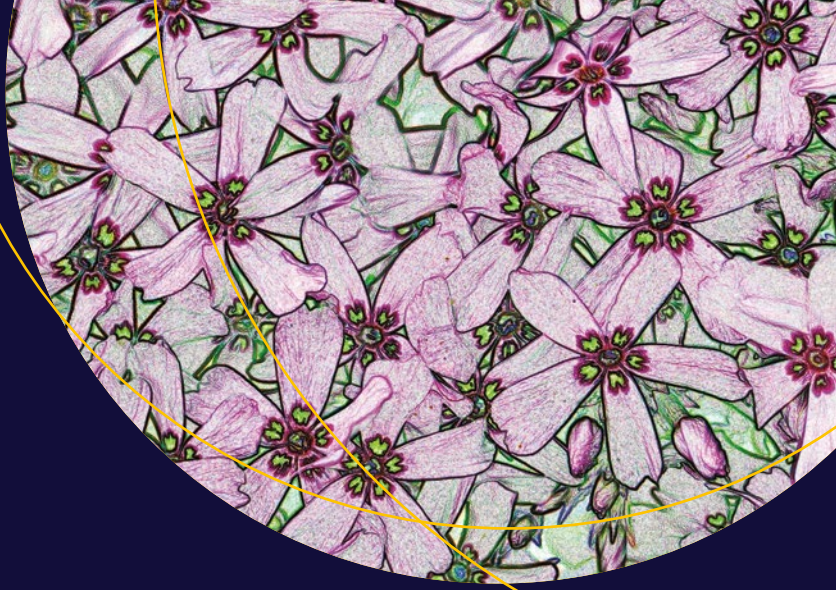

Databases for Small Business

Essentials of Database Management, Data Analysis, and Staff Training for Entrepreneurs and Professionals

Anna Manning

Apress®

DATABASES FOR SMALL BUSINESS

ESSENTIALS OF DATABASE MANAGEMENT, DATA ANALYSIS, AND STAFF TRAINING FOR ENTREPRENEURS AND PROFESSIONALS

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The Apress Business Team

This book is dedicated in loving memory of my wonderful parents, Peter and Pam, who could not have been more supportive of me.

Contents

About the Author

Anna Manning is a founding director of an engineering startup company, having worked for eight years as a data scientist at Manchester University. A specialist in data mining and data protection, she was one of the original designers of data mining based software for protecting confidential data now used by national statistics agencies worldwide. She has also served as a data analyst for a nonprofit organization for a number of years. Dr. Manning's papers in the field of data mining have been published in various research journals. She has a PhD in data mining and a master's degree in informatics from the University of Manchester, an honors degree in law from the University of Law, and a BA hons. in mathematics from Trinity College, Dublin. Anna enjoys cycling, debating, and going to the theater. She is a parish councilor in the village where she lives, near Chester in northwest England.

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Richard Roiger is a professor emeritus at Minnesota State University, Mankato, where he taught and performed research in the Computer & Information Science department for 27 years. Dr. Roiger holds a PhD in computer & information sciences from the University of Minnesota. After retirement, he continues to serve as an adjunct faculty member, teaching courses in data mining, artificial intelligence, and research methods. Richard is a textbook writer and has published several journal articles. Dr. Roiger is a board member of the Retired Education Association of Minnesota, where he serves as their financial advisor. Richard enjoys interacting with his grandchildren, traveling with his wife, writing, and pursuing his musical talents.

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A huge thank you to my husband, Howard, for helping me with the content of the book and providing me with endless encouragement (and cups of tea). The wheelbarrow design in the Smart Wheelbarrows Inc. case study came from Howard. He produced the drawings at the beginning of the chapter and explained which components would be necessary to build the wheelbarrow. He proofread most of the chapters before they were submitted, providing me with invaluable feedback.

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Introduction

Most people who run a small business are familiar with word processing and spreadsheets. However, relatively few are familiar with databases, even though the software is easily available and often free. I have written this book with the aim of addressing this knowledge gap.

This book is written with complete database beginners in mind, with an assumption that you have experience of spreadsheets. The book shows you how to create a database from scratch, all the way through to analyzing the data and presenting it in reports. The aim is that you can build the databases presented in the book and use them as a test suite to experiment on.

Four case studies are considered throughout the book. The aim of these case studies is to provide a good variety of small businesses. The examples are:

- A small online business selling greetings cards
- A small engineering business
- A small legal firm
- A small nonprofit

Even if your business is, for example, a legal firm, it is still worth reading the other examples as well. The important point to remember is that databases are not difficult to learn. If you are familiar with spreadsheets, it is only a small step to using databases.

Relational databases (the databases addressed in this book) have been with us for over 40 years. The fundamental criteria for their design and use have not changed enormously, despite the massive changes in technology that have occurred during this time. At present, databases are following a number of new trends—for example, moving away from the desktop and into the cloud. However, wherever your database is stored and however the instructions are given, you will need to understand the fundamentals of database design in order to be effective.

