Chapter 1

Getting the Gist of the Semantic Web

In This Chapter

- Understanding why the Semantic Web is just another way of saying Web 3.0
- Looking past the hype for real solutions to real problems
- Discovering how the Semantic Web may change the world
- Figuring out how to make smart data work for you

Congratulations on your curiosity: It takes courage and open-mindedness to even open the pages of a book with the word *semantic* in the title. Of course, the title also contains the word *Dummies,* which lessens the intimidation factor just a bit! The intent of this book is to give you a gentle and complete introduction to the Semantic Web. For many people, this is just the first step. Only a few chapters in this book have code examples — just enough to whet your appetite in case you decide that the next step is to fire up your trusty text editor and bang out some code. More often, I'll be giving you a guided tour of how the Semantic Web changes the Web as you know it, as well as business software applications, open-source software, social networking, and even everyday search engines that you're already using.

In this chapter, I give you a general introduction to what the Semantic Web is, how it may benefit you in your daily life, and how your job might change because of these important developments. The Semantic Web is much more than just a new technology; like any important subject, the Semantic Web is a multi-faceted and sometimes controversial topic. First and foremost, it is a Web technology platform, but it is also one of the newest incarnates of the artificial intelligence legacy, it will become a key enabler for enterprise software, and as a social movement, it just might change the world. But most importantly, this chapter explains how the Semantic Web will make your life easier.

Exploring Different Ways of Looking at the Semantic Web

One of the most frustrating things about the Semantic Web for newcomers is that it means so many different things to different people and communities. I've taken special care in this book to carefully distinguish a few elemental, but differing views of the Semantic Web. Here are some of the different ways of looking at Semantic Web:

- As an upgrade to the current Web/Internet
- As a metadata technology for business software
- As a social movement favoring open-source data
- As a new generation of artificial intelligence

In fact, each of these views is quite true, but they each appeal to different audiences and focus on different facets of the Semantic Web itself. The Web community is mainly concerned with making Web sites more interesting and easier to use. Starting in 2004, a special focus on group and social collaboration on the Web has produced a wave of new Web sites that call themselves Web 2.0. *Web 2.0* is a term used to distinguish Web sites (such as Amazon.com, Facebook.com, YouTube.com, Digg.com, Wikipedia.org, Twitter.com, and so on) that harness the collective inputs from hundreds or thousands of people in order to make their features and content more interesting than could ever be developed by just one company. But now with the availability of Semantic Web technology, many people are gearing up for what's now called *Web 3.0*.

Finding the Connection to Web 3.0

Most people agree that the first Web (Web 1.0, if you please) has profoundly changed the world. It has connected people in faraway places and ushered in a new era of learning opportunities for folks of any race, creed, culture, or religion to become exposed to fresh ideas with the click of a mouse. The Web hasn't solved world hunger, but it has leveled the educational playing field for millions of souls who would have otherwise been denied fair access to the amassed knowledge of humanity.

The second wave of the Web, Web 2.0, as it is known in pop culture, is no less profound, but perhaps more subtle in reach. Web sites that are part of the Web 2.0 phenomenon have already altered the political landscape of America, helped to elect the first African-American president of the United

States, cracked major news stories before the networks, impacted an entire generation of kids under the age of 18, and collected the largest cache of human knowledge in the world — not too shabby.

Web 3.0 — the Semantic Web — is what folks are calling the third major wave of the Web. Interestingly, the principal inventor of the Web itself, Tim Berners-Lee, doesn't much favor the idea of versioning the Web, and he views the Semantic Web as more aligned with his original vision anyway — which means that we're actually just now seeing the evolution of a Web he was thinking about almost 20 years ago.

Nova Spivak, an entrepreneur and Web visionary, has a compelling chart, similar to the one shown in Figure 1-1, that he uses to describe the Web 3.0 phenomenon. This chart compares the technical power of the way people connect data inside technology and the social richness of the connections people can make using that same technology. In this way, you can see the clear progression of technology from the Personal Computing era, to the first Web 1.0 of pages and documents, to the Web 2.0 era of social networking, and to the Web 3.0 era of the Semantic Web and data networking. In Nova's conception of Web 4.0, he envisions the Web as an operating system for applications with global reach and data systems that exist entirely in the network.

