Material		9,130	9,130	9,130
Maint. Material		0	0	0
Material Handling		0	0	0
Device Change		0	0	0
Contractor		0	0	0
Energy Usage		0	0	0
<b>Total Cost Savings</b>		<b>\$9,130</b>	<b>\$9,130</b>	<b>\$9,130</b>
Est. Project Cost		1st Year	2nd Year	3rd Year
Maintenance Labor	8	265	0	0
Tooling Labor		0	0	0
Contractor		0	0	0
Material		278	0	0
<b>Total Project Cost</b>		<b>\$543</b>	<b>\$0</b>	<b>\$0</b>
Est. Cost Savings		9,130	9,130	9,130
Est. Project Cost		543	0	0
Negative Carry Over		0	0	0
<b>Yearly Net Cost Savings</b>		<b>\$8,587</b>	<b>\$9,130</b>	<b>\$9,130</b>

3 Year Average Annual Savings \$9,130  
3 Year Average Net Savings \$8,949  
3 Year Average Project Cost \$181

Project Pay Back 0.71 Months

COST SAVINGS ANALYSIS WORK-SHEETCOST SAVINGS

Large tops were cut out of square as per operator

3 to 4 damaged tops a day ( 90" x 30" )

3 x \$ 24.86656 x 250 days = \$ 24,866.56

wood Core Cost ( 60" x 30" )

2 to 3 damaged

3 x \$ 15.5416 x 250 days = \$ 11,656.20

Total Cost Savings----- \$ 36,522.76

Top would have to be cut down to a different size, therefore using the remainder of the wood core. In lieu of this fact, we are only taking 25 % of this total

\$ 9,130.69

PROJECT COST

Cost

Photo switches ordered 5-15-89

3---Telemechanique photo switches ( dark operated )

XUG-H303235 \$ 84.60 each \$ 253.80

1/4" X 1 1/2" X 48" Flat stock steel \$ 10.00

Misc. Hardware \$ 5.00

8 hrs labor @ \$ 13.25 x 2.5 = \$ 264.96

Auto blow off to clean dust off eyes

Misc. Hardware \$ 10.00

Total

Cost----- \$ 542.96

PAY BACK PERIOD

3 YEAR AVERAGE OF THE SUMS OF THE ANNUAL COST SAVINGS =  
(\$ ) / 12 MONTHS = ( \$ SAVINGS PER MONTH. )

SUMS OF THE ANNUAL PROJECT COSTS = ( \$ ) DIVIDED BY  
(\$ SAVINGS PER MONTH) = ( PAY BACK MONTHS. )

A 2

MAINTENANCE SUPERVISOR: \_\_\_\_\_ DATE: \_\_\_\_\_

REDACTED INFORMATION

DATE:



Computer Furniture

Machine Improvement  
Cost Saving Analysis

Project: 8600 Assembly Table A/N  
MI # 25-90  
Date 07-89

Project Description : Add support to hold pieces in position until the glue has dried. Previously, the pieces would fall out of position unnoticed by the assembler until it was too late to readjust. The part would then have to have these pieces cut off and re-run.

Est. Cost Savings Rate	Hours	1st Year	2nd Year	3rd Year
	8.91			
Production Labor	75	1,671	1,671	1,671
Maintenance Labor		0	0	0
Machine Utilization		0	0	0
Production Material		19,200	19,200	19,200
Maint. Material		0	0	0
Material Handling		0	0	0
Device Change		0	0	0
Contractor		0	0	0
Energy Usage		0	0	0
<b>Total Cost Savings</b>		<b>\$20,871</b>	<b>\$20,871</b>	<b>\$20,871</b>
Est. Project Cost		1st Year	2nd Year	3rd Year
Maintenance Labor	5	166	0	0
Tooling Labor		0	0	0
Contractor		0	0	0
Material		8	0	0
<b>Total Project Cost</b>		<b>\$174</b>	<b>\$0</b>	<b>\$0</b>
Est. Cost Savings		20,871	20,871	20,871
Est. Project Cost		174	0	0
Negative Carry Over		0	0	0
<b>Yearly Net Cost Savings</b>		<b>\$20,697</b>	<b>\$20,871</b>	<b>\$20,871</b>
3 Year Average Annual Savings			\$20,871	
3 Year Average Net Savings			\$20,813	
3 Year Average Project Cost			\$58	

