

Chapter 1

Introduction

Engineering design probably started when an unknown caveman had an imaginative idea for making a better club with which to fend off a fellow caveman or bring home more meat for dinner. Ever since, people have attempted to create bigger and better structures and products to improve their lives. I have always been amazed at how the Egyptians built the Pyramids and the Romans the Coliseum and Forum with the tools they had at hand. Even in the past century, it is amazing to those of us whose lives are centered around computers to envision building structures such as the Golden Gate Bridge and the Empire State Building or designing hybrid automobiles and supersonic aircraft without the tools we have become accustomed to.

The computer has changed the practice of engineering forever. In the most simplest terms it has taken the drudgery out of the design process. In the words of James Clerk Maxwell “the human mind is seldom satisfied, and is certainly never exercising its highest functions, when it is doing the work of a calculating machine.”¹

Today, the Computer-Aided Design (CAD) industry is a multi-billion dollar business with literally millions of engineers, architects, and drafters using these computer systems on a daily basis. The technology has clearly changed how many professions are practiced, predominately, but not in all cases, for the better. It was not always obvious that we would succeed in this endeavor. Computers were too slow, the software plagued with errors and functional shortcomings and management didn’t want to rock the boat. Eventually, the industry solved both the technical and management issues and today few would want to tackle any complex design project without the latest available technology.

This book is intended to tell the story about how we have gone from a few academics with great foresight to an industry that produces the tools used to design everything from new razors to airplanes that fly around the world non-stop. As in few other disciplines, the work of developing this technology was built on the experiences of those that went before. It makes for a fascinating story.

How Did I End Up Writing This Book?

I first decided that I wanted to be an engineer when I was twelve years old and was watching the construction of a school building a few blocks from my home. Unlike many of my friends, I never wavered from this goal while in junior high school and high school and at the age of 18 found myself a freshman at the Massachusetts Institute of Technology firmly intending to become a civil engineer and build bigger and better dams and bridges. That started to change when at the end of a sophomore surveying final exam in the spring of 1957, Professor Charles Miller (see Chapter 5) asked me if I wanted to work for him that fall on a project he was supervising that involved applying computer technology to engineering design.

¹ Goldstine, Herman - *The Computer - from Pascal to von Neumann* 1972 - Princeton University Press, p. 343

Talk about a life changing decision. For the next half century I was involved in the development, marketing and writing about computer technology as applied to engineering design and manufacturing. Miller frequently talked to us about the analogy between how machines changed physical labor and how computers would change the way people solved intellectual problems.

This book is my attempt to document how the computer changed the practice of engineering. I have chosen to do it by looking at the companies and individuals who created this new technology, primarily through the eyes of someone who was there.

As with anyone writing this type of book, it is probably best to lay out my credentials up front. Academically, I have BS and MS degrees in civil engineering from MIT. The MS may be a little misleading in that Professor Miller was attempting to change how civil engineering was being taught at MIT and was experimenting with reaching out to other disciplines. I ended up doing as much graduate work in business management and operations research as I did in civil engineering. There were few computer science courses at the time – in fact we didn't even call it computer science.

By the time I received my masters degree there was little question in my mind that I wanted to work in the new emerging computer industry rather than practice civil engineering. This is when I met the second person who had a major impact on my professional career, Jack Gilmore (that is his picture on the cover of this book). Jack was the vice president of a small software consulting firm that was engaged in developing a graphics system for doing computer-aided drafting (see Chapter 6). Except for several years in the Army, I worked for Jack at Adams Associates (later named Keydata) until late-1969. Nearly all my work involved computer graphics including the design and implementation of the first graphics-oriented oil refinery control system.

This was followed by a stint in corporate planning at URS, a major architectural and engineering firm, and then working as a salesman for Calma, one of the first commercial CAD² vendors (see Chapter 11). After Calma, I worked for Tektronix in several different marketing and sales management positions. Tektronix was the major vendor of graphics terminals in the 1970s and early 1980s. For several years it attempted to develop an end user CAD system business for which I ran the field operations side.

In 1980 I joined Auto-trol Technology (see Chapter 9) where I spent the next 12 years in a variety of marketing, sales and software development management positions. For several years in the early 1980s I was responsible for the company's competitive analysis activity. Being a natural pack-rat (just ask my wife), I saved a considerable amount of material from that work that has helped in writing this book.

My career took a significant change in direction in late 1991 when I formed Technology Automation Services and began publishing *Engineering Automation Report*. For the next eight years I covered the CAD industry, interviewing many of the people mentioned in succeeding chapters. In 1994, I acquired the *Anderson Report on Computer Graphics* started by Ken Anderson in 1978 and then in 1997 I acquired the *A-E-C Automation Newsletter* started by Ed Forrest in 1977.

² For simplicity, I have decided to refer to this industry as Computer-Aided Design or CAD rather than use all the other acronyms that are applicable to specific aspects of the technology such as CAE for Computer-Aided Engineering, EDA for Electronic Design Automation, CAM for Computer-Aided Manufacturing or PLM for product Lifecycle Management. I have included an appendix explaining much of the nomenclature applicable to the material in this book.