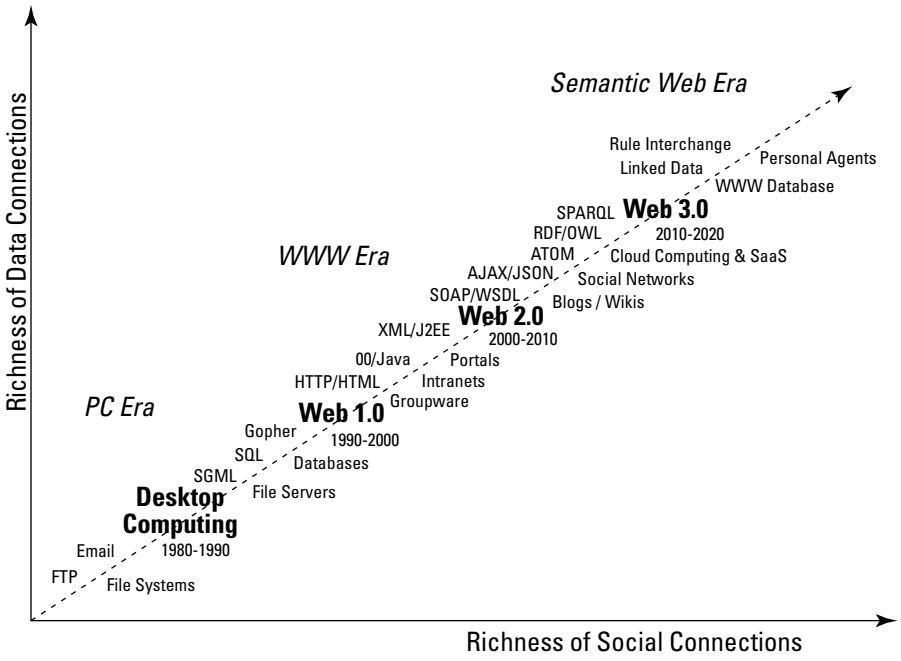

Figure 1-1: Four major waves of Web evolution.

It's still much too early to foretell what profound changes to humanity the Semantic Web and Web 3.0 evolution will bring, but there are indeed some early indications that the changes will be every bit as cataclysmic as Web 1.0 and Web 2.0 were. For example, this book shows you how the Semantic Web may well lead to a "giant database in the sky" containing data, not just pages, about anything you can think of. In this book, I explain how medical researchers from every corner of the globe are using Semantic Web formats to exchange and mash up data that might lead to the next great scientific breakthroughs. I also share with you how the Linked Data Initiative is organizing the publication of terabytes of information into the public domain, and how it's using the Semantic Web formats so that you can freely remix and publish your own Web sites with open-source data. You also discover how businesses large and small are aiming to change the rules of their industries by using Semantic Web data and technology to create new business models. Who knows, maybe this book will give you the spark for a new idea that changes the world that your children will live in!

Exploring the Business Side of Semantics

If you're interested in core technology and money-making, the business side of the Semantic Web will hold a lot of appeal for you. Each year, companies all over the globe spend trillions of dollars buying and installing software that will help them run their businesses. A significant portion of that money spent on software is spent on getting the software to talk to other kinds of software. The Semantic Web technology represents a fundamentally new way of formatting data — a way that can potentially save businesses billions of dollars and help software vendors spur a new growth wave of business software.

Semantic Web data formats were designed from the ground up as purpose-built languages for metadata — providing a way to accurately describe and define data by using more data. In business software systems, these new formats provide a way to more easily connect and exchange data with many systems, and the Semantic Web also provides new ways to model complex data environments that can be more simply maintained over time. Business software created between 2010 and 2020 will be built substantially on the Semantic Web formats of today. I go into much more explanation about these business software topics in Chapters 3, 5, and 10.