Database design is part of a process of data handling and processing. Before you can enter data into the database, the data needs to be collected and cleansed. Once it is stored, you will need to know how to take advantage of it by analyzing it and assessing whether your business is meeting its goals. You will need to be able to write clear and meaningful reports based on your analysis.

After reading this book and following the examples, you will be in the position to design a simple database of your own with tables, relationships, and simple queries over those tables. You will be able to analyze the data and write reports based on the results.

Even if you choose not to create a database yourself, after reading this book you will be an "intelligent customer." You will better understand potential database designs presented to you and will be able to decide whether they are being reasonably priced or, whether, as is often the case, they are an extremely simple design behind a fancy interface.

CHAPTER

1

How Data Can Benefit Your Small Business

Collecting and analyzing data is important to your small business because it can improve efficiency and profitability. Data can provide a record of what has been going on—who your customers are, what their demographic is, and what they've bought. It can enable you to find trends—for example, your customers' favorite products. There are hidden patterns in data that are important to your business, such as groups of products that sell together. Data can provide an archive that can be searched.

When those in small businesses find out what an enormous difference their data can make to them they are generally fascinated to find out more. The fact is, for small businesses, data is collected about many aspects of their operations already. All businesses collect details about income and expenditure in order to satisfy tax requirements. Many businesses collect the names and addresses of their customers so that they can contact them.

The aim of this book is to demonstrate that the data you are collecting has benefits far beyond its initial purpose. The book will explain the value of your data and show you how to take full advantage of it. The book is designed to be an introduction to databases and a signpost to further references, should these be necessary.

As a starting point, I am assuming that you have a basic familiarity with packages such as word processing and spreadsheets, but are completely inexperienced with databases. Further, I am aware that most small businesses don't have only one person working exclusively on their data and that most of their staff has several roles in the company. I also assume that your small business is constrained by a small budget.

You may have been using your data ineffectively for some time without realizing its full potential. If this is the case you will be delighted to have the improved insights and data analysis presented in this book. And, if you are simply storing your data without using it for anything beyond what's absolutely necessary, you will be pleasantly surprised to realize that the first and most important steps of learning the techniques for processing and analyzing your data are well within your reach.

Your business could be at one of a number of stages. You could be starting out and be keen to making sure you are fully abreast of the latest technology. You may have been operating for some time and wish to encourage further growth. Or your business may be experiencing challenging times and is looking for help to move forward. Whatever your circumstances, you will find that your data can make a significant difference to the profitability of your business.

What Is Meant by Data and Databases

The following sections describe the meaning of data and spreadsheets. Databases are introduced by using spreadsheets as a starting point.

Data

Data can take many forms, including numbers, text, images, hyperlinks, and sound. Data can be about any subject at all, or be about more than one subject.

Spreadsheets

As mentioned, I am assuming that you are familiar with spreadsheets, some common examples being Microsoft Excel, LibreOffice Calc, and Google Sheets. I will use a spreadsheet as a starting point for describing databases.

Spreadsheets and databases are both used to store and manage data. A very simplistic way of expressing the difference is to regard a spreadsheet as a large sophisticated programmable calculator and a database as a highly efficient electronic filing system that makes data quickly available for look-up and analysis. The main differences between spreadsheets and databases are how they store and manipulate data and often the amount of data involved.

A spreadsheet stores data items (e.g., numbers, text, and hyperlinks) in cells, with multiple cells represented in a system of rows and columns. Values in one cell can be related to values in other cells with the relationship defined by a formula.

Two of the most serious problems with spreadsheets are as follows:

- *Storing repeated data*: The same data may be stored in multiple spreadsheets. If you need to make changes to the data, the same change is likely required in every location where the data is stored, thus increasing the risk of errors.
- *Finding data*: Finding an item of data in a spreadsheet can involve scanning across numerous columns.

HYPOTHETICAL EXAMPLE OF A SMALL BUSINESS: CARDS FOR EVERYONE INC.

This book uses three case studies for the purposes of illustration: a small engineering firm, a small law firm, and a small nonprofit. They are introduced in the next three chapters. In addition, you'll read about a hypothetical example that depicts a small online business called Cards for Everyone Inc., which sells a range of cards online.

Cards for Everyone Inc. buys cards from a range of suppliers and displays images of them on its web site for sale. The web site was designed by a contractor so that employees of the company can update it themselves. The business has three employees: Pat, Zeph, and Leona.

Pat, the manager, has a number of roles, including buying the supplies and marketing the business. Pat must keep the web site up to date as stock levels change.

Zeph and Leona are assistants who process the orders by locating cards in the stockroom and putting them into envelopes for distribution. When new stock arrives, they place it in the storeroom and pass the details on to Pat so that she can update the web site.

A database addresses both of these issues. Repeated data items are minimized by splitting the data into tables (made up of rows and columns) so that, ideally, each data item is stored only once. Very efficient data retrieval is made possible by relationships defined between the tables: they link the data together and make retrieval efficient. Chapter 6 explains the pros and cons of spreadsheets and databases in more detail.