Project Pay Back

A 3

0.10 Months

COST SAVINGS ANALYSIS WORK-SHEETCOST SAVINGS

8 pieces @ 8.00 on 54" 8600 line tops have to be removed and scrapped. Average 6 tops per week as per Dan Kempker and Glen Holencheck

8 x \$ 8.00 x 6 per week x 50 weeks = \$ 19,200.00

Cost to re-run top

15 minutes x \$ 8.91 x 6 tops X 50 weeks x 2.5 = \$ 1,670.25

Total \$ 20,870.25

PROJECT COST

16 -- 1/4 " Thumbwheel screws @ \$ .50ea = \$ 8.00

Labor

5 hrs @ \$ 13.25 x 2.5 = \$ 165.62

Total \$ 173.62

PAY BACK PERIOD

3 YEAR AVERAGE OF THE SUMS OF THE ANNUAL COST SAVINGS =  
(\$ 20,813 ) / 12 MONTHS = ( \$ 1,734 SAVINGS PER MONTH.)

SUMS OF THE ANNUAL PROJECT COSTS = ( \$ 58 ) DIVIDED BY  
(\$ 1,734 SAVINGS PER MONTH) = ( .1 PAY BACK MONTHS.)

MACHINE IMPROVEMENT ACCOUNTABILITY FORM

1. DATE: 11/1/87

2. MACHINE TYPE & ASSET NO. CONVEYOR AND LIFT #7934-B

3. DEPT. & LOCATION: 7423 N-20 CF-F1

4. SUGGESTION OR PROBLEM: Modify program in programmable controller to operate conveyor and lift only when product is on conveyor and has accumulated loads to a specified amount, instead of running lift and conveyor continually. This modification will reduce cost of electricity, maintenance, and wear of mechanical parts such as rollers, belts, motors, chains and lubrication. This modification will also reduce noise levels in the production areas.

5. SUGGESTED BY: Paul Matthews

6. MODIFICATION OR SOLUTION: Modify program. This modification will reduce the actual running time of the lift and conveyors from 10 hours per shift to 2.87 hours per shift.

7. SUBMITTED BY: Paul Matthews

8. COST ANALYSIS:

A. CURRENT YEARLY COST.....	\$	3816.00
B. ALTERNATE YEARLY COST.....	\$	389.00
C. YEARLY COST SAVINGS.....	\$	3427.00
D. LABOR + MATERIAL COST.....	\$	500.00
E. PAYOFF.....	$\frac{I}{S}$	= 0.15 yrs.

9. APPROVED BY: Al Vis, Bob Ellis

MACHINE IMPROVEMENT ACCOUNTABILITY FORM

1. DATE: 11/1/87

2. MACHINE TYPE & ASSET NO. CONVEYOR AND LIFT #7934-C

3. DEPT. & LOCATION: 7427 P-21 CF-F1

4. SUGGESTION OR PROBLEM: Modify program in programmable controller to operate conveyor and lift only when product is on conveyor and has accumulated loads to a specified amount, instead of running lift and conveyor continually. This modification will reduce cost of electricity, maintenance, and wear of mechanical parts such as rollers, belts, motors, chains and lubrication. This modification will also reduce noise levels in the production areas.

5. SUGGESTED BY: Paul Matthews

6. MODIFICATION OR SOLUTION: Modify program. This modification will reduce the actual running time of the conveyors and lift from 10 hours per shift to 4/10's hours per shift.

7. SUBMITTED BY: Paul Matthews

8. COST SAVINGS:

A. CURRENT YEARLY COST.....	\$	4185.00
B. ALTERNATE YEARLY COST.....	\$	152.00
C. YEARLY COST SAVINGS.....	\$	4033.00
D. LABOR + MATERIAL COST.....	\$	500.00
E. PAYOFF.....	$\frac{I}{S}$	= 0.12 yrs.

9. APPROVED BY: Al Vis, George Goosen

MACHINE IMPROVEMENT ACCOUNTABILITY FORM

1. DATE: 11-01-87

2. MACHINE TYPE & ASSET NO. CONVEYOR AND LIFT #7934-A

3. DEPT. & LOCATION: 7421 K-20 CF-F1

4. SUGGESTION OR PROBLEM: Modify program in programmable controller to operate conveyor and lift only when product is on conveyor and has accumulated loads to a specified amount, instead of running lift and conveyor continually. This modification will reduce cost of electricity, maintenance, and wear of mechanical parts such as rollers, belts, motors, chains and lubrication. The amount of downtime will also be reduced. This modification will also reduce noise levels in the production areas.