Setting Information Free

"Information wants to be free." That has become the unofficial motto for the free content movements that are often associated with Creative Commons copyright licenses and open-source software. The legal foundations for free content and free software have been inexorably moving forward on the

principle that people can collectively help to make humanity wealthier by allowing others to copy, remix, and reuse all sorts of content and software. Very much in this same spirit, Tim Berners-Lee and the Linking Open Data Community Project are working hard to leverage Semantic Web data formats as a means to share databases of content, link them to one another, and effectively build a Web of linked data that spans the globe.

Unlike the current Web of linked documents, the Web of linked data will allow publishers to describe data models, data concepts, and data records in such a way that they can be linked, described, and queried as if they were part of a single database.

Much of this vision is already materializing: The current state of Linking Open Data is described in Chapters 2, 15, and 17. Already available to you are the entire contents of Wikipedia, CIA World Factbook, WordNet, and many commercial data models for music, restaurant reviews, and social networks defined and accessible in the Linking Open Data project (which is described in Chapter 2). Practically speaking, you could build your own application on open data in the Semantic Web formats today. This book can help you get started.

Rebirthing Artificial Intelligence

The science of artificial intelligence (AI) goes through ups-and-downs in the academic community. In times past, artificial intelligence research has seemed to hold the promise of radical new computers and the keys to new forms of life, but after years of failed promises, the research funding for AI inevitably dries up. This boom-and-bust cycle for AI has repeated itself many times throughout the 1960s, '70s, '80s, and '90s. Now, the boom cycle has come again, largely due to the Semantic Web excitement.

New research funding since the late 1990s into the areas of knowledge representation (KR) and AI for the Web has grown substantially worldwide, with particular growth in Europe and Asia. The Semantic Web has been yet another source of rebirth for AI, and most of the Semantic Web roots go deep into KR and AI problems that originally emerged several decades ago. For academics and researchers, these AI foundations of the Semantic Web are the most interesting and fruitful.

Checking Out the Semantic Web's Origin

The modern origins of the Semantic Web can be traced to Netscape and the Defense Departments of the United States and Europe. In 1998, Tim Bray and Ramanathan Guha built a metadata language called MCF (Meta Content Framework) for XML to help Netscape describe content ratings of Web pages.

Soon thereafter, the World Wide Web Consortium (W3C) looked to create a general-purpose metadata language called RDF (Resource Description Framework). This new language was largely based on the original MCF specification by Guha and Bray.

Also in 1999, the Defense Departments of the United States and the European Union (EU) Commission independently opened research topics in the area of intelligent agents. Both the United States and the EU had recognized that in order for software to act more autonomously — without the constant updating by human engineers — the software needed a better data format than XML, relational databases, or the Unified Modeling Language (UML) could provide. So the U.S. Defense Advanced Research Projects Agency (DARPA) created DAML (DARPA Agent Markup Language), and the EU created OIL (Ontology Inference Layer). These two formats were remarkably similar and were eventually combined to form DAML+OIL, and that finally turned into OWL (Web Ontology Language).

Today, RDF and OWL are the backbone of the Semantic Web and are recommended standards maintained by the W3C. (See Chapters 5 and 6 for more on RDF and OWL.)

Unpacking Semantic Web Baggage

Inevitably, profound ideas generate profound resistance, and the Semantic Web is no exception. The seminal article announcing the arrival of the Semantic Web was published in May 2001 in *Scientific American* magazine. But years later, the Semantic Web hasn't really changed much of anything. Critics are rightfully disappointed with the lack of real change wrought by Semantic Web formats in the years since they were announced by Tim Berners-Lee, Jim Hendler, and Ora Lassila. There's still a lot of baggage left over (missed expectations, pointed critiques, and unfulfilled capabilities) from these early and grand proclamations, so what gives?