The next section gives an example of a database used by Cards for Everyone Inc.

A Database Used by Cards for Everyone Inc.

Typical data for a given customer in Cards for Everyone Inc. is their name, address, telephone number, and e-mail address. Table 1-1 shows an example database table containing this data for three customers. Each customer is allocated a row in the table, also known as a *record*. Every record is divided into five columns, one for each part of the record (i.e., Customer ID, Name, ZIP Code, etc.). Every customer record has a unique customer identification number, called the Customer ID. No two customers can have the same Customer ID, thus avoiding duplication.

Table 1-1. Basic Customer Database Table

Customer ID	First Name	Last Name	ZIP Code	Phone	E-Mail
1	Lisa	Garcia	MI 48823	517-xxx-xxxx	Lgarcia@hotmail.com
2	John	Williams	OR 97062	503-xxx-xxxx	Jwilliams@gmail.com
3	Steve	Jones	FL 33901	239-xxx-xxxx	Sjones@aol.com

Further database tables at Cards for Everyone Inc. contain details of products, suppliers, and invoices. As with the customers, each product, each supplier, and each invoice is given a unique identification number in their respective tables. Identification numbers can appear in more than one table in order to help construct relationships. At this point, these tables are for illustration purposes only; Chapter 7 contains more detail about their meanings and construction. Table 1-2 shows a table of five products for Cards for Everyone Inc., with the Product ID in column 1. Notice that the table has a column for the identification number of the supplier in column 2.

Table 1-2. Basic Product Database Table

Product ID	Supplier ID	Product Name	Category	Price ($)	Quantity Available
11	100	Cats	Birthday	2.00	5
20	200	Roses	Thankyou	3.00	8
23	200	Boats	Birthday	2.50	10
42	300	Hearts	Valentines	4.50	9
61	300	Rabbits	New Baby	5.00	11

A list of hypothetical suppliers is given in Table 1-3.

Table 1-3. Basic Suppliers Database Table

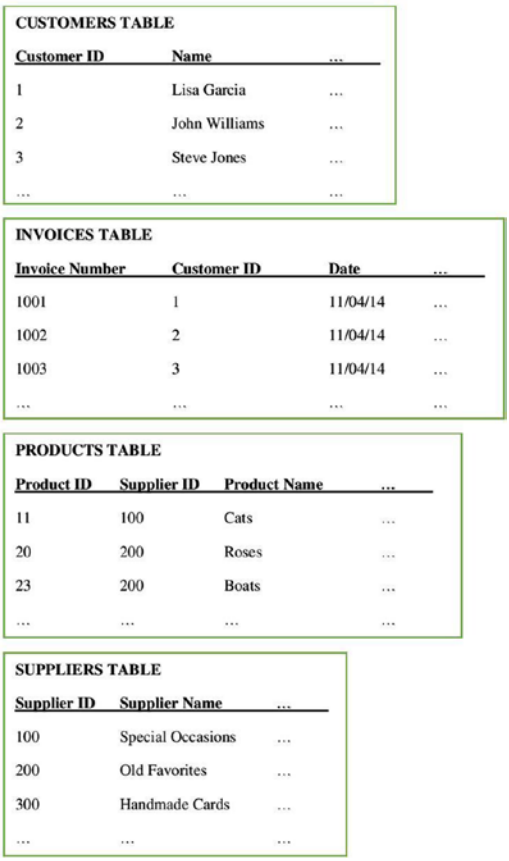
Supplier ID	Supplier Name	ZIP Code	Telephone	E-Mail
100	Special Occasions	IA 52241	319-xxx-xxxx	admin@specialoccasions.com
200	Old Favorites	CA 92591	503-xxx-xxxx	office@oldfavorites.com
300	Handmade Cards	FL 33351	954-xxx-xxxx	enquiries@handmadecards.com

Five invoice records are shown in Table 1-4 with the corresponding Customer IDs in column 2.

Table 1-4. Basic Invoices Database Table

Invoice No.	Customer ID	Date	Amount ($)
1001	1	11/4/14	...
1002	2	11/4/14	...
1003	3	11/4/14	...
1004	2	12/14/14	...
1005	1	12/18/14	...

At present these four tables are little more than four separate spreadsheets of data, as shown in Figure 1-1.



CUSTOMERS TABLE

Customer ID	Name	...
1	Lisa Garcia	...
2	John Williams	...
3	Steve Jones	...
...	...	...

INVOICES TABLE

Invoice Number	Customer ID	Date	...
1001	1	11/04/14	...
1002	2	11/04/14	...
1003	3	11/04/14	...
...	...	...	...

PRODUCTS TABLE

Product ID	Supplier ID	Product Name	...
11	100	Cats	...
20	200	Roses	...
23	200	Boats	...
...	...	...	...

SUPPLIERS TABLE

Supplier ID	Supplier Name	...
100	Special Occasions	...
200	Old Favorites	...
300	Handmade Cards	...
...	...	...

