

# Improving Profitability Through Green Manufacturing

CREATING A PROFITABLE AND  
ENVIRONMENTALLY COMPLIANT  
MANUFACTURING FACILITY



DAVID R. HILLIS  
J. BARRY DUVALL

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Environmentally Compliant  
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# IMPROVING PROFITABILITY THROUGH GREEN MANUFACTURING

## PREFACE

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Let us tell you our story—we were on the road, driving over to meet with people at a manufacturing plant in western North Carolina. We were early for our meeting so we thought we would stop at a fast food restaurant for coffee and a chance to review our meeting agenda. We carried our coffees back to the table, opened a file folder, and booted-up a laptop. A minute later we were surprised to find that we didn't have enough table space. Our two cups of coffee and the packaging debris of cup lids, cream containers, sugar packets, napkins, stirrers, and a tray left just enough room for one laptop or one open file folder. So we made a quick trip to the waste container to dump all this trash and leave the tray. We realized that even though all this trash was annoying it had served a purpose—it had utility. We finished our coffees and left for the meeting.

When we arrived our host asked if we cared for a coffee. We declined with a laugh and recounted our experience with “coffee waste.” They wanted to know if the restaurant “recycled?” It did not but we pointed out that that was not the issue. So we mentioned the “Three Rs.” It is a path for waste reduction promoted by Singapore's National Environment Agency and other agencies

around the world. The “R”s stand for “Recycle, Reuse, and Reduce” packaging and convenience materials. The goal for implementing the Three Rs is to minimize the amount of solid waste that is generated daily. For us, the reality of this concept struck home on another business trip to southern California.

On that trip we stayed at a chain hotel that provides a complimentary breakfast for its guests. There were two of us at the table and by the time we finished eating the entire table was covered in packaging litter. There were single-use plastic spoons, knives, plastic foam cereal bowls, paper coffee cups, plastic juice cups, paper milk cartons, plastic fruit containers, paper sugar envelopes, napkins, and several cellophane wrappers. We picked up all this litter and placed it into the appropriate recycling containers: paper, plastic, and food refuse. We had accomplished the first R—Recycling.

When our morning meetings were finished we stopped at a corner restaurant for lunch. We had soup, salad, and coffee. This food all arrived on sturdy china plates with stainless steel flatware. There were paper napkins, but that was the only single-use item. All the other items were in the second category—Reuse.

Finally, at the end of the workday our host suggested we have dinner at an Ethiopian restaurant. There were four of us at the table and the food was brought out on a large platter. There were some bowls with sauces but little else. There were no eating utensils. We discovered that we were to use the flat bread that was served to scoop up the food. By the time we finished eating there was one large empty tray in the center of the table along with a few bowls. The restaurant had provided cloth napkins, which would be laundered and reused. The dinner was an example of the third category—Reduce.

These stories help make the point that a strategy for waste reduction should aim at moving up the hierarchy away from single-use items to a system that reduces the packaging and convenience items. Recycling therefore is not an endpoint but a starting point for the Three Rs of waste reduction. So, you may ask how do you move up this hierarchy? A partial answer is waste

reduction begins with the design of the product. Recycling is accepting the current design and then trying to make the best use of the waste that is generated by that design. In our southern California trip we started the day with a “serving design” for breakfast that was predicated on recycling. By evening of that day the serving design for dinner was based on the third R, reduce. That design had less waste. So think of the Three Rs as a systems approach to waste reduction. The approach presented in this book is also a systems approach, but it is applied to manufacturing. Both approaches provide a strategy for analysis, decision making, change, and improvement. They also provide opportunities! The beauty of the systems approach is that it can be used to analyze complex things and make them simple. Albert Einstein said it well: “make everything as simple as possible, but not simpler.”

In our discussions with corporate executives and environmental groups, and working with practicing professionals on the plant floor, we came to the realization that success in manufacturing is not based on magic or “green technology.” We learned that traditional manufacturing companies can be environmentally responsible and profitable through improved decision making.

In this book we provide a model for improvement that you can modify and apply in your own way, in your own environment. We have provided examples of this systems approach along with supporting methods and techniques that are being used by a variety of manufacturing companies to be environmentally responsible and profitable. Now it is up to you! We hope this will be helpful to you in your company and industry. Please let us know how things go and feel free to contact us if we can help you in the future.

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# CHAPTER 1

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## MANUFACTURING

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### INTRODUCTION

It frequently surprises people when they learn that the world's leading manufacturing country is the United States of America. Why this may be so astonishing is the prevalence of “Made in China” labels found on so many consumer products, particularly clothing and electronics. In 2007, prior to the recession in the latter part of that decade, the value of goods produced by the United States reached over \$1.8 trillion. (see <http://unstats.un.org/unsd/snaama/cList.asp>)—and, even more surprising, the amount produced in 2007 was nearly twice the value made two decades earlier. Today the United States is still a major producer, generating much of its prosperity from manufacturing. Nevertheless, there is no doubt that a large portion of our products come from overseas.

Part of the reason the United States continues to lead in the production of goods is the manufacturing methods or procedures

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that were developed during the twentieth century. These methods enabled companies to produce large amounts of affordable goods profitably. During the latter half of that century other nations adopted these methods and even made substantial improvements. Now many believe that manufacturing in the United States is too costly both in dollars and harm to the environment. This is not true. There are ways to make manufacturing sustainable and profitable while meeting environmental obligations and requirements.

## MANUFACTURING SEQUENCE

To understand how this can be done let's begin by examining the *manufacturing sequence*. The production of a product begins after a raw material has been transformed into a manufacturing "stock." Think of "pig iron" as a raw material and 16-gauge cold-rolled steel as a manufacturing stock. Yes, an argument can be made that pig iron is a manufacturing stock after iron ore has gone through a smelting process. Regardless of where the starting point occurs there is a specific series of steps that occur in the manufacture of a product and its sale to a customer. Figure 1.1 illustrates these steps.

A simple example of this sequence is the manufacture of a molded plastic bowl that is actually a component that will be assembled with other parts to create a more complex product—an inexpensive food processor. The bowl is produced by a molding process using a stock of plastic pellets. The pellet stock is polystyrene, which is produced from an aromatic polymer that comes from a liquid hydrocarbon manufactured from the *raw material*, petroleum. The food processor is next distributed to a customer. After years of use the bowl cracks and the owner finds that it has a recycle number "6" discretely molded on the bottom of the bowl. The owner of the bowl deposits it in a recycling bin that ultimately allows it to be *recycled* into another stock. The manufacturing sequence in this instance is a closed loop, illustrating one of the several definitions for a *product life cycle*.