5. SUBMITTED BY: Paul Matthews

6. MODIFICATION OR SOLUTION: Modify program. This modification will reduce the actual running time of the lift and conveyors from 10 hours per shift to 2.1 hours per shift.

7. SUBMITTED BY: Paul Matthews

8. COST SAVINGS:

A. CURRENT YEARLY COST.....	\$	3077.00
B. ALTERNATE YEARLY COST.....	\$	500.00
C. YEARLY COST SAVINGS.....	\$	2705.00
D. LABOR + MATERIAL COST.....	\$	750.00
E. PAYOFF.....	$\frac{I}{S}$	= 0.28 yrs

9. APPROVED BY: Al Vis, Arden Edema

SYSTEMS 1

MACHINE IMPROVEMENT

COST - SAVINGS ANALYSIS

PROJECT: Product Damage Roll-Form

A/N # 2726  
 M I # 73-90  
 DATE: 11-03-89

**PROJECT DESCRIPTION:**

Paul Dzwonek day shift operator of our Box Drawer Roll-Former and PM team member for Department 2221 had brought to my attention that over the past year the Former on the Roll-Form Machine has been malfunctioning during start-ups and after breaks. This malfunction is causing approximately 25 parts per week to be scrapped.

After investigating the problem, I determined a sensor in the Former which indicates the part is present should be changed to a different type. Also, the electrical circuit was modified and another sensor was installed at the entry side of the Former. This sensor will allow for product tracking and prevent accumulated product from entering the Former if a form malfunction was to take place.

<u>ESTIMATED COST SAVINGS</u>	<u>1ST. YEAR</u>	<u>2ND. YEAR</u>	<u>3RD. YEAR</u>
LABOR PRODUCTION	N/A	N/A	N/A
LABOR MAINT.	N/A	N/A	N/A
MATERIAL SAVINGS PROD.	\$ 8,125	\$ 8,125	\$ 8,125
MATERIAL SAVINGS MAINT.	N/A	N/A	N/A
MATERIAL HANDLING	N/A	N/A	N/A
DEVICE CHANGE	N/A	N/A	N/A
<b>TOTALS.</b>	<b>\$ 8,125</b>	<b>\$ 8,125</b>	<b>\$ 8,125</b>

<u>ESTIMATED PROJECT COST</u>	<u>1ST. YEAR</u>	<u>2ND. YEAR</u>	<u>3RD. YEAR</u>
LABOR MAINT.	\$ 199	N/A	N/A
LABOR TOOLING	N/A	N/A	N/A
CONTRACTOR	N/A	N/A	N/A
MATERIAL	\$ 205	N/A	N/A
<b>TOTALS.</b>	<b>\$ 404</b>	<b>\$</b>	<b>\$</b>

	<u>1ST. YEAR</u>	<u>2ND. YEAR</u>	<u>3RD. YEAR</u>
ESTIMATED COST SAVINGS	\$ 8,125	\$ 8,125	\$ 8,125
ESTIMATED PROJECT COST	- \$ 404	- \$ 0	- \$ 0
NEGATIVE CARRY OVER	- \$	- \$	- \$
<b><u>YEARLY NET COST SAVINGS</u></b>	<b>\$ 7,721</b>	<b>\$ 8,125</b>	<b>\$ 8,125</b>

3 YEAR AVERAGED ANL COST SAVINGS	\$ 8,125	PER YEAR	
3 YEAR AVERAGED NET COST SAVINGS	\$ 7,990	PER YEAR	<b>A 8</b>
3 YEAR AVERAGED PROJECT COST	\$ 135	PER YEAR	
PROJECT PAY BACK PERIOD	.596	MONTHS	

# COST SAVINGS ANALYSIS WORK-SHEET

## COST SAVINGS

### MATERIAL SAVING PRODUCTION

MARK STOKEN CALCULATED AN AVERAGED COST OF THE PARTS RUN ON THE ROLL-FORM UP TO OPERATION 20 IN THE WELD DEPT USING INTELLECT.

THE AVERAGE PART WORTH CALCULATES TO \$6.50 EA.