Figure 1-1. Separate Database Tables for Cards for Everyone Inc.

A database enables these tables, and their data, to be linked together using the unique identifiers of each table, as shown in Figure 1-2. A database structure such as the one shown in Figure 1-2 prevents you from having to store data repeatedly, risking both typing and mismatch errors. Databases are excellent for pulling data together, separating the themes, and enabling efficient storage, updates, and retrieval.

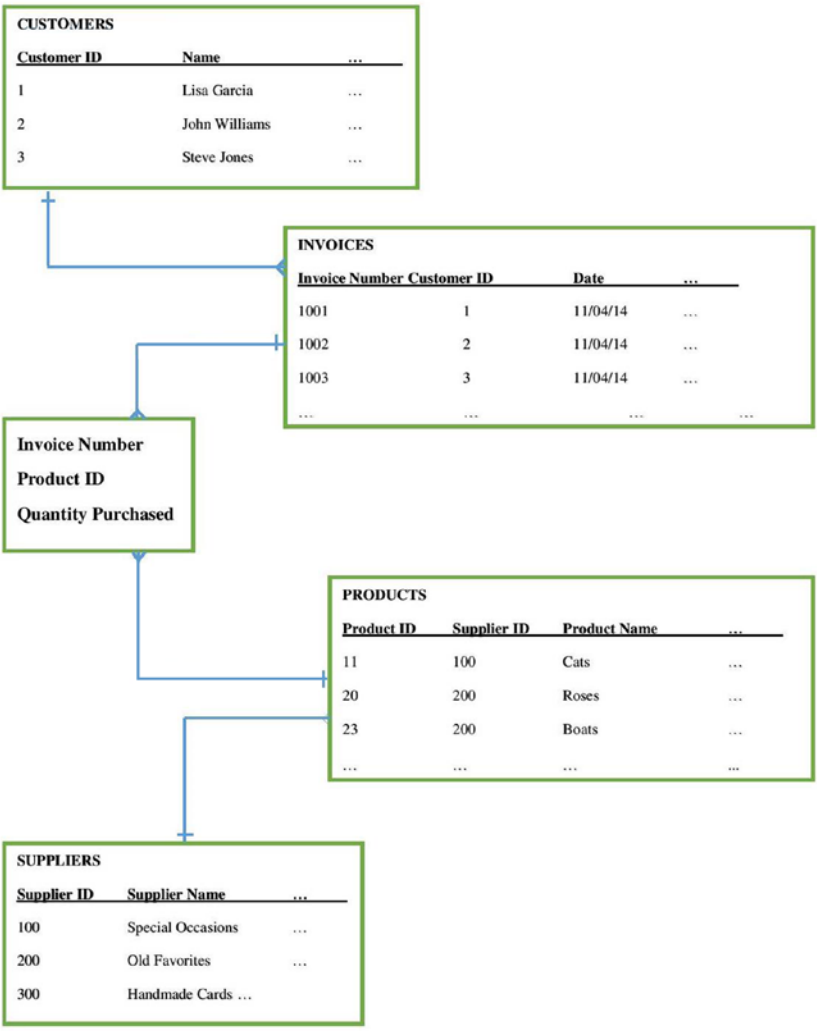


Figure 1-2. Linked database tables for Cards for Everyone Inc.

The resulting connected data structure can be viewed in three main ways:

> *Query*: This is a question asked about data in a database, from one or more tables or from other queries. Queries can be used to filter data, to perform calculations, to summarize data, and to perform management tasks. For example, when an order comes in, it would be useful to know if there are enough products in stock and, if not, where to order more from. This involves

querying the Products and Suppliers tables simultaneously. Queries can be highly complex, spanning many tables. Figure 1-3 shows a very simple database query from Cards for Everyone Inc. The query has counted the number of cards of each category in Table 1-2.

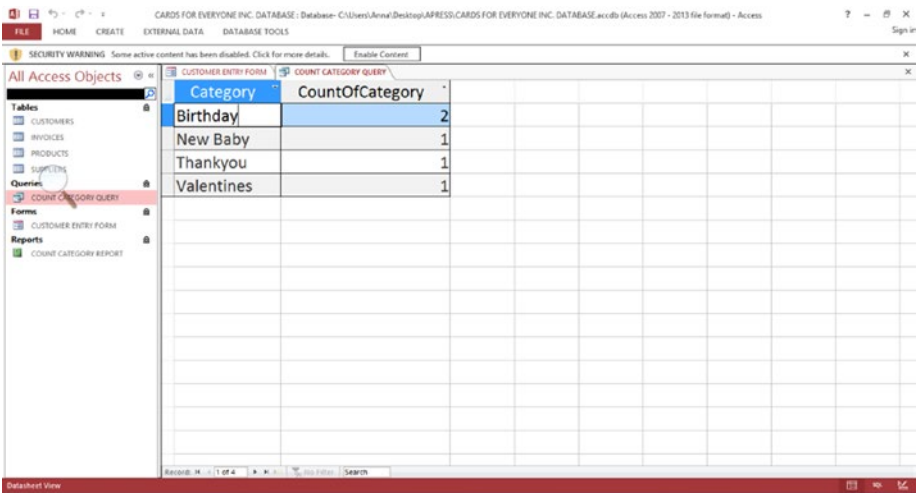


Figure 1-3. Simple query for Cards for Everyone Inc.