Inflated hype and expectations

Early writings about the Semantic Web made it seem like a computer would soon be able to read your mind, to know what you mean without you really saying much to the computer at all. Promises about linguistic parsing and expert analysis of your queries gave way to the reality that data semantics are hard. Those early ideas about having software that automatically knew what you were searching for or programs that could automatically connect your datebook to travel plans made in other programs seem naive and simplistic

today. And despite the fact that many of those early promises are now finally finding business models, the time that it took to go from idea to prototype makes the whole thing seem improbable and not worthwhile. In fact, the early hyperbole directed at the Semantic Web has prompted many pundits and skeptics to ignore the impressive breakthroughs that the community *has* yielded and effectively throw the baby out with the bathwater by dismissing the whole notion as a failed fad.

The legacy of artificial intelligence

Some folks are savvy enough about the roots of the Semantic Web to trace back core ideas and concepts to their artificial intelligence (AI) legacy. For some, the AI origin of the Semantic Web alone is enough to dismiss the whole thing as an ivory-tower exercise in futility. Originally based in the logical foundations of Semantic Networks and Description Logics (each well-known domains of AI research), most mathematicians and AI researchers see those AI foundations as anachronisms from the 1970s that don't have a place in modern computing. It's true that the Semantic Web formats are grounded in these mathematical foundations that are almost 40 years old, but it's also true that the Semantic Web fundamentally alters these older AI concepts and catapults them into the Web age by making them dependent on URIs (Universal Resource Indicators) and compatible with XML. In fact, this combination of AI roots with Web foundations is what makes the Semantic Web so compelling and so different from other modern software languages.

Politics of standards movements

Professional software engineers accept that committee-based designs are often the worst of all worlds. Although the W3C does a phenomenal job of avoiding "groupthink" and *anti-patterns* (common patterns of incorrect solutions) in their specifications, the Semantic Web is often rightly criticized as accepting design trade-offs intended to appeal to small minorities. In general, it's difficult to do anything when you depend upon consensus from a large and diverse committee. That's why it can take many years to design and approve even simple specifications. RDF, OWL, and other Semantic Web technology standards are not perfect by any means. But neither are any standards. In the software industry, consumers (like you and me) accept the slow and sometimes painful process of the standards groups because the outcomes are generally good for us in the end. By having a reference implementation and specification, you can go out and build your own part of the Semantic Web and have the confidence that it will work well with others — and that's worthwhile in my book.

Instilling Simplicity in Complex Data

Simply put, the Semantic Web helps to simplify a very complex world of data. Semantic Web data formats are a way of leveling the field for data of any type and origin. Out of necessity, the Semantic Web itself can be viewed as complex, but it can also be incredibly simple.

The real world of data is complex — exceedingly complex. Humanity has generated more new data in the last few years than previously generated in all the preceding years of human history combined. This newly generated data comes in all kinds of formats, structures, styles, and languages. The Semantic Web offers a common baseline for these many complex kinds of data. It's powerful enough to capture the computational semantics of most other kinds of data formats, and it's simple enough to then allow modelers to begin connecting all the data.

There's no magic in the Semantic Web. You can't push a button and see all your data cleaned up or all your Web pages linked together. But whereas the problem was at one time insurmountable, there's now hope for more automated, routine, and predictable ways to bring data together, share it, and make it useful for newer software applications.

In this age, this time, people all over the world are looking to recombine data from the Web in new ways. New inventions, Web sites, and businesses in the future will work on Web data directly, and the Semantic Web will be a substantial means of empowerment for the young entrepreneurs of today.

Seeing the Semantic Web's Starring Role in Web 3.0 Showcase Applications

Any good technology should be more than just vision; in fact, most good technologies start from an underground hacker ethos that encourages the continuous tweaking and refinement of code. So what's available today? What can you go out and see today that's substantially built upon the ideas and technology of the Semantic Web?

First, that crazy vision of the "giant database in the sky" is actually happening. Second, without too much fanfare, a whole host of new business applications are being built using the Semantic Web formats and standards. Third, the entire set of global standards is already being aligned with Semantic Web

underpinnings, promising some hope for data interoperability in the coming decades. Finally, don't look now, but your tax dollars have been funding Semantic Web government projects since 1998, and some government agencies depend on the Semantic Web data for some pretty serious projects. In the next few sections, I take a closer look.