In 2000 I sold the newsletter business to Cyon Research which subsequently acquired Stephen Wolfe's *Computer-Aided Design Report*. A decade earlier Wolfe had acquired *CAD/CIM Alert*, one of the industries other early newsletters. One result was that I ended up with nearly complete runs of the five most significant newsletters that covered the CAD industry. These provided a significant portion of the background material for the book.

Documenting an Evolving Industry

Why write a book about the CAD industry? That is a reasonable question and one I have attempted to answer many times while working on this book. This is an industry that got its start barely 60 years ago, shortly after the Second World War. Although we are starting to lose some of the early pioneers, many of the people who were instrumental in much of the early research and involved in forming the companies I write about are still alive and kicking. That might not be the case 20 years from now. Therefore, I felt that it was important to document this important industry while they were still in a position to contribute.

Over the course of my career in this industry, I have been fortunate to meet and get to know many of the individuals I write about. With few exceptions, they have all been very helpful in answering my many questions and in volunteering material I might not have otherwise had access to.

The other reason for doing it is that no one has written a book about the industry as a whole and only a few books have been written about individual companies in the CAD industry. In fact I can only think of two – John Walker's *The Autodesk File* and Richard MacNeal's *The MacNeal Schwendler Company – The First Twenty Years*. There have been a number of books that cover specific aspect of design technology such as Donald LaCourse' *Handbook of Solid Modeling*, David Rogers' *An Introduction to NURBS* and Jami Shah and Martti Mäntylä's *Parametric and Feature-Based CAD/CAM*. On the other hand, there have been countless books written about using one or another of the various CAD software packages being sold. For example, David Cohn alone has written or co-authored over 15 books on AutoCAD.

This is a fairly close knit community. One of the aspects that make it an interesting story is the way key people have moved from one company to another over the course of the past 40 years. A number of people have been involved in two, three or even more start-ups, each time trying to create the next great technology.

One of the other reasons I wanted to write this book is that there is a lot of inaccurate information floating around. One well-respected consultant has on his web site that Computervision and Applicon were founded in 1972 when they were actually started in 1969. Another market research firm had Auto-trol Technology's revenue in 1980 as 87% mechanical when in fact, mechanical was a much smaller portion of the company's business. I have gone to great pain in an attempt to ensure that the facts contained in this book are as accurate as possible. Where a statement is my opinion I have tried to make it clear that such is the case.

What This Book Is and Is Not

As any reader can see, this is a fairly lengthy book. It could easily have been several times as large - perhaps two or three volumes. My intent was not to outdo Will

and Ariel Durant and their 11 volume *History of Civilization*. The hard decision was where to draw the line. One part of the decision was to write about what I was most familiar with, both from a research perspective and the companies described in detail.

A significant result is that the book covers early research at MIT but not a lot about what went on at other universities. Unfortunately, this means just passing attention has been paid to work done at Cornell, Syracuse, the University of Utah, the University of Rochester and Rensselaer Polytechnic Institute. Also, significant work done at the University of Cambridge in England is covered only as it affected other elements of this story.

The second decision was to focus on companies and technologies applicable to mechanical design and manufacturing with some AEC (Architecture, Engineering and Construction) involvement. Even in the latter case, I do not spend much time on architecture per se. It could easily be a book in its own right as could Electronic Design Automation (EDA) which also is covered only to the extent that the companies I do write about were involved in that technology.

For the most part, the book covers software and systems companies headquartered in the United States. The fact remains that with just several significant exceptions, the vast majority of the worldwide CAD industry has been centered in this country. The major exception is Dassault Systèmes of France and that company is covered in depth in Chapter 13. Another exception is the field of architectural modeling which has been driven in part by several European firms, but that is a subject for another day.

Over the years there have been hundreds if not thousands of companies that have developed hardware and software products used to automate the engineering design process. The decision of which to cover has strictly been mine and I apologize to those, including some moderately successful firms, that space simply did not allow me to cover.

As the reader will see, I do not delve too deeply into the technology used to support CAD. There are no formulas describing how to solve the intersection of curved surfaces or discussion of the intricacies of object oriented software. I do make the assumption that the reader is generally knowledgeable about computer hardware and software although perhaps not as to how it applies to the CAD industry. There is an appendix that helps explain some of the terms and acronyms that are used.

Each chapter on a specific company stands on its own although I have tried to minimize redundancies between chapters.

Help From Many Sources

I would be hard pressed to thank everyone who has provided information for *The Engineering Design Revolution*. My standard statement in recent years has been “don’t throw it out, just ship it to me.” In no particular order I would like to thank Steve Wolfe, Brad Holtz, David Cohn, Joel Orr, Dick Sowar, Pat Hanratty, Dick Harrison, Fontaine Richardson, Carl Howk, Phil Villers, Tom Lazear, Rachael Taggart, Lee Whitney, Rick Carrelli, Steven Weisberg, Greg Smith, John Baker, Peter Marks, Dave Albert, Dick Miller, Russ Henke, Charles Lang, and everyone else who provided information and took the time to discuss their experiences.