25 PARTS PER WK \* \$6.50 EA \* 50 WKS IN A YR. = \$8,125

P/N 1324026-5 \$ 7.00

P/N 1514027 \$ 6.50

P/N 2324026-3 \$ 6.00

### PROJECT COST

#### LABOR MAINT.

TIME TO INSTALL EYES AND WIRE CIRCUIT MODIFICATIONS

6 HRS \* \$33.12 PER HR. = \$198.72

#### MATERIAL

2 EYES \$ 75 EA

1 TIMER \$ 55 EA

TOTAL \$205

### PAY BACK PERIOD

3 YEAR AVERAGE OF THE SUMS OF THE ANNUAL COST SAVINGS =  
(\$ 8,125 ) / 12 MONTHS = ( \$ 677.08 SAVINGS PER MONTH. )

SUMS OF THE ANNUAL PROJECT COSTS = ( \$ , 404 ) DIVIDED BY  
( \$ 677.08 SAVINGS PER MONTH ) = ( .596 PAY BACK MONTHS. )

MAINTENANCE SUPERVISOR: \_\_\_\_\_ A9 \_\_\_\_\_ DATE: \_\_\_\_\_

DEPARTMENT SUPERVISOR: \_\_\_\_\_ DATE: \_\_\_\_\_

## **APPENDIX B. PACKAGING ELIMINATION AT STEELCASE**

### **I. Reduction of Packing Parts and Material**

1. Board grade reduction of corrugated cartons for desks, files, tables, E E panels, binder bins, 8000 and 9000- line panels.
2. Elimination of expanded polystyrene (EPS) foam side-block of cartoned E E panels.
3. Redesign of context top cap- reduction of board usage and savings of approximately \$200,000 per year.
4. Purchase of new stretch wrap machines with film pre-stretching capabilities- 50% less film usage.
5. Pending reduction of outer shipping carton by substitution with stretch-wrapping- estimated waste reduction of 1,000 tons per year.
6. Wood shooks used to ship raw parts to subsidiaries- reusable container with an average life of five trips.
7. Metal tubs- used with EPS blocks to ship panel base trim to vendor and back for plating

### **II. Changing Formally Carton Items to Uncartoned**

1. Elimination of 60" binder bins- 9.3 lbs/bin x 1,258 bins/month x 12 months= total of 70 tons per year of source reduction.
2. Uncartoned shipment of sensor chairs, using foam bun: 11 lbs/chair x 4,359 chairs/week x 52 weeks= total of 1,246 tons per year of source reduction. Buns weigh 0.5 lbs. and have life of four trips. Also, 300 cartoned chairs are loaded per trailer, versus 190 cartoned chairs. Total savings: \$890,000 per year.

### **III. Increase in Uncartoned Shipments**

1. Steelcase is working on ways to have dealers order more uncartoned shipments. Current orders are approximately 40% uncartoned.



## **APPENDIX C. WASTE REDUCTION PERSONNEL AT STEELCASE**

**Simon Aguilar, Supervisor of Energy Center, Coordinator of recycling, and the Waste Minimization Project**

**Rich Anthony, Packaging reduction**

**Bill Baxter, director of World Class Manufacturing Program**

**Don Bennett, Packing reduction**

**Mike Dorn, Chair Plant, foam recycling**

**Al Dykehouse, Director of Plant Engineering and Maintenance**

**Pat Irish, Computer Furniture, sawdust and scrap wood**

**Ken Leatherman, Panel Plant, fabric recycling**

**Sam Mancuso, Superintendent of Maintenance**

**Vern McCormick, Machine Improvements Program, Assistant Foreman**

**Bob Michaels, Chair Plant, foam recycling**

**Tom Nichols**

**John Velthouse, Print Shop, office paper recycling**

**Mike Willyard, Computer Furniture, sawdust and scrap wood**

**APPENDIX D. SAMPLE MACHINE IMPROVEMENT FORM**

**MACHINE PROBLEM  
or  
IMPROVEMENT FORM**



*• Please use this form for Machine Improvement Ideas*

Submitted by: \_\_\_\_\_ Date \_\_\_\_\_

Plant: \_\_\_\_\_ Dept.: \_\_\_\_\_ Asset #: \_\_\_\_\_ Post: \_\_\_\_\_

Machine or Equipment Description: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Problem or Improvement Idea:** \_\_\_\_\_  
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**• PLEASE FILL OUT FORM COMPLETELY AND TURN INTO YOUR DEPARTMENT SUPERVISOR •**

**SUPERVISOR: FORWARD TO PLANT MACHINE IMPROVEMENT GROUP**