Linked open data in the cloud

A controversial dream of many is to enable the Web itself to evolve into a global federated database. This idea of massive technology virtualization is the kind of science fiction that used to make serious people laugh. But today more than 30 organizations publish their libraries of data into Semantic Web formats and make them queryable from the Web itself. The leap of understanding that you need to absorb is that, unlike a regular database, the Semantic Web data and data models can be directly and precisely linked together over the Web itself. Instead of having to go through proprietary software APIs and query listening services, the data and data models are fully accessible from the Web itself. I can publish some data in a model from Australia, and you can include it directly in your data and data model published from New York. As long as we both have an Internet connection and use the Semantic Web, a lot of magic happens for free.

The organizations that are participating in this movement aren't fly-by-night companies or mom-and-pop shops with a small amount of data. The U.S. Central Intelligence Agency's World Factbook, containing detailed data about every country in the world, is accessible in Semantic Web formats. All the data from Wikipedia containing data about practically everything is accessible in Semantic Web formats. Every data item in Freebase, a Web database for anybody to use, is accessible in the Semantic Web formats. And you and I can build any software application we want that will remix and mash up data from any of those sources for free!

But taking this vision even further, media giant Thomson Reuters offers a free service — cloud-based Software as a Service (SaaS) — that can automatically semantically parse any unstructured text you send it, and give you back a Semantic Web–compatible list of people, places, things, and so on that are automatically linked to any of those open-source data models available in that giant database in the sky. Now you can start from any document, any time, from anywhere and automatically get structured data about the concepts and data from your raw text. Welcome to the Semantic Web!

Now imagine what the next few years will yield.

Active metadata in business systems

Once upon a time, business software systems were islands of information that couldn't easily be connected. In fact, most business systems are still just that: disconnected applications that largely work in a self-contained manner. Over the years, a specialized kind of software called *middleware* has evolved to connect business software together, but it's still quite hard, laborious, and expensive to do that. You might have even heard of a new family of standards that was created to solve that problem; service-oriented architecture (SOA) standards aim to solve this with standardized XML frameworks.

The truth is that all this middleware and SOA software depend entirely on metadata formats for data, processes, and APIs, but those formats are exceedingly brittle and don't respond well to change.

Major business software vendors like IBM, Microsoft, and Oracle (to name just a few) are already investing in the Semantic Web as a way to expand their business software systems. Oracle has released functionality that brings the Semantic Web into its database systems, into the governance and risk applications, and even its SOA systems. IBM has built its software registry and repository business software using the Semantic Web foundations, and Microsoft has several business solutions that use Semantic Web languages for media management and user-profile management in the telecommunications environment.

New businesses and online properties are trending toward the Semantic Web as well. Commercial and non-commercial sites like Digg.com, Yahoo!, and BBC online are using the Semantic Web metadata in very interesting ways to improve their visitor experiences. Garlik is a very successful startup using Semantic Web data aimed at protecting the privacy of its customers and preventing identity theft.

At its core, the Semantic Web is more than just a social movement or a big database in the sky: It offers tangible benefits for technologists interested in finding powerful solutions to very fine-grained problems with traditional metadata formats and languages. The Semantic Web is more than just a pretty face, a neat vision, or a trendy idea: It's a legitimately different technology that's purposefully built to make metadata active, dynamic, and change resilient. No other data technology is comparable in its flexibility and power.

Bridges across global standards

One powerful testament to the impact the Semantic Web has already made can be found in the adoption rate of its technology among the ranks of standards bodies. In the world of software, a few key global organizations are entrusted with the reference standards for the data formats and protocols that drive the electronic economies of every nation on earth.

Every single one of the major standard organizations is in the process of adopting Semantic Web formats for the implementation of some of their newest standards, or as a central framework for unifying their standards into a common cannon of specifications.

The World Wide Web Consortium (W3C) is the main standards body for the Web, XML, and Web services. The W3C holds the reference standards for the Semantic Web and is actively mapping the Semantic Web to other technical areas inside its organization — including to XML and Web services. The International Standards Organization (ISO) maintains thousands of standards including key metadata and data exchange standards for numerous industries. Many of the newest ISO standards leverage the Semantic Web as a way to unify a family of standards and to provide a common reference language for the standards themselves.