Forms: These are electronic versions of paper forms and a useful means of visualizing the data. They are composed from one or more tables of the database or from one or more queries and can be used to enter, edit, or display data. Forms are a useful method of searching the data through filtering. For example, forms can be used as invoices, drawing together customer and product details, which can be edited and searched (based on the customer, products bought, etc.) Figure 1-4 shows a very simple form for Cards for Everyone Inc., which provides a method for viewing data in the Customers table and a means for entering data. The form is a far more user-friendly way than inputting data directly into the table.

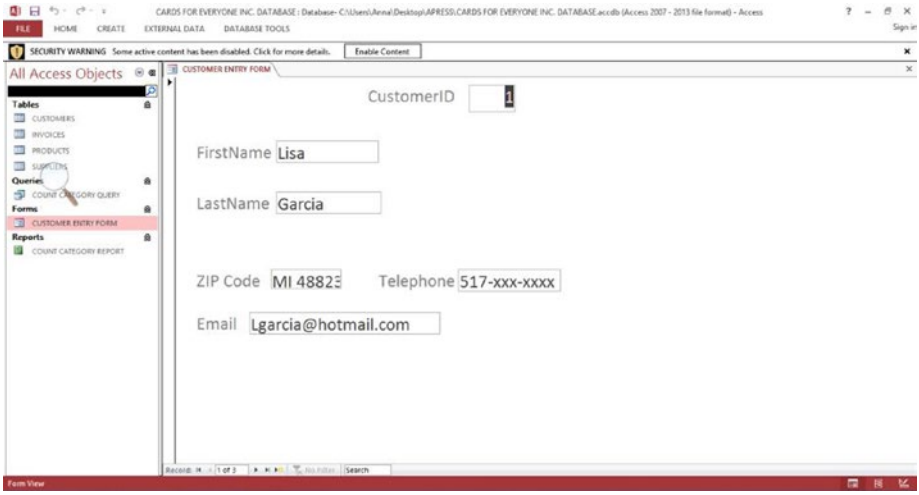


Figure 1-4. Sample form for Cards for Everyone Inc.

Reports: They enable a document to be designed from database tables or queries that can be shared easily in electronic form or viewed away from a computer. Reports can be used to summarize which products have been selling well and which customers have been buying them. Figure 1-5 shows a report of the query data from Figure 1-3.

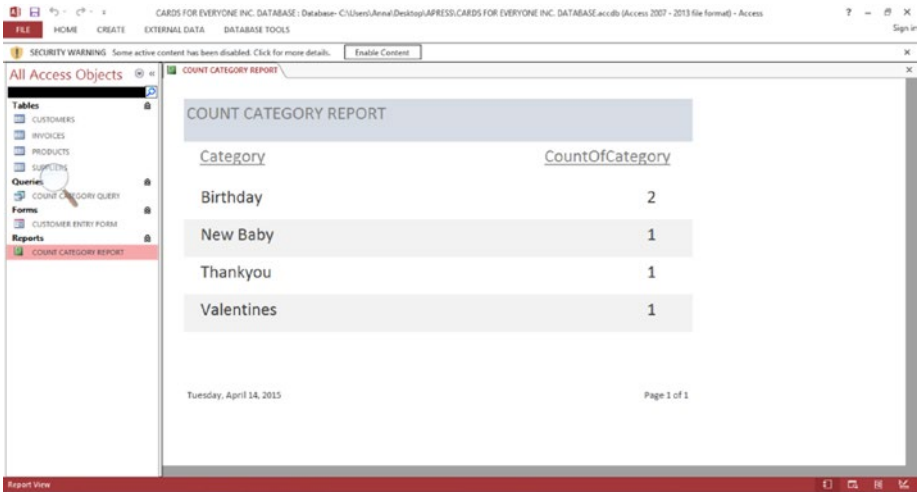


Figure 1-5. Sample report for Cards for Everyone Inc.

The relationships shown in Figure 1-2 could be handled in a spreadsheet by using master tabs, lookup formulas, cross-referenced spreadsheets, and Visual Basic programming. This will work as long as the connections are kept up to date. However, problems may arise during the introduction of a new product due to the effort needed to check the data to ensure everything matches up correctly.

Note In this book I refer to *relational databases* by default as they are the most popular. There are other databases, such as object-oriented, hierarchical, file, and network.

The Benefits Data Can Bring to Your Small Business

There is little point in taking the trouble to create and populate a database if there is no ultimate benefit to your small business. The following sections discuss the wide range of advantages that using databases can bring.

