Preface

Once upon a time, a consultant made a visit to a development project. The consultant looked at some of the code that had been written; there was a class hierarchy at the center of the system. As he wandered through the hierarchy, the consultant saw that it was rather messy. The higher-level classes made certain assumptions about how the classes would work, assumptions that were embodied in inherited code. That code didn't suit all the subclasses, however, and was overridden quite heavily. If the superclass had been modified a little, then much less overriding would have been necessary. In other places some of the intention of the superclass had not been properly understood, and behavior present in the superclass was duplicated. In yet other places several subclasses did the same thing with code that could clearly be moved up the hierarchy.

The consultant recommended to the project management that the code be looked at and cleaned up, but the project management didn't seem enthusiastic. The code seemed to work and there were considerable schedule pressures. The managers said they would get around to it at some later point.

The consultant had also shown the programmers who had worked on the hierarchy what was going on. The programmers were keen and saw the problem. They knew that it wasn't really their fault; sometimes a new pair of eyes are needed to spot the problem. So the programmers spent a day or two cleaning up the hierarchy. When they were finished, the programmers had removed half the code in the hierarchy without reducing its functionality. They were pleased with the result and found that it became quicker and easier both to add new classes to the hierarchy and to use the classes in the rest of the system.

The project management was not pleased. Schedules were tight and there was a lot of work to do. These two programmers had spent two days doing work that had done nothing to add the many features the system had to deliver in a few months time. The old code had worked just fine. So the design was a bit more "pure" a bit more "clean." The project had to ship code that worked, not code that would please an academic. The consultant suggested that this cleaning up be done on other central parts of the system. Such an activity might halt the project for a week or two. All this activity was devoted to making the code look better, not to making it do anything that it didn't already do.

How do you feel about this story? Do you think the consultant was right to suggest further clean up? Or do you follow that old engineering adage, "if it works, don't fix it"?

I must admit to some bias here. I was that consultant. Six months later the project failed, in large part because the code was too complex to debug or to tune to acceptable performance.

The consultant Kent Beck was brought in to restart the project, an exercise that involved rewriting almost the whole system from scratch. He did several things differently, but one of the most important was to insist on continuous cleaning up of the code using refactoring. The success of this project, and role refactoring played in this success, is what inspired me to write this book, so that I could pass on the knowledge that Kent and others have learned in using refactoring to improve the quality of software.

What Is Refactoring?

Refactoring is the process of changing a software system in such a way that it does not alter the external behavior of the code yet improves its internal structure. It is a disciplined way to clean up code that minimizes the chances of introducing bugs. In essence when you refactor you are improving the design of the code after it has been written.

"Improving the design after it has been written." That's an odd turn of phrase. In our current understanding of software development we believe that we design and then we code. A good design comes first, and the coding comes second. Over time the code will be modified, and the integrity of the system, its structure according to that design, gradually fades. The code slowly sinks from engineering to hacking.

Refactoring is the opposite of this practice. With refactoring you can take a bad design, chaos even, and rework it into well-designed code. Each step is simple, even simplistic. You move a field from one class to another, pull some code out of a method to make into its own method, and push some code up or down a hierarchy. Yet the cumulative effect of these small changes can radically improve the design. It is the exact reverse of the normal notion of software decay.

With refactoring you find the balance of work changes. You find that design, rather than occurring all up front, occurs continuously during development. You learn from building the system how to improve the design. The resulting interaction leads to a program with a design that stays good as development continues.

What's in This Book?

This book is a guide to refactoring; it is written for a professional programmer. My aim is to show you how to do refactoring in a controlled and efficient manner. You will learn to refactor in such a way that you don't introduce bugs into the code but instead methodically improve the structure.

It's traditional to start books with an introduction. Although I agree with that principle, I don't find it easy to introduce refactoring with a generalized discussion or definitions. So I start with an example. Chapter 1 takes a small program with some common design flaws and refactors it into a more acceptable object-oriented program. Along the way we see both the process of refactoring and the application of several useful refactorings. This is the key chapter to read if you want to understand what refactoring really is about.

In Chapter 2 I cover more of the general principles of refactoring, some definitions, and the reasons for doing refactoring. I outline some of the problems with refactoring. In Chapter 3 Kent Beck helps me describe how to find bad smells in code and how to clean them up with refactorings. Testing plays a very important role in refactoring, so Chapter 4 describes how to build tests into code with a simple open-source Java testing framework.

The heart of the book, the catalog of refactorings, stretches from Chapter 5 through Chapter 12. This is by no means a comprehensive catalog. It is the beginning of such a catalog. It includes the refactorings that I have written down so far in my work in this field. When I want to do something, such as Replace Conditional with Polymorphism, the catalog reminds me how to do it in a safe, step-by-step manner. I hope this is the section of the book you'll come back to often.

In this book I describe the fruit of a lot of research done by others. The last chapters are guest chapters by some of these people. Chapter 13 is by Bill Opdyke, who describes the issues he has come across in adopting refactoring in commercial development. Chapter 14 is by Don