Object Management Group (OMG) is the global standards organization that maintains the Unified Modeling Language and other software modeling formats that apply to databases, online analytical processing (OLAP), and data warehousing. OMG is also incorporating the Semantic Web into its core specifications as a metamodel for many of its core reference models. Finally, OASIS (Organization for the Advancement of Structured Information Standards) is also leveraging the Semantic Web formats in its community for a host of standards that aim to improve data processing for security, data centers, and Web service process definitions.

The Semantic Web is becoming a common bridge across silos of disconnected standards in a way that no other technology could. The Semantic Web isn't just a fancy software vocabulary like so many others: It's a foundational data language upon which any other data language can be built. And by building with the Semantic Web, you can all go a long way toward making software easier to connect in the future.

Cutting-edge research and development for nation states

Despite all the cool new things that the Semantic Web allows you to do with your most frequently visited Web sites, business software systems, and global standards, there are actually some much more serious reasons for the Semantic Web, too.

The origin of the Semantic Web came from government funding into research and development on serious problems that countries face in several key areas:

- **National security:** What is the best way to link the entities and records among enormous volumes of data the government collects every day? By linking that data together more effectively, experts can see national security threats forming before they become reality. In that regard, the Semantic Web is like a more powerful telescope that lets people see deeper into the masses of data on the networks.
- **Disaster preparedness:** How do you create computer systems that can be mashed up and remixed on the fly in times of emergency? Disasters rarely happen exactly as you've planned for them. Aiding first-responders and government officials to quickly assess all the data they can, to best organize a response to the changing ground situation, is critical for limiting casualties in those precious first hours of any large-scale disaster.
- **Military operations:** How do you enable a network-centric software architecture that can dynamically connect to your friends' and allies' data? Within one country, and among allies of different countries, huge, complex command structures need to work together seamlessly to be efficient and fight in a coordinated way. Software systems, data, and networks must be capable of that dynamic interoperability in order for those future combat systems to work properly.

The Semantic Web was originally conceived to help solve these gigantic serious challenges at the national level. Today, there are Semantic Web–based systems in production that solve parts of those challenges. Hundreds of more projects are underway that use the Semantic Web in key ways that help government officials communicate more effectively and more quickly than ever before.

Many of these national-level research programs (in the United States and also abroad, especially throughout Europe) are funded through university grants for special programs. Thousands of schools worldwide are teaching classes and funding active research into the use of Semantic Web languages, formats, and technical components to help push forward the various industrial uses of the technology. These special programs are sometimes very focused on

the logical and mathematical foundations of the Semantic Web, whereas other research programs are more high-level and seek to find more of a systemic use of the technology in applied settings.

Likewise, much of the Semantic Web research and development happening in the university system, from government funding or private funding, is being applied in other areas. A particularly popular area of applied research in the Semantic Web domain is life sciences: drug discovery, clinical healthcare, and biological research. Semantic Web research in these domains is particularly strong because these areas have suffered for years from an inability to effectively share complex research and clinical data sets with other researchers who might be able to use them for new discoveries. As a consequence of this historical deficiency, the life sciences area is now one of the fastest-growing domains for adopting Semantic Web data formats — it helps the whole community exchange data easier and with better accuracy.

Core research and development may not be the most compelling case to convince pragmatic businesspeople or casual Web surfers to embrace the Semantic Web, but no one can deny the impact these researchers are having on society and governments as a consequence of their investment in Semantic Web.