Providing a Solid Understanding of Your Customers

Small businesses can effectively compete with large companies by targeting a niche market. Data helps you understand your customers better and identify this niche market more accurately. By storing, sorting, and filtering data about your customers, it is possible to learn more about the customers who are most profitable. Small businesses are well placed to build personal relationships with customers and suppliers. Efficient use of your data can add extra weight to these advantages. Maintaining a close connection with your customers not only helps your business retain them but can also help you profile similar customers for future marketing.

Gaining a Deeper Understanding of Your Sales

By gathering and placing as much information about your products and customers into a database, you can see which products are selling well, which customers are returning for repeat orders, which items do not sell so well, etc. These functions are extremely time-consuming when done manually.

For example, knowing the top 50 customers that your business has can enable you to create specific offers just for these people/businesses or perhaps create a rewards scheme for these loyal customers.

Efficient Stock Control

By simply glancing at your database, you can see what is nearly out of stock and where to order further supplies from. The database can also alert you when supplies are running short so you can order more before you run out of essential items.

Responding to Change

A well-organized database can help a business respond to changes and make decisions. If data covering many of the business operations is available via linked tables in a database, managers can gain a holistic understanding of the current state of the business before making decisions. This is particularly pertinent to small businesses, which can often respond more flexibly to change than their larger counterparts. This is often due to the lack of hierarchy in a small business.

Data Analysis

The querying and reporting capabilities of databases make them an invaluable resource for analyzing data and predicting future trends, as they can draw data together across the whole of your small business. For example, a report may show that sales of certain products increased after an e-mail promotion, while sales of other products increased after an in-store promotion.

Improving the Security of Your Data

Security control and authorization can be implemented in a database by moving sensitive data into a separate table with its own authorization controls. When database users log in they will only be able to access the data that they are permitted to view. For example, there could be restrictions on fields such as employees' salaries, which can be viewed only by those dealing directly with payroll.

Why Some Businesses Choose Not to Use Their Data

The reasons that small businesses neglect to put their data to beneficial use in the ways discussed in the preceding section are various and complicated. The purpose of this section is to help you understand why you have not yet found the motivation to take advantage of your data rather than to pass any judgment. The aim is also to encourage you to move away from any hesitation that you may have.

It's Too Expensive

Many small businesses have small budgets and regard databases as too expensive. They believe that they have to pay an expert to create databases. However, the software itself is not expensive and open-source versions are often available. For example, MS Access may already be available on the version of MS Office you are using. And some open-source software suites have database packages available, such as OpenOffice and LibreOffice.

Concern may also arise that new and expensive hardware is necessary. There are many options, not least of which is a database stored in the cloud, which requires minimal investment and maintenance of office hardware. Cloud computing is discussed in Chapter 18.

It's Too Disruptive

If a company is running smoothly there may be a concern that implementing a database would disrupt the status quo and cause a falloff in business. There may be apprehension that a period of time would arise when it would not be possible to take any orders.

The physical move to a database from other methods of electronic storage is not as difficult as you might think. For example, there is usually a fast method to transfer data between databases and spreadsheets and most electronic data can be quickly manipulated to the point where it can be presented on a spreadsheet.

Staff training is covered in Chapter 20. A sensible way of starting is to choose an area of your business to place onto the database so that everyone can get used to the nature of the new technology. For example, you could move a spreadsheet about your customers' contact details onto a single table in the database and allow your employees to become used to accessing and manipulating it. Once everyone is familiar with the first table, you can import more spreadsheets into additional tables.

It is worth noting that a spreadsheet and a database can be used alongside each other until all employees are comfortable. You must ensure that updates are only made to one of the files and then transferred to the other so that changes are not overwritten. The most obvious method would be to make changes to the spreadsheet and then transfer the changes to the database at regular intervals. Such a transfer can be completed with a few simple instructions known as an *update query*, which is covered in Chapter 20. In this way the spreadsheet keeps operating as normal, but employees can open the database to see how the data is stored and can become familiar with accessing it.

It Will Take Too Much Time

As in all aspects of life, only you can answer the recurrent question, "How bad do things have to get before I will make a change?" If you are using paper files and running around your office in a panic every time a customer contacts you, searching for a file, it makes sense to improve your efficiency. You do need to invest the time to learn about databases, but this is ultimately less than the time you will waste if you continue to work with out-of-date systems. You can implement the database in small steps, as described in the previous paragraph about disruption. The benefits of databases and the importance of your data to your small business was explained earlier in this chapter. The decision comes down to a balance between investment and reward, and it is up to the individual business to decide where it sits on the spectrum of possibilities.

It's Too Difficult to Learn and Implement

It may seem daunting to learn about databases when you haven't used one before. But, if you are already using word processing and spreadsheets, the step up to using a database is not as great as you might think. This book will help you set a number of small goals and make steady progress.

It's Too Low on the Priority List

Running a small business can be overwhelming, with long hours and little time to keep organized. You may have a long list of things you would like to sort out before attempting to focus on your data. It can seem like a long-term goal and, like any long-term goal, it is easy for it to become overshadowed by more short-term plans.