Recognizing Compelling Reasons for the Semantic Web

By now, you've already heard about a lot of compelling things that the Semantic Web can do or is already doing for you:

- Making your country safer
- Making your country more prepared for disasters
- Improving the speed with which researchers create new medications
- Unifying disconnected software standards
- Making business software more change-resilient and less expensive
- Building a giant database in the sky from open-source data
- Giving humanity the gift of open knowledge

But all of those reasons might seem a little altruistic, esoteric, or even far-fetched for most people. What about some pragmatic, down-to-earth ways that the Semantic Web can be good for you today? The following sections preview what I tell you about what Semantic Web can do for you in the rest of the book:

- Make your life simpler
- Save you money and time
- Help do new projects faster

Make your life simpler

The whole purpose of using a computer in the first place is to have it handle the routine and repetitive tasks for you. Doing the hard work, the boring work, and the insanely complex work is precisely what a well-designed Semantic Web application should do for you. Here are a few examples of how the Semantic Web can make your life simpler today:

- **Use fewer mouse clicks to find the data you need.** Try searching with Yahoo! Search, which uses the Semantic Web inside SearchMonkey.
- **Stay organized on the Web and in your Web browser.** Try the Adaptive Blue Glue toolbar, which uses Semantic Web metadata to better link your actions and predict what you might want to do next.
- **Collect your interests more intuitively and share them with others.** Try Twine's Semantic Web–enabled interest networking site, where you can put the ideas you're interested in and share them with like-minded people who share their interests with you too.
- **Organize your disconnected travel plans better.** Try TripIt's travel service, which lets you combine itineraries and bookings made from different Web sites into a single compact Semantic Web–enabled itinerary that summarizes just what you need to know.
- **Pinpoint the *exact* news you want to see.** Try the Thomson Reuters Calais Web Service, which lets you automatically scan news stories for ideas and concepts (not just keywords) and then link them to any other Semantic Web resource on the Web (like Wikipedia, Freebase, or the World Factbook) for more data.

Save money and time

You might be one of those very practical folks who isn't really interested in improving your Web surfing; instead, you'd rather invest your time and money in solving big business problems for your company. Here are some ways you might be able to help your company save money on the operational tasks that it already does:

- **Finding business resources more quickly and easily:** How much time do people spend every day trying to find people or documents that they need? Try thinking about how the Semantic Web could help with locating business resources and read on to find out how IBM and NASA are doing just that. (See Chapters 11 and 15.)
- **Diagnosing remote technical problems:** How often can complex mechanical problems be diagnosed and cross-referenced to technical data in real time? Try thinking about how the Semantic Web might help decipher complex data for root-cause analysis and read on to hear how the French automaker Renault and the U.S. Defense Department are aiming at that challenge. (See Chapters 11 and 15.)
- **Preserving corporate knowledge:** The embedded corporate knowledge that goes home when the lights go out is astounding. How can businesses preserve and encourage a corporate knowledge center? Think about how the Semantic Web can help build a better knowledge base and read on to find out more about what the oil company Chevron and pharmaceutical giant Pfizer are thinking about that problem. (See Chapters 10 and 11.)
- **Integrating information:** Most companies have severe cost overruns associated with the need to integrate information and metadata, but there has to be a better way. Think about how the Semantic Web data formats will make it easier to bring together complex data and then read on to find out more about how companies like Oracle, British Telecom, Metatomix, and BBC are headed that way. (See Chapters 3, 11, and 15.)

Do new projects faster

Sometimes you might have a tactical necessity to improve a process or just help a business project move along more quickly. Semantic Web vendors, and many companies using the Semantic Web, are looking to make completing projects easier and faster:

- **Finding and linking Web services:** In complex and large IT systems, finding services can be tricky. IBM is leveraging the Semantic Web to make that job faster and more effective.
- **Building application mashups faster:** For millions of Web entrepreneurs, the speed with which they can build a new application and place it in the clouds is crucial. The Thomson Reuters Calais service helps those businesses reduce their time to market with impressive Semantic Web data scanning.

- **More targeted and effective advertising:** How do you quickly boost click-throughs and get more people to look at your business's offer? Dapper has an advertising program that can help you place the ads more effectively with Semantic Web metadata and analysis.
- **Empowered information workers:** Every modern business is powered by information workers that build, use, and depend on software applications in their daily lives. Making this infrastructure work are armies of information workers who maintain metadata, data files, and master records in all sorts of applications. Try the Dow Jones Synaptica Taxonomy Management Tool for a Semantic Web–driven approach to making information workers more effective at managing the lifecycle of corporate data and metadata.