To improve the functioning of your business, you may be inclined to focus on what could be higher priorities, such as taking steps to improve the ways in which you manage your office, keep records, and store your products and supplies. Only then will you feel in a position to look at your data.

However, if you were to begin with your data it is likely that many of the other parts of your business would require careful organization for the process to work effectively. This is because your data often reaches all areas of your business such as your customers, your sales, and your inventory.

For example, suppose Cards for Everyone Inc. was not very efficient at handling telephone orders from customers. Customers phone in and the details are written onto pieces of paper and left in a tray on Pat's desk until she can pass the information on to Zeph and Leona to process. With a database that links products to suppliers, they can quickly check to see if there is enough of the product in stock to meet the order and, if not, who to contact for

more. This provides an incentive to update the Quantity Available field of the Products table (Table 1-2) immediately and to begin an invoice for the order. The paper telephone notes can be destroyed as soon as the data has been entered onto the database, and the bottleneck of paper piling up on Pat's desk will be removed.

A Failure to Anticipate How Quickly the Business Would Grow

When a business starts it is usually possible to recognize each customer by name. Simple filing systems will suffice. However, there is a point at which customers are not instantly recognizable: generally speaking, this will occur when numbers rise above the 50 customer mark. In most instances, a small business will want to keep its service as personalized as possible.

A database can enable you to keep your service personalized even when the number of customers grows. This is because data retrieval is highly efficient. For example, important data about customers' preferences can be kept with their records so that this data can be accessed quickly when a customer contacts the company. In the case of Cards for Everyone Inc., some customers may have preferences for certain types of cards—such as cats or rabbits—and will appreciate an e-mail letting them know about the availability of new designs.

A Failure to Understand How Valuable the Data Can Be to the Business

Many small businesses do not understand the value of their data in terms of leveraging their profits. The data held by your small business has the potential to increase revenue by providing helpful information, increasing the number of customers, and improving the customer experience. Managers may be happy to make decisions on the basis of their past experiences, intuition, or comparison with other products on the market. Using data from the database allows this process to move from guesswork to precise market planning, thereby making small businesses more competitive, particularly in relation to their larger, more database-savvy counterparts.

In some cases, a small business may be operating perfectly well without a database. For example, if you own a café with regular demand for a fixed set of items that you buy fresh each day, you may well be operating from direct observation. If you notice that you are low on salt and pepper, you could easily drive down to the store for more. It is not straightforward to keep records of your customers. However, you could make records of what is selling each day, what the weather is like, and what events are going on in your town, and then

use this information to improve your sales, tighten your profit margins, and introduce new products. This information is particularly important when you have competition—say, a new café opens across the street. It is never a good idea to turn a blind eye to your data.

Case Studies

Three case studies are introduced in the next three chapters and recur throughout the book: a small engineering firm in Chapter 2, a small law firm in Chapter 3, and a small nonprofit in Chapter 4. The history of each organization is described in detail in order to put the current position of each business into context. The business objectives of each case study are discussed. Business objectives are fundamental to successful database design and usage, an issue covered Chapter 5.

CHAPTER

2

A Small Engineering Company: Case Study

This chapter introduces the first of three case studies that serve as examples throughout the book. Many readers will identify closely with only one of these and it is perfectly reasonable to select the case study that best fits your situation or experience. To recap, Chapter 3 covers a small law firm and Chapter 4 covers a small nonprofit.

This chapter introduces a small engineering business based on the east coast. Currently it makes and sells two versions of the same product and is looking to expand. Spreadsheets are used to store data at the present time.

Smart Wheelbarrows Inc.: Background

Smart Wheelbarrows Inc. sells foldup wheelbarrows to professionals with limited living space, such as those living in city apartments with roof-top gardens and those living in condominiums. The wheelbarrow was designed by Howard, the business's CEO, so that the frame, main container, and wheel all fold as flat as possible and can be hung on a peg. They are made of aluminum

to keep them light. Figure 2-1 shows the wheelbarrow in its folded and unfolded states.

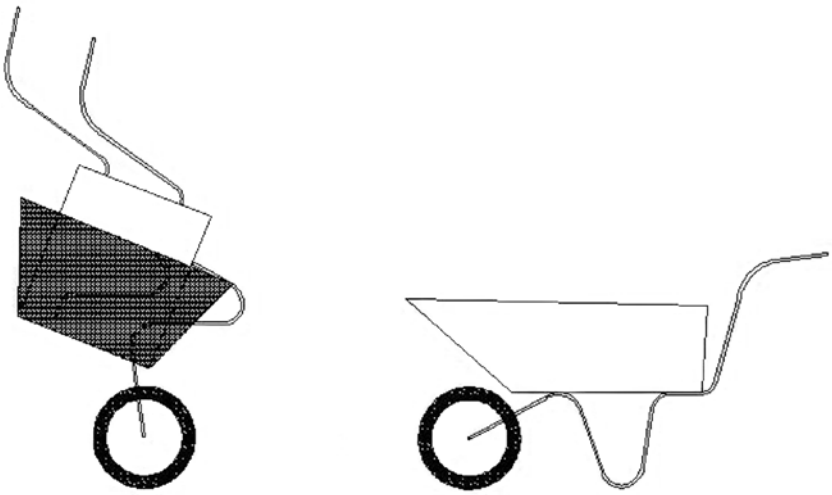


Figure 2-1. Foldup wheelbarrow, folded and unfolded

The folding mechanism of the wheelbarrow is achieved via a number of edges that divide apart, referred to as *split edges*, and a number of hinged edges.

Smart Wheelbarrows Inc. is based in Connecticut and rents a unit in a technology center. The unit is divided into a small office, a production line, and a storeroom. The company was incorporated in 2012 and started selling one size of folding wheelbarrow, the "standard" size, in four colors: red, green, black, and white.

It became clear via word of mouth that customers were using the wheelbarrows for decoration as well as gardening purposes. It was also found that some executive customers were using the wheelbarrows for things such as moving food and wine around their gardens. This led to two further colors, gold and silver.

Feedback from a customer survey indicated that there was a demand for a smaller version of the wheelbarrow for decorations, such as for holding plants. The capacity to fold up would not be necessary for this product.

The result of this information was the development of twelve products in total, six standard-sized folding wheelbarrows and six small non-folding. The standard-sized red, green, black, or white version cost $120 and the equivalent

small versions cost $70. The standard gold or silver wheelbarrows cost $125 and the small gold or silver wheelbarrows cost $75. The gold or silver wheelbarrows were slightly more expensive because the paint was more expensive than the other colors and had to be ordered from a specialized company. Table 2-1 summarizes the range of wheelbarrows on offer from Smart Wheelbarrows Inc.

Table 2-1. Products Sold by Smart Wheelbarrows Inc.

Product Name	Color	Price ($)
Standard Wheelbarrow	red, green, black or white	120
Standard Wheelbarrow	silver or gold	125
Small Wheelbarrow	red, green, black and white	70
Small Wheelbarrow	silver and gold	75

Smart Wheelbarrows Inc. distributes its products via other businesses, such as florists, garden centers, and online retailers like Amazon. It also takes orders directly from consumers through a web site (designed by a contractor) and via the telephone.

The wheelbarrows are made partly on the company's premises and partly by a contractor. The manufacture of the main container is outsourced to a local firm that has the necessary equipment. The manufacture and painting of the frame is conducted in-house as Howard was unable to find anyone to make the frames, so he bought the necessary equipment and hired the staff, as described in the next section.

Employees at Smart Wheelbarrows Inc.

Smart Wheelbarrows Inc. is run by Howard, who has eight employees. Howard is an experienced mechanical engineer who used to work at a large engineering firm but felt frustrated by the lack of freedom to follow through on his own ideas. Howard asked his former colleague Sanjiv, from the same engineering firm, to join him as the Technical Production Manager.

Howard and Sanjiv recruited two people, John and Chen, to work in the office. John is responsible for taking orders and making sure the orders go out correctly. Chen is responsible for bookkeeping and payroll.

John and Chen keep the web site up to date (it was designed to be updated easily) and answer the phones. They cover for each other during sickness and vacation and work as a team.

Howard wears several hats in the company. He does a great deal of networking and marketing. He also manages the administration office, both in person and remotely. When he is in town, Howard pops his head around the door of the office a few times a week to make sure everything is running smoothly. However, much of the time Howard is out of town and checks the orders online regularly via an encrypted spreadsheet in the cloud. He also looks at the bank account online (examining the running cash flow of the business) and keeps an eye on the profit and loss account from time to time.

Howard and Sanjiv recruited four people to work on the production line, managed by Sanjiv, as follows:

- Helen, who takes tubes of aluminum and feeds them to a machine that bends them to form the shape of the frame of the wheelbarrow.
- Miguel, who takes the frames and welds on the locking hinges.
- Sam, who hangs the tubes with attached hinges and operates the paint spraying in a special booth. Each part receives two coats of paint.
- Valentina, who takes all the components, assembles the wheelbarrow (folded for the standard size), and packs it into a box ready to be shipped. One of the components is a U-clip that's bolted onto the container through holes placed there by the manufacturer and used to attach the frames. She needs to check that all the parts have been added and this is done by weighing each box to check that it is the expected weight. A small discrepancy can mean the omission of something small such as a fastener.

The storeroom manager, Steve, handles supplies coming in and finished products going out.

There is a great deal of flexibility between those managed by Sanjiv so that sickness and holidays can be covered. Sanjiv can perform all jobs, so is able to cover. He also makes sure that all four production line operators can do each other's jobs. This gives more interest to their work, increases the skills of the workforce, and provides better cover during staff shortages. Table 2-2 summarizes the staff employed by Smart Wheelbarrows Inc.